UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART XIV

REPORT

OF

THE COMMISSIONER

FOR

1886.

A.—INQUIRY RESPECTING FOOD-FISHES AND THE FISHING GROUNDS.
B.—PROPAGATION OF FOOD-FISHES.

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National Oceanic and Atmospheric Administration

Report of the United States Commissioner of Fisheries

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Resolved by the Senate (the House of Representatives concurring), That the report of the Commissioner of Fish and Fisheries for the year 1886 be printed; and that there be printed 11,000 extra copies, of which 3,000 shall be for the use of the Senate, 6,000 for the use of the House of Representatives, 1,500 for the use of the Commissioner of Fish and Fisheries, and 500 for sale by the Public Printer, under such regulations as the Joint Committee on Printing may prescribe, at a price equal to the additional cost of publication and 10 per cent. thereto thereon added, the illustrations to be obtained by the Public Printer, under the direction of the Joint Committee on Printing.

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REPORT OF THE COMMISSIONER.

1.—INTRODUCTORY NOTE.

During the period of time covered by this report the work of the United States Fish Commission was under the direction of Prof. Spencer F. Baird. In consequence of his declining health and the pressure of administrative duties as Secretary of the Smithsonian Institution, as well as Commissioner of Fisheries, the preparation of a report proper to accompany the various reports and papers constituting the appendix was prevented.

The following digest of the operations of the year, which has been prepared from data compiled mainly by Mr. C. W. Smiley, editor, for the convenience of the Commissioner in the preparation of his annual report, aims to present briefly, from an impersonal standpoint, the principal features of interest in connection with the work accomplished.

The personality of the distinguished naturalist who founded the United States Fish Commission, and under whose wise and broad administration it has grown to be the custodian and conservator of one of our most important food resources is, however, fitly represented by his important posthumous paper on the sea fisheries of eastern North America, which appears in the appendix. This monograph, after some introductory account of the fisheries, follows with a list of the food and bait fishes and invertebrates, together with biographical notices of the most important species. The food and the reproduction of the sea fishes, their migrations and movements, numbers and abundance, and the dangers and fatalities to which they are subject from enemies in the sea, from man, and through physical causes or changes are discussed at length. The important fishing grounds are described in detail, as well as the apparatus of capture, from the primitive bow and arrow to the elaborate nets and pounds of the present time. The various kinds of bait, the methods of preserving fish and bait, and the disposition of offal are considered. The statistics of the value of the American fisheries are given, and followed by a review of the economical applications of the products of the fisheries as food for man and animals, and for use in the arts and industries in the form of oils, fertilizers, medicines, etc. The maintenance and improvement of the fisheries by legislation, artificial propagation, and the transfer of species from one region to another are subjects which receive the attention warranted by their importance.

2.—INQUIRY RESPECTING FOOD-FISHES AND THE FISHING GROUNDS.

A.—Field-work.

In this branch of inquiry field-work was carried on in a thorough manner along the Eastern coast of North America from the Straits of Florida to Newfoundland. From February 20 to May 10 the steamer *Albatross*, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding, was engaged in a survey of the region about the Bahama Islands, in the joint interests of the Fish Commission and the Navy Department, the expenses of the cruise being shared by the two. The purpose of the voyage, on the part of the Fish Commission, was to ascertain, if possible, the winter range and habits of certain important food-fishes, which resort to the Eastern coast of North America during the warmer months, but whose first appearance in the spring and whose abundance during the fishing season vary from year to year. The principal species concerning which information of this character was desired were the mackerel, menhaden, and bluefish; but attention was also to be paid to other economic forms, such as the Spanish mackerel, sheepshead, and drum, if found to occur abundantly in those waters. On behalf of the Navy Department several lines of soundings were to be made to the northward and eastward of the islands and in the deeper channels which separate them, the hydrography of this important region being but little known. Mr. James E. Benedict was in charge of the civilian scientific staff, and was assisted by Mr. Thomas Lee, Mr. Charles H. Townsend, Mr. Willard Nye, jr., and Mr. F. L. Washburn, the two last mentioned being volunteers.

The work of sounding was begun to the north of Great Abaco Island, and was carried thence southeastward along the Atlantic side of the islands as far as San Salvador or Watling's Island, and offshore in some places to a distance of over 100 miles. The greatest depth of water discovered was 3,196 fathoms, in latitude 28° 34′ 42″ north, longitude 76° 10′ 25″ west, or about 110 miles northeast of Great Abaco. Several lines were run between the five islands lying at the mouth of Exuma Sound, namely, Cat Island, Long Island, Watling's Island, Concepcion Island, and Rum Cay, showing that the intervening channels are of great depth, the depth in one place exceeding 2,400 fathoms. From this point the soundings were carried through Exuma Sound to its upper end, and thence by way of the open sea on the eastern side of Eleuthera Island to the town of Nassau, New Providence Island. Subsequently the work was continued through the Northeast and Northwest Providence channels and the Tongue of Ocean. On the homeward journey soundings were also made to the east and north of Great Abaco Island and Little Bahama Bank, and off the coast of the Southern Atlantic States as far as Cape Hatteras. During these explorations one trip was made to Key West and Havana for the purpose of obtaining coal and other supplies, giving opportunity for a limited amount of work in the Straits of Florida. The customary physical observations were made at all of the sounding stations, in order to determine the currents, temperatures, and densities of the water and the character of the bottom. The dredge, beam trawl, and tangles were also occasionally employed to ascertain the abundance of bottom life, but generally with poor results, the white coral ooze which predominates in the deeper waters about the Bahama Islands being comparatively barren and the shallower spots generally too rough for the successful working of the dredging appliances. Surface collecting in the same region with the towing nets was equally unproductive, but by allowing the naturalists to land upon the islands and work along the shore very important results were obtained. The shore work was vigorously pushed at every place where the steamer made a harbor, and parties of two were occasionally left upon the islands while the steamer continued its sounding operations in the neighboring region. The fisheries which center at Nassau, including the important sponge fishery, were carefully studied, but no traces were found of the pelagic fishes, whose winter abode, it was thought, might be in this region. In the Straits of Florida and along the line of the Gulf Stream farther north the results of dredging were exceedingly rich.

From July 8 to October 28 the steamer *Albatross* was at work upon the offshore fishing grounds of Eastern North America, between New York and Newfoundland, with headquarters at Wood's Holl, Mass. Mr. Benedict having resigned his position, Mr. Thomas Lee acted as chief naturalist during these explorations, and was assisted by Mr. Sanderson Smith. From July 15 to 18 a short trip was made to the outer edge of the submerged continental plateau south of Martha's Vineyard, where the tilefish was formerly abundant. On August 2 the *Albatross* started east on a second cruise to the great cod and halibut banks lying off the coasts of the British Provinces, the purpose of which was to study the character and resources of the banks in general, and of those areas specially which are but little known; to search for new or reported banks, the existence or location of which was uncertain; and, partly in the interests of the Navy Department, to investigate certain reported dangers lying in the track of ocean steamers and fishing vessels. Diligent search was made for the mythical Hope Bank, supposed to be located south of Halifax, some distance off Le Have Bank; but although numerous soundings were made over a wide area inclosing its reported position, and thence to Sable Island Bank, no unusual inequalities in the bottom were discovered. A line of soundings was run between Banquereau and the Grand Bank to develop the contour of the intervening gulley in which halibut abound. Trials were made for codfish on the eastern part of Grand Bank, the eastern edge of which was found to be incorrectly represented on the published charts. Fruitless search was made for a reported bank of great promise to the fishermen, which was supposed to be located about 200 miles east of the Grand Bank in about 45° north latitude. Soundings were made from this point to the Flemish Cap, which was partly explored, and thence to the northeastern edge of the Grand Bank. St. John's, Newfoundland, was then visited for supplies, giving the naturalists an opportunity to study some important salmon streams, the steamer starting homeward from this place on August 21. During the trip to the westward the explorations were continued off the southern end of Green and St. Pierre Banks, between the latter bank and Banquereau, across Banquereau and Sable Island Bank, past the reported position of Hope Bank, and thence along the edge of George's Bank to Vineyard Sound, the steamer arriving at Wood's Holl August 29. Subsequently two trips were made to the deep-water area lying between latitude 36° 30′ and 39° north, and longitude 70° and 74° 33′ west.

The steamer *Fish Hawk* was engaged but little in this branch of inquiry during 1886. In August a few of the light-ships at which temperature observations are taken for the Commission were visited, and the keepers instructed as to the proper methods of immersing and reading the thermometers, especially during extremes of temperature. In October a few casts of the beam trawl were made in the region off Sandy Hook, N. J., where specimens of the English sole had been planted several years before, but without finding any trace of them.

The schooner *Grampus*, Capt. J. W. Collins commanding, made many important investigations respecting the fishing grounds and food-fishes off the New England and adjacent coasts, but these were mostly undertaken in the interest of fish culture. In August, a cruise was made to the tilefish grounds south of Martha's Vineyard, and six days were spent in fishing with cod trawls and hand lines in depths of from 60 to 160 fathoms, over an area about 120 miles in length. Only a few fish, mostly hake, were captured. From September 22 to October 9 the *Grampus* was engaged in an attempt to carry living specimens of halibut from the fishing grounds to Wood's Holl, for the purpose of securing their spawn in suitable condition for hatching. Fishing for this species was mainly carried on off Le Have Bank, in depths of 200 to 300 fathoms. A number of halibut were taken and transferred to the schooner's well, apparently without receiving serious injury from the hooks or subsequent handling. None of them lived, however, more than thirty-six hours, and the conclusion was reached that the fish could not survive the great change of temperature and pressure incident to their transfer from deep water to the surface. As it was probable, however, that halibut taken in shallow water could be successfully transported, a search was made for them in other localities, but none were found. With other species less difficulty was encountered. On this and the previous cruise, Mr. Raymond L. Newcomb acted as naturalist, and Mr. James Carswell accompanied the *Grampus* as fish culturist, in the search for halibut. During most of the remainder of the year the *Grampus* continued her fishing trips in Massachusetts Bay and off Cape Ann, carrying several cargoes of live fish, principally cod, in good condition, to the Wood's Holl station.

In December, Mr. Charles H. Townsend, an assistant of the Commission, was sent to the western part of the Caribbean Sea for the purpose of studying the fisheries of that region in the interests of the American fishermen. One of the objects of his trip was to ascertain if that region was to any extent the winter home of pelagic fishes which resort to the eastern coast of the United States in summer. His work extended into 1887. Free transportation as far as Swan Island was furnished by Mr. J. M. Glidden, president of the Pacific Guano Company.

The Wood's Holl station was occupied in the interests of scientific inquiry from early in July until the middle of October, becoming during this period the headquarters for the steamer *Albatross*. The Commissioner, Professor Baird, was in attendance during the entire season, and personally directed the work as in previous years. Prof. A. E. Verrill was in charge of the laboratory, assisted by Mr. Richard Rathbun. The regular force of workers in the biological laboratory was constituted as follows: Prof. S. I. Smith, of Yale College; Prof. John A. Ryder, of Washington; Mr. Sanderson Smith, of New York; Prof. Leslie A. Lee, of Bowdoin College; Prof. Edwin Linton, of Washington and Jefferson College; Prof. B. F. Koons, of the Storr's Agricultural School; Mr. J. H. Blake, of Cambridge, as artist; Mr. Peter Parker, jr., of Washington; Miss K. J. Bush, and Miss. C. E. Bush, assistants of Professor Verrill; and Mr. A. H. Baldwin and Miss M. J. Rathbun, assistants in the National Museum. The chemical and physical laboratory was in charge of Dr. J. H. Kidder, and the aquaria were managed by Mr. William P. Seal, of Philadelphia. Tables in the biological laboratory were also occupied by the following college representatives: Prof. S. F. Clarke, of Williams College; Prof. E. B. Wilson, of Bryn Mawr College, and Dr. A. T. Bruce, of Johns Hopkins University. Mr. Vinal N. Edwards, a permanent observer and collector for the Fish Commission in the Vineyard Sound region, worked in conjunction with the summer party, and assisted it in various ways.

Although acting as superintendent of the station during the summer, Professor Ryder was able to devote much time to the problems of lobster and oyster culture, which were then being carried on, especially with reference to the care and rearing of the young. During the spring hatching season for cod and lobsters he also made elaborate studies of the development of those two species from their earliest stages. The other naturalists were mostly engaged in preserving, assorting, and studying the large collections brought in by the steamer *Albatross* from its several cruises to the fishing grounds. Much field work was also done in the neighboring region, in continuance of the investigations of former years, for the purpose of obtaining information respecting the times of occurrence, the abundance, life histories, habits, diseases, parasites, etc., of the useful fishes and marine invertebrates. The Roosen process of preserving fresh fish, which has attracted much attention in Europe, was given several trials, with the expectation of finding it adapted to the preservation of bait for the offshore fishing vessels, a problem of unusual importance at the present time. It proved to be entirely unsuited to this purpose, however, the fish placed in it becoming too soft either for bait or for food, though generally free from the offensive odors of decomposition. Many large aquaria were added to the equipment of the lower floor of the laboratory and fish-hatching building, and under Mr. Seal's arrangements gave excellent opportunities to observe the habits of even large-sized fishes, of which an abundant supply for that purpose was always kept on hand. During the hatching season it was intended that these aquaria should be used for the temporary storage of the fry.

B.—Special Investigations.

Temperatures and densities.—One of the most important scientific problems before the Fish Commission has been the determination of the temperature and density of the water along the sea-coasts and in all inland lakes and rivers which afford valuable fisheries, or might be suited to that purpose. The object in studying these physical characteristics is at least twofold: First, to ascertain the influence of temperature and density on the movements of those migratory fishes which form so large a proportion of the fishery production of the country, and the appearance and abundance of which during any fishing season may possibly, in a measure, be predicted by a thorough knowledge of the physical conditions essential to their well-being; second, to furnish a guide in the transplanting of fishes and the stocking of any region with the species most likely to survive and propagate. General results are not so important or so applicable to this study as special series of observations continued from year to year. In the furtherance of this object, observations of temperature, and where expedient determinations of density, were made at all of the stations of the Commission during the entire year, or while operations were in progress. The same observations were made with great care by the vessels of the Commission, whether in port or cruising, and generally at intervals of one hour. The bottom and serial temperatures, and other physical data obtained by the steamer *Albatross*, on the fishing banks and in deep water, are of special value in the same connection. The most important continuous series of surface temperatures, however, are those taken for the Commission by employés of the Light-House Board and Signal Service along both sea-boards of the United States, at several stations on the Great Lakes, and upon some of the most important shad and salmon rivers on both sides of the continent. This co-operation between the two bureaus just mentioned and the Fish Commission has continued for many years, and has resulted in the accumulation of a large amount of valuable information. During 1886, these observations were carried on at thirty-six light-ships and light-houses, and at forty-eight stations of the Signal Service.

Rusty mackerel.—The rusting of mackerel, which sometimes occurs when, through the leaking out of the brine in which they are preserved in barrels, they are left more or less exposed to the air, has been a source of frequent loss to the fish dealers. The character and precise cause of this peculiar change being unknown, specimens of rusty mackerel were obtained during the year and submitted to Prof. W. O. Atwater, of Middletown, Conn., for examination. His report upon the subject has not yet been received.

Disease among trout.—The investigations by Prof. S. A. Forbes, of Illinois, of specimens of trout from Baird Station, Cal., affected by a disease hitherto unknown in that region, proves that the disease is identical with that found among the herring in Madison Lakes, Wisconsin, where it was very wide spread and destructive in 1884. Mr. Forbes's report will be found in the account of McCloud River station, by Livingston Stone.

C.—Preparation of Reports, etc.

The study of materials and the reduction and compilation of observations made by the field parties, including the preparation of reports upon the same, was continued during the year at the Washington and Wood's Holl stations of the Commission and at many college laboratories. As heretofore this class of work was done mostly by volunteers, among whom are some of the most accomplished naturalists of the country. Prof. A. E. Verrill has had general charge of the collections of marine invertebrates obtained along the Eastern coast, north of Cape Hatteras, which he is studying in their relations to the fishing grounds. The fishes were being treated in a similar manner by Prof. G. Brown Goode and Dr. T. H. Bean. Other special subjects were intrusted to the following persons: The crustacea to Prof. S. I. Smith; the bottom deposits to Prof. L. A. Lee; the internal parasites of fishes to Prof. Edwin Linton and Prof. B. F. Koons; the crustacean parasites of fishes and the temperature results to Mr. R. Rathbun; special groups of the mollusca and the preparation of charts to illustrate the marine investigations of the Commission to Mr. Sanderson Smith; embryological work respecting the cod, lobster, and oyster and other economic species to Prof. John A. Ryder; the preservation of bait to Dr. J. H. Kidder and Mr. Rathbun.

D.—Proposed Extension of the Inquiry to the Pacific Coast.

The first extensive fishery investigations made upon the Pacific coast of the United States were undertaken by the U. S. Fish Commission in connection with the Tenth Census, beginning in 1879 and extending through two or three years. Although these were mainly limited to a study of the history of the fisheries and of their condition at that time, large collections of fishes, containing many new and interesting species, were also obtained and described. An important result of these researches was to furnish conclusive proof of the value and extent of the fishery resources of the Western coast, which were then developed and utilized only to a very limited extent in the vicinity of the large settlements, and especially about San Francisco. A few fishing vessels, however, were in the habit of visiting, each season, certain rich cod and halibut banks off the central and southern Alaskan coasts, but the extent and character of these banks was unknown. The advantages which the Eastern fisheries have derived from the investigations of the steamer *Albatross* seemed to warrant the extension of the survey to the Pacific coast, and upon the solicitation of many persons interested in the matter the Commissioner decided to detail the *Albatross* for that purpose as soon as Congress could make provision for her voyage around and for the necessary alterations in her machinery. Appropriations for this purpose were passed in August, 1886, and before the close of the calendar year new boilers for the steamer were under construction. The plans for the Pacific work contemplated a thorough survey of the entire coast from southern California to the upper limit of the extensive cod and halibut banks in Alaska, upon the basis of the East coast explorations; but considering how little has been done to make known the contour and character of the bottom in that region, except near the shore, it was expected that hydrographic work in laying out and defining the fishing banks would demand a larger share of attention than hitherto. The study of the fishery resources will, however, be kept up at the same time, with the view of completing results as the explorations continue.

3.—INQUIRY RESPECTING THE FISHERIES.

Considerable progress was made during the year in the study of several of the more important fisheries, with respect both to their methods and their statistics. An event of more than usual interest was the completion of the fishing schooner *Grampus*, which has been constructed upon an entirely new plan proposed by Capt. J. W. Collins. While intended to serve as the model of a type of off-shore fishing smack, which it is thought will insure greater speed and safety to this class of vessels, she has also been specially adapted to certain branches of marine work for the prosecution of which no adequate means have hitherto been provided.

A.—Office and Field Work.

The office and field work in charge of Mr. R. E. Earll had reference mainly to the following subjects:

(1) *The mackerel fishery.*—The extent of the southern spring fishery and the condition of the fish, both fresh and salt, when placed upon the

market. The effect of the spring fishery upon the demand for and the average price of salted mackerel caught later in the season. As to whether the continuance of the spring fishery is tending seriously to affect the abundance of mackerel, or, as is often claimed, has any influence in breaking up or scattering the schools of fish.

(2) *The menhaden fishery.*—The present extent and location of this fishery. As to whether the methods of the fishery are in any way connected with the continued absence or scarcity of menhaden on the New England coast.

(3) *The sardine industry.*—The statistics of the industry, and the changes which have taken place in the methods of capture and of preparation of the fish since the investigations of 1880. The influence of the abrogation of the Treaty of Washington and of the proposed duties upon the supply of fish and upon the cost of producing the canned goods.

(4) The fisheries of the Great Lakes, respecting which a report, based upon the investigations of 1885, has nearly been completed.

(5) A general and statistical review of the vessel fisheries of the United States, material for which is being collected by means of circulars filled out at the custom-houses located at fishing ports.

(6) The compilation of national and State laws relating to the fisheries.

Mr. W. A. Wilcox was employed at Gloucester, Mass., during the entire year, as an agent of the Commission in collecting data relative to the statistics and methods of the New England fisheries. He was assisted by Capt. S. J. Martin, and rendered monthly reports which have been published in the Fish Commission Bulletin for 1886. During September and October the Senate Committee on Fisheries visited Gloucester for the purpose of giving personal consideration to the different phases of the industry, and also took testimony of the fishermen. The facilities of the station were placed at its disposal.

The sturgeon fisheries of Delaware Bay and River were made the subject of an investigation by Mr. S. G. Worth, who reported over two hundred and fifty boats, carrying from 200 to 500 fathoms of net each, engaged in the industry. Mr. Worth's inquiries also had reference to the expediency of propagating sturgeon by artificial methods. The statistics of the salmon canning establishments of the Pacific coast, from 1883 to 1886, were collected by Mr. Loren W. Green, an assistant at the California stations of the Fish Commission. Mr. Green, in the course of this work, visited all of the canneries of fish on the Sacramento River. His report on the subject is contained in the Fish Commission Bulletin for 1886.

B.—THE MACKEREL FISHERY DURING 1886.

The following summary of the mackerel fishery for 1886 was prepared by Mr. W. A. Wilcox:

The work of the season began early, the first vessels sailing from Gloucester on March 11. A large fleet was soon cruising off the Delaware coast. On March 28, the first mackerel were seen and caught in latitude 37° 30', longitude 75° 35'. An immense body of fish, in large schools, was seen extending some 25 miles. The fish remained in this location up to April 20. A small catch was made, 25 miles north of where they were first seen, up to May 15. For a week during the middle of May quite a large body of fish was seen, and some good fares were secured in latitude 38° 30', longitude 74°, off Fenwick's Inlet. The weather was unfavorable for fishing much of the time, the early catch small, and the fishing followed at a loss. May 15, part of the fleet were off Block Island taking some mackerel, but no large body of fish was again seen off the United States coast until fall. The early catch was noticeable as being all large fish, and, as usual in the spring, of poor quality. The body of fish appear to have crossed the southern part of George's Bank, and were next found off the Nova Scotia coast, between Cape Sable and Canso, mackerel having been caught there between May 25 and June 5, passing on into the Gulf of St. Lawrence, being found June 15 off North Cape, Prince Edward's Island. On July 8 they were found 15 miles N. by E. from North Cape, soon disappearing. From July 8 to August 1 was the only time mackerel were found in abundance in the Gulf of St. Lawrence, and not always during that time, yet vessels that were on the grounds of Orphan and Bradley Banks, and off Escumenac Point, had a fair catch. The fish were mostly taken from 10 to 25 miles from shore.

The early catch came to a close abruptly. Only the first arrivals secured fares, later arrivals spent weeks and months, taking very few if any fish. Vessels with a fair catch came home, selling their catch at the extremely low price of $4.50 a barrel, and at once returned in hopes of securing another fare of better fish and realizing more for them; in most cases they were disappointed, catching only a few barrels of fish.

Returning from the disastrous trips to the Gulf of St. Lawrence, the fleet cruised off the home shore, from the Bay of Fundy to Cape Cod, adding a small amount to the catch which was continued up to the middle of December. Quite a body of fine mackerel were off Block Island, and in Barnstable Bay as late as December; they seldom schooled, yet quite an amount was taken by small boats and net fishermen. The work of the season is remarkable for the scarcity of fish, they having been seen only occasionally in any amount either in American or provincial waters. The amount taken is the smallest since 1843, and with three exceptions, since 1818. The catch often shows great fluctuations, years of small production being followed by abundance. As late as 1883, the catch of Massachusetts was only 154,140 barrels, followed the next year by 304,938. The rapid and great advance in prices is noticeable, yet under the circumstances not remarkable.

The American catch of mackerel for 1886.

State.	Apparatus.	Vessels.	Tonnage.	Crews.
Massachusetts	Vessels	220	16,350.69	3,313
Do	Weirs and traps			243
Maine	Vessels	99	5,944.36	1,377
Do	Weirs and traps			
New Hampshire	Vessels	4	186.91	60
Rhode Island	Weirs and traps			
Connecticut	Vessels	2	88.13	19
New York	do	1	77.00	17
Pennsylvania	do	1	79.15	17
Total		327	22,726.24	5,046

The American catch of mackerel for 1886—Continued.

State.	Apparatus.	Southern.		New England shore.		Nova Scotia shore and Gulf of St. Lawrence.		1886. Total barrels.	
		Cured.	Fresh.	Cured.	Fresh.	Cured.	Fresh.	Cured.	Fresh.
Massachusetts ..	Vessels	2, 642	9, 928	8, 126	10, 032	51, 633	......	65, 401	19, 960
Do	Weirs and traps ..	....	....	1, 299	5, 991	......	......	1, 299	5, 991
Maine	Vessels	95	2, 590	6, 604	2, 528	10, 727	780	17, 426	5, 898
Do	Weirs and traps ..	....	....	80	950	....	......	80	950
New Hampshire.	Vessels	....	....	125	1, 500	....	......	125	1, 500
Rhode Island....	Weirs and traps ..	....	....	650	1, 100	......	......	650	1, 100
Connecticut	Vessels	....	....	275	....	....	......	275	......
New York.......	...do	....	....	50	....	100	......	150	......
Pennsylvania ...	....do	....	68	200	....	148	......	348	68
Total	....	2, 737	12, 586	17, 409	22, 101	65, 608	780	85, 754	35, 467

C.—The Schooner Grampus.

In previous reports allusion has been made to the building of a sailing vessel for the work of the Commission, which was to be named the *Grampus*. The vessel was completed and went into commission on June 5th of the present year. Her operations are fully discussed in a report published in the appendix.

The purposes for which this vessel was constructed are varied and important. For some time the Commission has felt the necessity of having a suitable sailing vessel, provided with a well, in which marine fishes can be kept alive and transported from the fishing grounds to the hatching stations on the coast where the eggs may be obtained for the purpose of artificial propagation.

Such a vessel can also serve a useful purpose by bringing in alive marine species, not perhaps in a gravid condition, which can be put into large aquaria and thus afford to biologists an opportunity to study the habits of our ocean fauna under conditions that can not possibly be otherwise afforded.

Another important duty which it is believed may be performed by a welled vessel, that is seaworthy and swift, is to visit European waters and bring therefrom alive certain species of marine fishes which are held in high repute for food and do not occur in American waters. Among these may be mentioned the sole, turbot, plaice, and brill. The introduction and propagation of these species in our waters must be of great advantage to the United States, not only in giving to our people additional species of delicate food fishes, but in introducing for their capture the method of fishing with a beam trawl, which is not now in vogue here and might, perhaps, profitably employ many vessels and men.

The *Grampus* has been fitted for using a beam trawl to test its utility in American waters in a commercial way. Although we have not the species of flat fishes which constitute the principal objects of the beam trawl fishery in Europe, there are several kinds in our waters that are nearly as good, and it is possible that on the sandy and muddy bottoms frequented by these off our coast the beam trawl may be very effectively used.

It is also of the highest importance that the movements of the migratory fishes should be followed in the spring and autumn, when they are approaching and leaving the feeding grounds which they frequent in summer.

Hitherto less has been done in this direction than is desirable, and a sailing vessel which is able to remain at sea in all weathers is especially well adapted to carrying on such investigation, since she is not dependent upon a supply of coal, and may, if necessary, cruise for weeks or months in succession. The *Grampus* being especially fitted for carrying on fishing operations can use all the appliances and methods for the capture of fish much better than they can be used on larger and more expensive steam vessels. In connection with these researches to ascertain the movements and habits of the migratory species, various forms of apparatus will be used to ascertain their presence, as well as the occurrence of crustacea or other forms of minute life that may constitute the food of fishes. Observations of the temperature, density of water, and the influence of winds and currents upon the movements of fish can also be studied.

She is especially adapted to making researches at sea for the discovery and investigation of fishing grounds, as well as for collecting the fauna of the localities visited, and thus determining the value of certain regions for the purposes of commercial fishing.

The *Grampus* is a two-masted, schooner-rigged vessel, 90 feet long, over all; 81 feet 6 inches on load-water line; 22 feet 2 inches beam, and 10 feet depth of hold; her registered tonnage is 83.30 tons. In model and rig she is a radical departure from the vessels commonly in use in the New England fisheries; and an additional important object sought in building her was to produce a type of fishing vessel which will be safer and better adapted in various ways to the exigencies required of a schooner employed in the ocean fisheries.

In the cruises made the present year she has shown remarkable seagoing qualities, and has demonstrated the fact that in safety, speed, and "handiness" she is far superior to the clipper fishing schooners of New England. Her influence is already being felt, and the principal features in her model and rig, which have been alluded to in a previous report, are being copied by the New England builders.

It is reasonable, therefore, to suppose that marked innovations may be caused by her advent, and that a few years will witness a change for the better in the form and rig of our fishing vessels. Such a change will result in the obtainment of greater safety and other scarcely less desirable qualities that must prove very beneficial to the fishing interests, and especially in preventing the sacrifice of life and property which has heretofore seriously handicapped these industries.

4.—FISHERY RELATIONS OF THE UNITED STATES WITH CANADA.

The treaty of Washington, defining the fishery relations between Canada and the United States, terminated July 1, 1886, but, by courtesy of the British Government, the privileges which it had granted to American fishermen were extended to the 1st of January following. In connection with the correspondence which ensued between the representatives of the two Governments relative to this subject, the U. S. Fish Commissioner was occasionally called upon for information. In December, 1886, he made the following report to the honorable Secretary of the Treasury, in reply to several questions which the latter had presented for his consideration. This report is of special interest as giving in concise form a comprehensive view of the fishery question based upon the evidence in the possession of the Fish Commission. The questions and replies are as follows:

Question 1. "What do you estimate to have been the value of the products of the British North American fisheries for 1885?"

The Canadian fisheries in 1885, as shown by tables compiled by the Canadian government, furnished occasional or continuous employment to 59,493 persons, with 1,177 vessels and 28,472 boats. The value of these, together with that of the other apparatus and capital, including shore property, gives a total of $6,697,459 employed in the fisheries industries, with a total value of products amounting to $17,722,973.18. The tables from which the summary is obtained have been compiled from the annual report of the Deparment of Fisheries, Dominion of Canada, for the year 1885.

In using the figures, it should be remembered that the tables include not only the commercial fisheries, but also the persons, apparatus, and capital employed in fishing for local supply, and probably a large number who fish only to furnish food for their own families. This class, owing to the lack of manufacturing interests and the character of the soil, composes in many localities a large part of the population.

Question 2. "What are the descriptions of the fish—in consequence of the present habits of the fish, the present methods of catching, drying, curing, and preserving—American fishermen desire to take either in the jurisdictional waters of British North America, or in the open sea or open bays near the British colonial possessions?"

Prior to, and during the first half of the present century, many of the New England vessels engaged in the offshore cod fisheries, being of small size, found it desirable to fish in the vicinity of the shore, where they could make a harbor in case of severe storms. Owing to their small tonnage, they found it difficult to carry sufficient quantities of codfish to make a trip to the more distant fishing grounds profitable, and many of them found it desirable to land and dry their fish upon the shores, thus enabling them to bring home a much larger quantity as a result of the voyage. At that time the majority of the fish were exported to Spain and the West Indies, and the methods which our fishermen found it necessary to adopt in drying their fish on the provincial shores made them especially adapted for these markets.

Since 1850 the small vessels engaged in the offshore fisheries have been gradually replaced by larger ones, and thus the privilege of fishing for cod in the vicinity of the shore has become less important, and as the codfish are more abundant on the offshore banks, 20 to 200 miles from land, vessels engaged in this fishery now prefer to visit these localities; and they have been doing so, with comparatively few exceptions, for the past fifteen or twenty years. The catch of these vessels, instead of being exported, is now to a great extent consumed in this country, and our market at present calls for fish cured in a different way, so that the privilege of drying and curing fish on Canadian soil, now that the vessels are large enough to readily carry the undried fish, is no longer of any advantage whatever to our fishermen.

Formerly vessels employed in the mackerel fisheries were provided only with hand-lines, and the crews caught the fish from the vessel's deck. When fishing in this way they found it desirable to grind up fish and clams, which they threw in large quantities into the water to attract the mackerel and keep them in the vicinity of the vessel. The best results were then obtained by fishing in shoal water, as the bait thrown overboard could not sink to any great depth, and the entire body of fish were thus kept near the surface, where they were within reach of the hook and line. About 1,865 purse-seines were introduced for the capture of mackerel, and in a few years they came to be generally adopted by vessels employed in the mackerel fishery. These are fished to best advantage at some distance from the shore, and the fishermen usually avoid shoal water, as the seines are liable to be ruined when set in depths where the lead lines may chance to come in contact with the bottom.

During earlier years the halibut-fishery in the vicinity of Provincial shores was of some slight importance to the American fishermen, but this has been confined wholly to deep water, many miles from land, since 1875.

The shore herring fisheries, and the occasional capture of certain species for bait, were also at one time of value to fishermen from the United States; but such a decided opposition on the part of the resident Provincial fishermen was manifested to the exercise of the privilege of taking fish, accorded by the Treaty of Washington, that the practice of catching their own supply was practically abandoned, and the fishermen have almost without exception, since the well-known difficulty at Fortune Bay, Newfoundland, about ten years ago, purchased their cargoes of herring from the local fishermen, and, where these had no suitable apparatus for obtaining the same, have carried their own apparatus and hired the provincial fishermen to manipulate it.

The mackerel is, then, the only species of any importance visiting Provincial waters which American fishermen at present desire to catch within 3 miles of the shore, or indeed within a much greater distance. This is practically the only Provincial shore fishery in which our fishermen have had any considerable interest since the ratification of the Treaty of Washington, as the great majority of our vessels employed in other fisheries on the banks off the Provincial coast seldom fish nearer than 25 or 30 miles from land, and a majority of them secure their cargoes from 100 to 200 miles from shore.

At the present time the advantage to be derived from any privilege of fishing within 3 miles of the Canadian coasts, even for mackerel, is comparatively insignificant, as the results of the season which has just closed show conclusively that our vessels which have fished wholly outside of the 3-mile limit have done fully as well as the Canadian vessels which have had the opportunity of fishing everywhere, without restriction as to distance from shore.

Question 3. In the method of fishing on that open sea, or in those open bays, of preserving the catch and sending it to our ports for a market now desirable for our American fishermen, of what importance is the right to enter, in a commercial way, British colonial ports in the neighborhood?

The nature of the occupation of fishing, when the size of the vessel is considered, renders it impossible for a fishing vessel to provide against all contingencies. On leaving the home ports the vessels are ordinarily provided with what is supposed to be a full outfit of provisions and apparatus, but a scarcity of fish may render it desirable that it should remain on the fishing grounds longer than was expected, or it may be delayed by head-winds, storms, or floating ice, until the supply of provisions or water is exhausted. It then becomes convenient, in order to prevent actual suffering, that the vessel should make a harbor and obtain additional quantities. Instances have occurred during the present year when vessels short of provisions have attempted to reach one of our own ports to obtain a supply rather than incur the risk of seizure by entering those of Canada for that purpose.

Again, portions of the vessel's equipment, such as anchors, cables, fishing-boats, and apparatus of capture, are liable to be lost during stormy weather, and it is a great convenience to be able to purchase new material in the nearest Provincial port rather than to incur the loss which must be sustained, provided the vessel is obliged to return to American markets to purchase them. This is true both in the fisheries carried on near the land and also in those on the more distant fishing grounds. This season much inconvenience was experienced by many of the vessels engaged in the mackerel fishery from the tearing of their seines and the loss of their seine-boats in heavy weather, owing to the refusal of certain Canadian officials to allow them to land their seines for purposes of repair or to buy new boats for continuing their fishing operations. Many of them were provided with two boats, and some carried two seines to guard against such contingencies, but in a number of cases vessels so equipped were equally inconvenienced with the others.

The only occasion that vessels would have for entering the harbor, due to the methods of preserving fish, would be for the purpose of obtaining either salt, barrels, or ice. It sometimes happens that the salt is damaged by a leak in the vessel, or that a detention beyond the expected time causes the melting of the ice, and it is important that our fishermen should be permitted to purchase additional quantities in Canadian ports, rather than run the risk of losing the entire cargo of fish or of returning with only a partial trip. The present interpretation given to the treaty of 1818 by the Canadian authorities, while it might allow a leaking vessel to enter a port for repairs, would not allow it to replace the salt that might have been rendered worthless by the leak.

The privilege of landing cargoes of fish at Provincial ports for shipment to the United States is of considerable importance to vessels engaged in the mackerel fishery, but of little value to those employed in the capture of other species. Vessels are thus enabled to land trips for shipment and to immediately resume their fishing operations, thus saving the two to four weeks necessary for making the homeward and return passage; but with the privilege of transshipping cargoes should be coupled that of refitting at the port where the fish are landed, otherwise the vessel might be short of provisions or apparatus, which would render it impossible for it to continue its fishing operations.

Most of the vessels from Gloucester, Mass., engaged in the off-shore cod fisheries have made a practice of obtaining fresh bait in Provincial ports; but a majority of vessels similarly employed from other places carry salt bait, thus being entirely independent of the Canadian supply. The chief difference between the two classes is that the Gloucester vessels fish with trawls, while the crews of most of the other vessels catch their fish with hand-lines. It is claimed by certain of the Gloucester fleet that they get more and larger fish by the use of fresh bait, but the fishermen from other ports have found their own methods profitable and have not felt disposed to follow Gloucester's example even when they had free access to Canadian ports for the purpose of obtaining bait.

A few of the vessel-owners in Gloucester have long maintained that the time lost in going to and from Provincial ports to secure bait, and the temporary demoralization of the crews resulting from a visit to these ports more than offset any advantages that are to be derived by the use of fresh bait, and urge that salt bait would be found, on the whole, more profitable; but as a considerable percentage of the men employed on the vessels have families or relatives in the Provinces, they have continued to urge upon the owners the necessity of obtaining bait in these localities, and it has been difficult to dissuade them. After the experience of the present year quite a number of other Gloucester owners and fishermen as well are convinced that it is on the whole better to substitute salt bait than to continue the old practice of leaving the Banks in the midst of the fishing season to obtain other kinds in the Provinces. That this opinion is shared by the Nova Scotia fishermen is proven by the fact that for some years they have been in the habit of purchasing large quantities of salt clams from dealers at Portland and other towns in the State of Maine, to be used by them in the cod fisheries.

Since the introduction of the purse-seine the mackerel fishermen have required no bait.

In the halibut fishery it is only necessary to take a sufficient quantity to last one or two days, as the remainder of the catch can be obtained on refuse fish taken on the trawls with the halibut, or, if necessary, small halibut can be cut up and used for baiting the hooks.

In the past the cod-fishermen frequenting George's Banks have at certain seasons of the year obtained their bait from Canadian ports, but the experience of the present year has proven that they are not dependent upon them, as most of the vessels have obtained their supply on our own coast with comparatively little difficulty, and frequently with less loss of time than was customary when visiting localities in New Brunswick and Nova Scotia.

It will thus be seen that though the privilege of obtaining bait and the ice necessary for preserving it in British North American ports has been in the past and may even still be considered a convenience to certain classes of vessels, it is not of vital importance.

The agitation of the question of bait supply has had a very beneficial influence upon our own fishermen, and has resulted in the development of extensive shore-bait fisheries along the coasts of Maine and Massachusetts, which give promise of being able to supply in large part, if not wholly, the demands of our entire fleet. During the past summer the experiment of shipping bait to Boston from the more remote localities on the coast of Maine has been made with success, and the cost of transportation is not high enough to be a barrier to the continuance of the business. If this practice increases, as at present seems probable, it will doubtless result in a great saving of time to our fleet, which has often in the past been seriously inconvenienced in its fishing operations, owing to the time consumed in sailing from port to port in search of a supply. The U. S. Fish Commission has recently begun a series of experiments with a view to determining the praticability of preserving fresh bait long enough to admit of its shipment from New England ports to the fleet fishing on the more distant banks, but the work is not yet sufficiently advanced to warrant an opinion as to the probable result.

Question 4. "The same question in regard to the fishing on the permitted coasts and the commercial entry in the prohibited bays and harbors, but not for fishing."

There is at present comparatively little fishing by American vessels on that portion of the coast to which free access is given by the treaty of 1818; but vessels fishing in that vicinity should have the same privileges in other ports as are accorded to other vessels, as it would seem unwise to discriminate, and it would, perhaps, owing to the few settlements of any importance on the permitted coast, be more convenient for the vessel to enter ports in the prohibited districts to purchase the necessary articles than to go out of their way in an opposite direction, where there might be any uncertainty of securing them.

Question 5. "What is your estimate of the total tonnage of the American vessels, the number of fishermen thereon, engaged in the Canadian and North Atlantic fisheries in 1886, and the total value of their catch?"

A careful estimate of the extent and importance of our New England vessel fisheries indicates that during the present year there have been 1,956 vessels, aggregating 115,130 tons, with crews numbering 17,996 men, employed in the various sea fisheries. The fleet is estimated to have been divided as follows: 1,530 vessels in the food-fish fisheries, 215 in the shell-fish and lobster fisheries, 177 in the capture of whales and seals, and 34 in the menhaden fishery.

The 1,530 food-fish vessels aggregated 71,200 tons and furnished employment to 14,240 men. The vessels, with their equipment, were valued at nearly $5,000,000, and their catch is estimated to have sold at prices to fishermen for $4,590,000. Of this fleet 350 sail were engaged in the off-shore mackerel fisheries, 200 in the cod fisheries on Quereau, Grand, and Western Banks, 165 others in the cod fisheries of George's and Brown's Banks, 65 in the off-shore halibut fisheries, and the remaining 750 in the miscellaneous shore and off-shore fisheries.

The off-shore mackerel vessels are the only ones that have engaged to any extent in catching fish in the vicinity of waters under British jurisdiction. Of this fleet about one-half, or possibly a slightly larger percentage, have fished in the Gulf of St. Lawrence during a portion of the mackerel season, the remainder of these vessels having remained off our own coast.

Below are given two tables, showing in detail the extent and character of our New England vessel fisheries in 1886. The figures as there explained are estimated from partial statistics furnished by collectors of customs on Treasury circular No. 63, Bureau of Navigation, and from special, but as yet unfinished, investigations by the U. S. Fish Commission. The statements in both tables are therefore subject to revision; but, as due allowance has been made for the statistics not yet received, it is believed the totals will not be materially changed by the final compilations.

Table estimating by fisheries the total number, tonnage, and value of New England vessels employed in the North Atlantic food-fish fisheries in 1886, with the number of men and value of apparatus and outfit on same, and the total value of their catch.

[These estimates are based upon partial returns from collectors of customs on Treasury Circular No. 63, current series, and upon special investigations by the U. S. Fish Commission.]

Fisheries.	Number.	Tonnage.	Value.	Value of apparatus and outfit.	Number of men.	Value of catch.
Off-shore mackerel fisheries	350	30,000	$1,325,000	$520,000	5,500	$875,000
Cod-fisheries on Quereau, Grand, and Western Banks	200	16,500	765,000	330,000	2,800	990,000
Cod-fisheries on George's and Brown's Banks	165	10,000	640,000	200,000	2,000	850,000
Off-shore halibut fisheries	65	5,000	400,000	110,000	900	750,000
Miscellaneous shore and off-shore fisheries	750	9,700	430,000	260,000	3,040	1,125,000
Total	1,530	71,200	3,560,000	1,420,000	14,240	4,590,000

Table estimating by fisheries the total number, tonnage, and value of New England vessels, with the number of men thereon, employed in the various fisheries in 1886.

[Based upon partial returns from collectors of customs on Treasury Circular No. 63, current series, and information obtained from other sources.]

State.	No.	Tons.	Value.	No of men.	State.	No.	Tons.	Value.	No. of men.
Food-fish.					*Lobster and shell-fish.*				
Maine	525	18,000	$900,000	3,600	Maine	40	750	$30,000	100
New Hampshire	20	600	30,000	120	New Hampshire	......	......	......	......
Massachusetts	850	50,000	2,500,000	10,000	Massachusetts	15	850	8,000	40
Rhode Island	35	400	20,000	80	Rhode Island	10	100	7,000	25
Connecticut	100	2,200	110,000	440	Connecticut	150	2,600	200,000	400
Total	1,530	71,200	3,560,000	14,240	Total	215	4,300	245,000	565
Whale and seal.					*Menhaden.*				
Maine	2	100	$10,000	20	Maine	......	......	......	......
New Hampshire	......	......	......	......	New Hampshire	......	......	......	......
Massachusetts	160	36,000	1,500,000	2,500	Massachusetts	......	......	......	......
Rhode Island	......	......	......	......	Rhode Island	19	960	$161,000	291
Connecticut	15	2,000	160,000	240	Connecticut	15	570	66,550	140
Total	177	38,100	1,610,000	2,760	Total	34	1,530	227,550	431

Table estimating by fisheries the total number, tonnage, and value of New England vessels, with the number of men thereon, etc.—Continued.

SUMMARY.

State.	No.	Tons.	Value.	No. of men.
Maine	567	18,850	$940,000	3,720
New Hampshire	20	600	30,000	120
Massachusetts	1,025	86,850	4,008,000	12,540
Rhode Island	64	1,460	188,000	396
Connecticut	280	7,370	476,550	1,220
Total	1,956	115,130	5,642,550	17,996

Question 6. "What change has, in your view, come to American fisheries since the last full year of the Washington treaty in regard to the character, quantity, and general features of that industry?"

There has been little change in the fisheries other than the mackerel fishery during the past year. In this fishery the scarcity of mackerel has been very marked and the catch has been much below that of the average year. The decrease, however, can be in no way attributed to the abrogation of the Treaty of Washington, but must rather be accounted for by natural causes which have affected the abundance, movements, and locality of the species.

For several years prior to 1886 mackerel appeared in more than average quantities, and for eight or ten years, ending with 1885, they have been much more plentiful on our own coast than on any portion of that of British North America. For this reason the fleet of American mackerel vessels visiting waters in the vicinity of British territory has of late been very small. In 1885, out of a total of about 380,000 barrels caught by our fleet, only 26,000 barrels, or less than 7 per cent., were taken in the vicinity of Canada, the quantity obtained within the 3-mile limit being only 3,564 barrels. The fact that, during a season when permission had been given to allow American vessels to fish anywhere in the waters of British North America without restriction as to distance from shore, less than 1 per cent. of the catch of our mackerel fleet was secured within 3 miles of British territory, and that more than 93 per cent. of the total catch of mackerel was obtained in the vicinity of our own coast, is certainly significant.

During the present year mackerel have been peculiarly scarce in all localities, though for the first time in eight or ten years they have been more abundant in the Gulf of St. Lawrence than off the New England coast, and a large percentage of the American vessels employed in the fishery have visited that locality. The catch has, as a rule, been unusually small, but the price has increased in proportion, so that the season for some of the vessels has not been wholly unprofitable. The limited catch can not in any way be accounted for by the restrictions placed upon our vessels within the 3-mile limit, for their catch, as previously stated, has been equal to that of the Canadian vessels that fished without restriction as to distance from the shore.

The vessels engaged in the cod-fishery have met with more than average success. This is partially attributed to the fact that the squid, used for bait, have been very plenty during the summer and fall months on the fishing-grounds. It has not infrequently occurred that vessels have sailed without any bait, depending upon the supply that they could catch on the Banks upwards of a hundred miles from shore.

Question 7. "Your Commission has, in its annual reports, alluded to the diminished necessity on the part of American fishermen to go to British North American ports or waters for *bait*. What are the new features of that necessity?"

A few years ago the United States Fish Commission obtained from Norway a number of gill-nets suitable for catching codfish, and used them with success in the cod-fisheries about Gloucester, Mass. Similar nets are now made in this country, and are extensively employed by the shore cod-fishermen of that vicinity, who obtain large catches by their use. These fishermen formerly depended in large part for their bait upon frozen herring, brought from New Brunswick and Newfoundland, but where gill-nets are used bait is no longer required. Thus far, however, gill-nets have not been extensively employed in the capture of codfish on the more distant fishing-banks.

The development of our shore bait fisheries, referred to in answer to a previous question, also renders our people less dependent upon the Provincial supply, and the growing sentiment upon the part of certain Gloucester owners in favor of substituting salt clams purchased in American markets for fresh bait obtained in the Provinces, seems destined to decrease still further our dependence upon the Canadian supply. It can not be denied, however, that there are still a large number of vessels that would consider it a convenience to obtain bait in the Provinces, provided commercial privileges, under proper restrictions, are accorded to our vessels.

Question 8. "Your Commission has also alluded to inquiries presented by it in respect to the general value of the inshore Canadian waters to American fishermen, and the yearly value of the liberties given to American fishermen by the Washington treaty. Have you ascertained new facts of public interest in that regard which you can conveniently communicate to me?"

The decreased importance to American vessels of the inshore Canadian fisheries has resulted—

(1) From the increased size of our vessels, which did away with the necessity of fishing close to land, where harbor could be made in case of storms, and of landing in the vicinity of the fishing grounds to dry their fish before sailing for home;

(2) From the substitution of the purse-seine for the hand-lines in the capture of mackerel, which has necessitated the fishing in deeper water and at a greater distance from shore; and

(3) From the change in the location of the mackerel fisheries, which has for the past few years enabled our vessels to obtain full cargoes in the vicinity of our own coast, instead of going to the Gulf of St. Lawrence, where they formerly met with better success, but where of late years—prior to the present season—they have found fishing unsatisfactory.

This recent return of the mackerel to the more northern waters should, however, not be considered as indicating a permanent change in the location of the fishery, for within a short time, and possibly next season, they may again appear in greater abundance on our own coast; and, indeed, the study of the movements of other fishes renders it not wholly improbable that mackerel may at no distant day disappear entirely from the Gulf of St. Lawrence and from other portions of the Provincial shores, where they are now abundant.

5.—PROPAGATION OF FOOD-FISHES.

DISTRIBUTION OF FISH AND EGGS.

The cars of the Commission have been extensively used in transportation. Some changes have been made in methods of distribution. Carp and other fishes of the same family are shipped during the fall and early winter, and not in the spring, which is the season of their greatest emaciation. Eggs intended for shipment to foreign countries were packed at the stations for the entire trip, and not repacked in New York. The boxes containing them were transferred from the non-conducting material surrounding them in the outer shipping cases to the refrigerating-rooms of ocean steamers.

Trout have been shipped by express, without a messenger, from Washington to New York and back, with no loss. A shipment to

Natural Bridge, Va., under less favorable conditions, was not so satisfactory; but these experiments indicate that it is possible to send trout moderate distances without attendants.

Below is a summary of the distribution for eighteen months, including 1886 and one-half of 1887; it covers, also, the distribution of 1885–'86 from the McCloud River and Cold Spring Harbor Stations not previously reported. The total number is somewhat too large, since the eggs of the Salmonidæ, after being counted as distributed from the station where they were obtained, were hatched at other stations, and the fry produced were sometimes again reported. The distribution of whitefish (94,670,000) is the largest that has been made up to this time.

Summary of distribution from January 1, 1886, *to June* 30, 1887.

Kind of fish.	Eggs.	Fry.	Large fish.	Miscellaneous.
Whitefish	32, 600, 000	62, 070, 000		
Grayling			2	
Smelt		2, 100, 000		
Saibling	18, 000			
Brook trout	82, 000	7, 488	1, 711	
Lake trout		155, 800	6, 923	
Atlantic salmon	754, 000	446, 588		
Land-locked salmon	377, 500	44, 017		
Rainbow trout	429, 000	49, 930	16, 482	
Brown trout	84, 500	26, 500		
Eels				200
Shad	10, 718, 000	99, 752, 000		
Carp		136, 163		
Tench				1, 202
Gold-fish		2, 805		
Brook pickerel				14
Rockfish		75, 000		
White perch				68
Black bass		48		
Sunfish				125
Redeye		2, 328		
Codfish		662, 000		
Sole				19
Lobsters		5, 000		

The grand total of the distribution is 210,628,413.

Notes on the Species Propagated and Distributed.

a. **The Sole** (*Solea solea*).

During 1886 several consignments of soles were brought across from Liverpool in the White Star steamer *Britannic*. Early in the year 24 were brought in one shipment without loss. From two later consignments 37 fish out of 49 sent were safely received at Wood's Holl, where they were kept with the hope of using them for breeding purposes.

The hanging fish-globes now employed for carrying soles across the Atlantic give better results than any other form of apparatus as yet devised for the purpose.

b. **The Halibut** (*Hippoglossus hippoglossus*).

As the fishing for this important species in moderate depths has become unprofitable because of the scarcity of the fish it was earnestly desired to begin its artificial propagation during the present year. The

Grampus was accordingly sent to the fishing-banks in the latter part of September in search of halibut. It was found that the spawning season was near at hand. The fish were caught in deep water, from 200 to 350 fathoms, and placed in the vessel's well apparently in good condition; but all of them died within twenty-four hours, probably on account of the difference in pressure and temperature. Attempts will be made to get halibut from shallow water in the Gulf of St. Lawrence or on the west coast of Newfoundland for future experiments, when it is expected that they will better endure transportation in the vessel.

c. **The Codfish** (*Gadus morrhua*).

The apparatus which proved most satisfactory for hatching the floating eggs of the cod was the tidal box devised by Colonel McDonald in 1881, modified by Capt. H. C. Chester's addition of inverted glass cylinders, having the mouth closed by cheese cloth and the bottom perforated for ventilation.

During January and February eggs were hatched easily in the apparatus above mentioned, but owing to the severe weather it was very difficult to obtain spawning fish.

On the 25th of January two acid carboys, each containing 40,000 codfish just hatched, were forwarded by express from Wood's Holl to Washington. After being forty-four hours in transit, about 7 per cent. of them reached Washington alive. On the next day 50,000 fish were sent in a carboy. After a journey of forty-four hours fully 50 per cent. of them reached the station in good condition. On January 28 a shipment of 500,000 fish in ten carboys was taken from Wood's Holl by messengers. They reached Washington on the 29th with a loss of less than 10 per cent., and were sent forward the same day to Pensacola, Fla., where they arrived shortly after midnight, February 1, with an additional loss of about 10 per cent. At Pensacola they were transferred to the revenue steamer *Forward*, which had been placed at the service of the Commission by order of the Secretary of the Treasury, and carried to the place selected by Mr. Silas Stearns for their final destination in the Gulf of Mexico, southeast by east from Pensacola Bar, in 100 fathoms of water. This experiment was made to determine whether or not the cod can be successfully transferred to Southern waters and become the object of a profitable fishery there.

In February a shipment of 500,000 young cod was forwarded from Wood's Holl through Washington to Old Point, to be deposited in Hampton Roads, with the hope of forming a colony in Chesapeake Bay.

Work of the Grampus.—During the winter of 1886–'87 the *Grampus* was engaged in obtaining eggs of the codfish for hatching at the Wood's Holl Station. In many cases the fish were taken with the gear of the *Grampus* and carried alive in the well to the station. Between 600 and 700 live fish were thus secured. Over 43,000,000 eggs were obtained; 20,000,000 were hatched and planted in the immediate vicinity of the station. Frequently eggs were obtained by sending men to collect them on board fishing vessels on the grounds. Owing to the cold and inclement weather during much of the winter cod were unusually scarce and fishing, even under the most favorable circumstances, was poorly remunerated. The work of collecting, however, was continued whenever opportunity offered until the middle of March.

Work of the Fish Hawk.—Early in January, 1887, the crew and some of the hatching apparatus of the vessel were utilized in the work at Wood's Holl. Late in February and till near the end of March the *Fish Hawk* was engaged in making short trips off Portsmouth and in Ipswich Bay, boarding fishing vessels to collect codfish spawn for shipment to Wood's Holl.

d. **The Mackerel** (*Scomber scombrus*).

In the month of May Captain Chester secured three gravid mackerel at Wood's Holl, and from them eggs were taken and placed in the apparatus which had been used for eggs of the cod. The fish commenced hatching in ninety-four hours after the eggs had been placed in the jars. This adds another very important species to the list of fishes that may be propagated at the Wood's Holl Station.

e. **The Black Bass** (*Micropterus dolomiei*).

11 breeders and 100 yearlings were collected during the summer at the Wytheville Station. 48 yearlings were sent away during the year.

f. **The Red-eye** (*Ambloplites rupestris*).

At the Wytheville Station, during the fiscal year 1886–'87, 77 breeders and 2,125 yearlings were obtained. 18 breeders were sent to the Central Station and 2,085 yearlings were distributed, including 586 in Cacapon River and 600 in Cowpasture River. On March 1, 1887, 25 red-eyes, about an inch in length, were sent to Max von dem Borne, Berneuchen, Germany, 20 of which reached their destination in safety.

The red-eye is a good pan fish, gamey, and weighs a half pound on the average; it is likely to do well in ponds.

g. **The Sunfish** (*Lepomis gibbosus*).

During the summer of 1886, 125 sunfish, about 1 inch in length, were taken at Cold Spring Harbor and forwarded, through Mr. E. G. Blackford, to Max von dem Borne, Berneuchen, Germany, who was fully advised of their predatory character.

h. **The White Perch** (*Roccus americanus*).

Three shipments of the young of this fish were sent from the Cold Spring Harbor Station to Max von dem Borne, in October and December, 1886, and March, 1887, of which only three, from the last shipment, reached Germany alive.

i. **The Rockfish or Striped Bass** (*Roccus lineatus*).

600,000 eggs were obtained at the Battery Station, near Havre de Grace, Md., but owing to pressure with the shad work, few of them were hatched. 75,000 fry were successfully planted in Lake Ontario, near Oswego, N. Y.

j. **The Smelt** (*Osmerus mordax*).

Large numbers of smelts were hatched at the Cold Spring Harbor Station, the parent fish having been obtained on the south side of Long Island. The hatching was rendered difficult by the glutinous nature of the eggs, but about one-half were developed. Over 2,000,000 young were planted in Cold Spring Harbor and 50,000 were deposited in Saranac Lake, in northeastern New York.

About the first of April a lot of eggs were sent to Northville Station, where they arrived in bad condition and apparently dead, but upon digging into the mass about 15 or 20 per cent. were found to be good.

k. **The Whitefish** (*Coregonus clupeiformis*).

Notwithstanding the stormy and very cold weather 129,400,000 whitefish eggs were obtained during November and December for the hatching stations at Northville and Alpena, Mich. The first eggs were received from Lake Erie November 7; the last from Lake Michigan December 13. On November 28 about 30,000 eggs were taken from two whitefish which had been hatched and reared at the Northville Station; this is believed to be the first record of their breeding in captivity. The hatching season at Northville lasted from March 11 to April 12; at Alpena, from April 22 to May 8.

32,600,000 eggs were distributed, mostly to neighboring state fish commissions; 62,070,000 fry were planted in waters of Michigan, Ohio, Indiana, and New York; 2,500,000 eggs were sent to England, 1,000,000 to Germany, and 1,500,000 to New Zealand; 5,000,000 were forwarded to the Central Station at Washington; 10,000,000 each to the State hatcheries of Pennsylvania and Minnesota; 1,000,000 to New York, and 1,600,000 to Delaware. From the 1,000,000 eggs sent to the Cold Spring Harbor Station nearly 950,000 young were obtained, and these were deposited in deep, cold lakes on Long Island.

l. **The Dwarf White fish** (*Coregonus albula*).

In January, 1886, Max von dem Borne sent 80,000 eggs of this species as a gift from the Deutsche Fischerei-Verein, by Herr von Behr, to the United States Fish Commission. These were received at the Cold Spring Harbor Station, and Mr. Mather was directed by the Commissioner to forward 70,000 eggs to Bucksport and 10,000 to Northville. Mr. Atkins received his allotment February 1. The first fish hatched out March 24, and about 51,000 young were obtained; these were planted April 21, 1886, in Heart Pond, a small lake near Bucksport which empties into the Eastern River, a small tributary of the Penobscot. Some of the eggs sent to Northville were hatched March 7, but no healthy young were secured from them.

m. **The Brook Trout** (*Salvelinus fontinalis*).

The Northville Station.—At the Northville ponds 186,750 eggs were taken. From December 28, 1886, to February 9, 1887, 82,000 eggs were shipped away, 10,000 to England, the remainder to Minnesota, Delaware, and Pennsylvania, and to the Central and Wytheville Stations. 527 young fish were sent away and 4,000 fry were retained for breeding purposes.

The Wytheville Station.—In December, 1886, 193 breeders were received from the Northville Station. In April 5,000 fry came from the Central Station. In January, 1887, 26,508 eggs were received from Northville and 75,000 from Mr. R. E. Follett, of Windham, Conn. During May and June, 1887, 750 yearlings and 2,488 fry were planted in suitable streams in Maryland and Virginia.

n. **The Saibling** (*Salvelinus alpinus*).

The Cold Spring Harbor Station.—In February and March, 1887, three shipments, each containing about 20,000 eggs of the saibling, were received from Berneuchen, Germany. 3,000 eggs from the first lot were repacked and sent to the State hatchery at Plymouth, N. H., where they arrived in good condition. The sound eggs of the second shipment were mixed by mistake with eggs of the brown trout received from Germany at the same time, and were distributed in this state to the hatcheries at Corry, Pa., Wytheville, Northville, and Cold Spring Harbor. 15,000 good eggs from the last shipment were sent safely to the Northville Station March 17, and hatched soon after; but the fry refused to eat, and most of them died of "blue sac" and starvation.

o. **The Lake Trout** (*Salvelinus namaycush*).

The Northville Station.—6,150 lake trout, hatched in January and February, 1886, were sent to Ohio, Indiana, Kentucky, and Tennessee. Owing to a lack of available funds no eggs were taken.

The Wytheville Station.—During the fiscal year 1886–'87, 800 yearlings were sent to the Central Station, 50 to the Gasconade River, Missouri, and 350 were planted in streams near the station.

The Cold Spring Harbor Station.—150,000 eggs were received from Northville December 19, 1885. 80,000 fry were distributed to waters in and near the Adirondacks; 5,000 to Monroe, N. Y.; 5,000 to Gloucester, Mass.; and 20,000 to Long Island waters. An attempt to rear some of the fry at the hatchery was unsuccessful, on account of the high temperature of the water. In June, when it reached 60° Fahrenheit, the young began to die, and none lived until September.

The Bucksport Station.—100,000 fry were obtained from eggs received from Northville. Of this number 35,000 were kept for rearing; 1,439 were placed in Craig's Pond June 17; and 2,113 in Pond B June 22. Upward of 31,000 were kept in the troughs and fed on liver, refuse meats, salt codfish, insects, and entomostraca.

p. **The Rainbow Trout** (*Salmo irideus*).

The McCloud River Station.—The first eggs for the season of 1885–'86 were taken on December 26, 1885, which was somewhat earlier than usual. The species seem to spawn sooner than formerly. The spawning season closed May 10. 221,425 eggs were taken from 226 fish. 30,000 eggs were lost because of high and muddy water; 15,000 were hatched for the trout ponds and the river, and 131,000 were distributed, chiefly to State fish commissions and to Central Station. During the spawning season of 1886–'87, which lasted from December 26 to April 11, 268,400 eggs were taken from 299 fish. 84,100 of these were lost from various causes; 39,300 were hatched and the fry planted in the McCloud River; the remaining 145,000 were sent to State commissions and to Central Station.

The Northville Station.—The spawning season in the ponds lasted from January 9 to April 25. 196,350 eggs were obtained from 375 fish; 25,000 were sent to the Michigan Fish Commission; 25,000 to Mr. Blackford, for shipment to France; while 25,000 fry were hatched out and nearly all of them kept at the station. 4,920 young fish were shipped away from the station.

The Wytheville Station.—During April and May, 1887, 8,000 fry were received from the Central Station, and 220,500 eggs were collected at Wytheville. During the fiscal year 1886–'87, 12,095 yearlings, 271 two years old or older, and 98,000 eggs were shipped away. 40,000 eggs were sent to Germany, 10,000 to England, and 5,000 to France. The remaining eggs and fry were distributed to private applicants, to suitable streams for stocking, and to various hatcheries. Mr. Max von dem Borne, writing from Berneuchen, Germany, on April 11, 1887, stated that the fry hatched from the eggs received were in excellent condition.

q. **The Brown Trout** (*Salmo fario*).

The Cold Spring Harbor Station.—64,000 eggs were received in very bad condition from the Deutsche Fischerei-Verein March 1, 1886, and 40,000 came from the same source, in good condition, March 20. On April 16, 50,000 eggs arrived in good order from Max von dem Borne. 13,000 eggs were repacked and sent to the Northville Station, and 1,000 to the Wisconsin Fish Commission. During April and May, 23,500 young trout were planted in suitable waters in New York.

In July a brown trout was caught in Allen's Creek, a tributary of the Genesee River, New York, which weighed 3 pounds. This must have been hatched from the first lot of eggs received in America. One of this first shipment, which was hatched and reared at Cold Spring Harbor, weighed 3½ pounds in October, 1886, at the age of three and one-half years.

During March, 1887, 108,000 brown trout eggs were received from Germany, but 60,000 of them were unfit to be developed. The last shipment of 50,000 eggs contained 13,000 dead ones. The good eggs of this lot were mixed by mistake with 14,500 saibling eggs, which arrived the same day, and 50,000 mixed eggs were sent to several State and National fish commission hatcheries. 10,000 eggs were received, also, on account of the New York Fish Commission, from Herr von Behr.

The Northville Station.—20,000 eggs were received March 17 from the Cold Spring Harbor Station, having come originally from Germany. 2,500 of these were sent to the Michigan Fish Commission and 5,000 to the Wisconsin Commission. The remaining eggs yielded nearly 9,000 fry, which were kept at the station. During November and December 9,400 eggs were taken from stock-fish in the Northville ponds, but only 1,500 fry were obtained from them.

The Wytheville Station.—2,165 brown trout eggs were received in March, 1886. They were hatched at a very unfavorable time, the water being muddy during incubation and remaining so until the surviving fish were several weeks old. 286 were reared, and in November they were between 2½ and 3 inches long. In March, 1887, 9,100 eggs were received from Cold Spring Harbor, and in May, 3,000 fry arrived from the Central Station.

r. **The Loch Leven Trout** (*Salmo levenensis*).

On January 14, 1887, the Cold Spring Harbor Station received 48,000 eggs of the Loch Leven trout from the Howietoun fishery in Scotland, but nearly one-half of them were dead. Strong and healthy fry were hatched from the remainder.

s. **The Atlantic Salmon** (*Salmo salar*).

The Bucksport Station.—205 salmon were purchased from the Penobscot River fishermen, from May 29 to June 8, and placed in the inclosure at Dead Brook. Only 147 of these lived through the summer. 1,158,776 eggs were taken from 101 females, an average of 11,473 each. Of these eggs, 1,099,000 were distributed, 320,000 being awarded to Massachusetts and 779,000 to the U. S. Fish Commission, the work having been conducted by these two commissions conjointly. 25,000 eggs were reserved for experiments at the station, and the fry were afterwards liberated in Craig's Pond. The remaining eggs were sent during February, 1887, to the following places:

Cold Spring Harbor, 300,000; F. A. Walters, Bloomingdale, N. Y., 250,000; E. B. Hodge, Plymouth, N. H., 100,000; Grand Lake Stream, 104,000.

The Grand Lake Stream Station.—About the 1st of March, 1887, 104,000 eggs were received from Bucksport. These were hatched with a loss of only 255 eggs and young, and the fry were planted in tributaries of the St. Croix River about the middle of June.

The Cold Spring Harbor Station.—240,000 eggs were received from Bucksport January 7, 1886, and 260,000 on the 7th. 446,573 fry were planted in tributaries of the Hudson and St. Lawrence Rivers and Lake Ontario. During 1886 small numbers of young salmon were taken in the streams in which they were planted in May, 1885. From information furnished by Mr. A. N. Cheney of Glens Falls, N. Y., and from other sources, it appears that more than 24 salmon were taken in the Hudson during 1886.

t. **The Landlocked Salmon** (*Salmo salar,* var. *sebago*).

The Grand Lake Stream Station.—The spawning season lasted from October 29 to November 18. 752 fish were taken, the females yielding 942,500 eggs, or an average of 1,935 each. 641,500 eggs were distributed and 214,000 were reserved for Grand Lake Stream. The distribution, according to the contributions for the expenses of the year, was as follows:

Contributor.	Money contributed.	Eggs distributed.
The U. S. Fish Commission	$860.00	377,500
The Massachusetts fish commission	300.00	132,000
The New Hampshire fish commission	300.00	132,000
Total	1,460.00	641,500

The eggs allotted to the U. S. Fish Commission were distributed in March, 1887, to various State commissions, to England, France, and Germany, and to the Wytheville and Cold Spring Harbor Stations. The 214,000 reserved for Grand Lake Stream were hatched and planted with a very small loss.

On March 8, 1886, 19,000 eggs were sent from the Grand Lake Stream Station to the Pennsylvania commission at Corry, Pa. Near the end of June about 12,000 fry developed from these eggs were planted in streams flowing into the lake of the South Fork Fishing and Hunting Club, in Cambria County, Pa.

The Wytheville Station.—50,000 eggs were received on March 13, 1887, from Grand Lake Stream; 12,997 yearlings were liberated in tributaries of the Shenandoah River, in the hope that this would establish a run in the Potomac River.

The Northville Station.—29,000 eggs were received from Grand Lake Stream on March 19, 1886, and on April 14 they hatched, with a loss of only 575. On April 27, 10,000 fry were planted in a lake of Clare County, and 12,000 in Rapid River, in Kalkaska and Antrim Counties, both places of deposit being in the northern central portion of Michigan.

The Cold Spring Harbor Station.—34,000 eggs were received from Grand Lake Stream on March 18, 1886. After a small loss in shipping and hatching, 31,020 fry were placed in two lakes of the Adirondack region. On April 1, 1887, 25,000 eggs received from the Grand Lake Stream Station were repacked and shipped to Leon d'Halloy, vice-president of the fish commission of the Lower Seine, France.

u. **The Shad** (*Clupea sapidissima*).

During the season of 1886 over 90,000,000 shad fry were distributed. Now, as the number of shad taken for market was less than 6,000,000 it will be seen that for every adult shad captured 15 young shad, artificially hatched, were placed in the waters. As the cost of this production and distribution was less than $20,000 the young fish were obtained and distributed all over the United States at the rate of about $215 for a million, or about 46 fry for a cent. In 1885, which showed a great improvement over previous years, the rate was about 30 fry for a cent. The total number of eggs collected and fry planted have also greatly increased over the results of previous years, as from the beginning up to and including 1882 the total number of young shad obtained was only about 200,000,000, while in 1885 less than 35,000,000 fry were sent out from the stations.

Shad fry for distribution in 1886 were derived from the following sources:

From Battery Station, Susquehanna River	43,776,000
From Central Station, Potomac River	28,151,000
From steamer *Fish Hawk*	21,018,000
From steamer *Halcyon*	310,000
Total	93,255,000

The following statement shows the general planting summarized by the streams or drainage basins in which the fish were deposited:

To tributaries of Narragansett Bay	2,534,000
To tributaries of Long Island Sound	749,000
To Hudson River	2,312,000
To Delaware River	21,618,000
To tributaries of Chesapeake Bay	52,835,000
To tributaries of Albemarle Sound	1,990,000
To tributaries of the Atlantic south of Albemarle Sound	4,183,000
To Mississippi River and minor tributaries of the Gulf of Mexico	4,758,000
To Colorado River, tributary of the Gulf of California	850,000
To Columbia River basin	850,000
Total	92,679,000

The Fort Washington Station.—The first ripe shad was taken April 16. From that time until near the end of May the run of fish was abundant and reasonably steady. The maximum number of eggs taken in one day was 3,503,000, on April 22; the period of greatest activity, was from April 20 to 27, inclusive, when 16,017,000 were procured, being nearly one-half of the entire number obtained during the season. In all, 36,362,000 eggs were collected. The number hatched and planted from the station in waters near by, was 3,154,000. The number forwarded to the Central Station was 33,208,000.

The Central Station.—The number of eggs received alive from Fort Washington was 28,283,000. Of these, 1,586,000 were transferred to other stations, and the number of fry sent out to be planted was

24,997,000. The cost of collecting, developing, and transporting the eggs at this and the Fort Washington stations was $3,796.45, which is at the rate of $127.66 per million, or 78 shad for one cent. There has been a marked gradual increase in efficiency of the force in transporting and hatching eggs, the percentage of loss diminishing year by year from 1883, when it was 29 per cent., to 1884, when it was 26 per cent., to 1885, when it was 10 per cent., while in 1886 it was only 7 per cent.

The Battery Station.—The work of the shad season began April 18 and ended June 10. The first run of fish continued for a week. All the runs of the season were very large. The number of eggs collected was 60,766,000. The supply of hatching apparatus was inadequate to meet the requirements. The number of fry hatched was 45,231,000, the percentage of hatching being 74.4; 43,776,000 fry were shipped away and deposited mainly in the Susquehanna River and other tributaries of the northern part of Chesapeake Bay; 1,000,000 fry were sent to Oregon, besides 585,000 eggs, resulting in a deposit of 850,000 fry in the Columbia River.

Work of the Fish Hawk.—From April 26 to May 1 the *Fish Hawk* visited the fishing shores and gillers in the northern end of Chesapeake Bay, and obtained 2,192,500 eggs for the Battery Station. During most of May the vessel was engaged on the Delaware in transporting spawn-takers, and in collecting, transferring, and depositing eggs. 34,454,500 eggs were obtained, from which 23,196,000 fry were hatched on board and 21,018,000 deposited in the Delaware River.

Work of the Halcyon.—From April 27 to May 23 the steamer *Halcyon* was occupied in Chesapeake Bay and in the Delaware River in gathering, transferring, and hatching eggs, and depositing the young shad. 4,561,000 eggs were taken; most of them were transferred to Battery Station or to the *Fish Hawk*, while some were hatched on board and deposited. 3,000,000 fry were received from Battery Station and deposited in the tributaries of the Upper Chesapeake.

The Cold Spring Harbor Station.—Late in April 1,796,000 shad eggs were received from the Central Station at Washington. Only 100,000 fry were obtained from these, and deposited in the Hudson River, near Albany.

Experiments in planting shad.—Attempts have been continued to acclimate shad in the Colorado River of the West, and thus to establish fisheries on the Colorado, Gila, and other tributaries of the Gulf of California. This experiment was begun in 1884 by the deposit of 983,000 fish, followed by 998,000 eggs in 1885 and 850,000 eggs in 1886, making a total of 2,831,000, all of which were planted at the Needles. If successful, the fry deposited in 1884 should return as mature fish in 1888.

The effort to transfer shad to the Columbia River basin was repeated also. 1,000,000 fry, 200,000 eggs on trays, and 335,000 eggs in hatching jars were sent out from Havre de Grace on May 9, 1886. The eggs in jars gave the best results, and this may indicate the proper method of shipping them across the Atlantic. 850,000 fry were deposited in the river basin.

Plantings have been made during the present season in streams of all the Atlantic coast States from Massachusetts to Florida. Particular localities selected for planting are chosen with a view to the general distribution of shad in all waters of the Atlantic coast.

v. **The Carp** (*Cyprinus carpio*).

The total distribution for the season aggregated 133,769, of which 38,634 were delivered to State commissioners and 95,135 to individual applicants. 589 applications had to be carried over until another year, and the number of fish given to each applicant was reduced from 12 to 15, instead of 20 as in preceding years.

The Washington Station.—The yield of the ponds was small, possibly, in part, on account of the low temperature of the entire season. Inability to drain them in the spring, because of the filling in of the Potomac flats, had an injurious effect on the carp, as it was impossible to kill the eels, sunfish, perch, and other predaceous fish that prey upon them.

The Wytheville Station.—During the fiscal year 1886–'87, 452 scale carp and 3,017 leather carp were received from the Central Station. 450 scale carp were planted in south fork of Reed Creek, in Wythe County, Va., and 1,925 leather carp were distributed to 91 applicants in southwestern Virginia and eastern Tennessee.

w. **The Gold-fish** (*Carassius auratus*).

The Washington Station.—During the season 2,755 gold-fish were sent out, in lots of 4 to 10 each, to applicants in 22 States and 2 Territories. 260 of the Japanese fan-tail variety were issued in small lots in December, 1886.

The Wytheville Station.—During the fiscal year 1886–'87, 50 gold-fish were distributed to 9 applicants in Virginia, North Carolina, Mississippi, and Texas

x. **The Tench** (*Tinca tinca*).

Less than 1,000 tench were reared at the Washington Station, their number being reduced by the ravages of eels. At the Wytheville Station 2 breeders and 450 yearlings were received from the Central Station, and the yearlings were planted in the south fork of Reed Creek, in Wythe County, Va.

y. **The Lobster** (*Homarus americanus*).

The Wood's Holl Station.—During the season the experiments were continued in the artificial propagation of the lobster. Eggs were obtained and placed in hatching jars, the number in the apparatus sometimes reaching nearly 1,000,000, and the young were deposited in Vineyard Sound and adjacent waters. In April and May Capt. H. C. Chester made some experiments with a view to keeping lobsters alive with the use of a very small quantity of sea water. These experiments seemed to demonstrate the feasibility of transporting the species across the continent. On May 29, 5,000 lobsters, 2 or 3 weeks old, were sent to the Cold Spring Harbor Station. These were planted off Rocky Point, in Cold Spring Harbor, June 5.

z. **The Oyster** (*Ostrea virginica*).

At the Saint Jerome Station experiments were continued in the artificial propagation of the oyster, according to the system devised by Prof. John A. Ryder, and by other methods. The work lasted from April to November 20, and was in charge of Mr. W. de C. Ravenel. On June 23 ripe oysters were found in sufficient numbers to begin spawning regularly. Collectors were put out and afterwards placed in ponds. Spat first appeared July 29. Sand and slime were deposited so rapidly and extensively as to interfere with the success of the undertaking.

6.—THE STATIONS OF THE FISH COMMISSION.

A.—MARINE STATIONS.

Gloucester, Mass.—This station was occupied mainly in the interests of the Gloucester fisheries and for the purpose of obtaining continuous and accurate returns of their statistics. It was in charge of Mr. W. A. Wilcox, a special agent of the Commission, assisted by Capt. S. J. Martin.

Wood's Holl, Mass.—Operations were carried on during the entire year at this important station, which is located on Vineyard Sound, at the southwestern extremity of Cape Cod and opposite the northern end of the Elizabeth Islands. It is now thoroughly equipped both for the propagation of marine fishes and for the purposes of scientific inquiry. The hatching of codfish, begun in November, 1885, was continued through the winter and into the spring of 1886, and was again taken up in November of the same year. The propagation of lobsters was carried on from May until July, and experiments with reference to the planting and breeding of oysters were conducted during the spring and summer. From early in July until the middle of October the station was occupied in the interest of the sea-coast investigations respecting food-fishes and the fishing grounds, under the immediate direction of the Commissioner, and during this period it was also the headquarters for the steamer *Albatross*.

Capt. H. C. Chester, who had served as superintendent of the station since its foundation, was obliged to relinquish his position in June, on account of ill health, and was succeeded by Prof. John A. Ryder, as acting superintendent, until October 1, when the station was placed in charge of Mr. Charles G. Atkins.

A frame store-house and a short section of wharf in front of the coal shed were finished during the summer, completing the principal structures required at this locality for the purposes of the Fish Commission. The final work upon the stone pier was also completed during this year by the Engineer Corps of the Army, and an appropriation of $14,000 was made by Congress to enable the Revenue Marine Bureau to construct a coal shed and wharf adjacent to the buildings of the Commission. This work, however, was not begun until the following year.

The system for supplying salt water to the laboratory building was entirely reorganized by the substitution of wooden and hard rubber pipes for the iron ones previously in use, thus obviating the inconveniences resulting from the accumulation of iron rust in the water. In the present arrangement wooden mains, having a 6-inch bore, lead from the harbor to the water tower, and thence to the lower story of the laboratory, the distributing pipes from this point being entirely of hard rubber with brass fittings. A standard Gardner clock, connected by telegraph wire with the Naval Observatory at Washington, was placed in the headquarters building for the convenience of Government vessels touching at the station, and a time ball, working in the same circuit, was arranged on top of the water tower where it could be seen by the many vessels passing through Vineyard Sound. Wood's Holl having been selected as one of the principal stations of the Signal Service, and the shore terminus of the Government cable connecting the main-land with the Elizabeth Islands, Martha's Vineyard, and Nantucket, the necessary accommodations were furnished that Bureau by the Commission. An office room in the laboratory building was assigned to their use, the exposed instruments were placed upon the roof of the storehouse, and permission was given to use the flag-staff for displaying the usual weather signals.

Saint Jerome, Md.—This station is located on the west shore of Chesapeake Bay, about 6 miles above the mouth of the Potomac River. The experiments in oyster culture, described in former reports, were continued here during a large part of the year, under the direction of Mr. W. de C. Ravenel, and upon a much larger scale than in previous years. Careful observations relative to the temperature and density of the water were made in connection with the work.

B.—Stations for Propagation of the Salmonidæ.

Maine.—The two stations located in this State, one at Bucksport, the other at Grand Lake Stream, are operated conjointly by the United States, the State of Maine, and one or two other of the New England States. They are both in charge of Mr. Charles G. Atkins as superintendent. At the Grand Lake Stream Station, under the direction of Assistant Superintendent W. O. Buck, 855,500 schoodic or land-locked salmon eggs were obtained in good condition. Of this number 377,500 were allotted to the United States, and were distributed in March, 1887, while 214,000, reserved by the State of Maine, were hatched and planted in Grand Lake Stream. Of sea salmon or Penobscot salmon eggs a net stock of 1,099,000, resulting from the winter's work, were available for division among the contributors to the fund. Of the assignment made to the United States, 779,000, nearly all were distributed in February, 1887, 25,000, however, being retained at the station for hatching, in order to make experiments in the rearing and feeding of the young during the following spring and summer.

New York.—At the fish-cultural station located at Cold Spring Harbor, Long Island, and owned and operated by the State of New York, certain privileges have been granted to the United States Commission gratuitously from year to year. During 1886 considerable work was done under this agreement by Mr. Fred Mather, superintendent, in hatching the eggs and distributing the fry of the following species to the rivers and lakes of New York, namely: Lake whitefish, lake trout, brown trout, shad, and Penobscot and land-locked salmon. Experiments were also made in the hatching of smelt and tom-cod.

Virginia.—The Wytheville Station, located on the summit of the Alleghany Mountains in southwestern Virginia, is leased from that State, and has been in charge of Col. Marshall McDonald, with Mr. George A. Seagle as superintendent. Many improvements and additions made to the station in 1885 rendered it practically complete in all its appointments for the season of 1886, and more extensive operations were carried on this year than hitherto. The following species were under cultivation: The rainbow, brook, and brown trout, land-locked salmon, red eye, black bass, carp, and tench.

Michigan.—The stations at Northville and Alpena, Mich., are operated mainly in the interests of the whitefish fisheries of the Great Lakes, but at the former station lake, brook, rainbow, and brown trout, and saibling were also propagated during 1886. Both stations are in charge of Mr. Frank N. Clark. Northville Station is the headquarters for the whitefish work and is kept open during the entire year, but the Alpena Station is closed during the summer. During the season of 1886, 129,400,000 eggs of the whitefish were obtained from the fisheries of Lakes Erie, Huron, and Michigan. Of this number 56,800,000 were placed in the hatchery at Alpena, and 72,600,000 were sent directly to Northville; but subsequently 21,000,000 were transferred from Alpena to Northville. The collection of eggs continued from November 4 to December 2. Of the total number, 32,600,000 eggs were distributed mainly to State hatcheries, and 62,070,000 were hatched and the fry planted in Lakes Huron, Michigan, Erie, and Ontario, and two smaller lakes in the State of Michigan.

California.—The salmon station at Baird, Cal., on the McCloud River, was not operated during 1886, but the collection of eggs of the rainbow or California trout was continued as usual at the McCloud River Station, the season lasting from December, 1885, until May, 1886. The total number of eggs taken was 221,425, this having been a smaller yield than usual, due to the loss of many breeding trout by disease and from the effects of a severe storm. The following season, beginning December, 1886, and ending May, 1887, 268,400 eggs were secured. Mr. Livingston Stone has continued in charge of the California work, with Mr. Loren W. Green as superintendent of the McCloud River Station.

C.—STATIONS FOR PROPAGATION OF SHAD.

Battery Island.—This station, located on Battery Island, near the mouth of the Susquehanna River, a few miles south of Havre de Grace, Md., was in charge of Mr. T. B. Ferguson, with Mr. L. R. Grabill as superintendent during the shad season, which continued from April 19 to June 10. The total number of shad eggs brought into this station was 60,766,000, of which 2,099,000 were received from the steamer *Fish Hawk*, and 2,433,000 from the steamer *Halcyon*, the remainder having been obtained by a temporary force employed for the purpose. About 44,000,000 eggs were hatched and the fry distributed. Experiments in the hatching of rockfish or striped bass met with partial success. Some improvements were made to the station during the year.

Washington.—The shad eggs obtained on the Potomac River were transferred to the Central Station in Washington, where they were hatched and the fry distributed. The total number of eggs thus received was 28,283,000, of which 24,997,000 were hatched and 1,586,000 transferred to other stations. The propagation of other species of fish was also carried on at this station, which is the headquarters for the cars and for the general distribution of young fish. It is in charge of Col. Marshall McDonald.

Fort Washington, Md.—This station, situated on the Government reservation at Fort Washington, on the Potomac River, was occupied during the shad season as a receiving station for the eggs collected from the fishing shores and from the gillers along the river. A seine is also operated at this point by the Fish Commission. The eggs are retained at Fort Washington until they are sufficiently hardened to permit of their being safely transported, when they are transferred to Central Station, Washington. Over 36,000,000 eggs were received here during the season of 1886, of which one-third were taken from the fish caught in the Fish Commission seine. About 3,000,000 of the eggs were hatched at the station and the fry planted in the vicinity. Operations were in charge of Col. Marshall McDonald.

Delaware River.—Operations were carried on in the Delaware River, with headquarters at Gloucester City, N. J., by the steamer *Fish Hawk*, assisted part of the time by the steamer *Halcyon*, from May 5 to June 3, The total number of shad eggs taken was 34,454,500, of which 23,196,000 were hatched on board the *Fish Hawk*, a part of the remainder having been transferred to Battery Island Station.

D.—STATIONS FOR PROPAGATION OF CARP.

Washington, D. C.—Many improvements were made in the carp ponds on the Monument Lot, in Washington, and a new and more commodious office building was constructed. Congress directed the filling in of Babcock Lake as an additional precaution looking toward the safety of the Washington Monument; but as this work was ordered not to begin before December, it did not interfere with the year's operations. This lake was drained and the fish removed for the last time on November 11. The Monument Lot ponds are chiefly used for the propagation of the several varieties of the German carp, but tench, golden-ide, and gold-fish are also produced in limited numbers. They are in charge of Dr. Rudolph Hessel.

Two or three ponds on the Arsenal grounds in Washington are still used for the rearing of scale carp. They are cared for by an employé of the Arsenal.

E.—NEW HATCHING STATIONS PROPOSED.

Duluth, Minn.—The following petition from the fishermen of Duluth was forwarded, under date of April 18, 1886, to the Hon. Knute Nelson, member of Congress from Minnesota:

The fishermen of Lake Superior, whose market and shipping point is at Duluth, Minn., feel the need of some relief being obtained for them from the U. S. Fish Commission, and a careful consideration of the facts as presented to Prof. Spencer F. Baird, Commissioner, and do hereby petition you to use your influence in securing for them the favors herein set forth.

They have formed themselves into an association to promote their mutual interests; their aims and objects being a better understanding of the fishing laws of States; a uniform action amongst the fishermen concerning the regulation of the sizes of meshes of all nets, and the enforcement of the laws concerning them.

To secure the artificial propagation of the eggs of both whitefish and lake trout by a fish hatchery.

To this end we have pledged ourselves to aid, by manual labor and by the use of our fishing plants and men, to procure eggs in the season for such a fish hatchery.

Realizing that the capital invested in the fishing industry is not proving remunerative under existing circumstances, and realizing from our past experience that the continual diminished catches both of whitefish and lake trout are decreasing one-third of the previous year's catch year by year, we therefore feel the necessity of providing for larger deposits of fry of these fishes, and assure you that a better sentiment is prevailing to-day amongst fishermen concerning the production of such fry.

While gratefully acknowledging the good work done by the Minnesota fish commission for us as fishermen, and the kindly interest evinced by Prof. Spencer F. Baird in the welfare of the fishermen of Lake Superior, yet we pray you to introduce a bill asking for an appropriation to establish a fish hatchery, under the instruction and charge of the U. S. Fish Commission, and have assured Professor Baird that we will, by such manual labor as may seem fitting to the U. S. Fish Commission or the assistants, place our apparatus and fishing plants to aid them in collecting and procuring eggs for this hatchery; and your petitioners will ever pray, etc.

This petition was accompanied by a letter from Mr. C. H. Evans, of Duluth, in which it was stated that if the Government would build a fish hatchery in that city, at a cost of $10,000, and maintain it, the people would donate a suitable site with an ample supply of good water. The fishermen of the region, who employ several steamers to collect the fish for marketing at Duluth, also offered to save the spawn and deliver it at the hatchery.

In response to inquiries by Mr. Nelson, the Commissioner replied that the whitefish interest of Duluth had not been wholly neglected, as many millions of the fry of that species had been planted in Lake Superior from the Michigan stations at Northville and Alpena; but that if it was deemed desirable to increase the work, and Congress should provide the means, a hatching station could be built at the proposed location. As a result of this correspondence, the following item was inserted in the sundry civil appropriation bill and became a law August 4, 1886:

Fish hatchery at Duluth, Minn.: For the establishment of a fish hatchery on Lake Superior at or near Duluth, Minn., $10,000: *Provided*, That the city of Duluth shall furnish, without charge, a suitable site for the said fish hatchery.

A site offered by the Lake-Side Land Company, of Duluth, at the mouth of Lester River, on the northern outskirts of the city, was found, upon examination, to afford the requisite facilities for the purpose, and it was accordingly accepted. Jurisdiction to the land was ceded to the United States by an act of the legislature of Minnesota, approved March 2, 1887.

Clackamas River, Oregon.—In February of the present year the Commissioner received from the Hon. J. H. Reagan, chairman of the Committee on Commerce, House of Representatives, a "Memorial of the Oregon legislature, relative to the establishment of a fish hatchery on the Clackamas River, Oregon," with a request that it be given consideration. The Commissioner, in reply, stated that the "salmon fisheries of that region could not be maintained in the face of the adverse influences exerted by civilization without resorting to artificial propagation on a scale commensurate with the importance of the fisheries, nor without such legislation as will give a reasonable measure of protection to the salmon during their spawning." He also explained that a reconnaissance of the Columbia River basin had been made, under the direction of the U. S. Fish Commissioner, by Mr. Livingston Stone, who reported favorably as to a location on the Clackamas River, as would be seen by reference to his account published in the Report of the U. S. Fish Commission for 1883.

The following amendment to the sundry civil appropriation bill was introduced in the United States Senate December 21, 1886, by Senator Dolph, but was not incorporated in the bill as passed:

For the establishment of a salmon hatchery on the Columbia River, its tributaries or other branches, and for the current expenses of the same for one year, $20,000.

7.—THE VESSELS OF THE FISH COMMISSION.

A.—The Steamer Albatross.

The steamer *Albatross*, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding, continued in active service during the greater part of the year. At the beginning of the year the steamer was at the Washington navy-yard, making preparations for a cruise to the region of the Bahama Islands, for the purpose of investigating the winter range and habits of certain pelagic fishes, which, during the warmer months, are of great economic importance to the American fishermen; and of making a series of deep sea soundings for the benefit of the Navy Department. She was detained in the Potomac River by ice until February 17, but left Norfolk on the 20th of that month and proceeded to sea. The cruise lasted until May 10, when the steamer returned to Washington. March 30, while coaling at Key West, the officers and crew rendered effective service in fighting a disastrous fire which destroyed a large part of the town. From July 15 to October 28 the *Albatross* was surveying on the northern fishing grounds, from the latitude of Virginia to the Grand Bank of Newfoundland and the Flemish Cap, with headquarters at Wood's Holl, Mass.

In preparation for the proposed trip to the Pacific coast extensive repairs to the steamer were necessary, and it was decided that new boilers would be required to insure her safety for so long a cruise. The expenditures for this purpose were provided for by the following act of Congress, contained in the sundry civil appropriation bill, approved August 4, 1886:

Steamer *Albatross*: For the construction and introduction of new boilers for the steamer *Albatross*, and other necessary general repairs, $20,000; for expenses of voyage from New York to San Francisco, including cost of coal and other necessary supplies, $7,500; in all, $27,500.

The plans for the new boilers were prepared by Passed Assistant Engineer George W. Baird, U. S. Navy, of the steamer *Albatross*, and received the approval of Mr. C. W. Copeland, the designer of the vessel, and of Chief Engineer B. F. Isherwood, U. S. Navy, to whom they had been submitted for criticism. Proposals for constructing the boilers were received and opened December 21, as follows:

Name.	Address.	Time required.	Amount.
Slater & Reid	167 Charles street, New York, N. Y.	130 days	$14,300.00
Atlantic Works	East Boston, Mass	120 days	19,800.00
John H. Dialogue	Camden, N. J	Reasonable time	27,000.00
Donald McNeil and John McNeil	Brooklyn, N. Y	3 months	16,825.00
C. H. De Lamater & Co	New York, N. Y	4 months	17,600.00
H. A. Ramsay and H. A. Ramsay, jr.	Baltimore, Md	6 months	16,538.28
Columbian Iron Works and Dry Dock Company	do	120 days	13,430.00
Oliver Reeder, C. M. Reeder, and L. B. Reeder	do	135 days	21,985.00
Pusey & Jones Company	Wilmington, Del	112 days	19,500.00

The bid of the Columbian Iron Works and Dry Dock Company, of Baltimore, being the lowest, was accepted, and the construction of the boilers was immediately begun.

B.—STEAMER FISH HAWK.

The steamer *Fish Hawk* was at Wood's Holl from January 1 to February 21, when she proceeded to the eastern part of the Gulf of Maine, for the purpose of collecting cod eggs for the Wood's Holl Station, generally making Portsmouth her headquarters. She remained in this region until April 12, when she returned to Wood's Holl, having obtained several million eggs, which were shipped directly as they were taken. While at Portsmouth the last part of February the *Fish Hawk* encountered a severe gale, and slight damage was done to the steamer by two schooners fouling while at anchor. The steam-launch was also sunk and not recovered until the following September.

From April 26 to June 3 the *Fish Hawk* was engaged in shad propagation in the Delaware and Susquehanna Rivers, being stationed most of the time in the vicinity of Gloucester City, N. J. The total number of shad eggs obtained was 34,454,500, of which 21,018,000 were hatched on board. From early in July until August 28 she was engaged most of the time in freighting for the Saint Jerome and Battery Island Stations, and left the last of August for Wood's Holl, visiting on the way the light-ships at Winter Quarter Shoal, Five Fathom Bank, and Sandy Hook, for the purpose of instructing the keepers in the methods of making temperature observations. Returning from Wood's Holl the latter part of October, an unsuccessful search was made in the vicinity of Sandy Hook for the English sole, which had been planted there some years before. The balance of the year the steamer remained in Chesapeake Bay, serving as a freight boat, the crew also assisting at times in the work at the stations. In July the command of the *Fish Hawk* was transferred from Ensign W. J. Maxwell, U. S. Navy, to Mate James A. Smith, who had previously commanded the *Halcyon*.

C.—STEAMER HALCYON.

This steamer, previously called the *Lookout*, was at Battery Station at the beginning of the year, where she remained until March 28, undergoing repairs. Subsequently she made an investigation of the pound and gill-net fisheries in some of the tributaries of the Lower Chesapeake, and from April 27 to May 23 was employed in connection with the work of shad propagation in the Susquehanna and Delaware Rivers. From the close of the shad season until the last of July, and again from the first of November until the end of the year, the *Halcyon* was mainly in Chesapeake Bay, acting as a dispatch boat or freight boat in connection with the stations, or investigating the fisheries. From August 9 to October 25 she was at Wood's Holl, Mass. Mate

James A. Smith, U. S. Navy, who commanded the *Halcyon* during the first half of the year, was transferred to the steamer *Fish Hawk* in July, and was succeeded on the *Halcyon* by Mr. William Hamlen.

D.—SCHOONER GRAMPUS.

The fishing-schooner *Grampus*, which was under construction at Noank, Conn., at the beginning of the year, was completed June 5, and left for Wood's Holl the same day. She is the first of a new type of vessel, designed especially for the offshore fisheries by Capt. J. W. Collins, who superintended her construction and subsequent operations. A description of her principal features and of her merits is given elsewhere in this report. The signal letters G. V. Q. F. were assigned to her by the Bureau of Navigation of the Treasury Department.

The *Grampus* made her first cruise August 12 to the offshore fishing-grounds south of Martha's Vineyard, where a week was spent in a fruitless search for the tilefish. Certain alterations in her fittings, shown to be necessary by this trip, delayed the vessel in port until the last of September, when she began a cruise to the vicinity of Le Have Bank, Roseway Bank, and Seal Island Ground, for the purpose of securing and bringing to the Wood's Holl Station, in her well, living specimens of halibut and other food-fishes, the spawn of which was desired for propagation. Returning to Wood's Holl October 12, a short trip was made to the mackerel fleet operating at the western end of Vineyard Sound, and during most of the remainder of the year she was engaged in fishing for spawning cod, which were carried to the Wood's Holl Station, and in investigating the fisheries of the western part of the Gulf of Maine, Massachusetts Bay, and the Vineyard Sound region.

ASSIGNMENTS OF NAVAL OFFICERS.

The following changes in the assignments of naval officers to the service of the Fish Commission were made during the year:

Lieut. Seaton Schroeder, executive officer and navigator of the steamer *Albatross*, was detached January 2, and was succeeded by Lieut. H. S. Waring.

Ensign W. J. Maxwell assumed command of the steamer *Fish Hawk* January 10, relieving Lieut. L. W. Piepmeyer, but July 24 he was transferred to the steamer *Albatross*, from which he was finally detached August 28.

Ensign W. S. Benton joined the *Albatross* January 13, and Ensign W. S. Hogg on the 16th of the same month.

Mate James A. Smith was detached from the steamer *Halcyon* and took command of the steamer *Fish Hawk* July 31, and August 3 Mate Hugh Kuhl joined the *Fish Hawk* as executive officer. Assistant Engineer S. H. Leonard was detached from the *Fish Hawk* December 18.

8.—COURTESIES AND ASSISTANCE RECEIVED BY THE FISH COMMISSION.

A.—FROM THE UNITED STATES GOVERNMENT.

TREASURY DEPARTMENT.—*Secretary's Office.*—In planting young codfish at Pensacola it was very desirable to have the use of a steamer. The revenue cutter *Forward*, by direction of the honorable Assistant Secretary, C. S. Fairchild, transported the fish and messenger in charge of the shipment to the point selected for depositing the fish.

Bureau of Statistics.—This Bureau has issued circulars and letters of instruction to collectors of customs, at ports where fishing-vessels are documented, with the result of furnishing the Fish Commission much statistical material.

Light-House Board.—The assistance of this Board in securing ocean temperature observations at thirty-five of the principal light-houses and light-ships upon the Atlantic coast has been continued.

Coast and Geodetic Survey.—The Commissioner has received a large supply of maps and charts published by this Survey; especially upon the fitting out of the *Grampus* in May a complete set was furnished for her use.

Life-Saving Service.—The keepers and patrolmen of this service, by direction of Superintendent J. H. Kimball, continue to report the stranding of marine animals upon the sea-coast. Among the specimens thus obtained were the following:

In March Mr. D. M. Etheridge, keeper of the Currituck Inlet Station, forwarded a rare shark, *Hexanchus griseus*, the first of this species seen on the United States coast.

Mr. E. H. Bunkers, Fletcher's Neck Station, Biddeford Pool, Me., sent a specimen of *Argentina silus*, a fish which is extremely rare on our coast, although not uncommon in Norway.

On July 5 Captain Edwards, of the Amagansett Station, forwarded a torpedo, or cramp-fish, to be mounted for exhibition.

WAR DEPARTMENT.—Permission for using the buildings and grounds at Fort Washington for the purpose of hatching shad was continued.

Signal Office.—During the occupancy of the Wood's Holl Station in July, August, and September, the Signal Office furnished weather predictions and special warnings of approaching storms. Copies of temperature reports made by observers at certain points of interest were also furnished as during preceding years.

Engineer Office.—Col. Peter C. Hains, engineer in charge of Potomac River flats improvements, gave authority to cut sods from the flats for turfing about the carp ponds.

NAVY DEPARTMENT.—The officers and crews of the *Albatross*, *Fish Hawk*, and *Halcyon* have been furnished by the Navy Department, and the facilities of various navy-yards, particularly those at Washington and Norfolk, have been extended to the Commission.

During the shad distribution in May and June the Department detailed Mr. H. E. Quinn to assist in the work.

Bureau of Construction and Repair.—The loan of two launches was continued during the present year.

Bureau of Steam Engineering.—By order of Mr. Charles H. Loring, Chief of the Bureau, a lot of engines, tools, etc., which were no longer required by the Department, were lent to the Commission and proved very useful.

Bureau of Yards and Docks.—A dredge and some scows belonging to the Washington navy-yard were lent to the Commission in June.

Hydrographic Office.—Upon the fitting out of the *Grampus* the Hydrographic Office furnished a valuable set of charts for her use in navigation.

Bureau of Navigation.—Commodore J. G. Walker furnished the *Grampus* with the Nautical Almanac, azimuth tables, and other books. He assisted also in procuring her instruments.

Naval Observatory.—Allan D. Brown, Superintendent of the U. S. Naval Observatory, detailed Mr. W. F. Gardiner in July to oversee the work of erecting a time-ball at Wood's Holl Station.

STATE DEPARTMENT.—When it became desirable to have the Roosen apparatus for experiments upon the preservation of bait, the Secretary of State directed the United States consul at Leith, Scotland, to procure and forward a set to the Wood's Holl Station.

In June the Secretary furnished, upon application, a circular letter to all consular officers of the United States in British North America, introducing Capt. J. W. Collins, commanding the schooner *Grampus*, and asking for him such official aid and facilities as might be required during a cruise in Canadian waters. The Secretary also addressed a letter to Sir Lionel Sackville West, requesting him to inform the Marquis of Lansdowne of the proposed scientific expedition of the vessel.

INTERIOR DEPARTMENT.—*Patent Office.*—The Official Gazette of the Patent Office has been supplied as heretofore; also specifications and drawings of various patents relating to fish and fishing apparatus.

Geological Survey.—The Director of the Survey allowed Prof. W. J. McGee to make a reconnaissance of Battery Island, with a view to determining the feasibility of sinking wells at that station.

GOVERNMENT PRINTING OFFICE.—The Government Printer has rendered much aid in advancing the publications of the Commission. Mr. James W. White, foreman of binding, wrapped the Commission's quota of its annual report.

BOTANICAL GARDENS.—Mr. William A. Smith, superintendent, at various times has furnished plants for the use of the Commission.

B.—BY RAILROAD COMPANIES OF THE UNITED STATES.

The distribution of fish and eggs is greatly facilitated by the courtesies of the railroad companies in transporting the cars free or at a reduced rate, in granting permission to carry fish and eggs in baggage cars, and to make repairs at their shops.

The Northern Pacific Railroad Company passed a car free from Saint Paul to the Pacific coast and back. The Atchison, Topeka and Santa Fé transported a car without charge with fish for the Southern Pacific region. During the whitefish distribution the Grand Rapids and Indiana Railroad lent the Commission a baggage car, which they transported free.

C.—By Steam-ship Companies.

The foreign steam-ship companies, without exception, have continued to transport free of charge the fish and eggs which are exchanged between the United States and foreign countries.

Messrs. Glidden and Curtis, of Boston, furnished transportation for a Fish Commission naturalist, Mr. Charles H. Townsend, from New York to Swan Island, on board the schooner *Mosquito.*

D.—Courtesies from Foreign Countries.

Australia.—Mr. F. Abbott, of the botanical gardens, Hobart, Tasmania, in September sent some seeds of hardy Eucalyptus, and offered to send those of *Nymphæa gigantea*, for the plant collections at the carp ponds.

England.—During the year, 61 soles were brought over alive from Liverpool in the White Star steamer *Britannic* and placed in large tanks at Wood's Holl, to be kept for breeding purposes.

Germany.—On January 28, were received from the German Fishery Association 50,000 eggs of a small whitefish (*Coregonus albula*); these were forwarded to Bucksport, for hatching and planting in Maine waters. On February 4, 50,000 additional eggs were received, and the good ones sent to Northville for lakes in Michigan and adjacent States.

During March, 1886, 104,000 eggs of the brown trout (*Salmo fario*) were received. The good ones, 35,000 in number, were sent to Northville, Wytheville, and Cold Spring Harbor. On April 16, 50,000 eggs were obtained from Max von dem Borne, of Berneuchen; these were forwarded to Northville, Mich.; Madison, Wis.; and Cold Spring Harbor, N. Y.

During March, 1887, 58,000 eggs of the brown trout were received from Max von dem Borne, and 50,000 from the German Fishery Association.

On February 9, 1887, 20,000 eggs of the saibling (*Salvelinus alpinus*) were received from Berneuchen. On March 9 another consignment of 40,000 eggs arrived, one-half of them from Max von dem Borne, the other from the German Fishery Association.

Scotland.—On January 14, 1887, the Cold Spring Harbor Station received 48,000 eggs of the Loch Leven trout (*Salmo levenensis*), from Sir J. R. Gibson Maitland, proprietor of the Howietoun Fishery at Stirling.

9.—COURTESIES AND ASSISTANCE RENDERED BY THE FISH COMMISSION.

England.—Shipments to England were made to the National Fish Culture Association, South Kensington, London. On January 15 and 29, 1886, two lots of whitefish eggs, each of 1,000,000, were forwarded by the Cunard steamer *Aurania*. On January 15, 1887, 1,500,000 eggs of the same species, followed on February 19 by 1,000,000, were shipped through Mr. E. G. Blackford, of New York. Few of these, however, arrived in good condition.

50,000 lake-trout eggs were sent by the *Aurania* on January 15, 1886, and arrived in excellent order.

10,000 brook-trout eggs were carried by the Cunarder *Servia*, January 29, 1886, and 10,000 were forwarded through Mr. Blackford on January 15, 1887.

10,000 eggs of the landlocked salmon were taken March 16, 1886, by the White Star Line steamer *Germanic*. On March 5, 1887, Mr. E. G. Blackford assisted in sending 25,000 eggs of the same species. Both of these shipments were successful.

10,000 eggs of the rainbow trout were sent from Wytheville during the fiscal year 1886–'87.

France.—During the fiscal year 1886–'87, 5,000 eggs of the rainbow trout were sent to France from the Wytheville Station. On April 6, 1887, 25,000 eggs of this trout from the Northville Station were sent to Mr. E. G. Blackford for shipment to France.

25,000 eggs of the landlocked salmon, from Grand Lake Stream Station, were shipped on April 1, 1887, to Léon d'Halloy, vice-president of the Lower Seine Fish Commission.

Germany.—In April, 1886, an unsuccessful attempt was made to transport shad to the Danube River.

On March 20, 1886, 20,000 landlocked salmon eggs were sent to von dem Borne for the Fischerei Verein. 30,000 eggs of this species were forwarded on March 5, 1887, through Mr. E. G. Blackford, to von Behr for the same association, and 10,000 to Max von dem Borne for his establishment at Berneuchen.

In January, 1886, two shipments of whitefish eggs, each containing 1,000,000, were made from Northville to the Deutsche Fischerei Verein, Germany. These were repacked at Cold Spring Harbor. A third consignment of 1,000,000 from the same station was reshipped by Mr. Blackford March 10 in the original packages, modified only by replacing some of the packing with ice. On January 22, 1887, again 1,000,000 whitefish eggs were sent from Northville to Mr. Blackford, to be forwarded to Germany.

At Cold Spring Harbor 50,000 lake-trout eggs, which had come from Northville, were reshipped on January 18, 1886, per steamer *Fulda*, to the Fischerei Verein.

On February 22, 1886, 25,000 brook-trout eggs, from Northville, were repacked at Cold Spring Harbor, and sent to the Verein per steamer *Eider*.

On February 19, 1886, 25,000 rainbow-trout eggs, from Wytheville, were shipped to the Fischerei Verein on the steamer *Hermann*. 10,000 eggs of this species were sent to Max von dem Borne on January 24, 1887. 30,000 eggs were sent from Wytheville February 7 and 14, 1887, to Herr von Behr.

Attempts to convey sunfish, red-eye, and white perch in 1886 and 1887 to Max von dem Borne have been described in the systematic account of these species.

Mexico.—By request of the minister of Mexico, 25,000 lake-trout eggs were sent from Northville, January 18, 1886, to Estévan Cházari, of the City of Mexico.

New Zealand.—On February 5, 1886, there were sent from the Northville Station 1,000,000 whitefish eggs to Mr. Charles B. Buckland, of San Francisco, destined for Sir Julius Vogel, Wellington, New Zealand. Owing to want of care in transportation this shipment was a failure.

On January 5, 1887, there were forwarded from Northville 1,500,000 whitefish eggs to Mr. Charles B. Buckland, acting resident agent for the New Zealand Government at San Francisco, to be forwarded to New Zealand. These eggs were taken by the steamer *Alameda* and their safe arrival was acknowledged February 26 by Mr. W. J. M. Larnach, minister of marine. About one-half of the eggs were placed alive in the hatcheries.

Switzerland.—1,000,000 whitefish eggs and 50,000 eggs of the lake trout were sent to Switzerland January 13, 1886, per steamer *Amerique*, via Havre. On February 2, 10,000 brook-trout eggs were forwarded. On February 15 Col. Emil Frey announced the safe arrival of the whitefish and lake-trout eggs, and their distribution to the hatcheries at Zurich, Zug, Geneva, Locarno, Interlaken, Lucerne, Brassus, Saint Moritz, Stanz, and Chur.

Assistance rendered by steamer Albatross.—Note has been made, under the heading of the steamer *Albatross*, of the services rendered on March 30 by the officers and crew of that vessel in saving part of the town of Key West, Fla., from a destructive fire.

On the 19th of July, as the steamer *Albatross* was returning to Wood's Holl from a dredging trip, the steam-collier *Panther*, belonging to the Philadelphia and Reading Railroad Company, was discovered aground off Naushon, and was assisted from her perilous position.

10.—PUBLIC EXHIBITIONS OF THE METHODS AND RESULTS OF THE COMMISSION.

At the exposition held at Louisville, Ky., during this year, a few of the appliances of the Fish Commission were displayed in connection with the exhibit made by the National Museum. The Commission was also represented at the Nebraska State fair, in Lincoln, Nebr., by numerous articles of interest, furnished at the request of Mr. W. L. May, a member of the Nebraska State fish commission. The method of hatching whitefish eggs in the McDonald jars was exhibited, in April, at the exposition building in Chicago, under the direction of Mr. J. F. Ellis, 3,000,000 eggs of the whitefish having been sent from the Northville Station for that purpose. A similar exhibition, with respect to both whitefish and brook-trout eggs, was made in December at an industrial exposition held at Wilmington, Del., Dr. E. G. Shortlidge having charge of the apparatus.

11.—VISITS FROM REPRESENTATIVES OF FOREIGN GOVERNMENTS.

A visit was received in September from Mr. Kadzutka Ito, commissioner of fisheries for the island of Yezzo, under the Japanese Government. Mr. Ito was commissioned by his Government to study the fishing industries of the United States and the methods and results of the U. S. Fish Commission. He is a graduate of the Imperial College of Agriculture at Sappora, and has been for several years chief of the bureau of fisheries in the Department of the Hokkaido; he is also an officer of the bureau of colonization. While in the United States he inspected nearly all of the stations of the Fish Commission and the principal fishery centers. He remained in this country nine months.

Dr. Filip Trybom, of the Swedish commission of fisheries, who arrived in the United States in 1885, continued his studies in this country until November, 1886, visiting the principal fishing ports and the hatching stations of both the Atlantic and Pacific coasts and of the Great Lakes.

12.—DEATHS DURING THE YEAR.

Notice of Capt. Hubbard C. Chester.—During this year the Fish Commission lost one of its most valued members, Capt. Hubbard C. Chester, who died July 19, at the age of fifty-two years. A native of the fishing town of Noank, near New London, Conn., Captain Chester, at an early age, entered the whaling service, in which he gained rapid promotion and received that thorough disciplining which, with his natural tastes and great energy, specially fitted him as an associate of Captain Hall in his Arctic expedition. The services which he rendered as executive officer of the steamer *Polaris*, and his successful rescue of the unfortunate party which drifted to sea on the detached ice-floe, have gained him well-merited fame.

Captain Chester joined the Fish Commission in 1874, soon after his return from the *Polaris* expedition, and has taken part in nearly all of its branches of service. On the smaller steamers, before the *Albatross* was built, he was generally in charge of the dredging operations, and also participated during two or three seasons in the shad operations on the Susquehanna and Potomac Rivers. He assisted in preparing and installing the exhibits of the Fish Commission and National Museum at the Centennial Exposition at Philadelphia in 1876, and in 1883 had charge of packing the large collections sent by the Fish Commission to the London Fisheries Exhibition and their subsequent installation. In 1885 he was made the first superintendent of the Wood's Holl Station, which was then permanently organized, and continued to fill this position until June of this year, when his final illness unfitted him for active service. Captain Chester was a member of the party which conducted the experimental work of cod hatching at Gloucester, Mass., during the winter of 1878-'79, when by unwise exposure he contracted a serious lung trouble, from which he never fully recovered. He also took part in the subsequent experiments of the same nature at Wood's Holl, and during the winter of 1885-'86 was in charge of the work. The Commission is indebted to him for important improvements in the methods of hatching cod and lobster eggs and in the dredging appliances.

Notice of Capt. Nathaniel E. Atwood.—It is very appropriate that mention should be made in this connection of the important services rendered to science and to the fishery industries of New England by Capt. N. E. Atwood, of Provincetown, Mass., who died November 7, 1886, in his eightieth year. His warm devotion to the interests of the Fish Commission, and his frequent contributions to its fund of information, made him an honored associate in its work, and his loss will be deeply felt by those who enjoyed his friendship. Starting life as a fisherman in 1816, when only nine years of age, he continued actively in this vocation for half a century, at the end of which time he turned his attention to the curing of fish in his native town. In 1857 he was elected to the State house of representatives, and subsequently to the State senate, in which he served as a member of the committee on fisheries. Captain Atwood was an accurate observer of natural phenomena, and possessed a wonderfully retentive memory, lacking only the necessary training to fit him as an accomplished naturalist. He gave valuable assistance to Dr. D. Humphreys Storer in the preparation of his monograph on the fishes of Massachusetts, begun in 1843, and was afterwards a constant helper of Prof. Louis Agassiz in his ichthyological studies. The Fish Commission is indebted to Captain Atwood for most of its information respecting the history of the important fisheries of Cape Cod, and in many other directions it has had the benefit of his varied experiences.

13.—PUBLICATIONS BY THE FISH COMMISSION DURING 1886.

Annual Reports.—The annual report of the Commissioner for 1883, of which only the press-work and binding remained to be done January 1, was not received from the Printing Office until August 11. Most of the report for 1884 was also in type at the beginning of the year, and the bound volumes were ready for distribution by the middle of December.

Quarto Reports.—Considerable progress was made with the quarto reports relating to the fisheries and fishery industries of the United States, which were ordered printed by an act of Congress passed in 1882. These reports have been prepared by Prof. G. Brown Goode and a staff of associates, under the joint co-operation of the Commissioner of Fisheries and the Superintendent of the Tenth Census. The "Geographical Review of the Fisheries," which, after being put in type, was transferred to the Department of the Interior, in 1885, for publication as a volume of the Census Report, was returned to the Commission during the current year, and will form Section II of the Quarto series. Only the press-work and binding remain to be done. The account of the fishing grounds of North America and of the ocean temperatures of the Atlantic coast, now constituting Section III, and the report upon the fishermen, forming Section IV, are also in type. Section V, in which the History and Methods of the Fisheries are discussed, was nearly ready for the Printer at the close of the year.

Bulletin.—The printing of the Bulletin for the current year (Volume VI) was begun early in February. Signatures were mailed to correspondents March 30, July 23, October 22, and December 20.

Pamphlets.—The following publications, mostly extracted from the Annual Reports for 1883, 1884, and 1885, have been issued during the year for separate distribution:

96. TANNER, Z. L. Report on the work of the U. S. Fish Commission steamer *Albatross* for the year ending December 31, 1883. (From Report 1883, pp. 117–236.)
97. STONE, LIVINGSTON. Explorations on the Columbia River from the head of Clarke's Fork to the Pacific Ocean, made in the summer of 1883, with reference to the selection of a suitable place for establishing a salmon-breeding station. (From Report 1883, pp. 237–258.)
98. ATWATER, W. O. Contributions to the knowledge of the chemical composition and nutritive values of American food-fishes and invertebrates. (From Report 1883, pp. 433–499.)
99. VERRILL, A. E. Results of the explorations made by the steamer *Albatross* off the northern coast of the United States in 1883. (From Report 1883, pp. 503–699.)
100. BUSH, KATHARINE, J. List of deep-water mollusca dredged by the U. S. Fish Commission steamer *Fish Hawk* in 1880, 1881, and 1882, with their range in depth. (From Report 1883, pp. 701–727.)
101. EISEN, GUSTAV. Oligochætological researches. (From Report 1883, pp. 879–964.)
102. SEAL, WILLIAM P. The Aqua-vivarium as an aid to biological research. (From Report 1883, pp. 965–969.)
103. BENECKE, B. Utilizing water by fish-culture. (From Report 1883, pp. 1101–1142.)
104. RYDER, JOHN A. An exposition of the priciples of a rational system of oyster culture, together with an account of a new and practical method of obtaining oyster spat on a scale of commercial importance. (From Report 1885, pp. 381–423.)
105. SMITH, SIDNEY I. Report on the Decapod Crustacea of the *Albatross* dredgings off the east coast of the United States during the summer and autumn of 1884. (From Report 1885, pp. 605–705.)

106. RYDER, JOHN A. On the development of Osseous Fishes, including marine and fresh-water forms. (From Report 1885, pp. 489-604.)
107. TANNER, Z. L. Report on the construction and outfit of the U. S. Fish Commission steamer *Albatross*. (From Report 1883, pp. 3-116.)
108. BAIRD, SPENCER F. Report of the Commissioner for 1884. A. Inquiry into the decrease of food-fishes. B. The propagation of food-fishes in the waters of the United States. (From Report 1884, pp. xiii-lxxi.)
109. BAIRD, G. W. Specifications for building the new boilers, etc., of the steamer *Albatross*, 1886. (Printed by R. Beresford, Washington, D. C.)
110. TANNER, Z. L. Report on the work of the U. S. Fish Commission steamer *Albatross* for the year ending December 31, 1884. (From Report 1884, pp. 3-112.)
111. NICKLAS, CARL. Pond culture. (From Report 1884, pp. 467-655.)
112. SMILEY, CHARLES W. Some results of carp culture in the United States. (From Report 1884, pp. 657-890.)
113. FEWKES, J. WALTER. Report on the medusæ collected by the U. S. Fish Commission steamer *Albatross* in the region of the Gulf Stream, 1883-'84. (From Report 1884, pp. 927-980.)
114. RYDER, JOHN A. On the origin of heterocercy and the evolution of the fins and fin-rays of fishes. (From Report 1884, pp. 981-1107.)

14.—DIGEST OF THE APPENDICES WHICH ACCOMPANY THIS REPORT.

The appendices which accompany this report consist of thirty-two papers, all of which have a more or less direct bearing upon the work of the Fish Commission. A large proportion, moreover, relate to the work accomplished at the stations of the Commission and by the vessels in its service during the current year. Several of the longer papers will be published in pamphlet form for separate distribution. The arrangement of the appendices is as follows:

A.—THE FISHERIES.

This appendix consists of a comprehensive report by the Commissioner, Prof. Spencer F. Baird, upon the Sea Fisheries of Eastern North America. The paper was mostly prepared in 1877 and 1878, but was withheld from year to year for revision and completion, until it became evident that the author's declining health would prevent his giving the subject further attention. It is an important contribution to the literature of the American fisheries, and shows much careful research and thoughtful study.

B.—SCIENTIFIC INVESTIGATION.

Four papers are included in this appendix, two relating to fishes and two to marine invertebrates. The first is by Prof. D. S. Jordan and Mr. D. K. Goss, his assistant, upon the flounders and soles of America and Europe; the second is by Professor Jordan and Mr. C. H. Eigenmann, upon the Sciænidæ (drum-fishes, etc.), of the same region. The former is illustrated by 23 figures the latter by 12 figures. Prof. Edwin Linton reports upon the Entozoa, or intestinal worms of the marine fishes of New England, and Mr. J. Walter Fewkes, upon the medusæ collected by the steamer *Albatross* during its cruise to the Gulf Stream in the winter of 1885-'86.

C.—FISH CULTURE.

This appendix contains a single paper by Messrs. Bettoni and Vinciguerra, of Italy, upon the fish-cultural establishments of Central Europe.

D.—REPORTS OF VESSELS AND STATIONS.

This appendix consists of twenty-two reports, covering the principal field operations of the Commission during the current year. They relate to the steamers *Albatross*, *Fish Hawk*, and *Halcyon*; the schooner *Grampus*, and the fish-cultural stations at Bucksport and Grand Lake Stream, Me.; Wood's Holl, Mass.; Cold Spring Harbor, N. Y.; Battery Island, Saint Jerome, and Fort Washington, Md.; Washington, D. C.; Wytheville, Va.; Northville and Alpena, Mich.; McCloud River, Cal.

E.—MISCELLANEOUS.

The first paper in this appendix is a compilation, by Mr. Sanderson Smith, of the data necessary for locating and defining all the dredging stations made in the North Atlantic Ocean, adjacent to the coasts of North America, by the vessels of the Fish Commission, the Coast and Geodetic Survey, and the various expeditions sent out by European governments. It is accompanied by several charts, showing the positions of the dredging stations. Following it are translations of two papers, one from the Russian, by Professor Kostytscheff, on the chemical composition of fish products, the other from the French, by Dr. Mauriac, on cases of poisoning produced by spoiled codfish, and a compilation of the Norwegian fishery statistics for 1885.

APPENDIX A.

THE FISHERIES.

I.—THE SEA FISHERIES OF EASTERN NORTH AMERICA.

PREPARED FOR THE CONSIDERATION OF THE INTERNATIONAL COMMISSION HELD AT HALIFAX IN 1877.*

BY SPENCER F. BAIRD.

ANALYSIS.†

* This paper was mostly written in 1877 and 1878, but its publication was deferred by the author, in the hope of being able to prepare additional material, which seemed essential to its completeness. The opportunity for this, however, never occurred, and his subsequent illness, while the paper was going through the press, prevented him from ever examining the proofs. The accounts of the fishing-grounds and the fishery marine are additions to the original manuscript, the former being an abstract of a report by J. W. Collins and Richard Rathbun, published in Section III of the Fisheries and Fishery Industries of the United States, Washington, 1887; and the latter having been taken from unpublished manuscript prepared by J. W. Collins.

† This analysis is somewhat fuller than the paper itself, the additional items representing points upon which information was considered desirable, but which time did not permit the author to obtain.—EDITOR.

II.—Methods of Capture (Fisheries).

III.—Economical Applications of Products of the Fisheries.

IV.—MAINTENANCE AND IMPROVEMENT OF FISHERIES.

V.—POLITICAL CONSIDERATIONS.

THE SEA FISHERIES OF EASTERN NORTH AMERICA.

INTRODUCTORY.

In the present work I propose to give some account, as far as known, of the more important fishes of the Eastern United States north of Delaware Bay, together with an account of the methods by which they are pursued, captured, and utilized, as also of their application, with some statistical tables illustrating the results of the fisheries in the region referred to. For the better elucidation of the subject, I also propose to embrace a reference to corresponding fisheries in Europe and other parts of the world, so far as these throw light upon the American species.

A limitation of the subject to the region north of Delaware Bay is made, partly in view of the fact that the fisheries of that region are much more important in an economical point of view, and can be better monographed at present, and partly because this is the portion of Eastern North America which is embraced in the Washington treaty, and of which the information referred to is needed for the proper consideration of the international, political, and economical treatment of the subject.*

* In confining attention in the present article specially to the subject of the fisheries of the region covered by the treaty of Washington, it is not to be supposed that there are no productive fisheries on a large scale further south, the contrary being quite the fact. No portion of the globe exceeds the Southern and Gulf coasts of the United States in the number and variety of excellent food-fish, their waters teeming with them throughout the year and permitting their capture, especially in the cooler seasons, to almost any imaginable extent. A few hours' labor, either with the line, the cast-net, the gill-net, or the seine, suffices to supply the fisherman with food for days; and the introduction of the wholesale means of capture (pounds and traps not yet attempted) will probably produce no appreciable effect upon the supply.

Among the species which may be mentioned in this connection are the menhaden, bluefish, and mullet, all of which yield important fisheries in North Carolina, Virginia, and farther south. The menhaden is taken in great numbers and salted in barrels, being considered a very desirable article of food.

The bluefish spends several months on the Southern coast after leaving the Northern and Middle States, and is found of very great size—from 12 to 16 pounds. During the late autumn and early winter vast numbers of these are shipped to the Northern markets, where they find a ready demand. I find a memorandum that on the 20th of November, 1872, three thousand bluefish, averaging 12 pounds each, or 36,000 pounds altogether, were shipped from a single fishing station in North Carolina.

It is much to be regretted that there is no machinery employed in the United States for securing the statistics of our fisheries, the example of Canada and of European nations not having yet been adopted. The only sources of knowledge at our command are the reports of the cod and mackerel landed at American seaport towns, as made by the Statistical Bureau of the Treasury Department, the reports of inspections of mackerel by the States of Maine, New Hampshire, and Massachusetts, and other incidental mention of local yields, such as the annual production at Gloucester, &c., as can be picked up.

Of all these fish, however, the mullet is perhaps the most important, as being taken in larger quantities and occupying a greater number of persons in its manipulation. The fish, however, are almost exclusively consumed in the South, a very few being sent to Baltimore, Philadelphia, and New York. At present it may be considered as even more of a staple than the shad and alewife, which have been diminished very materially in later years; the supply of mullet, however, is apparently inexhaustible, and is repeated from year to year, though sometimes, owing to extreme weather and other conditions, the product is less, the condition of the lower classes being affected accordingly. Indeed, it may be said to occupy the same position that the mackerel does in the North; and the increasing yield of this fishery has undoubtedly had much to do with the reduced demand for the mackerel. Although as a fresh fish it may be considered as inferior to the best quality of mackerel, it is by most persons considered superior to it when salted. At Cape Hatteras the mullet fishery is said to begin about the middle of July; about Fort Maçon in September, and later further south, continuing for from one to two months at each station. The fish then come in from the sea for the purpose of spawning and enter the fresh water, being similar in this respect to the shad and alewife, although not apparently penetrating any considerable distance from the mouth. Like the herring and cod, they appear to spawn on a falling temperature, or when the waters have acquired a certain minimum. There is but little system adopted in the fishery, several individuals combining for a particular occasion and selecting one of their number as chief. The outfit consists simply of two or three six-oared boats, a seine from 75 to 100 yards long, several splitting tables, some barrels, and salt. The fish are split and cleaned, but without removal of the head, and are slashed in the thickest side for the better penetration of the salt. The fish are all fat and plump, and are graded by size and not by quality. The lower grades are worth from $4 to $5 a barrel; the higher sometimes bring from $8 to $10. Not more than from seventy to a hundred can be packed in a barrel. As many as five hundred barrels of mullets are taken sometimes at a single haul. The entire catch at Fort Macon alone is estimated by Dr. Yarrow at 12,000 barrels. The catch of a single county of North Carolina, Carteret, is given at 70,000 barrels. A large portion of the fish are bartered in the seaboard counties for agricultural products, 2 barrels being usually considered equivalent to 15 bushels of corn. They are sent by the railway lines all through the interior of the State, where they meet with great demand. Mullet roes are also considered a very great delicacy; a portion of them are pickled and the others slightly salted and smoked. They usually bring from 25 to 40 cents a dozen.

With an increased demand and improved methods of capture and preparation, there is no reason why the yield of the mullet fishery should not be fully equaled in bulk and value to that of the mackerel, as the fish itself is in countless abundance and found for many hundreds of miles along the coast.

Dr. H. C. Yarrow, U. S. A., from whose manuscript notes I have obtained the facts referred to above, states that two-thirds of the entire population of the coast of North Carolina is employed in this fishery.

Canada, on the other hand, has a special department of the fisheries, organized for obtaining the necessary data, and from which we can learn with great precision the number of vessels and boats, their tonnage, the men employed, with the yield of the different kinds of fishing, in all the districts of the several provinces constituting the Dominion. The statistics of Newfoundland, which does not belong to the confederation, are scarcely more valuable or reliable than those of the United States. It is much to be hoped that both countries will, in time, initiate and carry on a system more like that of Canada, from which, year by year, tabulated and final results may be obtained.

Having been requested by the Secretary of State to proceed to Halifax and be present during the International Fishery Convention, I have been enabled, from the testimony adduced in regard to American fish and fisheries, and still more by personal inquiries of the witnesses, to obtain a great deal of information of much value, a portion of which will be embodied in the present report, and the remainder in an extension of the subject hereafter.*

The greater portion of the statistics employed in the present report is the result of special correspondence, initiated and maintained with

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* The treaty of Washington, made by the joint high commission in 1871, provided that nearly all the restrictions to the unimpeded use of the fisheries by the Americans on the shores of the British provinces on the Atlantic coast, and by the subjects of these provinces in American waters as far south as the parallel of 39°, or Cape May, should be mutually conceded, and either party was to have the privilege of exporting fish other than the products of the Great Lakes to the other country free of duty; and that a commission should meet at Halifax, to consist of a commissioner and agent for each side, to determine what the commercial value respectively of these concessions amounted to, and if it were found that the privileges granted to the Americans were greater than those secured by the same treaty to the Dominion, a money value should be estimated for a twelve years' period and paid by the United States. It was not supposed at the time that the balance might be on the other side.

This convention was organized in obedience to the provisions of the treaty at Halifax on the 15th of June, and was represented by Hon. E. H. Kellogg on the part of the United States, and Sir Alexander T. Galt on the part of Great Britain, the third commissioner, in accordance with the provision of the treaty, being Mr. Maurice Delfosse, the minister from Belgium to the United States. Mr. Dwight Foster, of Boston, was the agent for the American cause, and Mr. F. C. Ford, of London, for the British. Mr. J. H. G. Bergne, of the foreign office, London, was chosen as secretary of the joint convention.

Subsequently the selection of counsel was authorized to assist the agents in their labors, those for the United States being Mr. Richard H. Dana, Jr., of Boston, and Mr. William H. Trescot, of Washington; the British counsel being one for each province, namely: Mr. Joseph Doutre, for Canada; Mr. S. R. Thomson, for New Brunswick; Mr. Wetherbe, for Nova Scotia; Mr. Davies, for Prince Edward Island; and Mr. Whiteway, for Newfoundland.

It is not my province to refer to the history and results of this convention excepting so far as relates to the testimony available for the objects of the present report. Suffice it to say that a vast body of testimony was taken on both sides, much of it contradictory, but leaving a residuum of well-established fact, and that this was supplemented by personal inquiries and special conference with the most intelligent witnesses.

different parts of the country for the purpose, being partly the result of answers to a series of questions issued in printed circulars prepared for the purpose.

The reports of the Massachusetts commissioners of inland fisheries have furnished much valuable information, as well as the report of the commissioner of Maine.

Colonel Lyman, one of the Massachusetts commissioners, has also supplied some manuscript records of the weirs and pounds of Massachusetts, which have contributed greatly in making up these statistical tables. Especially important, too, have been communications from Capt. N. E. Atwood, of Provincetown; Capt. Prince Crowell, of East Dennis; Vinal N. Edwards, of Wood's Holl; Mr. Samuel Powel, of Newport, R. I.; Capt. Benj. Ashby, jr., of Noank, Conn.; Captain Hurlbut, of Gloucester; Captain Babson, collector of the port of Gloucester, and others hereafter enumerated.

To Mr. G. Brown Goode, assistant of the U. S. Fish Commission, I am indebted for very important service in collecting information and preparation of statistical tables, nearly all of which have been made up by him for the purpose. The primary divisions into which an article like the present will naturally fall are as follows:

I. *The natural history or biology.*—This considers the fishes and certain other marine animals as they occur in nature, and without particular reference to their relations to man, except incidentally, or as they existed in North America before its occupation by the white man. Under this head will be included, first, an account of the individual habits and general history of each species included in my subject, and next a general view of our marine fishes as a whole; *e. g.*, their physical and mutual relationships; their migrations and movements; their abundance; their food; their diseases and fatalities; and finally, their reproduction and growth.

II. *Methods of capture.*—After consideration of the inhabitants of the sea, without any special relation to man, we naturally proceed to the history of the various methods by which they are pursued and captured; this involving the subject of fishing grounds, boats and vessels, men, the apparatus of capture, bait, manner of fishing, packing on shipboard, and disposition of offal. Results of the fisheries and their statistics will naturally fall under this head.

III. *Utilization of the products of the fisheries.*—As food, clothing, medicine, fertilizers, industrial applications, etc., or whatever applications are made of the fish after they have been caught. The general statistics of fishery products may come under this head.

IV. *Maintenance and improvement of the fisheries.*—This subject naturally follows those preceding, and does not usually come up for consideration among communities until real or imaginary scarcity or difficulties of capture, etc., begin to press upon their members.

V. *General political considerations.*—Under this head are included the subject of the fisheries in relation to the State, bounties, inspection, international relations, &c.

I propose to consider the subject of the fish and fisheries of Eastern North America substantially as given above, although I shall not be able to follow the various subdivisions in equal detail, indeed omitting some of them entirely for the present. So much yet remains to be known in regard to many of the topics enumerated that I can only hope that the meagerness and incompleteness of what I may say of them will call attention to the fact and secure the co-operation of others in a future more reliable rendering of the whole subject.

GENERAL CONSIDERATIONS IN REGARD TO THE SPECIAL IMPORTANCE AND VALUE OF THE SEA FISHERIES.

It may be safely stated that as a source of animal food to man the sea is the great fountain head, and that without this resource the supply of such food would be comparatively limited and far inferior to the demand of the various populations of the globe.

In the much greater proportion of ocean to land this reservoir of food is practically inexhaustible, and not only do the people living near its shores find a daily supply for consumption in a fresh state, but by proper methods of preparation and preservation the product of the sea can be fitted for long-continued keeping and for transportation to distant markets, where fishing is difficult, or into the interior, where it is impracticable. It is not a little remarkable that abundant as is the supply of fish in the warmer portions of the world it is impossible to preserve them there, and consequently, in Catholic countries especially, where the consumption of fish on certain days is a necessity, the colder countries of the North are drawn upon to furnish cod, haddock, hake, herring, etc., to their own great profit. It is difficult to make a calculation as to the comparative amount of animal food derived from the ocean and the land, but it is stated (Report of the British Sea Fisheries, 1866, I, p. xvi) that the weight of trawled fish supplied to the London market amounts to 300 tons daily, and is nearly equal to the total amount of beef, and that the price paid to the fishermen for this food is only one-eighth of that paid to the first producer of the beef. It is also a gratifying and important consideration that the sources of food in the sea are very far from being all made use of, and that while in regard to the best known and most highly appreciated fish improved methods are constantly being devised for successfully increasing the amount of the catch at less expense, there are a vast number of sea animals which, while highly prized in some portions of the world, and really of superior excellence and wholesomeness as food, are despised elsewhere. In time, however, such prejudices will be overcome and the various species referred to fully appreciated.

Numerous illustrations of the propositions here enunciated will be found in the portions of the present article devoted to the consideration of particular kinds of fish found in American waters. There is practically no difficulty in even a dense population finding its subsistence in the sea, both as regards the food necessary for daily consumption and for the means of securing either necessities or luxuries by means of a trade in the same commodity, this fish supply being furnished and maintained without the necessity of any previous cultivation or care, nature providing for the successions of the crop, and leaving it only to man to gather its full perfection. A spear, the bow and arrow, a hook and line, a boat, even of the simplest and most primitive character, possibly even a floating log, will answer the necessary purpose; while the more extended investments of nets, weirs, and pounds, vessels for going a considerable distance to sea or even sailing to distant waters, are generally within the reach of the successful fisherman or a combination of several of them.

The case is very different on the land, where only a nomadic people can derive support from the wild game or fowl, and this scarcely more than sufficient for daily food and clothing, leaving but little for sale or export. As the population increases, this food becomes scarce and is either exterminated or driven away, so that it offers but a scanty provision for the sustaining of life. It is then necessary to resort to the arts of the agriculturist; the land must be cleared and tilled, the seed sown, and a harvest obtained, sometimes after many months of waiting, and with a chance, unfortunately too often realized, of a partial or total destruction of the whole by storm, rain, hail, drought, blight, or destructive insects. Even at best, too, only a small margin of annual profit is left after the interest on the investment and other deductions are made from the proceeds; and although the farmer who controls a large body of land and works it by labor-saving machinery, or can gather in a large aggregate of the small proceeds of individual laborers, may acquire a competence and even wealth in time, yet comparing the profits of a laborer who has but a small tract of land at his command with those of the fisherman who has the sea for many miles under his control, we shall find the actual results to be very different in the two cases.

Fishing, as an occupation, in fresh waters, is much less remunerative than the same business prosecuted in the sea, as by the limitation of area the supply becomes sooner exhausted, and is under the influence of climatic and physical conditions and the direct agencies of man. So far as the rivers are concerned, it is only where they are in connection with large interior lakes, which take the place to them of oceans, that the most favorable conditions for the fresh-water fisheries are to be met with; and the great lakes themselves, such as those along the northern border of the United States, by their vast extent and great depth, are really, for all practical purposes, simply oceans, and furnish trout, whitefish, sturgeon, and other species in enormous numbers. Even here, however, the possibility of the exhaustion of the fisheries is to be considered and remedies applied in the way of protection, artificial propagation, &c.

I do not refer in this to the proceeds of rivers connected with the ocean and supplied with anadromous fish, such as salmon, shad, alewives, &c. These are simply pathways for certain forms of sea fish, which enter them for the purpose of spawning and return to the sea again, thus coming within most convenient reach of human energy in their capture.

Apart from the illustrations already presented of such fisheries in the United States, I may refer to the fisheries of the Volga, which is connected with the Caspian Sea. Here, according to Von der Schultz, an enormous number of pounds are annually captured.

For the artificial culture of fish in fresh water it is probable that the carp and tench are most profitable, as furnishing the greatest yield in pounds, and even in values, for a given outlay; and as these are herbivorous fish, thriving in waters not suited to most other species, there is reason to anticipate that a great advantage will result to the United States from the measures now in progress by the U. S. Fish Commission to multiply them, especially as the climate and waters of this country appear eminently adapted to their condition.

The agency of the sea fisheries is also of importance to the welfare of a nation otherwise than merely in the actual yield of food obtained, or of other articles of necessity or luxury. The influence of a sea-fishing life in rendering men bold, self-reliant, hardy adventurers is well known, and the infusion into the general population of such an element is of great importance. The pursuit of sea-fishing has an important and very valuable influence in training men for a sea-faring life generally, there being but little practical difference between the fitting out of a vessel for a distant sea fishery and taking the same or another vessel for an extended voyage to various points of the globe in the interest of commerce. It is from the hardy population of the fishermen that the merchant marine derives essentially its material, while the armed vessels of governments depend more indirectly upon the same source for manning their ships. It is for this reason that in all maritime nations the fishing population is looked to as a source of strength and protection, supplying, as it does, an element absolutely necessary to the well-being of the country, and in many instances bounties and privileges have been extended to increase the inducements to enter upon and prosecute the sea-fisheries. The life of the fisherman is, of course, not one of ease; he is exposed to dangers and hardships which to a landsman would appear appalling, but which are taken by the fisherman in the regular way of his duty. There is, however, no class of community more liable to peril than the fishermen, their dangers being proportioned in a great degree to their enterprise. Of the fishing population of the United States, that of Cape Ann may be considered as eminently typical of the bold and resolute sailor, and every year the

Cape has reason to deplore a large loss of life and property especially as the result of winter-fishing on the George's Bank not inaptly termed the "Gloucester grave-yard."

Proctor's "Fisherman's Memorial and Record Book" gives the names of 1,252 men and 280 vessels lost in the fisheries from the port of Gloucester between the years 1830 and 1873, or during a period of nearly half a century. It is estimated that ten women and twenty children are annually deprived of husband and father by this service, the actual losses averaging twenty-eight lives and six vessels annually. The total amount of property lost in the period mentioned was $1,145,500.

For the better illustration of the present article it would be desirable to present a statement of the product and values of the fisheries of the several maritime nations, so as to show the aggregate; and if reliable data were available for this purpose the result would be an amazing one. Unfortunately, the statistics of most nations are so inaccurate or incomplete as to render such a comparison entirely impossible. We have, however, in an important report from Mr. Richard D. Cutts, "The Fisheries and Fishermen of the North Pacific, and the Commerce in the Products of the Sea, Washington, 1872," a table of the products of certain portions of the fisheries of fifteen countries in the year 1865. They are as follows:

Codfish	$20,730,249
Herring	17,685,408
Whale oil	6,057,967
Mackerel	4,689,687
Sardines	2,600,000
Cod-liver oil	3,419,896
Seal oil	757,838
Pilchards	375,000
Total	59,606,218

This, however, is merely a suggestion, and is probably far below the aggregate of that year, and much less than that at the present time.

The general facts in regard to these subjects may perhaps be best appreciated by some particular statistics in regard to certain countries, especially Norway, for which I give the figures for 1866.

Total product of Norwegian fisheries.

The following statistics of the average product of the Norwegian fisheries is given by Baars in 1866 (Les Pêches de la Norwége, p. 58):

Winter herring, 600,000 barrels, at 18 francs	$2,400,000
Summer herring, 220,000 barrels, at 20 francs	800,000
Salted fish, 22,000,000 kilograms, at 40 francs per 100 kilograms	1,760,000
Dried fish, 12,000,000 kilograms, at 35 francs per 100 kilograms	850,000
Pickled fish, 60,000 barrels, at 20 francs	250,000
Cod-liver oil, 60,000 barrels, at 90 francs	1,080,000
Cod roes, 35,000 barrels, at 50 francs	350,000
Lobsters, 2,000,000, at 6 cents each	120,000
Fish guano, 350,000 kilograms, at 30 francs	5,100,000
Total	12,710,000

According to Schultz (Rep. U. S. F. C.), the annual catch of fish in the Caspian Sea and its tributaries amounts to 68,000,000 pounds, worth about $10,500,000.

The subject of the yield of the fisheries of the United States and the Dominion of Canada is of more special interest in the present report. So far as Canada is concerned an excellent system of supervision by the Government enables us to gather, with more or less accuracy, the returns as to the number of vessels, of men, and the general yield for the different classes of objects in the various portions of the Dominion; and which, although these returns are probably considerably below the actual figures, still answer a useful purpose as a basis for comparison and for obtaining a general average.

Newfoundland, which is not a part of the Dominion, has unfortunately no corresponding record to which reference may be made. The case is equally unsatisfactory in the United States. Here the General Government does not pretend to exercise any supervision in the collection of statistics of the sea fisheries, with the exception of such as are conducted by a certain class of vessels, occupied in foreign waters. Of the great local business of fishing, either by means of small boats that go out to a short distance from the land or the larger coasting vessels, we have no reliable data. It is true that certain States, especially Maine, New Hampshire, and Massachusetts, provide for the inspection of pickled fish, which is branded according to the several degrees of excellence; and this furnishes us, as far as that class of products is concerned, with tolerably reliable information. Other products, however, are unrecorded, and only an approximation to the amount can be made. The State of Massachusetts has, however, lately undertaken to secure reliable facts under this head, and the commissioners of inland fisheries have been empowered to require, under suitable penalties, an annual return of the yield of every weir, pound, and gill-net on the coast.

While it is probable that the supply of fish on the outer banks and in the deep sea, away from the immediate coast, is as great as that of former years, a lamentable falling off is to be appreciated in the capture of anadromous fish, such as the shad, salmon, and the alewife, as well as of many species belonging immediately to the coast, such as the striped bass, the scup, and other fish.

Fortunately, it is believed they are capable of remedy by proper legislation and protection, artificial propagation, etc., and that we may look forward in the distant future to a very considerable return to the former very desirable state and condition of the fisheries.

In proof of the abundance formerly existing I will only refer to the chapter under that head in the first report of the United States Fish Commission, in which the quotations are supplied from early historical records, extending back to the first peopling of the country by the whites. The capture of thousands of striped bass by means of nets stretched across the mouths of tidal rivers, the schools of scup so thick that they crowded each other out of the water in their passage, single hauls of from three to five thousand shad, and of from one to nine hundred thousand alewives with the small nets used at that time, the taking of a hundred sturgeon with the hook and line in a day, and other similar facts all going to prove the general statement. A fisherman could, in a few hours and within a short distance from his home, fill his boat with cod, haddock, halibut, and other valuable species, and could take hundreds of pounds where now from one to ten would be considered a satisfactory return under the same circumstances.

As already stated, however, we may look forward, if not to the former state of things, yet to a great improvement on the present condition, and to this the efforts of State governments as well as of the General Government and of the Dominion of Canada are being directed with the utmost zeal, seconded by a growing public sentiment.

It may be remarked that the number of shad and herring (alewives) barreled on the Potomac River as the result of six months' fishing is equal to the entire yield of the Scottish fisheries for the entire year of 1873, one of their most successful years.

In an appendix to the Documents and Proceedings of the Halifax Commission, pp. 3360 *et seq.*, prepared by Mr. Goode, will be found a statement, as approximately accurate as possible, of the yield of the shore fisheries returned in the year 1876, with partial returns for 1877. These, it will be understood, are entirely the results of the inshore fisheries, with scarcely an exception, the capture being made by pounds, traps, or gill-nets, set either on or close in shore, or by line-fishing from open boats, also close to the land.

I have also compiled a table of the sea fisheries of Canada for the year 1876, rearranging the tables of the report of the minister of marine and fisheries, so as to show what are purely sea fisheries, what are fresh water, and what are incidental products. In preparing this table I have converted the estimates of the weight of dry, smoked, and pickled fish into their estimated weight when fresh, so as to supply a more ready comparison. It is extremely difficult to obtain any estimate of the yield of the distant fisheries, prosecuted in vessels and from the ports of the United States. The report of the Washington Bureau of Statistics for the fiscal year ending June 30, 1877, enumerates:

	Pounds.
Codfish	71,373,900
Mackerel	30,542,500
Herring	22,328,700
Other fish	11,503,540
Fresh fish, not cured	99,677,911

A second column gives the estimated weight of these fish when fresh, and is obtained in making up the table of Canadian statistics by multiplying the weight of the codfish by three; and adding one-fifth, or 20 per cent., to the weights of the herring and mackerel. We have thus an aggregate which we are sure is very far below the proper figures.

Within the last two years a very great increase in the demand for fish fresh from the sea has sprung up in the United States, most portions of the interior being now regularly supplied. To this end the improved methods of preservation and transportation have greatly conduced. The use of ice in its various applications,* the employment of refrigerating chests and refrigerator steamboats and cars and other devices, permits the transportation of fish many miles in a brief space of time. During the present year salmon have been loaded in cars on the Restigouche River and delivered in New York in thirty hours. The fish are packed in boxes with snow and placed in a refrigerator car supplied with a quantity of ice, so that on arriving in New York the snow is generally entirely unmelted. Fish are packed in chests in Florida and delivered in New York by steamer in the same manner. Fish taken in pounds or gill-nets or with lines along the coast are concentrated at shipping points and forwarded by rail or in smacks, properly iced. They are then repacked and sent by various lines of conveyance to their distant markets.

Such is now the method and system adopted in this business that it becomes very difficult to obtain fresh fish in seaport towns, the machinery of collecting and transporting being so arranged as to prevent, to a very great extent, the diversion of any portion of the stock to the local consumption. Indeed, it is not at all uncommon for fish to be sent directly away from a village on or near the coast to New York or Boston in a general shipment to market, and afterwards returned to its starting point for consumption. One supposed evidence of an increasing scarcity of fish is the increase in price at such stations. This is, however, a fallacious argument, as the market is regulated by the rates obtainable in the centers of supply rather than elsewhere, and the local prices necessarily must correspond. The proprietor of a weir or pound generally has his entire catch pre-engaged to the wholesale dealer in New York or Boston, and he cannot keep his accounts satisfactorily if he permits any portion to be diverted by the way. Formerly, before the introduction of the use of ice and the improved system of transportation, whenever a great catch of fish was made, the principal market would be found at a point on or near the landing, the fish being taken in wagons and peddled in the interior, but always over a limited area, the result being that prices were usually or frequently very low, and not remunerative, in cases of a glut in the market. It is to the interest of fishermen, of course, that there should be no danger of such a glut, and that all the catch be disposed at a fair price.

* In 1874 there were 25,000 tons of ice brought from Norway to Hull, for the preservation of fish taken by trawl nets.

I.—NATURAL HISTORY.

GENERAL CONSIDERATIONS IN REGARD TO THE SPECIES OF FOOD-FISHES OF THE EASTERN COAST OF THE UNITED STATES AND OF THE DOMINION OF CANADA.

The peculiar difficulties of investigating the natural history and general character of the inhabitants of the sea, excepting so far as they can be observed in aquaria, have tended very greatly to prevent the acquisition of satisfactory information in relation to their habits and characteristics; and it is therefore not surprising that our knowledge of this portion of the animal kingdom is far inferior to that of species belonging to the land. This proposition applies almost equally to the fish of all countries, there being very few species, even on the coast of Europe, the biology of which has been worked out in a satisfactory manner. Of a few species we know more than we do of others, especially of the salmon, several kinds of herring, and the cod. All these, as constituting an important source of wealth, have been investigated by scientific commissions, organized by Governments, and embracing men trained to research, and competent to do the work assigned them.

With an enlightened appreciation of the importance of this subject, the Norwegian Government has, for a number of years, employed some of its best naturalists, such as Professor Sars, Prof. A. Bœck, Mr. Robert Collett, and others, in these inquiries, providing them with all the necessary facilities. The inherent difficulties in the way will be readily appreciated, in view of the fact that even under such circumstances the investigators have not succeeded as yet in entirely working out the problems submitted to them for solution, but year by year further discoveries have been made, the sum of which constitutes the most if not the only reliable data at the service of inquirers elsewhere.

In view of these considerations, therefore, I trust that I shall be excused, if the accounts I give of the present state of our well-established knowledge of the habits and distribution of the American sea fish be more or less meager, especially as the limitation of the present report will forbid going into very minute detail. By distributing questions, as is now being done to a considerable extent, to the most intelligent observers throughout the country, and submitting particular questions and inquiries, and then by collating the results, it is hoped that a large body of facts will shortly be available.

The fishes of any region may be considered either in a purely zoological point of view, or as they would be treated in a natural history monograph, or in their relations to particular industries or to some special relation they may have to the land or water. For the purposes I have in view the subject of the biology or natural history of our fishes may be treated under the following heads:

A. A systematic list of the species embraced in the subject, including also the fishes and marine invertebrates serving as food and bait.

B. Biographical notices of the most important species. After treating them separately they may be considered collectively, or at least by groups of species.

C. The relationships of fishes in general to each other and to the shores and sea-bottom, as also to physical condition, their migration and movements, and the influence of men upon the same.

D. Their numbers and abundance formerly and at the present time.

E. Their fatalities, diseases, and destruction by natural causes and other than by ordinary human agency (which belong to the subject of the fisheries).

F. Their food, animal and vegetable.

G. Their reproduction, including their fecundity, their habits during that season, their rate of growth, and their conditions of maturity.

A.—List of the principal food and bait marine fishes of the Eastern United States and British Provinces.*

1. Principal food and bait fishes.

LOPHIIDÆ.

1. *Lophius piscatorius* (Linn.). Goosefish; Monkfish; Molligut.
Nova Scotia and Chesapeake.

PLEURONECTIDÆ.

2. *Pseudopleuronectes americanus* (Walb.) Gill. Common Flounder; Winter Flounder; Mud Dab (Massachusetts Bay); Sole (New York).
Nova Scotia to Cape Hatteras.
3. *Limanda ferruginea* (Storer) Goode & Bean. Rusty Dab; Sand Dab (Maine).
Nova Scotia to Long Island.
4. *Glyptocephalus cynoglossus* (Linn.) Gill. Pole Flounder.
North Atlantic, south to Block Island.
5. *Pomatopsetta dentata* (Storer) Gill. Smooth Plaice; Smooth-back.
Massachusetts to Maine.
6. *Hippoglossoides platessoides* (Fabr.) Gill. Arctic Dab.
Polar regions to Cape Cod.
7. *Pseudorhombus dentatus* (Linn.) Günther. Common Flounder.
Cape Ann to Brazil.
8. *Hippoglossus vulgaris* (Fleming). Halibut.
Greenland and Newfoundland to Cape Hatteras.
9. *Platysomatichthys hippoglossoides* (Walb.) Goode & Bean. Greenland Turbot.
Greenland to Eastern Banks.

* This list is intended to present the principal species of food and bait fishes found north of the Delaware or the thirty-ninth degree of latitude.

GADIDÆ.

10. *Pollachius carbonarius* (Linn.) Bon. Pollock: Coal-fish (England).
Greenland to Cape Hatteras.

11. *Gadus morrhua* Linn. Common Codfish; Sarandlik and Sarandlisksoak (Greenland).
Polar regions to Cape Hatteras.

12. *Microgadus tomcodus* (Walb.) Gill. Tomcod; Frost-fish.
Newfoundland to Cape Hatteras.

13. *Melanogrammus æglefinus* (Linn.) Gill. Haddock.
Newfoundland to Cape Hatteras.

14. *Phycis chuss* (Walb.) Gill. Codling (New York); Old English Hake; Squirrel Hake (Massachusetts); Ling; Chuss (formerly at New York); Codling (Newport); Fork-beard (England).
Newfoundland to Cape Hatteras.

15. *Phycis tenuis* (Mitch.) DeKay. Codling (New York); White Hake (Massachusetts); Squirrel Hake (Maine).
Newfoundland to Cape Hatteras.

16. *Brosmius brosme* (Müller) White (d. @ s.) Cusk (Massachusetts); Torsk or Tusk.
North Atlantic, south to Cape Cod.

MERLUCIIDÆ.

17. *Merlucius bilinearis* (Mitch.) Gill. American Hake; Silver Hake (Maine); Whiting (Massachusetts); Stock-fish.
Nova Scotia to Cape Hatteras.

SCORPÆNIDÆ.

18. *Sebastes marinus*; Linn. (d. @ s.). Norway Haddock; Hemdurgan; Red-fish; Bream (Maine); Rose-fish; Snapper (Massachusetts Bay, Storer); Red Sea-perch (New York); Red Perch (Eastport).
Polar regions to Block Island.

LABRIDÆ.

19. *Tautoga onitis* (Linn.) Gthr. Black-fish; Tautog.
Bay of Fundy to South Carolina; New York.

20. *Tautogolabrus adspersus* (Walbaum) Gill. Burgall or Bergall (New York); Cunner or Conner; Chogset (New England); Bluefish or Blue Perch.
Newfoundland to Cape Hatteras.

XIPHIIDÆ.

22. *Xiphias gladius* Linn. Common Swordfish.
Nova Scotia to West Indies.

23. *Tetrapturus albidus* Poey. Billfish; Spearfish.
Cape Cod to West Indies.

24. *Histiophorus americanus* Lac. Sailfish.
Cape Cod to West Indies.

SCOMBRIDÆ.

25. *Scomber scombrus* Linn. Mackerel; Wawwhunne-kesuog (Narragansett Indians, Trumbull); Caballa (Cuba).
Greenland to Cape Hatteras.

26. *Scomber grex* Mitchell (= *S. pneumatophorus* De la Roche). Chub Mackerel.
Nova Scotia to Cape Hatteras.

27. *Sarda mediterranea* (Schn.) Jordan. Bonito; Skip-jack (Boston market).
Cape Cod to Florida.

28. *Orcynus thynnus* (Linn.) Goode (d. @ s.). Horse-mackerel (Massachusetts, &c.); Albicore (Rhode Island); American Tunny.
Newfoundland to Florida.

29. *Orcynus alliteratus* (Raf.) Gill. Little Tunny; Albicore; Alliterato; (Naples); Mackerel (Bermuda).
Pelagic, occasional on coast (found in large numbers at Wood's Holl, Mass., August, 1871).

30. *Scomberomorus maculatus* (Mitch.) Jordan. Spanish Mackerel; Spotted Mackerel; Bay Mackerel (rare in Massachusetts Bay).
Cape Cod to Florida.

31. *Scomberomorus regalis* (Bloch) Jordan. Cero; Black-spotted Spanish Mackerel; King-fish.
Cape Cod to Florida.

CARANGIDÆ.

32. *Carangus hippos* (Linn.) Gill. Horse-crevallé; Jiguagua (Cuba).
Cape Cod to Florida.

33. *Trachynotus carolinus* (Linn.) Gill. Pompano (Southern coast); Cavallé or Crevallé (South Carolina); Pompynose (New Orleans).
Cape Cod to Florida.

34. *Trachynotus ovatus* (Linn.) Gthr. Short Pompano.
Cape Cod southward.

STROMATEIDÆ.

35. *Poronotus triacanthus* (Peck) Gill. Harvest-fish (New Jersey); Butter-fish (Massachusetts); Dollar-fish (Maine).
Maine to Cape Hatteras.

SCIÆNIDÆ.

36. *Cynoscion carolinensis* (Cuv. & Val.) Gill. Salmon-trout; Spotted Sea-trout (South coast); Spotted Silversides (Scott).
Cape Hatteras to Florida.

37. *Cynoscion regalis* (Bloch) Gill. Squeteague or Squit (New England); Shecutts or Checutts (Mohegan Indians); Chickwick (Connecticut); Weakfish (New York); Bluefish (Beesley's Point, New Jersey); Trout (Southern coast); Salt-water Trout; Gray Trout (Southern coast).
Cape Cod to Florida.

38. *Pogonias chromis* Lacépède. Drum.
Cape Cod to Florida.

39. *Liostomus obliquus* (Mitch.) DeKay. Lafayette (New York); Goody (Cape May); Chub (Norfolk); Roach (Northampton County, Virginia).
Cape Cod to Florida.

40. *Sciænops ocellatus* (Linn.) Gill. Bass; Red Bass; Sea Bass; Spotted Bass (South Carolina); Redfish (Gulf of Mexico).
Cape Cod to Florida.

41. *Menticirrus nebulosus* (Mitch.) Gill. Kingfish; Whiting; Hake (New Jersey); Barb (New Jersey).
Cape Cod to Florida.

42. *Micropogon undulatus* (Linn.) Cuv. & Val. Croaker; Verrugato (Cuba).

SPARIDÆ.

43. *Archosargus probatocephalus* (Walb.) Gill. Sheepshead.
Cape Cod to Florida.

44. *Stenotomus argyrops* (Linn.) Gill. Scup (Vineyard Sound); Scuppaug; Porgy (New York); Bream (Rhode Island, formerly); Fairmaid (East shore of Virginia).
Cape Cod to Florida.

PRISTIPOMATIDÆ.

45. *Hæmulon arcuatum* Cuv. & Val. Grunt.
South Atlantic coast of United States.

SERRANIDÆ.

46. *Centropristis atrarius* (Linn.) Barn. Black Sea Bass; Sea Bass (New York); Black Perch (Mass.); Black Bass; Blackfish (New Jersey); Bluefish (Newport); Black-harry; Hannahills (New York, DeKay); Black-will (Eastern shore of Virginia).
Cape Cod to Florida.

LABRACIDÆ.

47. *Roccus lineatus* (Bl. Schn.) Gill. Striped Bass (Eastern States); Rockfish (Pennsylvania, &c.); Missuckeke-kequock (Narragansett Indians).
Nova Scotia to Florida.

48. *Morone americana* (Gmelin) Gill. White Perch.
Nova Scotia to Florida.

EPHIPPIIDÆ.

49. *Ephippus faber* (Cuv.). Moonfish; Angel-fish (South Carolina); Three-banded Sheepshead; Three-tailed Porgy; Porgy (Chesapeake Bay).
Cape Cod to Florida.

LOBOTIDÆ.

50. *Lobotes surinamensis* Cuv. Flasher (New York market).
Cape Cod to Florida.

POMATOMIDÆ.

51. *Pomatomus saltatrix* (Linn.) Gill. Bluefish (New York and New England, except Rhode Island); Horse-mackerel (Newport and Beesley's Point, N. J.); Skip-jack (North Carolina); Green-fish (Virginia, DeKay); Tailor (Maryland and Virginia); Whitefish and Snap-mackerel (young).

ELACATIDÆ.

52. *Elacate canadus* (Linn.) Gill. Crab-eater.
Cape Cod to West Indies.

AMMODYTIDÆ.

53. *Ammodytes americanus* DeKay. Sand-launce; Sand-eel (New England).
Newfoundland to Cape Hatteras.

MUGILIDÆ.

54. *Mugil albula* Linn. Striped mullet.
Cape Cod to Florida.

55. *Mugil brasiliensis* Agassiz. White mullet.

ATHERINIDÆ.

56. *Chirostoma notata* (Mitch.) Gill. Silversides; Friar (New England).
Maine to Florida.

BELONIDÆ.

57. *Belone longirostris* (Mitch.) Gill. Silver gar; Bill-fish.
Cape Cod to Florida.

SCOMBERESOCIDÆ.

58. *Scomberesox saurus* (Walb.) Fleming. Skipper; Saury; Skip-jack.
Nova Scotia to Florida.

CYPRINODONTIDÆ.

59. *Cyprinodon variegatus* Lac.
Cape Cod to Florida.

MICROSTOMIDÆ.

60. *Mallotus villosus* (Müller) Cuv. Capelin.
Polar regions to Nova Scotia.

61. *Osmerus mordax* (Mitch.) Gill. Smelt.
Nova Scotia to Cape Hatteras.

SALMONIDÆ.

62. *Salmo salar* (Linn.) Günther. Salmon; Mishquammauqueck (Narragansett Indians).
Polar regions to Cape Cod.

ELOPIDÆ.

63. *Megalops thrissoides* (Bl. Sch.) Günther. Jew-fish; Tarpum (Bermuda).
Cape Cod to Florida.

DUSSUMIERIDÆ.

64. *Etrumeus teres* (DeKay) Brevoort. Round herring.
Cape Cod to Cape Hatteras.

CLUPEIDÆ.

65. *Brevoortia tyrannus* (Latrobe) Goode & Bean. Menhaden (Vineyard Sound); Munnawhatteaug (Narragansett Indians); Pogy, Poghaden (East coast of New England); Mossbunker (New York); Panhaden, Panhagen (New England); Hard-head, Bony-fish (Massachusetts Bay); Skippaug or Bunker (East end of Long Island); Bony-fish (Saybrook); Whitefish (Saybrook to Milford, Connecticut); Fat-back and Yellow-tail (coast of North Carolina); Bug-fish (Carolina).
Nova Scotia to Brazil.

66. *Alosa sapidissima* (Wilson) Storer. Shad.
Newfoundland to Florida.

67. *Opisthonema thrissa* Gill. Thread-herring; Menhaden (Portland); Shad-herring (New York).
Newfoundland to Florida.

68. *Pomolobus æstivalis* (Mitch.) Goode & Bean; and *Pomolobus vernalis* (Mitchell) Goode & Bean. Herring (Southern States); Alewife (New England); Gaspereau (British Provinces); Spring-herring (New England); Aumsuog (Narragansett Indians); Kyack, Blueback, Alewife, Sawbelly, Cat-thresher (Portland, Me.).
Newfoundland to Florida.

69. *Pomolobus mediocris* (Mitch.) Gill. Tailor-herring (Potomac); Fall-shad.
Newfoundland to Florida.

70. *Clupea harengus* Linn. English Herring.
Polar regions to Cape Cod.

DOROSOMIDÆ.

71. *Dorosoma Cepedianum* (Lac.) Gill. Toothed Herring.
Cape Cod to Cape Hatteras.

ENGRAULIDÆ.

72. *Stolephorus vittatus* (Mitch.) Jordan & Gerard. Anchovy.
Cape Cod to Cape Hatteras.

ANGUILLIDÆ.

73. *Anguilla bostoniensis* (Les.) DeKay. Common Eel.
Newfoundland to Cape Hatteras.

ACIPENSERIDÆ.

74. *Acipenser oxyrhynchus* Mitch. (d.s.) Sharp-nosed Sturgeon.
Cape Cod to Florida.

75. *Acipenser brevirostris* Lesueur. Short-nosed Sturgeon.
Cape Cod to Florida.

PETROMYZONTIDÆ.

76. *Petromyzon americanus* Lesueur (d. s.) Lamprey; Lamper eel.
Cape Cod to Cape Hatteras.

2.—Invertebrates actually used as food and bait on a large scale.

MOLLUSCA.

Architeuthis Harveyi Verrill.

The giant squid, and other species of giant squids when they can be obtained.

Ommastrephes illecebrosa Ver.

The squid generally north of Cape Cod, and the only squid of the Gulf of Maine, Bay of Fundy, &c.

Loligo Pealii Lesueur. Squid.

South of Cape Cod, and also occurring in Massachusetts Bay.

Mya arenaria Linn. Long Clam.

Ranging from South Carolina to the Arctic Ocean.

Venus mercenaria Linn. Round Clam; Quahog.

Massachusetts Bay to Florida; Quahog Bay, Me.; Gulf of Saint Lawrence (Local).

Spisula solidissima Gray. Sea Clam; Surf Clam.

Labrador to Gulf of Mexico.

Gnathodon cuneatus. Louisiana.

Mytilus edulis Linn. Common Mussel (or muscle).

Modiola plicatula Lamarck. Ribbed Mussel.

These two species are both said to be used as bait off Sandy Hook, N. Y. I know nothing very positive about them.

CRUSTACEA.

Panopeus Herbstii Edwards. A crab, but know of no common name.

Range, Long Island Sound to Brazil; used for blackfish, Southern States.

Crangon vulgaris Fabr. Sand Shrimp.

North Carolina to Labrador.

Mysis, sp.

Used by boys in Eastport Harbor for catching pollock and red perch.

Thysanopoda, sp.

Used by boys in Eastport Harbor for catching pollock and red perch.

Homarus americanus Edw. Lobster.

Ranges from Labrador to New Jersey.

Callinectes hastatus Ordway. Common edible Crab, or Blue Crab.

Ranges from Cape Cod to Florida, and is occasionally found in Massachusetts Bay.

3.—INVERTEBRATES WHICH MIGHT POSSIBLY ANSWER AS BAIT.

It would seem as though nearly all the species of invertebrates which are found in the stomachs of fish, as food, might serve as bait for the same species at least; and the character of the food of some fishes is very varied. The following species are among the more common ones on the New England coasts and are easily obtained and of about the right size for bait, or could be rendered so by very little cutting. Of course there is the question as to whether they would all or even many of them prove attractive to fish when on a hook, but forms closely related to some of them are now standard articles of bait.

CRUSTACEA.

Gelasimus minax, pugnax, and *pugilator.*

The three species of Fiddler Crabs found on the Southern New England coast.

Cancer irroratus. Rock Crab.

Labrador to South Carolina.

Panopeus.

Several species of this genus are found on the Southern New England coast and to the south of New England, one of which, *Herbstii,* is already used as bait for blackfish.

Carcinus mœnas. Green Crab.

Cape Cod to New Jersey.

Eupagurus.

There are several species of "Hermit Crabs" common to the New England coasts, two or three of which, living not far from land, could easily be obtained as bait. One common species (*pollicaris*) is abundant on the oyster-beds of Southern New England (Long Island Sound) and could, therefore, be obtained of the oystermen.

Pandalus annulicornis. The Deep-water Prawn or Shrimp.

Common in the Gulf of Maine and Massachusetts Bay, in moderate to considerable depths, where it can be taken in large quantities by the beam-trawl.

Palæmonetes vulgaris. Common Prawn.

Massachusetts to South Carolina. Abundant in places, in shallow water.

ANNELIDA.

Nereis virens, and other "marine worms" which occur, buried in muddy and sandy beaches; nearly everywhere.

MOLLUSCA.

There are six species of Gasteropods of medium size which might possibly answer.

Buccinum undatum. Whelk.

Entire New England coast, but most abundant north.

Urosalpinx cinerea. Drill.

Massachusetts Bay to Florida. Very thick shell, for which reason might not answer.

Purpura lapillus. Purple.

Long Island to arctic. Also very thick shell.

Lunatia heros. Sea Snail.

Georgia to Gulf of Saint Lawrence.

Crepidula fornicata. Double-decker.

Casco Bay, Me., to Florida.

Littorina littorea.

New Haven to Nova Scotia. Imported from Europe. Very abundant on the shores northward of Newport, R. I. Is very good eating for man.

Two other Gasteropods are common south of Cape Cod, but they are of large size.

Fulgur carica. Winkle.

Sycotypus canaliculatus. Winkle.

Of Lamellibranchs there are the following:

Mulinia lateralis. No common name, but related to the Sea or Surf Clam, smaller size.

Massachusetts to Florida.

Callista convexa. Related to the Quahog, but of smaller size.

New Jersey to Gulf of Saint Lawrence.

Astarte undata.

Scapharca transversa. Bloody Clams.

Argina pexata. Bloody Clams.

Florida to Cape Cod.

Pecten irradians. Scallop.

Florida to Cape Cod.

If ascidians could be used as bait, the best three species would be the following, but I have not heard of their ever having been found in the stomachs of fish:

Molgula Manhattensis.

North Carolina to Maine; sometimes thrown up on the beaches in immense quantities; lives in shallow water.

Cynthia pyriformis. Sea Peach; abundant in Bay of Fundy, in moderate depths.

Boltenia Bolteni. Sea Lemon.

Cape Cod northward, with last above in Bay of Fundy.

RADIATA.

Brittle-stars (Ophiurans) are often found in fishes' stomachs, and might answer as bait. The commonest species is—

Ophiopholis aculeata.

New Jersey to the Arctic Ocean; low water to 100 fathoms and deeper.

Some species of common starfishes and sea-cucumbers might possibly also do.

4.—LISTS OF SPECIES, ANNUAL ESTIMATE FOR 1871–'72, FOUND IN THE STOMACHS OF FISHES—FOOD OF FISHES.

In the following lists have been brought together the principal results of the various recorded examinations of stomachs of fishes in this region up to the present time, whether done in connection with the U. S. Fish Commission or independently. The special dates and localities are given in each case.*

Lophius Americanus DeKay. Goosefish; Angler.

A specimen caught in Vineyard Sound, in June, contained crabs, *Cancer irroratus;* and squids, *Loligo Pealii.* Another contained a medium-sized skate. Still another a large common flounder; bluefish (*Pomatomus saltatrix*); fragments of clam shells (*Mya arenaria*); crabs; and eel-grass. Wood's Holl, 1871; E. Palmer.

Specimens taken in the rivers with herring had their stomachs filled with that fish. A. E. Verrill, Eastport, Me., 1871.

Alutera Schœpfii. (Walb.) Goode & Bean. File-fish.

A specimen taken at Wood's Holl, in August, contained a quantity of the finely-divided stems and branches of a Hydroid, *Pennaria tiarella.*

Pseudopleuronectes Americanus Gill. Winter Flounder.

A specimen caught at Wood's Holl, in August, contained large numbers of *Bulla solitaria.*

Specimens taken, in 1871, in the rivers about Eastport, were filled with herring. A. E. Verrill, 1871.

Lophopsetta maculata Gill. Spotted Flounder.

Numerous specimens caught in seines at Great Egg Harbor, April, 1871, contained large quantities of shrimp, especially *Mysis Americana* and *Crangon vulgaris;* the prawn, *Palæmonetes vulgaris;* numerous Amphipods, *Gammarus mucronatus;* one contained a *Gebia affinis.*

Chænopsetta ocellaris Gill. Ocellated Flounder; Summer Flounder.

Several specimens taken in the seines at Great Egg Harbor, New Jersey, in April, contained large quantities of shrimp, *Crangon vulgaris* and *Mysis Americana;* one contained a full-grown *Gebia affinis.*

One caught at Wood's Holl, June 6, contained twenty-six specimens of *Yoldia limatula;* and numerous shells of *Nucula proxima, Angulus tener,* and *Tritia trivittata;* and Amphipod Crustacea belonging to the genus *Ampelisca.*

Specimens caught at Wood's Holl, in July, contained rock-crabs, *Cancer irroratus; Pinnixa cylindrica; Crangon vulgaris;* squids, *Loligo Pealii; Angulus tener; Nucula proxima;* and many "sand-dollars," *Echinarachnius parma.*

August 16. One specimen contained a scup and one squid (*Loligo*); Sept. 1. Another specimen had two small crabs and two minnows. Wood's Holl; E. Palmer, 1871.

* This article is essentially the same as the one contributed by Prof. A. E. Verrill to the report of U. S. Fish Commission of 1871–'72. I am indebted to Mr. R. Rathbun for rearranging it and adding notes by Professor Verrill made at Eastport, Me., either in 1871 or previous years, and notes of the fishes found as food in the stomachs of other fishes at Wood's Holl in 1871 by Dr. E. Palmer, Professor Verrill having enumerated in his report only the invertebrate contents.

Gadus morrhua var. Cod.

The codfishes devour a great variety of Crustaceans, Annelids, Mollusks, starfishes, &c. They swallow large bivalve shells, and after digesting the contents spit out the shells, which are often almost uninjured. They are also very fond of shrimps, and of crabs, which they frequently swallow whole, even when of large size. The brittle-starfishes (Ophiurans) are also much relished by them. I have taken large masses of the *Ophiopholis aculeata* from their stomachs on the coasts of Maine and Labrador; and in some cases the stomach would be distended with this one kind, unmixed with any other food.

In this region I have not been able to make any new observations on the food of the cod. This deficiency is partially supplied, however, by the observations made by me on the coast of Maine, &c., coupled with the very numerous observations made at Stonington, Conn., many years ago, by Mr. J. H. Trumbull, who examined large numbers of the stomachs of cod and haddock, caught within a few miles of that place, for the sake of the rare shells that they contained. This collection of shells, thus made, was put into the hands of the Rev. J. H. Linsley, who incorporated the results into his "Catalogue of the Shells of Connecticut," which was published after his death, in a somewhat unfinished state, in the American Journal of Science, Series I, vol. xlviii, p. 271, 1845. In that list a large number of species are particularly mentioned as from the stomachs of cod and haddock, at Stonington, all of which were collected by Mr. Trumbull, as he has informed me, from fishes caught on the fishing-grounds near by, on the reefs off Watch Hill, &c. Many other northern shells, recorded by Mr. Linsley as from Stonington, but without particulars, were doubtless also taken from the fish-stomachs by Mr. Trumbull. There was no record made of the Crustacea, &c., found by him at the same time.

The following list includes the species mentioned by Mr. Linsley as from the cod. For greater convenience the original names given by him are added in parentheses, when differing from those used in this report:

List of mollusks, &c., obtained by Mr. J. H. Trumbull, from codfish caught near Stonington, Conn.

GASTROPODS.

Sipho Islandicus (?), young, (Fusus corneus).
Ptychatractus ligatus (Fasciolaria ligata).
Turbonilla interrupta (Turritella interrupta).
Turritella erosa.
Rissoa exarata (?) (Cingula arenaria).
Lunatia immaculata (Natica immaculata).
Amphisphyra pellucida (Bulla debilis).
Chiton marmoreus (?) (Chiton fulminatus).

LAMELLIBRANCHS.

Martesia cuneiformis (Pholas cuneiformis).
Periploma papyracea (Anatina papyracea).
Thracia truncata.
Tagelus divisus (Solecurtus fragilis).
Semele equalis (?) (Amphidesma æqualis).
Ceronia arctata (Mesodesma arctata).
Montacuta elevata (Montacuta bidentata).
Callista convexa, young, (Cytherea morrhuana).
Cardium pinnulatum.
Cyprina Islandica.
Gouldia mactracea (Astarte mactracea).
Yoldia sapotilla (Nucula sapotilla).
Yoldia limatula (Nucula limatula).
Nucula proxima.
Nucula tenuis.
Modiolaria nigra (Modiola nexa).
Crenella glandula (Modiola glandula).
Pecten tenuicostatus, young, (Pecten fuscus).

ECHINODERMS.

Echinarachnius parma.

Microgadus tomcodus Gill. Tomcod; Frost-fish.

Several specimens from New Haven Harbor, January 30, contained numerous Amphipods, among which were *Mœra levis; Gammarus*, sp.; *Ampelisca*, sp.; an undetermined Macrouran; numerous Entomostraca; the larva of *Chironomus oceanicus*.

A lot taken in a small pond at Wood's Holl, in March, by Mr. Vinal N. Edwards, contained the common Shrimp, *Crangon vulgaris;* large numbers of the green Shrimp, *Virbius zostericola;* the Prawn, *Palæmonetes vulgaris;* large quantities of Amphipods, especially of *Gammarus annulatus*, *G. natator*, *Calliopius læviuscula*, and *Microdeutopus minax;* and smaller numbers of *Gammarus ornatus* and *G. mucronatus*.

Another lot of twelve, taken in April at the same place, contained most of the above, and in addition several other Amphipods, viz: *Mœra levis*, *Pontogeneia inermis*, *Ptilocheirus pinguis*, and *Caprella;* also *Nereis virens*, and various small fishes.

Melanogrammus æglifinus Gill. Haddock.

The haddock is not much unlike the cod in the character of its food. It is, perhaps, still more omnivorous, or, at least, it generally contains a greater variety of species of shells, &c.; many of the shells that it habitually feeds upon are burrowing species, and it probably roots them out of the mud and sand.

A complete list of the animals devoured by the haddock would doubtless include nearly all the species belonging to this fauna. We have had few opportunities for making observations on the food of the haddock south of Cape Cod, but have examined many from farther north.

A specimen taken at Wood's Holl, November 6, 1872, contained a large quantity of *Gammarus natator* and a few specimens of *Crangon vulgaris*. Another from Nantucket contained the same species.

The following species of shells were mentioned by Mr. Linsley, in his catalogue, as from the haddock:

List of mollusks obtained from stomachs of haddock, at Stonington, Conn., by Mr. J. H. Trumbull.

Neptunea pygmæa (Fusus Trumbulli).
Astyris zonalis (Buccinum zonale).
Bulbus flavus (?) (Natica flava).
Margarita obscura.
Actæon puncto-striata (Tornatella puncto-striata).
Cylichna alba (Bulla triticea).
Serripes Grœnlandicus (?) (Cardium Grœnlandicum).

The above list doubtless contains only a small portion of the species collected by Mr. Trumbull, but they are all that are specially recorded. As an illustration of the character and diversity of the haddock's food, I add a list of the species taken from the stomach of a single specimen, from the Boston market, and doubtless caught in Massachussetts Bay, September, 1871.

GASTROPODS.

Natica clausa.
Margarita Grœnlandica.

LAMELLIBRANCHS.

Leda tenuisulcata.
Nucula proxima.
Nucula tenuis.
Crenella glandula.

ECHINODERMS.

Psolus phantapus.
Lophothuria Fabricii.

In addition to these there were fragments of shrimp, probably *Pandalus annulicornis*, and numerous Annelids, too much digested for identification.

Pollachius carbonarius Bon. Pollock.

A species of *Thysanapoda* and one or two species of *Mysis* serve as food for the pollock about Eastport, Me. These crustaceans go under the general name of "shrimp" among the fishermen, and swim together in large schools. A. E. Verrill, 1871.

Phycis tenuis DeKay. Hake.

Feeds largely on worms, crustaceans (*Pandali*, &c.), and mollusks, frequenting muddy bottoms. A. E. Verrill, Eastport, Me., 1871.

Anarrhichas lupus Linn. Wolf-fish.

This species is said to feed on the sea herring (*Clupea elongata*), but in two specimens examined at Eastport, Me., in 1871, no traces of herrings were found. The stomach of one specimen contained about four quarts of sea-urchins (*Strongylocentrotus Dröbachiensis*), a part of them entire, and all with the spines on. The other contained a mixture of the same sea-urchin and *Buccinum undatum*. A. E. Verrill, 1871.

Batrachus tau Linn. Toadfish.

Several specimens examined at Great Egg Harbor, New Jersey, April, 1871, contained young edible crabs, *Callinectes hastatus* of various sizes up to those with the carapax two inches broad; shrimp, *Crangon vulgaris*; prawn, *Palæmonetes vulgaris*; *Ilyanassa obsoleta*; various fishes, especially the pipe-fish, *Syngnathus Peckianus*; and the anchovy, *Engraulis vittatus*.

A specimen caught at Wood's Holl, in July, contained the common rock-crab, *Cancer irroratus*.

Cyclopterus lumpus Linn. Lumpfish.

In the rivers near Eastport, Me., specimens taken in connection with herring had been feeding upon the latter fish. A. E. Verrill, 1871.

Prionotus Carolinus Cuv. & Val. Sea Robin.

A specimen caught at Wood's Holl, May 27, contained shrimp, *Crangon vulgaris*; and a small flounder.

Another caught May 29, contained Amphipod Crustacea, *Anonyx* (?), sp.; and *Crangon vulgaris*.

Specimens dredged in Vineyard Sound, in August, contained mud-crabs, *Panopeus Sayi*; rock-crabs, *Cancer irroratus*; and several small fishes.

Sebastes marinus Lütken. Redfish; Red Perch.

At Eastport, Me., the red perch feeds upon a species of *Thysanopoda*, and one or two species of *Mysis*, which swim together in large schools, and are called "shrimp" by the fishermen. A. E. Verrill, 1871.

Tautoga onitis Gthr. Tautog; Blackfish.

Specimens caught at Wood's Holl, May 23, contained the common rock-crab, *Cancer irroratus*; hermit-crabs, *Eupagurus longicarpus*; shells, *Tritia trivittata*, all crushed.

Others caught May 26 contained *Eupagurus pollicaris*; *E. longicarpus*; the barnacle, *Balanus crenatus*; the squid, *Loligo Pealii*; *Tritia trivittata*. Others taken May 29 had *Cancer irroratas*; mud-crabs, *Panopeus depressus*; lady-crabs, *Platyonichus ocellatus*; shells, *Tritia trivittata*, *Crepidula fornicata*, *Argina pexata*, and the scollop, *Pecten irradians*; barnacles, *Balanus crenatus*, all well broken up.

Another taken May 31 contained *Platyonichus ocellatus*; *Tritia trivittata*.

Others taken June 3 contained the mud-crab, *Panopeus depressus*; triangular crab, *Pelia mutica; Crepidula unguiformis; Triforis nigrocinctus;* the common mussel, *Mytilus edulis;* and the "horse-mussel," *Modiola modiolus.*

Another, on June 10, contained the common rock-crab, *Cancer irroratus;* mud-crab, *Panopeus Sayi; Nucula proxima;* several ascidians, *Cynthia partita* and *Leptoclinum albidum.*

Two caught July 8 and 15 contained small lobsters, *Homarus Americanus; Crepidula fornicata; Bittium nigrum;* a bryozoan, *Crisia eburnea;* sand-dollars, *Echinarachnius parma.*

A specimen caught in August contained long-clams, *Mya arenaria;* muscles, *Mytilus edulis; Petricola pholadiformis.*

Xiphias gladius Linn. Swordfish.

One specimen contained mackerel (*Scomber scombrus*), and butter-fish (*Paronotus triacanthus*). Wood's Holl, Mass., 1871; E. Palmer.

Sarda pelamys Cuv. Bonito.

Specimens taken at Wood's Holl, in August, contained an abundance of shrimp, *Crangon vulgaris*, scup, and occasionally fragments of fish and bones. Out of eighty-two individuals examined at one time, nearly every one was empty. Shiners seemed to form their common food. Wood's Holl, 1871; E. Palmer.

Scomber scombrus Linn. Mackerel.

Specimens taken July 18, 20 miles south of No Man's Land, contained shrimps, *Thysanopoda*, sp.; larval crabs in the zoëa and megalops stages of development; young of hermit-crabs; young of lady-crabs, *Platyonichus ocellatus;* young of two undetermined Macroura; numerous small Copepod Crustacea; numerous shells of a Pteropod, *Spirialis Gouldii.*

Orcynus thunnina. Small Tunny.

One specimen caught at Wood's Holl, in August, contained eleven squids, *Loligo Pealii.*

Often contained small fragments of fish and sea-grass (*Zostera*). Wood's Holl, 1871; E. Palmer.

Cybium regale Cuv. & Val. Cerò.

Stomachs often contained fine particles of fish. Wood's Holl, 1871; E. Palmer.

Palinurichthys perciformis Gill. Rudderfish.

A specimen caught at Wood's Holl, in August, contained a small *Squilla empusa;* young squids, *Loligo Pealii;* Butterfish, and several other young slender fish. Wood's Holl, 1871; E. Palmer.

Cynoscion regalis Gill. Weakfish; Squeteague.

Several caught in seines at Great Egg Harbor, New Jersey, April, 1871, with menhaden, &c., contained large quantities of shrimp, *Crangon vulgaris*, unmixed with other food.

Specimens taken at Wood's Holl, in July, often contained sand-crabs, *Platyonichus ocellatus;* and very frequently squids, *Loligo Pealii.*

August 8.—Nearly every one of ten specimens opened contained six scup (*Stenotomus argyrops*); one had a herring (*Clupea elongata*).

August 11.—Twenty specimens contained on an average about five scup each. Some were empty, while others had as many as nine. One or two squid were found.

August 12.—Twenty-five specimens examined contained on an average about four scup each; a few shiners, butterfish (*Poronotus triacanthus*), and squid were also found.

August 14.—Twenty specimens opened; of these one or two were empty, and the remainder had on an average about three scup each, without other kinds of food.

August 15.—Of fifteen squeteague examined, three had empty stomachs, and the remainder were more or less full of scup; a butterfish was found in one stomach.

August 16.—Out of ten specimens examined two were empty, and eight had a total of twenty-five scup.

August 19.—Ten squeteague opened contained a total of thirty-nine scup and six butterfish. One had nine scup in his stomach.

August 21.—Of forty specimens opened nearly all had more or less scup, with a few butterfish and squid.

September 2.—One squeteague had six butterfish; another a scup, with eel-grass (*Zostera*); another eel-grass only.

September 6.—One specimen contained three butterfish, two scup, and two dotted scad (*Decapterus punctatus*).

September 15.—One specimen contained a sand-crab and a bluefish (*Pomatomus saltatrix*).

September 18.—Ten stomachs opened contained three specimens of *Tracurops crumenopthalmus*, three butterfish, three scup, and one squid.

September 26.—One stomach contained three butterfish, one herring, one eel (*Anguilla Bostoniensis*), and three *pisquetos* (*Paratractus ?*).

Menticirrus nebulosrus Gill. Kingfish.

Four specimens taken in seines at Great Egg Harbor, April, 1871, contained only shrimp, *Crangon vulgaris.*

Others taken at Wood's Holl, May 29, were filled with *Crangon vulgaris.*

Specimens taken in July contained rock-crabs, *Cancer irroratus;* and squids, *Loligo Pealii.*

Stenotomus argyrops Gill. Scup; Porgee.

Forty young specimens, one year old, taken at Wood's Holl in August, contained large numbers of Amphipod Crustacea, among which were *Unciola irrorata, Ampelisca*, sp., &c.; several small mud-crabs, *Panopeus depressus; Idotea irrorata; Nereis virens*, and numerous other Annelids of several species, too much digested for identification.

Other specimens, opened at various times, show that this fish is a very general feeder, eating all kinds of small Crustacea, Annelids, bivalve and univalve mollusks, &c.

Centropristis fuscus. Black Bass; Sea Bass.

Specimens caught in Vineyard Sound, June 10, contained the common crab, *Cancer irroratus;* the mud-crab, *Panopeus Sayi;* three species of fishes.

Another, caught May 25, contained a squid, *Loligo pallida.*

July 27.—Ten specimens were opened and found to contain scup (*Stenotomus argyrops*) and squeteague (*Cynoscion regalis*).

September 5.—One specimen contained two butterfish (*Poronotus triacanthus*) and two chogsets (*Tautogolabrus adspersus*).

Roccus lineatus Gill. Striped Bass; Rockfish, or "Rock."

At Great Egg Harbor, New Jersey, April, 1871, several specimens, freshly caught in seines, with menhaden, &c., contained *Crangon vulgaris* (shrimp) in large quantities.

A specimen caught at Wood's Holl, July 22, 1872, contained a large mass of "sea-cabbage," *Ulva latissima*, and the remains of a small fish.

Specimens taken at Wood's Holl, August, 1871, contained crabs, *Cancer irroratus;* and lobsters, *Homarus americanus.*

Morone americana Gill. White Perch.

Numerous specimens caught with the preceding at Great Egg Harbor, New Jersey, contained *Crangon vulgaris.*

Pomatomus saltatrix Gill. Bluefish; Horse-mackerel.

Specimens caught at Wood's Holl, in August, frequently contained squids, *Loligo Pealii;* also various fishes.

Off Fire Island, Long Island, August, 1870, Mr. S. I. Smith saw bluefishes feeding eagerly on the free-swimming males (heteronereis) of *Nereis limbata*, (p. 318,) which was then very abundant.

Fundulus pisculentus Cuv. & Val. Minnow.

Specimens caught in July, at Wood's Holl, contained large numbers of *Melampus bidentatus*, unmixed with other food.

Clupea elongata LeS. Sea Herring.

Specimens taken in Vineyard Sound, May 20, contained several shrimp, *Crangon vulgaris*, about 1.5 inches long; *Mysis americana*, and large numbers of an Amphipod, *Gammarus natator;* also small fishes.

At Eastport, Me., and Grand Manan, the principal, if not the only, food of the herring in summer is a species of *Thysanopoda*, and one or two species of *Mysis.* These species are associated together, and move in large schools; they are known among the fishermen as shrimp. The food of the herring caught out in the bay by means of seines, and of those trapped in the weirs in the harbor, was of the same character for both. A. E. Verrill, 1871.

Alósa sapidissima Storer. Shad.

Several specimens taken in the seines, at Great Egg Harbor, April, 1871, contained finely-divided fragments of numerous Crustacea, among which were shrimp, *Mysis americana.*

Several from the mouth of the Connecticut River, May, 1872, contained fragments of small Crustacea, (*Mysis*, &c.).

Pomolobus mediocris Gill. Hickory Shad.

Several specimens taken in the seines at Great Egg Harbor, April, 1872, contained large quantities of fragmentary Crustacea; one contained recognizable fragments of shrimp, *Crangon vulgaris.*

Brevoortia tyrannus (Latrobe) Goode. Menhaden.

A large number of specimens freshly caught in seines at Great Egg Harbor, April, 1871, were examined, and all were found to have their stomachs filled with *large quantities of dark mud.* They undoubtedly swallow this mud for the sake of the microscopic animal and vegetable organisms that it contains. Their complicated and capacious digestive apparatus seems well adapted for this crude and bulky food.

Raia diaphana Mitch. Common Skate; "Summer Skate."

A specimen taken at Wood's Holl, May 14, contained rock-crabs, *Cancer irroratus;* a young skate; a long slender fish (*Ammodytes?*). Another, caught in July, contained *Cancer irroratus.*

Raia lævis (?) Mitch. Peaked-nose Skate.

Specimens caught in Vineyard Sound, May 14, contained numerous shrimps, *Crangon vulgaris;* several *Conilera concharum;* several Annelids, among them *Nephthys ingens; Meckelia ingens;* two specimens of *Phascolosoma Gouldii;* razor-shells, *Ensatella Americana* (the "foot" only, of many specimens); a small fish, *Ctenolabrus burgall.* Specimens taken at Menemsha, in July, contained large numbers of crabs, *Cancer irroratus;* and of lobsters, *Homarus americanus.*

Trygon centrura Gill. Sting-ray.

Specimens caught at Wood's Holl, in July and August, contained large numbers of crabs, *Cancer irroratus;* squids, *Loligo Pealii;* clams, *Mya arenaria; Lunatia heros.*

Myliobatis Freminvillei Les. Long-tailed Sting-ray.

Specimens taken in Vineyard Sound, in July, contained an abundance of lobsters, *Homarus americanus;* crabs, *Cancer irroratus;* also clams, *Mya arenaria;* and *Lunatia heros.*

Pteroplatea maclura Müll. & Henle. Butterfly Ray.

One specimen examined contained menhaden (*Brevoortia tyrannus* Goode). Wood's Holl, 1871. E. Palmer.

Eulamia obscura Gill. Dusky Shark.

Several specimens caught at Wood's Holl, in July and August, contained lobsters, *Homarus americanus;* rock-crabs, *Cancer irroratus.*

One specimen contained a flat-fish, in the stomach of which were star-fish and clam-shells. The common ray is often the food of this species as is also the bonito, as many as three of the latter being sometimes found in the stomach of a single individual. Other animals that serve as food are the herring, horse-mackerel, skate's eggs, crabs, and lobsters. Wood's Holl, Mass., 1871. E. Palmer.

Eulamia Milberti Gill. Blue Shark.

A large specimen caught at Wood's Holl, in August, contained a quantity of small bivalve shells, *Yoldia sapotilla.*

The common food of this species was the squeteague (*Cynoscion regalis*), and the bonito (*Sarda pelamys*). One individual contained a five-pound mackerel; another had a large codfish hook and piece of line. Scup, the common skate, sea bass, and a small shell (*Yoldia sapotilla*), also served as food. Three bonitos were often found in a single specimen. Wood's Holl, 1871. E. Palmer.

Galeocerdo tigrinus Müll. & Henle. Tiger Shark.

Specimens caught at Wood's Holl, in August, contained large univalve shells, *Buccinum undatum* and *Lunatia heros.*

One contained a quantity of pork in large pieces, while others had fed upon sea turtle, the common ray, sting-ray, bluefish, dogfish; quantities of feathers and eel-grass were also found in the stomachs of this species. Wood's Holl, 1871. E. Palmer.

Mustelus canis De Kay. Dogfish.

Several specimens caught at Wood's Holl, in August, contained lobsters, *Homarus americanus;* spider-crabs, *Libinia canaliculata;* rock-crabs, *Cancer irroratus;* Tautog (*Tautoga onitis*); and butterfish (*Poronotus triacanthus*). Wood's Holl, 1871. E. Palmer.

Eugomphodus littoralis Gill. Sand Shark.

Many specimens taken at Wood's Holl, in July and August, contained lobsters, *Homarus americanus*, in abundance; *Cancer irroratus;* and squids, *Loligo Pealii.*

Also menhaden, *Brevoortia tyrannus;* eels; and common flounder. E. Palmer, 1871.

Squalus americanus.

Specimens taken in the rivers near Eastport, Me., in 1871, associated with herring, were full of the latter fish. A. E. Verrill, 1871.

A Gephyrean worm is often used for bait by the fishermen on some parts of the coast of Maine. It has not been well described but it is apparently the *Holothuria chrysacanthophora* of Couthouy and the *Echiurus chrysacanthophorus* of Pourtales. It has been generally considered a rare species, and specimens of it are uncommon in museums. At Harpswell the fishermen sometimes dig it in immense quantities. It lives in the mud, just above the low-water mark, and is as readily obtained as clams. It is used in catching several species of fishes, but is specially desirable for hake. Its irregularity of occurrence seems to be the only reason why it should not be more extensively employed.

B.—BIOGRAPHICAL NOTICES OF THE MOST IMPORTANT SPECIES.

As already explained, our knowledge of the habits of the sea-fishes of America is very imperfect for various reasons, chief among which is, of course, their concealment from notice during the greater portion of their existence. We are even far from the knowledge of what species actually occur on our shores; many kinds coming to notice only at rare intervals, or under circumstances when the intelligent observer and naturalist fail to encounter them. Comparatively few species are readily, if ever, taken with the hook, or even the seine, and it is only since the more recent introduction of traps, pounds, and weirs, with their wholesale captures, that a fair idea of the geographical distribution of the sea-fishes along the coast has been attained. Even this apparatus fails to reach the outlying deep-sea species; and the beam-trawl and long-line, while constantly adding to the list, will never in all probability entirely complete it. During the summer of 1877 the parties of the U. S. Fish Commission trawled up at various distances off the coast of Massachusetts several species, some new to science, never before known in American waters, and it is probable that additions will be made continually, without exhausting the list.

It is not a little remarkable that fishermen who are continually in contact with fish throughout the year know actually so little about them. To questions as to the food of the various species, the peculiarities of spawning, the size and character of the eggs, the period of development, the history of the young, &c., a negative answer is usually returned, and it is only occasionally that one more intelligent, or at least more observant, than the rest can be found from whom any satisfactory information can be obtained. It is, however, to be hoped, and indeed to be expected, that the publication of a résumé of our actual knowledge of the habits and peculiarities of our fishes will call their attention to the subject, and secure their assistance in solving the many remaining problems.

As already explained, the facts, or probably it will be safer to call them statements until confirmed, here given are to a considerable degree the result of personal observation of members of the U. S. Fish Commission, supplemented and extended by the answers to questions distributed by the Commission. Personal inquiry of witnesses summoned before the Joint Fisheries Commission held at Halifax from June 15 to December 15, 1877, in addition to the testimony elicited on their examination by the counsel and printed with the other evidence, have also added not a little to the mass of facts. Great care, however, requires to be exercised in admitting the statements made on this occasion, as one witness, apparently honest and claiming to have been a practical fisherman for many years, stated under oath, that the eggs of the mackerel were as large as pease or BB shot, and that they could be hauled up on a hook in large masses.

Not much information is to be found in the various publications hitherto made relative to the fish and fisheries of Eastern North America, although some facts of value are contained in the writings of Gilpin, Perley, Ambrose, Storer, and others.*

C.—RELATIONSHIPS AND SURROUNDINGS.

FISHES CONSIDERED COLLECTIVELY OR BY GROUPS.—Although each species of fish on our coasts may be considered as possessing some peculiar habit or combination of habits by which it is distinguished from its fellows, they may be, for convenience of consideration, divided into groups, all the members of which possess certain common peculiarities, having an important bearing upon the methods and times of their pursuit and capture. These relationships are, to some extent interrupted by the reproductive instinct, which causes them to change their ordinary location and to assume new conditions. They are also affected by the exigencies of feeding, of pursuit by other animals or by man, or by the variations in their physical surroundings.

Deferring to a subsequent part of the chapter any consideration of the migrations and movements of the various species, we may arrange marine fish in certain groups, as follows:

a. The inshore fish, or those found within a short distance (sometimes miles) from the shores. These embrace a great variety of species, generally of small size and finding their harbor and shelter among rocks and stones, sea-weeds, eel-grass, &c. They are fish that can be taken from beaches, rocks, and wharves, or small boats from the shore, and furnish more occupation and amusement than actual profit in their capture. They are also among those most frequently taken in weirs, pounds, and fykes. Among them may be mentioned various Cyprinodonts, the cunner, the spearing or friar, the young Clupeids, the sea bass, the tautog, the scup, and many other species of less note.

These fish furnish an important article of food, but obtainable only by considerable effort; and being generally of small size, do not yield a very generous return. Some of the species, as the scup, in former years were, however, in such abundance on the south coast of New England that hundreds of pounds could easily be taken in a short time.

b. The offshore fish.—These are species which usually occupy greater depths, and are found at remoter distances from the shore than those first mentioned, being generally found on the banks or elevations in deeper water.

The greater portion of the *Gadidæ* or cod family, such as the cod, haddock, hake, &c., belong here; as also the halibut. This group is the most important of our coast-fishes, being usually of large size and occur-

* This section of the report as prepared at Halifax I have concluded to omit until a new digest of our knowledge of the subject can be prepared, so much information having been obtained in reference to the habits of our fishes since 1877 as to render it obsolete.

ring in great numbers, so that a few men, with proper apparatus, can capture a large number of pounds in a day. The salmon and shad may perhaps be included in this group.

c. Pelagic fish.—These consist largely of species belonging or allied to the mackerel family, and, next to the group just mentioned, furnish the most important supply of food. The prominent members of this group are the common mackerel, the bluefish, the menhaden, the swordfish, the bonito, and other kinds. Sometimes members of this group are found hundreds of miles from the land; at others they come close inshore, either in pursuit of food or for purposes of reproduction, when they can be taken from the shores or in nets. They, however, appear to be continually on the move, showing more or less at the surface, remaining in proximity to the shore during the warm season, then disappearing during the winter.

d. Deep-sea fish.—This constitutes a group, of which until within a few years very little was known, occasionally being found floating at the surface either dead or dying, or caught at great depth on cod or halibut lines. It is only within a few years, or since the labors of the Challenger and other vessels, provided with apparatus for fishing at great depths, that the number of species has been realized. While some of the fishes belonging to the second section occur not unfrequently at depths of many hundreds of fathoms, such as the cod, halibut, hake, &c., very few of this fourth group are taken in waters of less than 100 fathoms, and thence to 1,000 and even to 2,900 fathoms, by the Challenger. This group is of little ecomomical value, especially on account of their small size and apparently scant numbers, even apart from the practical difficulty of their capture, although it is not at all impossible that there may be edible species sufficiently large and abundant to be worth pursuing if they were more within reach.

The status of fish in the sea is very largely determined by the question of temperature. This, however, will be considered more definitely under the next head of the migrations and movements of fish as influenced by various causes.

MIGRATIONS AND MOVEMENTS.

The human race is more concerned in the movements and migrations of fish than in the question of their permanent abode. It is when they are aggregated in large bodies, and moving from place to place, either under the stimulus of search for food or other causes, that they furnish the best opportunity to man for their capture and utilization.

Little is known of the salmon, the shad, the herring, the menhaden, the mackerel, and the bluefish during a large portion of the year; but at certain periods these species collect in large bodies, and by a change of place come within the reach of their relentless pursuer—man. On the other hand, the *Gadidæ*, the cod, especially, and the halibut, are within reach throughout the greater part of the year, either on the offshore banks while feeding or inshore when spawning.

The movements and migrations of fish are of two classes; the one irregular and occasional, the other regular. The irregular migrations are such as occur only at long intervals, sometimes altering very materially the industrial and social conditions of maritime countries.

Among the most notable illustrations of irregular migrations, we may cite the case of the bluefish, which during the past century was a well-known inhabitant of the eastern coast of the United States, occurring in great abundance and of large size. This species appears regularly on our eastern coast in the spring and leaves in autumn; but some time after the middle of the last century it disappeared entirely, according to the histories of the time, and was not seen during the present century until much of it had passed by, having been absent for a period of about fifty years. Of course it is possible that it may have occurred in small numbers, but not sufficient to make any impression; at any rate, on its reappearance in 1825 or 1830 it was entirely new to all the fishermen.

Another case is that of the chub mackerel (*Scomber pneumatophorus*). This, twenty years ago, was extremely abundant and was taken in large numbers at the same time with the common mackerel; but of which in later years only occasionally individuals have been captured. I have succeeded in securing only one or two specimens since the commencement of the operations of the United States Fish Commission, although every effort has been made to obtain them.

A European member of the mackerel family is extremely capricious in its movements. It is the *Caranx trachurus*, or the scad, a well-known fish of the Mediterranean and of the European coast generally. This sometimes sweeps down in immense numbers upon the shores of regions where it was previously unknown, or where it has not been seen for many years; a notable instance of this occurring in 1862, when immense numbers made their appearance on the coast of Bergen and in the Shrange Fiord, furnishing occupation in their capture and preparation to a large population; but scarcely was it at all known except in straggling specimens before or since.*

The causes of these variations in distribution are entirely unknown; whether the fish have been exterminated by some disease or pestilence (as suggested in the case of the bluefish), &c., cannot be ascertained. Various changes in the number of herring on the coast of Northern Europe have been of a similar character. These have been more especially important as influencing the condition of the population of Norway and Sweden and other northern countries. On the coast of Sweden herring were formerly in enormous abundance, sustaining a large population along the shores, but have disappeared for decades. It is with the regular migrations of the fishes of our coast that we have at present most to do, and I shall proceed to consider them under several headings.

* Baars, Des Fischerein Industrie de la Norwége, 1873; p. 158.

The regular migrations of fishes are for the most part dependent, 1st, on the instinct of reproduction which causes them to seek grounds and regions more suitable to the purpose, especially so far as relates to a safe abode for the young during the earlier months of their life; 2d, the search for food; 3d, the influence of temperature, a most potent factor. A fourth agency is the pursuit of predaceous fishes, although this is generally much more restricted in its operations than the others The pursuit of fish by man has doubtless some effect, but this is exhibited more in a reduction of numbers by actual destruction of parent fish or their eggs and young than by causing a definite change of place.

I have already grouped the marine fishes provisionally according to their relations to the shores and sea-bottom. Their migrations involve a temporary change in their relations, offshore fish coming in to the coast or even ascending rivers. We may, however, arrange fish by the migrations and movements into the following groups:

(1) *Anadromous fish.*—Species passing most of their time in the ocean, and when mature entering and ascending fresh-water rivers and lakes for the purpose of depositing their eggs; the young fish remaining for more or less time, and then descending to the ocean and there attaining their full growth, probably not going very far from the mouth of the river which they thus descend. The more important species in this connection are as follows:

The Sturgeon (in part).
The Salmon.
The Smelt.
The Shad.
The Alewife.
The Tailor Shad.
The Gizzard Shad (?).
The Striped Bass (in part).
Various species of Cyprinidæ.
The Lamprey Eel.

A somewhat similar condition occurs entirely in fresh-water, where certain species which spend most of their time in larger or smaller lakes pass at the breeding season into the streams empying therein, to lay their eggs on the gravelly ripples. This is the case with nearly all the *Coregoni* or whitefish, the landlocked salmon, and smelt, the *Salmo oquassa*, or Rangeley trout, the brook trout, &c. Whether the fish ever *descend* into an outlet is an interesting problem.

Among the fish of this group we find species of great economical value, embracing as it does some of the finest table-fish, and sometimes in overwhelming abundance. They appear with great regularity in the mouths of rivers, ascending them to their very source, or at least until stopped by some impassable obstruction. They present a great advantage over the sea fishes so far as man is concerned, in the greater facility of capture. This pursuit is prosecuted with little comparative risk and exposure, while any one with a line, or a net of simplest construction, and a small boat, or even from the shore, can secure an abundant supply of food.

It is among the anadromous fishes that man in a savage or semi-civilized state finds his most copious supply of food, depending sometimes almost entirely upon it for subsistence through the year, eating it fresh during the run and dried or smoked the rest of the time.

The most prominent fishes under this head belong more especially to groups of the salmon, the herring, the shad, and the sturgeon. It is in the temperate regions of the northern hemisphere, so far as I am aware, that the anadromous habit is seen in its grand development.

No better illustration of the numbers in which anadromous fish enter the rivers can be given and the extent of diminution of the supply from various causes, hereafter to be referred to, than a presentation of the case as it relates to the Potomac River in the short distance between its mouth and the Great Falls of the Potomac, only twelve miles above Washington. Although this stretch of water is even now very productive, and annually becoming more and more so, as the result of careful propagation, many years will elapse, if ever, before it gets up to the measure of yield mentioned by Martin in his History of Virginia,* a work published in 1835. It is proper to say that some old fishermen along the river deny the accuracy of his statements in their detail, but admit that the numbers taken were enormously in excess of the present yield. I give, however, the statement, allowing it to speak for itself:

"As Alexandria is the shipping port of the District of Columbia, and one of the principal marts for the immense fisheries of the Potomac, it may be well to mention that in the spring of the year quantities of shad and herrings are taken which may appear almost incredible. The number of shad frequently obtained at a haul is 4,000 and upwards, and of herrings from 100,000 to 300,000. In the spring of 1832 there were taken in one seine at one draught a few more than 950,000 accurately counted. The prosecution of the numerous fisheries gives employment to a large number of laborers, and affords an opportunity to the poor to lay in, at very reduced prices, food enough to last their families during the whole year. The shad and herrings of the Potomac are transported by land to all parts of the country to which there is a convenient access from the river, and they are also shipped to various ports in the United States and West Indies. The lowest prices at which these fish sell when just taken are 25 cents per thousand for herrings and $1.50 per hundred for shad, but they generally bring higher prices, often $1.50 per thousand for the former and from $3 to $4 per hundred for

* A new and comprehensive gazetteer of Virginia and the District of Columbia, containing a copious collection of geographical, statistical, political, commercial, religious, moral, and miscellaneous information, collected and compiled from the most respectable and chiefly from original sources, by Joseph Martin. To which is added a history of Virginia from its first settlement to the year 1754; with an abstract of the principal events from that period to the independence of Virginia, written expressly for the work by a citizen of Virginia. Charlottesville, published by Joseph Martin. Moseley & Tompkins, printers, 1835, page 480.

the latter; in the height of the season a single shad weighing from 6 to 8 pounds is sold in the market of the District for 6 cents. Herrings, however, are sometimes taken so plentifully that they are given away or hauled on the land as manure for want of purchasers." Some idea may be formed of the importance of these fisheries from the following statement:

Number of fisheries on the Potomac, about	150
Number of laborers required at the landings	6,500
Number of vessels employed	450
Number of men to navigate these vessels	1,350
Number of shad taken in good season, which lasts only about six weeks.	22,500,000
Number of herrings under similar circumstances	750,000,000
Quantity of salt required to cure the fish ....bushels..	995,000
Number of barrels to contain the fish	995,000

In further illustration of the former extent of the fresh-water fisheries of the Potomac River, I give an extract from Burnaby's Travels in North America, referring more particularly to the sturgeon, although incidentally to the shad and herring.* At the present day the yield of these fisheries has decreased enormously, although enough are left to encourage the hope of a great improvement whenever the proper means for protection and the artificial propagation of fish are entered upon.

In the year 1873 the shad, herring, and bunch fish caught in the Potomac and sold in the Washington market amounted to 8,541,851 pounds; in 1874 the total sales at Alexandria, Washington, and Georgetown, from the same river, amounted to about 16,122,533 pounds, a by no means indifferent presentation.

(2) *Catadromous fish.*—Species of fish which are born in the sea, ascend the rivers and reach their maturity in two to four years, and then, when mature, descend to the ocean to spawn, and possibly never leave it again.

The Eel is the only species to which we can at present assign this peculiar habit.

(3) *Inshore fishes*, more especially fishes found inshore during the summer season, coming in apparently to breed. They are more or less closely related to the bottom, seldom or never schooling at the

*In the first report of the U. S. Fish Commission I have given numerous quotations from early authors in reference to the abundance of various fishes in the rivers and along the coast of the United States. Burnaby (Travels through the middle settlements of North America in the years 1759 and 1760, London, 1775), in speaking of the Potomac River, remarks as follows (on page 9): "These waters are stored with incredible quantities of fish, such as sheepsheads, rock-fish, drums, white-pearch, herrings, oysters, crabs, and several other sorts. Sturgeon and shad are in such prodigious numbers that one day, within the space of two (2) miles only, some gentlemen in canoes caught above 600 of the former with hooks which they let down to the bottom and drew up at a venture when they perceived them to rub against a fish; and of the latter, above 5,000 have been caught at one single haul of the seine." It is probable that the seines used in the Potomac waters over a hundred years ago were much smaller than those now employed, one of one hundred yards being, doubtless, of remarkable magnitude.

surface, and are generally most abundant within a few miles of the shore. These include a great variety of fishes on the American coast, confined for the most part to the United States and the region south of Cape Cod, which do not enter fresh waters, but are found, during the summer season at least, and are most abundant near the shore or on particular spots not far distant.

So far as we at present know, our information, however, being extremely imperfect, they come in regularly from the deep waters of the ocean, probably from the western edge of the Gulf Stream, in the spring of the year to spawn, remaining until fall. A few, as cunner and tautog, can be found at almost all seasons of the year. The rest, however, retrace their steps to spend the winters in the warmer depths outside, probably along the edges of the Gulf Stream.

The principal fish of this group are as follows:

Series 1.	*Series* 2.
The Scup or Porgy,	The Sheepshead,
The Squeteague or Weakfish,	The Lafayette,
The Sea Bass,	The Drum,
The Sea Robin (*Prionotus*),	The Whiting,
The Tautog,	The Kingfish,
The Cunner,	The Red Snapper,
Certain flat-fish,	The Red Bass,
The Dogfish and other Sharks.	The Pompano,
	The Mullet.

Of these the members of Series 1 are known to come in immense schools in the early spring on the south coast of New England, and are taken extensively in traps, pounds, and wiers. The movements of Series 2 are less well defined. They make their appearance on the coast in gradually increasing quantity, although farther south they are found in moderate numbers throughout the whole year.

There are two dogfish taken, one, the spinous dog (*Acanthias americanus*), coming first in enormous numbers, the livers furnishing a large supply of oil; the other, the smooth dog, succeeding it in smaller numbers. The spinous dog scarcely belongs to this section, as it does not remain inshore during the summer south of Cape Cod, although abundant north of it. It might be placed with the pelagic fishes but for not showing at the surface. It, however, appears more in enormous schools along the coast during spring and fall, and is very obnoxious to the fishermen, as all fishing becomes unproductive whenever the dogfish make their appearance.

An analogous movement is seen in certain fishes of the Great Lakes, as the salmon or lake trout, whitefish, &c., which, while residing for the greater part of the year in the deep waters where they are more or less undisturbed, during the spawning season (in the autumn) come inshore, especially the whitefish, and are taken in immense numbers by the traps and pounds. The white fish exhibit a very decided tendency to enter the mouths of rivers on this occasion, especially in Lake Superior and Hudson Bay. Detroit River is an especially favorite spawning-ground. Indeed, the whitefish might with eminent propriety be classed among the anadromous fish of the fresh waters, like the land-locked salmon, the blue-back trout of Rangeley Lake, &c. The spawning along the shores of lakes at all may be due to their being barred out from the rivers by artificial or other obstructions.

We may possibly place in this schedule the Capelin (*Mallotus villosus*), which is exclusively northern, and the Tomcod, although the latter sometimes enters fresh water to spawn, and may almost be entitled to a position in the first division, perhaps near the smelt.

(4) *Offshore fish.*—Not schooling at the surface; usually spawning in the deep seas, for the most part during the late autumn or winter, though generally resorting to rocks and banks, and sometimes near the shore for the purpose; never swimming at the surface, and their presence only to be determined by actual capture. During the winter they range considerably farther south than in summer. Of these may be mentioned the cod, the hake, the haddock, and most other *Gadidæ* except the pollock. The pollock, belonging to the cod family, is more of a surface fish, and is very often seen swimming or schooling near the top of the water. In some respects the halibut belongs in this division.

(5) *Pelagic or wandering fish.*—Usually surface swimmers, and for the most part regular migrants in large bands or schools from north to south in autumn and from south to north in spring; not at all regular, however, in their movements, and sometimes, for one cause or another, disappearing gradually or suddenly from a certain region, not to return again until the lapse of many years. Some, as the herring, the bluefish, and the menhaden, are autumn and winter spawners; the others lay their eggs, as far as we know, in summer or spring. It is among the fish of this group that we find, with the exception of the *Gadidæ*, the most important of all the sea fish in the entire northern hemisphere, whether we consider the number of fish taken, their excellence and high price, or the amount of capital and number of hands employed in their capture. They belong almost exclusively to the *Clupeidæ* (the herring family) or to the *Scombridæ* (the mackerel family). Two species of the former group, the shad and the alewife, have been fully considered under the first head, while no species of the second family belong elsewhere. The principal species are the following:

The Sea Herring.	The Cero.
The Menhaden or Pogy.	The Bonito.
The Common Mackerel.	The Tunny or Horse Mackerel.
The Chub Mackerel.	The Swordfish.
The Spanish Mackerel.	The Bluefish.

(6) *Deep-sea fish.*—We have already referred to this group under the head of relationships. How far they can be considered as migrants is

to be ascertained. It is probable that they change their locations but seldom, living as they do at great depth, where the prevailing low temperature (30° to perhaps 45°) is thought to vary but little.

Until within a few years little has been known of this group, the researches of the Challenger having been principally instrumental in showing its extent, variety, and the remarkable peculiarities of its different members. Many species have also been revealed to us by the contributions of the Gloucester fishermen to the U. S. Fish Commission.

Probably the only important factor in influencing the change of situation in this group of fishes is the search for food or the pursuit by fellow fish, cephalopods, &c.

In addition to the regular, periodical, or occasional movements of fish just referred to, there are cases in which the change of location is not so easily explained. Among these may be mentioned the selection of a fresh-water abode by species which are generally exclusively marine, and *vice versa*. Of course, the change in anadromous fishes is intelligible; but why such fishes as the sawfish, shark (*Pristis*), the sting-ray, and quite a number of other kinds should live and apparently thrive in fresh water, is not so easily understood. Other species are found up rivers to a considerable distance from their mouths beyond the brackish portion.

HIBERNATION.—Another subject which may be considered in connection with that of migration and movements is that of hibernation.

Many fresh-water fishes, such as carp and others, are known to bury themselves in the mud, either partially or entirely, during the cold weather, and to remain there until the warm season of the year. This is also the case to a greater or less extent with the eels, both in fresh water and on the coast. To what extent other kinds of strictly marine fish exhibit the same habit is at present difficult to determine. The disappearance from our coast during the winter season of the mackerel, menhaden, and some other species has given rise to the belief by some that they bury themselves in the mud at suitable places off the coast. Indeed, there are not wanting statements to the effect that mackerel have been speared in the mud by persons who were attempting to capture eels in this well-known method. Some of these instances appear to be fairly well substantiated; but whether they represent anything like a permanent condition it is now difficult to say. Those who believe in the hibernation of mackerel point to the existence of a film over the eye on the first appearance of this fish in the spring, which they suppose to be the result of the long exclusion of light or of contact with the mud, this film going away in the course of the summer.

The sturgeon is believed to be a hibernating fish to some extent.

Having thus considered the better marked movements of fishes under their different heads, I now propose briefly to consider the causes of such movements so far as we can understand them.

PHYSICAL CAUSES.—The more regular changes of position with the seasons are caused by the reproductive instinct, by conditions of temperature, and by search for food. They are also to a less degree affected by the pursuit of predaceous fish and other fellow occupants of the ocean and by the action of man.

Temperature of the water.—The most important of these agencies is probably that of temperature; since while there are certain species that appear to be quite insensible to considerable variations in this respect, the distribution of others is largely dependent upon the degree of heat in the water. Certain fishes, such as the cod and herring, are to be taken only in cold water, the herring usually at a temperature not exceeding 50° to 55°; the cod at a still lower degree. This relationship has an important bearing upon the herring fisheries; since, when the heat of the surface water is above the degree indicated, herring are seldom seen; as this decreases they make their appearance. This is so well established that now the herring fishery on the coast of Scotland is largely regulated by the temperature observed, and when it is decidedly above 55° the herring are not looked for.

On the coast of the United States there are two well-defined regions, one bounded to the south by Cape Cod and the other having this boundary as its northeastern limit. A few stragglers may be found occasionally on either side; but practically the cape constitutes the boundary line.

As a general rule the winter temperature of the ocean at different points along the New England coast is about the same, the surface water as well as that at the bottom showing the minimum degree down to absolute freezing. During this season, therefore, all the more delicate fish leave either to go south or off the shore until they find the temperature they require; possibly, however, not until they reach the edge of the Gulf Stream. The summer temperatures, however, vary extremely, and these variations are accompanied by the presence or absence of fish of different kinds. On the south side of New England the warmest temperatures observed were in Peconic Bay, where, in August, 1874, the bottom temperature was from 71° to 72½°, the surface temperature in one instance being as high as 74°. Here the same southern types of marine animals were predominant.

At Wood's Holl, in 1873, the mean temperature at the bottom in June was 61.7°, and in July 69.5°, and in August 70°, or an average of 67°. The surface was sometimes a few degrees higher.

Elsewhere on the south side of New England the bottom temperature ranged from 61° to 65° off the coast of Connecticut, in from 4 to 20 fathoms; in rather deeper water from 58.5° to 64°. Off Cox's Ledge it was 50° at 52 fathoms in August, and off several miles northwest of Block Island it was 45.5° at 47 fathoms, this being accompanied by a somewhat different fauna. In general, we may say that south of Cape Cod, while the inshore surface of the water during midsummer ranges from 62° to 70°, at a greater distance outward, up to perhaps fifteen or twenty miles, it ranges from 62° to 68°, and that at the bottom, inside the northern current that sweeps around the outside of Cape Cod and No Man's Land and into Fisher's Sound, the temperature inshore ranges from 61° to 70°; more offshore, it ranges from 60° to 64°. But in the colder water about Cox's Ledge and off Block Island and in certain parts of Fisher's Sound, it ranges from 45° to about 50°.

At Portland there is quite a different condition. The maximum temperature was observed inside of Casco Bay, where the range was from 57° to 65°, and outside from 50° to 59°. The bottom temperatures during the summer inshore were from 54° to 56°, and in the deeper waters of Casco Bay from 45° to 49°. Farther east and in the Bay of Fundy still lower degrees are shown.

The following table of temperatures actually observed along the coast at different times of year will be of interest. It is compiled from observations made by the U. S. Signal Service as a matter of special co-operation with the work of the U. S. Fish Commission.

Absolute highest and lowest temperature of water at the bottom at 3 p. m. during the year ending February 28, 1877.

Place of observation.	Spring.				Summer.			
	Highest.		Lowest.		Highest.		Lowest.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.
Indianola, Tex	Apr. 23	78.0	Mar. 21	57.0	....	....	....	....
Galveston, Tex	Apr. 30	79.0	Apr. 2	62.0	....	....	....	....
Mobile, Ala	May 4	68.0	Mar. 22	54.0	July 20	88.0	June 10	79.0
Punta Rassa, Fla	May 22	87.0	Mar. 21	67.0	July 17	93.0	July 31	79.5
Key West, Fla	May 3	84.8	May 24	57.0	June 24	90.0	Aug. 22	76.0
Jacksonville, Fla	May 22	84.0	Mar. 21	62.0	July 14	90.0	June 12	81.0
Savannah, Ga	May 30	73.0	Mar. 22	53.0	Aug. 20	86.0	June 15	69.0
Charleston, S. C	May 30	77.0	Mar. 22	54.0	Aug. 20	88.0	June 15	75.5
Wilmington, N. C	May 29	76.0	Mar. 3	51.0	July 19	87.0	June 10	74.0
Norfolk, Va	May 30	73.5	Mar. 4	44.0	....	....	Aug. 27	70.0
Baltimore, Md	May 28	71.0	Mar. 3	38.0	July 11	86.0	June 1	72.0
New York, N. Y	May 29	58.0	Mar. 1	32.0	July 20	75.0	June 1	55.0
New London, Conn	May 30	57.0	Mar. 2	34.5	Aug. 13	76.0	June 1	54.0
Wood's Holl, Mass	May 28	57.0	Mar. 1	30.0	July 6	70.0	June 1	58.0
Portland, Me	May 30	50.0	Mar. 1	31.5	Aug. 15	64.0	June 6	49.5
Eastport, Me	May 31	40.5	Mar. 18	31.0	Aug. 15	51.0	June 9	40.0

Place of observation.	Autumn.				Winter.			
	Highest.		Lowest.		Highest.		Lowest.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.
Indianola, Tex	....	....	....	....	....	....	....	....
Galveston, Tex	....	....	....	....	....	....	....	....
Mobile, Ala	Sept. 5	88.0	Nov. 1	57.0	Dec. 1	55.0	Jan. 9	40.0
Punta Rassa, Fla	Sept. 2	91.5	Nov. 26	68.0	Jan. 23	76.5	Dec. 5	52.5
Key West, Fla	Sept. 1	89.0	Nov. 11	65.0	Dec. 24	84.0	Dec. 6	45.0
Jacksonville, Fla	Sept. 2	89.0	Nov. 11	64.0	Jan. 29	64.0	Dec. 7	45.0
Savannah, Ga	Sept. 2	87.0	Nov. 27	52.0	Jan. 21	58.0	Jan. 5	37.0
Charleston, S. C	Sept. 3	84.0	Nov. 26	55.0	Feb. 3	55.0	Jan. 1	42.5
Wilmington, N. C	Sept. 1	83.0	Nov. 29	51.0	Jan. 22	51.0	Jan. 4	35.0
Norfolk, Va	Sept. 1	80.0	Nov. 20	46.5	Dec. 1	45.0	....	....
Baltimore, Md	Sept. 1	78.0	Nov. 30	45.0	Dec. 1	45.0	....	....
New York, N. Y	Sept. 1	72.0	Nov. 30	39.0	Dec. 1	38.0	....	....
New London, Conn	Sept. 1	72.0	Nov. 30	46.5	Dec. 1	45.0	Jan. 6	33.5
Wood's Holl, Mass	Sept. 1	70.0	Nov. 30	39.0	Dec. 1	38.0	Jan. 1	29.0
Portland, Me	Sept. 2	58.0	Nov. 26	41.0	Dec. 6	42.0	Jan. 16	29.0
Eastport, Me	Sept. 29	51.5	Nov. 26	43.5	Dec. 1	43.5	Dec. 26	27.0

The capture during the summer and autumn of fishes of the southern coast as far east as Long Island Sound, Vineyard Sound, and Buzzard's Bay, is not a matter of surprise.

The influence of temperature upon the movements of fishes, as already stated, is seen both in different parts of the coast and at different altitudes in the same region.

Oceanic currents also have more or less influence upon the distribution of fishes. This, however, depends more upon the pursuit by them of the less independent algæ, jelly-fish, crustaceans, ascidians, &c., that float hither and thither with the tide.

The apparent clearness of the water is also a factor in this consideration, various species preferring one extreme or the other, and coming inshore or near the surface with this variation.

The temperature of the atmosphere probably influences the movements of fish only so far as it affects the temperature of the water itself, the surface strata being, of course, heated or cooled very readily with variation of the air in this respect. The clearness of the sky and the consequent amount of light has a very decided influence on some fishes, especially the pelagic species, invertebrates too being affected in a similar manner. A bright sunny day will frequently call up forms that are never seen at any other time, while others again only approach the surface on cloudy days or even in the night exclusively. The action of the winds of the ocean is also to be considered in this connection, although possibly more is due to local currents as affecting the water than anything else. It is not impossible that variation in temperature may have great influence upon some fishes provided with air-bladders, by which the depth of immersion can be conveniently graduated.

In what way the influence of aerial currents or winds are felt by fish is difficult to say. Von Frieden, however, as the result of a comparison between the actual catches of herring by the German fishermen and the records of the corresponding days and hours, has come to the conclusion (Circulaire des Deutschen Fischerei-Vereins, 1874, p. 200) that the best results always followed with the wind from the northwest, and that generally northern winds were better than southern, and western better than eastern.

THE REPRODUCTIVE INSTINCT.—It is under the stimulus of the reproductive instinct that many of the more notable movements of fish take place, although by what prescience they are enabled to understand that the interests of their progeny require a change of abode, and especially from salt water to fresh, it is, of course, impossible to explain. The anadromous movements, or the ascent of rivers by salmon, shad, and fresh-water herring, &c., all in countless myriads, and with almost unerring regularity, are notable examples. It was formerly supposed that these fish moved in great bodies along our coast, sending off detachments into the mouths of the rivers as they went by. The more rational hypothesis now is that they live in the deeper waters of the sea in nearly the same latitude as the mouths of the rivers in which they were born, and return to them at the proper season. The young remain in the fresh water for a time, the period varying with the species, after which they also follow their parents in their return to the sea.

The movements of what we had previously designated as inshore and pelagic fish are also largely connected with the same reproductive instinct, and even the fishes of the Banks illustrate it to a greater or less degree.

SEARCH FOR FOOD.—Next, perhaps, to the influence of reproduction comes the search for food as influencing the migration and movements of fishes, certain species of fishes following up particular forms of other fishes, the attempts of which to escape fall under the same category; or of the lower animals, as they are carried almost unresistingly by winds and currents in various directions. A notable illustration of this is seen in the herring.

Professor Möbius, in investigating the food of the herring in the German seas, found that a certain copepod shrimp, one of the *Entomostraca* (*Temora longicornis*), was more eagerly sought after than anything else; this being so minute, however, that 18,000 were taken from the stomach of one herring and 60,000 from that of another.*

Professor Möbius thinks that the comb-like fringes attached to the gills of the herring serve as tangles in capturing these shrimps, precisely as do the similar apparatus of the basking shark and the whalebone of the whale. These specimens were obtained in February of 1872, when both the shrimp and the herring were in exceptional abundance; and he subsequently observes that the same relations were found continually, the abundance of the herring being in strict proportion to that of the shrimp.†

The chain of connection does not cease in the relation between the *Temora* or shrimp and the herring. A great variety of sea birds, gulls, gannets, &c., follow up the herring, as also numerous mackerel, tunnies, blackfish, swordfish, and even whales and porpoises, which devour the herring in countless numbers. The movements of the capelin in the North Atlantic influence very largely those of the cod and other species, as when the former come into the shores of Newfoundland and elsewhere in immense numbers to deposit their eggs on the beach, the cod, &c., follow, and are then captured within a very short distance of the shore.

DRIVEN BY ENEMIES.—A notable instance of these relationships is seen in the menhaden and the bluefish. The menhaden, in its movements along the coast, is very frequently accompanied by vast schools of bluefish, which, as already explained in a previous report, probably destroy more menhaden in a day than are taken by man in a whole sea-

* Circulare des Deutschen Fischerei-Vereins, 1873, p. 112.

† Circulare des Deutschen Fischerei-Vereins, 1874, p. 90.

son's fishing. This is not unfrequently illustrated in the driving ashore of the menhaden by the bluefish in immense masses, while the bluefish themselves in their ardent pursuit are stranded at the same time. A similar pursuit of the mackerel by the bluefish is often noticed. The bluefish themselves are, by an act of retributive justice, pursued and driven ashore by schools of porpoises and horse-mackerel or tunnies.

HUMAN AGENCIES.—The influence exerted by man in determining the abundance or the movements of fishes, apart from their actual capture, is manifested in various ways, although more particularly in the case of the anadromous fishes than any other. Whenever any impassable obstruction is laid across a river, ascended by anadromous species, as shad, salmon, &c., for the purpose of reproduction, the exclusion from their breeding grounds has very soon a marked effect. Usually, for the first two or three years not much difference is appreciable, as these species require three or four years to mature after passing down the river before they return to their starting point. There will therefore be three years of successive returns of schools, and after that there will be no young fish to keep up the supply, which will be confined to the older individuals returning in the vain attempt to find spawning beds. At the expiration of six or eight years the supply will probably cease entirely, and there will be no further run in the river. In this event the remedy is the removal of the obstructions by taking down the dams or barriers, or introducing a fishway, and planting the young fish above the former obstruction; at the end of three or four years the mature individuals will make their appearance again.

Nets constitute an obstruction of less moment than dams, since they are of temporary application and constantly liable to be torn or destroyed by the elements, or removed by legal enactments.

The disappearance of fishes to a greater or less degree from certain localities has frequently been ascribed to such agencies as the sound from the paddles of steamboats, the firing of cannon, &c. How far this is of any moment remains to be seen. A variation in abundance of fish is not unfrequently caused indirectly by man in destroying or fostering predaceous species. It has not unfrequently happened that one species of fish has greatly multiplied in consequence of the capture by man of some special enemy. There is no doubt whatever that the number of bluefish caught during the summer season for market purposes permits a vast increase in the number of menhaden, scup, sea bass, and other fishes which would otherwise be devoured.

Many such cases could readily be adduced, and suggest extreme caution in the adoption of measures for protecting certain fishes from natural enemies, without a careful inquiry as to the possibility of indirect results not anticipated. A noticeable instance has been furnished by Mr. Whitcher, the distinguished commissioner of fish and fisheries of the Dominion of Canada.

He states that the *Beluga*, or white whale, is a great consumer of fish of all kinds, but is especially destructive to the salmon and cod of the Lower Saint Lawrence, the former particularly. Some distance up the Saguenay River, where the salmon were supposed to have been much injured by the *Beluga*, a license was taken out in 1872 for their capture, and in 1873 a large number (some sixty) were secured at one haul. In this way a very great diminution was effected.*

These have in turn reacted upon the fisheries, since the sharks, which had been kept down in point of numbers by the belugas, multiplied, or at least came in such numbers as, in their turn, to affect very seriously the fisheries, the fish being greatly diminished and those captured showing marks of laceration by the teeth of their new enemies. The increased abundance of the sharks was also shown by the much larger number of them captured in the nets.

Another statement of Mr. Whitcher still further illustrates the relation between the white whales and the salmon. It is well known that within a few years the salmon fisheries within the Dominion of Canada have been very greatly increased by the enforcement of legislation for the protection of fish during their spawning season, and for the increase of the supply by artificial propagation.

Another illustration of the same character, as also furnished by Mr. Whitcher, is to be found in the Bay of Chaleur. In former years the streams emptying into this bay abounded in salmon, but presented the usual appearance of salmon rivers in a marked decrease in numbers by overfishing and other agencies, and this continued for a period of a number of years. More recently, however, as a result of the wise legislation on the part of the Canadian Government of protection during spawning season, and the measures of artificial propagation, the fish are again found in very great abundance. For twenty years the white whales were not known in the Bay of Chaleur, or only by stragglers, but latterly they have returned in large numbers. The first year of their occurrence they came after the salmon had entered the bay and drove them into the shores, where they were taken in very large numbers by the traps and nets that had got a small capture in the lower parts of the rivers. The next year the belugas, or porpoises, came early in the season, before the salmon, and apparently awaited their arrival. They committed great havoc among them and cut them off apparently from the immediate shores.

*According to the report of the British Fishery Commission, p. xliv, at one time in consequence of the apparent diminution in the abundance of fish in Loch Fyne, one of the best known herring fisheries in Scotland, what was then considered a very destructive mode of fishing, by the circle-net, was interdicted for a number of years. It was found, however, that this had not produced the effect supposed, as the decrease of the fish continued for a time, and after the circle-net fishing was restored the fish again became as abundant as ever.

D.—NUMBERS AND ABUNDANCE OF FISH.

That fish of many varieties have decreased greatly in abundance within the historic period in all parts of the world is well established, the reduction in some cases being truly enormous. This, however, applies only to certain varieties, especially of the anadromous fish, or those running up the rivers from the sea to spawn, and to the more inshore forms. The most indubitable cases of diminution are those of the shad, fresh-water herring, salmon, and striped bass. On the other hand, there is no reason to suppose that the cod, mackerel, bluefish, and the sea herring have been reduced essentially, if at all, in numbers, the stock of these fishes being from year to year about the same, and an apparent diminution in one region being balanced by a greater supply in another.

In previous pages of this article, in illustrating another subject, I have referred to the difference in the numbers of shad and herring in the Potomac at the present time and in the past, an experience which is shared to a greater or less extent by all the rivers of the Atlantic coast. Many streams which formerly furnished a vast quantity of food, within easy reach, have now become entirely unproductive, so that it is only by a combination of measures of artificial propagation in the rivers and judicious legislative enactments that anything like the earlier experience can ever be again realized.

The causes of this variation in abundance, so far as they can be detected, may be considered under two heads: first, the natural, or uncontrollable; and, second, the artificial, or those connected with the interference of man. Where the former alone are responsible there may be a hope of a return to original abundance; man's influence acts persistently and with increasing effect throughout long continued years.

There are two classes of natural causes of variation: first, those induced by physical conditions; and, secondly, the dependence of the fish upon, or the relations of fishes to, their fellow-inhabitants of the sea. The action of man is either direct or indirect. The direct agencies are those of overfishing and the pollution of the water. The indirect consist of the obstructions to the movements of the fish, the disturbance of the balance of nature, by unduly fostering or destroying certain classes of animals, and by breaking up the schools of fishes during a critical period, and preventing their spawning.

We have already considered under the heads of migrations and movements of fishes the subject of variations in abundance, depending upon migration, or change of place, where, although the fish may be scarce in one locality, they are proportionally more abundant in another, the actual number in the sea remaining the same. At present we are considering the subject of diminution in actual number of fish. It will be more convenient to consider this subject of variations in the abundance of marine fishes under the next head, of dangers and fatalities, where I propose to go into more details.

E.—THEIR DANGERS AND FATALITIES.

A general account of the fisheries of the North Atlantic coast of the United States is not to be completed without some mention of the agencies by which they are affected and reduced in abundance other than as the result of age. The variety of such influences is very great; perhaps more than in the case of the terrestrial vertebrates, and comparable only to the affections and influences upon insects, which, like the fishes, occur in overwhelming abundance at one time to be more than decimated at another.

We may consider the subject of the dangers and fatalities under three heads: first, those brought about by their fellow-inhabitants of the sea; second, by man; and, third, by natural or physical causes and changes.

1. FROM OTHER FORMS OF MARINE LIFE.

The injuries caused by their fellow-inhabitants are twofold in their action: first, upon the eggs and embryonic fish, and second, upon the more fully grown fish. The destruction of the eggs of fishes is something truly enormous, the percentage of the yield of even the youngest fish from a given number of eggs being extremely small. It has been calculated, in the case of the salmon or shad, that not five eggs out of one thousand produce young fish, able to commence feeding, all the rest being destroyed in one way or another. It is quite likely that even this ratio is too large. A part of this loss of eggs is due, however, to imperfect fertilization, and it is here that artificial propagation has the advantage in securing the contact of the milt with all the ripe eggs, leaving an insignificant fraction not fertilized. Probably not half, and sometimes even much less than half, the eggs discharged experience the same fortune in natural spawning. It would seem as if the immense disproportion of eggs to the resulting fish was an intentional provision in nature, to furnish food to the small inhabitants of the sea, especially to the young fish themselves, of various species, no other bait being so attractive to fish, even to those that have just laid the very eggs used for this purpose. The size of the eggs varies very greatly with the species, as will be seen in a subsequent chapter, some being adapted to the smallest mouth, others requiring one of considerable capacity to take them in. There is almost no season of the year when fish eggs cannot be found in the water, either floating free or else adherent to some object, and the work of devouring them is carried on continually. Of course it is only the smaller fishes that pick up the small eggs; but the former, in turn, contribute to some of larger size, and those to larger again, until finally, in the sequence, the largest inhabitants of the sea obtain their proper food.

It is among the aquatic mammals that we find the most powerful destroyers of fish, these requiring a much larger amount in proportion to sustain life, as they feed not merely for subsistence but for material to keep up the animal heat.

The cetaceans of various species are, of course, the most destructive by their much greater bulk, the larger of the porpoises being most notable in this respect. It is not unfrequently with feelings of satisfaction that the human spectator observes schools of bluefish that have devoured and driven on shore schools of mackerel and menhaden, themselves attacked and subjected to a similar treatment by troops of porpoises, forming a line outside of them and devouring them with extraordinary rapidity, frequently forcing them on the beach in large numbers. Whales, too, take their part in this conflict, but probably confine themselves to smaller fishes, especially the herring, and possibly mackerel, capelin, or other species, of which large numbers, while schooling can be taken at a gulp.

The method of feeding of the whale is, of course, only appreciable when the operation is conducted at the surface. Here they may be often seen (the finback whales especially), with the mouth wide open and swimming with great velocity against large bodies of herring and floating invertebrates, such as pteropods, jelly-fishes, &c. The greater the development of whalebone in the mouth, the less do the whales apparently feed on fish and the more on invertebrates. The finback is characterized by the small amount of whalebone. To what extent the sperm whale, which is essentially a large porpoise, feeds upon fish is not known; its principal food, however, is believed to be the giant cuttle-fish, which inhabits the depths of the ocean, with the largest of which it appears able to cope. It is very seldom that a sperm whale is captured without having in its stomach some fragments of this large cephalopod, the beaks being almost always found in their intestines and excrement. Ambergris almost always contains such remains.

Seals come next to the cetaceans in voracity and destructiveness, and occupy only a second place, in view of their more limited distribution and their confinement to a certain proximity to the land. The numbers of fishes, especially of the *Gadidæ*, doubtless also of salmon, devoured by the seals in the North Atlantic must be something almost beyond calculation, and the destruction on the part of the much larger seals, sea-lions, fur-seals, &c., of the Pacific is probably still greater.

How far the walrus is a destroyer of fish I am unable to say, although it is generally believed to depend, to a considerable extent at least, upon mollusca for food.

Otters are also worthy of mention in this connection, the sea-otter of the Pacific Ocean being very destructive in proportion to its size and numbers. The common otter also devours large numbers of fish in fresh water, levying tribute on many a fine salmon, shad, and other valuable fish.

Although at first sight we may not be inclined to attach much importance to birds as destroyers of fish, yet it is found that they represent by no means an insignificant factor in the casualties of the class. Every fish-culturist is painfully aware of the destruction of his trout, carp, or other fresh-water species by herons and kingfishers. The fish-hawks take their toll in the rivers and lakes, perhaps more rarely in the sea; but it is among aquatic birds, especially the gulls, the *Pelecanidæ* (including cormorants, pelicans, gannets, &c.), the *Alcidæ*, or auks, and some of the ducks that we find the most active oceanic enemies of the finny tribe. In many parts of the ocean the number of birds belonging to these groups is enormous, and even supposing that each bird devours daily only half, or even a quarter, of its weight (a by no means difficult feat), the amount of destructiveness is something quite appalling. It has been estimated that the gannets alone, on the coast of Scotland, devour more herring than are taken by man, their voracity, like that of the cormorant, being very marked. The gulls are less destructive, as they must confine themselves more particularly to the smaller fish which come to the surface, either spontaneously or as driven by predaceous fishes.

The reptiles probably contribute but little to the mortality among fishes in the open sea; but in lagoons and along the shores of islands, especially in brackish water, as well as in fresh, they play their part in the economy of nature. It is especially among the crocodiles, alligators, and caymans that this destructiveness is seen. The sea-snakes of the tropics and sub-tropics in all probability consume large numbers of fishes of such size as can be readily swallowed entirely. In fresh waters the various species of water-snakes also consume a considerable number. Some species of turtle are very destructive to fish, although it is more particularly in fresh water where such forms as the snapping-turtle of North America play well their part. The sea-turtles are said to be vegetable feeders rather than animal, seeking the eel-grass, algæ, and other plants. Probably, however, they do not disdain an occasional fish.

Frogs are also very destructive to fish in fresh water, and require a careful looking after by the fish-culturist. The salamanders are too diminutive to devour large fish, but probably consume eggs and young on a large scale. The *Menobranchus*, or large salamander, in the Great Lakes, is said to commit great havoc on the whitefish spawning-grounds, gorging itself on the eggs, and by the aggregate of their numbers largely reducing the crop of young fish.

The destruction of fish in the sea, as might naturally be expected, is greatest from fellow-fishes, the smallest being consumed by those a little larger, these again falling victims to the still more powerful, and so on until we reach such forms as the swordfish, the tunny, the largest sharks, &c., which apparently at least, when fully grown, are free from danger from their own kind. Here, however, there come in as antagonists and destroyers the larger cetaceans; possibly the giant cuttle-fish, and man; although such insidious enemies as the lamprey, the myxine, or hag, the pug-nosed eel, and other parasitic fish may even cause the very largest to succumb.

In most cases the fish is destroyed by being taken in at a gulp, by one of its fellows larger than itself, although there are certain forms, such as the *Chiasmodes*, the *Sacoopharynx*, &c., which, in the possession of very wide jaws and a capacious stomach sac, can take in entire and digest fishes of twice their own size. Specimens illustrating this are to be found in the National Museum. In many cases, as with the sharks, bluefish, &c., the victim is lacerated, either torn or bitten in two. Fish like the sand-lance (*Ammodytes*), when swallowed alive, often burrow through the stomach and produce death. It is not uncommon for codfish to be taken with the sand-lance in the abdominal cavity, encysted and mummified, several specimens of these having been obtained by Captain Atwood, of Provincetown. The lampreys and myxines, already mentioned as destroying the very large fish, frequently do this still more extensively on the smaller ones. The so-called pug, nosed eel of the Gloucester fishermen (*Simenchelys parasiticus*) is not unfrequently found nestling along the backbone of the halibut and cod where they seem to have the power of abiding for some time without actually causing death. The eel is another of the fishes that destroy life in an unusual way. It is especially noteworthy in connection with gilling for shad, in view of its habit of fastening upon a ripe female, when meshed, and penetrating the abdominal cavity and devouring the eggs in its progress. It is a very common experience for the gillers to find perfectly sound, plump shad, taken in the net, with one and sometimes two or three eels in the abdomen, their destruction having been effected within a period of a few minutes.

It may safely be said that of oceanic fish more or less predaceous, there are many forms that live on vegetable substances while young, but for the most part changing to a carnivorous habit when old. How many species confine themselves exclusively to fish it is impossible to say, as a careful examination of the stomachs of most forms shows at least the occasional presence of crabs, worms, radiates, &c.

I have already referred to the subject of the rapacity of fish, under the heads of migrations and movements, and variations in abundance, &c. I would here simply call to mind the ravages of the bluefish in its attacks upon the mackerel, menhaden, and other species. Great as are these ravages, however, they are probably nothing in comparison with those of different species of the sharks. These, by their enormous size and immense abundance, must, of all oceanic forms, be the most destructive of fish life and constitute the largest factor in the element of mutual injury. Neither is it the largest of the sharks that are the most dangerous. The smaller forms, which come in large schools, migrating with the season, are most effectual in their agency. Every fisherman on the New England coast is familiar with the so-called dogfish (*Acanthias americanus*), a species which rarely exceeds 3 feet in length, but which frequently comes in on the fishing-grounds in countless numbers and renders the fisherman's life a burden by the destruction of his bait and the disturbance of the fish.

Holdsworth (Deep-Sea Fishing) refers to the finding of twelve full-sized herring in the stomach of a pollock, and from thirty to thirty-five in the stomach of a codfish. I have taken forty-seven scup of quite considerable size from the belly of a bluefish of about 5 pounds weight. Instances of this kind could be readily multiplied.

To what extent fishes are destroyed by invertebrates it is difficult to decide, although probably this agency is one of considerable moment. Many species are infested with entozoa or intestinal worms, which find a lodgment in the brain, in the muscles, or the viscera, and which must necessarily involve more or less of mortality. Others have external parasites adherent to them, consisting in larger part of crustaceans of greatly modified shapes. The free-swimming crustacea, as lobsters, crabs, &c., undoubtedly kill great quantities of fish. Their office seems to be more particularly that of scavengers to destroy the weakly or dead individuals. Certain of the jelly-fishes are known to feed on small fishes. It is quite probable that the squids and cuttle-fish live mainly upon fish. Enormous numbers of squids are found at certain times in certain waters, and represent undoubtedly great destruction among fishes. Many illustrations of this relationship could be multiplied, but the subject need not be continued, as I merely wish to show the general relationships.

How far fishes are affected by epidemics or other diseases it is difficult to say, although there are many instances on record in which this condition is assigned as the cause of their disappearance. It is said that the bluefish off the coast of New England were all exterminated by some disease shortly after the middle of the last century, their carcasses being found floating in enormous masses over the sea. Whatever may have been the cause of their absence it is very certain that the bluefish was not known again until about 1820, when they made their appearance gradually, of small size, but for many years in nothing like their original abundance. It is said that they were often known of such magnitude in the last century that fifteen would fill a barrel, representing a weight of 200 pounds when cleaned and dressed. Comparatively few such fish are now taken in Vineyard Sound.

Of late years there have been seasons, especially in the summer and autumn, when fish in the Gulf of Mexico have been found dead in immense numbers. The cause of this has not been ascertained, some ascribing it to actual disease, others considering it the result of some poisonous infusion or exhalations in the water.

2. THE INFLUENCE OF MAN.

A very large element in the aggregate of destruction of fishes by the agency of other animals is furnished by the fishing and fisheries, man deriving, in all parts of the world, especially near the sea-shore, a large part of his food from the sea, and drawing upon it for supplying distant localities, or laying up stores for seasons when fish could not be readily obtained. These fisheries in the northern hemisphere are particularly extensive, a large portion of the population of both shores of the Atlantic finding extended employment in this vocation. The herring fisheries of Scandinavia, Holland, and Great Britain, and in less degree of British America and New England, the fisheries for cod and other *Gadidæ* in the entire North Atlantic, the capture of halibut, salmon, &c., are all included in this list. In the North Pacific Ocean the salmon and cod represent for the most part this industry. In the warmer countries of the world, although fish are perhaps absolutely as abundant as in the north, they can be used only for daily consumption, it being found almost impossible to salt or dry them for future use; and hence the anomaly of vast importation of cod, herring, and other salted and dried fish into Cuba, the West Indies, and South America, when these regions can show much better food-fish in countless abundance.

Great, however, as is the destruction of fishes by man in his various fisheries, it can easily be shown that it constitutes a very insignificant portion of the slaughter, when compared with what is effected by fishes themselves, and it may safely be said that the total of the fisheries of the North Atlantic and Pacific for the year does not equal the destruction, possibly in a single hour, by other causes.

We are apt to ascribe a very undue influence to human agencies in affecting the supply of fish by positive diminution or by direct extermination. That man does influence the supply to some extent may readily be conceded, especially in the case of the anadromous fish. The obstructions of rivers by dams are among the most important. The other agencies of poisoning the water by refuse from factories have little weight excepting in rivers, scarcely attaching to bays and shores. It is even a question whether, in some instances, man does really increase the food supply by the destruction of certain forms that are predaceous. Reference has already been made to the great problem whether the pursuit of the bluefish by the Gloucester fishermen on the eastern coast of the United States is attended by a further increase of the fish on which it especially preys, such as the menhaden, scup, weakfish, &c., and whether every shark and every porpoise killed by man also gives a new lease of life to a great number of fishes.

A movement now (1877) on foot promises to add another to the illustrations of man's indirect influence upon the fisheries in the disturbance of the balance of power. It has been ascertained that by treating fish with bisulphide of carbon or benzine the oil can be extracted much more easily than by the ordinary process, leaving, indeed, a residuum in the form of a dry powder. It is claimed that the by-product of oil is about 80 per cent. more than by the kettle or presses, and the dried scrap instead of yielding 10.5 per cent. of ammonia produces 14.

A building is now being erected at Wood's Holl (85 feet by 40, and

34 feet high) to practice the process, which will be in operation before the close of 1877, with the special object of making artificial fish-flour and dried powders for fertilizing purposes. In this process they expect to work up a great number of refuse fish, which they promise to purchase at the same price as menhaden and in the following order of preference: Bluefish, porpoises, sharks, dogfish, menhaden, and skates. They propose to work up twenty tons of fish each day, and to employ from one to three steamers to cruise for these supplies, extending from Block Island to the coast of Maine, touching all intermediate points.

The extent of destruction to fish caused by the porpoises, skates, and dogfish is well known, and should the anticipated manipulation of forty thousand pounds of refuse fish per day be accomplished, or say twelve millions per year (counting three hundred days to the year, and allowing ten millions of pounds for the destructive kinds), we shall have an enormous withdrawal of predatory fish from the scene of action. This aggregate might be considered as equivalent in destroying capacity to two millions of bluefish at five pounds each; and an estimate of the amount of fish that would be devoured by such a body has been given in my first report. If the success anticipated for this venture be realized, it is probable that other establishments of a similar kind will be started, constituting a still greater relaxation of the exhaustion of the yield of fish. A few years of such fishing should present a marked influence upon the supply of edible fishes along the middle and northern coast of the United States.

3. NATURAL CAUSES OR CHANGES.

Fish as a class are quite subject to fatalities arising from natural causes, and which sometimes operate on a very large scale. Among these, volcanic eruptions are not the least momentous. It very frequently happens that such phenomena from volcanoes near to or in the sea are accompanied by discharges of boiling water or of poisonous gases, which contaminate the waters and cause great distruction to animal life therein. Many cases of this character are on record as incidents in the history of volcanic discharges. Not unfrequently mud is thrown out in vast masses, which fills lakes and streams, or invades the edges of the ocean with disastrous consequences to life. Violent storms and hurricanes are also to be considered in this connection, fish being not unfrequently blown on the shores or taken up bodily and carried to a great distance inland. Sudden changes by winds and currents of the sea bottom not unfrequently cut off portions of the sea occupied by large bodies of fish, which, unable to get back to proper physical surroundings, soon perish. Very often, too, this action of the winds and waves renders the waters very turbid and unfit for animal life in the sea, which is consequently speedily destroyed. Of this, striking illustrations will be given in a succeeding chapter.

An excessive change of temperature, whether the change be to extreme heat or extreme cold, constitutes an important member of the agencies injurious to fishes. The latter phase, however, is the more dangerous, as while the fishes that belong to the colder waters of the ocean are but seldom exposed to an unnatural degree of heat, those of the South Atlantic and the Gulf Coast of the United States are frequently killed at once by a severe turn of cold weather, hundreds of tons of fish frequently perishing within a limited district. This is quite a common accompaniment in the fall and winter of the severe northers on the Texas coast. Similar cases of death by cold or freezing are often observed on the shores of the New England and Middle States, although usually not so marked in their presentation. It is, however, quite common to find in early winter numbers of scup, tautog, sea bass, and other species in a drying condition on the beach.

Fish killed by cold.—I find among some manuscript notes communicated to me by J. Carson Brevoort, esq., that in 1849 many fish were killed in Massachusetts by the cold, 60,000 pounds of striped bass having been taken from Polk pound, and 120,000 pounds from Newton pound, Martha's Vineyard, and sent to the New York market. He also records that on the 30th of September, 1844, the shores of Jamaica pond were covered with young pompanos, from 1½ to 5 inches in length, supposed to have been killed by the cold.

Dr. H. C. Yarrow reports that in the winter of 1870–1871, in the latter part of December, great numbers of drum, flounders, small mullet, trout, and spots were frozen at New River (a prolific fishing ground), 45 miles from Fort Macon. The trout, mullet, and flounders were piled on the shore knee high, and were carted all over the country as manure, selling at $1 per barrel.

The same thing happened a year or two later. Thousands of fish have been frozen at the same place. Almost every winter during the last ten years more or less of the food-fishes have been destroyed by cold.

In addition to the destruction of fish in large numbers by sudden chilling of the water, such as frequently takes place in the Gulf of Mexico and the eastern coast of Florida after a severe norther, many are killed by the action of anchor-ice. Thus, in the vicinity of Wood's Holl, Mass., young herring and other fish are often found in the winter time floating in vast numbers, and also imbedded in the ice which forms at the bottom and floats to the top.

Other fatalities.—A further example of the method by which large numbers of fishes and other inhabitants of the waters may have been destroyed simultaneously is given by Mr. Henry O. Forbes, of Aberdeen, Scotland, in his account of a visit to the Cocos or Keeling Islands in 1884. In this region, immediately after a cyclone, which occurred January 28, 1876, the water on one side of an adjacent lagoon was observed to be rising from a considerable depth and of a blackened color. It continued to flow for about fourteen days, had an inky hue, and its smell was "like that of rotten eggs." This was diffused gradually around the lagoon, and passed into the ocean; and within twenty-four hours every fish, coral, and mollusk in the part impregnated with this discoloring substance died. So great was the number of fish thrown on the beach that it took three weeks of hard work to bury them in a vast trench dug in the sand.

It is supposed that this water was impregnated with hydro-sulphuric or carbonic acid. The statement is made that the corals and shells were deeply corroded, the corals, especially, being in many places worn down to the solid base. For a long time after the catastrophe there were no signs of life in the lagoon.

Precisely to what cause we are to ascribe the destruction of fish in the summer season, in the Gulf of Mexico, it is impossible to say. Here, without any apparent reason because of change of temperature or other physical condition, for a period of weeks together, myriads of fish, of all species, are found dying or dead, so much so that they drift ashore in vast numbers, threatening to create a pestilence. It appears that the cause, whatever it be, is disseminated in the water, as smacks loaded with living fish in their wells, intended for the markets of Key West, Cuba, or the north, when entering certain zones experience the loss of their entire cargo. It is possible that the fatality is caused by some algous or fungous plant, which exercises a deleterous effect upon animal life. The statement that the zones of dangerous water are differently colored from the main body, would strengthen this impression. One explanation is that the water from the Everglades, pouring into the Gulf, in some way exercises a deleterious influence.

As a general rule, of the fishes which perish from one of these causes or another, no matter how great the mass, it floats at the surface of the sea until decomposed and wasted, leaving but little in the way of definite remains.

In regard to the agency of physical causes in destroying immense numbers of fish simultaneously, under circumstances to involve their being imbedded and their skeletons thereby preserved, numerous illustrations can be adduced in modern times, as we have already shown. The eruptions of volcanoes along the sea-coast frequently discharge immense bodies of acid or heated waters into the sea that poison everything around them, the fish being imbedded in the mineral matter which accompanies the discharge, or covered up by the ordinary tides, or by the extraordinary currents produced by the same outbreak.

Another very frequent and important natural source of destruction to which we have just referred is in the sudden cooling of tropical waters by the "northers." These are frequently observed in the Gulf of Mexico, where, in the winter especially, the waters are frequently changed abruptly and to a very marked degree by the persistent blowing of an intensely cold and long continued wind from the north. This in the regions west of the Gulf is usually accompanied by blinding snow and involves the destruction of man and beast; and on the sea-coast millions of fish of all kinds frequenting the shallower waters are killed. Not unfrequently these are blown ashore in great heaps, poisoning the atmosphere and sometimes constituting by their decomposition the alleged cause of the yellow fever and other serious diseases.

The most plausible explanation of the phenomena of the occurrence of fossil fishes in enormous numbers is suggested by Dr. A. Leith Adams, of the Brtish army,* as the result of personal observation in New Brunswick. The occurrence took place at a small creek, called Anderson's Cove, a short distance to the east of the Magaguadavic River, which empties into the northwestern part of Passamaquoddy Bay, not very far from the town of Saint Andrews and from Saint Stephen. This cove is a lagoon of about 1,300 feet in circumference, into which a small stream enters and communicates with the sea, at high tide only, by a narrow channel. But in the vehement rush of the Bay of Fundy tides the water enters this lagoon with great force and stirs up the mud into a paste, which runs off slowly, at low tide. The incoming stream continually brings down a fresh supply of mud and slime.

On the 24th of September, 1867, a very heavy gale from the west blew directly into Anderson's Cove, disturbing the mud to an unusual degree. The same storm brought into the cove immense numbers of young herring, about six inches in length, with a few other fish, as mackerel and flounders. These, after the storm, were found washed up on the beach in great numbers, while the mud, which by this time had settled, was completely filled with them. The bottom of the lagoon was covered with a layer several feet in depth, the total amount of destruction being almost fearful to contemplate.

There is no reason to doubt that similar conditions, in earlier times, have given rise to some of the fossil deposits referred to.

Another of the natural causes of the destruction of fish is found in the numbers of certain fishes which are stranded when seeking the shallow waters for the purpose of depositing their spawn. Of these the capelin of Newfoundland and Gulf of Saint Lawrence is a notable instance, as it comes in close to the edge of the water in enormous numbers to deposit its eggs. Here the pressure of the continually succeeding schools is such as to force the fish in a body on the beach, this action being sometimes aided by high winds or heavy waves. Windrows of the fish are to be found on the beach, which are in large part carried away and used as manure on the fields. Many of these, of course, would become imbedded in the sand and mud, and constitute material for the investigation of the future geologist. It is in all probability to these circumstances that we owe the occurrence of the capelin as a Tertiary

*Field and Forest Rambles, or Notes and Observations in the Natural History of Eastern Canada. London. Henry S. King, 1873. p. 264.

fossil of the valley of the Saint Lawrence and of certain portions of Northern Europe.

The occurrence of fossil fish in immense numbers in certain geological formations has been a subject of much interest to the geologist and naturalist, and many hypotheses have been promulgated in explanation thereof. It is not at all probable that the ordinary casualties happening to fish would produce anything like the phenomena in question. It is believed that very few fish die of old age, the incidents of life in the sea being such that whenever any animal loses the ability to care for itself some enemy is ready to devour it. The accumulations referred to, found at Monte Bolca in Sicily, in Syria, in many parts of the United States, and elsewhere, probably result either from some mysterious disease attacking the fish in large bodies, or from some physical cause. There is but little evidence to prove the existence of serious epidemics among fish in the sea, although such an occurrence is not at all improbable. Even here, however, it is likely that there would be enough scavengers to devour the dead and dying almost as rapidly as they succumbed to the baleful influence.

One of the methods by which fish are destroyed in great quantities, and yet kept in a condition favoring their ultimate preservation, as in rock strata, consists in the sweeping of large schools, during storms, into low, shallow basins at the edge of the sea, where, of course, death will very soon ensue. The gradual concentration, however, of the water by subsequent evaporation, answers the purpose of a slow and careful salting of the fish, so that for a considerable time after the basin is dry the fish remain in a good state of preservation. If, as is probably often the case, sand and mud are swept in with the fish, and this is repeated at short intervals, a succession of strata with skeletons of fish and other marine objects may result.

A case of this kind has been mentioned to me by Lieut. Z. L. Tanner, U. S. N., who noted the phenomena during the cruise of the United States steamer Narragansett in 1872, at Christmas Island. The surface of the shallow basin inside of the beach was occupied by many hundreds and even thousands of fish, varying in length from a few inches to three or four feet, and preserved in perfectly good condition, the thoroughly cured flesh being, however, too strongly salted to be palatable.

F.—The natural food of sea fish.

The vegetable kingdom at sea, as well as on land, constitutes the starting point of all animal life, and whatever may be the extent to which animals devour their fellows, whether as adults, embryos, or eggs, there is no doubt that without the presence of plants in some form or other and their assimilation, the existence of animal life in the sea would be an impossibility. It is less easy, however, in the water than on the land to see the connection between the two kingdoms in this respect, especially as the most important element of the vegetable division is in the extremely minute and more or less microscopic form of diatoms. These, however, swarm in all portions of the ocean and extend into its uttermost ramifications, occurring at depths of three or four thousand fathoms, or at the surface, and equally abundant in the middle of the ocean as on its shores.

There appears to be an immense variety of the lower order of animals, whose special function it is to assimilate these minute algæ and convert them into animal matter. These, in turn, are devoured by animals of a higher organization or of larger dimensions, although still microscopic; and after a time, by a succession of such transformations, the matter becomes a portion of the organism of the larger mollusks, crustaceans, radiates, worms, or vertebrates.

The larger plant-growths in the sea also have similar relationships, the so-called sea-weeds, sea-mosses, kelp, &c., furnishing a rich variety of food. Various mollusks and crustaceans devour both the living sea-weed and the dead with avidity. The *Nereis* and others among the worms, too, will consume decaying vegetable matter.

The great sea-turtles are also believed to depend very largely upon sea-weeds for food, and the manatee or sea-cow of tropical and sub-tropical regions also feeds upon sea-weeds and other submerged marine vegetables.

There are comparatively few fishes within our knowledge that certainly eat sea-weed as a portion of their food, although it is said that the stomach of the striped bass frequently contains such quantities of ulva and other succulent vegetation as to render it almost certain that it must have taken it as an article of food. Not unfrequently the vegetable contents of the stomachs of certain fishes may have been taken in accidentally in connection with some shrimp or mollusk which was resting upon it at the time of capture.

Of the higher order of plants very few species are known in the ocean (indeed the *Zostera* or eel-grass is said to be the only form), but immense quantities of the trunks of trees, &c., are constantly carried into the sea from the rivers, and are very speedily attacked by animals specially appointed for the purpose, the most familiar being the teredo or ship-worm, and sometimes certain shrimps or crustaceans, the best known of which on our coast are species of *Limnoria* and *Chelura*. These very soon perform their part in honeycombing and reducing to minute fragments vegetable matter of whatever magnitude, and the fragments, after being made too small to serve as burrows, become in this finally divided state food for other marine objects.

The echini, so abundant on our coast, and especially in the northern waters, are quite omnivorous in their habits and consume both animal and vegetable substances, and are apparently especialy adapted for those of harder texture. They devour greedily the soft portions as well as the bones of fishes and possibly of other vertebrates, and have been known to eat off the bark from the stakes used in constructing the weirs for herring at Grand Manan. Fastening on the exterior, they eat off the bark in circular spots.

There is, therefore, no difficulty whatever in establishing the existence of vegetable matter in the sea in sufficient quantity to serve as the basis for the stupendous mass of animal food derived from it.

Starting thus from the vegetable kingdom the chain of succession of animal life furnishes in one or other of its links food to all the animals of the sea, in the process of such assimilation enormous numbers of distinct organisms being consumed for the support of a single individual. Nor is there any definite ratio between the size of the food used and that of the animal raised upon it, since the baleen or bone whales are believed to live almost entirely upon shrimps, floating mollusks, and upon the smaller fish whenever they can be obtained in sufficiently large schools. It is well known that herring are devoured in multitudes by whales, such as the finback, &c.

Sixty thousand copepods (*Temora longicornis*), by actual count, have been taken from the stomach of a single herring, while many thousands of herring have been taken from the similiar receptacle of the whale, which shows that this miscroscopic shrimp may be regarded as one chief source of the subsistence of the whale—another case of the relation between the infinitely small and the infinitely great.

Some fishes are believed to feed very largely upon the organic mud of the sea-bottom, this of course being rich in some of the smaller forms of animals and the diatoms. The examination of stomachs of large numbers of the common menhaden, by Professor Verrill, revealed no other substances than the mud in question; the fish being provided with very thick, muscular walls to its stomach, a so-called gizzard, for the special purpose of utilizing it. The *Dorosoma*, or gizzard shad, of the rivers of the Atlantic coast, has also a similar provision.

A favorite implement of the naturalist is that called the towing-net. This is simply a bag of gauze, the mouth of which is held open by a ring or brass frame, which is towed behind a boat or vessel so as to take a skimming of the surface of the water. This can never be used in any part of the ocean without very soon obtaining a greater or less number of the minute animal organisms, such as the adult shrimp, the larval stages of certain crabs, embryos of mussels and other mollusks, and small fishes.

Around floating sea-weed in mid-ocean are always congregated great swarms of minute animals. The presence of whales, dolphins, albicores, and other species of animals in mid-ocean also proves the occurrence of food in vast quantities; as although all these species may not themselves devour the lower order of animals, they yet feed upon fishes which do find their sustenance therein.

It is not probable that any fish feed directly upon purely inorganic matter. It is through plants that mineral substances of any kind are introduced into the system, especially that which is required for the formation of bone.

Except in the earlier stages of life, as already explained, the chief sustenance of fishes in the sea consists of animal matter, either dead or living. While some kinds of fish are believed never to feed upon anything but living animals, others are, to a very great extent, scavengers, being especially appointed to devour dead or decaying substances, such as offal or the so-called gurry, &c. The cyprinodonts of the coast are particularly active in this direction. Sharks also exercise the same function in a very marked degree. There are probably but few of the bottom fish that will disdain such substances, consuming living forms with the same readiness. In the business of clearing out refuse fish they are assisted largely by crustaceans, certain mollusks, echini, &c.

The living food of fishes may be divided into two sections: first, eggs and embryos; second, fishes and marine invertebrates of more mature and advanced ages.

The earliest form in which the fish serves as food for its fellows in the sea is in that of the egg, and it is for this reason that with the enormous fecundity of certain fish there is so little apparent increase in their schools. It may safely be assumed that only a small fraction of 1 per cent. of the total number of eggs laid by fishes ever develop embryo fish, by far the greater part being devoured in a very short time. The young fish, also, after birth, is for a certain time immature and to a considerable degree helpless and only able to take food for itself after the absorption of its yolk-bag and the accompanying development of its fins. Before it assumes the shape of the perfect fish and is able to care for itself, it becomes a prey to innumerable enemies; and if of the original deposit of eggs one fish becomes able to care for itself by feeding and hiding to every ten thousand eggs hatched, it may be considered a very satisfactory yield. The proportion, however, doubtless varies with the species.

Under the rate of the fecundity of fishes will be found a table of the numbers of eggs laid by particular kinds of fishes, partly copied from Buckland and partly original, from which we understand that even with this percentage of loss there is still a margin left for the maintenance of the species.

Although the percentage of loss after the embryonic development of the fish is complete is less than before, there is still a very great drain upon the numbers of the species, there being at every step an enemy lurking in wait to devour.

To the large fishes of course there comes a time of comparative immunity, when nothing but the rarer and more powerful inhabitants of the sea can interfere. Even then, however, numbers of smaller enemies may combine together for the overthrow of the monsters that would be more than a match singly for any antagonist, and thus while fish of the known voracity of the cod, haddock, &c., may consume readily species of a smaller size, they have as their antagonists the sharks, the various porpoises, and other cetaceans, and the rarer giants among the true fishes, such as the swordfish, the tunny or horse-mackerel, &c., which in turn have their antagonists as already mentioned.

The seals, too, devour the larger fish in great quantities; and in turn they are attacked by the cetaceans, such as the orca, or killer whales, and other kinds especially adapted for their destruction. Again, the whales are also antagonized by the killers and various species of swordfish; and, indeed, possibly with the exception of the sperm whale, there is no animal in the sea but what has its foe. Man, however, presents himself as the enemy and antagonist of all the species, and is provided with means for their capture.

We have already referred to the abundance of vegetable matter in the sea, and to the possibility of supplying it in sufficient quantity to serve as the basis of marine animal life, and the marine zoologist will have no difficulty in understanding how the countless numbers of fish in the ocean obtain their food, in view of the myriads of crustacea, of mollusks, of worms, &c., which inhabit the waters.

It is not the species that remain in or near the bottom that are of the most importance, but the free swimming and floating forms that are most extensively and readily devoured. While at no time does the apparatus of the zoologist fail to reveal the presence of animal life, even though of microscopic dimensions, at times this manifests itself in bodies, the masses of which almost stagger the imagination, the sea for hundreds of miles in extent being an animated mush, what with shrimps and other crustaceans, salpæ, and larvæ of mollusks, worms, &c., a bucketful of water taken indiscriminately over the entire area seems filled with animal life. Nor are these organisms confined to the surface, the evidence of the beam-trawl and the dredge revealing its existence in equal quantities below. Various species of minute crustacea are not unfrequently thrown in masses on the beach, so as to constitute wind-rows of many miles in extent, this of course being but a small percentage of what is left behind. Where these smaller animals are aggregated in unusual numbers are generally to be found great schools of mackerel, herring, whales, and other animals pursuing them, as though certain definite instincts of migration influence them, or they are driven in their season in a definite direction. Schools of fish follow, which are thus brought more nearly to the nets of the fishermen. Indeed, generally the movements of the fish are directed by the instinct of reproduction, in which they aim at finding a suitable locality for the deposit of their spawn, or in search of food, which they either follow or travel to meet.

Among the inhabitants of the deep sea which serve as food for the larger fishes and cetaceans are probably various forms of the cephalopods or cuttle-fish, of which the stomach of the sperm whale frequently contains large masses, proving their occurrence of dimensions far beyond those of which actual critical observation has yet been made. It will, therefore, be readily understood, from what has already been stated, that life in the sea is a perpetual contest, and that the problem of the survival of the fittest is there worked out to its extremest conclusion. As already shown, no form, however powerful, is free from danger of attack, the giant whale or the enormous kraken being equally liable. Of course many of these species when in fullest vigor can protect themselves by superior fleetness or strength, but with increasing years and infirmities they too must succumb. In this we see the wise provision of nature in securing the perfection of animal existence by providing for the reduction in the excessive abundance of certain forms of animal life and in the removal from the sea of such as are not possessed of the highest bodily vigor.

Much outcry is made not unfrequently as to the wastefulness of different modes of fishing, and legislation is invoked to protect fish, on the ground that the stock will become reduced and the business of the fishermen destroyed. When, however, we fully appreciate the enormous fecundity of marine animals and the immense mass of life that exists in the sea, we can readily understand that the destructiveness of what we are inclined to protect as food-fishes constitutes but a small fraction of the whole. Several calculations have been made by various persons in this regard. Thus, Professor Huxley, in considering the question of the destruction by the herring and cod fisheries on the British coast, calculated that the cod and ling alone actually caught in British waters would, if left undisturbed, have destroyed many more herring than the entire catch by the fishermen, who numbered 15,000 in 1872. Nearly a million barrels were cured, to say nothing of the vast numbers used fresh and for other purposes.

In the first volume of the Reports of the United States Fish Commission, I endeavor to estimate the amount of food devoured by a single species, the bluefish, which occurs in such overwhelming numbers on our coast. Here, taking 1,000,000 fish as the annual consumption in the New York market, and assuming the total number of these fish on our coast to be 1,000,000,000, of 5 pounds each, which may be regarded as an exceedingly moderate calculation, we may consider the amount of other fish that this body of marine wolves will consume. Allowing ten fish per day, which is a moderate estimate, the total destruction daily would be 10,000,000,000, which in the one hundred and twenty days of their abode on the eastern coast of the United States would give 1,200,000,000,000 of fish taken in this part of the season alone. It is not at all an extravagant presumption that each bluefish consumes half its own weight of food per diem; and we should therefore have a total destruction of 2,500,000,000 pounds daily, or 300,000,000,000 pounds in the year. The food of the bluefish consists of menhaden, mackerel, herring, scup, and other species.

It will also be remembered that while the bluefish prey upon other fishes of proportionate size, for every one weighing 5 pounds we may estimate at least a hundred of a smaller size. These are equally voracious, destroying other fish in proportion, so that it will somewhat tax the human imagination to appreciate the total destructiveness of animal life, resulting from the action of this one species alone.

Mr. Goode, in discussing the distribution and natural history statistics of the menhaden, attempts to make an estimate of the number of these fish devoured on the coast of New England in the summer months by bluefish and other species, and he comes to the conclusion that these may safely be given at three thousand millions of millions. In comparison with this the 750,000,000 captured by man during the same period sinks into utter insignificance. This calculation might be pursued to any extent; but I have presented enough to show that the question of human agencies in the way of affecting or influencing the great ocean fisheries is scarcely worth considering. I by no means wish to be understood as deprecating any legislation in regard to the fisheries, especially in respect to the spawning-grounds, as interference here, while not unnecessarily diminishing the supply to any appreciable extent, may tend to prevent their coming on particular parts of the coast, and thus within the reach of fishermen of a special neighborhood.

If it were in any way our duty to take measures for the prevention of the destruction of life in the sea, and of maintaining the yield of fish generally at its largest figure, we could accomplish it in no better way than by increasing the extent and magnitude of certain of our fisheries. Thus I have shown that there may be a saving of herring by the capture of the cod and ling on the British coast. For every bluefish captured in the waters of the United States many hundreds of other fish are left to enjoy their life, perhaps, however, in their turn to be the means of an increased destructiveness in another series of animals. The capture of whales gives a respite to the schools of mackerel and menhaden, while the destruction of the herring and menhaden relieves, though in an almost infinitesimal degree, the drain upon the crustaceans and the smaller fish.

Another consideration must not be lost sight of, namely, that the adult and old fish, which constitute an object of pursuit on the part of man, are, in proportion to their numbers, much greater destroyers of other fish and the marine animals generally than the younger. It is a well-established principle in the development of vertebrates that the earlier in life the greater the increase of the body resulting from the same amount of food. Thus the new-born infant of 8 to 12 pounds will double his weight in a few months, and with increasing ratio the rate of growth diminishes until when maturity has been reached, unless under particular conditions of the system, the consumption of several pounds per diem does not produce the slightest appreciable increase, and, indeed, may be attended by an actual reduction in weight. The same principle applies to fishes, although, perhaps, to a less degree, and experiments have been carefully made in regard to trout, the culture of which has been the source of greater care than that of any other fish.

Here, according to some writers, it has been ascertained that, while it may require 1 pound of flesh to increase the weight of a trout from 3 ounces to 6, the addition of the next 3 ounces to the weight requires at least 2 pounds of flesh; for the next 3 ounces, 3 pounds; for the next, 4 pounds, and so on in a constantly increasing ratio. Finally, when the fish has attained the maximum development possible in the given limits of the pond or stream, comparatively little effect is produced by any amount of feeding.

In this point of view, therefore, and in reference to a future supply of food, the capture of all the old and fully matured fish is especially desirable, apart from their own greater commercial value.

Worms, mollusks, &c., feed on the organic mud of the sea bottom, caused by the decomposition of sea-weeds, eel-grass, and land or fresh-water plants carried down. Other animals and fish feed on this. Infusoria eat diatoms; larger forms consume infusoria.

Apart from the consumption of shrimps and other crustaceans the stomachs of mackerel are not unfrequently found to contain small sand-lance and what the fishermen call all-eyes. These are said by them to be the embryors, quite recently hatched, of fishes, in which the body is transparent and the eyes very conspicuous, indeed, almost the only portion visible. In summer, schools of all-eyes are found on our coast, sometimes in immense quantities. Captain Hulbert informs me that in July the stomachs of the mackerel were fou nd loaded with these fish which were seen also on the surface of the water, forming extensive schools. On one occasion he went out seaward from Block Island for 25 miles without getting through the schools, and they were equally abundant to the right and left of him, so thick, indeed, that a dozen at a time could be scooped up in the palm of the hand.

To what species these belong is uncertain, although the fishermen surmise that they are young mackerel. It is, however, quite probable, after all, that they may be the young or zoea-stage of crustaceans.*

Fishermen inform me that they frequently find mackeral apparently feeding on the jelly-fish, their method of attack being from below, coming upward and striking through the center and making a hole in it. It is very common to find the jelly-fish floating on the surface torn to pieces in this way.

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* I have frequently found young mackerel—blinks—several inches in length in the stomachs of mackerel. These are sometimes as large as they are able to swallow. Without doubt they also feed to some extent on the smaller crustaceans. As is well-known, a variety of these forms grow on floating sea-weed, and many fishermen consider it a good sign of mackerel in the vicinity when they see floating eel-grass broken into small fragments. They assert that the cause of the eel-grass being "chopped up" in such a manner is because it is bitten into by mackerel. This is perhaps true, and, if so, is doubtless done by the fish while feeding on the small shell-fish with which the grass or sea-weed is generally covered. I have observed mackerel attacking jelly-fish.

J. W. COLLINS.

Whether they actually find nutriment in the jelly-fish itself, or whether they are in pursuit of young fish or crustacea that so often accompany the medusa, I am unable to say.

The habit of association between the jelly-fish and other species is a very curious one. In Norway the association of young cod and haddock with the *Cyanea arctica* is well known, Professor Sars having called attention to it, and having furnished specimens of fish taken under such circumstances to the National Museum at Washington.

It is a very common thing to find a number of young harvest-fish, dollar-fish, or butter-fish (*Stromateus triacanthus*), swimming near the jelly-fishes, and running under them for protection on the approach of an enemy; indeed, I have seldom found very young butter-fish except in association with the medusa. Young hake are frequently found in a similar association.

G.—REPRODUCTION.

The last division of our topic of the natural history of fishes relates to the subject of their reproduction, and I now proceed to give a brief statement of the more interesting facts of this character. The reproduction of fishes is, for the most part, by means of eggs discharged from the body and hatched externally to it, these eggs when emitted being either adherent to each other and to whatever they touch, or free, floating near the surface of the water, or sinking to the bottom. Not unfrequently the parent covers up the eggs in furrows excavated by a rapid movement of the tail. Occasionally the eggs are discharged in large masses, notably so in the case of the *Lophius*, or fishing-frog, where they are imbedded in a shell of jelly, sometimes 50 feet or more in length and several feet wide. In some instances adhesive eggs are attached to the body of the parent, where they remain until the young are hatched out. At other times they are carried in a pouch under the abdomen, most frequently of the male, as in the pipe-fish (*Syngnathus*); sometimes of the female, as in the *Solenostoma*. Occasionally regular nests are prepared (again generally by the male) usually of vegetable substances, as in the case of the sticklebacks, in which case the eggs are hatched and the young cared for by the male. Numerous other varieties of presentation could be mentioned, but these are sufficient for my present purpose. In not a few instances the eggs are retained in the body of the parent until they are fully developed, although without placental adhesion, except in a modified degree in some of the sharks. In one family, that of the Embiotocoids, of the Pacific coast of California, not more than five to ten or fifteen young are produced at a birth, these sometimes being 3 or 4 inches in length, from a parent of not more than 8 or 10.

Certain species of sharks and sting-rays produce living young, some showing an indication of placental relation to the mother. In all cases of this kind, where the young are hatched out within the body of the mother, the number is extremely small, compared to what is seen in the case of free eggs, and illustrates very well the enormous waste of life. The different species of Embiotocoids are enormously abundant on the California coast, fully equal, if not surpassing, in numbers many kinds the females of which lay hundreds of thousands of eggs at a time. As, however, all the ova developed produce young, which are protected in the belly of the mother to a period far beyond even that at which the young feeds itself, the larger part of the dangers of infancy are guarded against, and a yield of five to twenty young, from each parent, keeps up the supply more efficiently and extensively than sometimes where ten thousand times that number of eggs is discharged.

The eggs themselves, as laid by the parent, are for the most part globular, and vary greatly in size, those of the eel being microscopically minute; of the cod, much larger, though still very diminutive; those of the salmon, on the other hand, being of the magnitude of a pea; eggs of the ocean catfish are of still greater bulk, being sometimes half an inch in diameter. The males of some, if not all, of the marine *Siluridæ*, or catfish, have the curious habit of carrying the eggs either in the mouth or the cavity of the gills until they are hatched, half a dozen to a dozen eggs constituting a laying. One of the largest known eggs, with the exception of those of the Plagiostomi (sharks, skates, &c.), is that of the myxine, or hag, a fish well known in the North Atlantic as a parasite, attacking fishes caught on the hook. Here the shape of the egg is ellipsoidal, much like that of an olive, and the greater diameter sometimes almost three-quarters of an inch in length.

A great variety in shape and size of eggs is found among sharks and skates, these sometimes having a horny shell, and looking as much like dried sea-weed as anything else. The egg of the cestracion shark, of the Pacific Ocean, resembles a bit of sea-weed, twisted up into a spiral shape. That of certain skates is familiar to most visitors to the seashore from its resemblance to a brown pillow-case, with the four corners extended into tendrils. These cases are from 2 to 10 inches in length, according to the species. By means of the tendrils they can be attached to sea-weeds and other objects at the bottom of the ocean, and held there until the young are hatched out and escape through the open end of the bag. Many varieties of form of egg-cases exist among the skates, and furnish excellent specific characters.

In further reference to the number of eggs laid by fish I present herewith a table giving some computations, both original and selected, which will serve to illustrate better the variety in this respect:

Species.	Number of eggs.	Weight of fish.	Weight of roe.	Authority.
		Pounds.	*Pounds.*	
Cod	6, 867, 000		7¾	Buckland, British Fishes.
Do	3, 400, 000			Bertram, Harvest of the Sea, 1873, p. 4.
Turbot	14, 311, 200	23	5. 93	Buckland.
Flounder	1, 250, 000			Bertram, Harvest of the Sea, 1873, p. 4.
Sole	1, 000, 000			Do.
Mackerel	500, 000			Do.
Herring	35, 000			Do.
Perch	155, 620	3⅛		Buckland
Lumpfish	194, 112	11	1¼	Do.
Smelt	36, 000			Bertram, Harvest of the Sea, 1873, p. 4.
Carp	2, 059, 750	16½	5¼	Buckland's Familiar History of British Fishes.
Goosefish	1, 050, 100	50		G. B. Goode.
Do	2, 592, 000	60		S. F. Baird.

As especial attention has been given by the U. S. Fish Commission to the numbers of eggs laid by the various species of sea-fishes and their average magnitude, I will not here pursue the subject further, but merely insert some original measurements by the Commission of eggs of the herring, cod, and mackerel, showing their average size.

Kinds of fish.	Eggs.	Measurements.	Average.
		Inches.	*Inches.*
Herring (*Clupea vulgaris*)	29	1. 09	. 0372
	41	1. 56	. 0380
	63	2. 31	. 0366
Cod (*Gadus morrhua*)	43	1. 43	. 0332
	46	1. 40	. 0304
	62	1. 79	. 0289
Mackerel (*Scomber scombrus*)	39	0. 98	. 0251
	29	0. 72	. 0248
	77	1. 93	. 0251

The places of deposit of eggs by fish have already been referred to to some extent under the head of migrations and movements of fish as affected by the reproductive instinct. I shall therefore make only a brief recapitulation of some of the primary divisions.

The anadromous fish, as already explained, are those that run up from the ocean into the rivers and sometimes lakes in which to deposit their eggs, returning after a short time, and followed by the young after a period sometimes of months and sometimes of one or two years.

The catadromous fish, of which the eel is the only known instance, are those the eggs of which are laid in the sea, the young passing up the rivers and remaining in the fresh waters during the period of immature existence, after which they return to the ocean and probably never again leave it; others, coming from the depths of the ocean, come to the shore to spawn in the summer season, and sometimes even in the depth of winter; others, again, discharge their eggs freely in the sea wherever they happen to be, these eggs, as already explained, floating or sinking to the bottom and being adherent or non-adherent.*

* Prof. Alexander Agassiz has paid special attention to the character and place of deposit of the spawn of fishes of the Atlantic coast, and has furnished me with the

In the investigations before the British Fishery Commission as to the injurious effects of the beam trawl-net, much stress was laid upon its destructiveness to the spawn of fish, notably that of the cod, mackerel, plaice, turbot, and other species. Ample evidence, however, was adduced, both within the knowledge of Professor Huxley and from reliable investigations by Sars and others, that the ova of most of the important sea fishes are discharged in the open sea and float in it until the young fish escapes from the shell. Sars found this to be the case when visiting the Lofoden Islands for the purpose of this investigation, a conclusion absolutely contrary to his previous opinions. Nothing struck him with greater astonishment than the immense number of eggs, either containing embryos or emptied of them, which were to be met with in every direction, these being thickly scattered in the waters over many square miles.

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following list of what he calls pelagic spawners, or those the eggs of which are found floating freely in the sea:

The common Sea Perch.	The Mackerel.
The Tautog.	The Striped Bass.
Five or six species of Flounders.	One species of *Cottus*.
The Silverside or *Atherina*.	The Goosefish or *Lophius*.
The Butterfish.	The Cod.
The Menhaden.	The Hake or *Phycis*.

Most of these were observed by him in the vicinity of Nantucket and a few at Newport. The time of the spawning of these fish, as noted by him, was as follows:

The Flounders, from June to early September.

The Perch and Tautog, the last of June and early in July.

The Cod, in August.

The Hake (*Phycis*), from June to September; the young of all stages swimming on the surface.

The Sea Bass, recently hatched young seen from July to September.

Menhaden, August and September.

Atherina, June and July.

Cottus, July to September.

Butterfish, July to September.

Lophius, June and early July.

The eggs of these several species vary in size from the .06 to the .03 of an inch in diameter. He finds the young are easily identified by the pigment cells, the oil bubbles in the egg, the position of the yolk-bag, the extent of the development of the eyes, and the character of the fins. The only sea fishes whose eggs he knows are deposited on the ground are the *Batrachus tau*, or Toadfish, and some of the Cottoids.

As the result of his extended inquiries on the subject, as secretary of the British commission, Holdsworthy thinks that the herring comes shoreward to spawn, but that the eggs may be emitted at a considerable distance from the coast. The eggs are discharged near the bottom and cover the gravel or sea-weed with a kind of cake, which is then immediately milted by the male.

According to observers on our own coast, herring, when spawning, are sometimes in pairs; at others, a large number of both sexes appear to join together, the females discharging their eggs almost simultaneously and the males their milt, in such quantity as to whiten the water.

The Pilchard, a clupeoid fish, second in importance in England according to Holdsworthy, certainly spawns in deep water, and then both the adults and the young approach the shore.

Mackerel.—The mackerel, too, he found to have the same characteristic, the eggs of both species being found far out at sea. In both cases the egg was provided with a small globule of oil, apparently for the express purpose of facilitating its suspension in the water, and which was contained in the abdominal sack of the young fish in hatching, and constituted a large part of its embryonic nutriment.

Plaice.—The eggs of the plaice, too, one of the principal flat-fish of Europe, were found floating freely in the sea, and the inference was drawn that most of the flat-fish family, including the turbot, sole, &c., possessed the same characteristics. An analogy in the habits and physiological condition of other species of the cod family, such as the haddock, the pollock, and the hake, also induced Sars to include them in the same category.

As a general rule, the eggs of fish that float freely in the sea are single, and belong to the so-called dry eggs, or lack the glutinous envelope which is found in the case of the herring and some less important fish, which causes them to adhere to each other in masses and to any other object with which they may come in contact. The herring is almost the only sea fish of economical importance that exhibits the last mentioned characteristic. (Deep Sea Fishing, p. 42.)

Many forms of animal life, including fishes of the various *Antennarius*, *Chironectes*, &c., live habitually in mid-ocean, especially among the masses of floating sea-weeds, of which some species actually make nests in which their eggs are introduced.

The rate of growth of the young fish varies with the group. In *Crystallagobius*, according to Collett, and perhaps in other forms, the capacity of reproduction is developed in a year's time. For the most part, however, it is thought that the ordinary fishes require a period of three or four years before they are able to propagate their kind. It is likely that the sharks require a still greater allowance, although nothing definite is known on this subject.

The actual rate of growth of the individual varies with the species, and probably to a certain extent with the individual, and the average at maturity varies very much with different so-called schools. Thus among the codfish, a school of mature fish coming in to the coast of New Jersey and elsewhere on the south side of New England, may average not more than 5 to 10 pounds, while another school, which visits Cape Ann for the same purpose, averages a much greater weight, individuals of even 100 pounds not being extremely rare. The same difference in the size of cod occurs elsewhere, as also in that of other kinds of fish. What causes this difference it is, of course, impossible to say.

Many fishes experience curious changes of shape and color during the breeding season. These alterations are very much marked in the salmon, the male of which develops a lengthened, hooked jaw, in which formidable teeth make their appearance. A common alteration consists in the development of a hump in the nape of the neck or in the back of the male, as in the sea bass.

A change of color is also a very common feature, the male generally assuming brilliant tints during the brief season which are not appreciable at other times.

It is difficult to say how long fish can maintain their ability of propagation or reproduction, some forms, in all probability, being more persistent in this respect than others.

In conclusion, a volume could readily be written in regard to the peculiarities of habit, condition, and relationship of fishes, but as the present essay is intended more particularly as an illustration of the fisheries of the North Atlantic, I shall now bring this portion of my subject to a conclusion, and proceed to a more important division, that of the methods, processes, and results of the fisheries themselves.

II.—METHODS OF CAPTURE.

A.—THE FISHING GROUNDS.

In the Western Atlantic there is a remarkable chain of submarine elevations situated between the Gulf Stream and the east coast of North America, and extending from the vicinity of Cape Cod to a point far east of Newfoundland, a distance of more than 1,100 miles. Many of these elevations are of large extent, and, together with others of a similar character but comparatively smaller size that are nearer the land, lying inside of the main range, they constitute what are known as the "banks" or the great fishing-grounds for cod (that is, the various species of the *Gadidæ*, of which the cod, *Gadus morrhua*, is by far the most abundant) and halibut.

For the better understanding of the relative position of the banks, their importance, &c., the description will begin with the southwestern grounds and proceed to the north and east.

GEORGE'S BANK.

George's Bank is by far the largest and most important fishing-ground near the coast of the United States, and is second to none in the Western Atlantic except the Grand Bank of Newfoundland. It lies to the eastward of Cape Cod and Nantucket Shoals, and is seemingly an extension of the latter, since the water is no deeper between the southern part of the shoals and the western part of the bank than in many places on it. As laid down on the charts the southern limit is in 40° 40′ N. latitude, although 10 miles south of that the depth of water does not exceed 41 fathoms, and therefore the southern boundary may be placed at 40° 30′ and the northern at 42° 05′ N. latitude. The eastern part is in 66° 27′ and the western in 69° 00′ W. longitude, making the greatest length about 130 miles from the northeast to the southwest extremity, and the greatest width 95 miles north and south. The depth is from 2 to 50 fathoms. On the western part, between the parallels of 41° 10′ and 41° 53′ N. latitude, and the meridians of 67° 20′ and 68° 37′ W. longitude, are a number of shoals known as the East Shoal, the North Shoal, the Southwest Shoal, Cultivator Shoal, &c. The Southwest Shoal is the largest, being 15 miles in length. There is from 2 to 15 fathoms of water on these shoals and between them from 12 to 30 fathoms. The tides sweep over these with great force, causing strong rips, and during rough weather the sea breaks heavily on them, rendering approach to their vicinity extremely hazardous. The bottom is chiefly sand, although patches of rough ground, gravel, pebbles, and rocks, of more or less extent, are found on some parts of it.

Its situation between the Bay of Fundy and the Gulf Stream causes the tides to run swifter than on the other banks, and to swirl around instead of going directly back and forth in opposite directions. They run around the compass, from left to right, attaining the greatest strength when at SE. and NW., and the least in a southwest and northeast direction. The first attempt at fishing on this bank of which there is any record was made in 1821 by three Gloucester vessels. But the George's cod and halibut fishery is of later date, as it did not become fully established as a permanent business enterprise until about 1835, although vessels went there for halibut in 1830. At first the catch was mostly halibut, but since 1850 it has been chiefly codfish, although more or less halibut are taken with them. During the months of February, March, and April large schools of cod make their appearance on the bank. They are generally found on the "winter fishing-ground," a part of the bank lying to the eastward of the shoals, between 41° 30′ and 42° 00′ N. latitude and 66° 38′ to 67° 30′ W. longitude. This is essentially a spawning ground for the cod, which appear to come on the bank from the southeast, as they almost invariably, after reaching the ground, move slowly to the north and west as spring approaches. This is in the direction of the shoals, and, as the pursuit of the fish brings the vessels near the latter, great loss of life and property sometimes occur in heavy easterly gales and storms. As soon as the spawning season is over the schools of cod break up, but more or less fish are caught on different parts of the bank during the entire year, though rarely, if ever, are they found so plenty as when the winter school is on.

The codfish fleet, which numbers about one hundred sail, is wholly from Gloucester, Mass. Besides these there are twenty-five to thirty vessels from the same port that fish on George's for haddock in the winter, and a few others from New London, Conn., and other ports on Long Island Sound engage in the cod and halibut fishery in spring and summer.

BROWN'S BANK.

Brown's Bank lies in a northeasterly direction from George's Bank, being separated from the latter by a gully. This bank is imperfectly laid down on the charts, which therefore fail to give an adequate idea of its extent and importance as a fishing-ground. Its greatest length east and west is 53 miles, from 65° 10′ to 66° 23′ W. longitude, the greatest breadth 47 miles, from 42° 15′ to 43° 02′ N. latitude, and the depth varies from 20 to 55 fathoms. There is a small shoal on the northern part, the location of which has not been definitely determined, where it is said there is not more than 9 to 15 fathoms. The bank slopes gradually from the shoal in a southerly direction, but falls off steep on the northern side. The bottom is mostly composed of gravel, pebbles, and rocks, the latter predominating near the shoal.

The tides are nearly as strong here as on George's Bank, but run more directly to and from the Bay of Fundy, the northeast and southwest set being generally much weaker than on the latter bank.

Cod, halibut, and haddock are the principal fish taken, although cusk, pollock, and hake are found more or less. Cod are quite plenty in the winter and some good fares are obtained, although but comparatively few vessels fish there at that season, most of them being in the George's fleet. At other seasons, however, the fishing on Brown's Bank compares favorably with that on any of the banks in the vicinity, and quite a number of the so-called Georgesmen are engaged in fishing there. The cod is found the year around. Halibut were formerly found very plenty, but at present occur in much less numbers. Sometimes the haddock fishermen make a trip to this bank during the winter and good catches are occasionally obtained.

JEFFREY'S LEDGE.

This may perhaps be considered one of the best shore fishing-grounds in the Gulf of Maine, although it is comparatively small. It is seemingly an extension of the shoal ground that makes off in a northeasterly direction from Cape Ann. It is about 20 miles long NE. and SW. and from 2 to 4 miles wide. Its southern limit is 42° 54′, and northern 43° 11′ N. latitude, and the eastern and western boundaries may be placed at 69° 58′ and 70° 18′ W. longitude. The bottom is rocky on the shoalest parts, with gravel and pebbles along the edges. The depth of water is from 27 to 35 fathoms on the bank, falling off to 40 and 50 fathoms on the borders. Usually there is little or no tide, though occasionally there is some current setting to the SW. Cod, cusk, and haddock are taken in the fall, winter, spring, and early summer, with more or less hake or pollock mixed with them. For a number of years Jeffrey's Ledge was a favorite winter fishing-ground for haddock, which were very abundant, and even at the present time many vessels resort there in pursuit of haddock; but since the haddock fishermen have extended their cruises to the outer banks, a less number, of course, go to Jeffrey's. Besides the haddock catchers, the vessels engaged in the shore fisheries resort to this ground in the spring and fall.

CASHE'S LEDGE.

This is not a very important fishing-ground at present except for a brief season in the spring, although it is resorted to somewhat by the shore fishermen in summer and fall, and sometimes good trips are obtained. It bears east from Cape Ann, from which the shoals are 76 miles distant. The bank is about 22 miles long, from 42° 49′ to 43° 11′ N. latitude, and about 17 miles wide, from 68° 40′ to 69° 3′ W. longitude. There are three small shoals on the western part of the ground. The southern one has 7 fathoms, the middle one 4 fathoms and the northern one 11 fathoms of water. The position of the middle shoal is 42° 56′ N. latitude and 68° 52′ W. longitude. From this the south shoal bears S. by E. and the north shoal NNE., each being 3½ miles distant from it. These break in rough weather, and, though of small extent, are dangerous to passing vessels, especially as they are almost directly in the track of vessels bound to and from Cape Sable to Massachusetts Bay. With the exception of the shoals the depth of water ranges from 15 to 60 fathoms. The ground is more or less broken, with bottom of sand, pebbles, and rocks. The greater part of the fish caught here are cod, hake, and cusk. Halibut are rarely seen, and haddock and pollock are less plenty than the other kinds. Good trips are often secured on the edge of the ground in May and June, but the dogfish, which appear about the last of June or in July, usually drive everything before them and for a time stop the fishing. The class of vessels fishing on Cashe's range from 15 to 45 tons, and are what are known as shore-trawlers.

JEFFREY'S BANK.

This bank, which lies east of Cashe's Ledge, is of comparative little importance as a fishing-ground. It is about 20 miles long SW. and NE., and 10 miles wide, the northern and southern limits being 43° 15′ and 43° 30′ N. latitude. The eastern edge is in 68° 25′ and the western in 68° 46′ W. longitude. The bottom, which is somewhat broken, is composed of mud, sand, gravel, and pebbles, with a depth varying from 35 to 70 fathoms. Cod, haddock, hake, and cusk are the fish most plentiful; some pollock are caught, but halibut are rarely taken. The best season is in late spring and early summer, before the dogfish schools strike, after which but few fish can be obtained. This bank is resorted to by the smaller-sized vessels of from 15 to 50 tons.

GERMAN BANK.

Although this bank is not usually laid down on the charts it is one of the most important in the Bay of Fundy. It bears SE. from Baker's Island light (Mount Desert), from which the northwest part is about 52 miles distant. The length is about 15 miles and the width 9 to 10 miles. It lies between 43° 38′ and 43° 53′ N. latitude, and 66° 58′ to 67° 15′ W. longitude. There is from 65 to 100 fathoms of water. The bottom is mostly a tough red clay, but with spots of mud, sand, gravel, and pebbles on some parts. The tide sets out and in the Bay of Fundy about SW. and NE., but is not so strong as might be expected. Cod, hake, cusk, and haddock are the fish which are chiefly taken, but a few halibut and pollock are occasionally caught. The fishing season is from April to October, although fish are usually the most abundant in the spring. This bank is resorted to chiefly by vessels from the coast of Maine, but is sometimes visited by the Massachusetts fishermen.

MARBLEHEAD BANK.

This fishing-ground, which is quite an important one for the shore cod-fishermen, is not laid down on the charts. Therefore the fishermen who visit it are probably the only persons familiar with its location, or who are able to estimate its extent. The ground which they call Marblehead Bank is situated between Grand Manan and German Banks, the shoal water bearing SSE. from Mooseabec light, a distance of 32 miles. It is about 12 to 15 miles long and 7 or 8 miles wide, and lies between 44° 00′ and 44° 10′ N. latitude and 66° 58′ to 67° 13′ W. longitude. There is from 35 to 70 fathoms of water, and the bottom is mostly clay and gravel. The fish that occur in the greatest numbers are cod, pollock, and haddock, but with these are more or less hake and cusk. The best fishing is generally in the spring and early summer. The same class of vessels—shore fishermen—as frequent Grand Manan and German Banks also resort to this, but occasionally those of a larger size make one or more trips during the summer season.

GRAND MANAN BANK.

Grand Manan Bank lies at the entrance of the Bay of Fundy, and bears SW. ½ S. from the southwest head of Grand Manan Island, from which the northern part of the bank is 15 miles distant. It is 10 miles long and 5 miles wide, and lies in a SW. and NE. direction. The bottom is mostly stones and gravel, and the depth of water varies from 24 to 45 fathoms. The tides are quite strong, but not enough so to prevent trawling. Cod and pollock are the principal fish, cusk, hake, haddock, and halibut being less plenty. The fishing season is from April to October, when the fish come on the bank to feed. In the spring the fish are usually the most plentiful on the southwest part, but later in the season the best fishing is generally obtained on the other end of the ground. It is a favorite fishing-ground for the class of small vessels commonly known as shore-fishermen.

SEAL ISLAND GROUND.

Off the western part of Nova Scotia there is an important fishing locality known to the fishermen as the "Seal Island Ground," although no name is given on the charts. This may not, perhaps, be called a bank, as it is shore soundings, which slope gradually from the land to the south and west, but continue in a northerly direction beyond what may properly be considered the limit of the ground. To the south it extends nearly to Brown's Bank, from which it is separated by a narrow gully; to the west 38 miles from Seal Island, the western land of Nova Scotia; and to the northwest about 35 miles. The southern limit is in 43° 00′, and the northern in 43° 45′ N. latitude, while the western boundary may be placed at 66° 40′ W. longitude.

There is a small shoal, the Pollock Rip, with a depth of 7 fathoms, which bears SW. from Seal Island, from which it is distant 9½ miles, but with this exception, the ground slopes quite gradually, the depth varying from 15 to 70 fathoms. The bottom is principally composed of coarse gravel and pebbles, with occasional rocky spots of more or less extent. The tides sweep out and in the Bay of Fundy with considerable force, the course changing with the direction of the land, so that while they run nearly north and south on the northern part of the ground, they swing around to northwest and southeast to the southward of Seal Island. The flood is much stronger than the ebb, and the fishermen estimate that one flood will carry a vessel nearly as far in a northerly direction as two ebbs will in the opposite way.

The fish that are principally caught on this ground are cod, haddock, and pollock, although halibut, cusk, and hake are taken to a limited extent, and occasionally herring or mackerel are netted for bait. Cod are generally more plentiful from spring to fall than during the winter, but haddock and halibut are found all the year. Fishing usually begins in April or May, and continues until October. Halibut were formerly very abundant, but are now comparatively scarce.

This ground may be considered essentially a feeding-ground for the cod, which come here after the spawning season is over to fatten upon the crabs and mollusks on the bottom and the herring and other species of small fish that are swept back and forth in the tide-rips. All parts of the Seal Island ground are fished on at the same time. This was formerly a favorite fishing-ground for vessels from the coast of Maine, but since trawling has come to be so universally adopted but few American vessels except "hand-liners" go there. The fleet engaged in fishing there now is principally composed of vessels belonging to the western part of Nova Scotia, which generally "fish at a drift," going back and forth over the ground with the wind and currents.

ROSEWAY BANK.

Roseway Bank lies in a northerly direction from Le Have Bank and SE. from Shelburne light. It is oblong in shape and of small extent, the greatest length being only 19 miles, and breadth 12 miles. The limits are 43° 13′ and 43° 32′ N. latitude, and 64° 30′ to 64° 38′ W. longitude. The bottom is sand, gravel, and rocks, and there is a depth of from 33 to 48 fathoms. The current here is not nearly so strong as in the vicinity of Cape Sable, or Brown's Bank. The general set is about WSW. and ENE., the westerly current usually being much the strongest, although both the force and direction is somewhat influenced by the winds.

The principal fish are cod, haddock, and cusk, but hake, pollock, and halibut are occasionally taken. The season is usually from May to October, during which time fishing is carried on principally by small-sized vessels from the western part of Nova Scotia, although a few American vessels occasionally go there. To the northwest of Roseway, and between it and the land, is "Cape Negro Mud," a good ground for cod at certain seasons. It is of small extent, with muddy bottom, and a depth varying from 60 to 80 fathoms.

LE HAVE BANK.

Le Have Bank is situated to the eastward of Brown's and south and east of Roseway Banks. It extends from 42° 53′ to 43° 24′ N. latitude, a distance of 31 miles, and from 63° 50′ to 64° 47′ W. longitude, a distance of 41 miles. Much of this westerly extension is a long narrow prong that makes out from the main body of the bank. The bottom is largely composed of coarse gravel, pebbles, and rocks, with only here and there small spots of sand. The depth of water is from 40 to 50 fathoms. The general set of the current is mostly to the westward, but this, however, is influenced very much by the direction and strength of the winds. The fish that are chiefly taken on this bank are cod and haddock, although the other species of bottom fish are found more or less plentiful. Cod are found at all seasons of the year, but are more abundant during the early winter than at any other time, and good trips are frequently obtained by the Gloucester vessels, which are the only ones that go there at that season. The Gloucester winter haddock-catchers, who carry these fish fresh to Boston market, have extended their trips from George's and Brown's Banks to Le Have, and during the present winter (1880–'81) have made some remarkably good catches.

LE HAVE RIDGES.

The fishing-ground known as Le Have Ridges is simply a continuation of Le Have Bank to the eastward in the direction of the Western Bank, a distance of about 45 miles. This makes the eastern limit in 62° 50′ W. longitude, while the northern and southern boundaries are about the same as those of Le Have Bank. The bottom is a succession of ridges of gravel and pebbles, with occasional patches of rocks, and the depth varies from 55 to 85 fathoms. The current is weaker here than farther west on the bank, and, excepting with easterly winds, is but little noticed. The general set is westerly. The "Ridges" were for a number of years one of the favorite places of resort for the halibut catchers in the winter, and many good trips of cod have also been taken at that season. At present but few halibut are caught, except in the deep water along the southern edge of this ground, where sometimes they have been found quite plenty for nearly the entire year. Hake are also found in large numbers in the deep water about the borders of the ground, and even on the ridges. As a general thing but few vessels besides those from Gloucester have made a practice of fishing on Le Have Ridges, though a few cod fishermen from other places stop there now and then during the summer.

SAMBRO BANK.

This bank lies in a westerly direction from the Western Bank, but is so small that it is of little importance as a fishing-ground and is but little resorted to by American vessels. It lies between 43° 36′ and 43° 47′ N. latitude and 65° 40′ to 63° 00′ W. longitude, the greatest length being 15 miles and width 11 miles. There is from 50 to 60 fathoms of water, and the bottom is mostly sand, gravel, and pebbles.

WESTERN BANK.

The Western Bank is one of the most important fishing-grounds in the Western Atlantic, considered either as to size or the amount of fish taken on it. Lying off the eastern coast of Nova Scotia, it has Le Have Ridges on the west, and Bankquereau on the east, from both of which it is separated by gullies. The general direction of the bank is WSW. and ENE.; the eastern limit is 59° 07′, and the western 62° 27′ W. longitude, making the extreme length 193 miles. The southern limit is in 42° 51′, and the northern in 44° 46′ N. latitude, the extreme width, therefore, being 95 miles.

On the eastern part of the bank is Sable Island. This is about 20 miles long and 1½ miles wide, and composed wholly of sand, which for nearly the entire length is in hummocks, caused probably by the action of the wind. Off either end of the island are long and dangerous sand-bars. The general direction of the island and bars is east and west, although they take the form of a crescent with the concave side on the north. The depth on the bars for a distance of from 7 to 10 miles from the island does not exceed 2 fathoms, and even 10 miles farther out in an easterly and westerly direction there is not more than 10 or 11 fathoms. On the middle ground—a portion of the Western Bank which lies in a northerly direction from Sable Island about 25 miles distant—there are several shoal spots with from 10 to 19 fathoms on them.

As a general rule the bank slopes gradually from the island to the south and west, the depth ranging from 18 to 60 fathoms. The general character of the bottom is sandy, but there are patches of gravel and pebbles. The currents in the vicinity of Sable Island are occasionally quite strong, and generally irregular, being very much influenced by the winds. On the greater part of the bank there is usually but little current. The set of what there is, however, is mostly in a westerly direction. Cod and halibut are the principal fish taken, though the other species of bottom fish are found in limited quantity. The former are generally the most abundant in the spring, from the first of March to June, although good fares are obtained throughout almost the entire year. For more than twenty-five years the Western Bank has been a favorite resort of the halibut fishermen. At first these fish were found very plenty in from 45 to 60 fathoms, and since 1876 have been caught in great numbers along the edge on the south and east sides in from 100 to 300 fathoms. Like the cod, they are found during the entire year, the period of greatest abundance, however, being from the first of January to the first of October. The Western Bank may be considered both as a feeding and spawning ground for the cod and halibut. It abounds with shell-fish and crustaceans, as well as with several species of small fish upon which the cod and halibut prey. Although the cod do not gather in such great schools in winter as they do on George's Bank, it is nevertheless quite evident that they assemble at that season for the purpose of reproduction. Usually they are found the most plentiful on the western part of the bank in winter and early spring, but as the season advances they move into shoaler water in the vicinity of Sable Island, the "bend" of the island and about the bars being favorite grounds during the late spring and early summer. Vessels from all along the New England coast and from the British Provinces resort to this bank to pursue the cod fishery, but fishing for halibut is almost exclusively carried on by the Gloucester fleet.

THE GULLY.

Although the "Gully" cannot be called a bank, being just what its name suggests, a deep gully between two banks, it is nevertheless too important as a halibut fishing-ground to be omitted from a general description of the fishing banks. This lies between Bankquereau and the Western Bank, being bound on the north and east by the former, and on the south and west by the latter. The entire length of the gully is more than 60 miles, but the halibut ground is of less extent, and the limits, east and west, may be placed at the 59th and 60th meridians of west longitude. It is about 18 miles wide, on the eastern part, from 44° 08′ to 44° 26′ N. latitude, but narrower farther west. There are several ridges with rocky and gravelly bottom and a depth of 75 to 125 fathoms, on which the halibut are usually caught. On either side of these ridges the bottom is generally sand or mud, excepting in the eastern section, where it is composed mostly of pebbles and sharp rocks.

The current generally sets in a westerly direction, but is very irregular in strength; an easterly wind often causes it to increase very perceptibly, while at other times there may be but little or no tide. When the halibut fishing first began on this ground it was carried on chiefly in the spring on the northern and western part, but in the spring of 1877 the fishermen made trials farther out, in deeper water, and excellent fares were obtained as late as June and July. Since that time good fares have been taken during the winter season, and it appears that halibut come to this place especially to feed, as they generally move to other localities just previous to the spawning season. With a few exceptions the Gloucester halibut vessels are the only ones fishing on this ground.

BANKQUEREAU.

This may be considered among the most important of the fishing banks lying between the 40th and 48th parallels of latitude. It lies in an easterly and northerly direction from the Western Bank, being separated from the latter by the "Gully." The former bank is long and comparatively narrow, and lies in an east and west direction. The extreme length is 118 miles, from 57° 20′ to 60° 04′ W. longitude. The southern limit is 44° 05′ and the northern 45° 01′, a difference of 56 miles, but the widest place, the eastern part, does not exceed 46 miles.

There is a shoal ground called the "Rocky Bottom," on the eastern part of the bank, which has a depth of 16 fathoms, while elsewhere there is from 18 to 50 fathoms. The Rocky Bottom is much frequented by the hand-line dory fishermen during the summer, and sometimes several hundred dories are fishing there very close together.

The bottom is generally rocky, but there are patches of sand and gravel on some parts of the bank. The current from the Gulf of Saint Lawrence and the polar current meet here, but, though this causes considerable irregularity, the latter is usually the strongest, and the set is therefore chiefly in a westerly direction. The force is much influenced by the wind, so that there may be quite a strong tide for several days together and then but little or none.

But few kinds of fish, with the exception of cod and halibut, are taken on Bankquereau; hake, haddock, and cusk being comparatively rare. Halibut are found throughout the entire year in the deep water along the edges of the bank, where, at a depth of from 100 to 400 fathoms, large numbers of them are often taken. These are apparently both feeding and breeding grounds for the halibut, and it is not unusual for a school of them to remain several weeks or even months in one locality, although it is probable that some of the schools that "strike" on the eastern part of the bank in the spring are migrating farther north. The best season for cod is from May to November, when the schools gather on the bank to feed on the lant, squid, crustacea, and shell-fish that usually occur in great abundance. As a general thing cod are found the most plentiful on the eastern part of the bank, although good catches are frequently obtained farther west. French, British, Provincial, and American fishing vessels resort to this bank for cod in summer, and the American (Gloucester) fresh halibut fleet visit it at all seasons.

CANSO BANK.

This bank lies to the south and east of Cape Canso, from which it derives its name; it is unimportant as a vessel fishing-ground, and is too distant from the land to be much resorted to by small boats. It lies between 45° 00′ and 45° 16′ N. latitude and 59° 58′ to 60° 42′ W. longitude; the greatest length, in an east and west direction, being 30 miles, and the width 16 miles. There is a depth of from 30 to 56 fathoms, and the general character of the bottom is sandy, with spots of gravel or pebbles.

MISAINE BANK.

Although Misaine Bank is quite large, it is but little resorted to by fishermen, and therefore it may be said that as a fishing-ground it is unimportant. This fact seems quite remarkable, since it is not more than 30 miles distant in a northerly direction from Bankquereau, which is a good ground for cod and halibut. The extreme length is 61 miles, in an easterly and westerly direction, the limit being 58° 08′ and 59° 28′ W. longitude. The width is 41 miles, from 44° 59′ to 45° 40′ N. latitude. The depth of water varies from 40 to 60 fathoms, and the bottom is generally broken and rocky. But little can be said concerning the abundance of fish on this bank, since it is so rarely visited by fishing vessels that no reliable information can be obtained concerning this matter. The natural inference is, however, that the bank has been fished on more or less, and though cod and other bottom fish are found they are not so plentiful as on other banks.

ARTIMON BANK.

Artimon Bank lies north from the eastern part of Bankquereau, being separated from it by a narrow gully. It is of such limited extent that, compared with the latter, it is of but little importance as a fishing-ground. The fishermen generally prefer to try on the larger bank, and therefore but comparatively little is known about the abundance of fish on Artimon Bank, although it is known that the same kinds may be taken on one as on the other. It is 17 miles long and 10 miles wide, with a depth of 37 to 50 fathoms, and bottom of coarse gravel and rocks.

SAINT PIERRE BANK.

Until quite recently the bank of Saint Pierre was considered a very important fishing-ground for both cod and halibut, and was much resorted to by American as well as French and British provincial fishermen. At present, however, fish are much less abundant than formerly, and it can scarcely be placed in the front rank of fishing banks. It is situated to the northwest of Grand Bank and Green Bank, and off the south coast of Newfoundland, the northern part being only 11 to 15 miles distant from the French islands of Miquelon and Saint Pierre. It is oblong in form, and extends in a northwest and southeast direction. The length is 110 miles, and width 60 miles, and it lies between the parallels of 45° 15′ and 46° 45′ N. latitude, and the meridians of 55° 21′ and 56° 21′ W. longitude. There is from 22 to 50 fathoms of water. The bottom is generally rocks and pebbles, covered with a growth of reddish-colored bryozoans, but on some parts there are places of considerable extent where it is composed of sand or gravel. Ordinarily there is not much current on this bank, although sometimes, when driven by strong winds, the polar current, which sweeps around the south coast of Newfoundland, is quite strong. Cod and halibut are the only food-fish that are found in any numbers, although a few cusk and haddock are sometimes taken. The season for both cod and halibut is from the 1st of April to November. The best season for cod is from the 1st of June to October, when they come here in pursuit of capelin and squid. Halibut were formerly taken on the shoal parts of this ground during the spring and summer, but at present are rarely found in any abundance except in the deep water along the edge, or on rocky spots, a distance of 15 to 20 miles from the bank, where there are no soundings laid down on the charts. Some of the schools of halibut find their breeding grounds on these rocky patches, but the greater part pass along the edge in the spring on their way to the north. With the exception of the fresh halibut catchers, few fishermen besides the French make an attempt to fish on Saint Pierre, as the other banks offer much greater inducement.

GREEN BANK.

Green Bank is one of the least important of its size in the Western Atlantic, if only that part laid down on the charts as such is considered. But it may be said, however, that one of the best halibut grounds is in the deep waters near its southern part, and as this is also called Green Bank by the fishermen, it may not be out of place to consider it in this connection. This bank is situated between Grand and Saint Pierre Banks, being 7 miles distant from the former and 13 miles from the latter. The extreme length is 54 miles north and south, between 45° 15′ and 46° 09′ N. latitude, and it is 33 miles wide, the meridians of 54° 17′ and 55° 03′ W. longitude bounding it on the east and west.

The depth varies from 40 to 60 fathoms, and the bottom is composed of sand, shells, pebbles, rocks, and corals. The general direction of the polar current, which sets over this bank, is usually from northwest to southwest, its course, as well as force, being more or less influenced by the wind. But little is known of the abundance of the cod here, as the fishermen prefer to go to grounds that are better understood than to stop on this.

Since 1875 halibut have generally been found very abundant in the winter and spring and sometimes, even during the summer, in from 75 to 300 fathoms, along the edge of the ground between the Grand and

Saint Pierre Banks, which is near the southern part of Green Bank. This locality appears to be a feeding-ground in winter, and during the spring is in the direct line of the route followed by the halibut that are migrating from the Grand Bank to other places farther north, and at this season it is not uncommon for immense schools to make their appearance, moving leisurely along the edge, perhaps in some cases only a very little for several days at a time, and again more rapidly. The only vessels fishing for halibut at this place are from Gloucester, Mass.

GRAND BANK.

Considered either as to area or with regard to the extent of its fisheries, the Grand Bank is by far the most important fishing-ground in the Western Atlantic, if not in the world. It lies south and east from Newfoundland, is triangular in form, with sides nearly equal, one of them facing the east, one the south and west, and the other to the north and west. The north and east sides are each about 264 miles in length, and the other is 225 miles from the southern to the northwestern limit. It extends over more than four degrees of latitude, from 42° 57′ to 47° 02′ N., and nearly six degrees of longitude, from 48° 22′ to 54° 16′ W.

The most remarkable shoals are the Virgin Rocks and the Eastern Shoal Water. The former are a number of rocky hummocks, severally known as the Main Shoal, Portuguese Shoal, the Haycocks, and the Eastern Shoals. On these the depth is from 4 to 25 fathoms, while between them it is from 40 to 50 fathoms. One or two of them break in rough weather, and though not very large, are at such times dangerous to passing vessels. They lie between 46° 25′ and 46° 30′ N. latitude and 50° 31′ to 50° 58′ W. longitude. The Eastern Shoal Water extends from about the fiftieth meridian nearly to the eastern edge of the bank and from 43° 50′ to 44° 50′ N. latitude. The depth of water is from 22 to 30 fathoms and the bottom is chiefly sand, but with some patches of rocks or gravel. With the exception of the shoals already mentioned, the bottom is generally level, the depth being from 30 to 50 fathoms, excepting in the whales deep, near the western part of the bank, where there is from 52 to 67 fathoms on a muddy bottom. The Grand Bank may be considered as a vast sandy plain in mid-ocean, but notwithstanding this is the general character of the bottom, there are extensive tracts where it is either composed chiefly of rocks and gravel or where these occur in patches of more or less extent.

There is perhaps less current here than on any other of the banks, and oftentimes for days and weeks together it may be scarcely perceptible. This is generally the case during moderate weather, but a continuance of strong winds usually makes some tide.

The principal food-fish taken here are the cod and halibut. Haddock, cusk, and hake are rare. There are a few cod ("ground keepers") in winter, but the best season is between the first of April and the first of November. The Grand Bank is essentially a feeding-ground for the cod, which find there not only an abundance of shell-fish and crustacea of various kinds, but mollusks and several varieties of small fish that they are especially fond of. The appearance of large schools of cod at the same time with certain kinds of bait, for instance the capelin and squid, has caused these to be known to the fishermen as the "capelin school" and the "squid school." The spring fish, which feed largely on the bottom, and to some extent on lant, are at first found the most abundant on the southern part of the bank, but later spread over a large area. The capelin school comes in May and June, and at that time fish are found more or less plentiful all over the bank, although the locality between the latitudes of 44° 00′ and 45° 15′ and that east of the Virgin Rocks north of the forty-sixth parallel are the most generally resorted to by trawl fishermen, while the dory hand-liners gather about the Virgin Rocks, which is a favorite place for them at that season. The squid school appears in July and is found on the same grounds as the capelin school. Indeed, it is quite probable that it is made up chiefly of the same fish, their numbers increased, perhaps, by some new accessions. For several years but comparatively few cod have been taken after September. Cod-fishing on the Grand Bank dates from the earliest settlement of America. The halibut fishery, however, is of comparatively recent date. This was begun in 1865, at which time, and for several subsequent years, halibut were found very numerous on the bank. At first they were taken almost wholly on the Eastern Shoal Water, later on other parts of the bank, and since 1875 principally in the deep water along the western edge, where immense schools have been found in the winter and spring, and, though less frequently, sometimes in summer. During the early part of the year the halibut usually do not remain long in one place, as many of the schools perform their migrations at that season. The summer schools, however, are generally spawn fish and move but little.

A large fleet of French vessels of various rigs, but mostly brigs and barks, resort to this bank to engage in the cod fishery. Besides these there is a fleet from the British provinces and another from the United States, the whole aggregating several hundred sail, with crews numbering many thousands of men.

FLEMISH CAP.

Although the Flemish Cap is quite large, but comparatively little is known of it, and its boundaries are not fully defined on any of the charts. It is the most northern of the large fishing banks in the Western Atlantic, being located between 46° 36′ and 47° 59′ N. latitude and the meridians of 44° 06′ and 45° 25′ W. longitude. The extreme length is therefore 83 miles and width 53 miles. The bottom is broken into patches of more or less extent of mud, rocks, pebbles, gravel, and sand. A slaty rock is the most common on that part of the bank resorted to by fishing vessels. The depth varies from 73 to 155 fathoms.

Cod and halibut are the only fish taken as an object of pursuit. Owing to the bank being situated so far to the north and east nothing is known about the abundance of fish in the winter season. Indeed, all that is known of them is in the period between the last of April and the first of August. In the spring and early summer cod and halibut have been found in great abundance. During the spring, however, the weather is often so rough that fishing can be carried on but a small part of the time, and after June the ground is so much infested with ground-sharks that the trawls are soon destroyed. Besides this there is more or less danger from drifting icebergs, which are often seen in great numbers. All these causes combined have hindered most of the fishermen from making any attempt to fish there. The only vessels known to have visited this bank for cod and halibut are a few from Gloucester, Mass., and this has never been done until within a few years.

COD FISHING-GROUNDS IN THE BAY SAINT LAWRENCE.

The cod fishing-grounds in the Bay Saint Lawrence are comparatively of little importance except to the fishermen of the British Provinces. But few American fishermen go there, as the ocean banks are generally preferred by them. There is little difference between the depth of water and character of the bottom of the banks and elsewhere, and therefore the whole bay may be considered as a cod fishing-ground, with from 10 to 60 fathoms of water, and bottom generally rocky but somewhat diversified with areas of greater or less extent of sand, gravel, or mud. The only places of which special mention need be made are Bradelle Bank, Orphan Bank, "Pigeon Hill Ground," and "Miscou Flat."

Bradelle Bank is in a northeasterly direction from the North Cape of Prince Edward Island, and in a direct line between that and the northern Magdalen Islands, the SW. edge being 22 miles from the former headland. It is 36 miles long and 24 miles wide.

Orphan Bank is north of Bradelle. The center bears ESE. from Point Miscou, from which it is 47 miles distant. It is 36 miles long NE. and SW., and 15 miles wide, with a depth of from 10 to 30 fathoms, and bottom of rocks, coral, and sand.

Pigeon Hill Ground is the shore soundings that lie southeasterly from Shippegan Island at a distance of 10 to 20 miles, and extends in the direction of the coast about 18 to 20 miles.

Miscou Flat is a stretch of rocky shoal ground that makes out from Point Miscou about ESE. nearly twenty miles. There is from 10 to 22 fathoms of water, the ground gradually sloping toward the outer part.

On all these grounds cod-fishing is pursued only during the warmer season, from May to October. The abundance of cod, especially of the large fish, varies somewhat with different seasons, their presence in greater or less numbers being governed to a great extent by the amount of bait-herring, mackerel, &c., on the ground. The fishing is largely carried on by the local residents in small boats, although some Nova Scotia vessels, and a limited number from the United States, sometimes engage in it.

FISHING-GROUNDS NEAR THE MAGDALEN ISLANDS.

The cod and halibut grounds about the Magdalen Islands are at present of little importance to American fishermen. Since the introduction of trawl-fishing it has usually been found that better results could be obtained elsewhere. These grounds are rocky patches, and generally of limited extent, with comparatively shoal water and sharp bottom. They occur all around the islands, but are not of sufficient importance to make a special description necessary. A few trips of halibut have been taken on the shoal about Byron Island, but the appearance of these fish is so uncertain in that locality that the halibut catchers rarely go there. The fishing is done almost wholly in the small boats of the resident fishermen, and by the small vessels belonging to the British possessions and at the French islands of Saint Pierre and Miquelon.

CAPE NORTH FISHING-GROUND.

Around the northern part of Cape Breton Island, at a distance varying from 4 to 15 miles from the land, is a fishing-ground that is of considerable importance for a few weeks in the spring and early summer. This lies between Cape North and Saint Paul Island, and extends westerly about 15 miles, and southwesterly along the coast as far as Limbo Cove. The land is bold and high, with steep shores, so that notwithstanding the close proximity of the fishing-ground the depth of water on it is from 65 to 100 fathoms. The bottom is mostly tough clay, but 10 or 15 miles from the land there are some rocky ridges. The current sets out of the Gulf of Saint Lawrence toward the southeast, although the direction in which it runs in the vicinity of Cape North changes more or less in conformity with the land. The strength is increased by strong westerly winds, and after a long continuance of these, the current sometimes runs 3 or 4 miles an hour. As a general thing, however, the tides run slowly About 1860 and 1861 cod and halibut were found in abundance, but later the halibut seemed to disappear, and for several years have been taken only occasionally. The cod are still found quite plenty in May and June, at which time they are moving slowly in by the headland on their way to the shoaler grounds in the bay of Saint Lawrence. The fishing is often obstructed by floating field-ice, which sometimes prevents the vessels from reaching the ground until late in the season. This place is resorted to by provincial and American vessels, but owing to the difficulties that have been alluded to, the fleet is usually small.

THE GREENLAND HALIBUT BANKS.

Mr. N. P. Scudder makes the following statement about the grounds in Davis Strait which are resorted to by the halibut fishermen of Gloucester:

"The fishing banks are 15 to 40 miles from the coast, and, if we can rely upon the Danish charts, extend from Disko Bay to within 3° of Cape Farewell; for these charts give soundings all along the coast between these two points. Extensive as the banks may be, only a small part of them, the part about Holsteinborg and Cape Amalia has been tried by American fishermen. That the fish are to be found throughout the whole extent is more than probable; for the species is identical with that taken on the Grand Banks, and we would naturally infer it would be found in all favorable situations within the limits of its distribution. It is also reported that Capt. Rasmus Madson, commonly known as 'Captain Hamilton,' who has been to Greenland several times, set his trawls for these fish farther to the south (probably off of Godthaab) and found them very abundant, but was unable to secure many on account of the numerous ground-sharks playing the mischief with his trawls.

"The depth of water on the banks is from 15 to 90 fathoms. * * * At the inner edge the banks have a sudden slope, leaving a long submarine valley, the depth of which I did not ascertain, between them and the mainland. The surface of the banks is varied, though generally rocky, with here and there sandy and clayey spots. The character of the fauna varies considerably and often abruptly in places a little distance apart. * * * The halibut were also more plentiful upon the edge than any other part of the bank. * * * It will readily be seen from the preceding remarks that a careful survey of the banks, with the view of determining their limits, character, and fauna, could not fail of being of great use to the fishing interest, to say nothing of its immense importance from a natural history and geological point of view." (Report U. S. F. C., 1880, pages 193–4.)

Besides the banks that have been described there are many small patches, generally some part of the shore soundings, along the coast from Florida to Maine which are resorted to by small boats and also by larger craft. Although these fishing-grounds are important in the aggregate there are none of them sufficiently large to require a special description in this place.

Mention should also be made of some of the more noted inshore fishing-grounds of the north. Among these, perhaps the most important is the Strait of Belle Isle, though at present this locality is rarely visited by fishing vessels of the United States. The inshore halibut grounds, along the shores of Anticosti Island and the coast of Lower Labrador, were important for a few years, 1870 to 1874, but have seldom been visited since 1875, the few trips that have been made to those localities since that period being usually unremunerative. Other inshore localities, which are no longer good grounds for halibut, might be mentioned, but it may suffice to say that at present the only place where halibut are found abundant near the shore is on the west coast of Newfoundland.

THE MACKEREL FISHING-GROUNDS.

The principal fishing-grounds for mackerel (*Scomber scombrus*) are along the coast of the United States north of Cape Hatteras and in the Bay and Gulf of Saint Lawrence. The ordinary range of the mackerel on the American coast is between the parallels of 35° and 52° N. latitude. Instances have been recorded of their appearance north and south of these limits, but all the evidence goes to show that their presence in those waters is exceptional. The extent of the fishing-grounds on which mackerel are commonly caught is considerably less than that first mentioned, since they are rarely taken south of the thirty-seventh or north of the fiftieth parallel of north latitude, and the best obtainable evidence shows that the average southern limit of the first catches in the spring is about 38° 00′ N. latitude.*

The most northern localities where mackerel have been found abundant by fishermen who were seeking them (this is by no means a common occurrence) are the Seven Islands, 50° 05′, and Mingan Islands, 50° 14′ N. latitude, both of these groups of islands being situated near the coast of Lower Labrador.

Mackerel appear on the coast of the United States early in April—very rarely in March—and until the middle or last of May the fishing-ground for them is along the coast from off the capes of the Delaware to the South Shoal of Nantucket, advancing northwardly with the season and at varying distances, say from 3 to 60 miles, from the land. From June to September the best grounds for these fish are off the coast of Maine. Sometimes they are caught in the bays, some distance inside of the outer islands, but more generally from 5 to 70 miles offshore. Large schools of mackerel frequently appear on George's Bank in the summer, and it is not uncommon for that to be one of the favorite grounds for these fish during a large part of the season. When the autumn migration of the mackerel takes place, which is generally in October, and continues sometimes through November, they begin to move southward; the fishing-grounds, of course, change (the vessels follow-

* The journal of schooner Alice, of Swan's Island, Maine, records the fact that the first mackerel in 1879 were caught in 37° 50′ N. latitude and 74° 03′ W. longitude. The first catch of the Alice in 1878 was in 38° 38′ N. latitude.

The journal of schooner Augusta E. Herrick, of Swan's Island, records first mackerel taken in 1879 in 37° 57′ N. latitude and 74° 22′ W. longitude.

First mackerel taken by schooner John S. McQuin, of Gloucester, in 1879, in 37° 42′ N. and 74° 13′ W.

First fish by Charles Haskell, 1879, in 38° 08′ N., 73° 57′ W.

First fish by schooner Albert H. Harding, 1879, in 38° 08′ N., 74° 30′ W.

First fish caught by schooner John Somes, in 1838, was in 38° 21′ N. and 74° 12′ W.

ing the schools) from the coast of Maine to Massachusetts Bay and the waters off Cape Cod. They have never been followed far south of Cape Cod when leaving the coast, the inclemency of the weather at that season generally preventing such an undertaking. It should, however, be said that mackerel have been found for the past few years quite abundant and of large size during the entire summer season and quite late in the fall, in the vicinity of Block Island.

We will now consider the more eastern or northern resorts of the mackerel. Toward the latter part of May, about the time when the southern wing of the great army of mackerel is approaching the waters of Cape Cod, another body, which may be called the northern wing, and which would appear to be distinct from the other, sweeps in past the island of Cape Breton and enters the Bay of Saint Lawrence. The mackerel make their appearance in those waters late in May or early in June. These are, however, apparently but the vanguard of the schools of fish that follow, and which are undoubtedly part of the same body of fish that first makes its appearance on the coast of the Middle States. During the month of June large quantities of mackerel are moving along the coast of Nova Scotia and passing through the Gut of Canso into the Bay of Saint Lawrence. Many fish are caught in nets, seines, and pounds while these migrations are taking place, and also during the fall when the mackerel are returning over the same track on their way south, and therefore the coast of Nova Scotia for a brief season in the early summer and late autumn may be considered a fishing-ground for mackerel, although the fishery on that coast is carried on exclusively by residents of the Province. Of the Bay of Saint Lawrence it is only necessary to say that from early in June to October, seldom later, this is a well-known habitat of the mackerel, though since the universal adoption of the purse-seine by the mackerel catchers much better fares have been obtained on the coast of the United States, and as a rule trips to the bay have resulted in loss. This is partly due to the mackerel being less abundant and of a poorer quality than formerly, but in a greater degree to the difficulties of seining on grounds where the water is generally shoal and the bottom foul. In conclusion, mention should be made of the fishing-ground off the east side of Cape Breton Island, in the vicinity of Sidney, where mackerel have occasionally been found abundant; Sable Island, where they were found quite numerous and of large size for one or two seasons, about 1853 and 1854; and the west coast of Newfoundland, where they have been known to occur at irregular intervals and where at least one trip has been obtained by an American schooner.

B.—The fishery marine.

Important changes have been made in the models of fishing vessels during the last half century, and in the appliance of labor-saving apparatus to their rig and fittings. Although these improvements have contributed much to the comfort and safety of the fishermen as well as to the success of the fisheries, it will, perhaps, suffice for the present purpose to allude very briefly to the vessels of former days, some of which may yet be occasionally seen, particularly in the shore fleet of Eastern Maine.

The "bankers" of the last century and the beginning of this were narrow, straight-sided, square-sterned schooners, with high quarter-decks, and very bluff—nearly square—bows. They were short-masted, consequently having but a small spread of canvas, and were extremely slow sailers. These vessels were usually from 40 to 75 tons, carpenters' measurement. The Chebacco boats, or "ram's-head boats," as they were sometimes called, which at that time were employed in the shore fisheries, were of small size, 10 to 20 tons, and were generally sharp aft, with two masts and no bowsprit. Next came the pinkie and the square-stern schooner with low quarter.* About 1845 the "half sharp" schooner made its appearance, and from this date rapid changes were made, and a few years later, about 1850, the "sharp-shooter" (as the clipper schooner was at first called) was introduced.

The fishing vessel of the present time is the embodiment of the combined and intelligent efforts of fishermen and builders through a long period of years, and as a result we now have the schooner-rigged clipper, with broad beam, a large spread of canvas, and possessing excellent sailing and sea-going qualities. Although there is a general resemblance to each other among the vessels composing the fishing fleet, certain changes in the rig and slight differences in the model are sometimes rendered necessary for their better adaptation to certain branches of the fisheries. Nearly all of the larger class of vessels are, however, constructed on a model which is well adapted for any fishery, and it is only the so-called market boats, which are usually of smaller size, and a very few vessels built for the mackerel fishery alone that differ from the rest; these are usually very sharp, and sometimes not so deep as the others, large deck room and swift sailing being the qualities most desired. There are, however, considerable differences in the rig. These are rendered necessary by the changes in the seasons, it being evident that in some branches of the fishery where speed is a special object a larger number of sails can be carried in the summer, when light winds are prevalent, than during the winter months, when heavy gales are frequent. The winter rig of the vessels employed in the George's cod-fishery is the lightest of any. To fit them for a winter trip the maintopmast is sent down, and they then carry but three sails, namely, mainsail, foresail, and jib. In the spring, when there is no longer a probability of meeting heavy gales, the topmast is replaced, and they then carry a staysail, and some have also a gaff-topsail.

* Although sloop-rigged vessels have been and are still employed in the fisheries, these form but a comparatively small part of the fishing fleet, the schooner rig having always been a favorite one with our fishermen.

The summer rig of the Georgesmen, that has just been described, is the same as the winter rig of the vessels that are employed in other branches of the fisheries; for instance, the bank halibut fishery, the haddock fishery, and the shore cod fishery. In summer nearly all of the bankers and mackerel catchers have flying-jibs. Many of the latter class of vessels, and also a few of the halibut catchers, have a foretop-mast, and carry, in addition to the sails that have already been mentioned, a fore gaff-topsail and balloon-jib. A vessel rigged in this manner has eight sails, and resembles a yacht in appearance; a schooner of 75 tons will spread nearly 1,300 yards of canvas. The necessity of making rapid passages to and from the fishing-grounds, and moving swiftly from place to place in pursuit of fish, renders it necessary to have a large amount of canvas to improve the prevailing light winds of summer.

The size of the vessels engaged in the fisheries varies from 5 to 193 tons, although there are but few that are more than 110 tons. The fleet engaged in shore fisheries is composed of vessels of the smallest class, from 5 to 50 tons, the average being about 20 tons. A portion of these, more particularly on the east coast of Maine, are old-fashioned vessels—a few of them are pinkies—and are not employed except during the season when fine weather may be expected. The greater part of the shore fleet, however, are the best class of small-sized vessels, and many of them are employed in fishing at all seasons. Many of these pursue the cod and haddock fisheries in winter. In summer the small vessels engage in many kinds of fishing, changing from one to another, and following whatever promises the best results at the time.

The winter haddock catchers are usually all first-class vessels varying in size from 25 to 80 tons, averaging about 50 tons. Many of these vessels are among the finest in the fleet, and the majority of the larger ones are generally employed in the mackerel fishery in summer. While the smaller haddock schooners do not go farther than 30 or 40 miles from the land, and usually a much shorter distance, the larger ones make trips to George's and Brown's Banks, and occasionally even farther east.*

The Georgesmen are all first-class vessels, averaging a little more than 60 tons, the extremes being from 40 to 85 tons. These vessels, like all others that are employed in the winter fisheries, are heavily ballasted with rocks or iron (generally with the former); the ballast is covered with planks, which are fastened down in the most secure manner. Above this platform the hold is divided by bulkheads and partitions into sections or pens, in which the fish are packed away in ice, or salted. Although the vessels undoubtedly fish on George's Bank the greater

* Trips are made to the western part of Nova Scotia, and during the winter of 1880-'81 many of the large vessels went as far as Le Have Bank, where haddock were found in great abundance, some of the vessels getting as many as 500,000 to 600,000 pounds each during the winter, most of which were caught on this bank.

part of the time, they also make trips to Le Have Bank, Brown's Bank, Seal Island Ground, German Bank, and occasionally to some other grounds. A few trips have been made as far east as the Western Bank (Western Bank and Le Have trips are usually made in December and January), and as far south as Block Island, but only at rare intervals.

The greater part of the vessels composing the mackerel fleet are clipper schooners, many of them being equal in appearance and sailing qualities to first-class yachts. It has already been mentioned that some of them carry a great amount of light sail, but while this is true of the larger vessels and for some others, there are a few of the smaller ones that have no flying-jibs. The average size of the mackerel catchers is about 60 tons, the extremes being from about 20 to 151 tons. There are few, however, over 100 tons; and the largest one is a three-masted schooner.

The bankers average larger than the vessels employed in other fisheries. Few are less than 60 tons; the average size is about 75 tons; while a small number are more than 100, and the largest, a three-masted schooner, is 193 tons. The fleet is composed chiefly of the finest class of sea-going vessels, and this may especially be said of those employed in the bank halibut fishery. There are, however, a few old-fashioned schooners that make trips for cod in summer. The salt carried by the cod-fishermen serves for ballast, and this is stowed in "pens" or bins in the hold. The halibut catchers and a few other bankers are ballasted like the Georgesmen, though perhaps not so heavily, the ice and salt they carry making up the deficiency. The fishing-grounds visited by the bank fleet extend from Le Have Bank to Davis Strait, although the Grand Bank, Banquereau, and Western Bank are the principal ones.

The vessels of the New York market fleet belong chiefly to the ports on Long Island Sound. They differ in some respects from the vessels of Northern New England, as they are, with the exception of the halibut catchers, nearly all welled smacks, and a considerable portion of them are sloops. The smacks take the greater part of their catch to market alive, preserving, however, the dead fish in ice. The vessels engaged in the halibut fishery are arranged somewhat similar to those already mentioned, and the fish are kept in the same manner, namely, by icing them. Although there is not so large a proportion of extremely sharp vessels in the New York fleet as in the fishing fleet north of Cape Cod, there is, nevertheless, a general resemblance between the schooner-rigged vessels and those of Massachusetts. The average size of the market smacks is about 40 tons, the extremes being 20 and 65 tons. The smacks fish from Cape Henlopen to George's Bank, principally on some part of the shore soundings, catching cod, haddock, &c., in the winter, and besides these several other varieties in summer. The halibut catchers go farther east on George's Bank and adjacent grounds. The few vessels employed in the southern coast fisheries belong to the same class as the smacks that have been mentioned; indeed the greater part of them were built in the ports of Long Island Sound.

The next to be considered are the open boats, of which there are a great many kinds, a few only of which, the more notable forms, can be mentioned here.

The sharp-stern fishing-boat is more universally used in the coast fisheries than any other, and to show how widely these are distributed along the coast it is only necessary to mention that the boats of Block Island and No Man's Land, the "five-handed" boat of Cape Cod and the coast of Maine, and the "quoddy" boat of Eastport, belong to this class.

One of the most peculiar fishing-boats on the coast is the cutter-rigged sloop, used exclusively by the Irish fishermen of Boston. These are said to resemble the fishing-boats of Ireland, and are generally called "Dungarvan boats" by other fishermen. The length varies considerably, the average being about 30 feet on top. They have a reasonably sharp but rounding bow, square stern, with the rudder hung outside; are deep in proportion to their length, with a wide stem and deep keel. They are said to be excellent sea-boats. The forward part is decked over, thus forming a cuddy where the crew eat and sleep. There is a cockpit aft, with a seat around it. The midship section is partially covered on each side. In the bottom of this is placed the ballast, on top of which the fish, gear, &c., are stowed. The bowsprit is adjustable, and two jibs are carried, one being set on a stay, the lower end of which fastens to the stem. In other respects they do not differ materially in rig from other sloops. In spring, summer, and fall these boats are employed in the cunner, haddock, and other fisheries for Boston market, the catch being chiefly sold fresh. In autumn most of them engage in the herring fishery with gill-nets at Cape Ann and other points in Massachusetts Bay.

The dory, which is so well adapted to the deep-sea fisheries, and is quite indispensable to our bank fishermen, originated during the latter part of the last century in Salisbury, Mass. This boat was originally designed for a lighter, and for many years was scarcely used for any purpose besides that of removing the cargoes from vessels at Newburyport. It was, however, employed to some extent in the fisheries early in the present century, and since the introduction of trawl fishing it has come into general use. The thwarts are adjustable, and, when these are removed, several dories may be "nested" inside of each other, the whole occupying the same space as one boat, and for this reason they are much better adapted for stowage on the deck of a vessel than any other style of boat. In addition to this, they are excellent boats in a rough sea, are capacious, light to handle, and also cheap; therefore it follows, as a matter of course, that they are extensively used in most of the important fisheries, among which may especially be mentioned the bank cod and halibut fishery and the mackerel fishery (each vessel with a purse-seine usually carries two dories). Large numbers are also employed on the haddock vessels, the shore fishing fleet, and in the boat fisheries of the coast. These boats are flat-bottomed, with flaring sides, sharp bows, and V-shaped, oblique, projecting sterns. They are from 12 to 16 feet in length (bottom measurement), different sizes being required for the various kinds of fishing. There is but little variation in the models, although for certain purposes* they are built somewhat wider and deeper than the average.

The seine-boat that is used in the mackerel fishery is a modification of the whale-boat, and is sharp at both ends. It has been found admirably well adapted for purse-seining, as it moves easily through the water and at the same time has sufficient buoyancy to carry safely a large seine while being towed very swiftly by a vessel. The ordinary size of these is 36 feet in length, though a few larger and smaller ones are used.

In addition to the boats that have been described, the following may be mentioned as being, perhaps, the most noticeable: (1) The square-sterned, sloop-rigged lobster-boat of Bristol, Maine; (2) the square-sterned "reach-boat"; (3) "double-ender" (a canoe-shaped boat), both this and the preceding being common on the coast of Maine; (4) the "drag-boat" of Cape Cod; (5) the square-sterned, cat-rigged boat of Southern Massachusetts; (6) the sloop lobster-smack of Long Island Sound; and (7) the surf-boat of New Jersey.

The other forms of fishing-boats are mostly modifications of those that have been noticed, and it is scarcely desirable to make further mention of them here.

C.—Methods of capture of sea-fishes, and the changes in this respect in later years.

The different varieties of sea-fish and their varying habits and modes of occurrence involve the necessity of special or peculiar methods for their capture; and the great diversity of implements and processes in use in different parts of the world is therefore not a subject of wonder. For the most part, however, nearly all the methods will fall under the head of the bow and arrow, the spear or lance, the line, the seine, the beam-trawl, the weir or trap; with some subsidiary means, such as the employment of narcotics or poisons, explosives, &c. I shall consider these methods under the foregoing heads.

The bow and arrow.—It is probable that in the pursuit and capture of wild animals our savage ancestry first made use of the hand or foot, the power of running, the strength of arm, and the acuteness of the perceptions, especially those of sight and smell, which in all probability were developed to a very high degree, and in this respect equaling, if even

*Dories built expressly for haddock fishing, where but little rowing is required, are not so sharp as others, carrying capacity being the chief requirement. The same may be said of those used by the fresh-fish companies in the larger fishing ports. A few have been built with rounding sides, but this form has not been so favorably received by our fishermen as the other with straight flaring sides.

they did not sometimes surpass, the most highly favored of the associated animals. Very soon, however, subsidiary apparatus would be called into play, either the throwing of stones or sticks, picked up at random, or the use of a specially fashioned club either for striking or throwing; and ultimately the arming of the stick with an implement for piercing, constituting the spear or lance, and, finally, the discharge of this spear, in a modified form, by means of a bow, constituting the bow and arrow.

It is, of course, difficult to say how soon the arrow and the lance were brought into play. We only know that among the very earliest prehistoric implements are the stone tips, undoubtedly used for this purpose and continued to be employed by the wild tribes down to the present day. The bone and wooden tips, which doubtless were called into play at about the same time, perished, as being constructed of less durable material.

The spear and the bow and arrow constitute very efficient means for capturing fish, in view of the closeness of approach to many species which is possible. No more effective method could be devised for capturing such species as the salmon than the spear, with its modifications of the harpoon, the grains, &c. In sea fishing it is especially such fish as the flounders, skates, eels, and other kinds that fall victims in large numbers to this method. The Esquimaux and the Indians of the northwest coast of America employ the bow and arrow very extensively for the capture of fish of various kinds. There are numerous and varied illustrations of this fact among the collections of the National Museum at Washington.

The harpoon comes legitimately in this series of weapons and has numerous applications. The head is placed at the end of a stiff handle, and sometimes when this is buried in the flesh it slips off, but remains connected by a thong or cord either to the harpoon itself or to a buoy which is thrown overboard. The latter method is most generally employed in the capture of the swordfish. In the whale fishery the end of the line is attached to a boat, which thus serves as a buoy or float. The combination of a torpedo or an explosive with a lance, either kept in the hand or discharged from a gun, is a more recent and extremely efficient method of capture of the large animals of the sea.

The line.—This may be considered essentially under the two divisions of the line held in the hands or at the end of a rod affixed to some object on the shore or to a float of some kind, and having at the extreme opposite end one or more hooks baited, with or without floats, for buoying the hook to a certain height above the bottom, or for showing by its motion the attack of the fish. Here we have the first idea of the hook, either covered with some substance attractive to the fish that conceals its character or simulates small fish and other objects that tend to attract its victims. The use of the hook and line in combination for the capture of fish is of the utmost antiquity in this respect, perhaps little inferior to the bow and arrow. While, of course, the lines themselves have perished with time, we still have the hooks, sometimes of stone and sometimes of bone, of shell, or of metal, and usually constituting very attractive objects of archæological research. Usually the barb of the hook is on the inner or concave line. A curious anomaly, however, in this respect, is seen in the hooks of the prehistoric tribes of the coast of Lower California, which, whether made of bone or of shell (sometimes of extreme artistic beauty), invariably have the barb on the outer or convex outline. Sometimes the barb is dispensed with entirely, with or without some device to occupy its place and function.

The hook and line, whether in the hand or affixed to the end of a rod, is the simplest of all methods for capturing fish, and the one most universally employed. Where fish are abundant it will generally take a sufficiency for all ordinary purposes, although where a large market is to be supplied it is not wholesale enough for the requirement. It does not waste the fish as much as other methods, and has especially the advantage of seldom taking those about to spawn, most species refusing, when in this condition, to be allured by the bait. There are some fish, indeed, which cannot be induced to take the hook at any time, and of course we have to depend on other methods, especially the net, in one form or another, for capturing them.

The trawl-line.—Where fish are needed in larger number than they can be taken by the hand-line, with a given number of persons, and where distant markets, rather than the local consumption, are to be provided for, what is called the trawl-line comes efficiently into play. This term, however, is applied to it only in the United States, where it is sometimes called the "set-line." On the continent of Europe it is known as the "long-line," while in England it is called the "bultow," and one variety of it, the "spiller." It consists of a long line, having fastened to it at regular intervals, usually 6 feet, a succession of short lines, usually about 3 feet in length, and having hooks at the ends. The antiquity of the trawl or long-line is probably very great, the period of its first introduction into Europe not being anywhere a matter of record. It was first used in North America on the banks of Newfoundland for sea fishing by the French. Its introduction to the main land of the provinces and of the United States has been somewhat more recent, although now it is very generally made use of.

According to Captain Atwood,* the use of trawl-lines was first introduced into Massachusetts by a number of Irish fishermen of Galway, who settled on Cape Cod. Their success with this novel apparatus was so great as to induce its immediate adoption by the native population.

There has been a singular antagonism on the part of those who use

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*Writing of the occurrences of the year 1843, Captain Atwood says: "About this time we began setting trawls for halibut, as has been described elsewhere." Capt. Peter Sinclair, of Gloucester, claims to have been the first to use trawls in Massachusetts Bay, about 1850, and makes the statement that a man named Atwood, who belonged at Provincetown, and was with him at the time, afterwards introduced the method of trawling in that place.

the hand-line, to the introduction of the trawl, and many accusations have been brought against it, on the score of its destruction of the fish and the injury to the fishing-grounds, in regard to which we shall inquire hereafter.

One proof of the antiquity of the long-line is the fact of its existence in almost the form used by civilized nations among the Indians of the northwest coast of America. It usually happens that aboriginal methods now employed by savage tribes have been handed down from a very high antiquity, and it is not at all improbable that the people of modern Europe simply developed an implement made use of many thousands of years previously by their ancestors.

The trawl-line as mentioned consists essentially of a line of varying length, sometimes, as on the coast of England, as much as 7 or 8 miles, more usually, however, from 100 yards upwards, with short lines of perhaps 3 feet in length attached at intervals of 3½ to 6 feet, each with a hook, but commonly not provided with leads or sinkers. To one end of this long line is attached a weight, by means of which it is carried to the bottom. The line is then paid out at the side of the boat, the hooks being previously properly baited, and the other end is weighted and dropped to the bottom also. At each end of the long line is an attached buoy, which, floating at the surface, indicates the location of the two ends. Sometimes, in the case of very long lines, there may be intermediate weights and intermediate buoys, those at the extreme ends in such a case being differently marked for their proper designation.

The bait used on the long-lines varies with the country and the circumstances, the longer lines used in England for the capture of cod being baited almost entirely with the whelk (*Buccinum undatum*), a mollusk or shell-fish very abundant in England, and for the capture of which numerous vessels of from 10 to 20 tons are employed.

The whelk is taken sometimes with the net, more usually by the use of some bait which attracts them into a basket or inclosure, in which they are then lifted out. The abundance of this object in the European waters is very great, as with all its consumption the numbers do not appear to decrease.

In the ordinary boat fishing the long-line is usually baited with the common muscle, the use of fish, such as fresh herring, &c., being much less common than in Northern Europe and in America. The whelk and species closely allied to it are abundant in the United States; but so far comparatively little use is made of them. It is probable that in the search for improved qualities and increased quantities of bait for the capture of codfish this will soon come into play and constitute a very desirable and satisfactory substitute for the other varieties. The clam among the mollusks is more generally employed for this purpose, both the *Mya arenaria*, or soft clam, and the *Venus mercenaria*, or hard clam. There are several other species which are used in large numbers for this purpose, to which reference will be made in another place. Of course fish may be employed, either herring or mackerel, fresh or salted, as well as capelin, portions of the cod, the lamprey, and, indeed, fish generally; the most appetizing and attractive fish bait for this and other purposes is probably the menhaden or pogee.

The trawl-line reaches its maximum of application and of size in the cod and other white fisheries which are carried on in the North Sea on a very large scale. At Great Grimsby, one of the principal centers of this kind of fishing, the long-lining is prosecuted by means of smacks of about the class and size of those employing the beam-trawl, from 40 to 60 tons, and even greater tonnage. A crew of nine to eleven hands is required to bait and work the lines; and the fish when caught are kept alive as long as possible, in wells. A complete set of long-lines, as used in all these vessels, consists of about 15 dozen, or 180, lines, each of 40 fathoms in length, and carrying 26 hooks on smaller short lines, called snoods. These are placed about a fathom and a half apart, so as to prevent the snoods from becoming entangled with each other. These 180 lines are united into one, forming a single line of 7,200 fathoms, or about 8 miles in length, and carrying 4,680 hooks. Contrary to the practice in Norway, where the lines are set in the afternoon and taken up the next morning, in England the lines are always put down and taken up by daylight; they are "shot" at sunrise or earlier, and taken up before night; sometimes, indeed, two casts can be made in one day. The baiting is generally done at night. A small anchor holds the line steady at every 40 fathoms, with a buoy at each end, and at each intermediate mile, as already explained.*

According to Mr. Holdsworth the use of wells in cod-fishing was first tried at Harwich, in 1712, and soon increased very rapidly, until now it is very extensively employed by many nations. In the work of Holdsworth (Deep-Sea Fishing and Fishing Boats) will be found very useful statements in regard to the use of the trawl in England.

As already stated, the whelk is used as bait on the largest long-lines, as any other would be too readily washed away by the rapid tide. The shorter lines, shot from boats, usually in quieter waters, are served by means of the softer muscle, a mollusk, also extremely abundant in the United States. The fish are usually taken alive, and after a puncturing

* Although the British fishermen set longer trawl-lines in one string than the Americans do, they rarely if ever use so many fathoms or such a number of hooks to the vessel as the latter. The greater part of the American "bankers" set more than nine miles of trawl in the aggregate, having 9,000 hooks attached, while the smallest amount would be about two-thirds as much. It should also be borne in mind that it is not uncommon for the American fishermen to set and haul this amount of gear twice a day. The vessels engaged in the winter haddock fishery on our coast have a still greater number of hooks than the cod fishermen. The smallest class of these rarely have less than eight miles of trawl, with 12,000 hooks attached, while all of the larger vessels have, at least, half as much more, and quite a number have twice as many, namely, 24,000 hooks, or about sixteen miles of trawl.—J. W. COLLINS.

of the air bladder by a long needle, they are placed in wells in the vessel and carried alive to market when a cargo has been obtained.

According to Holdsworth (p. 148), there is no reasonable ground to believe that the catch on the coast of England has been diminished in numbers in consequence of the action of the long or trawl lines, the principal means of capture. On the contrary, the same ground has, year by year, furnished an increasing abundance in proportion to the number and size of the vessels employed, the catch being nearly if not entirely as great on any given number of hooks as it was many years ago.

The capture of cod on the Norwegian banks is also made principally by the trawl-line, although the hand-line and the gill-net are also brought into play.

For the purpose of ascertaining the present views of the Norwegian experts charged by the Government with the supervision of fishery operations, I addressed a letter to one of their number, Mr. Robert Collett, of Christiania, Norway, and his reply is herewith presented:

"You ask me whether any question has arisen in Norway as to the greater destructiveness to fish or to the fishing-grounds in consequence of the use of the long-lines. Not at all. I am quite sure the long-line is just used in the 'great cod-fisheries,' particularly in Lofoden Islands and along the coast of Aalesund, *in the spawning season*, and it would be a very bad fishery if the fishermen had nothing but hand-lines.

"I never heard of any putrefaction of the grounds by the fishes breaking off from the hooks, and in the great depths, where the fishery is very good, nothing of that kind would be felt. I never heard of such a thing in Norway, and I could give you an example from the herring fisheries that proves there is nothing probably in this outcry.

"In the year 1834 great herring flocks were caught in a little fiord, Oxlofiord, a branch of Stonfoldenfiord, in Namdalen. By an accident once, the masses could not be taken up from the nets, and several thousand barrels died before they could be used. All these dead fishes were thrown into the water on a very small area in a narrow fiord and covered the bottom with a very thick layer. Notwithstanding, two years later the fiord was again full of fish, and thousands of barrels were caught just on the spot where the fishes had been thrown out.

"As to the nature of the bait, it is partly fish, greatly invertebrates. On the great cod-fisheries in Lofoden, where they are catching the fish from January to March (the spawning season), they use herring. In Finmark they use *Mallotus villosus*, the best bait that is known. (When this fish is in the fiord you cannot get cod with any other kind of bait.)

"Here they also use cephalopods (*Ommastrephes*). In the southern part of Norway, where they catch cod every season, they use *Mytilus modiolus*, *Mytilus edulis*, young *Clupea harengus*, *Arenicola piscatorum*, and *Palæmon squilla*. I have not heard of any other sort of bait. The bait is always used fresh, and it is only in the case of extreme scarcity of fresh bait that salted herring are used.

"I remember now another fish which they use in the northwestern parts, viz, the *Ammodytes lancea.* These as well as the young herring are used whole, *i. e.*, the whole little fish on a hook.

"ROBERT COLLETT.

"CHRISTIANIA, NORWAY, *October* 4, 1877."

The winter fishing on George's Bank is entirely by hand-lines, the weather being too inclement to permit the use of the trawl. At the Lofoden Islands, 24 lines, each with 120 hooks, are usually fastened together into one, thus carrying 2,880 hooks, although sometimes, in particular localities, where the nature of the bottom requires it, a much shorter length is employed. As in England, the short lines, or snoods, are between 6 and 7 feet apart. Here, however, the lines are shot in the afternoon, remaining down all night and taken up the next morning. No line can be put down before noon, nor can it remain down after midday.*

Very often a glass ball, the size and shape of an egg, is fastened about a foot from the hook, so as to buoy the bait a few feet from the bottom and make it more easily observed by the fish.

The usual yield of a long-line, with the number of hooks given above, is 240 to 360 fish per day, and it is readily managed by two persons, while a hand-line, worked by one person, rarely takes more than 50 per day, thus showing a marked difference in favor of the trawl. Very frequently the long-line, instead of being kept down for a period of twelve hours or longer, is overhauled much more frequently, especially in comparatively shoal water, where the line is no sooner fairly down than it is again overhauled and rebaited.

Various modifications as to the size and bait of trawl-lines are found in other countries; but what we have already stated will furnish a sufficient idea of the general character and applications of this important item of fishing apparatus.

As already stated, very grave complaints have been made against the long or trawl line in the United States, and legislation or mutual consent invoked either for its entire abolishment or its restricted use under certain specified conditions.

The advantages of this method will readily be understood, as consisting in the much greater efficiency and the much larger yield of fish taken by the same force of men; as also in the fact of the more continued exposure of the bait, in consequence of which fish that are deterred from biting at the hand-line in its incessant motion, or only kept down during the convenience of the fisherman, are more tempted by the bait on the long-line, which is much more quiet and remains on the ground sometimes for a number of hours.

* Baars, Des Pêches de la Norwége; Paris, 1867. H. B., Die Fischerei Industrie Norwéges, Bergen, 1873.

The disadvantages of the long-line, as alleged by those opposed to its use, may be formulated essentially as follows:

(1) It is more expensive, requiring a larger capital, and consequently rendering the poor fishermen unable to compete with the more wealthy in regard to its acquisition and employment. Objections of this kind generally come from the hand-line fishermen, who, however, when able to purchase the long-line, are very apt to forget their former scruples and to use it without hesitation. This change of policy, is excused on the score of self-protection and the necessity of employing methods similar to those of a rival fisherman for the purpose of making a living.

(2) It is sometimes objected that it requires two or more persons to use the trawl-lines instead of one. That a combination of persons should accomplish a much larger result than the aggregate of their separate endeavors is in accordance with the general principles of a sound political economy.

(3) It is asserted that the line is much more liable to be lost than the hand-line. This is said to be caused by the wearing of the line on rocks, although generally the buoys at each end enable the separate portions to be recovered. As a matter of actual experience, however, the expense of lines absolutely lost in this way amounts to a very small percentage of the original cost.

(4) The fish are brought up dead or not always perfectly fresh, and many of them are devoured by other fish, as eels, codfish, sharks, crabs, &c., either while living or after death.

This objection is, of course, one that may be fairly put; but after all, the yield of sound, merchantable fish is sufficiently great to permit an average wastage; and if it be fish killed on the hook and remaining in the water for some time, it is for the advantage of the consumer to have the services of these scavengers in assuring a supply of perfectly fresh fish for the market.

Although these objections will not apply to so great an extent to the hand-line, yet they do attach to the use of the gill-net, and, in fact, to a still greater degree, in both methods a considerable loss taking place. This destruction, however, which has been claimed as involving a wastage of the fish in the sea, is not a question for the consideration of the owner of the line, as an equivalent in weight to the very fish thus consumed while attached to the hook would in all probability have been taken while swimming free in the sea by these same enemies.

The practical experience in trawling, however, is that while some of the hooks are brought up entirely empty, very few hooks have mutilated fish upon them, a large proportion being alive and in good condition, and on being placed in the wells of the smacks are capable of being kept for a long time.

As a general rule codfish in England are sent alive to the markets, and the enormous quantity consumed there and elsewhere is taken for the most part by the long-line. If in consequence of a storm or some special condition the line be necessarily left down longer than usual, a still larger percentage of fish will be found dead, possibly the entire number. But it must be remembered that this fishery is almost universally prosecuted in the colder waters of the ocean, frequently where the temperature varies from 35° to 42°, which of course serves to preserve the fish much longer than a warmer medium.

(5) The wastage of the fish by dropping off the hook before they can be taken into the boat. This accusation is based upon the alleged practice of using considerably smaller hooks than those required for the hand-lines; and while it is possible that this may happen occasionally, it is quite certain that the fishermen will graduate the size of the hook so as to obviate such a danger, and even if a considerable percentage be lost, as already explained, this is the concern of the fishermen and not of the general public, the fish thus slipping away being consumed by the scavengers in place of live fish in equal bulk.

(6) The capture of roe or spawning fish. It is difficult to know what weight to attach to this objection, although it is very generally asserted that a spawning fish will bite at a long-line when it will not do so at a hand-line, the fish at this time being much more cautious in its approaches. So far as the cod are concerned, however, and the *Gadidæ* generally, it is probable that the force of the objection is lessened by the fact that the long-line is used more especially at the time when the fish are not spawning. As a general rule the cod, haddock, and hake, &c., are known to spawn in the winter months, usually in January, February, and March, sometimes a little earlier and sometimes a little later. It is precisely at this time, when, in consequence of the inclemency of the weather, in North America at least, this mode of fishing is more or less intermitted, consequently allowing the spawning fish a sufficient opportunity for discharging its roe undisturbed. This explanation applies more to the offshore fish, however, as the winter inshore fisheries of the New England coast are almost exclusively directed to outside fish that have come in to lay their eggs.

When we bear in mind the very small percentage of deep-sea fish that can be taken by man at all, and the immense yield of eggs of most of the species (amounting to several millions for each female cod, and others in proportion), we can easily believe that an objection of this kind can have but little weight, even if the fish were harried to the utmost during their spawning season. If, however, as is most probable, they are comparatively undisturbed on many fishing-grounds at that time, the objection falls essentially to the ground.

To the subject of the prolific character of the fish of the sea and the number of eggs laid by some of the more prominent species, reference has been made in another part of this report (page 82).

There is another consideration which may be borne in mind in regard to the so-called lazy or logy cod which cannot be caught with the hook and line. Many of these are in reality past the period of bearing, as there is every reason to believe that, like other vertebrate animals, after a number of years of service in this respect, the fish, whether male or female, becomes sterile. Sometimes this is the result of sickness or disease; at others the fish is in its best condition for food. A codfish of 20 or 30 pounds is probably as efficient for reproduction as one of 50 pounds, and perhaps more likely to furnish a healthy progeny, able to meet the exposures of the sea.

(7) The long-line fishermen, in their wholesale method of capture, in America, at least, clean their fish at sea and throw the refuse, consisting of the heads, entrails, &c., commonly called "gurry" in America, overboard. This pollutes the fishing-ground and drives away fish for a period of months or even years, and this in connection with the fish that break away from the line on being hauled up, or which are partly devoured at the bottom.

This, with the alleged destruction of fish by the use of the trawl-line, is the objection upon which the opponents rely as the most formidable and as carrying the greatest weight. This will be considered in considerable detail (in another place under the head of Disposal of Offal), as, if established, it would constitute a reasonable ground for regulating this fishery, even by its restriction, limitation, or total abolition.

Bearing now in mind that the objection to the trawl-line is based more exclusively on the injurious effect of throwing overboard the offal of the fish cleaned at sea, the matter of self-interest and the desire to economize waste products will doubtless in time regulate the subject. It is a very significant fact that in Europe, where the practice of trawling has been conducted for many centuries and on a scale greatly in excess of anything of the kind in the United States, and where the same ground has been fished over and over again by a much larger percentage of hooks than is ever seen off the coast of North America, there has never yet been any suggestion of injury from this mode of fishing. The controversy there has not been on account of the interference of the long-line with the hand-line fishing; but it has been in opposition to the use of the beam-trawl, and it never, apparently, has come into the mind of the hand-line fishermen that there was any evil whatever resulting from the other mode of fishing besides the advantage given by the fact of a greater proportionate yield. The drift and purse seine interest, too, antagonizes the beam-trawl, but not the long-line, and it is not to be imagined that any real objection to the long-line would have failed to be brought forward and to excite the animadversion of parties fishing in a different manner.

The largest lines used in America are far inferior to those used in the British seas, where they are sometimes over 8 miles long and carry between 6,000 and 7,000 hooks.

The experiences recorded in such works as that of Holdsworth on deep-sea fishing, and of other writers, all tend to show that notwithstanding the ever-increasing number of long or trawl lines in certain localities, there is no reason to believe that the fish have decreased in number in consequence, the captures always being proportioned to the increase in the length of the lines and the size of the vessels and their crews. In some cases it is alleged that the cod, in its well-known voracity, swallows the head and backbone of its fellow as it is thrown into the water, and is thereby rendered ill and sometimes even killed by the feast. This can only result from the laceration of the gullet and stomach by the bones, a condition which must ensue very rarely in a fish which fills its stomach with large sharp-edged shells without experiencing any evil effect.

The digestion of fish is very rapid, and it is not an uncommon thing to find that when a fish has been seized by another and is too long to be swallowed entire, the portion near the stomach is digested while the fragment projecting from the mouth is fresh and sound.

Upon the whole, therefore, I am inclined to conclude, from all the considerations and the testimony offered, that there is no actual proof that the use of the trawl or long line in itself is injurious to the fisheries, so far as relates to the driving of the fish away from the grounds. It may render the desirable fish less eager to take the hook, or it may attract predaceous fishes, so as to frighten away the more noble for the time; but that any influences thus exerted can extend over a period of more than a few hours it is difficult to understand. If there be any evil effect, it is possibly from the gurry, but even this I am not willing to admit. This evil, if it be one, will be remedied in our waters, as it has been within a recent period in other cases, by a utilization of this material as a wasted product, the yield or profit therefrom and its conversion into oil or guano being greater than the cost of saving and delivering it on shore. At any rate, before any legislation is invoked, a more careful examination on the ground of the more important regions alleged to be affected should be made by scientific men. The question of refuse matter on the bottom at depths of 15 to 30 fathoms can easily be settled by the use of the water telescope, a well-known implement in scientific research.

In further illustration of the subject, I call attention to the fact that in the investigations in Norway as to the cause of the disappearance of the herring from accustomed grounds, it was maintained that the dead fish, dropping from the gill-nets, or remaining in the meshes of the nets, that had become lost and entangled at the bottom, had produced this state of things. The water telescope was brought into use and it was ascertained that the number of such fish was much less than was alleged and that after being dead one day they had entirely disappeared, and furthermore it was found there had been an entire abandonment of certain localities where the gill-nets had not been used at all, and fish had previously been taken wholly by drawing seines from the shore.

Captain Nathaniel Atwood, of Provincetown, while earnestly combatting the assertions in regard to the injurious effects of the trawl-line upon the fisheries, admits that they do appear to have a positive action on the abundance of the halibut, or at least those of the large individuals which are specially sought after for the market. He thinks that these large halibut are quite likely each to occupy a considerable area of ground, to the exclusion of others of the same species, and that when they are caught, it takes a considerable time for their restoration. He mentions a curious relation in the co-existence of halibut and haddock, the result of the capture of the halibut in the grounds conjointly occupied by them, being a very marked increase of haddock, so much so as to render them almost a drug in the market and reducing the price very materially. This is due to the fact of haddock being devoured in immense numbers by the halibut while present, and their consequent increase when their enemies are captured.*

I have already adverted to the fact that in the course of an extended and exhaustive investigation by Professor Huxley and his associates into the subject of the British sea fisheries, contained in a Blue Book of 1400 pages and involving the answering of 61,830 questions, there were but six witnesses of the entire number examined who made any objections to trawl-lines. One fisherman alone (vol. 2, p. 554, question 24,996) considered it a destructive mode of fishing in itself, his objection being that by using very small hooks they caught too many young fish, which, had they been allowed to grow up, would have furnished a more profitable yield.

One fisherman, in answer to questions 39,994 and 40,389, said he found a difficulty in getting bait of the right kind with which to supply the hooks, although approving of their use.

To No. 40,976, a fisherman replied that the trammel nets, such as he used, were liable to be torn by contact with the long-lines. Another trammel-net fisherman, in answer to question 41,023, maintained that the long-lines frightened the fish away from his net, so that he could not get all that he expected.

The net.—Having thus concluded the subject of line fishing, we come to the second of our principal divisions, namely, that of the use of nets. It is hardly necessary to go into any minute account of this mode of

*Another instance of this mutual interdependence of fish, as asserted by the fishermen, occurs on the coast of Nova Scotia, in this case between the lobsters and the starfishes. According to this the lobsters are destroyed by the starfishes in great numbers, and in the immediate vicinity of the canning establishments where the lobsters are taken and put up there is found to be an appreciable diminution of them from this cause. The starfishes are then said to multiply very greatly. The fishermen insist that the starfishes feed upon sea-weed, and that they devour this in such quantities as to clear the bottom of this covert, and that the food-fishes finding no means of concealment do not resort to what were formerly excellent fishing-grounds. The statement that starfish eat sea-weed is perhaps yet to be substantiated.

capturing fish, as I have already treated it at great length in the first volume of the Reports of the U. S. Fish Commission. I may simply remark that the use of the net extends back to a very remote antiquity, possibly as great as that of the hook and line, if it be not still older. That the inhabitants of the pile dwellings of Switzerland and Central Europe used the net is shown by the finding of many specimens of the netting and the sinkers. The employment of the net by all civilized nations proves that it has been handed down to them from a high antiquity. The seine was used in the pre-Columbian epoch by the Indians of North America, as it is not unusual to find on the rivers and shores large numbers of small rounded stones, notched on two sides, to serve as weights, of precisely the same character as those in use at the present time by the Indians of the northwest coast of America.

The principal forms of the net are the hand or scoop-net, the dip-net, the casting-net, the seine, the trammel-net, the gill-net, the purse-net, and the stake-net.

The scoop-net is familiar to every one. It has various shapes, and is used for landing fish caught with the hook, or capturing fish, particularly the small varieties, penned up in restricted localities.

The dip-net may be considered a modification of the scoop-net, being suspended at the end of a long handle.

The casting-net is largely in use by the Spaniards and Italians, both in Europe and America. This is circular, varying in diameter from 12 to 15 feet. It has leaden balls around the edge, and a long rope attached to the center. This is thrown very skillfully to a considerable distance in such a way as to fall flat upon the water, and dropping rapidly to the bottom incloses any fish that may happen to be beneath it. When the rope is hauled on, the leaden balls at the edge come together at the bottom, so that the net is pursed up when drawn from the water, and the fish are found therein as in a pocket.

The seine is also familiar to all. This is a continuous net, with floats of cork, glass balls, or light wood along the upper margin, and weights of lead or stone along the lower or bottom. Sometimes it has a bag in the center, for the greater facility of holding the fish. This net is sometimes worked from the shore, one end being held on or near it, and the other carried around so as to form a sweep when the two ends are hauled in simultaneously. Sometimes this is dropped in the sea and made to inclose a school of fish. This becomes a purse-net when there is some arrangement for bringing the lower edge of the net together, like the inclosure at the mouth of a purse, so that the fish find themselves closely confined, both laterally and below.

The trammel-net is a very efficient means for capturing fish in waters where dragging is not possible or convenient. This consists of three nets bound together at the edges, the outer ones on either side having a large mesh, and the central one a fine mesh and much fuller than the others. Fish swimming incautiously against this net pass through the outer mesh and strike against the finer central net, carrying a fold of it through the large mesh of the net in the opposite side, and thus become pocketed.

The simplest of all nets, perhaps, is the gill-net, which is a webbing of usually very fine twine, made to float either from the surface or carried to the bottom. The fish, unaware of its presence, or careless in regard to it, in swimming against it pass the head and shoulders through the mesh and become entangled and held until removed, or until devoured by some predaceous fish or invertebrate. No mode of fishing is more economical than this, as the capital required is comparatively light. The nets can be managed by a few persons, and it is only the large fish that are taken, the smaller ones passing readily through the meshes.

The stake net will be found described in the report of the U. S. Fish Commission. It comes more properly under the head of weirs and pounds.

The beam-trawl.—The beam-trawl is not used in America for the capture of fish, although it has been a favorite piece of apparatus with the U. S. Fish Commission for capturing specimens of various kinds of fishes and other marine objects. It is, however, extremely probable that at no distant day it may come into use and our fisheries be prosecuted to a very considerable degree by its aid, although hardly to such an extent as it is employed around Great Britain and off the coasts of France, Holland, and Belgium.

It is essentially a large bag-net, the mouth of which is low and broad, and which is dragged along the bottom behind a vessel of suitable dimensions. This is kept in shape by means of a beam of wood resting at either end on iron runners, which hold it up at the proper distance from the ground and receive the friction of the bottom. As these runners are connected above to the beam, at the lower end they are united by a leaded rope, which constitutes the lower edge of the bag. This leaded line is very slack and forms a bend reaching nearly half way the length of the net, which is usually twice as long as it is broad and ends in a long, narrow apex. As it is drawn along the bottom with the tide, the fish, which usually are found lying with their heads towards the tide, are first dislodged by the lead line, and whether they head upward or forward, are met by the upper side of the net, extending behind the beam. By the continual motion of the trawl they are ultimately carried back to the opposite end of the net, and there, getting into the pockets, are prevented from returning.

The size of the beam varies considerably. By an old British enactment the beam was not to exceed 36 feet in length; but it is sometimes now made nearly 50. The length of the net for a 36-foot beam would be about 70 feet, and one for a 50-foot beam would be about 100 feet long. The net is made with meshes of suitable size, and is usually saved from abrasion on its under surface or posterior end by folds of old netting.

The beam-trawl is now used almost exclusively on the coast of Great Britain for the capture of the more important food-fishes, especially of the turbot and sole, few of which reach the markets captured in any other way. About nine thousand tons of fish are furnished annually from this source alone to the London market; and it is not too much to say that without its use it would be impossible to furnish the English markets with fish.

There are other modifications of the trawl in different countries, all, however, on the same general principle of the dragging of a bag of netting along the sea-bottom. Sometimes this is carried under the vessel, where it is used particularly for the capture of whitebait and other small fish. In other cases, as in Spain, two vessels are used. The simplest form, however, that in common use by the English, French, and Dutch trawlers, is as described. This is dragged behind the vessel at the rate of one or two miles an hour, always with the current, and is sometimes kept down for several hours in succession.

Many objections have been brought to the use of the beam-trawl on the score of its exhausting the grounds, destroying the spawn of the fishes, killing great numbers of small fry, &c. A royal commission was therefore ordered to investigate the whole subject of the methods of capturing fish in the British dominions, and to determine whether any of them were hurtful or not. This was composed of Professor Huxley, Mr. James Caird, and Mr. S. Le Fevré, who took up the subject, and after investigating it most thoroughly gave it as their opinion that, so far from being a destructive method of fishing, the use of the beam-trawl was one of the most commendable; that it involved no greater unnecessary waste to fish life than other methods, and less than most; that so far from destroying the spawn of fish, no one could show that an egg of a fish was ever taken in it, especially in view of the fact that cod, mackerel, the turbot, and the flat-fish generally, the eggs of which it was especially accused of destroying in great numbers, all spawn in the open sea, their eggs floating generally near the surface until hatched, and that, consequently, the beam-trawl could have no influence whatever upon them. It was also shown that the actual nesting-places of many of the fish, such as the herring, &c., are among the rocky portions of the sea-bottom, where the beam-trawl could not be used, requiring, as it does, a perfectly smooth, level sea-bottom for its action.

The masses of so-called fish spawn taken up from the bottom by the beam-trawl, has proved, in all cases to belong to one of the lowest forms of sea animals, either the *Alcyonum digitatum*, or so-called dead man's fingers, on the English coast, or to the compound ascidian, very abundant in America.

The report of the commission states emphatically as the final result of its inquiries that this mode of fishing has been prosecuted in many localities from fifty to a hundred years, not only without diminishing the supply, but indeed showing increased captures, in consequence of the increased number and size of the vessels employed.

As the beam-trawl can only be used to advantage in the capture of the flat-fish and flounders, what it may take of cod and other fishes constituting but a small percentage of its catch, it is not likely that its use will be introduced into the United States until these fish assume a greater proportional value. With the great number of more or less desirable species of the flat-fishes in our waters there is no doubt that immense catches could be made by this means, and the day is probably not very distant when we shall find trawlers at work along Vineyard Sound and off the coast of New York, New Jersey, and the States farther south. Here there are thousands of square miles of sea-bottom admirably adapted to its use, where a rich harvest awaits its introduction.

Weirs and pounds.—The various forms of this most wholesale mode of taking fish will be found fully figured and described in the first report of the U. S. Fish Commission. I may, however, briefly recapitulate some of the more prominent varieties. These are, the floating trap or madrague, the heart-net or pound, the stake-net, and the weir in its various forms.

These all depend upon the movement of the fish in bands, and are sometimes worked in deep water, in which the apparatus is constantly immersed, sometimes depending upon the retention of the fish which come in at high water until the water runs out, leaving the fish high and dry, or else concentrated in small inclosed pools.

The Seconnet (Rhode Island) traps consist in a succession of inclosures held by anchors, and are similar in general character to the madrague of the Mediterranean. While in America the nets scarcely take anything else but scup, sea bass, tautog, and similar fish, those of the Mediterranean are especially used for the capture of tunnies or horse-mackerel. A corresponding difference in the size of the net and in the thickness of the netting is to be found. The heart-nets, or pounds proper, are principally in use in Vineyard Sound and Buzzard's Bay. In these a wall of netting supported upon stakes extends perpendicularly from the shore and ends in a heart-shaped apartment, the pointed end of which passes into what is called the bowl. The fish, in their movements along the coast, come to the wall of netting and are arrested and turned seaward. Their course along the line of netting brings them to the main inclosure, which is so constructed that in circling round in schools they cannot readily find their way out, owing to their indisposition to turn an abrupt corner. Their only escape is into the bowl, which constitutes a second apartment having a bottom of netting. Here they remain until the fishermen come on the scene, and closing up the narrow entrance to the bowl secure whatever it may contain. They proceed to lift the netting of the bowl in which are the living fish, and throwing away the refuse, the desirable varieties are put in a boat or smack, or else placed in what is called a pocket, another inclosure, in which they can be kept until marketed. Of this apparatus there are many varieties.

The stake-nets are used more particularly in the waters of the Dominion for the capture of salmon. The weirs are more generally to be found on the north side of Cape Cod and on the coast of Maine and the Provinces. In these northern localities their use is principally confined to the capture of the herring. On Cape Cod, however, they take immense numbers of sea herring, alewives, and other species.

Many minor varieties, and some of considerable prominence of both pounds and weirs, are to be met with in different parts of the world. I have, however, mentioned those in more general use in the United States.

Other methods.—The remaining methods of capturing fish most usually employed are narcotics, poisons, and explosives. The narcotics and poisons are essentially of a simple character, in some cases the fishes being merely stupefied, and in others actually killed. These are not used in sea fishing, but many an owner of a trout pond or stream has had reason to deplore the dishonesty of the age in the loss he has experienced in a single night by the poacher who has resorted to poisons for securing his bag of fish. Vegetable substances are generally used for this purpose, some of them of a character very easily obtained. It is not necessary for my present object to mention them.

Explosives as a means of capturing fish have come into use quite recently. The explosion of dynamite and other cartridges by means of a time fuse or a wire often results in benumbing or killing large numbers of fish. It is frequently employed by poachers upon trout or other ponds. In the mining regions of California very great destruction to trout and salmon in the rivers and pools has resulted from this practice. In the sea not unfrequently the involuntary result of submarine explosions, for the removal of sunken wrecks or rocks, is the destruction of great numbers of fish, which show themselves on the surface soon after the explosion. In some cases, as on the coast of California, where schools of fish have been thus exposed, great slaughter has been produced in this way. This method of destroying fish is highly objectionable, on the ground that it kills many more fish than can be utilized, as they are washed away by the tides and lost.

D.—Bait used in the sea fisheries of eastern North America.

Baits and allurements.—Having thus presented an account of the more effective apparatus by which fish are captured, I proceed to indicate the more common baits and allurements to the hook or the net employed by the American fishermen. These are of various kinds, the simplest consisting of the naked hook, which by its rapid motion through the water induces many fish to snap at it, and to be caught thereby. The bluefish, bass, pickerel, and many other varieties are caught with a hook having some bright substance forming part of the shank. This may be a piece of bright pewter, tin, bone, iron, or other substance, and presented in the form of a plate, a cylinder, a spoon, or else a screw, by which a rapid rotation or whirling motion is caused when drawn through the water. Not unfrequently an eel-skin or similar substance is stretched over the shank of the hook, and answers an excellent purpose. A bait of white cloth is sometimes quite sufficient in taking mackerel. The efficiency of a piece of red flannel fastened to three hooks, placed back to back, in taking frogs is well known to boys in the country.

Vegetable substances are not much used, as few fish are attracted by them. Bread crumbs, corn, cabbage leaves, &c., may be employed in the capture of carp and other vegetable feeders.

Animal matter is generally employed as bait to attract fishes to the hook or into a net, other substances being considered of little account in comparison, almost every animal of any kind or description being available to a greater or less extent for the purpose. In sea fishing mammals are not used very extensively. Portions of meat of almost any kind are used by the fresh-water angler for the capture of catfish, eels, the percoids, &c. At sea the flesh of the porpoise and other cetaceans is not unfrequently relied upon for the capture of cod and halibut when other bait fails.

Few persons realize the extent to which birds are sometimes employed as bait in the great offshore fisheries, the banker, when other bait fails, being able frequently to take large numbers of fish by the use as bait of the *Procellaria*, including petrels, fulmars, &c., as also of gulls, murres, &c. Most of these forms are easily caught on the hook, sometimes as many as a thousand birds, and especially of the petrel family generally (*Puffinus major*), have been taken and used for bait by a single vessel on the Grand Bank. The gannets, penguins, cormorants, &c., are also taken in some parts of the world for a similar purpose.

On this subject, Capt. J. W. Collins says: "A few years ago, when many of the Grand Bankers went "shack fishing" and depended to a considerable extent on catching birds for bait, many thousands (mostly *Puffinus major*) were caught and used by the crew of each vessel on a single trip. As these trips were sometimes three or four months in length, and it was often possible for the crew to catch several hundreds in a single day—indeed I have known of one man taking nearly a hundred in a few hours—it will readily be seen that an enormous amount of these birds must have been utilized in a single summer for this purpose."

There is but little, if any, use of the reptiles in the sea fisheries of the United States, although the frog is called into play in certain forms of fresh-water fishing.

The various kinds of marine *vertebrates* constitute the chief portion of the sea-fisherman's bait, partly in consequence of their more ready availability, and partly because the fishes sought for are more accustomed to fish as food, and are more readily attracted to it. The other kinds of bait just mentioned come into play as *substitutes*, but can hardly be considered as representing the regular resources of the North Atlantic fishermen, and I therefore proceed to a more detailed consideration of the standard articles of supply for bait, consisting especially of fishes, crustaceans, and mollusks.

In the portion of the report devoted to the methods and apparatus of fishing practiced in the Eastern United States and the British Provinces some allusion has been made to the subject of bait for the hand and long lines, but it may be well to review the subject in a more systematic manner, beginning with the enumeration of the following as the more prominent substances used:

1. Menhaden.
2. Alewives.
3. Sea Herring.
4. Mackerel.
5. Capelin.
6. Sundry species of less note.
7. Roes of various fishes, especially of cod and mackerel.
8. Squid.
9. Whelks.
10. Clams.
11. Mussels, oysters, and scallops.
12. Lobsters, crabs, shrimps, and other crustaceans.

Other varieties of animal substances are used as bait under particular circumstances and in particular localities; but those just mentioned are of most economical value, and the possibility of obtaining one or other of them in greater or less abundance constitutes a very important factor to the fisheries of the mackerel, the cod, the halibut, and other species.

Of the species mentioned, the menhaden is at present peculiar to the shores of the United States, while the fifth, or capelin, is found only about Newfoundland, on the coast and islands of the Bay of Saint Lawrence, and the coast of Labrador. Dr. Gilpin refers to the occurrence of capelin in Halifax Harbor one season; but it is unknown as a regular visitant there, nor has it ever been positively noticed even as an occasional visitant of the Bay of Fundy.

The special details in regard to the natural history and character of the fishes just enumerated belong in the chapter on the natural history and economy of the several American species, and are merely alluded to briefly in this special connection as bait.

In the very great variety of fish bait, and its occurrence at the various seasons of the year at different points, all portions of the United States and the Provinces may be considered as equally well provided in this respect; and although circumstances may render the procuring of this bait in a particular locality a convenience, yet it can be easily shown that whatever be the restrictions upon either country as to particular localities, there can be no question as to the possibility of securing an ample supply in some other, although possibly at somewhat greater trouble and expense.

(1) *Menhaden.*—Of all the species mentioned as used for bait the menhaden is probably that of most importance, whether we consider its wide extent of distribution, its overwhelming abundance along the

coast at different times, or its attractiveness to other fish. Wherever it is met with, at different seasons of the year, from Florida to Penobscot Bay, it is always in request for bait. It is, however, only in the northern part of the United States that it is "slivered" and put up in large quantities either in ice or in salt and carried on distant voyages for the purpose of catching cod or mackerel. There is a peculiar toughness of the flesh and rankness of flavor which seem to constitute an appetizing attraction, not to be resisted by fishes generally, and the possessor of menhaden bait will be able to entice mackerel and cod, striped bass, sea bass, and other fishes, when a fellow-fisherman near by finds other bait valueless in comparison.

The earliest appearance of schools of menhaden off the coast of the Middle States is the signal for securing a quantity for the cod fishing banks; and until their disappearance from the North they are in constant request, this application of the fish, of course, being entirely independent of its use in the preparation of oil and guano.

(2) *Alewives.*—The two species of alewives, taken together, have a still greater range than the menhaden, being found from Florida to the coast of Labrador, and are, if anything, more abundant in the Middle and Southern States than at points farther north. They enter the mouths of all the rivers from the sea in vast schools, beginning in the early spring in each latitude, and can be taken for a few weeks in any quantity. They can be obtained as early as January in the Saint John's River, Florida, and in March or April in the Potomac, and would, undoubtedly, if other fish were unprocurable, be used for the spring cod fishery, serving a very excellent purpose in this respect. It is probable that the numerous schools of adult fish, coming in from the depths of the ocean to the shores in the spring, and of the young that pass out seaward in the autumn draw the larger sea fish into the vicinity of the land, and there can be no reasonable question that the great decrease in numbers of the latter, within the last fifty or one hundred years, has been caused, in large part, by human agencies, which have rendered it necessary to change the location of the fishing-grounds and to greatly limit the capture in ordinary boats of cod, haddock, hake, and the like in the bays and on the shores of New England, which was formerly so extensive and profitable.

As will be shown elsewhere, it is entirely within the power of man to restore, in a great measure, the previous abundance and greatly to improve the general fisheries of the coast.

The attractions of the young shad and salmon are doubtless to be added to those of the alewife and herring in drawing the larger fish towards the shore, but they are of less moment in this respect in view of their inferior abundance.

(3) *Sea Herring.*—Next to the menhaden, and indeed in advance of it in some parts of British North America, is to be mentioned the sea herring, which is to be found in one locality or another throughout the entire

year, the fishes now spawning in one vicinity and then feeding in another. Without the sea herring the fisheries of the northeastern coast of North America would be very indifferent, and it is a subject of great congratulation that it is to be had at nearly all seasons, especially when most needed as bait.

Both the menhaden and the herring are used either entire for baiting the hooks, or chopped up fine in a bait-mill as chum for attracting the mackerel within reach of the hook and line or into the net. The sea bass of the New England coast finds during the summer season the chum of the menhaden an irresistible attraction, bringing them within reach of the angler whenever its influence is experienced.

Menhaden and herring are usually cut in pieces for bait for cod and for many other varieties of fish; only the small herring, "spurling," are used whole.

(4) *Mackerel.*—The mackerel is used very frequently as bait, generally the smaller and inferior individuals, or those less valuable for salting being employed. They are also sometimes chopped up as bait for mackerel when cheaper material is not to be had.

(5) *Capelin.*—Allied if not identical forms of capelin occur on both sides of the North Atlantic, and are everywhere eagerly sought after as bait for cod during the period of its presence. Unfortunately on the American coast it is found for only about six weeks. It is then in overwhelming abundance, coming in for the purpose of spawning, the eggs being sometimes washed on the shore in great windrows, and frequently in the edges of the sea forming beds several inches deep. When perfectly fresh no fish can resist its attractions, and for shore cod-fishing during the season nothing better can be had. It is, however, not considered especially advantageous for the bank fishing. The capelin is kept fresh in ice by the American bankers from 8 to 10 days, and occasionally a little longer. The French fishermen use immense quantities of salt capelin in the Grand Bank cod-fishery, though by Americans they are not considered good bait when salted.

In Norway the capelin is used very largely in the spring cod fisheries of Finmark, and its approach is hailed with the greatest satisfaction by the fishermen.

(6) *Sundry fishes used as bait.*—The sand-launce (*Ammodytes*) may also be referred to as specially useful as a bait, as it can be obtained in certain localities along the coast of the United States and the Provinces in vast numbers, and is frequently used as a substitute for other kinds of bait, and the corresponding European species is equally satisfactory, being used by the fishermen on a large scale. Although less in size than most of the species just enumerated, it can be used entire and constitutes quite a tough, desirable bait. This fish lives mostly in the sand, where it buries itself with great rapidity and is entirely concealed from view.

Other baits are frequently used both in the large and small fisheries, eels and lampreys, portions of the bellies of cod and mackerel, the eyes of these and other fishes, and indeed almost any form of refuse fish. Dead fish of any kind are also used to constitute bait for taking lobsters.

(7) *The roe of fish.*—There is no question but that the roe of fish constitutes a very large percentage of the food of the inhabitants of the sea, as it is only by the provision for the destruction of the large proportion that particular species are prevented from increasing in undue and overwhelming numbers. It is rarely that any fish can resist the attractiveness of fish roe, the eggs of trout and salmon being used largely in California for this purpose when nothing else has any attraction.

Besides the use of the roe of fishes as food for man it constitutes an important element on a large scale in the sardine fisheries of Europe. The salted roe of the cod and of the mackerel is prepared for this purpose and shipped, to the extent of many millions of pounds, about 9,000,000 pounds of cod roe (worth $600,000), and one or two millions of that of the mackerel, having been furnished in one year by Norway. Small shipments have been made from the United States to Europe for the same purpose.

These eggs are used especially for attracting schools of sardines into the vicinity of the gill-nets, and for that they are considered almost indispensable.* It is a question whether this same roe could not be employed advantageously in the mackerel fishery as a toling-bait of a more satisfactory character even than the finely-chopped flesh of fish It keeps much more readily than any other, and its use, if not already attempted, should be experimented upon, as the roe both of the cod and the mackerel until recently has been a refuse product. It is worth considering whether it may not be prepared and used to advantage for the purpose in question.†

(8) *Squid.*—The squid, one of the cephalopods, a group of the mollusks, is also a highly important element in the question of bait for the capture of deep-sea fishes, especially the cod and its allies, and occurs in overwhelming numbers along the entire coast of the eastern United States and of the Dominion. Of this there are two principal forms

*According to De la Blanchère, Le Pêche et les Poissons, 1,500,000,000 of these fish are brought into the port of Concarneau alone, this being only one of many from which the industry is carried on in France, Spain, and elsewhere.

†All bait as above referred to is used fresh whenever it can be done. It is, however, preserved in various ways, sometimes by drying, more frequently by salting. The use of ice of late years has come into play very extensively and constitutes a necessary element in most fisheries whether for the preservation of the bait itself or of the fish when caught. For the most part the bait is preserved by keeping ice in contact with it. It is probable, however, as already suggested, that hard freezing may more advantageously be substituted in many cases as being more likely to retain the same attractiveness that freshly-caught bait presents. It is quite probable that by using special apparatus and adjustments the hard freezing may be conducted at very little expense.

equally attractive to the fish, and occurring in very great numbers, the more northern, the *Ommastrephes*, being found about Newfoundland and other portions of the Dominion, and the *Loligo* in increasing numbers from Cape Cod south and westward. They are used either fresh, immediately after being caught, or sometimes kept in ice; being very largely salted, however, in which condition they maintain their attractiveness for about three weeks.* They are usually taken at sea by means of the jig, and inshore the weirs and pounds are sometimes found to contain them in immense numbers.

The squid, of one species or another, is found off the coast throughout the greater part of the year, in Newfoundland more especially in the spring and summer, and on the Massachusetts coast at almost all times. It occurs more rarely in winter, apparently passing off into the warmer waters. It is probable that by exposing the squid to the cold of a freezing mixture and rendering them specially hard, they may be kept indefinitely or until wanted. Among other pounds where squid have been taken in large numbers, that at Waquoit, Mass., captured more than 6,000 in a single day; and at the same pound, the captures for the first twenty-five days in May alone amounted to 35,000. (Rep. U. S. F. C., 1871-'72, page 174.)

(9) *Whelks.*—As already mentioned when discussing the subject of the long or trawl line as used in Europe, the whelk or *Buccinum undatum* was referred to as the principal bait for that mode of fishing; and although captured every year in immense numbers for use by quite a large fleet of boats and vessels, it still appears to be as abundant as ever. Here we have another indirect illustration of the influence of man in producing a balance of power in the sea, the whelks being notorious enemies of the oyster and other mollusks and destroying them in great numbers. The drain, therefore, upon the increase of the whelk doubtless has a material effect on the supply of these other objects.

In England whelks are taken on long-lines, on the snoods of which the common shore crabs are fastened or threaded, no hooks being employed. When laid down, the whelks seize this bait and, retaining their hold with great tenacity, are hauled up.

Another method of taking them is by means of baskets baited inside with pieces of fish, a net being stretched over the end, with the basket in the center. The whelks enter this, and when the baskets are drawn up, they remain in them.

Shallow hoop-nets, too, are baited with fish for this purpose, and the incidental advantage of their capture, as already stated, is in the diminution of an inveterate enemy of the oyster. Each smack requires

* Squid can usually be kept from 2 to 3 weeks in ice, and for months when salted. While the French use salted squid almost exclusively on the Grand Bank, the Americans and Provincials prefer to have them fresh, and use but few salt ones, and those only in the fall when no others can be obtained.—J. W. COLLINS.

as bait for a voyage from fifteen to twenty-five bushels of whelks. These are preserved in bags made of netting and may be kept for a long time in the wells of the smacks. When wanted, the shells are broken and the animals extracted.

The whelk is especially common in the United States from Portland to the Bay of Fundy, and extends to the south of Cape Cod, although rarely. It is usually known in America as the winkle, and is so abundant on the coast of Maine that it could readily be used as bait for cod.

There are many other of the univalves that may be employed as bait, such as the *Busycon* and *Pyrula*, which though seldom used are capable of the same application.

(10) *Clams.*—The clam in its various forms constitutes a very important portion of the bait used on a large scale in the United States and belongs especially to the following species:

The soft clam, *Mya arenaria*.

The common hard clam, *Venus mercenaria*.

The most important of these is perhaps the soft clam, *Mya arenaria*, which occurs in immense numbers along the entire eastern coast of the United States, and is consumed both as food and as bait. For the latter purpose it is collected very largely on the clam flats of Massachusetts and Maine, in some localities the plow being used at low tide to turn up immense numbers. An especially favorite locality is near Ipswich, Mass., where the immense size of the aboriginal kitchen-middens attest the antiquity of the abundance of this species, these being rivaled, however, by the piles of recent shells heaped up by the clam-diggers. About forty barrels of salted clams constitute an average fare for a cod fishing-vessel, and there appears to be no special difficulty in furnishing any number that may be called for, as notwithstanding the demand, the price at which they are sold now is little more than it has been for many years.

The so-called hard clam is more southern in its distribution than the *Mya*, and is less extensively used as bait, in view of the great demand for it as an article of food. On the sea coast, in a small way, however, it is used to a considerable extent.

The hen clam, or *Mactra solidissima*, is also a species which furnishes a valuable bait, and is especially abundant at present in the vicinity of Nantucket, Mass., where large numbers are taken out and used by the cod-fishermen.

In the Gulf of Mexico and the vicinity of Mobile and New Orleans the *Gnathodon cuneatus*, a so-called clam, is also employed largely in the minor fisheries, but has no prominence at all as a bait for the more important enterprises.

According to Mr. N.B.Nutt, collector of customs at Eastport, clams are not collected to any great extent in that vicinity as bait, but they are gathered along the shore from Machias to Mount Desert and sold by dealers at Deer Isle, Booth Bay, and Portland. Forty barrels represent the allowance for an ordinary voyage of a vessel of from 50 to 75 tons. Of late years clams have been less in demand for cod-fishing, fresh herring purchased near the grounds or pickled herring being more extensively used.

(11) *Mussels, Oysters, and Scallops.*—Of the mussel there are two distinct species, both known under the same name, and, although generically distinct, having a very close external resemblance which prevents their being distinguished by the ordinary observer. One of these is the *Mytilus*, the other the *Modiola*. These are well-known inhabitants of the waters, being found attached in great numbers to the piles of piers, and to rocks, gravel, mud, and any other object to which their byssus will adhere. They are a favorite article of food in some parts of the world, being used largely in Europe for this purpose; but they are less esteemed in the United States. Occasionally very grave inconveniences result from poisoning, of greater or less intensity, being produced by them. In view of the well-known fecundity of the mussle, it may be imagined that the spat in regions where they abound constitutes a very important element in the food of young fish, and the contents of the towing-net are very frequently composed largely of extremely minute mussels, which are greedily devoured by a great variety of species.

The oyster is not often used as bait. It is almost too valuable to be wasted in this way, and is of so soft and delicate a texture as to break away from the hook with but a slight touch.

The common scallop, *Pecten irradians*, which is extremely abundant off the coast of the Middle and Northern States, is largely utilized for food, and only occasionally used as bait for fish.

(12) *Lobsters, Crabs, Shrimps, etc.*—The lobster constitutes a very attractive bait in the small fisheries; but it is too valuable in itself as an article of commerce, to be employed to any great extent. Frequently, however, young lobsters, not marketable, or falling within prohibited limits of the legal enactments of certain States, are used for capturing shore fishes.

Along the coast of the South Atlantic and Middle States a very favorite bait for the ordinary shore fishes is the common blue crab (*Callinectes hastatus*) a species occurring in enormous abundance, and constituting a favorite article of food, whether as hard or soft shell. This is a great resource to the fishermen, few fish resisting its attractions, especially when the old shell has been thrown off, leaving only a soft skin behind. Diminishing in abundance towards Cape Cod, its place is supplied, thence northward, by what is there called the common crab (*Carcinus mænas*). This appears to constitute an especial attraction to the tautog, and doubtless constitutes its food in the sea in very great part.

Shrimps also are used all along the eastern coast of the United States in sea fishing.

E.—Methods and Routine of Fishery.

The necessary limitations of space in the present essay require me to defer the consideration of this subject to another occasion, especially as it will come naturally within the investigations of the forthcoming census of 1880.

F.—Preservation of Fish and Bait.

The subject of the preservation of the products of the fisheries is one of very great importance, and is receiving more and more attention every day. In the earlier period of the American Republic the abundance of animal life in the waters was so great that there was little difficulty in taking the needed supply of food whenever it was wanted, rendering the question of its preservation comparatively unimportant. Of course, the methods of salting and drying were in vogue, but the long-continued preservation of fish in a fresh state was of comparatively little consequence. The circumstances have changed very greatly in this respect. The abundance of fish, &c., has diminished to a greater or less extent, while the population of the country has increased enormously. The demand for fresh fish, too, has increased more than in proportion to the increase of population. The great extension of the system of communication with the seaports, both by steamboats and railroads, has been such as to render it practicable to carry the products of the sea fresh to a great distance. The same methods are available both for keeping bait for use in the fisheries as are employed in keeping the products of the fisheries themselves, and it will therefore not be necessary to discriminate between them.

We may consider this subject of preservation under several heads: (1) As fresh, without any special treatment; (2) as fresh, by means of ice; (3) by drying; (4) by salting or the addition of some chemical substance; (5) by smoking; (6) that of immersion in alcohol or some saline substance, for scientific purposes, which properly does not enter into the plan of this paper.

Fish may, of course, be preserved for a greater or less time for purposes of food or bait without any treatment whatever, this depending upon the amount of moisture in the atmosphere and the temperature. In the colder seasons of the year of any locality an object of this character can be kept for many days, especially if the entrails are removed, the adherent blood washed from the inside, and the inside surface allowed to dry in some way. In warmer latitudes and periods, however, the flesh corrupts rapidly. The difficulty is that in the tropical or sub-tropical latitudes a fish will acquire a taint of corruption or decomposition within a very short time after the capture, so that even before the boat's load can be landed and subjected to the treatment of salt, or otherwise, it will have passed beyond the stage when this can be applied with any success.

Of course, when fish are taken in cold weather and frozen they will remain in good condition as long as the cold lasts;* and the absence of a definite continuance of this condition suggested the use of ice in some form in the warmer season of the year. The simplest method of using ice is, of course, to lay the fish on it, and thus keeping down the temperature. The more common method of employing ice, however, is to pound it up and arrange it in layers with the fish, one alternating with the other until the given receptacle is filled. This, however, has the very serious disadvantage in the quantity of moisture necessarily held in contact with the fish, the ice melting very rapidly and the fish becoming saturated with the resultant water, from which in time comes an acidity or mustiness of the fish which is not at all palatable. In some cases, indeed, fish will keep better by being immersed in water kept cool by means of floating pieces of ice than when packed away in pounded ice itself. Fish thus treated become unpalatable when kept some time after removal from the ice. About two weeks represents the limit of time during which, under ordinary circumstances, fish may be kept by the method indicated. After that period the fisherman finds that his bait ceases to be attractive, and the necessity for a renewal occurs.

Icing of fish and bait.—The fishermen at New London and Noank, who are almost exclusively occupied in furnishing fresh fish to the New York market, by the exercise of special precaution are able to keep their fish and bait fresh a much longer time than is the experience at Gloucester. They exercise very great care in the preparation of the bait, which is opened and thoroughly washed and cleaned, the adherent blood along the backbone being especially removed.

Their bait pens are in one large apartment instead of three or four smaller ones, as is the practice at Gloucester, and are carefully lined with some non-conducting substance. The bottom is paved continuously with ice, to the original thickness of the block, whatever that may be. On this is placed a layer of fish three or four inches thick, and above this a layer of equal thickness of finely-pounded ice, snow answering a very good purpose if this can be had. On this is another stratum of fish, and then pounded ice, and so on until the whole is filled. The atmospheric air is excluded very thoroughly in this way, and the amount of melting is comparatively trifling. The resultant water is immediately absorbed by the porous layers of pounded ice and held as by a sponge, so that the fish are kept comparatively dry.

In the other method of breaking up the ice with a hammer and sliding in layers over the fish there is much greater exposure to the air, and the water from the melting ice sinks to the bottom and keeps the fish or bait saturated throughout. In this way two weeks is usually

* I am informed that the first to commence the business of freezing herring and bringing them from Newfoundland was Capt. Henry Smith, of Gloucester, in 1856. In 1857 Capt. Sylvanus Smith went into the same business and continued it for some time.

the limit during which bait can be kept fresh, instead of six or eight weeks, as claimed by the New London fishermen, who see no difficulty whatever in carrying enough fresh bait for a long voyage to the banks, supplemented, should it be necessary, by soft clams, and thus obviating the necessity of going into Newfoundland or elsewhere for a fresh supply.

Ice can be applied much more advantageously for cooling fish (independently of freezing them) in specially constructed apparatus, known usually as refrigerators. The refrigerator, however, furnishes the most economical mode of applying cold to the fish. In some cases the function of the refrigerator is simply to prevent an unnecessary waste of ice by melting away, so that a given quantity will last a much longer time. Other forms of refrigerators have a very different function, the simplest of which consist of an arrangement by which a current of cold, dry air is made to circulate through a provision chamber, taking off the excess of moisture and allowing it to be condensed upon the ice itself. This desiccation may be so rapid and excessive as to bring it under the head of "preservation by drying." It is not at present used to any great extent in the sea-fisheries for the preservation, on a large scale, of fish for a long time. This is most effectively accomplished by the hard freezing process, which is destined to take the place of all others before long, as preserving the animal fiber indefinitely, or as long as the freezing is maintained at the proper temperature, and with a comparatively small consumption of ice and salt.

According to Mr. E. G. Blackford, the eminent fish-dealer in Fulton Market, New York, a room, 10 feet each way, or of 1,000 cubic feet, with properly constructed non-conducting walls surrounding it, can be kept in effective operation in the summer weather of New York by the use of 2,000 pounds of ice and 2 bushels of salt per week, with less in colder weather. This would be, for a room of that size, 4½ tons of ice and 9 bushels of salt per month. As, however, all the bait necessary for a trawling expedition to the banks for cod could be kept in a room of half that size, it is likely that three-fourths the amount of ice and salt would be sufficient, or about 3½ tons of ice and 7 bushels of salt per month. With all the fresh bait on board required for a voyage to the banks and the filling up of the vessel, the amount for two months should not exceed at the outside 7 tons of ice. Allowing as much more for wastage, 14 tons would probably be an ample allowance. During 1877 ice cost $2 a ton at Gloucester and $12 a ton at Newfoundland.

A patent has been recently introduced to the notice of fish-dealers, by which fish are arranged conveniently in vessels which are filled up with water, and the whole then frozen into a solid cake, and kept in this condition until used. This process is claimed by those interested to keep the fish perfectly fresh indefinitely without the evaporation and loss of savor so frequently found in the dry-hard method.

In freezing animals hard and stiff care must be taken to extract the heat slowly in proportion to their size. It is a common occurrence for moose, reindeer, and other large mammals when killed in a very cold atmosphere to become putrid internally in a few hours, although the exterior may be frozen stiff. The remedy here is probably immediate disemboweling. It is said that halibut cannot be frozen stiff and dry to advantage from the tendency to spoiling in the interior.

It is not an uncommon thing for fishermen on the banks to renew their supply of ice for bait from the floating icebergs. They do not usually venture on a large berg for this purpose; but generally there are to be found in its vicinity fragments of greater or less size which have been broken off from the main mass and are easily secured. The supply of fresh water, too, is not unfrequently obtained in a similar manner.

Desiccation.—Desiccation, or drying, comes next to cold, either natural or artificial, as a method for preserving fish for food or bait, and, indeed, is sometimes more available. This consists, in the simplest form, in the exposure of the fish, usually split to some extent, to a dry atmosphere or the sun, causing the evaporation of the moisture to a greater or less degree. Sometimes this process is accelerated by the application of artificial heat, which causes a more speedy evaporation of the moisture. A current of air, either warm or cold, made to play over the fish, carries on the work very rapidly. Quite recently the production of this current of dry air by cold has been called into service, and with very excellent results, the flesh not being altered in any way, and the desiccation being rapid and thorough. Of late years artificial processes of desiccation have been multiplied, and are being applied to all forms of marine products, including oysters, clams, lobsters, shrimps, &c., as well as fishes themselves. Of course the use of a similar method for preserving vegetables and the flesh of land animals is familiar to every one. The preservation of bait by drying has not been very general; but it seems probable that when the application of the desiccating process comes to be more economically applied, it can be called into play to very great advantage.

A writer in the Newfoundland Chronicle for September, 1877, speaking of squid bait, remarks that during the squid season, which usually lasts about six weeks, there is no other bait so attractive to codfish, and that even when salted it is preferred by the fish to fresh herring. He suggests that the proper method of preparing the squid so as to be available under all circumstances and at all seasons is to wash and dry it as soon as possible in the sun and without salt. He does not state, however, whether the experiment has actually been tried.

If the bait thus prepared proves to be attractive to the fish there will be no difficulty, if it cannot be readily dried in the atmosphere of New England, in doing this by means of some of the patent desiccating processes.

Considerable quantities of squid are dried on the coast of Newfoundand, the bodies being first split open and the heads and entrails removed. I secured a few of them in the fall of 1876 and tried them on the Grand Bank, but under such unfavorable circumstances that nothing definite could be learned as to the relative value of squid bait prepared in that manner. The Newfoundland fisher men, however, claim that, when soaked for several hours before it is used, it nearly equals for bait the squid that are just caught.

The method of preserving fish and bait by salting is of course familiar to all, and need not be discussed here to any great length. It will be sufficient to mention that the principal subdivisions consist of salting by sprinkling salt on successive layers of fish, which are piled up in masses, known as kench-curing; of immersion in a saline solution, known as pickling; and of salting for a certain length of time by either of these processes and then drying by exposure to the air and by smoking, all of which have their advantages under particular circumstances.

Salting, etc.—The salt used in the preservation of fish in the methods indicated is, for the most part, the common chloride of sodium, or table salt. The quality of this, however, varies in different regions, some varieties being considered preferable for special applications, and others much less satisfactory.

A very troublesome affection of salted and dried fish is that known as "reddening," where patches of red color make their appearance on the surface of the fish, and rapidly extending, soon render it unfit for food. This is usually met with in the foggy August or dog-day weather. A careful examination of this substance by Dr. Farlow has shown that this redness is due to a minute algous plant abounding in the shallow sea-shores and not unfrequently included in the crystallized salt made by solar evaporation. Its presence is indicated by a slight pink or rosy tint in the salt, and at any rate it appears that fish treated with this salt is more liable to the affection than where the salt is obtained from mineral deposits or else is perfectly white sea salt.

Other saline substances are used in some cases; and quite recently borax, in one form or another, has been warmly recommended as securing the proper preservation of the flesh by the use of a much smaller quantity of mineral matter. A favorite Swedish preparation, called aseptin, used for keeping milk and other animal substances without imparting a saline taste, consists essentially of borax.

Quite recently other chemical substances have been suggested, and among others is one lately communicated by D'Amélio to the Academy of Sciences in Paris. For this purpose the meat, either raw or boiled, is cut into sections (if the action is to be very rapid) and immersed in a solution of citric acid in water in sufficient proportion to render it decidedly acid. After two or three hours the meat is withdrawn and subjected to a moderate degree of artificial heat, or exposed to the air until dry. With the artificial heat the result should be accomplished in an hour, and in the open air in five or six days. This meat can be kept for years. To restore it to softness and flexibility it is only necessary to plunge it three or four days into fresh water. In time it acquires the hardness of wood, and the fatty portions have a tallowy odor.

Smoking.—A remaining method of preserving fish for food, if not for bait, is that of smoking, which has been used from time immemorial. This consists merely in exposing the flesh, either fresh or after being salted to some degree, to the smoke produced by burning bark or wood. This changes the texture of the fiber apparently by the action of pyroligneous acid or some creosote product, at the same time preserving it and giving it a very agreeable taste. The celebrated Finmark haddies consist of the haddock slightly smoked to a moderate degree, not enough to keep them for a long time, but involving a less amount of salt and of smoking than usual. Other fish, of course, are readily prepared in the same way.

G.—DISPOSITION OF OFFAL OR "GURRY."

The question of a convenient or economical disposition of the offal of fish, especially of the heads and entrails, is a serious matter to the fisherman, especially when the cleaning or preparation for market is conducted at sea. This waste matter constitutes a large percentage of the entire mass (about a third), and what is thrown away every year by fishermen of any considerable fishing station may amount to hundreds of tons. Men fishing in small boats, however, usually have no other convenient alternative.

The objections made to this disposition of offal are of two classes, one on the score of waste, the other on the ground that the capture of fish in that locality is greatly interfered with. In the same connection I may refer to the question of waste of fish by means of the trawl-line, or the purse and gill net. As already mentioned, a severe complaint brought in North America against the apparatus referred to, is that large numbers of fish are lost from the trawl-line or from the nets in consequence of storms or otherwise; and that apart from the waste, these fish falling to the bottom, contaminate the fishing-grounds by their decomposition and drive other fish away, as shown by the inability to make successful catches until after a period sufficient to allow this matter to be decomposed or removed in some manner.

The assertions of injury to the fishing-grounds in consequence of the gurry being thrown overboard or of the number of dead fish dropping from the lines or partly devoured by other fishes, apply most generally to the localities of the capture of the *Gadidæ* or members of the cod family, especially the true cod, haddock, hake, cusk, as well as of some other species, including also the halibut and others of the flat-fish family. It must be remembered, however, that these grounds are always in the colder portions of the sea, not unfrequently where the temperature of the water is but little above the freezing-point of fresh water, and always where it is as low as 50°. In regions where such temperatures prevail the year round, the cod and its allies are found continuously. In others, as in the south side of New England, the fish come in as the waters at the bottom of the sea assume the temperature which they affect.

So far as the cleaning of fish at sea and the throwing overboard of the offal or so-called gurry are concerned, the practice is highly reprehensible in an economical point of view; and as representing an enormous waste of material capable of being devoted to useful purposes, the practice should be frowned down and prevented by legislation if possible.

On the coast of Norway all such materials, which formerly were wasted, are now carefully husbanded and add very greatly to the percentage of the yield of any fishery. Sometimes this material is boiled and made to furnish a large amount of oil and scrap. At others the heads are assorted and dried as a special food for animals. The actual yield of guano alone from the Norwegian fisheries has in a single year amounted to 7,700,000 pounds, a very notable element in the productive resources of the country. Whether this material be injurious to the fisheries or not, its preservation and utilization is too important to be neglected; and for this, instead of enacting a prohibitory law, which could not be enforced, it might be better to offer a bounty or drawback of some kind, in proportion to the amount of this material delivered on shore. In this event, even if the fish were more conveniently cleaned at sea, the refuse might be saved in barrels and put on shore at a convenient point. If the solid parts were for the most part saved, the juices and small particles might be poured into the sea without any detriment.

In regard to the allegation, however, that this offal or the dead fish falling from the hooks, in whatever quantity this may be present, affects the fishing-ground, it is extremely difficult to comprehend how this can have any serious effect. In the first place, the cold water in which the fishes of the cod family occur abound to an enormous degree with marine crustaceans, the self-appointed scavengers of the ocean. These are largely a species of *Gammarus* and allied forms very varying in size and in overwhelming and almost incredible numbers, and their efficiency in their appointed task is so great that a large fish placed in a box or suspended in a bag of netting, will frequently be picked to a most perfect and complete skeleton in from twelve to twenty-four hours; indeed, not unfrequently the fish on the trawl-lines are brought up skeletonized in this way.

The same waters in which these shrimps are to be found abound very largely in lobsters, which are baited by precisely the same offal which is considered so detrimental to the fishing. There are also immense schools of small fish such as cunners, and more particularly the Cyprinodonts, which are as active and prompt in their attacks upon dead matter as the crustacea; as witness the experience of those who find a large and valued bait cleaned entirely from the hook by these smaller fish before it has been down more than a very few minutes. The wolf-fish or catfish (*Anarrhichas*), the sculpins, the sea-ravens, the goosefish,

&c., may also be mentioned among these scavengers, the latter especially finding no difficulty in swallowing entire the largest masses of offal that are likely to be thrown overboard. There is no doubt whatever that all such substances scattered in or floating through the water are promptly seized by the lobsters, dogfish, and other species of sharks, and numerous others of the finny tribe that are always on the watch for such material, and it is altogether incredible that with all these agencies working together there should be any appreciable quantity of dead fish or its refuse left at the end of twenty-four hours.

A large part of the gurry is probably carried off from the grounds by the tides and thus distributed over a wide extent of the sea, the chances of its reaching the bottom and remaining there for any time being still further diminished. Even supposing the skeletons and bones to be thoroughly cleaned and left, and that by their whiteness or other quality they should terrify the fish, another series of scavengers comes into play, namely, the sea-urchins, or sea-eggs. These, which swarm in enormous troops in the same waters, concentrate themselves in a very short time upon a bone and devour it as perfectly as the sea-lice do the flesh, leaving nothing whatever. It has been suggested that these sea-fleas and sea-urchins only carry on their operations in shallow water. This, however, is a great mistake, as the dredgings of scientific investigators in the vicinity of Grand Manan and elsewhere show that no portion of the sea-bottom, even to several hundred fathoms in depth, is without them, and, indeed, if there is any difference it is probably in favor of the colder and deeper water.

The inquiry naturally arises, why, if the chopped fish, including entrails and roe, constitute an attractive bait to the mackerel sufficient to draw them many miles out of their intended course, and dead fish can be used to bait perch pots, should precisely the same material, in not quite so minute a state of division, terrify and drive away the inhabitants of the deep sea? It is, of course, possible that a great abundance of animal matter floating in the water, or for the moment lying on the bottom, may affect the actual fishery in consequence of the preference on the part of the fish to this matter over the more doubtful attractions of a baited hook. This, however, would be only temporary, and the interruption would soon cease. Possibly, too (and perhaps this is a powerful agency), the presence of this offal may attract the dogfish, sharks, and other predaceous species, so that they may drive away the weaker and comparatively defenseless cod.*

*At one time the practice of the French fishermen of throwing overboard the gurry was bitterly complained of by the English on the ground that it materially affected the fishing. The explanation given was probably the true one, namely, that this offal attracted an immense number of sharks, dogfish, and other predaceous fish, which concentrated in unusual numbers, and not only devoured the offal, but drove out all the fish from the ground. Nothing was suggested as to any defilement of the sea bottom itself by the accumulation of decaying animal matter. (British Fishery Commission Report, p. lxi.)

The fact that the throwing overboard of offal does not in itself drive away fish generally is illustrated in the fishery for the small dog shark about Provincetown. Great numbers of these are taken annually for the livers, which are removed, and the rest of the fish thrown overboard. The result is apparently to increase the number of these fish, and make the catch of a larger number practicable.

The number of skates is greatly increased in any given locality, on the banks where they abound, by throwing overboard large quantities of gurry. This is especially noticeable to the trawl fishermen, who often find after remaining in one berth or position for several days, that the ends of the trawls next the vessel have on them an increased number of skates.

In further reference to this subject of gurry on fishing-grounds and to the alleged wastage of fish by dropping from trawls and gill-nets, it is not a little remarkable that the question of the injury of the use of the trawl-line to the fish and fisheries of the locality where practiced, should at the present time be for the most part confined to North America, while European writers now scarcely refer to any inconvenience likely to result from this cause. The practice of line fishing is considered in its two divisions of hand-line and trawl, or long-line, but this is merely a question of comparative expediency and the cost of the investment.

In the question at issue between the fishermen of Great Britain in 1866, the case lay for the most part between the trawls on the one side and the hand-line fishermen on the other, the latter making no charge of any injury to the fishing in the rejoinder against the long-lines.

It is perhaps less the practice in Europe than it is in America to clean the fish at sea, and to throw the refuse overboard, a wasteful practice, which of course is to be discountenanced. In Norway, on the great fishing-grounds, the sale of the offal to companies organized for utilizing it is a matter of very great importance. It is sold at a fair price, the dried head of the cod being in part prepared as food for cattle, but for the most part converted into guano, which has an established position in the European markets, as might be expected, allowing it to constitute one-third of the total weight of nearly 20,000,000 codfish.

In England the codfish taken are for the most part sold entire or dressed in the fishmongers' establishments.

If a considerable percentage of the fish taken on the long-line or trawl is necessarily lost by dropping off from the hooks by their excessive weight on being hauled up, the injury, if it be one, of their decay on the sea-bottom would in all probability have impressed itself upon the minds of observers in England; but the only allusions I have been able to find to this subject of dead fish on fishing-grounds is in connection with the herring fishery on the coast of Norway, where it was alleged that the dead fish which were lost from the gill-nets polluted the water and tended to drive the herring away.

According to Feddersen (Rep. U. S. F. C., 1873–5, p. 183), neither this nor the discharge of oil into the ocean from factories on shore proved to have any deleterious influence, the fish coming year after year even in increasing abundance to localities infected as mentioned, while they were just as likely to disappear capriciously and suddenly from waters where no such complaints could be alleged; indeed, as stated on page 118, a careful examination of the bottom of the sea, by means of the water telescope failed to reveal a persistence of dead fish, the appointed scavengers of the sea very soon removing them effectually. It was only occasionally in the crevices of the rocks and apparently sheltered from convenient approach that the dead herring or their skeletons were known to remain even for a few weeks, subsequent examinations failing to indicate the presence of any dead animal matter.

H.—REVIEW OF THE AMERICAN FISHERIES.

The time when a faithful presentation of this subject can be made has not yet arrived, and its discussion must be deferred until an exhaustive canvass of the country has been made. As a slight contribution to the subject the following tables are given:

Fishery products of Gloucester in 1876.

Cod, 425,000 quintals	$2,295,000
Mackerel, 101,032 barrels	909,000
Herring, 30,000 barrels	127,500
Dry-fish, other than cod (pollock, cusk, haddock, and hake, about equal proportions), 40,000 quintals	120,000
Shell-fish	10,000
Fresh fish, 11,000,000 pounds	745,000
Fish oil (cod-liver nine-tenths at least), 275,000 gallons	132,000
Fish manure (herring), 8,000 tons	25,000
Miscellaneous	10,000
Smoked halibut (three-fourths made from catch of "fresh" vessels), 2,750,000 pounds	275,000
	4,648,500

40 per cent. of flitching from halibut.
405,000 quintals, pickle-cured.

The following table shows the value and extent of the fishing business of the port of Gloucester for the year 1875:

Bank codfish, 177,473 quintals	$998,628
George's codfish, 185,758 quintals	1,021,669
George's halibut, 2,462,364 pounds	172,365
Bank halibut, 7,248,423 pounds	507,389
Hake, 4,257 quintals	12,774
Cusk, 2,349 quintals	7,047
Pollock, 9,417 quintals	32,964
Herring, 38,292 barrels	153,168
Shore fisheries, the work of dory fishermen:	
Fresh fish	89,738
Cured	185,697
Oil	8,945

Mackerel:	
18,172⅝ barrels No. 1	$327,112
7,065⅛ barrels No. 2	184,780
21,763 barrels No. 3	174,104
4,039⅜ barrels No. 4	24,205
Pickled fish, 31,750 herring	13,494
163 barrels cod, 40¼ barrels swordfish	1,097
410⅜ barrels trout, 75¾ barrels fins and napes	4,042
21⅞ barrels salmon, 205 barrels tongues and sounds	2,282
Shell-fish, clams, &c	10,000
6,500 tons manure	20,000
All other fish	8,000
Oil, other than above	100,000
	4,059,500

III.—ECONOMICAL APPLICATIONS OF THE PRODUCTS OF THE FISHERIES.

The inhabitants of the sea which occupy a more or less direct relation to man in their economical application are usually classed by the common name of fish, the term fisheries being applied to the methods of their capture. This, however, is to a certain extent a misnomer, as in addition to what are properly known as fish we have to consider the cetaceans, such as the whales and porpoises; the crustaceans, as the crabs, lobsters, and shrimps; the mollusks or shell-fish, such as the clams, oysters, and the like; the corals, sponges, and many other forms of animal life.

The uses to which the various marine animals are put are very various, although by far the most important application is in the way of food for man, and to some extent for the lower animals.

The objects of the fisheries and the applications of the animals of the sea when caught may be considered under the following heads:

(1) *Food.*—For the direct use by man himself; and, second, as bait for the prosecution of the fisheries.

(2) *Oil.*—For food or medicine; for illumination; for use in the arts, as in the manufacture of soap, the dressing of leather, &c.

(3) *Manure.*—Applied in a fresh state directly to the soil; as dried and subjected to chemical manipulation and combination with other substances.

(4) *Utility and ornament.*—A systematic account of all the uses in their minutest detail to which the inhabitants of the sea are put by man would go far beyond the limits of the present article, and it is possible but briefly to refer to some of the more important, concentrating attention hereafter upon those which bear most closely upon the subject of the value of the fisheries in the United States and the Dominion of Canada.

For the present it is necessary to leave out the consideration of the cetaceans and other marine mammals, as well as the corals and sponges, and some of the applications even of the fishes and crustaceans; and to furthermore restrict our consideration to the fishes proper, introducing other forms only so far as they relate to the question of bait.

1. *As food for man and animals.*—By far the most important application of fish is as sustenance for man; a large proportion of the population of the globe deriving its support more or less exclusively from this source.

Although the fresh-water fisheries in many countries are of great importance, and supply a notable percentage of valuable food, it is from the sea that not only the great portion of the fish found in our markets is derived, but also the bulk of that which is preserved by various methods for a greater or less length of time, and for transportation to distant markets.

Fresh fish can, of course, be kept in a cool climate for a considerable time without any special preparation; but the simplest mode of treating it for preservation is that of drying, by exposure to the sun, either with or without a certain amount of salting.

Next to the drying we have the smoking either of the fresh meat or when it is more or less salted. The salt may be applied either dry or in solution, when the fish are to be used almost immediately (which process is known as corning), or else kept for a longer period. Salt, being a substance found universally, is the cheapest and most convenient medium. The use of borax has already been alluded to on page 137. Salicylic acid, too, in solution can be used to keep fish fresh for a considerable length of time.

Until quite recently the ice has been used by itself, without the addition of any salt whereby to produce the so-called freezing mixture, the fish being kept in boxes or bins in the holds of vessels, in contact with ice, reduced to a greater or less degree of firmness, and drainage being provided to carry away the water. Sometimes the fish are packed with ice and a non-conducting substance like sawdust, which greatly retards the rapidity of melting and permits the shipment in large quantities.

A much better method of using ice alone consists of its application in some of the modern circulating refrigerators, in which it is placed above the receptacle containing the fish or other meats, and a circulation so established which, while keeping the temperature of the air surrounding the meats at a low point, extracts all the moisture from the atmosphere, leaving it perfectly dry, and furnishing an atmosphere corresponding to that of an ordinary clear cold winter's day. The flesh of fish thus treated is very much more palatable than where there is a direct contact with the ice itself; in the latter instance the fish, while not undergoing decomposition, becoming stale and sometimes more or less sour.

The greatest improvement, however, in the preservation of fish for food is by the use of freezing mixtures. Under no circumstances by the use of plain ice at melting temperatures, in an ordinary summer's atmosphere, can the temperature be kept below 40°, and where the fish are not actually in contact with the ice, possibly not below 50°. This involves a tendency to become stale, as above referred to. If, however, the fish be frozen hard and stiff immediately after being caught it may be kept in this condition for an indefinite period of time, and when carefully thawed out and used immediately after, will be very little if at all inferior to a fresh fish. For this purpose the fish are now exposed as soon as possible after being caught to the proximity of a freezing mixture of ice and salt; and as soon as well frozen they are transferred to a much larger chamber in which the temperature is kept by the same means at about 12° to 16°.

These apartments have double walls, with some non-conducting substance interposed, as charcoal or sawdust, and usually have several iron cylinders passing through, which are kept filled with a mixture of ice and salt, provision being made for their introduction above the chamber and for the drainage of the melted liquid below without the necessity of opening the room. Here immense quantities may be kept in a state of absolute unchangeableness as long as the condition of the market requires. This method is now employed in New York and elsewhere for the preservation of all kinds of fish, salmon, striped bass, cod, Spanish mackerel, bluefish, &c., being piled up by the cord.

A very important result of these processes consists in equalizing the market, preventing a glut at one time and an excessive cost at another. Any one of the fish just mentioned, with numerous others, can now be obtained without any difficulty, at any season of the year, from such dealers as E. G. Blackford, Middleton, Carman & Co., and others, in Fulton Market, New York.

There seems to be no reason why dry, hard freezing may not maintain animal matter in a sound and wholesome condition for any period during which it may be applied without interruption; and as a case in point, I adduce certain well-substantiated facts in regard to the occurrence of a carcass of the mammoth in Siberia. It is well known that at one time, probably during the interglacial period, the mammoth, or fossil hairy elephant, was extremely abundant in arctic Asia and America, in the former especially, and that even now a large percentage of the ivory of commerce is derived from the tusks of these animals found in the soil, in the river-beds, or dredged up in the Arctic Ocean off the mouths of the Siberian rivers. It is probable that herds of these animals, in crossing the rivers, were drowned and carried out to sea by the powerful current, when the meat soon decayed or was devoured, and the bones decomposing in time left only the tusks to reward the gatherer. Some years ago a merchant of St. Petersburg, in visiting Northern Siberia in the course of his trade, came across the carcass of a mammoth that had been washed out from a frozen gravel bank along one of the rivers, and lay on the beach, where it had been for many months the prey of dogs and of wolves and other wild animals. At the time he found it a considerable portion was left, although most of the meat had been consumed. It was even then not offensive at all, and the dogs were devouring it with great eagerness. He obtained the skeleton and a portion of the skin, which are now to be seen in the Museum of the Academy of Science of St. Petersburg. The natives assured him that the meat was fresh and fine, and in no way disagreeable. Here we have a case of meat preserved in a natural ice-house through a period, the antiquity of which we cannot readily measure, but certainly an estimate of many thousands of years is entirely within the mark.

The animal was imbedded in the frozen soil below the point where the surface would thaw in the short summers of that country, and remained all that time, with all tendency to decay or deterioration absolutely suspended.

All these processes mentioned for the preservation of fish for food are applied to a greater or less degree in keeping fish to be used as bait in the fisheries, namely, salting, keeping in ice, and hard freezing; drying is less available. They have been discussed under that heading at page 133 *et seq.*

Next in importance is the method of the preservation of fish in oil of one kind or another. Here the fish, after being treated properly, are sealed hermetically in metallic vessels of smaller or larger size. This method of preservation is applied more particularly to the sardines, but is also used in the case of the imitation of sardines, as the pilchards, menhaden, &c. In France, Italy, Spain, and Portugal, however, where olive oil is inexpensive, nearly all kinds of fish are preserved, as the tunny, bass, perch, mullet, &c., and various mollusks. Specimens of such preparations were exhibited at Philadelphia in 1876. In the United States, where olive oil must, for the most part, be imported at a heavy cost, other vegetable oils, especially that of cotton-seed, have been found very satisfactory substitutes.

A novel, and what promises in time to become an important, preparation of food is the result of a process for obtaining the extract from the flesh of the menhaden, as invented and patented by Mr. S. L. Goodale, of Saco, Me. The value, both in a hygienic and dietetic point of view, of the beef extracts of Liebig and other inventors, is now well known and established, and the fish extract of Mr. Goodale, strange to say, has no fishy taste whatever, and is scarcely distinguishable from the meat extract. He claims that an immense amount of this substance can be obtained during the ordinary process of utilizing the menhaden, adding greatly to the profits of the business and without interfering with the preparation of oil and scrap. Samples of this extract were presented at the Philadelphia Exhibition, which were considered very excellent, promising a satisfactory future. In his opinion at least 20,000,000 pounds of this extract can be obtained from the menhaden annually without interfering with the yield of oil and scrap, and possibly of nearly equal money value.

It was first brought to notice at the Centennial Exhibition, and received the high commendations of the jury on the fisheries and foods. The fish are first thoroughly cleaned and washed, and then immersed in boiling water for a short time for the purpose of removing the skin. They are then subjected to a subsequent treatment by which 3 pounds of extract are obtained from each barrel of menhaden, or 4 pounds if the entire fish is manipulated without separation from the bones. This process does not in any way affect the value of the fish for the production of oil or manure, and therefore constitutes an important utilization of a waste product, the proceeds of which will probably in time much more than pay all the increased cost of treatment.

The same method can be applied to other fishes of sufficient size to warrant their evisceration, although it is hardly likely that any fish but the menhaden can be profitably treated in this manner, being actually shipped to Italy for the purpose of adulterating the genuine olive oil. There are other modes of preserving animal substances, especially fish, in use in various parts of the country, but those already given are the most important.

In addition to the consumption of the flesh of fish as food, other parts of the body are used for a similar purpose, the most important being the livers and the air-bladders. The livers of many fish, especially the *Gadidæ*, of some of the sharks and some other species, furnish oil in very great quantity; and those of the cod especially, and other fish of the cod family generally, are used as food, particularly as nutriment for invalids affected by consumption or other wasting disease. The oil is also used for industrial purposes, which will be referred to hereafter.

The air-bladders or sounds of fish are very extensively employed in the preparation of so-called isinglass, of which the most esteemed is that from the sturgeon and the hake.

Of late years an excellent glue is made from the skin as well as the air-bladder of fishes, but this has mostly technical applications. The isinglass of fish when used as food is usually employed for the most part in the preparation of jellies, gum-drops, &c., as well as in the refining of beer and other beverages.

Under the head of the application of fish as food must be included their use as bait for the fisheries, as also their destruction by their fellows for their sustenance. These subjects will be referred to hereafter.

Besides the use of the meat of the fish, either fresh, salted, dried, smoked, pickled, spiced, in oil, &c., there are certain portions of the body which are considered more or less delicacies. Among these the heads of many species are preferred to the rest of the body. The boiled head and shoulders of the cod, the striped bass, and some other species are considered especially excellent, as are the fins of the halibut. Indeed, in the earlier history of the country the head and fins only of the halibut were utilized, the rest being thrown away. The tongues and sounds, too, of the cod, hake, and other gadoid fishes are very highly valued for food, and are usually put up salted separately. The air-bladders or sounds of fish have already been referred to as of special commercial value, those of the sturgeon furnishing the well-known Russian isinglass, and being utilized for the same purpose.

Of late years the air-bladders of the hake have been collected very assiduously, and are worth more than all the rest of its body. They are gathered especially on the coast of Maine and in the Bay of Fundy, where vessels are in the habit of visiting the different fishing stations and buying these sounds for from 50 cents to $1.25 a pound. The drum, squeteague, and, indeed, almost any other of our species in which the walls of the air-bladder are thickened, and that organ is of considerable size, are valued for the same purpose. Several fresh-water fish in South America are also utilized in the same direction. There are establishments in Massachusetts where the business of collecting the air-bladders of fishes of all kinds, and of working them up into marketable products, is carried on.

The skins of many fishes, too, are convertible into a coarse gelatine or tenacious glue. In Russia the cartilaginous backbone of the sturgeon is highly prized as an article of food, and is collected and sold in bundles like whips.

The roes of a great many fish are used as a special article of food, sometimes with the rest of the animal, as of the herring; at others separate from it. The roes of the mullet of the southern coast of the United States are salted and barreled and consumed largely throughout the interior of the adjacent States, the meat itself being less prized.

The caviare of the sturgeon is a well-known article of commerce, and is now being put up in the United States in large quantities, particularly for export to Europe.

I have already referred to the extent to which the business of putting up fish in oil and spices and inclosing them in hermetically sealed tin cans is carried on abroad, particularly by the inhabitants of France, Spain, Italy, and Portugal, this process having been until recently scarcely known in the United States; but it now bids fair to become an important element of our industries. Few persons realize the extent to which the menhaden is utilized in this direction, several establishments in New Jersey finding it really difficult to secure a sufficient supply of fresh fish to meet their demands. Here they are put up in oil under name of American sardines, or spiced and known as ocean trout. The herring is also put up both in oil and spices in New York and at Eastport, in Maine. Mackerel are preserved to some extent in Canada in pound cans, like the canned salmon, several thousand pounds being included in the returns of the proceeds of the Canadian fisheries for 1876.

There is no doubt but that there is a wide field in America for the utilization of fish in this way, and that a large market could soon be built up, not only in this country but abroad. In 1876 the value of the sardines and anchovies, prepared in oil and imported from abroad, amounted to $595,901, each year showing a considerable increase. The only advantage that foreign countries have over us in this matter is in the price of oil; and if the cultivation of the olive in California proves to be a success this will furnish the finer material, although the best quality of purified cotton-seed oil is believed to be equally wholesome and can be furnished at a very low figure.

2. *As oil.*—We have already referred to the use of the oil of the livers of fish as an article of food or medicine, but it is in its industrial applications that the oil of fishes merits the principal consideration. While there is a great difference in the amount of oil furnished by the livers in different species, almost any will yield it in greater or less abundance on being boiled and pressed, varying in amount with the species. The most of the fish-oil is, however, derived from the body generally. In one fish abounding on the northwest coast of America, known as the candle-fish (*Thaleichthys marinus*), closely allied to the smelt and capelin, which, indeed, it resembles, the dried fish is used for the purpose of illumination, the amount of oil being such that it furnishes no mean substitute for a candle, being capable of ignition and burning for a considerable time. As this fish is very abundant, it is not improbable that it will hereafter constitute an important source of oil, parties in British Columbia and Alaska being now engaged in the business on a small scale.

It is from the menhaden or pogy of the Atlantic coast of the United States, however, that the greatest quantity of oil is obtained.

Next to the menhaden or pogy the sea herring is probably the most extensive source of supply in the United States, the fish as caught in weirs in the Bay of Fundy and elsewhere being treated for this purpose. It is not improbable that the offal of cod and other fish will after a time be largely utilized in this direction, as it is on the coast of Norway, where very little is wasted.

A further extensive source of oil for technical purposes is found in the liver of the dog shark (*Acanthias*), a small species scarcely more than one or two feet in length, but occurring on the American coast in immense numbers.

As almost any fish will furnish oil when boiled or steamed and subjected to great pressure, other species are treated for this object from time to time, according to their abundance or the immediate necessities, but those mentioned above are probably the most important. The capelin, it is true, furnishes an excellent source of supply, but it is found for so short a time on the coast of Newfoundland and the other regions inhabited by it, that it would hardly pay to put up permanent establishments for operating on a large scale.

The limitations of my subject exclude the consideration of oils as obtained from whales, porpoises, blackfish, grampuses, &c., the supply of which is of course very great, although diminishing in quantity, while that from the true fishes appears to be increasing.

The use of fish-oil as food or medicine is comparatively limited. Its application is more generally to the manufacture of soap, and in the dressing of leather, for purposes of illumination, and, to some extent, in painting. During the late civil war in the United States, when the supply of turpentine was limited, the oil of the menhaden was employed as requiring less turpentine in its service.

3. *As manures and fertilizers.*—The refuse, or so-called "scrap," left after the expression of oil from boiled or steamed fish, is used very largely as a fertilizer, for which it is especially valuable in consequence of the large amount of phosphorus contained in the bones, and of the nitrogenous matters. This is used either directly or after being subjected to chemical treatment, and, for the most part, mixed with the phosphatic earths found on the coast of South Carolina and Georgia, with the mineralized guanos of the Sombrero Island of the West Indies, or with the well-known guano of Peru or of the islands of the Pacific.

4. *Other purposes.*—The remaining applications of fish are of much less moment than those to which we have already adverted, being usually exceptional and confined to limited areas.

Although the skins of fishes have been utilized in various ways by different nations for a long period of time, within a few years this industry has become prominent, and will in time represent a very important element in the total products of the sea. Although the skins of cod, salmon, and other fishes are not unfrequently used as clothing for both the feet and the body by the tribes of the northwest coast of America, it is only of late that such skins promise to come into use among civilized nations. A patent has been taken out in the United States for the manufacture of shoes from the skin of the cusk (*Brosmius vulgaris*). The skins of various species of sharks are now very carefully saved in the Red Sea, the Mediterranean, and the Indian Ocean, and constitute a considerable article of commerce, the best material being furnished by the genera *Scyllium*, *Scymnus*, *Spruax*, *Acanthias*, *Sqatina*, *Squalus*, &c. These are used largely for polishing wood and metal, for covering boxes, spectacle and spy-glass cases, &c.

The skin of the burbot or ling (*Lota*) is employed in Russia and Siberia for trimmings of dresses and for the windows of dwellings, instead of glass. It is also made into bags for holding clothing, &c.

The skins could be taken off from many fish which are now entirely wasted, and from others the meat could be employed in some form or other. When tanned or dressed the skins could be converted into articles of clothing or ornament, and could be used in polishing wood or metal.

As already explained we are far from deriving all the benefit that we might from our sea fisheries, not only neglecting, as we do, a large part of our actual catch, but failing to secure what is in other countries considered a source of national wealth. Apart from the increase in quantity of the well-established preparations of fish by drying, salting, smoking, &c., there is a large field open in putting up fish in hermetically sealed cans, either in oil, pickle, or spices.

The Centennial Exhibition of 1876 afforded an opportunity for the presentation of vast numbers of preparations of fish, as made and consumed in large quantities in France, Italy, Spain, and Portugal, which could be readily imitated in the United States, and find a market either here or in foreign countries. Indeed, almost every fish of the Mediterranean in the various preparations, notably the mullet, the mackerel, the tunny, the perch, bass, &c., and even squids or cuttle-fish, were found to constitute no inconsiderable item.

Of herring there are many preparations greatly in demand in Europe, of which we know nothing. A reference to some of these will be found in the Report of the U. S. Fish Commission, Vol. III, page 183 (Widegren on the Herring and its Preparation as an Article of Trade).

The carcasses of sharks, skates, and other now refuse fish could be converted into food for dogs, poultry, and even used in feeding young trout or salmon, &c., in piscicultural establishments. Even if they could be sold at from 1 to 3 cents a pound for the dried meat, in the large demand that could readily be developed for the various purposes mentioned, a satisfactory profit could be derived. The meat could be chopped fine or converted into meal, as with the well-known fish-meal of Norway.

IV.—MAINTENANCE AND IMPROVEMENT OF FISHERIES.

CONSIDERATIONS RELATIVE TO THE BEST MODE OF MAINTAINING AND INCREASING THE SUPPLY OF THE SEA FISHERIES.

This subject may be best treated under the following heads: First, legislation in the way of regulation and prohibition; second, the increase of the absolute number and variety of fish; third, equalizing the supply of fishes and bringing them from distant points within easy or convenient reach of the fishermen.

1.—LEGISLATION.

The history of the fisheries for many centuries past has been largely a record of attempts either to give monopolies to favored individuals and companies, or well-meant, but in most cases ill-judged, endeavors to protect the fish from destruction and to secure the rights of the people in their capture. The tendency, however, of later years, has been materially to relax and in many cases to abolish these regulations, and it is now becoming generally conceded that, so far as the sea fisheries are concerned, the less the obstacles we place in the way of the prosecution of the fisheries the better. It very rarely happens that the enactments for the protection and regulation of the fisheries are based upon a thorough knowledge of the habits, migrations, and general relations of the fishes themselves, and even while removing or preventing a difficulty in one direction, they bring about a still greater one in another. In many cases action, when taken, is the result of the unfounded clamor or jealousy of fishermen using one kind of apparatus against those employing another, or, in some instances, it results from the influence of the wealthier classes, who wish to preserve the fishing as a sport and relaxation, as against the interest of those who depend upon it for a living. In considering the complaints, therefore, in regard to a particular mode of fishing, and the invocations for its restriction, due caution should be exercised in determining how far the personal element comes into play and how far the interests of the great mass of the community and the world are at heart.

Legislation on this subject is usually included under the following heads: First, the places of fishing; second, the season; third, the time of day; fourth, the size and length of the nets, and the size of the mesh; fifth, the distance apart of nets, weirs, pounds, &c.; sixth, the number of fish that may be taken; seventh, the police and regulation of the boats and men; and, eighth, regulations in regard to the preparation of the fish, and for securing to the purchaser a proper knowledge of their character and quality.

It will, of course, be understood that legislation can be properly enforced against foreign nations at least only within the territorial limits of the country; and as the three-mile line is usually accepted as defining the boundary between the inshore and offshore fisheries, it is usually the space within that limit to which the local laws apply. In some nations the particular areas of the fishing-grounds are assigned to the inhabitants of certain districts, those adjacent to it not being permitted to enter, and severe conflicts sometimes result from such an attempt.

How far one of the United States can enforce any fishery regulations at sea, outside of the three-mile line, or indeed even within it, is a question not to be discussed here; that the United States can do so is perhaps more certain, the vessel being considered a part of the country and carrying into it the conditions of its shore.

In accordance with a convention consummated in August, 1843, between France and England, the exclusive right of fishing by the fishermen of either nation was given within 3 miles of its own coast, the intermediate space being common ground. A provision was made for the employment of cruisers by both nations, not only to protect the rights of their own fishermen, but to see that they obeyed the laws made for their regulation. Cases were specified in which the vessels of one nation might enter the territorial limits of the other, but in no part of the treaty was there any prohibition, when once within the limits, to purchasing bait, or supplies, or of deriving any other commercial advantage.

This treaty is referred to in the Report of the British Sea Fisheries Commission, where it is expressly stated that the vessels of Belgium, with which there was no such treaty, were not bound by it, and that there was nothing to prevent their fishing if they were so minded, indicating that the submission to a restriction must be a matter of joint agreement between two contracting parties (p. lxiv).

With reference to the difficulty of estimating the extent of the three-mile limit, Prof. George F. Barker, writing from Brookfield Center, Conn., September 7, 1877, said:

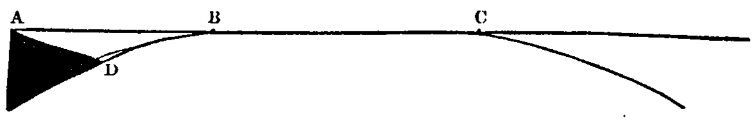
"With reference to the question you propose, *i. e.*, whether the probability of an accurate judgment of distance is greater when the estimate is made by an observer standing on shore or by a person in the vessel, I would say that in my opinion the probability of a correct estimate of distance is considerably greater in the latter case. Distance, according to the present theory of vision, is always estimated by the eye from the magnitude of the visual angle under which the distant object is seen. Now, since any given object, placed at a suitable distance, will subtend any angle whatever, it is obvious that size and distance are both variables in the calculation, and that if neither is given the problem is indeterminate. A man who does not know how large the object is which he sees, cannot, from this datum alone, form any accurate idea of its distance. Hence, to estimate the distance of any object accurately, the size of the object which subtends the given visual angle must be accurately known. A man of average height placed a mile off will subtend an angle of about two minutes, and if two miles off, of about one minute. To tell that he is two miles off, and not one mile, the eye must accurately appreciate this slight difference of one minute of arc. The human height is so well known that persons are often introduced into art compositions to assist in judging of distances. But at three miles distance, a man is too small an object by which to estimate distance by the unaided eye, the limit of error being so large as to render the estimate of no value. Hence, other familiar objects larger in size must be chosen. If a person on the shore, accustomed to this kind of estimate, sees a vessel which he is familiar with at the landing, he can tell approximately her distance, if she is not too far off. So a person sailing away from the shore may estimate quite accurately his distance from it, provided he be familiar with the size of the objects on shore. If neither person knows by personal inspection the size of the object looked at, the one in the vessel has the advantage, because the sizes of houses and their parts, windows, doors, &c., and also of well-known trees and animals, vary much less than the sizes of vessels. But there is another advantage on the side of the man in the vessel. He forms his judgment not by a comparison with a single object, but from a large number of objects, whose sizes are well known; and his estimate is, therefore, the mean of a large number of separate judgments, and so more reliable than any single one. Moreover, if these objects are successively back of each other in the line of sight, another advantage is gained, as any one must admit who notices how much larger, because apparently further off, the sun is when on the horizon, where there are objects of comparison, than in the zenith, when there are none. Moreover, as a rule, seafaring men have trained their eyes to estimate distance from a vessel."

To the above may be added the views of C. P. Patterson, Superintendent of the U. S. Coast Survey, given under date of August 31, 1877, as follows:

"From my experience, I conclude, and have always safely acted upon that conclusion, that persons on board a vessel, with rare exceptions, judge the vessel to be nearer the land than she actually is, and this arises in a measure from the fact that the eye rarely recognizes the *foreground*, as it were, of the distances, but is apt, unconsciously, to begin estimating the distance from an imaginary line at some distance from the vessel, the higher the eye above the water the greater being this distance, and the greater the real distance of the vessel from the shore than that estimated. This is particularly seen in handling a vessel in a harbor, or running close in along a shore.

"If the eye is placed at the mast-head of a vessel, the horizon rises, as it were, with the eye, the sensation created being that the vessel is at the bottom of a bowl and the eye on a level with the rim, and from this position estimated distances to objects are almost invariably too short. My own custom was to increase estimated distances accordingly. If a man at the mast-head estimated the distance to an object, unseen from the deck, to be 20 miles, I concluded at once that it was 24 or 25 miles.

"From the shore the eye recognizes a marked foreground (there always being a very decided one, even on a sand-beach of the edge of the breakers or water), which it cannot ignore, and from which it at once begins to estimate distances. The eye being filled with this 'foreground' takes cognizance but indifferently of the object itself, as well as the distance intervening between the outer edge of the foreground and the object, as shown thus:



A being the elevation of eye above the water, D the edge of the breakers and foreground, B limit of foreground, and C the position of object. The angle which the eye instinctively measures is D A B, and this is equal to D A C, be the object wherever it may on the horizon. Then the distance B C is measured only by the greater or less distinctness of the object, there being nothing with which to compare it. From the want of a foreground, if A was the mast-head of a vessel the distance the eye would endeavor to measure is B C, almost entirely ignoring A D B, and in addition the shore being much more prominent to the eye from the vessel, than the vessel from the shore.

"If the eye on the shore is placed where it can take in a long stretch of coast, it will nearly always underestimate the distance of a vessel from it.

"Of course, the cupidity of commerce sways the judgments of the best people in the direction of their own interests, but I give the results of my own experience for what they are worth.

"The matters stated in your letter also have an effect in the general estimate of a distance over the water from the land to a vessel or from a vessel to the land.

"My conclusion is that as a general rule the distances of the land from vessels and the distances of vessels from the land are usually underestimated. In one case the eye ignores the nearer part of the distance, and in the other the more distant part.

"In this I am confirmed by the experience and opinion of Commander E. P. Lull, U. S. N., Hydrographic Inspector, United States Coast Survey."

The season of fishing, too, is also a subject of legislation. The Government of Norway determines with great care the time when the nets and long-lines shall be set, the introduction of the latter into the water not being permitted at the Lofoden Islands fisheries before 12 o'clock m., their lifting being imperative before noon of the following day. France, England, and other nations have made regulations in regard to the size of the mesh, specifying the minimum for the beam-trawl and for the drift-net, the object being to secure to the young and unmarketable fish a chance to escape. This precaution, however, is of little value in the case of the beam-trawl, where many fish are taken which would have passed through the meshes of an ordinary net without difficulty.

The distance apart of nets, so as to prevent interference, has also been provided for; as also the restriction of particular kinds of fishing to certain grounds, in Great Britain trawling being sometimes limited to certain areas, to prevent interference in the use of the long-lines.

Nearly all nations have regulations in regard to the boats and vessels to be used, among others requiring them to be numbered in certain ways, so that they may be more easily designated and identified in the event of their attempting to evade the law.

The preparation of fish for the market has also been the subject of legislation. Many nations which pay no particular regard to the times, places, and circumstances of the sea fisheries, have considered it expedient to secure the interest of the purchaser by regulating and restricting the mode of preparation and of packing, this being the case, perhaps, more especially in Holland and the Scandinavian countries than elsewhere. The herring fishery in Holland was formerly kept, in all of its stages, under the control of the Government, although of later years this is more particularly confined to the packing and inspection. In

Norway, however, the Government requires that the herring which are found to have in their stomachs certain kinds of food shall be kept alive, inclosed in the nets until this food is absorbed, as otherwise the fish cannot be preserved for any length of time, thereby affecting their quality as food. Still more generally is there an inspection of fish by the State after they have been put up, the packages being marked by Government officials, who are supposed to be beyond danger of any corrupt influence in making the distinctions as to quality.

There is, perhaps, no nation in the world where there are fewer regulations and restrictions in regard to the sea fisheries than in the United States, no response having been made either by the General Government or by the State to the numerous appeals to take the subject under their jurisdiction, and to prevent what is claimed to be improper methods, or unseasonable times of capturing fish, or undesirable modes of preserving them.

There are, however, in several of the States, especially of New England, State inspectors of fish who brand the packages, in accordance with the quality of the fish, these marks guiding the purchaser in his selection and in the price to be paid by him.

Although the propriety of maintaining such restrictions has been questioned, on the ground that all these matters should be subject to the general law of demand and supply, and to individual reputation, yet it is not likely that any change will be made. While it is comparatively easy in many cases to enforce regulations in regard to fishing and the treatment of fish near the shores and under the jurisdiction and supervision of officers, it becomes a much more difficult matter when the fishing is prosecuted at a distance, as in this country on the George's Bank, the Grand Bank, &c. It is, of course, possible to send Government cruisers to accompany the fishing fleets, to see that the fishermen obey the laws in this matter, and this is done to some extent by the Norwegian, Dutch, English, and French Governments, the two latter maintaining a sea police, more to prevent encroachments by the opposite nation upon the fishing-grounds, or injury or outrage upon their own vessels. Great Britain, too, has during some years maintained a certain number of armed vessels within her dominions in North America to prevent the encroachments of the American and French fishermen. The United States, however, has never had any provision of this kind, but has allowed the sea fisheries to regulate themselves entirely. Some of the States supply armed protection to their oyster fisheries, both Maryland and Virginia having now, or until quite recently, such a provision.

The propriety of international agreement in regard to certain modes of fishing has not unfrequently been urged, and more particularly it has been proposed that the United States and Great Britain have an agreement to prohibit the use of the trawl or long-line on the Banks of Newfoundland and in other portions of the high seas. Apart, however, from the questionable propriety of interfering with this mode of fishing, there would be the consideration of enforcing such rules, as it could only be done by means of a fleet of Government vessels of both nations, stationed in different portions of the high seas, involving, of course, the danger of irritation at any attempt at enforcement, especially by the vessel of the opposite nationality.

Again, even if this could be effected and enforced by the United States and Great Britain in respect to their own subjects, there is no probability that other nations would enter the convention or consider themselves bound by its provisions; and without the co-operation of armed vessels of other nationalities, any attempt at regulating the fishermen of the same would be resented by their respective Governments, and danger of war ensue. If there were no interference with the subjects of other Governments, the effect would be simply to give them the monopoly of capture by the prohibited apparatus, or during the prohibited season to other parties, and thus a season's loss would be inflicted upon the subjects of the consenting nations. It might also be a question how far any Government could pretend to interfere with the fishing operations of its own subjects on the high seas; provided, of course, these did not involve any criminal action, or such as is, by common consent, allowed to be a matter of jurisdiction. Of course, the vessels and their catch might be controlled on their entering port; but there would seem to be nothing to prevent the taking of the fish to a foreign nation. It is for these and other reasons, that need not here be detailed, that most careful consideration should be given to any proposition looking towards the restriction or regulation in any way of the sea fisheries of the United States, whatever may be the practice and policy of other nations.

There is, however, a plea for the interference of the Government, in certain cases, in regard to the fisheries that belong to the rivers, or are near the shore, and thereby most specially related to the adjacent commonwealth. Nearly all civilized nations have looked with more or less care after their interior or river fisheries; and quite a number of the States of the American Union have their own special enactments on this subject. This refers more generally to the times when fishing may be authorized; the character of the apparatus, whether lines or nets; but more particularly to the protection of the fish during the spawning season, especially of the trout and salmon. In States possessing shad and alewife fisheries there is usually a definite date when the fish are supposed to have reached their spawning beds or the condition of spawning, and at that time all fishing is interrupted. This varies according to latitude, being earlier in the South and later in the North.

Again, the question of the pollution of rivers is one that comes up for consideration, in many cases the introduction of sawdust or the refuse from gas or manufacturing establishments being prohibited or controlled. Other States, again, require from the proprietors of artificial dams the introduction of some device by which shad, salmon, and other fish may ascend, and thus be enabled to reach their spawning-grounds. There is also an inspection in the markets, in nearly all the larger cities, of the quality of fresh fish, so as to prevent the introduction for sale of any that are not considered wholesome and fit for food. All these provisions are wise and beneficent, and tend, when judiciously and properly enforced, to protect the fish against decrease and to secure their multiplication, as well as to benefit the purchaser. If the anadromous fish are prevented from access to their spawning-beds, it is within the power of a single person to destroy fisheries of immense value and to deprive a large portion of the community of a wholesome food and an important means of support.

These conditions of protection and regulation, while they cannot be said to apply at all to the deep-sea fisheries, have comparatively little reference to the inshore sea fisheries. But even here we readily imagine that State action, if not that of the General Government, is desirable. The most important point in this connection is the protection of the spawning-grounds (when they can be definitely ascertained) from pollution by the introduction of noxious substances and from the disturbing influences of fishing or other operations. A notable instance of the advantage of regulation in this case is to be found in the matter of the herring fisheries of the Bay of Fundy. The spawning-ground for this fish is remarkably limited in extent, being for the most part situated immediately around the southern extremity of Grand Manan, or what is known as the Southern Head. Here, during the months of June, July, and August the herring resort in immense numbers to deposit their eggs; and limited as they appear to be in distribution at that time, the great number of vessels that followed them to that region took immense quantities of spawning fish, and apparently broke up the schools and prevented them from depositing their eggs under proper conditions. The result appeared, at least, to be a very great diminution of the fish, and the threatening of their practical extermination. Under these circumstances the Province of New Brunswick passed a law establishing the months of June (?), July, and August as a close time, during which no fishing was to be allowed, and appointed an officer to enforce the regulation. For several years many attempts were made to violate the law, with more or less success; but gradually the power of the Government, and perhaps an improved public sentiment, succeeded in breaking up this encroachment, and of late years the protection of these spawning-grounds has involved but little difficulty. It would appear, as the result of this action, that shortly after the enactment the fish began to increase in number, and they are now said to be as abundant in the Bay of Fundy and its vicinity as they were ever known to be since the earliest history of the country. It is of course barely possible that there is some fallacy in this conclusion, and that it was one of these alternations of decrease that invoked the legislation in question, and that the subsequent increase would have taken place, even if the practice of fishing during the spawning season had been continued.

All the European herring fisheries, especially the most important, as those of Norway and Great Britain, are without restriction as to time of catch, and indeed it is when the herring are fullest of ripe roe that they are the most esteemed. At the Magdalen Islands the herring are taken principally during their spawning season without any restriction or suggestion of diminution. The question, therefore, as to the actual importance of the measure referred to may be considered as unsettled, although I can hardly believe that the provision in regard to the herring fisheries at Grand Manan has not had a beneficial influence. It will not, however, do to prohibit the catch of herring when they are filled with roe, since it is when they are in this condition that they are most highly prized and most marketable, the roe of the sea herring being universally considered a very great delicacy.

There are, however, some fish on the coast of the United States for whose protection during the spawning season I have already urged in a previous report that some provision of legislation is desirable. I refer more particularly to certain fish on the south side of New England, especially the scup, sea bass, and the tautog. These fish appear to come to the coast in well defined bands of immense numbers, at a particular season, following generally a definite line of migration and proceeding to their spawning-grounds, where the operation of reproduction is conducted on an enormous scale, in this respect closely resembling the anadromous fish, such as the salmon, shad, and alewife, and apparently almost equally susceptible to any interference by human agencies. Legislation is expedient here, too, both for the protection of the fish and of the fishermen themselves, since after a few weeks' fishing the glut is so enormous as to bring down the price to a mere nothing, involving the necessity of wasting immense numbers of the catch, the best use to which they can be put being their conversion into manure.

In this case, however, I simply suggested an intermission of capture from Friday night until Monday morning, or if this be too long a period, from Saturday night until Monday morning, so as to secure the escape of a sufficient number of the school and an opportunity to deposit their eggs, this weekly intermission to be continued only for the limited period during which these particular fish are on the move. They move in so close and solid bodies and in so limited an extent that it is by no means impossible to imagine the capture of the greater part of the school and the cutting off of the rest of it from reaching a suitable spawning-ground, or disturbing the individuals so that their eggs are not deposited at the proper time or under proper conditions.

The other fish taken during the same period, especially the mackerel and menhaden, are not affected, as it is only a portion of the migrating bands, and that which happens to be nearest the shore, which is taken under such circumstances, enough possibly passing outside to maintain the supply of eggs and young fish.

As to the conclusions at which I arrived in 1871 in regard to the propriety of a partial close time, I still maintain the same opinion, and am fully satisfied that a fair trial for four years would show such a positive increase in the number of these most important and valuable fish as to satisfy the most skeptical. Unfortunately, in this particular case concurrent legislation of two States is considered desirable, since the migrations and spawning-grounds are partly in Rhode Island and partly in Massachusetts, the fish for the most part passing through the waters of the first-mentioned State before they reach those of the latter. So far, neither State has shown a willingness to legislate either separately or conjointly, and the abundance of the fish referred to will probably be determined by the number of the bluefish that visit the same waters. I think, however, that if protected in some way there would be a decided increase without reference to the presence of this wolf of the seas.

I have found a decided unanimity of opinion among fishermen as to the expediency of such a close time, even among those who do not consider it necessary, in order to maintain the supply of fish, the prevention of a glut of the market, and the securing of time for the proper repair of the nets, and for the needed attention to home business, being important and well-accepted arguments with all classes concerned for the proposed close time.

In many cases it would seem that fish, after they have deposited their eggs, become sickly and unfit for food, and no one can examine a male salmon under these circumstances and appreciate the alteration in appearance and condition without realizing the impropriety of using it as an article of food. For this reason a close time is proper, not only to secure an opportunity for undisturbed spawning by the fish, but also to prevent the consumption of unsuitable fish.

In the New England States the alewife fisheries were formerly, and are still in some degree, taken under the protection of the towns, the catch within the jurisdiction of each town being considered as belonging to its inhabitants, to be distributed pro rata among them, or else sold for the common benefit. Sometimes each individual was authorized to take a certain number of fish; at others officers were appointed to capture them and apportion them suitably. Regulations were made to secure free access from the sea of the fish to the pounds or other spawning-grounds, and for the escape to the sea again of the fish, both young and old, during the summer.

How far it will be desirable, now or hereafter, to regulate the size of the meshes of nets used in our inshore fisheries it is hardly necessary to take into consideration at present, for the reasons already mentioned.

2.—INCREASING THE NUMBER OF FOOD-FISHES BY ARTIFICIAL MEANS.

There are two methods by which this can be accomplished: (1) By the actual transfer of fishes from one region of the globe to another, or one part of the coast to another; (2) by the artificial propagation and multiplication of fish found in a particular region.

Many instances are on record of the successful transportation of fishes, both fresh and salt water species, to localities previously uninhabited by them, and very extended efforts are now being made, promising the fullest measure of success, to carry the shad and the eel of the Atlantic coast to the Mississippi Valley and the Pacific slope, as well as the tautog, the lobster, and the oyster, and to transfer the California salmon and trout to the Mississippi Valley and the eastern coast of the United States, the carp from Germany to America, &c. Less has been done in this direction with the sea fishes, although even here there is something to record. It is said that the *Scarus*, a well-known labroid fish of the Ægean Sea, was brought, in the time of the Emperor Claudius, to the coast of Italy and planted near the mouth of the Tiber. They were protected from capture for five years, at the end of which time they swarmed in enormous abundance and constituted an important element in the Roman fisheries, being considered one of the greatest delicacies. (Report U. S. F. C., III, p. 10). In the United States the scup is said to have been carried in a smack from Vineyard Sound to Cape Cod Bay, and that a similar experiment was made in a transfer of the tautog both to Massachusetts Bay and the South Carolina coast.

The attention paid by the early Romans to securing an ample supply of fish is well understood, as also the enormous expense of their operations in the construction and maintenance of fish ponds, &c. Among the most highly esteemed species were the red mullet (*mullus*), and the sea eel, the latter being kept in tanks constructed for the purpose, and fed, in some cases, it is said, with the flesh of slaves, as imparting an added delicacy. The introduction of fish from distant points was there practiced to a greater or less extent.

The limitations of temperature, however, and appropriate food, will probably determine what may be accomplished in the way of exchanges between the northern and southern coasts of the United States; and there are a few species in European waters the introduction of which it will be well to attempt, especially if brought into waters of the same general physical conditions. Among such desiderata may be reckoned more especially the turbot and sole, which constitute the most important element in the beam-trawl fisheries, and which, as already explained, always command a high price. There seems no good reason why these fish might not become, in a few years, after a successful transfer of a few individuals, as abundant as they are on the European coasts. An ample supply of suitable food and of the necessary external conditions could be assured to the new-comers. The experiment would perhaps succeed best on the eastern coast of Massachusetts, where the conditions are quite similar to those of their native habitat. If they were found to thrive in the region south of Cape Cod, an enormous fishery might in time be assured in view of the adaptation of the waters to successful beam-trawling.

As a return to Europe for the contribution of the turbot and sole the alewife might be offered, a fish which should thrive in all the rivers, ponds, and lagoons connected with the sea, whether in the warmer or colder portions; and as they move in well-defined bands of vast numbers of individuals, within narrow limits, it would add greatly to the food resources of the country. A very considerable expenditure of money on the part of European Governments, especially that of Germany, where the ordinary sea fisheries are restricted, would probably be amply justified in a few years, the fish being by far more valuable and worthy attention than the salmon and trout, and perhaps not excepting the shad.

From present information on the subject there are no other European sea fish, excepting the turbot and the sole, that would be especially important in America; possibly the fresh-water sterlet of Russia and the hucho salmon of the Danube might be introduced to advantage. This last-mentioned species remains throughout the year in the Danube River and its tributaries, and constitutes and excellent article of food. It might, perhaps, be quite advantageously planted in the Mississippi, where it would find an ample supply of the poorer sorts of fish, for the most part not considered worth anything for market purposes.

The artificial propagation of sea fishes has not yet been attempted on any experimental scale, although there seems to be no particular reason why a vast increase cannot be accomplished in this direction, as with the anadromous or interior species. There is no question as to our ability to multiply salmon and shad to any desired extent, and the same general treatment might readily be applied to many of our coast fishes. The principal difficulty in the way would be the construction of the proper establishments, although the recent experiments of the U. S. Fish Commission, and that of Maryland, point out a reasonable method of accomplishing this, as will be referred to hereafter. It would be quite impossible to undertake to feed the young fish when hatched, as is done with trout; but the methods used for shad and in most cases for salmon hatching, could be made use of, namely, that of introducing the young fish into the water and leaving them to their own resources so soon as the yolk-bag is absorbed and the fish is able to feed itself.

According to reliable estimates, not more than 1 egg in 200 hatched naturally in the waters produces a fish capable of feeding itself, this representing by far the greatest expectancy of destruction in the number of eggs laid by the female.

On the other hand, artificial impregnation and propagation should give us not less than 175, or even more yet, of the 200, a vast difference, which could not fail to tell in the result. In other words, the proportional result of artificial hatching is 175 fold that by the natural spawning of the same number of fish. The young, when ready for introduction into the water, could readily be placed in sheltered bays and coves, and possibly fenced off for a time from the intrusion of larger fish, and kept there until they had attained a sufficient size to protect themselves to a considerable degree.

This experiment of artificial hatching could be adopted very readily on the south coast of New England, in connection with fisheries of scup, tautog, and sea bass, especially as all these fish are greatly in demand and are taken in great numbers in the fish pounds and traps of the southern coast during the months of April, May, June, and July. The sea bass especially spawn very largely during the latter period. An ample supply of scup could easily be obtained during the spawning season, and if necessary the tautog and sea bass could be kept in pens until ripe. These fish are very frequently kept for weeks, or even months, waiting the call of the market, and as they are very hardy, it would not injure them at all for market purposes to strip them of their spawn at the proper time. The eggs of this fish probably hatch out very quickly; in the tautog, indeed, an embryonic development of the egg is said to take place before it is laid, so that not unfrequently some of the eggs squeezed out into a bucket of water will hatch out almost immediately. In an experiment of artificial impregnation and hatching of the sea bass, prosecuted at Noank, Conn., in 1874, there was reason to conclude that the period of development did not exceed one week.

The pound-nets frequently take great numbers of spawning mackerel, which might also be manipulated; and there is no reason why the sheepshead might not be treated in a similar manner, nor, indeed, why the process might not be extended to such species as the cod. The striped bass is a fish that promises ample success in such an experiment as soon as we can succeed in taking it in sufficient numbers. At least some spawning fish are found in the rivers at the same time with the shad and herring; whether simply in pursuit of this prey or in search of a spawning-ground is not yet ascertained. In 1873 the parties of the U. S. Fish Commission engaged in hatching shad in the Roanoke River succeeded in taking several ripe striped bass, from one of which 100,000 eggs were successfully taken and hatched. The eggs are smaller than those of the shad, although similar to them in being non-adhesive and in being hatched out in a short time.

The principal difficulty in regard to the multiplication of the sea fish by artificial means is in the arrangements necessary for the care and preparation of the egg. The ordinary hatching establishments used for trout and salmon are not available since salt water is required for the purpose. It is true that this might be pumped up by means of a wind-mill or otherwise into tanks, and allowed to trickle into the hatching troughs, and thus produce the necessary current. Even if this could be done, however, the limits of space and the comparatively small number of fish that could be obtained will probably render it expedient to adopt some other method.

The first suggestion would be the employment of the floating-box, as constructed by Seth Green, E. A. Brackett, and others, and used in the hatching of shad. A serious difficulty, however, is in the danger of having them upset and the contents spilled out, or else greatly injured by the action of the waves, experiments made in this direction nearly always resulting disastrously.

Much more wholesale and efficient methods of accomplishing this important object are, however, at our command, as suggested by the success of experiments prosecuted during the spring of 1877 at Havre de Grace in hatching eggs of shad on a large scale, in connection with the operations of the U. S. Fish Commission and of the Maryland commission. Mr. T. B. Ferguson, the efficient and accomplished Maryland commissioner of fisheries, has devised a method by which the hatching of shad can be prosecuted in tidal waters and by which not only a great number of eggs can be hatched in a very small space, but also the danger of losing the eggs in consequence of the upsetting of the hatching boxes in stormy weather can be prevented. This device consists in a series of buckets, with wire-gauze bottoms, which are alternately depressed and raised by means of an axis rotated by steam-power. The buckets dip into the water, the eggs floating in them, and the gentle motion of elevation and depression through the space of five or ten inches, the extent and rapidity of which can be varied at pleasure, gives the eggs that agitation and the continual contact with a new supply of water necessary to their proper condition. Nine million eggs were thus hatched with a much less expenditure of labor than heretofore; and instead of some hundreds of floating boxes being called into play, six to twelve buckets, worked along the edge of a floating scow, answered all the purpose.

Still other methods can be used, possibly in some cases to even greater advantage, namely, the placing of the eggs in funnel-shaped vessels, with a stream of salt water pumped up through the bottom, giving the eggs a constant agitation. A wire-gauze screen prevents the eggs from dropping into the mouth of the funnel, and the constant overflow of the water carries off all the dead offal matter. It would, of course, require a considerable expenditure to start such an establishment. A small engine, of four or five horse-power, with the necessary accompaniments, however, would probably be large enough. With such an apparatus in connection with some of the great fisheries, like those in Seconnet River at Rhode Island, or at Menemsha Bight on Martha's Vineyard, results of incalculable value might and probably would in time be obtained. Instead of counting the yield of the fisheries by the hundreds of thousands, millions could be estimated for, and it would not be difficult to guarantee the propagation of one hundred millions of young fish as the result of a single season's work. These, when the yolk-bag was absorbed, could be scattered or sown along the coast in different localities so as to increase the opportunity of finding suitable food and of escaping the ravages of their enemies.

3.—EQUALIZING THE SUPPLY OF FISHES.

A third subdivision of the subject of maintaining the supply of sea fish along the coast, and of increasing it, may now be considered. The connection between the fresh-water or rather the anadromous fisheries of our coast and the sea fisheries has been dwelt upon in previous reports, and while not assenting to the possibility of diminishing the supply of sea fish by ordinary human agencies, I have been satisfied of the disappearance of certain fish from our shores for the want of suitable food, and their migration elsewhere. Of the possibility of attracting fish from great distances by suitable food we have numerous instances. Thus the mackerel fishermen have been in the habit of throwing chopped bait overboard, which was carried a distance, possibly of miles, by the tide. When the school of mackerel strikes this stream of food it follows it up an indefinite distance and comes in immediate proximity of the source of supply, where the fishes can be captured by the hook or the net. Where many vessels are engaged in this business, it is said that the schools of mackerel are brought from a distance of many miles and held in the vicinity, against their ordinary instinct of migration. On the occasion, some years ago, of the lamentable falling off in the autumn mackerel fishery on the coast of Nova Scotia, involving considerable destitution and distress among the fishermen, the cause was believed to be in the immense amount of mackerel bait thrown overboard in the Bay of Saint Lawrence by the mackerel smacks, which kept the fish in the bay a long time beyond their usual period of leaving it, so that when they once commenced their autumnal migration they passed directly out to sea, without stopping, as was their custom, in the shores.

The effect of gurry, too, on fishing-grounds may probably be explained by the attractions of this stream of animal matter carried by the tide over a distance of many miles to the dogfish, sharks, and other predaceous species, these following it up and concentrating in the vicinity, where they drive away the food-fishes which form the more special subject of the attention of the fishermen. A similar instance is found in connection with the salmon in the Gulf of Saint Lawrence, where the fish are taken in quantities for salting, smoking, or other modes of preparation. Here immense quantities of offal are thrown into the water, where, however, instead of attracting the destructive fishes, has the effect to bring in such species as the cod and render them capable of capture. At one time this practice of throwing offal overboard was considered very objectionable, and an enactment was passed requiring it to be brought on shore and buried or utilized there in some manner. As the result of the diminution of this supply of animal matter the fishes abandoned the ground entirely, and great complaint was made as to the absence of the food-fishes, even of the salmon itself; and subsequently a compromise was effected by which this matter was placed in perforated boxes and the softer portion allowed to pass out and wash away. This, in connection with the great numbers of maggots of the blue-bottle fly which also passed into the water, in a short time restored the previous ample abundance of the fishes. In view, therefore, of these circumstances we can readily understand how much the movements of the sea fish along the coast may be influenced by the enormous schools of salmon, mackerel, shad, and alewives, the adults coming in during spring and summer and returning with the young at other seasons of the year, and upon which they prey to a greater or less extent. It is now the general impression that the anadromous fishes just mentioned pass the period of their growth in the sea at no great distance from the mouth of the river in which they were hatched, possibly extending their movements outward 5 to 50 or even 100 miles, but still occupying a certain relation to the rivers in question. A proof of this generalization is found in the fact that in a cruise made by Mr. G. Brown Goode in a mackerel vessel off the coast of Maine, in 1873, young shad, probably one or two years old, as well as alewives, were found in considerable proportion among the mackerel taken in nets 25 to 30 miles off the shore, and he was assured by the fishermen that this was a very common occurrence. Such fish are not brought in, as they are not considered marketable, and are generally thrown into the water when taken from the nets, where they become the prey of other fishes.

It is only necessary to bear in mind the enormous mass of these anadromous fish one hundred years ago, and even later, to appreciate the influence they can exert in attracting fish from the outer waters to the shores and keeping them there for a considerable part of the year, and the lamentable result of the destruction of this source of supply, not only on its own account but also for its influence upon the sea fish. It is well known that while these anadromous fish were present there was an ample supply of cod, haddock, halibut, hake, and various other species close in to the shore. On the whole New England coast, as well as in many parts of the Dominion of Canada, the fisherman, in an ordinary open boat, could go out and catch a full fare at a short distance from the land, both for use as fresh fish and for purposes of commerce, and that it was not until this source of supply was cut off that it became necessary to resort, to so great an extent, to distant parts of the sea. We may therefore hope, as the result of methods now being practiced and their future extension, that the old state of things will be renewed to our great advantage.

As an illustration, both of the loss to our own industries by the destruction of the supply of anadromous fishes, and of the amount of attraction that would be furnished from a single river to the incoming fishes and the retention on the coast of the outside fishes, I may again refer to the quotation on page 50 from Martin's Gazetteer of Virginia. Omitting here any considerations as to the enormous value of this fishery, but bearing in mind that this was only one of at least forty rivers where an almost equal catch might be looked for, let us proceed to consider the amount of food and bait available for the sea fish, resulting from the herring alone. For the 750,000,000 actually captured we may suppose that this was not more than one-fourth of the total number in the river during the season, which would give 3,000,000,000 for the Potomac River only. From Florida to the Bay of Fundy, without any reference to Dominion waters, we may safely assume the number to be at least one hundred fold, a calculation probably far within bounds, five times that amount and more, possibly, being the more reasonable. We have, therefore, 300,000,000,000, representing a weight of not less than 200,000,000,000 pounds. The progeny of these herring in their various stages of growth from the first year to the fourth, may certainly be estimated at twice the aggregate weight of the parents, or 400,000,000,000 pounds, giving us 600,000,000,000 pounds of fish along our coast of this one species. It may safely be assumed that at present not more than one-tenth of 1 per cent. of these fish now inhabit the waters specified, or only 600,000,000.

I have made no reference to the adult and young of the shad, the tailor herring, the gizzard shad, the striped bass, the various *Cyprinidæ*, and other fishes running in from the sea at about the same time with the other fish, and tending to swell the aggregate in the waters. But I think it will be readily understood what a loss we have experienced, not only in the way of direct food, but in the inducements to other fishes to come within our reach; and in the Dominion in the numbers of anadromous fish.

It is, therefore, very encouraging to believe that, even though from the changes in the physical condition of the land, water, artificial obstructions, &c., we may not look for the old-time abundance, we may yet hope for a very considerable increase; even if we get back to one-fourth the original supply, we may well be satisfied.

A comparison of the statistics of the number of shad and alewives caught in the Potomac River in a single season of six weeks' time, and salted, to the extent of 995,000 barrels,* with those of the sea herring in any part of the world, will show the insignificance of the latter; while the fishery on the Potomac during the period referred to equaled the total yield of the Scottish salmon fisheries in 1873, prosecuted throughout the year, and employing 15,000 boats and 45,594 men, and equaled nearly twice the entire number of barrels of the sea herring put up in the Dominion of Canada in 1876.

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*It is proper to say that the accuracy of Martin's figures has been disputed by some recent writers, Even if they are, however, twice as large as the fact would justify, the generel argument would not be invalidated.

V.—POLITICAL CONSIDERATIONS.

MEMORANDUM OF POINTS ATTEMPTED TO BE ESTABLISHED IN THE CASE FOR GREAT BRITAIN, BY GEORGE M'KENZIE AND OTHERS.

Mackerel.—Mackerel keep close to the shore. All mackerel fishing, therefore, must be near shore, within the three-mile line.

The proportion of mackerel taken outside this line, usually one-third or less of the catch.

The American average catch of fish, six or seven hundred barrels.

Shrimps and small fry are the food of the mackerel. Not found out at sea, but close inshore.

Americans pay no attention to the three-mile line, after the abrogation of the reciprocity treaty, keeping outside only when cruisers were in sight, and returning when they went away.

The universal testimony of the Americans is that unless permitted to fish within the three-mile line, it would not pay to come into the bay.

According to their own statements two-thirds and even more of their catch are always taken within the three-mile line.

Seining for mackerel will soon clean out the fisheries of the Gulf of Saint Lawrence.

The presence of Americans is injurious to the body of the fishermen of the Dominion.

Would be willing to pay the whole duty imposed by the United States, and even more, if Americans could be kept entirely outside of the three-mile line; the Dominion catch would be much greater.

Gurry.—Throwing gurry overboard drives the fish away. This practice is exclusively American. Dominion fishermen clean their fish on shore.

Transhipping is a benefit to the Americans, enabling them to make more trips in the same time.

No Dominion fisherman ever goes to American waters in a British vessel to fish. Reason (according to McKenzie, p. 121), the Americans would run them off.

Americans tranship at Charlottetown and the Gut of Canso.

Codfish (Thomas Bennet, Newfoundland, p. 134).—The cod fishery on the coast of Newfoundland is entirely inshore.

Americans obtained bait illegally on the coast of Newfoundland before the Washington treaty.

Newfoundland has reaped no benefit from the Washington treaty; the exports to the United States are lower than when there was a heavy duty on Newfoundland products.

The amount exported to the United States is too trifling to have any appreciable effect on the commerce of Newfoundland.

Americans fishing off the Newfoundland banks derive a great profit by selling the small fish, under 22 inches, in the Newfoundland markets.

Thinks the remission of duty by Newfoundland on these far larger than the remission on all the products sent by Newfoundland to the United States. The remission of duties by the United States on Newfoundland products of late years is only $49,000, while the amount remitted by Newfoundland is $78,000.

Never knew a Newfoundland fisherman to go to the coast of the United States to fish.

APPENDIX.

The foregoing paper having been prepared for use in presenting the case of the United States before the Halifax Commission, it seems desirable to append the testimony of the author as given before that Commission on October 18 and 19, 1877.

[Extracted from "Documents and Proceedings of the Halifax Commission, 1877, under the treaty of Washington of May 8, 1871." pp. 2795-2816 and 2821-2849.]

Prof. SPENCER F. BAIRD, assistant secretary of the Smithsonian Institution, Washington, and United States Commissioner of Fish and Fisheries, called on behalf of the Government of the United States, sworn, and examined.

By Mr. DANA:

Question. It is not necessary, of course, to ask this witness any questions to show his position or general acquaintance with and knowledge of the subject. I would like, however, to have you state, if you please, as I am going to give, by and by, some of the results of your inquiries—I would like to have you state particularly how you have obtained, and from what sources you have obtained, information respecting the fisheries of late, besides what you have studied in books.—Answer. I have been in the habit for five years past of spending from two to three months on the sea-coast for the purpose of prosecuting inquiries into the condition of the fisheries, to determine whether, as alleged, the American coast fisheries have been decreasing, and to ascertain what steps, if any, might be adopted to remedy the difficulty, if found. I have, in pursuance of that work, established stations in successive years at Eastport, Portland, Salem, Wood's Holl, on the south coast of New England, and at Noank. And I have had with me a force of experts, naturalists, and gentlemen interested in the biology of fishes, and have endeavored to gather such information as I could from my own personal observation and that of my colleagues, as well as by inquiries from fishermen and others whom I have met.

Q. How far have you prosecuted that personal inquiry of the fishermen and persons engaged in the fisheries?—A. I have, by the help of a phonographic secretary, taken the testimony of many hundreds of fishermen along the coast in reference principally to questions in the natural history of fishes. The facts as to the statistics of the fisheries have come out incidentally, and were not the original object of my inquiry. I was interested more in determining what kinds of fish we had, what natural, physical, or moral causes influenced them, and what would probably be the result of these causes, and how any evil influences could be remedied.

Q. Then have you employed fishermen to examine and make inquiries?—A. I have had in my employ several men, some for the whole year, or several years in succession, and others for a part of the year, who have taken a series of printed questions that I prepared in regard to the natural history of fishes, and pursued these inquiries in regions where I myself could not go conveniently, especially in the winter season or in the early spring.

Q. Then you issued some printed circulars?—A. Yes; a great many thousand blanks, inviting responses, and I have had a reasonable percentage of returns, of which I consider a fair percentage more or less reliable. But, as a general rule, as everybody knows, fishermen know less about fish than they do about anything else. That is to say, they know how to catch fish and the practical details of their business, but of their natural history they know very little. About such questions as the time of their migration, the rate of their growth, their spawning seasons, and other matters only here and there will you find a man who has observed and noted the facts closely enough to be able to answer your questions.

Q. You employed some such persons?—A. I have one man especially, a skilled fisherman, resident on the south coast of New England, and whom I employ to visit the different fishing stations and gather statistics.

Q. Have you any of those circulars about you?—A. I have one. [Circular produced.

Q. [Reading circular.] There are something like nearly ninety different questions. Under one head you require the man's name, &c. Then as to the distribution of fishes: what kind of fish he has in his neighborhood, their abundance, migrations, movements, food, relationships, reproduction, artificial culture, diseases, pursuits, capture, their economical value, application, &c.—A. That circular was issued in 1871. I have issued a great many editions of it. Then I have another circular which refers more particularly to the coast and river fisheries. I have only issued this within the present year.

By Hon. Mr. KELLOGG:

Q. Was that about the time, Professor?—A. Yes; the first thing I did was to distribute these questions in order to get as much information as I could. I have some eight or ten special circulars, but these are the ones I have most used. I have issued special circulars for the cod and mackerel and menhaden, but of these I have not copies with me.

By Mr. DANA:

Q. Here [referring to circular spoken of as issued during the present year] you have the home fisheries, the river fisheries; they don't come directly under our cognizance.—A. These are the coast and river fisheries particularly.

Q. Not the deep sea?—A. Only incidentally. They are sea-coast fish, but not outside. There is a schedule of the principal fish marketed in the Boston market. My object was to get the number of pounds of these fish taken in the vicinity of the person to whom the circular was given.

Q. You think these have been pretty fully answered?—A. I have a great many answers.

Q. And from your information, which you gather as you go about, from what is sent to you by the return of these circulars, and from the persons employed by you, it has been your business to make yourself fully acquainted with the subject?—A. Yes; I have, of course, used what published material I have found. I found a great deal of value in the reports of the Canadian fisheries. What little I know of the fisheries in Canada I have learned from these documents.

Q. Wherever there are documents published by the United States you have them?—A. Yes; I have them; and I have European documents, English, Norwegian, &c. I believe I have everything.

Q. I will question you first about codfish. I want you to state what is your opinion about the cod as a fish for all sorts of commercial purposes, as compared with others.—A. I think the cod stands at the head of fish at the present day. There is no fish that furnishes food to so many people, the production of which is of so much importance, or which is applied to such a variety of purposes. The commercial yield is very great, and its capture is the main occupation of a large portion of the inhabitants of the sea-coast region of the Northern Hemisphere.

Q. Besides as an article of food, either fresh or salted, what other purposes does it serve?—A. Well, it is applied to a great many purposes by different nations. It is used, of course, as food in the different modes of preparation. Particular parts are used as food, other than the muscles. The sounds are used as food, converted into gelatine, and in the form of isinglass. They serve a great variety of purposes. The roes are used as food, and bait for fish. The skin is tanned for leather and clothing. A great many nations dress very largely in the skins of cod and salmon. And the fish is dried and used as food for cattle in Iceland and Norway. The bones are used as fuel in some places; and, of course, the oil is used for medicine, and for the various purposes to which animal oils are applied. There is scarcely any part that is not valuable. The offal, in Norway, is converted into a valuable manure. Every part is called into play.

Q. The bones?—A. They are burned as fuel, as well as eaten by dogs, or converted into fertilizers.

Q. It is not, probably, applied in the United States to all the uses you have specified?—A. No; I don't think the skin is used as clothing in the United States, but it makes an admirable leather for shoes, and makes very nice slippers. We have in Washington quite a large number of articles made from the skins, as used in Alaska, the Aleutian Islands, and in Siberia.

Q. You think they can be used?—A. I have no doubt in the course of years the skin will be utilized very largely. In fact, I may remark, that at the late exhibition at the Westminster Aquarium, among the special articles exhibited were shoes made from leather of the codfish, furnished by an exhibitor from Christiania.

Q. You think it is the foremost fish?—A. I think it is. There is none that furnishes so important an industry or which is so abundantly or widely disseminated.

Q. What is the geographical distribution of the cod?—A. There are quite a number of species of the cod, some characterized by certain peculiarities and some by others. The cod in the North Pacific is different from that in the North Atlantic. Both are, however, codfish, and no one could mistake them for anything else but cod. In the Atlantic the cod are found on the American side from the Winter Quarter Shoals, on the coast of Virginia; that is the most southern point I have traced it to; from that indefinitely to the northward. It is found everywhere upon the coast, in the Bay of Fundy, the Bay of Saint Lawrence, off Labrador and Newfoundland, on the Grand Bank, and many other places. The European species, although by some considererd distinct from ours, probably have a geographical range equally extensive. I believe they are not in Spitzbergen.

Q. What is the most important locality?—A. Probably the most important single locality that furnishes the greatest amount of fish with the least possible labor in the shortest possible time is that in the vicinity of the Lofoden Islands, on the northwest coast of Norway. That is a region where usually twenty-five millions of fish are taken in three months by some twenty-five thousand men. The Dogger Bank, in the North Sea, is another European locality. In America the most extensive stores of cod are found, I suppose, on the Grand Bank and the George's. They are found, perhaps, also on the great banks off the coast of Labrador, 20 or 30 miles off the coast, extending for hundreds of miles.

Q. Now give the Commission some notion of the abundance of codfish.—A. Well, I have covered that point in my reply to the previous question. It is found in the greater part of those regions at some portion of the year. It is usually more abundant in the spring or summer, autumn or winter, in each locality, in numbers only to be measured by the ability of man to capture.

Q. What do you say of their migrations?—A. The cod is a fish the migrations of which cannot be followed readily, because it is a deep-sea fish and does not show on the surface as the mackerel and herring; but so far as we can ascertain, there is a partial migration; at least some of the fish don't seem to remain in the same localities the year round. They change their situation in search of food, or in consequence of the variations in the temperature, the percentage of salt in the water, or some other cause. In the south of New England, south of Cape Cod, the fishing is largely offshore. That is to say, the fish are off the coast in the cooler water in the summer, and as the temperature falls approaching autumn, and the shores are cooled down to a certain degree, they come in and are taken within a few miles of the coast. In the northern waters, as far as I can understand from the writings of Professor Hind, the fish generally go off-shore in the winter time, excepting on the south side of Newfoundland, where, I am informed, they maintain their stay, or else come in in large abundance; but in the Bay of Fundy, on the coast of Maine, and still further north, they don't remain as close to the shore in winter as in other seasons.

Q. Take them as a whole, then, they are deep-sea fish? I don't mean the deep sea as distinguished from the banks.—A. An outside fish? Well, they are to a very considerable extent. The largest catches are taken off-shore, and what are taken inshore are in specially favored localities, perhaps on the coast of Labrador, and possibly off Newfoundland. They bear a small proportion generally to what is taken outside, where the conveniences of attack and approach are greater.

Q. Now, what is known about the spawning-grounds of codfish?—A. We lack positive information in regard to the spawning-grounds of this fish, except that we know single localities. We know the Lofoden Islands are great spawning-grounds. We know that the fish come there almost exclusively for the purpose of spawning. They are not there in the ordinary times of the year. They come in December and January, and spawn in February and March, and are there in most overwhelming abundance.

Q. But on the coast of America?—A. We know there is one large spawning-ground in Cape Cod Bay.

Q. You mean Massachusetts Bay inside?—A. Yes; there is said to be there a long reef about 4 miles wide and about 20 miles long, and the cod go in there and furnish a very important winter fishery.

Q. Then I presume there are similar spots along the whole American coast?—A. Probably they spawn at the Georges, and undoubtedly in a great many localities in the Bay of Saint Lawrence, and on the Banks, although I cannot speak of that, because I haven't had an opportunity of knowing.

Q. What are the relations of cod to other fish?—A. They are friends and enemies. They are warriors and victims. They are extremely voracious, and devour everything that is small enough, without any kind of consideration, and in turn are consumed in all their stages by such fish as can master them. The adult fish are principally interfered with by horse-mackerel, the bluefish, the porpoise, and by sharks, and anything else big enough to swallow them, instead of being swallowed by them. It is merely a question of size whether the codfish is the active or passive agent.

Q. Now what fish do they devour mostly?—A. They eat everything, but they live very largely on herring or mackerel, or any of the small fish found on the sea bottoms. They devour crabs and small lobsters. The stomach of the cod is one of the best dredges you can have. You find there sometimes rare specimens that are never found elsewhere.

Q. Do they digest the shells?—A. No; they digest the nutriment and then throw out the shells. Sometimes you find the shells packed solid one inside of another like saucers in a pile. The wonder is how they empty them out.

Q. But they do?—A. I suppose they must.

By Hon. Mr. KELLOGG:

Q. They devour them whole and then when the meal is digested they eject the shells?—A. The mouth is quite large, and the shell goes out as easily as it goes in.

By Mr. DANA:

Q. What do you think are the seasons for spawning on the American coast?—A. I presume that, like many other fish, they may spawn over quite a range of time. But, so far as our own observation on the American coast goes, their season is from November until March. In Cape Cod Bay they spawn about December and January.

I have no doubt, however, that farther north, where the changes of temperature are not so abrupt, they may spawn more irregularly, and have only an interval of a few months when there is no spawning.

Q. Will you describe this spawn so as to show the prolific nature of the fish?—A. The cod is one of the brag fish in regard to spawning. That is, we hear of ordinary multiplication of fish by that process, but the cod has been found to contain from three to seven million eggs by actual count. Turbot, I think, are one of the very few fish that can beat it. They run up to twelve millions.

Q. We do not have the real turbot?—A. No; from three to five million might be considered a fair annual estimate of the eggs of the codfish. From three to five millions of ripe eggs have been found in the ovary of one single cod, and more.

Q. What becomes of these eggs when discharged?—A. The question of the spawning places for codfish has been one that was originally very uncertain. The researches of naturalists have shown that these eggs are discharged in the open sea on the Lofoden Banks. Some miles from the shore they can be found floating at the surface, and can be taken up by the bushel in towing nets. The eggs are very small, from one-twentieth to one-fiftieth of an inch in diameter, and they have a small globule of oil to make them float.

Q. Now, do these eggs all produce fish unless they are injured in some way?—A. No; there are a great many contingencies. It is not likely that a very large percentage will be fertilized by the male. There is always an uncertainty about that. Then, as they are floating in the water, every fish that may be fond of that kind of sustenance devours them very greedily, and by the time they are hatched out a large percentage is destroyed in this way. Then, the young fry, while in a helpless state, are devoured in large numbers. I should think it extremely probable that not one hundred thousand out of the three millions—possibly not ten thousand—attain to a condition in which they are able to take care of themselves. It is entirely impossible to make any estimate. We know, however, from the analogy of other fish, from the facts in regard to salmon, shad, and that kind of fish, we can make an approximation.

Q. These eggs rise to the surface?—A. They float at various distances from the surface down. Some are a little heavier and some a little lighter. I mean that they are not attached to the bottom. Their specific gravity is very nearly that of the water. Of course when the water is cold they will float better, because the density is greater, but when the water is warm they will sink.

By Hon. Mr. KELLOGG:

Q. Before you leave this subject, I would like to ask whether the spawn are visible in the ocean, that is cod spawn. What is the color?—A. It is transparent, with a little spot of oil in one corner. You would not notice it under ordinary circumstances, but you might if you were looking for it.

Q. The ocean might be full and a common man would not see it?—A. Certainly.

By Mr. DANA:

Q. Be kind enough now to tell us what are the principal modes of capturing cod?—A. The modes of capture vary with the region. For commercial purposes, the fish are caught with hand-lines and the trawl-line, or long-line as it should be called. It is taken very largely in gill-nets on the coast of Norway, and in some other regions. I believe it is so taken on the coast of Labrador, but I don't think it is taken frequently on our own coast in nets.

Q. To what extent is the trawl-line used?—A. It is used all over the world. It is one of the oldest methods of catching fish.

Q. From your investigation, do you think the capture of fish generally, or codfish, or other kinds, by some contrivance like the trawl, is as ancient as any other?—A. I know it is. The Indians, the Aleutian Islanders have used them.

Q. That was not derived from us?—A. No. Travelers have found them in use when the first white men came among them. We have specimens in great number of the trawl of the native savage. Ours have only been brought in within the last five or six years. I don't think it is possible to fix the date of the first use of the trawl. They have been traced back to such a period that there is no possibility of saying that it was introduced by this man or known to that one.

Q. What are the advantages of the method of trawl-fishing for cod?—A. The alleged advantages, as far as I have heard them spoken of, are the larger yield of the fishery. The same number of men in the same time, and in the same locality, will catch a larger fare of fish with the trawl than with hand-lines. Then they require less exposure of the fishermen. They can be set over night and left down through the day at times when the weather would be too inclement for hand-line fishing. Then it requires much less skillful fishermen to use the trawl than the hand-lines. It is merely a matter of putting on the bait and throwing it overboard, and it does not require the delicate manipulation and skill that the hand-line fishing does, and therefore does not call into play to the same extent the functions of the practiced fisherman.

Q. Now, are there any disadvantages connected with the use of the trawl, alleged or actual?—A. There are a great many accusations brought against it. How far these are valid it is impossible for me to say. The principal objection I suppose is that it tempts all kinds of fish. One objection is that it takes fish that are too small size. They use a smaller hook than the ordinary hand-lines, and they say it takes a great many unmarketable fish, which affects the supply. Then another complaint is that the fish being longer in the water are liable to be destroyed by the depredations of sharks, dogfish, and fish of that class. Another objection is that after the fish are caught the marketable fish, owing to their weight, slip off from the small hook and float away and are lost. Another objection is that they catch what they call mother fish, that is the parent fish, which some fishermen think should be left to reproduce their kind.

Q. If they are taken after depositing their spawn you only lose one fish?—A. Yes; but it is probable, judging from the testimony of fishermen, that the fish can be taken during their spawning season with a trawl when they will not bite a hook. As a general thing very few will bite on the ordinary line, but the trawl bait is said to be attractive to them, and the fish are believed to be more likely to take the bait at that time from a trawl than from a hook on an ordinary line.

Q. Well, taking the reasons given both ways, what conclusion have you come to about the use of the trawl for cod-fishing?—A. Well, it is just one of the wholesale modes of capture, which it is difficult to avoid, because the tendency is to centralize, to accomplish the same work by less expenditure of money and of human force.

Q. Do you think it is a case for prohibition or regulation?—A. I don't see how it can be either prohibited or regulated. I hardly see. Of course I have had no practical experience. I may say that the trawl is used very much less on the coast of America than on the coast of England and of Europe generally, and I have failed to find anywhere in the English writers or in the testimony of the British Fishery Commission any complaint there such as occurs in America. There is a great complaint there against what is called the beam-trawl. When they speak of the trawl they don't mean what we mean. What they refer to is a trawl such as we use in our steamer to capture flounders and such fish. Wherever you see the word trawl used by an English or European writer you must apply it to that large net that is dragged behind the vessel along the bottom of the sea. The word trawl is never applied in Europe to the line, and, therefore, there is a great deal of vagueness and error involved in the consideration of the subject unless you know what the particular speaker or witness means by a trawl. But speaking of the long-line, which is the general term, or bultow, I have failed to find in the reports of the British Fishery Commission any complaint by anybody except three cases of complaint against the trawl-line or long-line. One was that it destroyed the young fish, and the others were that they interfered with the nets. They complained that the trammel-net especially, which is a particular kind used in England, was fouled by these lines and injured.

Q. On the other hand, the net was in the way of the trawl?—A. No; the trawl was in the way of the nets. The trawlers didn't care about the net, but the net fishermen did complain of the trawl. But I have looked carefully to find whether there was any complaint against that line, and I haven't found it. There may be, but I am quite confident it has not assumed anything like the antagonistic features and impression of magnitude that it has in the United States and America generally.

Q. We mean by the trawl a long line weighted or anchored which sinks to the bottom and has —— A. It has branches three feet long. That is called a long-line or bultow.

Q. Then at intervals there are buoys?—A. Yes.

Q. To show the position. They are usually in a straight line?—A. In Europe there are generally several shorter lines united in one long line, so much so that on the coast of Great Britain they have a line of trawls six or eight miles in length. In America the trawling on the banks is generally by means of five shorter lines radiating from the vessel, but in England the trawling is done generally on a large scale, without rowboats, directly from a vessel of forty or sixty tons, and the entire series of lines is united in one and sunk.

Q. They are hauled in from aboard the vessel, and not from a boat at all?—A. Yes.

Q. Now, what do they call that which we call a trawl, if it is used at all?—A. They call it a long-line or bultow.

Q. What bait do you find to be the best for codfish?—A. Well, I can't say I find any bait to be the best, because I never caught many fish, but I know that everything of an animal nature, and to some extent vegetable, has been used for the cod. Generally, in America, our bait consists of herring, menhaden, mackerel, a portion of the offal of the fish, sea-birds of various kinds, clams, squid, and the various species of shells, and in fact anything that can be got hold of.

Q. Well, now, what are the methods of preservation of this bait? We have heard of their using salt clams, &c. Has much attention been paid to the possibility of greater preservation of the bait than we have ever yet had?—A. Yes; the science of preserving bait, as well as of the preservation of fish on shipboard, is very low indeed, far below what can be applied, and I have no doubt will be applied, both in keeping fish for food and in keeping it for bait.

Q. Now, will you state what observation you have made respecting the method of preserving fresh bait from the start all the voyage through?—A. As a general rule it is now preserved either by salting or freezing. Of course they keep it as long as it will remain without spoiling, and when you have to carry it beyond that time, either ice it or salt it. Salting, of course, is a very simple process, but it alters materially the texture and taste to such a degree that fish or other bait that under certain circumstances is highly prized by the fish is looked upon with a great deal of indifference when salted. Now, there are special methods of preserving the fish or bait by some chemical preparation, which preserves the fish without giving the saline taste. There are preparations by means of which oysters or clams or fish can be kept in solutions for six months without getting any appreciable taste, and without involving the slightest degree of deterioration or destruction. One process submitted to the group of judges, of whom I was chairman, was exhibited by an experimenter who placed a great jar of oysters in our room prepared in that way. I think about the 1st of August those were placed in our room and they were kept there until the middle of September, for six weeks during the hottest portion of the centennial summer, and that was hot enough. At the end of that time we mustered up courage to pass judgment upon this preparation, and we tasted these oysters and could not find them affected. We would have preferred absolutely fresh oysters, but there was nothing repugnant to the sensibilities, and I believe we consumed the entire jar. And we gave the exhibitor, without any question, an award for an admirable new method. That man is now using that process on a very large scale in New York for the preservation of fish of all kinds, and he claims he can keep them any length of time and allow them to be used as fresh fish quite easily. I don't suppose any fisherman ever thought of using any preservative except salt.

Q. That is entirely experimental?—A. It is experimental, but it promises very well. Now, borax is one of the substances that will preserve animal matter a great deal better than salt and without changing the texture. Acetic acid is another preparation, or citric acid will keep fish a long time without any change of the quality, and by soaking it in fresh water for a little while the slightly acidulated taste will be removed. I don't believe a cod will know the difference between a clam preserved in that way and a fresh clam.

Q. Now, about ice. We know a good deal has been done in the way of preserving bait in ice. How far has that got?—A. It is a very crude and clumsy contrivance. They generally break up the ice into pieces about the size of pebble stones, or larger; then simply stratify the bait or fish with this ice, layer and layer about, until you fill up a certain depth or distance. The result is that if the bait can be kept two weeks in that method it is doing very well. They generally get a period of preservability of two weeks. The ice is continually melting and continually saturating the bait or fish with water, and a very slow process of decomposition or disorganization goes on until the fish becomes musty, flabby, and tasteless, unfit for the food of man or beast.

Q. Well, there is a newer method of preservation, is there not?—A. There is a better method than using ice. The method described by the Noank witness, by using what is equivalent to snow, allows the water to run off or to be sucked up as by a sponge. The mass being porous prevents the fish from becoming musty. But the coming methods of preserving bait are what are called the dry air process and the hard freezing process. In the dry air process you have your ice in large solid cakes in the upper part of the refrigerator and your substance to be preserved in the bottom. By a particular mode of adjusting the connection between the upper chamber and the lower there is a constant circulation of air by means of which all the moisture of the air is continually being condensed on the ice, leaving that which envelops the bait or fish perfectly dry. Fish or any other animal substance will keep almost indefinitely in perfectly dry air about 40° or 45°, which can be attained very readily by means of this dry air apparatus. I had an instance of that in the case of a refrigerator filled with peaches, grapes, salmon, a leg of mutton, and some beefsteaks, with a great variety of other substances. At the end of four months in midsummer, in the Agricultural Building, these were in a perfectly sound and prepossessing condition. No one would have hesitated one moment to eat the beefsteaks, and one might be very glad of the chance at times to have it cooked. This refrigerator has been used between San Francisco and New York, and between Chicago and New York, where the trip has occupied a week or ten days, and they are now used on a very large scale, tons upon tons of grapes and pears being sent from San Francisco by this means. I had a cargo of fish-eggs brought from California to Chicago in a perfect condition. Another method is the hard frozen process. You use a freezing mixture of salt and ice powdered fine, this mixture producing a temperature of twenty degrees above zero, which can be kept up just as long as the occasion requires by keeping up the supply of ice and salt.

Q. How big is the refrigerator?—A. There is no limit to the size that may be used. They are made of enormous size for the purpose of preserving salmon, and in New York they keep all kinds of fish. I have been in and seen a cord of codfish, a cord of salmon, a cord of Spanish mackerel, and other fish piled up just like cord-wood, dry, hard, and firm, and retaining its qualities for an indefinite time.

Q. Well, can fish or animals be kept for an unlimited period if frozen in that way?—A. You may keep fish or animals hard dried frozen for a thousand years or ten thousand years perfectly well, and be assured there will be no change.

Q. Have geologists or paleontologists satisfied themselves of that by actual cases of the preservation of animal substances for a long period?—A. Yes; we have perfectly satisfactory evidence of that. About fifty years ago the carcass of a mammoth, frozen, was washed out from the gravel of the river Lena, I think, one of the rivers of Siberia, and was in such perfect preservation that the flesh was served as food for the dogs of the natives for over six months. Mr. Adams, a St. Petersburg merchant, came along on a trading expedition, and found it nearly consumed, and bought what was left of it for the St. Petersburg Academy of Science—the skeleton and some portion of flesh—which were preserved first in salt and afterward in alcohol. Well we know the period of time that must have elapsed since the mammoth lived in the arctic circle must be very long. We know we can talk with perfect safety of ten thousand years. The geological estimate of it is anywhere from fifty to a hundred thousand years; we cannot tell. There is no unit of measure; we know it must have been some hundreds of thousands, and probably it would have remained in the same condition as much longer.

Q. Now, to come to a practical question, is this a mere matter of theory or of possible use? For instance, could this method be adapted to the preservation of bait for three or four months if necessary?—A. The only question, of course, is as to the expense. There is no question at all that bait of any kind can be kept indefinitely by that process. I do not think there would be the slightest difficulty in building a refrigerator on any ordinary fishing vessel, cod or halibut, or other fishing vessel, that should keep with perfect ease all the bait necessary for a long voyage. I have made some inquiries as to the amount of ice, and I am informed by Mr. Blackford, of New York, who is one of the largest operators of this mode, that to keep a room ten feet each way, or a thousand cubic feet, at a temperature of 20° above zero, would require about 2,000 pounds of ice and two bushels of salt per week. With that he thinks it could be done without any difficulty. Well, an ordinary vessel would require about seventy-five barrels of bait—an ordinary trawling-vessel. That would occupy a bulk something less than 600 feet, so that probably 4½ tons of ice a month would keep that fish. And it must be remembered that his estimate was for keeping fish in midsummer in New York. The fishing-vessels would require a smaller expenditure of ice, as these vessels would be surrounded by a colder temperature. A stock of 10 to 20 tons would in all probability be amply sufficient both to replace the waste by melting and to preserve the bait.

Q. Have you any doubt that some method like that will be put into immediate and successful use, if there is sufficient call for it?—A. I have no doubt the experiment will be tried within a twelvemonth. Another method of preserving is by drying. Squid, for instance, and clams, and a great many other kinds of bait can be dried without using any appreciable chemical, and can be readily softened in water. I noticed lately in a Newfoundland paper a paragraph recommending that, in view of the fact that the squid are found there for a limited period of time, the people should go into the industry of drying squid for bait, so that it would always be available for the purpose of cod-fishing. I think the suggestion is an excellent one, and I have no doubt it will be carried out.

Q. Now, what is the supply of bait for codfish on the American coast?—A. Well, as the codfish eats everything, there is a pretty abundant stock to call upon. Of course, the bait-fish are abundant, the menhaden and herring. The only bait-fish that is not found is the caplin. The herring is very abundant on the American coast, and the alewives enormously abundant. Squid are very abundant of two or three species, and, of course, clams of various kinds. Then we have one shell-fish that we possess. It is never used here, although it is very abundant; but it is almost exclusively the bait for trawling on the coast of Great Britain. This shell-fish is known as the whelk, or winkle.

Q. Is it a kind of mussel?—A. No; it is a kind of univalve shell [submits specimen], and is almost exclusively used for the capture of cod in England on deep-water trawl-liners. It is not used here at all.

Q. Why is it not used here?—A. I don't know except that they have other bait that they get at more readily, and they have not learned how to use this.

Q. But it is very abundant?—A. Yes; quite as abundant as it is anywhere. This is a rather small specimen. The advantage of this kind of bait is that it can be kept alive for a long time merely by moistening it or keeping it in water, so there is no question about salting it or using ice or any other application.

By Sir ALEXANDER GALT:

Q. Is there any particular locality for that?—A. It is extremely abundant all through the northern seas. I am a little surprised that I have not seen more of them here. It is a northern shell. I presume it is very abundant in Newfoundland, and to the north. At any rate it is in any desired abundance in the Bay of Fundy, but not south of Cape Cod.

Q. From all you have learned, have you any doubt that, supposing the fishermen of the United States were precluded from using any bait except what could be got upon their own coast, they could obtain a sufficient supply there?—A. Well, unless the American fishery should be expanded to very enormous limits, far in excess of what it is now, I can't see that there would be any difficulty. I may refer to one bait at our command, which is an excellent bait—salt liver. In some parts that is considered an excellent bait. Of course each part of the world swears by its own particular bait. While the Cape Cod man swears by menhaden, the Newfoundlander by herring and caplin, and the Englishman by winkles, the Dutchman swears by salt liver.

Q. We could have that, of course.—A. Yes. Then the roes of cod are good for bait.

Q. What do you say about gurry? We had a good deal about that in the early part of this inquiry. Be so good as to tell what opinion you have or what conclusion you have come to about its use and abuse.—A. It hardly applies to cod any more than to any other fish cleaned at sea. The gurry is the offal, and that of course may be of salmon or cod or haddock or mackerel. The practice of throwing overboard gurry is in many respects reprehensible, because in the first place it is a very great waste of animal matter. The applicability of this offal to commercial purposes is such that whenever it can be had in sufficient quantities it should be utilized. It is so on the coast of Norway. An enormous number of pounds of fertilizer are made out of the gurry, and the heads are dried and used for food for dogs and cattle. I presume you refer, however, to the supposed influence of the gurry on the fishing-grounds, more particularly. Well, in the first place, more of it can be used now. In the process of hard freezing applied to cod it is brought in more as a fresh fish. But a large proportion of what is thrown overboard can be utilized. It can all be utilized, and it would be very proper, I think, to impose some penalty upon the waste of the gurry by throwing it overboard, in favor of securing its preservation and utilization. But of course the question is as to what influence the gurry can exercise upon the sea fishery, supposing it to be abundant and to be thrown overboard. I have no practical experience in regard to that. I know a great many persons testify that it is very objectionable. The reason why I should be inclined to attribute very little importance to the objection is the readiness with which all such offal is consumed in the sea by the scavengers appointed by nature to destroy it. In the northern seas, where codfish are most abundant and this gurry is in the greatest abundance, the waters abound with countless numbers of minute crustaceans whose business it is to destroy animal matter. The so-called sea fleas are so active that if you take a fish the size of a codfish and put it in a bag of net-work and put it overboard where it will be exposed for a tide in water of anywhere from five to ten or twenty fathoms, you will find, as a general rule, that next day you will have the bones picked clean and a perfect skeleton without a single particle of flesh. I have had thousands of skeletons (I may say literally so) of fishes and birds and small quadrupeds prepared for museum purposes by simply exposing them to the action of the sea fleas. I have put them in bags perforated with holes and left them at the edge of low tide for a tide or two, and the skeleton would be perfectly complete without a bit of meat left.

Q. Well, these sea scavengers, are they usually at the bottom?—A. Everywhere, at the bottom and the top. Then there are the dogfish, the small sharks, catfish, goosefish, sculpins, and the codfish themselves, a variety of lobsters, and other inhabitants of the sea, that are at work, always ready and eager to seize anything of this kind and consume it. Then when the bones are exposed there are the sea-urchins, that make a specialty of devouring them. Now, I cannot say but that this material, under certain circumstances, may lodge in the crevices of the rocks and remain there and become an offense to the surrounding fish, but I rather suspect that the trouble about the gurry is that it attracts the predatory fish. Where it is thrown overboard it tolls them from a long distance. The dogfish, the shark, and other fish are attracted and come to the place where this offal has been throw overboard, and after they have consumed all that, they turn their attention to the cod and other fish that may be there and drive them off.

Q. So that even throwing overboard the gurry there is a danger of defeating your own purpose?—A. Yes; certainly. That is the hypothesis given as to the supposed evil effect of throwing overboard the offal in the European waters. It prevents the fishing there as long as this state of things lasts, but whether there is an actual injury otherwise I cannot say. The general presumption is against the idea that these substances can have a lodgment for any length of time to produce any offense. It might do it in fresh water. In the lakes you may have such a condition where those scavengers are not provided. But it hardly seems to me that it can be in the seas, in the northern seas especially.

Q. What is the geographical distribution of mackerel?—A. The mackerel is a fish that has not so northerly a distribution as the cod, and perhaps extends somewhat further south; otherwise it is found over, to a very considerable extent, the same range. It is found as far south as the Azores in European waters, and as far as Spitzbergen and Norway to the north. On our southern coast we find it very rarely, and very few individual specimens have been taken in the vicinity of Charleston. It has never been taken in the West Indies; never in Bermuda, I believe; but it is found as far north as the Strait of Belle Isle, and how much further north I cannot say. The two species (American and European) are believed to be identical, and although they are constantly within a comparatively small number of leagues of each other, yet they do not occur all the way across.

Q. What is the season for mackerel?—A. In America the mackerel season is in spring, summer, and autumn. In winter they are not found on our coast, and we don't get them, but we have them on our shores as early as the middle of April and as late as November.

Q. Now, as to the variation of seasons. What do you say about that?—A. It is very rarely they appear in the same abundance in two successive years, or, at least, it is rarely that the sum total of the experience of the fishermen gives about the same aggregate. Sometimes they are so scarce that the actual catch of one year will be much below that of other years, but we cannot say there are any fewer fish actually in the water. It may be that they take a different line; they may keep in different waters; they may show themselves less to fishermen; and may have other modes of variation; but we only know by the practical results of fishing that the catch in some seasons is much greater than in others.

Q. What do you think is known or what do you think is the best conjecture as to their migrations?—A. There have been a great many hypotheses on the subject of the migration of mackerel. At one time mackerel, as was supposed to be the case with cod and sea-herring, was believed to have an extreme range, that a large school traversed the coast of America or Europe, and swept over a range of thousands of miles, making a circuit that occupied one year in its completion. But the evidence at the present time tends to show that the mackerel comes in on the American coast as a great army, broadside, and appears within a reasonable length of time, or very nearly the same time, on all that extent of coast.

Q. Do you think it strikes the coast a little later to the north and a little earlier to the south?—A. The left wing of the army, as we might call it, strikes the American coast first, and the right wing strikes the Bay of St. Lawrence last; but it comes in with a broad sweep, not moving along the coast but coming in broadside. When the quickening influence of the spring sun is felt on this great body of fish somewhere outside, where I cannot say, they start, and the given temperature is reached sooner at Cape Hatteras than at Bay St. Lawrence; but I do not believe that the fish that enter the bay always skirt the American coast, nor do I believe that the American fish go into the bay. They come in a large number of schools, each school representing a family, that is, they spawn together, and they may have a short lateral movement, and they move a limited number of miles along the coast till they find a satisfactory spawning-ground; but, as a general rule, they aggregate in three large bodies; one of those bodies is about Block Island and Nantucket shoals, another is in the Gulf of Maine and Bay of Fundy, and another in Bay St. Lawrence. There are connections between those three bodies. You find them all along the coast; there are a certain number which spawn and are taken all along the coast; they are caught in weirs and pounds in spring and fall within one hundred yards of the shore; but the mass, as far as I can learn from the testimony presented before the Commission, are aggregated in those three great bodies.

Q. Is anything known about their winter quarters?—A. Nothing definite. We miss them for several months, from the end of November until March and April, and we say, we guess, we suggest they go into the Gulf Stream. That they go somewhere where they can find a temperature that suits them and there they remain, is clear; but it is a little remarkable that they never have been seen schooling in the Gulf Stream, that they never have shown themselves, that no fisherman, mackereler, or steamboat captain has ever reported, so far as my information goes, a school of mackerel in the winter season. If they were free swimmers, one would suppose they would show themselves under such circumstances. There is a belief very generally entertained among fishermen that they go into the mud and hybernate. That is an hypothesis I have nothing to say against. It seems a little remarkable that so free a swimmer as the mackerel should go into mud to spend its winter, but there is abundance of analogy for it. Plenty of fish bury themselves in mud in the winter time and go down two or three feet deep. There are fish that are so ready to bury themselves in mud you can dig them out of an almost dry patch as you could potatoes. The European tench, the Australian mud-fish, and dozens of species do that. There is nothing whatever in the economy of the mackerel or in the economy of fish generally against this idea, that it is an inhabitant of the mud. And the fishermen believe that the scale, which grows over the eyes, according to their account, in winter, is intended to curb their natural impetuosity and make them more willing to go into mud and stay there in winter and not be schooling out on the surface of the water. There are well-authenticated cases of fish being taken from the mud between the prongs of the jig when spearing for eels. That this has occurred off the Nova Scotia coast, in St. Margaret's Bay, and Bras d'Or, Cape Breton, and parts of the Bay of St. Lawrence, I am assured is not at all doubtful.

Q. Do not fishermen mainly retain the old theory of the northern set of the whole body?—A. Very largely, but I think latterly they are changing their views.

By Hon. Mr. KELLOGG:

Q. The fish were mackerel that were brought out of the mud?—A. When after eels they brought up mackerel out of the mud, in several instances, in January.

By Mr. DANA:

Q. What can you tell the Commission about the period of the spawning of mackerel?—A. Mackerel spawn almost immediately after they visit our shores. The earliest fish taken in the weirs and pounds in Vineyard Sound and Buzzard's Bay are full of ripe spawn, so that when the fish are taken out of the pounds and put into boats to bring them to shore there are sometimes quarts and pecks of the spawn in the bottom of the boats. It runs out with the utmost freedom, as it does with any full-spawning fish. That period ranges from the middle of May on our coast, and from June and July in Bay St. Lawrence. Mr. Whiteaves says they spawn in the Bay of Chaleurs in June. The season extends from the early part of May to the beginning of July.

Q. Where do the mackerel deposit the eggs?—A. The mackerel, like all sea fish, with the exception of the herring, the tomcod, and sculpin, has a free floating egg. The egg is discharged in the water wherever the fish happen to be, inshore or offshore, and it floats just under the same condition that the egg of the cod does. It has a small globule of oil as a buoy, and it floats on the surface or anywhere from that to half way down, or perhaps almost to the bottom, depending on the gravity of the egg and the specific gravity of the water.

Q. Is the mackerel supposed to be able to control the time when it will spawn?—A. When the egg is ripe it has to be discharged, whatever happens. The egg cannot be retained after it is overripe.

Q. How do the eggs of each mackerel compare in numbers with those of the cod?—A. The average of the mackerel spawn is about 500,000. They are very small, as you can imagine, for mackerel is not a very large fish. The eggs, when spawned, are only about one-fiftieth of an inch in diameter, about half the size of that of the cod. They vary in size, some being smaller and others larger, but they only vary within moderate limits.

Q. You say they spawned all along the American coast?—A. I presume they spawn in some numbers along the entire coast from the shore of Virginia to the coast of Labrador; formerly they spawned on the coast of Newfoundland, when mackerel were caught there, where they were very abundant a great many years ago, and also off the Bay of Fundy, when mackerel were abundant there.

Q. What is the food of the young mackerel?—A. The young mackerel, like the young of most other fish, feed on diatoms and other marine plants of low origin. They feed on the eggs of crabs and marine animals, probably on the small eggs of fish themselves, and as they grow they eat anything small enough to be swallowed. They don't bite as bluefish do, but they take everything at one mouthful and swallow it whole.

Q. And what is the food of the adult fish?—A. The adult fish feed very largely upon young fish, sand lants and young herring, and probably upon the young of their own kind. They are cannibals, as all fish are. They feed very largely upon what is called hay seed or cayenne; that is a minute kind of shrimp, which is so diminutive you require a microscope to separate it into its component parts. They feed also on large shrimps and on the young of large crabs. Its favorite food in summer is what fishermen have described as all-eyes, that is, young fish which, so far as I can judge, must be young mackerel, because I do not know any other fish that could be so abundant of that size at that season of the year. It is called all-eyes because its body is perfectly transparent, and when you see them swimming in the sunlight you can only see two eyes as two small dark specks. That occurs in almost incredible abundance, covering miles square and furnishing food for an enormous yield of fish.

Q. With regard to its bearing upon the locations of mackerel, I will ask whether there is any particular place where the food of mackerel is to be found, or whether it is all along the coast where the mackerel come?—A. The shrimp belongs to a class of crustaceans which inhabit the high seas everywhere. We took them this year in great quantities in coming across from Salem to Halifax, at George's, La Have, and Brown's Banks, and in Halifax Harbor. We take them in Eastport, Salem, and Portland Harbors, and as far as I am advised by the specialists who are associated with me, there is no part of the ocean where these small animals are not to be found in ample abundance, sometimes enormously aggregated and at other times less common. They are found at all depths of water, from the surface to the bottom. We take them in our dredge and in our midway and surface nets. Those and the young of the large crabs are found under all circumstances and conditions.

Q. Then we take the common bait, pogies, or menhaden. They are mackerel bait, are they not?—A. Eaten by mackerel? I do not think they are, unless they eat them in the winter time. As to the spawning of pogies, we know nothing about it; we infer they spawn in winter off the southern coast.

Q. Are not menhaden used as bait for mackerel by fishermen?—A. The menhaden itself is taken all through the mackerel season at some part of the American coast.

Q. Is it abundant within your observation?—A. Yes; it is almost the most abundant of our fish; indeed, it is a question which is most abundant, sea herring or menhaden.

Q. In regard to the catching of mackerel as affecting the supply and the probable diminution or increase of mackerel, what have you to tell the Commission about the mode of taking mackerel?—A. The mackerel is taken in a great variety of ways. At present it is taken by jig hook and by the net in some form. Formerly it was taken by means of hooks, as we do for bluefish, sailing backward and forward in a boat having a number of lines put from the vessel, and taking them when the vessel is under full speed. That method is still practiced on the coast of Europe, where mackerel are still taken in that way. Then it was found that by keeping the vessel comparatively motionless and throwing chum or chopped meat overboard mackerel could be brought up to the vessel, and that proved a much more efficient and thorough mode of capture. Nets were introduced, and many mackerel are now taken in gill-nets. Seines which are hauled to the shore have been introduced at some places on the coast of Nova Scotia, and a good many mackerel are taken in pounds and weirs, enormous quantities being taken in spring and fall on the New England coast in that way. The purse-seine is perhaps the most efficient and comprehensive method, and it is used by vessels.

Q. What is the proper depth of a purse-seine?—A. Twenty, twenty-five, or thirty fathoms deep.

Q. To be successful it has to have that depth?—A. It has to be deep, but it must be shallower than the water, or it will get entangled and torn.

Q. Do you know whether it is true that there must be that depth in order that the mackerel shall not discover it so quickly and escape?—A. I could not say; that is a fisherman's theory, which I know nothing about.

Q. With regard to the preparation of mackerel, what have you to say?—A. Nothing, except that they are used in increasing numbers fresh. The principal consumption in Europe is in fresh fish. The people there do not salt fish, or scarcely at all. They are put up in Europe, and I believe, to some extent, in Canada in cans; I do not think that is done in the United States.

Q. Of course, you have obtained information as to the manner in which the fish can be used by consumers; you have nothing to do with the mercantile side of the question?—A. No.

Q. You have had it presented to you. Do you find that the demand for fresh fish of all kinds is increasing?—A. I know the tendency at the present day is to substitute fresh fish for salt, in view of the improved methods of preparation and preservation, and the improved means of communication, railroads and steamboats coming to the shores and carrying away the fish and distributing it over an extent of thousands of miles and more in the interior, it bringing a much better price as fresh fish, and yielding a much better profit to the seller.

Q. Is that trade rapidly increasing?—A. It is increasing with enormous rapidity. Every year witnesses a great extension of the methods and increased improvements in the mode of preparation and the size of the refrigerators and their number.

Q. In regard to herring, what have you to say?—A. Herring is a fish of wide range. Though I cannot say it goes farther north than cod—perhaps it does not—it goes scarcely as far south on the American coast. I have not found any evidence of its being taken south of Block Island. It is very abundant off Block Island and Narragansett Bay in winter, but whether it is found farther south I am unable to say; it is found as far north as Labrador. and much farther.

Q. It is found from Block Island to the shores of Labrador in great abundance?—A. Yes.

Q. It is pretty fairly distributed all along?—A. Yes; in some localities they are found in greater abundance at some periods of the year; but there is no part of the American coast, from Labrador to Block Island, where they are not found during a certain number of months.

Q. What are the movements of this fish?—A. They present migrations not so extensive and demonstrative as that of mackerel, but more so than those of cod. They probably move from their ground from time to time in search of food, and generally have definite places for spawning, to which they resort at different seasons of the year at each particular coast. While the spawn is deposited, as a general rule, in certain localities, it is sometimes a matter of uncertainty. The destruction of herring has been less in America than in Europe, where it has been very marked. There are extensive regions where formerly the herring business was carried on, from which they have entirely disappeared, so much so that they import herring from Scotland and America.

Q. As to the egg of the herring?—A. The egg is larger than that of the cod, and is about one-twentieth of an inch in diameter.

Q. What is the number to each fish?—A. About 30,000.

Q. Do you think they have any particular spawning-ground?—A. They have definite localities that are preferred by them. They spawn round the Magdalen Islands in great abundance, and in the bays of Newfoundland. The most extensive spawning-ground on the southern coast is round the southern end of Grand Manan, which is one of the most interesting and extensive spawning-grounds I know of. But they spawn also all along the reefs and rocky places of the New England coast as far as No Man's Land and Block Island.

Q. The yield of herring in New England, is it and can it be made very large?—A. I presume as many herring could be taken in New England, in seasons when they are able to be taken, as might be called for, if the price of them warranted it.

Q. Herring does not bring much in the market?—A. I believe not; they are taken in both spring and fall, but they are most abundant in the fall.

Q. I should like to put one or two questions to you bearing a good deal on this subject which the Commission has before it, respecting the kinds of fish which can be and are used in the United States. Leaving out cod, mackerel, and herring, will you tell the Commission what has been discovered regarding the kinds of fish that are used as a substitute for mackerel—salted fish, I mean?—A. There is a great variety in vast abundance of many kinds of fish all along the coast of the United States, from Saint John's River, Florida, and farther south, to the Bay of Fundy, and many of those could be utilized to very great advantage if there was a demand. They are taken in very large quantities and consumed as fresh fish, but they are not prepared in large quantities, with the exception of the Southern mullet.

Q. How far north is mullet found?—A. It straggles as far as Cape Cod; it is quite abundant at some seasons on the south side of New England, but not sufficiently so for marketable purposes, but off the coast of Virginia and off the Carolinas, and all the way down to the extremity of Florida, the mullet is in quantities scarcely credible. They are taken and sold in great numbers; many thousands of barrels are put up, and if there was any speedy call for them they could be furnished. I presume I am safe in saying that one million barrels of mullet could be furnished annually from the south shore of Chesapeake Bay to the south end of Florida, if they were called for.

Q. How far has the mullet come into the market now?—A. The mullet does not come into the Northern market at all, but in North Carolina, South Carolina, and Georgia it fills the markets at the present time, excluding other kinds of imported fish. In former years there was a great demand for herring and mackerel, but the mullet is supplying the markets because they are sold fresher and supplied at much lower price, and they are considered by the Southern people a much superior article of food.

Q. Is it preferred to mackerel as a salted fish?—A. The persons familiar with mackerel and with mullet from whom I have made inquiries—I never tasted salt mullet—give the preference to mullet. It is a fatter, sweeter, and better fish, and of rather larger size. They grade up to 90 to a barrel of 200 pounds, and go down to three-quarters of a pound, and as a salt fish the preference is given by all from whom I have inquired to the mullet.

Q. Do you think the failure of the mackerel market in the Southern and Southwestern States is largely attributable to the introduction of mullet?—A. I cannot say that, but I imagine it must have a very decided influence.

Q. Can the mullet be caught as easily as mackerel?—A. More easily. It is entirely a shore fish, and is taken with seines hauled up on the banks by men who have no capital, but who are able to command a row-boat with which to lay out their seines, and they sometimes catch 100 barrels a day per man, and sometimes as many as 500 barrels have been taken at a single haul. The capital invested is only the boat, the seine, perhaps 100 or 200 yards long, the salt necessary for preserving the fish, and splitting boards and barrels.

Q. Can pounds be used?—A. They have not been used, and I doubt whether they could be used. Pounds are not available in the sandy regions of the South.

Q. They are taken by seining?—A. Yes, seines can be used. This work is entirely prosecuted by natives of the coast, and about two-thirds of the coast population are employed in the capture of these fish.

Q. Then the business has grown very much?—A. It has grown very rapidly.

Q. When was it first known to you as a fish for the market?—A. I never knew anything about it until 1872.

Q. Then it has been known during only five years?—A. I cannot say; it has been known to me that length of time.

Q. During that time the business has very much increased?—A. I am so informed; I cannot speak personally. All my information of it is from reports made to me in replies to circulars issued in 1872 and 1873. I have not issued a mullet circular since that time, when I issued a special circular asking information regarding the mullet.

Q. Then it is your opinion that the mullet has become, to some extent, and will become, an important source of food supply?—A. It is destined, I suppose, to be a very formidable rival and competitor of the mackerel. I know in 1872 a single county in North Carolina put up 70,000 barrels of mullet, a single county of five States covering the mullet region.

Q. Repeat that statement.—A. I say 70,000 barrels of mullet were packed in Carteret County, North Carolina, in 1872—one county in the States of Virginia, North Carolina, South Carolina, Georgia and Florida, where mullet comes in great abundance during two or three months of the year. It is during the spawning season of the mullet that it is taken in this quantity, and mullet roes form a special delicacy over which every Southerner exults. It is a separate business, the roes being smoked and salted and sold in large quantities.

Q. Perhaps a reason—to get into the region of political economy—why mullet-fishing was not prosecuted formerly, was that the Southern people were not fishing-people under the slave system?—A. They probably had not a proper method of taking them. They used more casting nets than seines.

Q. State to the Commission what mode of fishing and what kinds of fish are caught on the south of the New England coast, south of Cape Cod. Is it not a great region for fish?—A. The variety of fish taken on the shores south of Cape Cod is very great, and constitutes a very important element in the food resources of the country. Many of them are fish of very great value as food, some selling as high as one dollar per pound, every pound of that fish that can be brought into market bringing never less than 60 cents and up to one dollar per pound. Other fish range from 20 cents, 35 cents, and 40 cents per pound. Others from 20 cents to 25 cents, very few bringing less than 8 and 10 cents a pound as fresh fish.

Q. What kinds of fish are they which bring the high price of a dollar a pound?—A. The pompano, which is the highest-priced fish.

By Sir ALEXANDER GALT:

Q. To what size does it grow?—A. Three pounds is the maximum. It is more generally one pound. The pompano brings one dollar per pound when it is freshly caught. Sometimes when it is brought to New York and kept for a long time the price may come down. I know one occasion when it was sold at 10 cents a pound; but the fish was not marketable and should not have been sold. The next best fish is Spanish mackerel, a fish of remarkable excellence.

By Mr. DANA:

Q. In New York market at the proper season what does it bring?—A. I don't suppose it is ever sold under 25 cents per pound, and from that to 40 cents.

Q. Is that a mackerel?—A. It belongs to the mackerel family, and weighs about 3 pounds. There is the cero, a kind of Spanish mackerel, which goes up to 15 pounds. Those are all found from Cape Cod to Florida along the entire coast. There is the scup, which occurs from Florida to Cape Cod in great abundance.

Q. The scup is found in great abundance off the south coast of Massachusetts and Rhode Island?—A. Yes. There is also sea bass, which is one of the finest of the American fish, and is worth from 18 cents to 25 cents per pound.

Q. How many pounds do they average in weight?—A. From 1 to 4 pounds; 3 pounds is a large fish.

Q. They are found in abundance on the south coast of New England?—A. Yes; very abundant. There is also the kingfish and the bonito, which is a very important fish.

Q. There is a fish of that character extending from Block Island away down to Cape Hatteras?—A. It is one of the same family. It weighs up to 5 pounds. I have seen five thousand of those fish taken at a single time in a fishing pound at Menemsha Bight. There is the bluefish, which is the *pièce de resistance.* There is the squeteague; of that fish I have seen 25,000 pounds taken at a haul.

Q. The bluefish is a great fish in the market?—A. It is the principal fresh fish during the summer season on the coast of the United States from Cape Cod to North Carolina.

Q. Caught all along the shores?—A. All along the coast, being most abundant in the summer season toward Cape Cod, and in winter in North Carolina.

Q. There is a great drift through Vineyard Sound?—A. There is a numerous catch.

Q. Are not the people on the southern coast of Massachusetts, and on the coast of Rhode Island, now very much engaged in catching fresh fish?—A. Very largely, taking them in pounds and gill-nets, and other modes of capture.

Q. Is this a part of the development of the fresh fish market?—A. Yes. Since bluefish has come back to the coast it has constituted an enormous element in the supply of fresh fish; it is not the controlling element, but it is the largest single element, although combining the striped bass, squeteague, mullet, and scup, they considerably outnumber the bluefish. [Photographs of the fish referred to were exhibited.]

Q. What about tautog?—A. It is an important fish, but is not in such immense abundance. While you talk of tautog being caught in thousands of pounds, you talk of others by hundreds of thousands or by millions.

Q. Pounds are very common on the American coast?—A. It constitutes the principal mode of summer fishing from round Cape Cod as far west as Long Island. Nearly all the fish taken on that coast are caught in the pounds. The small tunny is a fish which of late years has come into notice, and it is believed to have disturbed the mackerel and menhaden this year. It was never recorded till I found it in 1871 in Martha's Vineyard, where it was in enormous numbers. It is a fish weighing about 25 pounds, and it is something like the horse mackerel, but they never grow more than

25 pounds. Not unfrequently 500 or 1,000 of them are taken in a single night in one of the pounds, but the people make no use of them and consider them valueless They sell the fish weighing 25 pounds for 25 cents. It is a coarse fish and very dark meat, but still it is a food resource when other fish are not taken. These fish are found in the Mediterranean, where they are very much looked after and bring very good prices, they being specially salted and put up in oil. The American tunny is undistinguishable from the European, though efforts have been made to separate them.

Q. The pound-fishing which has come into general use in the southern part of New England, what is its effect on the supply of fish?—A. That is a question which I think will require a longer period of years than we have had for its definite determination. In 1871 I made my first inquiries into these pounds, and satisfied myself then that they must have a positive influence upon the abundance of fish, in view of the concurrent enormous destruction of bluefish. I considered the bluefish was the greatest agency in the destruction of our food-fishes. Its relation to scup and squeteague has long been established—that when bluefish are abundant the other fish are rare, and the moment bluefish diminish the other fish become enormously common. The squeteague in 1862 was unknown as a fish east of the waters of New Jersey except in small numbers, and was not found in Martha's Vineyard or Buzzard's Bay. In 1872, ten years subsequently, so plentiful were they that I know myself of 5,000 fish being taken at a single haul, averaging five pounds each fish. The bluefish then began to diminish, and from that time were much less abundant than in 1850 or 1860. Those pounds and the bluefish together I considered produced the decrease in the abundance of scup, sea bass, and tautog that has been so much complained of. I urged very strongly, and I still maintain my view, on the legislatures of Massachusetts and Rhode Island the propriety of exercising some sort of restriction upon the indiscriminate use of this apparatus. I recommend that one day and two nights, that is, from Saturday night, or, if possible, from Friday night till Monday morning, should be established as a close time during which those fish should not be taken by any of those devices, thus giving the fish a chance to get into the spawning-grounds inshore, thereby securing their perpetuity.

I was quite satisfied in my own mind that unless something of this kind was done very serious results would happen. Very much to my disgust, I must admit, the next year, even with all the abundance of those engines, the young scup came in in quantities so great as to exceed anything the oldest fishermen remembered, and thousands and tens of thousands of barrels of what was called dollar scup were sold. They were so thick in the pounds and so mixed with the fish that the owners could scarcely pick out the marketable fish, and consequently had to let large portions of the contents of the pounds go away. Since then scup has been very much more abundant than it was when I wrote my book and report.

Q. How do you account for this great increase?—A. I think those were scup, belonging to further south, which took a northern trip to northern waters and established themselves there. But I do urge in the most earnest manner the propriety of some restriction being placed on the pounds. I have not changed my views, although the evil has not arrived as I thought it would, and there are indications of some other agency; whether it be the diminution of the bluefish which permits the scup to increase or not I cannot say.

Q. Is it true the bluefish is diminishing?—A. It is not by any means so abundant as it was, very much to the regret of all people who catch them, either for market or for sport.

Q. Can you remember the time when there was no bluefish on the American coast?—A. I cannot. I know we have the record of the fact, and I know many persons who can remember it. Bluefish was absent from the American coast for sixty years, during which time there was not a single bluefish to be found on the coast.

Q. You think the pounds should be dealt with as a matter for regulation and not for banishment?—A. I don't think the market would be amply supplied without them, and I don't think it would be expedient to prohibit them. I think a certain amount of regulation, such as I have recommended, would be a great deal better for the fish and the fishermen. The disadvantage of the pounds is that they glut the market at times, so that there is no sale for the fish and fish are wasted, and by the adoption of a close time not only will it secure proper spawning of the fish, but also equalize consumption.

Q. There were some matters with regard to herring, in regard to which I did not ask you fully yesterday. Will you state to the Commission about the spawning-grounds of herring especially? I do not care for anything outside of the American coast. — A. The herring spawn along the whole coast of the United States, from the Bay of Fundy to No Man's Land, which is a small island between Block Island and Martha's Vineyard. I have specimens of spawn from almost all the localities between those two points, and I am informed they also spawn around Block Island; but I have never seen any evidence myself.

Q. But you know as to the fact?—A. I know it is so from testimony and reports.

Q. Do the eggs of the herring lodge on the bottom?—A. The herring is almost the one—is, I think, the only one—of our important sea fish the eggs of which are adherent; that is to say, when discharged, it falls to the bottom and adheres to the sea-weed, gravel, and rock. Generally it is scattered; but not unfrequently a great part of the spawn of the fish will be aggregated into a mass of the size of a walnut or hickory nut, but more generally they are scattered and attached singly or by twos and threes to sea-weed. I have here specimens of the eggs in the adherent form, some of which I dragged up at the southern end of Grand Manan.

Q. Are the spawning-grounds extended along the coast all the way?—A. Yes; all the way.

Q. And are very numerous?—A. There is no reason to suppose there is any part of the coast at which they are wanting. They are specially abundant about Cutler, in Maine, and about some of the islands off Penobscot Bay, about Cape Elizabeth, Portsmouth, off Newburyport, and particularly along the edge of the coast from north and east of the entrance of Massachusetts Bay. They also spawn inside of Cape Cod Bay, and all along the south coast of this region to No Man's Land, as I have already mentioned. The spawning season is later and later as you go south. On the coast of the United States the herring spawns on the fall of the temperature, just as the salmon, cod, and trout do—unlike the shad and mackerel, which spawn at a rising temperature. The moment the water along our coast gets to a certain degree of temperature, then the herring is incited to the act of spawning. I might say in completion of this point that herring spawns in the spring in Bay St. Lawrence and Newfoundland. It spawns in early summer at Grand Manan in July, August, and September. It spawns at the end of September in Eastern Maine, and it spawns in October off Boston, and does not spawn until November and sometimes December at No Man's Land.

Q. Making a difference of many months?—A. Yes; a difference of from six to eight months.

Q. Describe the modes by which herring are caught on the coast of the United States.—A. They are caught principally by weirs, pounds, and gill-nets on our coast. They are caught with seines largely in Bay St. Lawrence and Newfoundland; but the large, full-grown, spawning herring are usually taken in gill-nets on or near the spawning-ground. A very large number are taken on the whole coast of Maine and in the Bay of Fundy in weirs; but the great body of these are smaller herring, and are not used as fresh fish.

Q. How is it with weir-fishing?—A. The weir-fishing is generally conducted in Maine, and to some extent inside of Cape Cod to the north. South of Cape Cod they are more generally taken in pounds, but also in gill-nets.

Q. How are they taken along the Massachusetts coast?—A. They are taken, generally, in gill-nets in the fall. The regular pounds are usually not down as late as the herring season, but in spring large numbers are taken in the pounds.

Q. How do you feel sure that this statement about spawning on the coast is correct?—A. By actual capture of the fish in the spawning season, and by dredging up their eggs from the bottom with apparatus we use for such purposes.

Q. Is herring a very common fish on the United States coast?—A. It is exceedingly abundant. It is not utilized at all to the extent of the capacity. The herring is not a very favorite fish. It is a cheap fish; and as there are so many better fish on the coast, it is not very marketable for food. It is sold in great quantities, but at very low prices, and is used only by the poorer classes of the community. Of course, it is used for bait; but as fresh fish it is very seldom seen on the tables of the well-to-do people.

Q. Is it dried and pickled?—A. They are pickled to some extent. Some are smoked. A great many are worked up in the form of bloaters, and in this form it is very much sought after.

Q. You have been at the places where the business is carried on?—A. I have seen 20 or 30 large boats, of a capacity of perhaps 500 barrels or more, filled with herring, lying at the wharf at Boston at one time. They are boats probably from 4 to 10 tons.

Q. Market boats?—A. They are open boats, known as herring boats, and the coast now is lined with the boats with gill-nets catching herring for the fall trade.

Q. Have you anything to say about the predaceous fish, such as the shark and dogfish? Do you think they do a great deal of harm to the food-fish?—A. They constitute a very important factor in the question of the abundance of fish on our coast. They destroy enormous weights and quantities of all the useful fish, and in proportion as they increase in numbers the food-fish diminish, and *vice versa*. They perform the same function as bluefish; they are constantly in the pursuit of other fish and destroying them.

Q. There is no probability of changing that relation which fish seem to bear to one another?—A. They all have the relation of attack, defense, pursuit, and flight.

Q. But, notwithstanding that, I suppose they belong to what you call the balance of nature?—A. The balances of nature are such that it is extremely difficult to say what will be the effect on the fisheries of destroying or multiplying a particular stock of fish. The sharks, for instance, are destroying great quantities of food-fish. A new enterprise has just been started, and will be opened in the course of a few weeks, to utilize the sharks, porpoises, dogfish, and tunnies. An establishment expects to work up twelve million pounds annually of those fish, for which heretofore there has not been a market. They are caught in great quantities on the shores, but not utilized, and now there is to be a market for them, and the parties offer the same price for them as they do for menhaden.

Q. Where is the company started?—A. At Wood's Holl, Mass. The company expects to keep two or three steamers constantly traversing the coast from Block Island to Penobscot Bay, or Bay of Fundy, and the company advertises that it will take all dogfish, sharks, porpoises, blackfish, and other offal that may be offered to it, up to the amount, I think, of 20 or 25 tons a day. By a new process the oil will be extracted without heat, leaving the meat entirely free of grease, and, when it is dried, it will be ground up to make what they call fish flour, or meal which can be used for fertilizing purposes or food, as you please. The same substance is made from cod in Norway and is an article of food. It makes a nice form of food, and is used as fish-cakes and other preparations.

Q. It can be made up like flour?—A. Yes, and can be mixed up without any difficulty. The effect of the abstraction of twelve million pounds of those predaceous fish will undoubtedly be very great. Whether, as those fish eat bluefish, it may not allow bluefish to multiply, and in that way restore the balance again, it is impossible to say; but if it was to take bluefish also, we would relax very largely the pressure on eatable fish, and they would necessarily increase.

Q. Is the philosophy of that substantially that when one kind of predaceous fish becomes very numerous, and is destroying useful fish, it either disappears in time, or by what we regard as the regular course of nature and the work of man, that fish diminishes, or is exterminated, and others take its place?—A. After they have eaten up everything, they will start out and go somewhere else. Whenever they have made their favorite food scarce they go somewhere else. So it is a very serious question as to what had better be done, no matter what promise there may be in regard to altering the relations willfully and purposely between the different forms of the animals of the sea. If you take them for food, you allow the consequences to come as they may, but any question of protecting one kind of fish, or destroying or exterminating others, should always be considered with a great deal of care, and from a great many points of view that do not strike the mind or attention at first thought.

Q. To undertake to regulate the relations of fish beyond shoal water where you can fish with nets, seines, and pounds, would be impracticable?—A. It would be very difficult, indeed, and the effect would probably be very trifling.

Q. You spoke yesterday of the fish of the Southern States, the fisheries of which in the new order of things are being rather more developed by greater diversity of industry, and so forth; can you mention any other fish that are coming into use?—A. There are a great many species, probably not less than fifty, all having a definite value as an article of food, and all caught and consumed on the coast, or sent in limited quantities either to the northern markets or to Cuba, that could be taken into consideration, but perhaps the capture of the fish that takes the rank of fisheries relates more particularly to the mullet, menhaden, striped bass, and bluefish. There is a very extensive fishery of bluefish on the southern coast. The bluefish, after leaving the northern waters, spends a certain time on the coast of Virginia and North Carolina, and by the time it gets back there it has attained enormous dimensions, the fishes being generally from 12 to 15 pounds, at which size they are found only casually and occasionally on the northern coast. It is not at all an uncommon thing for one fishery of a single locality to take 3,000 bluefish averaging 12 pounds each fish.

Q. What do you mean by one fishery?—A. A single station at one particular point, the fishing being controlled by one man or firm. An enormous number of bluefish are sent late in fall and in early winter to the northern markets.

Q. So that when bluefish leave the New England coast they do not disappear altogether from the American coast?—A. Not at all. It disappears some time in February, and where it goes we cannot tell.

Q. It disappears from the southern coast?—A. Yes; a small school of bluefish is found all the year south to Florida, but the large school of bluefish usually disappears in February, and, indeed, I may say we never see it again. The fish, as they make their appearance in spring, are smaller fish.

Q. Do they first appear on the south coast of New England?—A. On first appearing on the coast of Carolina and Virginia, they come in something like the mackerel, only they have a rather more coastwise travel because they do not spawn on the northern coast. Probably the big bluefish go out somewhere to spawn, but what becomes of them, whether they spawn themselves out to a condition of nonentity I cannot say. We do not see them; they may go to Africa, or the Mauritius, for bluefish are found all the world over; but whether they go to any other portion of the world from the United States I cannot say.

Q. What have you to tell the Commission about menhaden at the South?—A. The menhaden is a very important fish on the south coast as an article of food. It is caught, salted, and pickled, and to some extent used in the country. There is quite a large export of menhaden to the West Indies from the Southern States.

Q. Is it used fresh?—A. It is salted and pickled; it is also eaten fresh very largely, and considered a very capital article of food.

Q. You have eaten it yourself?—A. Yes; it is a sweet fish, quite as good as herring, but rather more bony; the bones are, however, more adherent to the skeleton. You can prepare menhaden by maceration, so that the greater part of the bones will stick to the vertebral column inst ead of being loose and lying about the muscular parts, as in herrings.

Q. It is also salted in the South?—A. Yes.

Q. Is there now a large business in menhaden, or is there likely to be?—A. It is a business capable of almost any extension for which there is a demand. There is no limit apparently, speaking in reasonable terms, to the number that can be taken, any more than there is in the North. There is nothing like the same quantity taken in the Southern as in the Northern waters. It is taken somewhat for the manufacture of oil, but the business is not fully developed.

Q. What other fish did you mention in the South?—A. The mullet, menhaden, bluefish, and striped bass to some extent, but striped bass is more an estuary fish coming into brackish waters, and can scarcely, with propriety, be mentioned in this connection.

Q. What have you to say about the drum?—A. It is a fish that can be taken in almost any desired quantity. It is obtained weighing up to 100 to 120 pounds, but it generally weighs from 10 to 20 pounds. There is the channel bass, which can be also taken in any desired quantities. It is entirely a sea fish, and is caught in the rapid channel-ways between the shores and islands on the coast.

Q. Especially, perhaps, in South Carolina?—A. Only stragglers come on the east ern coast, but it is found in enormous abundance from North Carolina down to the southern extremity of Florida, and in the Gulf of Mexico.

Q. Can the fish be salted for the market?—A. I don't think it has ever been tried; it is worth almost too much as fresh fish.

Q. Is the fish called red snapper there?—A. Yes; it is very abundant on the coast of Florida. It is a large fish, of a blood-red color, as red as goldfish, and weighs from 5 to 20 pounds. It is caught in great numbers in the winter season, and taken alive to Cuba. The Connecticut fishermen, after they have finished their halibut and cod summer and autumn fishing, go down to Florida, and spend two or three months catching red snappers and other fish and taking them to Cuba, selling them as fresh fish, alive. It is taken in the wells of vessels, and is sold at very high prices in Havana. Sometimes, on the return trip, they take a load to New York, and sell them in that market alive.

Q. In regard to pounds, they must be constructed in muddy ground?—A. In almost any ground, except sand, because the sand shifts.

Q. To construct a pound, you drive in piles or posts, and then make a straight line of net-work right up?—A. Yes. [Diagram of a pond exhibited.] The stakes are driven right down with a pile-driver, and from stake to stake is extended a wall of netting, which extends down to the bottom and makes a barrier for the fish. They are held down by a chain. There is also the heart, bowl, and pocket. The fish coming along the coast strike the wall of netting, and very naturally, in endeavoring to skirt it, they turn seaward and go along till they get into this receptacle either way. A fish never turns a corner, and when it gets within the netting it swims round and round, but never goes back again. Then gradually it is led into the inner inclosure, and the same process goes on; the fish swim round and round, but never find their way out back through the opening. You may leave the pound for a week, and you will have there all the fish that have come in, except the striped bass, which is the only fish you cannot cheat in a pound; and you very rarely take them in that way. Then when they come to haul the pounds, they throw a gate of netting across the opening, and in the bowl the netting extends over the bottom and comes up the side. They gather up the end and haul it over the boat, and gradually concentrate the fish in a corner, and turn them or throw them over into the permanent pocket, where the fish are kept until ready for market. Fish are kept there sometimes two or three weeks or more for a demand in the market; if there is a glut in the market, they may keep perhaps 1,000, 2,000, or 3,000 fish in one of these inclosures.

Q. How is the pocket formed?—A. It is a net-work, fastened down to the bottom by a chain, so that it will touch the bottom and not permit fish to go under it. [Diagram of trap exhibited.] The trap is only used in the waters of Rhode Island, and is used for scup, tautog, and sea-bass. There are no stakes used to the trap. It is a rectangular space of netting held at the corners by anchors. The fish go along the leaders and pass into the receptacle. The trap requires constant watching, or the fish could go in and out. The moment a school of fish enter, the netting at the end is raised. They pursue the same mode of emptying, and turn the fish into the pocket, as with pounds.

Q. The difference is that in the case of pounds, it is not necessary that boats should be employed to visit them frequently?—A. In stormy weather you sometimes cannot get to a pound for a week. In the case of traps they are visited three or four or half a dozen times a day. When the boats off shore see a school of fish enter the trap, they follow and take it whether large or small. [Diagram of weir exhibited.] This weir consists of a small circle of brush or boards, with two wings and a spring. The fish come into the weir at high tide, and as the water falls they are left in a cavity inside the weir, and are taken out in dip-nets. There are a dozen or twenty different forms of constructing weirs.

Q. What is the estimated cost of a pound?—A. $1,000 will pay for the construction of a very good pound, including the entire equipment. A pound is managed by from two to four men, while a trap requires two boats and about seven men.

Q. The trap is more expensive?—A. About the same cost as the pound, because, although it has no stakes, yet it requires to be of very considerable size and needs anchors. I should presume that the first cost of the two would not be very different.

Q. And what is the cost of a weir?—A. It is a simple thing. The cost merely represents the lumber and labor.

Q. That is a permanent erection?—A. Yes; the others are all taken up; the traps are only kept down six weeks in the year; the pounds are down for from two months to five, and at the end of the season they use an apparatus to pull the stakes out of the water, and then pack them on shore for next season.

Q. What are the kinds of fish taken in the great lakes?—A. There is a great variety of fish taken there, but the most important fish, as a matter of business, are the white-fish, lake herring, lake trout, wall-eyed pike, muskalonge, sturgeon, and a variety of others. The most important, however, are whitefish, herring, and trout.

Q. What are the methods of taking them?—A. They are taken very largely by pounds, which are constructed on a very large scale, and much more elaborate and expensive than on the coast. They are taken by gill-nets very largely, and by seines under certain circumstances. At a certain time of the year, whitefish can be taken in great quantities in seines, and kept in pounds until ready for market.

Q. Are those built and constructed to a great extent along both the Canadian and American shores?—A. I presume they are used in Canada, though I cannot say. I know they are on our own coasts. There is quite a number of these pounds worked by Canadians on the American coast.

Q. Have you any statistics respecting the lake fishery for the years 1876 and 1877?—A. I have only partial statistics for 1877. I published the statistics in detail in my report for 1872, and I am now having statistics for 1877 collected, and will have them I suppose by the end of the season.

Q. 1872 represents but faintly the present state of things. Can you tell us how it was in 1872?—A. In 1872 the American production of fish in the great lakes was 32,250,000 pounds. That quantity of fish was taken, but how much more I cannot say. Those were marketed at Buffalo, Cleveland, Chicago, and many other stations.

Q. Does that include the Canadian catch?—A. I presume there is no Canadian catch in that amount. Those are the figures as they were obtained by my agents, from the fishermen and dealers.

Q. You obtained them from the dealers in the large cities?—A. Yes; and the fishermen at the grounds. This year I have had every station on the American side of the lakes visited and canvassed.

Q. You have steady communication with and reports from the dealers?—A. I have reports only when I send specially after them, as I did in 1872 and am doing this year.

Q. How far have you got in your inquiry this year?—A. I have only a partial return from Chicago.

Q. What does that show?—A. The total marketing of salted fish in Chicago up to the middle of October amounted to 100,000 half-barrels, with about 20,000 half-barrels expected for the rest of the season, or equal to 60,000 barrels of those fish for Chicago alone for the present year. The corresponding supply of barrels of fish in 1872 was 12,600 in Chicago, so that the Chicago trade has increased from 12,600 in 1872 to 60,000 in 1877, or almost fivefold—4$\frac{8}{10}$. The total catch of fish in the lakes in 1872 was 32,250,000 pounds. If the total catch has increased in the same ratio as that market has done at Chicago, it will give 156,000,000 pounds of fish taken on the American side of the lakes for the present year.

Q. That, of course, cannot be a matter of certainty?—A. No.

Q. What other large central markets for lake fish are there besides Chicago?—A. Chicago and Buffalo are the most important. Cleveland takes a large quantity, but Chicago and Buffalo control the market. Detroit takes the fish to some extent, but it is not such a convenient shipping point.

Q. What proportion does that bear to the fish of Canada?—A. I cannot say. I may say, in regard to this point, that on the same ratio the total product of the salt fish from the lakes in the American market would be 48,546,000 pounds. Of course, those figures are comparisons, and the estimates may be fallacious. Chicago may have a larger share of the lake trade in proportion, or may have a smaller share; other places may have crowded on it, or it may have gained on them.

Q. You expect to have full returns?—A. I shall have them probably in the course of one month. I have not heard from my agent who is visiting all the Canadian stations and fishing points on the American coasts.

Q. You expect to ascertain the whole catch of the lakes for 1877?—A. Yes, with great precision. I have here an item which may perhaps be interesting in regard to the price of those fish. The ruling prices of fish on the 15th October in Chicago, were $7.50 per barrel for whitefish, $5.50 for salmon trout, and $3.75 for lake herring. Those are the prices paid to the captors for the fish by the merchants; that is, before they are handled and any profit put upon them.

Q. In regard to the increase in the consumption of fish, are any as beneficial means being adopted in Canada to maintain the supply?—A. Both Canada and the States bordering on the great lakes have striven very efficiently to prevent what would otherwise have been a great danger to the supply of an enormous amount of fish. They are hatching whitefish by artificial means to the extent of a great many millions annually. The two countries are not co-operating but concurring in this business, and probably this year they may introduce as many as twenty, thirty, or more millions of young fish into the waters, and that must necessarily have a very important influence on the maintenance of the fisheries. They have not done anything yet in regard to lake herring, but whitefish, which is a much more valuable fish, is being carefully guarded.

Q. What States of the American Union are engaged in the breeding of whitefish?—A. Ohio, Michigan, and Wisconsin.

Q. What has been the success generally of the fish-breeding system by artificial means?—A. It is now being practiced to such an extent in Canada and the United States as to show it is a very efficient mode of preventing the diminution of fish, and even of increasing the supply. It has passed the region of experiment, and it is a positive fact as shown by the large appropriations made on both sides of the border for this purpose. It commands the respect and consideration of men of all parties, and in our own country, at least, there is no difficulty in getting all appropriations that can profitably be expended to secure the result.

Q. It extends not only to the fish of the great lakes, but to river fish?—A. To salmon, shad, striped bass, and alewives.

Q. You find as the result that a much larger proportion of the eggs are turned into fish than when left to natural exposures and dangers?—A. An ordinary estimate in regard to shad is that under natural spawning 995 out of 1,000 eggs perish without producing a young fish able to feed for itself, and that you get five young fish which reach the stage of ability to feed for themselves; that is, after their fins are properly formed, and the fish is three-eighths of an inch in length. They have then passed the ordinary perils of infancy, and are able to take care of themselves. With artificial spawning, a fish culturist who could not bring 950 out of 1,000 eggs to that state would be considered as ignorant of his business, except some unusual circumstance that could not be controlled should come in to interfere.

Q. Can you tell the Commission how many traps and pounds there are in the southern part of New England, Connecticut, Rhode Island, and Massachusetts, at Martha's Vineyard, and all along to Cape Cod?—A. There are 22 traps on the south side of Cape Cod, in the bays and basins about Chatham; 9 in Vineyard Sound; 30 at Buzzard's Bay; 3 at Block Island; 30 in Narragansett Bay. This year there have been 94 traps and pounds on the southern coast of Rhode Island and Massachusetts, exclusive of Connecticut. I have not the figures for Connecticut here. This number represents the traps and pounds from Narragansett Bay to the eastern end of Cape Cod.

Q. Have they been increasing?—A. Yes; they are very measurably greater in number than they were when I made my first census.

Q. Can you state the number of men who are employed on those traps?—A. The number of men required to man the traps is 436, the traps requiring seven men each, taking 301.

Q. Your agent would know each of those traps?—A. I have the name of the owner, and the catch of the greater portion of them.

Q. Can you tell the Commission the catch of those traps and pounds?—A. I have here a table of the yield of that number of pounds in 1876.

Q. Give the result.—A. For some of the species the figures are very accurate, and for others they are estimated to some extent, but this estimate is essentially a record of the year, so far as they have reported it themselves, corrected by the personal observation of one at least of my men, who has taken a standard pound, and meted it every day himself, and enumerated the catch and the kinds of fish. The total catch for 1876 included flounders, tautog, mackerel, Spanish mackerel, pompano, butter-fish, squeteague, scup, sea-bass, striped bass, bluefish, menhadens, eels, cod, alewives, and herring. The total catch for the year was 34,274,350 pounds. That is from Narragansett Bay to the eastern end of Cape Cod, on the south coast of Massachusetts and Rhode Island only.

Q. Not the western part of Rhode Island?—A. It includes the whole of Narragansett Bay. It does not include Long Island, where there are a great many pounds, or the most westerly part of Rhode Island.

Q. Are all these pounds of fish capable of being used, and are used for food?—A. There is a large catch of menhaden in that fifteen millions.

Q. How many miles of coast-line does that catch represent?—A. About 250 miles of coast-line.

Q. Have you made up a calculation of the ratio of the catch per mile?—A. I have the ratio of 137,097 pounds of fish to the line or mile.

Q. And to the men?—A. The ratio of the catch is 78,610 to each man. The total value of the weir catch at the lowest wholesale rate is $847,900; at the lowest retail rate, $1,472,438; at a mean rate between the two, which perhaps more exactly represents the value, $1,160,168. That, however, is the catch of that region only with traps and pounds; there is also a very large catch with hand-lines, gill-nets, and seines. This is for but 94 weirs and traps. The aggregate catch of the entire fishery on the south coast of Rhode Island and Massachusetts is 45,917,750 pounds, of the mean value of $1,875,840, which gives a ratio of 133,671 pounds per linear mile, and equivalent to $7,504 to the linear mile. The yield in the trap and pound fishery is over 78,610 pounds to the man, of a money value of $2,661, being the product of each man's labor for an average not exceeding four months. That sum, to bring it to the annual amount, will have to be multiplied by three; each man thus would produce $8,000 worth a year by this mode of fishing.

Q. You do not mean to say that each man makes that amount?—A. No; but that is the ratio of fish to the man. Those pounds are generally owned by at least one of the men who run them, who sometimes hire what additional assistance they require; perhaps, however, in half of the cases the owners manage the pounds and have no division of profits.

Q. Those statistics were prepared to show the amount of the fish, including the fresh fish as well as those salted?—A. None of these are salted except such of the salted menhaden as is for food. They do not enter into the returns of pickled fish. These fresh fish go almost exclusively to New York, very few to Boston.

Q. It seems strange that you should be able to know the amount of fresh fish that passes into the great city and what is caught every day. What method have you adopted to ascertain those facts?—A. The entire fresh-fish trade of New York is confined to nineteen firms which form the Wholesale Dealers' Association, to whose books and figures I have had access through and by the assistance of the large wholesale and retail dealer in New York, Mr. Blackford, who has just taken great interest in my investigations and is a very hearty coadjutor. He has succeeded in interesting those dealers, and I have just prepared a series of blanks in which I hope to have the dealers record all the catches of fish every day and give me the returns.

Q. You have no doubt from your relations with the dealers who control the market that you know substantially the catch?—A. I cannot say that I know the maximum catch on the coast, but I know I have reason to rely upon the figures of the fish that is actually marketed and comes into the hands of the wholesale men.

Q. A large amount escapes notice?—A. Yes; all the local catch, the catch of fishermen which goes for their own benefit and is consumed on the spot; the catch consumed in seaport towns and villages cannot be included in this enumeration.

Q. Are these caught within the treaty limits?—A. All those fish which I have mentioned are caught east of Cape May.

Q. Northeast?—A. Yes; and all caught close to the shore, by traps or pounds, usually within 100 to 300 yards of the shore, or by gill-nets and hand-lines, used by men also from the shore.

Q. The whole fishery, with pounds and nets, that goes on from the shore, and with hook and line for market fish, all comes within the treaty limits?—A. Yes, of course, the mullet and winter bluefish are south of the treaty limits; but all the fish are practically within the treaty limits.

Q. And in those fisheries the Canadians have the same rights as Americans?—A. The Canadians have the same rights there as we have. It does not include the fishery, north of Cape Cod Bay and round to Eastport.

Q. Can you make any comparison of the corresponding ratio per mile, or otherwise, of the Canadian fisheries?—A. I do not think I could, because I believe the returns of the Canadian fisheries are not so large as they should be. I do not believe the Canadian returns are in proportion to the actual catch. I therefore think a comparative statement would be fallacious, and I would rather not make it.

Q. Some Canada tables have been published of the fisheries of 1876, including, perhaps, cod and herring?—A. Those relate to all the fisheries. This estimate I submit is for weir-fishing on a limited coast.

Q. The Canadian returns show a total amount of $11,000,000?—A. I think the total estimate of the Canadian fisheries for 1876 is between $11,000,000 and $12,000,000.

Q. If you put that of the United States at $50,000,000, would that be a low or high estimate?—A. I think we could figure up over $40,000,000 without any difficulty; that is, for all the fisheries.

Q. Including the lake fisheries?—A. Including hake, ring, and shell-fish. Our oyster fisheries are worth $30,000,000 a year.

Q. That is nearly double the entire Canadian return?—A. Perhaps. There are $3,000,000 worth of oysters put in cans in Baltimore yearly.

Q. They are all included in the Canadian returns?—A. I think so. Those industries with them are not so important as ours. Our off-shore codfish, lake and river shad, salmon, herring, lobster, crab, oyster, and clam fisheries are included.

Q. Now, with reasonable legislation to limit certain methods of fishing, is there in your judgment any danger to the existence of the inshore, coast, and lake fisheries?—A. I think that the lake fisheries would have been exhausted and greatly destroyed in a comparatively limited number of years but for the timely warning taken by Canada and the United States and the measures initiated in both countries for increasing the supply.

Q. You yourself have been very much engaged on the subject of the propagation of fish?—A. Not so much in the lakes directly as in the rivers.

Q. You have shipped some of your fish by rail to California?—A. Yes.

Q. I remember reading an account of one of your large collections for California being lodged in one of the rivers by a bridge breaking down, for which collection the State has never paid?—A. Yes, a car of live fish which was being sent to California.

Q. In order to get some idea of the manipulation practiced in the breeding establishments, perhaps you will state whether steam machinery is not now used?—A. That is a device we have adopted this year for the first time in hatching shad, in which, instead of depending on the natural current of the river usually employed, we make the trays filled with spawn move up and down in the water in a continuous alternation, and in that way hatching millions of eggs where formerly we could only hatch thousands.

Q. You can state a case showing the result of one year's experiment.—A. We had eleven millions of shad in Susquehanna River in about three weeks in May and June.

Q. Can you state to the Commission the result of some fish operations at Potomac River?—A. The instance to which you refer is that of black bass. The black bass is not indigenous to the Potomac River, and none were in it. About two years ago half a dozen adult fish were placed in the river, and it might now be said that the Potomac, with the exception of St. John's River, Florida, is the most prolific in black bass of any stream in the United States. Over an extent of one hundred miles, the fishing for black bass both for market and sport is unrivaled anywhere.

Q. Without claiming too much for our people, are not the ingenuity and industry of the American people in taking fish for consumption and other uses on the one hand, and in propagating them on the other, very great and very remarkable? How is that?—A. The methods of fish-culture as practiced in the United States, and in Canada so far as they cover the same ground, are, we think, better than those anywhere in the Old World, and both countries hatch fish by millions where thousands are considered a large performance in Europe. The United States have a single establishment in California at which more eggs are obtained than are gathered by all European hatcheries put together. This year we have taken about six million eggs, and we have taken as many as eight millions in a year. We have an establishment now on Columbia River where we expect to hatch twenty millions of eggs. Three millions of eggs, I may say, in illustration of magnitude, would fill a hay-field cart to its utmost capacity.

Q. You have an estimate of the combined fishing of the United States for the year 1876, including the Bank fishing?—A. Yes. This is a table of the product of the marine fisheries of the United States east of Cape May within the treaty limits. The total product of the inshore fisheries of that range, the fish taken by boats from the shore, that taken by seines, by traps, pounds, &c., amounts to 319,579,950 pounds, of a mean value of $4,064,484. The total fisheries of the United States, inshore and off-shore within the limits, amount to 1,045,855,750 pounds, of the value of $13,030,821.

This is exclusive of any of the Southern fisheries, exclusive of the lake fishery, of the whale, porpoise, and seal fishery, and of the salmon, shad, and herring fishery.

By Sir ALEXANDER GALT:

Q. Does it include the Grand Bank fishery and that at George's?—A. Yes.

By Mr. DANA:

Q. It is exclusive entirely of the fresh-water fish of the lakes and rivers, shad, herring, and salmon, of the whale and fur-seal, of the oysters, lobsters, and crabs. The total coast-line on which the fisheries are pursued is 1,112 miles, from Cape May to Eastport, including the islands. The ratio to the mile is 940,510 pounds, the ratio of value is $11,718.

Q. Will you state how the returns are obtained?—A. The figures in regard to the herring, cod, and mackerel are obtained from the reports of the Bureau of Statistics of the United States for 1876, the other figures are made up from a series of tables for each kind of fish. I had an estimate prepared of the production of each fishery, and those figures have been obtained partly from witnesses who have been here to testify, partly from the books of dealers in Gloucester, Boston, Newburyport, and elsewhere, partly and very largely from the returns I have gathered through agents I have sent out, and from circulars I have distributed. I have here an enumeration of all the different kinds of fish and quantity caught; it is simply a combined table from a great many sub-tables.

Q. These tables you will put into the case?—A. The tables were not made up by me, but under my direction. They are put in by the compiler under an affidavit.

Q. An examination will show they are very much in detail?—A. These tables, like all those of all nations, excepting, perhaps, those of France, are imperfect; and are short of the true figures. I have no doubt that a large percentage should be added to the tables of both nations in the New World. But they are accurate as far as they go; if they err, it is in the direction of deficiency, not of excess.

Q. It is so on both sides?—A. Yes.

Q. You are allowed a pretty large staff of persons to assist you as writers?—A. I have all the clerks and assistants I require. But a great many of those returns have been made to circulars I have distributed through the Departments of the Treasury and Post-Office, and other functionaries.

Q. In view of those vast resources of the country, and the supply of sea-fish of all kinds, the improved and increased methods of catching the fish, do you think there is any one kind of fish, the entire failure of which would prove a very serious matter, such, for instance, as the mackerel obtained in the Gulf of St. Lawrence?—A. I do not think that the entire failure of any kind of fish would affect the supply; but this would stimulate the fishermen to renewed efforts regarding some other fish. If all the mackerel disappeared, their places would be supplied by the Southern mullet, which are more abundant than the mackerel, and which could be taken in twice the quantity, if not more. If every mackerel was destroyed the mackerel fishermen would go down to the Southern coast, and take the mullet and pickle them.

Q. Your last statement applies only to fish caught north of Cape May?—A. Yes; it does not include any Southern fisheries at all, or any catch of the same fish in Southern waters, such as the bluefish or the mackerel.

By Mr. FOSTER:

Q. Is Cape May far north of the treaty line?—A. It is directly on the treaty line; this line cuts off Cape May and runs just at the north point of the coast there.

By Mr. DANA:

Q. So that these tables do not include the opening of Delaware Bay?—A. No; but only the fisheries on the coast of New Jersey—the outer coast of New Jersey—and from that northward.

By Mr. THOMSON:

Q. All this evidence which you have given, with reference to the mullet becoming the fish of the future, is mere matter of speculation, is it not?—A. It is nothing more than what I judge from the excellence of this fish, the ease with which they are taken, and the ease with which they are cured, and the extent to which it is practiced as a local fishery by the people of North Carolina and other Southern States.

Q. Has not that fishery been known for a great many years?—A. I cannot say. I have only known it since 1872 and 1873. It probably has been known as a fishery for some years.

Q. Persons have eaten these mullet twenty or thirty years ago down South?—A. Yes.

Q. And it has not progressed at all as food for Northern consumption?—A. It is not now used as a food-fish in the North; but it is a fish which occupies the place of Northern fish through a large portion of the Southern States.

Q. Do you know from definite personal knowledge of your own whether they would not rather have there one single salt mackerel than a whole barrel of mullet?—A. No, I cannot say anything about that—as to their preference.

Q. I was told that this was the case no longer ago than this morning by a lady who has lived there, and I wanted to know what your experience in this respect was.—A. I must to my shame confess that I have never tasted a salt mullet; but I propose, as soon as I go home, to get a barrel of them and I will send some to Halifax for the Commission. I hope they will make up their minds to try them; I will do it the very first thing after I reach home, and I hope you will all try them.

Q. Is it not a fact well known to those who are engaged in the sea-fisheries that Southern fish, or, in other words, fish taken in warm waters, are fish that will not bear transportation to Northern climates?—A. I cannot say anything about that at all, but I know the only peculiarity about mullet is, that it is a fall and winter fishery. It is a cold-water fishery. It begins in September and lasts until November and December.

Q. You say it is a cold-water fishery, but the water is nothing like as cold there as it is in our waters during the same months?—A. No; but the water there is about as cold in winter—if not then quite as cold—as it is here in the summer time.

Q. Could cod, from your knowledge, live in the waters which are frequented by the mullet?—A. No; neither could the mullet live in the waters which are frequented by the cod.

Q. Are not the mullet also a fat fish?—A. Yes; they are very fat.

Q. Is not this fact also against transportation?—A. I do not know. I am not versed in the physics of transportation.

Q. How long ago is it since you first turned your attention to the fisheries at all?—A. I have done so since 1871.

Q. Previous to that time your specialty lay in another direction?—A. No; I have always been interested in fish as a branch of zoology for a great many years. I have been a specialist in icthyology, and I described, prior to that date, hundreds of new species.

Q. Speaking about the pounds established along the New England shore, how many of them did you say were there?—A. Ninety-four.

Q. In answer to Mr. Dana you stated that this kind of fishing was open under the Washington treaty to British fishermen; do you think that you are quite right in stating that?—A. Yes.

Q. Do you think that under this treaty we have a right to set down pounds upon American soil?—A. You can, subject to the consent of the owners of the shore—just the same as with respect to any fishery so prosecuted in the Dominion.

Q. Is it possible for any person to carry on the business of pound fishing, except he is a resident on the coast?—A. I see no reason why any one from Canada could not go to Long Island Sound or to Vineyard Sound and prosecute this fishery.

Q. Then such a person must reside there?—A. No; very few of these pounds, and I think I may say that not one-half of the pound fishing in Buzzard's Bay and Vineyard Sound, are prosecuted by citizens of the State.

Q. A man must reside or remain there for the purpose of attending these pounds?—A. Yes, for two or three months in the year.

Q. He must be a resident of the shore for two or three months in order to attend to these pounds?—A. Certainly; he must be on the ground, as any fishermen must be when fishing, in his boat.

Q. Practically and really this is a fishery which must be carried on by persons on the spot?—A. Of course; all fisheries must be carried on on the spot; but they need not necessarily be carried on by residents of that region or by citizens of the State. Most of these fisheries in Buzzard's Bay are carried on by people who do not usually live on the spot.

Q. At all events, do you seriously state that under the provisions of the Washington treaty we have a right to put down pounds on the American shore?—A. I think so, with the consent of the owner of the shore.

Q. That is another question.—A. Will you kindly read the clause of the treaty of Washington in this relation?

Q. It is as follows:

"It is agreed by the high contracting parties that, in addition to the liberties secured to the United States fishermen by the convention between Great Britain and the United States, signed at London on the 20th day of October, 1818, of taking, curing, and drying fish on certain coasts of the British North American colonies therein defined, the inhabitants of the United States shall have, in common with the subjects of Her Britannic Majesty, the liberty for the term of years mentioned in Article XXXIII of this treaty, to take fish of every kind, except shell-fish, on the sea-coasts and shores, and in the bays, harbors, and creeks of the provinces of Quebec, Nova Scotia, and New Brunswick, and the colony of Prince Edward Island, and of the several islands thereunto adjacent, without being restricted to any distance from the shore, with permission to land upon the said coasts and shores and islands, and also upon the Magdalen Islands, for the purpose of drying their nets and curing their fish."

A. Yes; I do not understand that any mode of fishing is prohibited under this treaty, unless it is so mentioned in express terms, as is the case with shad, salmon, and shell-fish. I do not understand that any mode of fishing is prohibited to the citizens of the opposite nation, except what conflicts with the local law of the country.

Q. Can these pounds be put down without landing to make preparations for that purpose?—A. Yes; perfectly well. It is not absolutely necessary to go on shore at all to do it; indeed I know of a great many pounds which do not touch the shore, but which are started 20, 30, or 50 yards from the shore.

Q. Do you seriously contend that there are territorial rights given us under the Washington treaty, because you recollect that the putting down of poles in the soil is a territorial right?—A. Yes.

Q. Do I seriously understand you to contend that, under this treaty, rights are given either to the Americans on the one side or to the British on the other, as to doing anything on the shores of either country except landing to cure fish and dry nets?—A. I understand that if you wish to start a pound in Buzzard's Bay, you could go to Naushon Island, owned by John M. Forbes, an eminent citizen of the United States, and with his permission you can do so; and that you require no permission in this regard either from the State of Massachusetts or the Government of the United States; he has precisely the same right to give authority to put down a pound, I think, as has Ashby, who was a witness here and a native of Connecticut.

Q. That is to say that Mr. Forbes, who owns the land, could allow me to go and put down a pound there?—A. There is not the slightest question about it.

Q. Could he not do that before this treaty was ratified?—A. I do not know whether he could do so or not; I cannot say anything about that; that is a legal question.

Q. He could have given me that right previous to the treaty just as well as since?—A. I do not know what exact right the treaty may give in this relation; but that is no reason why this might not be done. I consider that this fishery is now perfectly open to Canadians.

Q. Has not the mode in which the rivers on the coast of Maine have been treated for a number of years back depleted the waters on that coast or on the New England coast of cod, for instance, which you say was once one of the most important fish found there?—A. The destruction of river fish, in my opinion, has had more to do with the diminution of inshore fish, such as cod and haddock——

Q. And mackerel, too?—A. No, not mackerel; this has nothing to do with them. Mackerel cannot be considered in that connection, because they do not depend on the fish of those rivers for food; but I think that such destruction has more than anything else to do with the decrease of these fish I have mentioned, inshore; and the result of the measures which are now being taken by the States of Maine and Massachusetts, in restoring the river fisheries, will bring back the original historical abundance of the sea-fish inshore.

Q. What this will do is as yet in the womb of the future; but at present are not those fisheries depleted?—A. The boat-fisheries for cod and haddock are now much inferior in yield on most parts of that coast to what was the case 50 or 100 years ago.

Q. You now allude to the coast fisheries within the three-mile limit?—A. Yes; the fisheries carried on in open boats, which go out as far as a man can comfortably go in a day and come back again.

Q. Do you wish the Commission to understand that this system of treating the rivers has destroyed the food of sea-fish, and therefore that the bait or food is not there to induce the cod to come inshore, but that this has had no effect on the fish outside of the three-mile limit?—A. I cannot say how far out the effect extends, because some distance outside of the limits there are other fishes, such as herring and mackerel, and food of various kinds which they can get at.

Q. Is it possible that the inshore fisheries can be either destroyed or very considerably depleted within the three-mile limit and yet leave the fisheries just outside of this limit as good as ever?—A. I think so.

Q. And undiminished?—A. I think so, for the very reason that these fish naturally keep off from the shore. They are off-shore fish, and we find them largely inshore at certain seasons of the year because they then follow the fish that are coming inshore; and if you had an enormous number of shad and alewives and salmon, and especially of alewives and shad inshore, that involves their pursuit by an enormous number of predatory fish, such as cod and haddock and pollock, just exactly as the same fish follow the herring and caplin on the coasts of the Dominion and Newfoundland.

Q. Then I understand you to mean that, although the food which these fishes prey upon may be destroyed by reason of the depletion of the rivers, this will only affect the fishing within three miles of the shore and have no effect on the fishing beyond this limit?—A. I cannot say how far it will have effect.

Q. Will this effect stop short of the three-mile limit?—A. I think there are a great many concurrent agencies which affect the fish supply at different seasons on the different parts of the coast, and that while the inshore fishing of herring and shad, or other incoming fish, regulates that to some extent, it does not cover the whole ground.

Q. I want a direct answer: Are you able to state that the destruction of bait, by reason of the bad treatment of these rivers, only affects the fishing along the coast to the extent of three miles from it?—A. I cannot say that; I cannot say how far such effect extends, and nobody can do so.

Q. It is reasonable to suppose that it extends for a considerable distance farther than three miles from the coast?—A. That I cannot say.

Q. Would this not more likely drive the fish to other coasts where the rivers are not so treated?—A. Fish certainly have to go where they can get food, and if they cannot procure it on one spot they have to go to some other spot for it.

Q. Is it not probable that they will go where the rivers are not so badly treated?—A. This depends on how far cod and haddock will migrate, under any circumstances. If they leave the shore, but can find an ample supply of food on George's Bank or on Nantucket Shoals, they will probably stay there.

Q. Do cod migrate at all? Is this known for a certainty to be the case?—A. It is not certain that they have such migrations as we ascribe to the bluefish and mackerel; whether they traverse a mile of sea-bottom in search of food, or whether they go 100 miles for it, under any circumstances, I cannot say.

Q. I understood you to say yesterday that you could not trace their migrations at all?—A. No, I cannot.

Q. And do you not pretend to say that they do migrate? I rather understood you to say also that mackerel do not migrate?—A. They migrate, but they do not sweep along the coast—at least I do not think they do so, as was formerly supposed, for very many miles; but rather come direct from their winter grounds inshore.

Q. I understood you to say your theory at present was that there was a vast body of mackerel which, forming one wing of their army, passed along the American coast; and that another wing directed their course into the gulf?—A. Yes.

Q. I see that in the answer of the United States, page 10, the following language is used:

"The migration of mackerel in the spring begins on the Atlantic coast from a point as far south as Cape Hatteras. The first-comers reach Provincetown, Mass., about May 10. Here they begin to scatter, and they are found during the entire season along the New England coast.

"Whatever may be the theories of others on the subject," says Professor Baird "the American mackerel-fisher knows perfectly well that in spring, about May, he will find the schools of mackerel off Cape Hatteras, and that he can follow them northward, day by day, as they move in countless myriads on to the coast of Maine, of Nova Scotia, and into the Gulf of St. Lawrence. They may be occasionally lost sight of by their sinking below the surface; but they are sure to present themselves, shortly after, to those who look for them farther north and east."

Do you now adhere to that statement?—A. I think that was not the most philosophical expression on that subject. My views in regard to the proper theory concerning mackerel have been modified since then, to the extent I have alleged.

Q. In fact, if I correctly understood you yesterday, you rather inclined to the theory which has been started here, that mackerel are not a migratory fish at all, but hibernate in the mud?—A. I cannot precisely say; but the evidence is quite strong in favor of hibernation of some kind, though I do not consider the case proven in this respect; at the same time I do not consider it philosophical to refuse to countenance its possibility.

Q. Will you tell me how, if possible, it could be otherwise, if it is true that the mackerel have, in the spring, scales over their eyes, as has been described by witnesses here, and, as I understand, you admit?—A. I cannot say that this is the case; I have never seen it.

Q. If these scales are on their eyes they could not possibly do otherwise than hibernate?—A. I cannot say that; I am not a mackerel, and I could not tell what they do or what they do not do.

Q. Is it certain that any fish, that you are aware of, hibernate in the mud?—A. That is not certain, but it is believed to be the case.

Q. Do you know of any fish which certainly does hibernate?—A. The eel does.

Q. Is its eyes protected against the mud by scales?—A. This is not the case so far as I know. It has not been noted or reported.

Q. How has it become a theory if it has never been noted? Is it the want of experience with reference to mackerel that you do not know whether scales are found over its eyes or not?—A. I have never caught mackerel in the critical period of the year when they are said to have scales over their eyes; but a specimen which I have preserved in alcohol did have scales over its eyes, though the action of the alcohol on the cornea of the eye always tends to make it opaque and destroys its transparency.

Q. Is there any period of the year when mackerel must be prevented from seeing, as far as you can judge from the specimen which you possess?—A. No; I cannot say that.

Q. What are these scales for?—A. I cannot say. The theory of the fishermen, however, is that it is to curb the roving habits of the mackerel, and make it more ready to stay in the mud; and that otherwise they would not want to stay there; that is the hypothesis of the fishermen, and I give it for what it is worth.

Q. You do not assent to it?—A. No; it is not proven to be true.

Q. And it is not disproven?—A. All that is proven in this respect is, that in winter we do not see the mackerel; they do not then school on the surface, nor do they go to the West Indies, or to Bermuda, or to Florida; nor do they then appear on the surface anywhere as far as the testimony has gone.

Q. With reference to the inshore fisheries in the State of Maine, and in the States of New England, generally, are they depleted or not?—A. The boat-fisheries there are not what they were fifty or one hundred years ago; that, I think, I am perfectly safe in saying; but whether there has been any decrease in them during the past few years I cannot say.

Q. I now quote from your own report, part second, for the years 1872 and 1873, page xi; it is headed "Conclusions as to decrease of cod-fisheries on the New England Coast," and it states:

"Of all the various fisheries formerly prosecuted directly off the coast of New England, north of Cape Cod, the depreciation in that of the cod appears to be of the greatest economical importance. Formerly the waters abounded in this fish to such an extent that a large supply could be taken throughout almost the entire year along the banks, especially in the vicinity of the mouths of the large rivers. At that time the tidal streams were almost choked up with the alewives, shad, and salmon that were struggling for entrance in the spring, and which filled the adjacent waters throughout a great part of the year.

"As is well known, the erection of impassable dams across the streams, by preventing the ascent of the species just mentioned to their spawning-grounds, produced a very great diminution, and almost the extermination, of their numbers, so that whereas in former years a large trade could be carried on during the proper season, now nothing would be gained by the effort."

On page xii you say this:

"It would, therefore, appear that while the river-fisheries have been depreciated or destroyed by means of dams or by exhaustive fishing, the codfish have disappeared in equal ratio. This is not, however, for the same reason, as they are taken only with the line, at a rate more than compensated by the natural fecundity of the fish. I am well satisfied, however, that there is a relation of cause and effect between the present and past condition of the two series of fish; and in this I am supported by the opinion of Capt. U. S. Treat, of Eastport, by whom, indeed, the idea was first suggested to me. Captain Treat is a successful fisherman, and dealer in fish on a very large scale, and at the same time a gentleman of very great intelligence and knowledge of the many details connected with the natural history of our coast-fishes, and in this respect worthily representing Captain Atwood, of Provincetown. It is to Captain Treat that we owe many experiments on the reproduction of alewives in ponds, and the possibility of keeping salmon in fresh waters for a period of years. The general conclusions which have been reached, as the result of repeated conversations with Captain Treat and other fishermen on the coast, incline me to believe that the reduction in the cod and other fisheries, so as to become practically a failure, is due to the decrease off our coast in the quantity, primarily, of alewives, and secondarily of shad and salmon, more than to any other cause.

"It is well known to the old residents of Eastport that from thirty to fifty years ago cod could be taken in abundance in Passamaquoddy Bay and off Eastport, where only stragglers are now to be caught. The same is the case at the mouth of the Penobscot River and at other points along the coast, where once the fish came close in to the shore, and were readily captured with the hook throughout the greater part of the year."

A. Yes.

Q. Do you dissent now from that opinion?—A. No; I used that as an impressive lesson to the State legislature to induce them to pass the measures necessary to restore these river fisheries, which they are now doing very rapidly.

Q. Where is Capt. U. S. Treat, of Eastport, now?—A. In Japan, teaching the Japanese how to catch and cure fish.

Q. On page xiv of this report you say:

"Whatever may be the importance of increasing the supply of salmon, it is trifling compared with the restoration of our exhausted cod-fisheries; and should these be brought back to their original condition, we shall find within a short time an increase of wealth on our shores, the amount of which it would be difficult to calculate. Not only would the general prosperity of the adjacent States be enhanced, but in the increased number of vessels built, in the large number of men induced to devote themselves to maritime pursuits, and in the general stimulus to everything connected with the business of the sea-faring profession, we should be recovering, in a great measure, from that loss which has been the source of so much lamentation to political economists and well-wishers of the country."

That you still adhere to?—A. Certainly. I made that report as impressive as I could in order to produce the effect desired, which was to cause the legislature to pass a law in this regard, and it has had that effect. They have passed such laws, and I hope that this evil will be remedied in a reasonable number of years.

Q. It is not remedied yet?—A. No.

Q. It takes a number of years to do that?—A. I can give an instance where it has had such effect, if you like to have it. In Massachusetts the most has been done for the restoration of alewives and shad in the Merrimac River; and the shore fisheries there have now increased in a very marked degree. At the present time it is perfectly possible for a man to go out in a boat from the city of Newburyport and catch 4,000 pounds of codfish and bring them back the same night. This is the only river in Massachusetts in which very great efforts have been made to restore these river fisheries; and it is now possible to capture these fish in much greater quantities than was the case ten years ago; and this I ascribe to the action of the State government with regard to the restoration of river fish.

Q. How many pounds did you mention?—A. 4,000.

Q. Caught by a single man?—A. Two men will do it; a man with a trawl and an assistant will go out in an open boat in the morning from the city of Newburyport and come back at night, or go out at night and return in the morning, and in the mean time take 4,000 pounds of cod. That is the only point along there at which, at that distance from the shore, I know that it is possible to catch cod in such numbers.

Q. Must not a great lapse of time, or at least a very considerable lapse of time, occur before the fisheries destroyed, as you have here described, can be restored by the process you speak of?—A. I think that this depends on the amount of time necessary for the restoration of the fish, which run out to sea from the rivers. I think that if this year there are no such fish as alewives, &c., to run into these rivers, and that if next year a great army was to so run in, concurrent with that army, an army of cod and other fish would be there to prey upon them.

Q. I see that in your Report for 1872 and 1873, referring to the lake fish, you say on page lxxxi:

"The restoration of food-fishes to localities originally tenanted by them, or their transfer to new waters, is, however, a question of time; and in the immense extent of our river and lake systems, many years must necessarily elapse before the work can be accomplished."

A. That is a great number of years, certainly; but that does not so much refer to any particular river as to the aggregate rivers and lakes scattered over the whole body of the United States.

Q. You say here that "many years must necessarily elapse"?—A. Certainly.

Q. When did you commence this work?—A. The actual process of artificial propagation began, under my direction, in 1872.

Q. Do you refer to any term of years? I suppose that you mean a period of 10, 12 or 14 years.—A. It might be more. The time of course depends on the expenditure involved, and the concurrence of suitable legislation to protect the fish, and many other points.

Q. How many fish-breeding establishments have you in the States?—A. Nearly every State in the Union has now a series of fish commissioners, whose business it is to propagate fish within their borders.

Q. There is only one in each State?—A. There is one State establishment; and a certain number of private establishments in each, founded for the purpose of gain.

Q. Do you know how many there are in Canada?—A. I know there are a great many. Canada is doing most admirably in this respect.

Q. And very much more in proportion than the United States?—A. No; I think not. I think by far less in proportion.

Q. In proportion?—A. Yes.

Q. To population?—A. I do not say according to population. I shall qualify that statement by saying that what is done in Canada is done on a much less scale of magnitude than is the case in the United States. I mean that the aggregate of artificial propagation in the United States is much greater than the aggregate in Canada; but I would not take a ratio. I think that both Canada and the United States are doing as much as they can in this regard, in the time that has been allowed for the purpose.

Q. I suppose that Canada is doing a very large work in this connection?—A. She is doing most admirably—yes.

Q. She is expending large sums of money on it?—A. Certainly. She is doing most admirably. I am very happy to say that Canada and the United States are working concurrently in a great many directions in the line of artificial fish-culture.

Q. Do you know the Canadian establishment on Detroit River?—A. Yes.

Q. Is it doing a large business?—A. I don't know what it is doing this year; but last year I understand that it did a very large business.

Q. It then hatched 10,000,000 eggs?—A. Yes, very likely.

Q. You say that cod cannot live except in cold water?—A. The cod is an inhabitant of the colder waters.

Q. Are you aware whether or not the Gulf Stream during the summer months swings in at all more toward the American coast?—A. It does.

Q. For how many miles?—A. I cannot say.

Q. Would that have any effect in driving the cod away from the American shores?—A. No; not the slightest.

Q. You think not?—A. Yes; it has not the slightest effect on them. If you go down to a certain depth in the ocean, in the tropics or anywhere else, you will find the water cold enough for cod; and there is nothing to prevent the cod being as abundant in tropical waters—say off Brazil or the West Indies—as anywhere else; as far as temperature is concerned, it is cold enough there for them at a certain depth.

Q. Have they ever been caught there?—A. Not that I know of; but the water there is cold enough for them.

Q. Is it not very venturesome to state that there is nothing to prevent them staying there?—A. They may be there, but they have not been caught there. Nobody has fished at those great depths, for you have got to go down from 6,000 to 15,000 and 20,000 feet to find that temperature in tropical seas.

Q. Have you the slightest idea as to what sort of animals reside down there?—A. Yes. We have a very good knowledge of such species as can be taken up by the trawling line and dredge from those depths; and we know that an ample supply of food suitable for cod is to be found there.

Q. Has any beam-trawl or dredge ever taken cod in those regions?—A. No; you do not catch cod with small trawls any more than you can so catch whales.

By Sir ALEXANDER GALT:

Q. Would not the temperature in those waters interfere with the spawn of the cod, as this spawn floats?—A. I think that the water there might be too warm for the development of codfish eggs in the abstract; but the effect would be to make them hatch out more rapidly than would be the case in cold water. Of course it is a very serious question to decide whether, with the present constitution of the cod, its eggs would develop in warm water, though whether it might not evolute and develop into a warm-water cod I do not know.

By Mr. THOMSON:

Q. On page lx of your Report for 1872 and 1873, you use the following language:

"It is in another still more important connection that we should consider the alewife. It is well known that within the last thirty or forty years the fisheries of cod, haddock, and hake along our coasts have measurably diminished, and in some places ceased entirely. Enough may be taken for local consumption, but localities which formerly furnished the material for an extensive commerce in dried fish have been entirely abandoned. Various causes have been assigned for this condition of things, and, among others, the alleged diminution of the sea-herring. After a careful consideration of the subject, however, I am strongly inclined to believe that it is due to the diminution, and, in many instances, to the extermination of the alewives. As already remarked, before the construction of dams in the tidal rivers the alewife was found in incredible numbers along our coast, probably remaining not far from shore, excepting when moving up into the fresh water, and, at any rate, spending a considable interval off the mouths of the rivers either at the time of their journey upward or on their return. The young, too, after returning from the ocean, usually swarmed in the same localities, and thus furnished for the larger species a bait such as is not supplied at present by any other fish, the sea-herring not excepted. We know that the alewife is particularly attractive as a bait to other fishes, especially for cod and mackerel."

A. Do I say mackerel?

Q. Yes.—A. That is an inadvertence. I do not think that the alewife is a bait for mackerel.

Q. You say:

"We know that the alewife is particularly attractive as a bait to other fishes, especially for cod and mackerel."

A. Well, I should not have said that.

Q. The alewives are the same as the fish we call gaspereaux in New Brunswick?—A. Yes.

Q. You further say:

"Alewives enter the streams on the south coast of New England before the arrival of the bluefish; but the latter devote themselves with great assiduity to the capture of the young as they come out from their breeding-ponds. The outlet of an alewife pond is always a capital place for the bluefish, and as they come very near the shore in such localities, they can be caught there with the line by what is called 'heaving and hauling,' or throwing a squid from the shore, and hauling it in with the utmost rapidity.

"The coincidence, at least, in the erection of the dams, and the enormous diminution in the number of the alewives, and the decadence of the inshore cod-fishery, is certainly very remarkable. It is probable, also, that the mackerel fisheries have suffered in the same way, as these fish find in the young menhaden and alewives an attractive bait."

You see you say that twice.—A. That is an inadvertence.

Q. You say:

"It is probable also that the mackerel fisheries have suffered in the same way, as these fish find in the young menhaden and alewives an attractive bait."

A. This is the case on the northern coast probably.

Q. It is hardly an inadvertence?—A. It is an inadvertence. It is a conclusion that is not justified by the fact.

Q. Then you dissent from that opinion now?—A. Yes; I do not consider that it has a bearing on the mackerel question.

Q. All that goes to show that all these speculative opinions are entitled to little weight; you see that you have changed your opinion in this respect?—A. Certainly; as the data vary the conclusions also vary.

Q. I suppose you will admit that there is not the slightest reason why within the next three years you may not have come back to the same opinion which you now repudiate, or have then formed opinions totally different from those which you now express before the Commission?—A. I cannot say; that will depend entirely on the facts as they come.

Q. After all, this is all the purest theory?—A. It is an hypothesis; it is not a theory.

Q. Well, it is an hypothesis?—A. It is not a theory until it is absolutely certified by the facts.

Q. Then, of course, an hypothesis is more vague than a theory. You gave in a mass of figures just now, which you state were made up by your assistant, based upon information which you have got from some of the witnesses here, in answer to questions put them, and what not—have I understood you rightly?—A. Partly.

Q. And your assistant has verified them by his affidavit—have I understood you rightly?—A. Yes; they are verified by the affidavit of the assistant who made them up.

Q. What sort of an affidavit is it? Does he state that these figures are correct, or simply that they are there?—A. He certifies that he has compiled them and what they represent.

Q. In point of fact you cannot yourself swear that this statement is correct?—A. I cannot swear that; but it is made up from the statistics of the Fishery Commission and investigations.

Q. Even to that I do not think you can swear?—A. No more than Mr. Whitcher or Mr. Smith can swear to the correctness of Canadian statistics.

Q. You directed it to be made up by one of your assistants?—A. Yes.

Q. And you do not know whether it has been made up correctly or not?—A. No more than any man can swear to the accuracy of his assistant's work.

Q. As a fact, you have no personal knowledge as to its correctness?—A. Certainly not.

Q. You directed it to be done?—A. Precisely; it stands on the same footing as any table made up by a clerk.

Q. Did you directly take into consideration statements made by witnesses here?—A. I have very largely taken into consideration inquiries made by Mr. Goode, my assistant, of witnesses here, according to the same definite plan which I have adopted elsewhere.

Q. Inasmuch as we have not the results of what these inquiries were, and since the Commissioners have not them before them, none of these inquiries which you made, and none of the information which you thus obtained, are before us, the papers being locked up in your desk.—A. They are in the archives of the Fishery Commission.

Q. Then we have no means of testing the accuracy of those figures?—A. No; not the slightest. They are there for what they are worth. I present them with the affidavit which was made by my assistant.

Q. You admit that you have not furnished us with any means of attesting their accuracy?—A. You must take them for what they are worth. They are of the same value as any table published by the Fishery Department of Canada or the United States or anywhere else.

Q. If I rightly understood your answer to Mr. Dana yesterday, you rather think that the throwing over of offal amounts to nothing?—A. No; I do not think that it does amount to anything.

Q. I thought you gave a rather interesting description of sea-fleas.—A. I merely say that it is a question whether it is or was injurious to the food of fishes on the coast, as has been maintained. It is a question as to which we have no definite proof that it injures the fishes; and I am inclined to believe that it has more of a local and immediate effect on the fish than it does injury to the fish.

Q. Would it not necessarily injure the spawn in its neighborhood?—A. No.

Q. You think not?—A. No.

Q. Not if thrown over on the top of spawn?—A. No; you might throw it over all day long and try to injure a load of floating spawn and you could not do it. Nobody has ever suggested that gurry affects the spawn. By spawn I suppose you mean eggs?

Q. Yes.—A. No; nothing of the kind is to be thought of.

Q. You quoted yesterday Mr. Whiteaves's report. He says on page 11:

"In case Americans are allowed to fish in Canadian waters, the custom (said to be practiced by them) of splitting the fish caught at sea, and throwing the offal overboard, on the fishing-ground, should not be permitted."

A. I do not think that I quoted Mr. Whiteaves on that point, but with regard to the spawning-time of mackerel in the bay.

Q. In your report of 1872 and 1873 Mr. Milner is your assistant?—A. Yes.

Q. On page 19 I find this language used:

"*Throwing offal on the fishing-grounds.*—It is the uniform testimony of all fishermen that throwing offal or dead fish in the vicinity of the fishing-grounds is offensive to the whitefish, and drives him away. The whitefish is peculiarly cleanly in its instincts, and has an aversion for muddy or foul water of any description. Most fishermen regard their own interest sufficiently to be careful in this particular, while many careless and shiftless men injure themselves and others by dumping offal and dead fish anywhere in the lake where they find it convenient, reducing the catch in the vicinity for several months."

A. Yes.

Q. It is also stated:

"Unsalable fishes are generally thrown overboard in the vicinity of the nets."

You do not dissent from that opinion?—A. No; not at all. The cases, however, are totally different. There are no scavengers in fresh water as there are in the sea; there are no sea-fleas, or sculpin, or lobsters, or anything of the kind, to clean up offal in fresh water, as is the case in the ocean.

Q. In your opinion, are purse-seiners proper or improper agents for taking fish?—A. I have not formed any opinion on the subject; but I am inclined to think, however, that this is not a destructive mode of fishing. They destroy a good many fish, but I do not think that they diminish the absolute number of fish in the sea.

By Sir ALEXANDER GALT:

Q. Will you repeat that?—A. I say I do not think that they affect the total number of the fish in the sea materially, although they destroy and waste a great many fish. If you will permit me, I would state my reason for this view; it is this: Every school of mackerel has a large body of predatory fish attendant upon it, such as dogfish, sharks, and other species, which are bound to have so many fish a day. They will eat their one, two, or three fish a day, and if they cannot get them dead they will eat them alive; therefore, if a large body of young mackerel is thrown out of these purse-seines, besides mackerel which are rejected and worthless, the predatory fish that are attendant upon the mackerel will eat these dead fish; and if they do not find them dead they will take them alive; so it does not affect the number of fish in the sea.

By Mr. THOMSON:

Q. Are you positive about that? Do you undertake to say that the predaceous fishes will, in preference to capturing live fish, which they can easily do, be content with dead ones?—A. I think that is very likely.

Q. There, there—you say "very likely"?—A. I cannot say. I am not a predaceous fish; but I would prefer a live fish. I am pretty sure, however, that these fish are quite ready to be saved the trouble of taking their prey. It is on precisely the same principle that bait-fish, such as capelin and herring, are placed on hooks and cast overboard to catch the same fish, which follow and eat them in the natural way. I think this may be inferred from that.

Q. You have something to do with the Annual Record of Science and Industry, I believe?—A. Something—yes.

Q. Do you agree with the language used in an article contained on page 473 of this journal for 1872?—A. I did not write that, but I published it.

Q. Have you in any article stated that you dissent from it?—A. No. It is not my business to do so. That article merely reflects the opinion of the writer. I would be very sorry to believe one-half of what I publish in that periodical; but it expresses the progress of belief and science, and I take it accordingly.

Q. It is a matter of speculation whether dead fish are eaten, as you say, by predaceous fishes; this is mere theory?—A. I have no doubt that they are so eaten.

By Mr. WHITEWAY:

Q. You have stated that the largest quantity of codfish taken in the shortest possible time was in the vicinity of the Lofoden Islands?—A. Yes.

Q. You said that something like 25,000,000 were taken by 12,000 people?—A. Yes.

Q. In a very short time—in the course of three months?—A. Yes; and in a very small space.

Q. Where did you get your statistics from?—A. From a report of the Norwegian Government.

Q. For what year?—A. 1868, I think.

Q. Whose report was it?—A. It is an extremely hard jaw-breaking title; it is an abstract, prepared by Hermann Baars, of Bergen, Norway. It was an article prepared by him for presentation at the Paris Exhibition.

Q. You have not seen reports published since that time?—A. Oh, yes; I have them much later.

Q. Did these later statistics correspond with the former as regards the quantity?—A. I know that the capture of cod in Lofoden Islands in 1876 amounted to 21,000,000 or 22,000,000; I have the figures here.

Q. Are you aware what quantity of codfish is caught on the coast of Newfoundland?—A. No. I have been earnestly trying to get the statistics of Newfoundland in this respect, but I have not been able to obtain them as yet. I hope you will send them to me.

Q. You are not aware whether it is an inshore or deep-sea fishery on that island?—A. No. I know nothing about it.

Q. You say that fish are dried and used as food for cattle in these islands and in Norway?—A. Yes.

Q. What sort of cattle use it?—A. Horses, oxen, and cows; they eat it with great avidity.

Q. What portion do they make use of?—A. Any part, but more generally the heads, which are offal; they make most admirable nutriment.

Q. You say that a great many nations dress very largely in the skins of cod and salmon?—A. Yes.

Q. Will you kindly tell me what nations these are?—A. They are Tchuktchi, the Aleutian Islanders, the Norton Sound Esquimaux, other natives of Alaska, and a few others.

Q. You say, further, that the most extensive resorts of cod are the Grand Bank and George's Bank; can you tell me the quantity of fish taken on these banks?—A. No; I have not made any investigation or tabulation in this regard.

Q. Then you really base that opinion upon no data?—A. I merely base it on my general impression on that subject. I merely speak of these as being the most prominent particular banks and localities which the cod frequent. In speaking of the islands and other places in this connection, I mentioned banks off the coast of Labrador, but I did not refer to the great sweep of northern waters where the cod is found diffused. I referred more particularly to the places that are known and publicly mentioned. What is not published in this regard I know nothing about.

Q. With reference to Labrador, can you answer whether the fish are taken inshore—that is, within the three-mile range, or on the Banks off-shore?—A. I am told, but I cannot say with what certainty, that at certain seasons of the year the cod are there taken in great quantities inshore from boats, but that the great bodies of the fish are on the Banks at some distance from the shore.

Q. Are these Banks fished?—A. That I cannot tell.

Q. Where are these Banks?—A. As far as I can learn, they extend at a distance of some 15 or 25 miles, perhaps, along almost the entire length of the coast of Labrador.

Q. Will you pledge yourself to that statement?—A. No; I know nothing about it.

Q. From whom did you get this information?—A. From the published writings of Professor Hind.

Q. I think he indicates in these writings the exact position of these Banks?—A. I think that probably he does. I may have located them too near or too far from the shore. I speak merely in general terms.

Q. I think that this report only indicates the existence of banks on certain portions of the coast of Labrador?—A. Perhaps I may have made them too extensive.

Q. You have referred to a bank on which codfish are taken, off Cape Cod, about 20 miles, I think, in length; can you give me any information as regards the annual product of this bank?—A. I think you will find that given in Captain Atwood's testimony.

Q. Can you give it?—A. No; I know nothing of it, except from Captain Atwood.

Q. Is any report made in any public office in Massachusetts or the States, from which you can gather information as regards the exact quantity of fish taken outside of the three-mile limit, and inside of this limit?—A. No.

Q. In other words, is a report concerning the quantity of fish taken within and without this limit published?—A. No.

Q. Is nothing published in this relation?—A. It is my business, or my self-imposed mission to collect that information, and I am doing so as fast as I can. I hope that my next report will contain a great deal of this and other useful information.

Q. How many vessels are engaged in this fishery off Cape Cod?—A. I cannot tell you; but I have a great deal of information on this subject in my records, which, however, I do not carry with me, and I do not trust my memory for anything.

Q. I think you referred to the herring fishery as yielding a very great quantity of fish on the American coast?—A. Yes.

Q. On the coast of the United States?—A. Yes.

Q. And the coast of Massachusetts?—A. Yes.

Q. Is that yield so great as you mention, during the winter?—A. It is during both spring and fall. These fish are found all along the coast in the spring.

Q. During what months is this the case in the spring?—A. In April and May.

Q. And in winter?—A. I do not think that they are caught in winter north of Cape Cod; I do not think so; but so little is known of the biology and the natural history of herring that this might be the fact, and yet it be not known—I mean not known to the ordinary public. It was entirely new to me five years ago that herring spawned on the Massachusetts coast at all.

Q. Then there is no winter herring-fishery there?—A. The winter fishery is a very small one; it is carried on around Block Island and Narragansett Bay, but whether capabilities exist for prosecuting a winter fishery elsewhere on the coast I cannot say.

Q. How do you account then for the fact that such a number of your vessels come to the southern coast of Newfoundland for herring, if they are so prolific on your own coast?—A. That I cannot say. Why trade follows one line or direction rather than another I do not know. They may not have appliances for catching them on our coast, and they may not have the means of taking them in such quantities as is possible at Newfoundland; but it is certainly a notorious fact that herring are much more abundant on the coast of Newfoundland than they are on the coast of the United States; though whether the herring that are wanted on the United States coast could or could not be had in the United States, I cannot say; but I do think that herring are vastly more abundant in Newfoundland and the Bay of Fundy than they are farther south.

Q. That accounts, then, for the number of your vessels that come to Newfoundland for them, no doubt. Give us the number of miles of United States coast along which fishing rights have been conceded to British subjects under the Washington Treaty?—A. 1,112.

Q. Can you give the extent of the Dominion coast, including that of Newfoundland?—A. Yes; the coast line of the Province of Canada is 810 miles; of New Brunswick, 1,000 miles; of Nova Scotia, 390 miles; of Newfoundland, 1,650 miles; of Grand Manan, 30 miles; of Prince Edward Island, 285 miles; of the Magdalen Islands, 85 miles; and of Anticosti Island, 265 miles; the total length of the coast line of Eastern British North America is 4,515 miles, four times that of the United States east of Cape Cod.

By Mr. DANA:

Q. Following the bays?—A. Following the large bays, but omitting the smaller ones.

By Mr. WHITEWAY:

Q. In your statement regarding the annual product of the Dominion fisheries, you have not included the Newfoundland fisheries?—A. No; I have only that of the Dominion of Canada.

Q. Are you aware that something like 1,500,000 or 1,600,000 quintals of fish are caught in Newfoundland alone?—A. I think that is very probable, but I do not know.

Q. Besides the large herring fishery?—A. I am very anxious to know exactly what the Newfoundland catch is; I have made inquiries respecting it; but I have not been able to obtain any such public data.

Q. You say that the depletion of the codfish on the coast has been the result of the depletion of the river fisheries on the coast of Massachusetts?—A. I gave that as presumably one reason for it. It is probably a very important element in the fishery.

Q. Then any act which may prove injurious to the bay fisheries on the coast would seriously affect the inshore fisheries by removing that which induced the cod to go on the coast?—A. Yes; it would have its effect, I think. Possibly a very decided effect.

Q. As a naturalist I would ask you to answer one or two questions. What do you mean by the term "fish"? Can you give us a definition?—A. Well, a fish is a cold-blooded vertebrate, having a particular mode of respiration. It breathes through gills instead of lungs, and it has a heart of a particular construction.

Q. I will read the definition from a book published in New York by Harper Brothers, the Encyclopedia of Commerce. I presume that is an authority that can be relied upon [reads definition]. I suppose that is a definition that can be relied upon?—A. No; I think it cannot be relied upon at all. That would make anything that floats in the water a fish. So that the seal would be a fish and the otter would be a fish.

Q. This is the Encyclopedia of Commerce. I suppose it is reliable. I mean as an encyclopedia of commerce?—A. Well, I don't know. I don't think it is quoted very much. It is probably a very good compilation. There are a great many books of that class that one has occasion to look at without feeling that they are perfectly accurate.

Q. Do you consider the seal a fish?—A. Not at all.

Q. Why?—A. Because it is a warm-blooded mammal. It breathes by means of lungs, &c.

Q. Is not the whale the same?—A. The whale is no more a fish than the seal.

Q. It is a mammal; it is a swimmer?—A. If you were to fall overboard in mid-ocean you would be a swimmer.

Q. How is it with the walrus?—A. It is a mammal, not a fish.

Q. So is the whale is it not?—A. Yes.

Q. How do you draw a distinction between the whale and the seal; the one you consider a fish and the other not?—A. I don't consider the seal a fish.

Q. I thought you did. Now, don't you consider it a very unreasonable action on the part of the United States, the refusal to admit seal-oil as fish-oil. Perhaps you don't care to answer?—A. I don't object to answer. I am not a politician. I am perfectly willing to answer the question. I know that the penguin is considered a fish, commercially—that is, that penguin-oil is received in England as fish-oil.

Q. That is a very important matter. I should like very much to have it taken down that, as a commercial oil, the penguin-oil is considered a fish-oil?—A. It is in London.

Q. Is it not in the United States?—A. No; but as far as I am informed the oil is classified in the London custom-house and trade returns as a fish-oil.

Q. What is the quintal in weight?—A. 112 pounds in some localities, and in some 100 pounds.

Q. It was given here as 114 pounds?—A. Well, it might be 114 pounds. It is simply my impression that the quintal is considered 112 pounds. I would not be positive. A practical fish-dealer would give more positive information than I could.

By Mr. DANA:

Q. Here, on the 148th page of British Testimony we have a letter from Governor Hill to the Earl of Kimberly, taken from the journals of the legislative council in Newfoundland. It appears here, in the evidence of Judge Bennett, as follows:

GOVERNMENT HOUSE,
Newfoundland, July 4, 1871.

MY LORD: I have the honor to inform your lordship that on the 1st instant I sent a telegram to your lordship, as follows, viz: "In reference to terms of Washington treaty, it is understood that fish-oil includes seal-oil. Explanation will oblige this Government." And on the 3d instant received the following reply, viz: "I am of opinion that fish-oil does not include seal-oil.—EARL KIMBERLY."

I have, &c.,

STEPHEN J. HILL.

The Right Honorable the EARL OF KIMBERLY,
&c., &c., &c.

Now you were asked a question what you thought of the exclusion of that oil.

Mr. WHITEWAY. He didn't answer it.

Mr. DANA. You withdrew it, didn't you? Perhaps this letter occurred to your mind.

The PRESIDENT. We suggested that the question had better be withdrawn.

By Sir ALEXANDER GALT:

Q. Before you leave, there are one or two questions I would like to ask you. We have been told by a witness—I think it was a pilot—that there was a difference in the appearance of the codfish that was caught in certain waters. I would like to ask if you have noticed that yourself?—A. Yes, there are a great many varieties of cod. They are, as far as I believe, one species, but they assume peculiar varieties, depending upon the particular bottom they are found on and the food they consume. Experts will tell you from what Banks particular fish are taken. For instance, inshore cod are nearly all red, while outside cod are gray. Some have larger heads, some smaller, some have stout shoulders, and some are slender, but all these differences are local and do not involve a distinction of species.

Q. Would not that, in your opinion, confirm the theory that the cod is not really a migratory fish?—A. It would. That is very good evidence that there is no great migration.

Q. There is another question I wished to ask you. You gave us a very interesting account of a company that has been formed for the purpose of catching these predaceous fish, and you seemed to think it would have the effect of materially diminishing their numbers. Well, if human means can reduce the predaceous fish, would you not think that the appliances that are being used by fishermen must be diminishing the edible fish?—A. I don't think that the amount captured by man has any appreciable influence upon the supply of fish in the sea.

Q. Well, that is what I understood you to say.—A. That whatever effect is produced by waste or extravagance in the capture of the fish is itself so trifling, in proportion to the natural wear and tear of the fish, that it may be thrown entirely out of account. The report of the British Fishery Commission is very satisfactory on that point.

Q. The only reason why I asked the question was that you seemed to think this company would succeed in reducing the number of predaceous fish.—A. Well, those are large and take a long time to get their growth. You can imagine a limit to the abundance of certain fish like the shark, though you cannot to the other fish, such as the cod and the mackerel.

Q. You are United States Commissioner. Are you clothed with authority respecting the several States of the Union?—A. No.

Q. Well, have you any authority?—A. I have none, except that they are all perfectly willing to have me spend all the money I will in their ports, and that they are willing to have me put as many shad, salmon, and cod, and useful food-fishes as I think I can spare in their waters.

Q. Have the United States collectively or the individual States the constitutional control over their fisheries; that is, their inshore fisheries?—A. The river fisheries are under the control of the several States, and the question of the jurisdiction of the sea fisheries has not yet been settled. For the present it lies in the States. The general Government has exercised no control or authority on the inshore fisheries.

By Hon. Mr. KELLOGG:

Q. Referring to your hypothesis about the waters of the world being supplied with one kind of fish as another leaves, what have you to say in regard to the whale fishery; what is going to supply that?—A. Well, a fishery diminishes to a certain extent until it does not pay, and then is abandoned. After being let alone it increases and again becomes a profitable enterprise.

Q. Have any of the species of fish that were used in ancient times disappeared? They used fish in ancient times just as much as they do now. Do you know of any tribe having actually disappeared?—A. The only kind of fish that has gone entirely out, so far as I know, is a kind of mackerel that was formerly found, known as the chub-mackerel or big-eye mackerel. It was formerly well known. Thirty years ago it was extremely common, a steady measurable article of the fish supply. I have been in search of specimens ever since I have been in my present line of inquiry, and have a standing offer of $25 for a specimen, but it has not been produced. There are many instances of the local abandonment of extensive shores. For instance, herring was formerly abundant on the coast of Sweden.

Q. Do you refer to a distinct species of mackerel?—A. A totally distinct species. We had two species on our coast and now we have only one. I dare say there may be a few, but we don't find them as formerly.

The following statistics, prepared by Mr. G. Brown Goode, are quoted from pages 3357, 3360–3 of the documents and proceedings of the Halifax Commission:

Estimated total of American fisheries for 1876.

Consolidated table of sea fisheries east of Cape May	$13,030,821
Lake fisheries in 1872 (Milner)	1,600,000
Products of whale fishery	2,737,379
	17,368,200

This is exclusive of all river fisheries; of the river fisheries of salmon, shad, alewives, and striped bass; of the coast fisheries south of Delaware Bay (mullet, bluefish, menhaden, &c.); of all the Pacific coast fisheries (salmon, cod, haddock, &c.); of the shell-fish (oysters, clams, &c.); of the Crustaceans (lobsters, crabs, &c.); of sponges; of skins; of fur and other seals, and of their oil. For these, thirty millions of dollars ($30,000,000) is considered to be a reasonable estimate.

Weirs and traps on the southern coast of New England.

Locality.	Weirs and traps.	Men.
South side of Cape Cod	23	88
Martha's Vineyard Sound	9	36
Buzzard's Bay	30	90
Block Island	3	12
Narragansett Bay	30	210
Total	95	436

In addition to the above there are one hundred fykes, managed by fourteen men.

Table showing the statistics of the manufacture of menhaden oil and guano in the United States in the years 1873, 1874, 1875, 1876.

	1873.	1874.	1875.	1876.
Number of factories in operation	62	64	60	64
Number of sail-vessels employed	383	283	304	320
Number of steam-vessels employed	20	25	39	46
Number of men employed in fisheries	1,009	871	....	....
Number of men employed in factories	1,197	1,567	....	....
Total number of men employed	2,306	2,438	2,633	2,758
Amount of capital invested	$2,388,000	$2,500,000	$2,650,000	$2,750,000
Number of fish taken	397,700,000	492,878,000	563,327,000	512,450,000
Number of fish taken (estimated in barrels)	1,193,100	1,478,634	1,887,767	1,535,885
Number of gallons of oil made	2,214,800	3,372,837	2,681,487	2,992,000
Number of tons of guano made	36,299	50,976	53,625	51,245
Number of gallons of oil held by manufacturers at the end of the year	484,520	648,000	125,000	264,000
Number of tons of guano held by manufacturers at the end of the year	2,700	5,200	1,850	7,275
Value of oil, at 37 cents	$819,476	$1,247,950	$992,140	$1,107,040
Value of guano, at $11	$399,199	$560,736	$589,875	$563,695
Total value of manufactured products	$1,218,675	$1,808,686	$1,582,015	$1,670,735

Total number of menhaden annually taken on the coast of the United States, estimate 750,000,000.

In 1874 one company, on the coast of New Jersey, put up 30,000 dozen boxes of menhaden in oil, under the name of "American sardines," the value of which was, at least, $90,000.

On the coast of New England thirty-five decked vessels and numerous small ones, engage in the bait fishery, the catch of which approximates 100,000 barrels annually, worth from $100,000 to $130,000.

In the following table the cured cod have been restored to their green weight (three times as much). The salted mackerel have been restored to their green weight (one-sixth additional). By inshore fisheries is meant those conducted from shore, and by offshore fisheries those conducted in large vessels, principally those having over 20 tons burden.

Products of marine fisheries of Northern Atlantic States.

Kinds of fish.	Inshore fisheries.							Offshore fisheries.							Aggregate of weights.	Aggregate of values.
	Pounds.	Price.	Wholesale value.	Price.	Retail value.	Price.	Mean value.	Pounds.	Price.	Wholesale value.	Price.	Retail value.	Price.	Mean value.		
Flounders and Flatfish	*1, 827, 000	4	*$73, 080	8	*$146, 160	6	*$109, 620								1, 827, 000	$109, 620
Halibut:																
Fresh								12, 339, 000	4	$493, 560	15	$1,850,850	9½	$1, 172, 205		1, 172, 205
Fresh, New York								1, 000, 000	10	100, 000	15	150,000	12½	125, 000		125, 000
Cured †								8, 476, 000	2	169, 520		302,500		236, 010		236, 010
Fins								200, 000	5¼	10, 500	7½	15,000	6⅜	12, 750		12, 750
Napes								10, 000	2½	250	3	300	2¾	275	22, 025, 000	275
Cod:																
Fresh, New York	5, 000, 000	5	250, 000	8	400, 000	6½	325, 000									325, 000
Fresh ‡	20, 000, 000	3	600, 000	5	1, 000, 000	4	800, 000									800, 000
Cured	28, 480, 000					1⅓	379, 733	160, 641, 700						3, 319, 182	214, 221, 700	*3, 698, 915
Roes	80, 000	1	800	2¼	1, 800	1⅝	1, 300	20, 000	1	200	2¼	450	1⅝	325	100, 000	1, 625
Tomcod	100, 000	3	3, 000	8	8, 000	5½	5, 500								100, 000	5, 500
Cunner	250, 000	3	7, 500	5	12, 500	4	10, 000								250, 000	10, 000
Tautog	615, 550	8	49, 244	15	92, 332	11½	70, 788								615, 550	70, 788
Mackerel:																
Fresh	3, 481, 000	8	278, 480	15	522, 150	11½	400, 315	2, 615, 000	8	209, 200	15	392, 250	11½	300, 725	6, 096, 000	701, 040
Cured								35, 632, 900							35, 632, 900	*1, 674, 222
Spanish Mackerel	105, 000	25	26, 250	30	31, 500	27½	28, 875								105, 000	28, 875
Bonito	2, 200, 000	5	110, 000	8	176, 000	6½	143, 000								2, 200, 000	143, 000
Pompano	5, 000	60	3, 000	100	5, 000	80	4, 000								5, 000	4, 000
Swordfish	1, 500, 000	7	105, 000	15	225, 000	11	165, 000								1, 500, 000	165, 000
Butterfish §	50, 000	4	2, 000	8	4, 000	6	3, 000								50, 000	3, 000
Sea Robins	90, 000	2	1, 800	3	2, 700	2½	2, 250								90, 000	2, 250
Squeteague	1, 727, 600	6	103, 656	10	172, 760	8	138, 208								1, 727, 600	138, 208
Kingfish	10, 000	15	1, 500	25	2, 500	20	2, 000								10, 000	2, 000
Spot and Croaker	75, 000	5	3, 750	10	7, 500	7½	5, 625								75, 000	5, 625
Sheepshead	75, 000	15	11, 250	20	15, 000	17½	13, 125								75, 000	13, 125
Scup	7, 760, 000	5	388, 000	8	620, 800	6½	504, 400								7, 760, 000	504, 400
Sea Bass	598, 500	10	59, 850	15	89, 775	12½	74, 812½								598, 500	74, 812
Striped Bass	123, 200	15	18, 480	20	24, 640	17½	21, 560								123, 200	21, 560
Bluefish	7, 068, 000	4	282, 720	8	565, 440	6	424, 080								7, 068, 000	424, 080
Smelt	400, 000	10	40, 000	15	60, 000	12½	50, 000								400, 000	50, 000
Menhaden	224, 834, 000							478, 912, 500							703, 746, 500	‖1, 657, 790
Eels	250, 000	12	30, 000	18	45, 000	15	37, 500								250, 000	37, 500
Sturgeon	75, 000	5	3, 750	10	7, 500	7½	5, 625								75, 000	5, 625
Sea Shad	3, 770, 200	5	188, 510	7½	282, 765	6¼	235, 637½								3, 770, 200	235, 637
Salmon	40, 100														40, 100	8, 020
Alewife	7, 385, 000	½	36, 925	1	73, 856	¾	55, 387½								7, 385, 000	55, 387

* From Report of Bureau of Statistics. † Gloucester, &c., flitches. ‡ Gloucester, Boston, &c. § Including whiting and white perch. ‖ From official reports.

Products of marine fisheries of Northern Atlantic States—Continued.

Kinds of fish.	Inshore fisheries.							Offshore fisheries.							Aggregate of weights.	Aggregate of values.
	Pounds.	Price.	Wholesale value.	Price.	Retail value.	Price.	Mean value.	Pounds.	Price.	Wholesale value.	Price.	Retail value.	Price.	Mean value.		
Herring	1,604,800	2	$32,096	4	$64,192	3	$48,144	4,000,000	....	....	....	....	....	....	5,604,800	$48,144
Herring (cured)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22,328,700	*459,833
Total	319,579,950		2,710,641		4,658,864		4,064,484								1,045,855,750	13,030,821
Ratio to mile of coast line (1,112)	287,392	....	....	....	....	....	3,655	....	....	....	....	....	....	....	940,510	11,718

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APPENDIX B.

SCIENTIFIC INVESTIGATION.

II.—A REVIEW OF THE FLOUNDERS AND SOLES (PLEURONECTIDÆ) OF AMERICA AND EUROPE.

BY DAVID STARR JORDAN AND DAVID KOP GOSS.

In this paper we have tried to give the synonymy of all the genera and species of flounders and soles (*Pleuronectidæ*) found in the waters of America and Europe, together with analytical keys by which the groups may be distinguished.

The material we have examined includes (1) all the flounders in the museum of the Indiana University, which contains a large representation of the species found on our Pacific coast, in the Gulf of Mexico, and in the Mediterranean; (2) much, but not all, of the material contained in the United States National Museum, more especially the specimens collected by Dr. Jordan and by Dr. Gilbert; and (3) all the flounders contained in the Museum of Comparative Zoology, at Cambridge, Mass. This museum is rich in South American forms, the collections made by Professor Agassiz, Dr. Steindachner, and others for this museum being very extensive. Only the collections in the Indiana University have been studied by the junior author; for all statements regarding other specimens, and, in general, for everything said regarding the South American species, the senior author is responsible. We are under special obligations to Prof. Alexander Agassiz, director of the Museum of Comparative Zoology, and to Mr. Samuel Garman, curator of the fishes, for many courtesies in connection with our studies in that museum.

We regard the order of *Heterosomata* ("flat-fishes," with both eyes on the same side of the head) as constituting a single family, *Pleuronectidæ*. We find ourselves unable to separate the soles as a distinct family from the flounders. The characters which mark them as a group seem no more important than those which set off one subfamily of flounders from another.

The group of "*Bibroniidæ*" recently recognized by some of the Italian ichthyologists as a separate family ("*Bibronidi*") is composed entirely of larval forms in the early stages of their development. In this condition the eyes are symmetrical and the body translucent. Several generic names have been given to these peculiar forms (*Peloria*, *Bibronia*, *Coccolus*, *Charybdia*, *Bascanius*, *Delothyris*), but, of course, these genera can have no permanent place in the system. *Peloria* has been shown by Dr. Emery to be the young of *Platophrys* (*Rhomboidichthys*). The others seem to belong to the *Cynoglossinæ* or to some allied group, but we are not yet certain as to the correct identification of any of them.

We recognize among the *Pleuronectidæ* seven subfamilies—*Hippoglossinæ*, *Pleuronectinæ*, *Samarinæ*, *Platessinæ*, *Oncopterinæ*, *Soleinæ*, and *Cynoglossinæ*. The *Samarinæ* and *Oncopterinæ* are all of recent discovery. The other groups correspond exactly to the five "subgenera" (*Hippoglossus*, *Rhombus*, *Platessa*, *Solea*, and *Plagusia*) recognized by Cuvier. These subfamilies are natural groups and are in most cases easily distinguished, although some few aberrant genera exist which serve as links joining one group to another. Thus *Isopsetta* of the *Platessinæ* is certainly a near ally of *Psettichthys*, which is as certainly a genuine member of the *Hippoglossinæ*.

The *Hippoglossinæ* and the *Platessinæ* are largely arctic in their distribution, few of the former group and none of the latter extending into the tropics. The *Oncopterinæ* seem to take the place of the *Platessinæ* in antarctic waters, but the species of this group are few in number. The *Pleuronectinæ* and the soles are, on the other hand, essentially warm-water fishes, their representatives in the north being comparatively few. The *Samarinæ* are few in number and belong to the East Indian fauna.

As the tropical *Hippoglossinæ* and all the *Pleuronectinæ* are sinistral species, the eyes and color being on the left side of the body, it follows that the tropical flounders are nearly all left-sided species, while those of arctic and antarctic waters are chiefly dextral species, the eyes and color on the right.

Still more curious is the relation between the number of vertebræ and the geographical distribution of the various species.

It has been already noticed by Dr. Günther and others that in some groups of fishes northern representatives have the number of vertebræ increased. In no group is this more striking than in the flounders, as the following table showing the numbers of the vertebræ in various species will clearly show. The numbers inclosed in brackets are copied from Dr. Günther; the others represent our own count of specimens contained in the museum of the Indiana University.

Numbers of vertebræ in flounders.

I.—HIPPOGLOSSINÆ.

Hippoglossus hippoglossus	16 + 34 = 50
Atheresthes stomias	12 + 37 = 49
Hippoglossoides platessoides	13 + 32 = 45
Lyopsetta exilis	11 + 34 = 45
Eopsetta jordani	11 + 32 = 43
Psettichthys melanostictus	11 + 29 = 40
Paralichthys oblongus	11 + 30 = 41
Paralichthys dentatus	10 + 30 = 40
Paralichthys lethostigma	10 + 27 = 37
Paralichthys albigutta	10 + 27 = 37
Paralichthys californicus	10 + 25 = 35
Xystreurys liolepis	12 + 25 = 37
Ancylopsetta quadrocellata	9 + 26 = 35

II.—PLEURONECTINÆ.

Monolene sessilicauda	[43]
Lepidorhombus whiff-iagonis	[11 + 30 = 41]
Citharichthys sordidus	11 + 29 = 40
Platophrys lunatus	9 + 30 = 39
Arnoglossus laterna	10 + 28 = 38
Arnoglossus grohmanni	10 + 28 = 38
Zeugopterus punctatus	[12 + 25 = 37]
Platophrys ocellatus	10 + 27 = 37
Pleuronectes maculatus	11 + 25 = 36
Pleuronectes rhombus	12 + 24 = 36
Syacium papillosum	11 + 25 = 36
Citharichthys arctifrons	10 + 26 = 36
Syacium micrurum	10 + 25 = 35
Phrynorhombus regius	10 + 25 = 35
Citharichthys spilopterus	10 + 24 = 34
Citharichthys macrops	10 + 24 = 34
Etropus microstomus	10 + 24 = 34
Etropus crossotus	10 + 24 = 34
Azevia panamensis	33
Pleuronectes maximus	12 + 19 = 31

III.—PLATESSINÆ.

Glyptocephalus zachirus	13 + 52 = 65
Glyptocephalus cynoglossus	[58]
Microstomus pacificus	12 + 40 = 52
Microstomus kitt	[13 + 35 = 48]
Parophrys vetulus	11 + 33 = 44
Platessa platessa	[14 + 29 = 43]
Isopsetta isolepis	10 + 32 = 42
Lepidopsetta bilineata	11 + 29 = 40
Limanda limanda	[40]
Liopsetta glacialis	13 + 27 = 40
Pleuronichthys decurrens	14 + 26 = 40
Pleuronichthys verticalis	13 + 25 = 38
Platessa glabra	11 + 26 = 37
Platessa flesus	[12 + 24 = 36]
Pseudopleuronectes americanus	10 + 26 = 36
Hypsopsetta guttulata	11 + 24 = 35
Platichthys stellatus	12 + 23 = 35

IV.—SOLEINÆ.

Brachirus zebra	[8+41= 49]
Solea solea	9+40= 4)
Solea kleini	10+37= 47
Solea aurantiaca	[46]
Monochirus ocellatus	9+28= 37
Monochirus luteus	8+29= 37
Monochirus hispidus	9+25= 34
Achirus fasciatus	8+20= 28
Achirus inscriptus	9+19= 28

V.—CYNOGLOSSINÆ.

Symphurus atricauda	10+42= 52
Symphurus nigrescens	9+40= 49
Symphurus plagiusa	9+38= 47

The subdivision of the flounders into genera leaves room for considerable variety of opinion. Most of the species are well defined and easily recognized, but they do not fall readily into generic groups unless we regard almost every well-marked species as the type of a distinct genus. A natural result of an attempt at sharply defining the genera is to reach what seems an extreme degree of generic subdivision. On the other hand, attempts to unite these smaller groups to form larger ones often leave these larger ones at once unnatural and ill-defined.

It will probably appear to some that the process of generic subdivision has been in this paper carried too far. It is possible that this is true, but the arrangement which we have adopted seems to bring out the relations of the different forms better than can be done by a more "conservative" view of the genera. For those who would reduce the number of groups we suggest the following list of genera as representing a not unnatural mode of arrangement.

I.—HIPPOGLOSSINÆ.

ATHERESTHES.
PLATYSOMATICHTHYS.
HIPPOGLOSSUS.
HIPPOGLOSSOIDES { *Lyopsetta.* *Eopsetta.* *Hippoglossoides.* }
PSETTICHTHYS.
HIPPOGLOSSINA { *Hippoglossina.* *Xystreurys.* }
PARALICHTHYS { *Paralichthys.* *Ancylopsetta.* }

II.—PLEURONECTIDÆ.

PHRYNORHOMBUS.
ZEUGOPTERUS.
LEPIDORHOMBUS.
CITHARUS.
PLEURONECTES { *Bothus.* *Pleuronectes.* }
ARNOGLOSSUS.
PLATOPHRYS.
CITHARICHTHYS { *Syacium.* *Orthopsetta.* *Citharichthys.* *Azevia.* *Etropus.* *Thysanopsetta.* }
MONOLENE.

III.—PLATESSINÆ.

PLEURONICHTHYS { *Pleuronichthys.* *Hypsopsetta.* }
ISOPSETTA.

PLATESSA { *Parophrys.* *Inopsetta.* *Lepidopsetta.* *Limanda.* *Pseudopleuronectes.* *Platessa.* *Flesus.* *Liopsetta.* *Platichthys.* }

MICROSTOMUS.

CYNICOGLOSSUS.

IV.—ONCOPTERINÆ.

ONCOPTERUS.

V.—SOLEINÆ.

APIONICHTHYS { *Apionichthys.* *Achiropsis.* }

GYMNACHIRUS.

ACHIRUS { *Achirus.* *Baiostoma.* }

MONOCHIRUS { *Monochirus.* *Microchirus.* *Quenselia.* }

SOLEA.

BRACHIRUS.

VI.—CYNOGLOSSINÆ.

SYMPHURUS { *Symphurus.* *Bascanius.* *Delothyris.* *Charybdia.* *Bibronia.* *Acedia.* } (*Bascanius* to *Bibronia*: Larval forms.)

ANALYSIS OF SUBFAMILIES OF PLEURONECTIDÆ.

a. *Flounders:* Edge of preopercle free; mouth with developed teeth; pectoral and ventrals well developed (one pectoral* or one ventral occasionally absent).

b. Mouth nearly symmetrical, the dentition nearly equally developed on both sides, the gape usually, but not always, wide.

c. Ventral fins symmetrical, similar in position and in form of base, the ventral fin of the eyed side not being extended along the ridge of the abdomen. HIPPOGLOSSINÆ I.

cc. Ventral fins unsymmetrical, dissimilar in position and usually also in form, the ventral fin of the eyed side being extended along the ridge of the abdomen. Eyes and color on the left side .... PLEURONECTINÆ II.†

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* Both pectorals are wanting in the genus *Mancopsetta* Gill (= *Lepidopsetta* Gthr.), an antarctic member of the *Pleuronectinæ*.

† In the *Samarinæ*, the eyes and color are on the right side, the mouth is small but nearly symmetrical, the ventral fins are both lateral but with base somewhat prolonged, the gill-rakers are minute, and in most of the species some of the dorsal rays are filamentous and simple, resembling spines. The group, like the *Oncopterinæ*, seems to lie between *Pleuronectinæ* and *Platessinæ*. It seems to include the genera *Samaris*, *Lophonectes*, *Pœcilopsetta*, and *Nematops*, all belonging to the Indo-Pacific fauna.

bb. Mouth unsymmetrical, the jaws on the eyed side with nearly straight outline, the bones on the blind side strongly curved; teeth chiefly on the blind side.

d. Ventral fins unsymmetrical, that of the eyed side extended along the ridge of the abdomen, snout with a free ray or other appendage in connection with the first ray of the dorsal. Eyes and color on the right side. ONCOPTERINÆ III.

dd. Ventral fins nearly or quite symmetrical, that of the eyed side with short base; eyes and color on the right side (with occasional exceptions). PLATESSINÆ IV.

aa. Soles. Edge of preopercle adnate, usually obscured by the scales; mouth very small, much twisted toward the blind side, and with rudimentary teeth; pectoral and ventral fins generally small, occasionally obsolete.

e. Eyes on the right side, separated by a bony ridge ....SOLEINÆ V.

ee. Eyes on the left side, not separated by a bony ridge....CYNOGLOSSINÆ VI.

ANALYSIS OF GENERA OF PLEURONECTIDÆ FOUND IN AMERICA AND EUROPE.

Subfamily I.—HIPPOGLOSSINÆ.

(*Large-mouthed flounders with the ventral fins symmetrical.*)

Mouth symmetrical, the jaws and the dentition nearly equally developed on both sides; gape usually wide, the maxillary more than one-third length of head. Lower pharyngeals narrow, usually with but one or two rows of sharp teeth; teeth in jaws usually acute. Eyes large; edge of preopercle free. Pectoral and ventral fins well developed, *the ventral fins similar in position* and in form of base, the ventral fin of the eyed side not being attached along the ridge of the abdomen. Septum of gill cavity without foramen.

a. Vertebræ and fin-rays much increased in number (the vertebræ about 50, the dorsal rays about 100, the anal rays about 85); body comparatively elongate; caudal fin lunate; lateral line simple; anal spine mostly obsolete. Dextral species, Arctic in distribution. (Genera allied to *Hippoglossus*.)

c. Large *teeth* in both jaws *arrow-shaped*, biserial, some of them depressible; upper eye with vertical range; gill-rakers short; scales deciduous, ciliated; lateral line without arch; flesh soft. Vertebræ (*stomias*) 12+37=49...................................ATHERESTHES, 1.

cc. Large teeth not arrow-shaped, biserial above, uniserial below; scales very small, cycloid; gill-rakers long and slender; eyes strictly lateral.

d. Lateral line without anterior arch; lower pharyngeal teeth uniserial. PLATYSOMATICHTHYS, 2.

dd. Lateral line with an interior arch; lower pharyngeal teeth biserial; vertebræ (*hippoglossus*) 16+34=50 .....................HIPPOGLOSSUS, 3.

aa. Vertebræ and fin-rays in moderate number (vertebræ less than 46, dorsal rays less than 95, anal rays less than 75); caudal fin double truncate or rounded, the median rays longest.

f. Lateral line without distinct anterior arch; vertebræ, 40 to 46; body normally dextral;* caudal peduncle distinct; scales ciliated; anal spine usually strong. Species of subarctic distribution. (Genera allied to *Hippoglossoides*.)

*Frequently sinistral in *Hippoglossoides elassodon*.

g. Lateral line simple (without accessory dorsal branch); teeth sharp, those of lower jaw uniserial; dorsal beginning above eye.

h. Teeth in the upper jaw biserial.

i. Scales comparatively large, thin, and deciduous (lateral line 70); body slender, the flesh soft; vertebræ (*exilis*) 11+34=45. LYOPSETTA, 4.

ii. Scales small and adherent (lateral line 96); body robust, the flesh firm; vertebræ (*jordani*) 11+32=43................EOPSETTA, 5.

hh. Teeth in the upper jaw uniserial; scales small and flesh firm; vertebræ (*platessoides*) 13+32=45..................HIPPOGLOSSOIDES, 6.

gg. Lateral line with an accessory dorsal branch; vertebræ 40 to 42; scales small, firm, ctenoid; dorsal fin beginning before the eye; teeth sharp, unequal, some of them canine-like; mouth not large; lower pharyngeal teeth sharp, uniserial; vertebræ (*melanostictus*) 11+29=40 ..................................PSETTICHTHYS, 7.

ff. Lateral line with a strong arch in front; no accessory branch; vertebræ in smaller number (35 to 41); teeth uniserial; anal spine usually obsolete; body normally sinistral.* (Species chiefly of the temperate or sub-tropical seas, none of them Arctic and none European.) (Genera allied to *Paralichthys*.)

k. Dorsal fin beginning above the pupil; gill-rakers short and thick; teeth rather small; no canines; body indifferently dextral or sinistral (in some species at least).

l. Scales ctenoid ..................................HIPPOGLOSSINA, 8.

ll. Scales cycloid; caudal fin subsessile, the caudal peduncle extremely short; skin of shoulder-girdle with patches of cup-shaped scales; vertebræ (*liolepis*) 12+25=37 ....XYSTREURYS, 9.

kk. Dorsal fin beginning in advance of eye.

m. Scales weakly ciliated; caudal fin with a distinct peduncle; teeth unequal, some of the anterior canine-like; gill-rakers rather long and slender; vertebræ, 35 to 41 ..................PARALICHTHYS, 10.

mm. Scales very strongly ctenoid on both sides of body; mouth smallish, with small, sharp teeth; anterior rays of dorsal notably exserted, the rays of the anterior part of the fin longer than some of those further back, thus forming a more or less distinct lobe; gill membranes considerably united; gill-rakers short and broad; caudal peduncle short; left ventral produced; vertebræ (*quadrocellata*) 9 + 26 = 35........................ANCYLOPSETTA, 11.

Subfamily II.—PLEURONECTINÆ.

(*Large-mouthed flounders, with the ventral fins unsymmetrical.*)

Mouth symmetrical, the dentition nearly equally developed on both sides; gape usually wide (narrow in *Platophrys*, *Etropus*, etc.), the maxillary commonly more than one-third length of head. Lower pharyngeals narrow, each with one or more rows or a narrow band of small, sharp teeth; teeth in jaws acute. Eyes not minute; pectorals and ventrals usually well developed. Edge of preopercle free. Ventral fins dissimilar in form or in position, that of the left or eyed side inserted on the ridge of the abdomen, its base extended along this ridge, its rays more or less wide apart. Caudal fin rounded or subtruncate; no ac-

*Dextral in some species of *Hippoglossina*; occasionally dextral in some species of *Paralichthys* and *Xystreurys*.

cessory lateral line; anal spine usually weak or obsolete; a pelvic spine sometimes developed. Vertebræ in moderate or small number, 31 to 40 (except in *Monolene*). Body sinistral. Species chiefly tropical or subtropical in distribution.

a. Pectoral fin of both sides present; dorsal rays less than 100.

b. Septum of gill cavity between gill arches and the termination of the shoulder-girdle with a large foramen; the emargination below the shoulder-girdle near the isthmus not deep; lateral line with a strong arch in front; last rays of dorsal and anal inserted more or less on the right side of the median line; teeth subequal, in bands.

c. Vomer toothless; ventral fins free from the anal; caudal fin subsessile; scales small, each with very long spinules; vertebræ (*regius*) 10 + 25 = 35.................... PHRYNORHOMBUS, 12.

cc. Vomer with teeth.

d. Ventral of eyed side united to the anal; scales small, very rough; body ovate; vertebræ (*punctatus*) 12 + 25 = 37. ZEUGOPTERUS, 13.

dd. Ventral fins free from the anal; scales ciliated, deciduous; body oblong, much compressed; vertebræ (*whiff-iagonis*) 11 + 30 = 41. LEPIDORHOMBUS, 14.

bb. Septum of gill cavity below gill arches, without foramen; a deep emargination near the isthmus; ventral fins free from anal.

e. Vomer with teeth; lateral line with a strong arch in front.

f. Teeth unequal, those of the upper jaw biserial, some of them canine-like; scales weakly ciliated; body elongate; mouth very large.................................. CITHARUS, 15.

ff. Teeth subequal, in villiform bands; body broadly ovate; caudal fin subsessile; interorbital area broad; scales small, cycloid, or wanting; vertebræ 31 to 36.......... PLEURONECTES, 16.

ee. Vomer toothless; ventral fins free from anal; caudal fin subsessile.

h. Lateral line with a distinct arch in front; teeth small, uniserial, or imperfectly biserial.

i. Interorbital area a narrow ridge, sometimes with a median groove.

j. Scales cycloid or weakly ciliated, deciduous; vertebræ 10 + 28 = 38.................................. ARNOGLOSSUS, 17.

ii. Interorbital space more or less broad, deeply concave; scales small, ctenoid, adherent; body ovate (pectoral of left side usually filamentous in the male); vertebræ (*lunatus*) 9 + 30 = 39........................... PLATOPHRYS, 18.

hh. Lateral line without arch in front; scales ciliated.

k. Teeth in upper jaw biserial, in the lower uniserial, the front teeth of upper jaw enlarged; vertebræ 35 or 36. SYACIUM, 19.

kk. Teeth in both jaws uniserial; interorbital space very narrow, the ridges coalescing between the eyes.

l. Mouth not very small, the maxillary more than one-third length of head.

m. Gill-rakers very short and thick, tubercle-like; scales small, firm, ctenoid .... AZEVIA, 20.

mm. Gill-rakers slender, of moderate length; scales thin, deciduous, ciliated; vertebræ 34 to 40.... CITHARICHTHYS, 21.

ll. Mouth very small, the teeth subequal, the maxillary less than one-third length of head.

n. Teeth uniserial; vertebræ 9 + 25 = 34....ETROPUS, 22.

nn. Teeth in villiform bands ........THYSANOPSETTA, 23.

aa. Pectoral fin of blind side wanting; eyes very close together; caudal fin subsessile; teeth small, uniserial; mouth moderate; lateral line of eyed side arched, that of right side nearly straight; dorsal fin beginning on snout, its anterior rays not exserted, its rays all simple and very numerous; scales small; body thin, very elongate; vertebræ (*sessilicauda*) 43; (deep-sea flounders, of uncertain relationship). MONOLENE, 24.

Subfamily III.—ONCOPTERINÆ.

(Small-mouthed flounders, with the right ventral fin extending along the ridge of the abdomen, dorsal beginning at the snout, a bony prominence of some sort connected with its first ray; eyes and color on the right side.)

a. Left side of snout with a horizontal slit-like cavity, into which a curved, bony, ray-like appendage is depressible; lateral line with an anterior arch and with numerous accessory branches nearly at right angles with it; scales cycloid; right ventral fin free from the anal fin; left ventral fin present; gill-rakers short and slender...ONCOPTERUS, 25.

Subfamily IV.—PLATESSINÆ.

Mouth small, unsymmetrical, the jaws on the eyed side with nearly straight outline, the bones on the blind side strongly curved; dentition chiefly developed on the blind side; eyes large; edge of preopercle not hidden by the scales; pectoral fins well developed; vertical fins well separated; ventral fins nearly or quite symmetrical; anal spine usually strong (obsolete in *Microstomus*). Body dextral (except frequently in *Platichthys stellatus*). Species arctic or subarctic in distribution.

a. Vertebræ in moderate number (from 10 + 26 = 36 to 11 + 33 = 44); dorsal rays 65 to 80; anal rays 45 to 60.

b. Teeth small, acute, in several series; lateral line nearly straight, with an accessory dorsal branch; lower pharyngeals narrow, with small biserial teeth; scales cycloid. (Genera allied to *Pleuronichthys*).

c. Lips thick—each with several longitudinal folds; dorsal fin beginning on the blind side; vertebræ 38 to 40. ...........PLEURONICHTHYS, 26.

cc. Lips simple; dorsal fin beginning on the median line; vertebræ (*guttulatus*) 11 + 24 = 35 ....HYPSOPSETTA, 27.

bb. Teeth chiefly uniserial, all more or less blunt, conical or incisor-like. (Genera allied to *Platessa*).

d. Lateral line with an accessory dorsal branch.

e. Lateral line without distinct arch in front.

f. Teeth compressed, incisor-like, close-set.

g. Scales closely imbricated, mostly cycloid; upper eye on median line; vertebræ (*vetulus*) 11 + 33 = 44...............PAROPHRYS, 28.

gg. Scales scarcely imbricated, all very strongly ctenoid; eyes both lateral...INOPSETTA, 29.

ff. Teeth conical, separated, not incisor-like; scales closely imbricated, all strongly ctenoid; mouth comparatively large (approaching that of *Psettichthys*); vertebræ (*isolepis*) 10 + 32 = 42. . . . . ISOPSETTA, 30.

ee. Lateral line with a distinct arch in front; scales imbricated, rough-ctenoid; vertebræ (*bilineata*) 11 + 29 = 40. LEPIDOPSETTA, 31.

dd. Lateral line without accessory dorsal branch.

h. Lateral line with a distinct arch in front; scales imbricated, rough-ctenoid; vertebræ (*limanda*) 40. . . . . LIMANDA, 32.

hh. Lateral line without distinct arch in front.

i. Scales regularly imbricate, all (on eyed side) ctenoid in both sexes; no stellate tubercles on head nor on bases of dorsal and anal fins; teeth, incisor-like, close-set; lower pharyngeals very narrow, each with two rows of separate, conical teeth; fin rays scaly . . . . PSEUDOPLEURONECTES, 33.

ii. Scales imperfectly imbricated, or else not all ctenoid.

j. Scales chiefly cycloid in both sexes; lower pharyngeals small and narrow, separate, each with 1 to 4 rows of small, bluntish teeth . . . . PLATESSA, 34.

jj. Scales rough-ctenoid in the male, more or less cycloid in the female (fin rays scaly in the male, naked in the female); lower pharyngeals very large, more or less united in the adult, their surface somewhat concave, the teeth in five or six rows, large, blunt, close-set; teeth in jaws incisor-like; fin-rays of dorsal, and anal without tubercles at base . . . . LIOPSETTA, 35.

jjj. Scales all in both sexes and on both sides of the body represented by coarse scattered stellate tubercles; similar tubercles between bases of dorsal and anal rays; lateral line without scales; lower pharyngeals broad, each with three rows of blunt, coarse teeth; teeth incisor-like . . . . PLATICHTHYS, 36.

aa. Vertebræ in increased number (varying from 13 + 35 = 48 to 13 + 52 = 65); dorsal rays 90 to 120; anal rays 70 to 100; teeth broad, incisor-like; scales small, all cycloid. (Genera allied to *Glyptocephalus*).

k. Left side of skull normal; anal spine obsolete; vertebræ 48 to 52. . . . . MICROSTOMUS, 37.

kk. Left side of skull, with large mucous cavities; anal spine strong; vertebræ 58 to 65 . . . . GLYPTOCEPHALUS, 38.

Subfamily V.—SOLEINÆ.

(Soles with the eyes on the right side, and separated by a bony ridge.)

Body oblong or elongate, with the eyes and color on the right side; eyes moderate or small, separated by a distinct bony ridge, the upper eye usually more or less in advance of the lower; mouth small, more or less twisted towards the blind side; teeth little developed, in villiform bands; edge of preopercle adnate, usually concealed by the scales; gill openings more or less narrowed, the gill membranes adnate to the shoulder-girdle above; blind side of head usually with fringes; pectoral fins small, sometimes wanting; ventral fins developed, one or both of them sometimes obsolete; scales usually ctenoid, rarely wanting; lateral line straight, usually single.

a. Gill openings very small, separate, each reduced to a slight slit below angle of opercle; right ventral beginning at the chin, confluent with the anal; pectoral fins wanting or very small; lateral line present, straight; eyes small; snout dilated, the dorsal beginning upon it.

b. Scales present, ctenoid; caudal fin somewhat confluent with dorsal.

c. Left ventral rudimentary, with two rays ..................APIONICHTHYS, 39.

cc. Left ventral well developed, with five rays..................ACHIROPSIS, 40.

bb. Scales none; caudal fin not confluent with dorsal and anal..GYMNACHIRUS, 41.

aa. Gill openings of moderate extent, confluent below.

d. Vertical fins well separated.

e. Right ventral fin with extended base, confluent with the anal fin; vertebræ about 28; body ovate in outline, the depth nearly half the length; pectoral fins rudimentary or wanting; lateral line straight; scales well developed, ctenoid, those on the head more or less enlarged, those of the blind side of the head with fringes..........................ACHIRUS, 42.

ee. Right ventral fin with short base, free from the anal; vertebræ 34 to 50; body elliptical or elongate, the depth one-third to two-fifths the length; lateral line single* on both sides.

f. Vertebræ 34 to 40; body oblong; pectoral fins usually small, sometimes wanting on the blind side.............................MONOCHIRUS, 43.

ff. Vertebræ 47 to 50; body elongate; pectoral fins subequal, present on both sides ....SOLEA, 44.

dd. Vertical fins fully confluent around the short tail, body oblong; scales very small, ctenoid; vertebræ (*zebra*) 8 + 41 = 49................BRACHIRUS, 45.

Subfamily VI.—CYNOGLOSSINÆ.

(*Soles with the eyes on the left side, not separated by a bony ridge.*)

Body elongate, more or less lanceolate in outline, with the eyes and color on the left side; eyes small, very close together, with no distinct interorbital ridge between them; mouth small, twisted toward the blind side; teeth little developed, in villiform bands; edge of preopercle covered by the scales; gill openings narrow, the gill membranes adnate to the shoulder girdle above, joined together and free from the isthmus below; pectoral fins wanting (in the adult); ventral fins small, that of the blind side often wanting; vertical fins more or less confluent; scales ctenoid; lateral line sometimes wanting, sometimes duplicated.

a. Ventral fin of eyed side only present, free from the anal; no pectoral fins; no lateral line; head without fringes..........................SYMPHURUS, 46.

Subfamily I.—HIPPOGLOSSINÆ.

Genus I.—ATHERESTHES.

Atheresthes Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 51 (*stomias*).

TYPE: *Platysomatichthys stomias* Jordan & Gilbert.

The single species which constitutes this genus† is one of the most

* Two lateral lines on the blind side in the Asiatic genus, *Pardachirus*.

† Arrow-shaped canine-teeth are also found in the Asiatic genus *Psettodes* Bennett, a curious group somewhat allied to *Atheresthes*. In *Psettodes*, the caudal fin is rounded, the dorsal fin begins on the nape, above middle of the cheek, the scales are small and ctenoid, and there are no gill-rakers.

remarkable of the flounders. Of all the group, it approaches in form and general characters most nearly to the Gadoid fishes, from which we may presume the flounders to be descended, although Dr. Gill has suggested the possibility of their descent from Trachypteroid fishes.

ANALYSIS OF SPECIES OF ATHERESTHES.

a. Head about 3⅗ in length; depth, 3¼; D. 103, A. 86; Lat. l. 135. Gill-rakers about 4 + 12, long and slender; interorbital ridge broad, scaly; eyes large; vertebræ, 12 + 37 = 49. Color olive brown, the margins of the scales darker; blind side dusted with dark points; inside of mouth and gill-cavity black. STOMIAS, 1.

1. ATHERESTHES STOMIAS.

(THE ARROW-TOOTHED HALIBUT.)

[Plate I.]

Platysomatichthys stomias Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 51, 301, (San Francisco).

Atheresthes stomias Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 57, 454 (off San Francisco). Bean, Proc. U. S. Nat. Mus., 1881, 242 (San Francisco, Port Etches, Afognak Island, Popoff Island, Shumagins). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 66 (Point Reyes to Farallones). Jordan and Gilbert, Syn. Fish. N. A., 820, 1882. Bean, Proc. U. S. Nat. Mus., 1883, 354 (Wrangel and Nabu Bay, Alaska). Jordan, Nat. Hist. Aquat. Anim., 1884, 188, plate 53 (Point Reyes).

Habitat.—Coast of Alaska, southward in deep water to near San Francisco.

This species is not uncommon in the deep water off San Francisco, and is brought in in considerable numbers from the sweep-nets (*parranzelle*) used in this region. Farther northward it is taken on the coast of Alaska, and it is properly a member of the Alaskan fauna.

Genus II.—PLATYSOMATICHTHYS.

Reinhardtius Gill, Cat. Fishes East. Coast N. A., 1861, 50. (*Nomen nudum.*)

Platysomatichthys Bleeker, Comptes Rendus, Acad. Sci. Amsterdam, xiii, 1862, 426. (*pinguis* = *hippoglossoides.*)

Reinhardtius Gill, Proc. Ac. Nat. Sci. Phila., 1864, 218. (*hippoglossoides.*)

TYPE: *Pleuronectes pinguis* Fabricius = *Pleuronectes hippoglossoides* Walbaum.

But a single species of this genus is known, an Arctic fish, in some degree intermediate between the true halibut and *Atheresthes*.

We continue to use the name *Platysomatichthys* for this genus, as the earlier name *Reinhardtius* was introduced without explanation or special designation of a type, although there is no question as to what species the author would have included in the group if he had taken the trouble to define it.

ANALYSIS OF SPECIES OF PLATYSOMATICHTHYS.

a. Head, 3⅘ in length; depth, nearly 3; D. 100, A. 75; Lat. l. 160; interorbital space, broad, flat, scaly; color brown, nearly plain ...... HIPPOGLOSSOIDES, 2.

2. PLATYSOMATICHTHYS HIPPOGLOSSOIDES.

(THE GREENLAND HALIBUT.)

[Plate II.]

Pleuronectes cynoglossus Fabricius, Fauna Grœnlandica, 1780, 163 (Greenland, not of Linnæus).
Pleuronectes hippoglossoides Walbaum, Artedi Piscium, 115, 1792 (based on Fabricius).
Reinhardtius hippoglossoides Gill, Cat. Fish. E. Coast N. A., 1861, 50 (name only). Gill, Proc. Ac. Nat. Sci. Phila., 1864, 218.
Platysomatichthys hippoglossoides Goode & Bean, Bull. Essex Inst., ii, 7, 1879 (coast of Massachusetts and northward in deep water). Collett, Norske Nord Havs Exped., 1880, 142 (Finmark, Hammerfest). Jordan & Gilbert, Syn. Fish. N. A., 1882, 819. Goode, Nat. Hist. Aquat. Anim., 1884, 197, pl. 56 (George's Bank and northward), and of late American writers generally.
Pleuronectes pinguis Fabricius, Zoologiske Bidrag., 1824, 43 (Greenland).
Hippoglossus pinguis Reinhardt, "Kgl. Dansk. Vidensk. Selsk., 116, 1838."
Platysomatichthys pinguis Bleeker, *l. c.*, 426, 1862.
Hippoglossus grœnlandicus Günther, iv, 404, 1862 (Greenland).

Habitat.—Arctic parts of the Atlantic, south to Finland and the Grand Banks.

Genus III.—HIPPOGLOSSUS.

Hippoglossus Cuvier, Règne Animal, ii, 1817 (*hippoglossus*).

TYPE: *Pleuronectes hippoglossus* L.

This genus contains but one species, the well-known halibut, abundant on both coasts of the North Atlantic and of the North Pacific.

ANALYSIS OF SPECIES OF HIPPOGLOSSUS.

a. Head, 3⅔; depth, about 3; D. 105, A. 78; Lat. l. 150 or more; interorbital space, broad, flat, scaly; gill-rakers, few, short, compressed, wide-set; color, dark brown; vertebræ, 16 + 34 = 50 .... HIPPOGLOSSUS, 3.

3. HIPPOGLOSSUS HIPPOGLOSSUS.

(THE HALIBUT.)

[Plate III.]

Pleuronectes hippoglossus Linnæus, Systema Naturæ, ed. x, 269, 1758 (European Ocean) (of Gmelin, Bloch, and early writers generally).
Hippoglossus hippoglossus Jordan, Cat. Fish. N. A., 1885, 133.
Hippoglossus vulgaris Fleming, British Animals, 1828, 197. Günther, iv, 403, 1862. Day, Fishes Great Britain, ii, 5, pl. xciv, and of European writers generally.

* Only an outline of the very extensive synonymy of this common food-fish is here given.

Hippoglossus vulgaris Storer, Fish. Mass., 145, 1839. DeKay, New York Fauna, Fishes, 1842, 294, pl. 49, f. 157. Storer, Synopsis Fish. N. A., 1847, 475. Lockington, Rep. Com. Fisheries, California, 1878–'79, 39 (Farallone Islands). Lockington, Proc. U. S. Nat. Mus., 1879, 71 (San Francisco). Bean, Proc. U. S. Nat. Mus., 1879, 63 (Unalashka and St. Michael's, Alaska, Eastport, Maine). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 454 (Puget Sound, San Francisco). Goode, Proc. U. S. Nat. Mus., 1880, 471 (Fisher's Island, Connecticut, &c.); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 66 (San Francisco, Cape Flattery). Bean, Proc. U. S. Nat. Mus., 1881, 242 (San Francisco, Puget Sound, Port Althorp, Chugachik Bay, St. Paul, Unalashka, St. Michael's. Jordan & Gilbert, Syn. Fish. N. A., 1882, 819. Bean, Cat.Col. Fish. U. S. Nat. Mus., 1883, 20 (Port Althorp, Alaska). Dresel, Proc. U. S. Nat. Mus., 1884, 244, (Davis Straits, Greenland). Goode, Nat. Hist. Aquatic Anim., 1884, 189, plate 54 (Sandy Hook, Montauk Point, Block Island, and northward), and of American writers generally.

Hippoglossus maximus "Gottsche, Wiegmann's Archiv, 1835, 164."

Hippoglossus gigas Swainson, Nat. Hist. Class'n Anim., ii, 1839.

Hippoglossus ponticus Bonaparte, Catalogo Metodico, 1846, 47 (Black Sea, after Pallas).

Hippoglossus americanus Gill, Proc. Acad. Nat. Sci. Phila., 1864, 220.

Habitat.—All northern seas, southward in deep water to France, Sandy Hook, and San Francisco.

The halibut, the largest and most widely distributed of all the *Pleuronectidæ*, is too well known to require discussion here.

Genus IV.—LYOPSETTA.

Lyopsetta Jordan and Goss, Cat. Fish. N. A., 1885, 135 (*exilis*).

TYPE: *Hippoglossoides exilis* Jordan & Gilbert.

This genus contains but a single species, a small, soft-bodied flounder, of the waters of the North Pacific. In its technical characters *Lyopsetta* is very close to *Hippoglossoides*, of which it might well be regarded a subgenus. The introduction of the name *Lyopsetta* is to be regretted from its close resemblance to *Liopsetta*, a word of similar sound, but very different meaning. At the time of the introduction of *Lyopsetta*, *Liopsetta* was regarded as an obsolete synonym.

ANALYSIS OF SPECIES OF LYOPSETTA.

a. Body rather slender, the flesh soft; mouth rather small, the maxillary 2⅗ in head; teeth small, slender, close-set, nearly uniform. Eyes very large, 3⅓ in head, separated by a sharp, scaly ridge. Scales rather large, thin, deciduous, weakly ctenoid; pectorals small, the right pectoral nearly 2 in head. Gill-rakers short, slender, x+9. Head, 4; depth, 3½; D. 78, A. 62, Lat. l., 71. Vertebræ 11 + 34 = 45. Pale brown, with dark points; bronze spots sometimes present; fins dusky; dorsal, anal, and ventrals edged with yellow........................EXILIS, 4.

4. LYOPSETTA EXILIS.

Hippoglossoides exilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 154 (off San Francisco). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 454 (Puget Sound, San Francisco, Monterey Bay). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 67 (San Francisco, Point Reyes, Seattle, Puget Sound). Jordan & Gilbert. Syn. Fish. N. A., 1882, 827.

Habitat.—North Pacific, in rather deep water. San Francisco to Puget Sound, and probably northward.

This small flounder is brought in in large quantities by the sweep-nets off San Francisco. It is of little value as a food-fish.

Genus V.—EOPSETTA.

Eopsetta Jordan & Goss, Cat. Fish. N. A., 1885, 135 (*jordani*).

TYPE: *Hippoglossoides jordani* Lockington.

This genus contains but a single species, a large flounder which is abundant on the coast of California. It is very close to the genus *Hippoglossoides*, and its separation as a distinct genus is perhaps hardly justified.

ANALYSIS OF SPECIES OF EOPSETTA.

a. Body broadly ovate; maxillary 2⅔ in head; teeth in two series above, the inner series much smaller, the outer canine-like in front, gill membranes somewhat united; gill-rakers strong, x + 15; eyes large, 3½ in head, separated by a narrow, blunt, scaly ridge; scales small, firm, strongly ciliated, smooth on blind side; anal spine strong; head 3½; depth 2½. D. 94, A. 72, Lat. l. 96. Vertebræ 11 + 32 =43. Color, olive-brown, nearly uniform........................JORDANI, 5.

5. EOPSETTA JORDANI.

(THE "CALIFORNIA SOLE.")

Hippoglossoides jordani Lockington, Proc. U. S. Nat. Mus., 1879, 73 (San Francisco). Lockington, Rep. Com. Fisheries, California, 1878–'79, 40 (San Francisco, Farallone Islands). Lockington, Scientific Press Supplement, April, 1879, 120. Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 454 (Puget Sound, San Francisco, Monterey Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 67 (Monterey, Puget Sound, San Francisco). Jordan & Gilbert, Syn. Fish. N. A., 1882, p. 826. Jordan, Nat. Hist. Aquat. Anim., 1884, 187.

Habitat.—Coast of California, Puget Sound to Monterey.

This is one of the commonest flat-fishes of the California coast, being found in abundance in shallow water from Monterey northward. It is a good food-fish, and large numbers are dried each year by the Chinese.

Genus VI.—HIPPOGLOSSOIDES.

Hippoglossoides Gottsche, Wiegmann's Archiv, 1835, 164 ("*limanda*"=*platessoides*).
Drepanopsetta Gill, Cat. Fish. East Coast N. Am., 1861, 50 (*platessoides*).
Pomatopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1864, 217 ("*dentata*"=*platessoides*).

TYPE: *Pleuronectes platessoides* Fabricius.

This genus, as here restricted, contains two closely related species, the one of the North Pacific, the other of the North Atlantic. Both are essentially Arctic species, inhabiting shallow waters in the regions where they are most abundant.

ANALYSIS OF SPECIES OF HIPPOGLOSSOIDES.

a. Teeth small, unequal, the anterior largest; gill-rakers short, X+10 in number; maxillary 2⅗ in head; eye 5½ in head; interorbital space with an obtuse, prominent ridge, with usually about six series of scales; head, 3⅗; depth, 2½; D. 88 (80 to 93); A. 70 (64 to 75); Lat. l. 90; vertebræ 13+32=45; color nearly plain brown. PLATESSOIDES, 6.

aa. Teeth small, subequal; gill-rakers slender, X+16; maxillary 2½ in head; eye large, 4 in head; interorbital space a narrow, knife-like ridge with usually a single series of scales; head, 3½; depth, 2½; D. 80 (77 to 84); A. 61 (59 to 64); Lat. l. 100; color brown, sometimes mottled with darker........................ELASSODON, 7.

6. HIPPOGLOSSOIDES PLATESSOIDES.

(THE SAND DAB.)

[Plate IV.]

Pleuronectes linguatula Müller, Zool. Dan. Prodromus, 45, 1776 (not of Linnæus).
Pleuronectes platessoides Fabricius, Fauna Grœnlandica, 1780, 164 (Greenland), and of numerous copyists.
Citharus platessoides Reinhardt, Kongl. Dansk. Vid. Selsk, 116, 1838.
Drepanopsetta platessoides Gill, Cat. Fish. East Coast N. Am., 1861, 50 (name only).
Hippoglossoides platessoides Gill, Proc. Acad. Nat. Sci. Phila., 1864, p. 217. Collett, Norske Nord-Havs. Exped., 1880, 144 (Norway to Spitzbergen). Goode, Proc. U. S. Nat. Mus., 1880, 471. Jordan and Gilbert, Syn. Fish. N. A., 1882, 826. Stearns, Proc. U. S. Nat. Mus., 1883, 125 (Labrador). Goode, Nat. Hist. Aquatic Anim., 1884, 197, pl. 55 (Wood's Holl and northward), and of recent American writers generally.
Pleuronectes limandoides Bloch, Ausl. Fische, iii., 24 tab. 186, 1787 (Europe), and of various copyists.
Hippoglossoides limandoides Günther, Cat. Fish., iv, 405, 1862. Day, Fishes Great Britain and Ireland, vol. ii, p. 9, pl. xcv.
Hippoglossoides limanda Gottsche, Wiegm. Archiv, 1835, 168 (not *Pl. limanda* L.).
Pleuronectes limandanus Parnell, Edinburgh New Phil. Journ., 1835, 210.
Platessa dentata Storer, Fish. Mass., 143, 1839. (Boston and Provincetown; not *Pl. dentatus* Linnæus.) DeKay, N. Y. Fauna, Fish, p. 298, 1842. Storer, Syn. Fish. N. A., 1846, p. 476.
Hippoglossoides dentatus Günther, Cat. Fish., iv., 406, 1862. Günther, Voy. Challenger, Fishes, 1880, 3. (Station 49, south of Halifax.)
Pomatopsetta dentata Gill, Proc. Acad. Nat. Sci. Phila., 1864, p. 217.

Habitat.—North Atlantic, south to Cape Cod, and the coasts of England and Scandinavia.

The identity of the American and European representatives of this species (*platessoides* and *limandoides*) is now conceded by all writers. A little difference is recognized between Arctic and subarctic examples, the former having a somewhat greater number of fin-rays.

Thus, Greenland specimens, according to Collett, have D. 88, A. 69, specimens from Finmark have D. 92, A. 72; these representing the var. *platessoides*. Specimens from England (var. *limandoides*) have D. 80, A. 66, while those from intermediate localities present in general fin formulæ likewise intermediate, showing that no sharp division is possible.

This is a rather common food-fish of the deeper waters northward, on both sides of the ocean.

7. HIPPOGLOSSOIDES ELASSODON.

[Plate V.]

Hippoglossoides elassodon Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 278 (Seattle, Tacoma, Washington Territory). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 454 (Puget Sound) and elsewhere. Bean, Proc. U. S. Nat. Mus., 1881, 242 (Puget Sound, St. Paul, Humboldt Harbor, Shumagins, Iliulink, Unalashka, St. Michael's). Jordan and Gilbert, Syn. Fish. N. A., p. 826, 1882. Bean, Proc. U. S. Nat. Mus., 1883, p. 20 (Unalashka). Jordan, Nat. Hist. Aquat. Anim., 1884, 188, pl. 52.

Habitat.—North Pacific, south to Puget Sound.

This is a rather abundant shore fish in Puget Sound, and it seems to be still more common northward, being, in Alaska, a food-fish of some importance.

Genus VII.—PSETTICHTHYS.

Psettichthys Girard, Proc. Ac. Nat. Sci. Phila., 1854, 140 (*melanostictus*).

TYPE: *Psettichthys melanostictus* Girard.

This genus contains but a single species, found on the coast of California. It is nearly related to *Hippoglossoides*, but possesses the peculiar accessory dorsal branch to the lateral line, characteristic of so many of the Pacific coast flounders.

ANALYSIS OF SPECIES OF PSETTICHTHYS.

a. Body elliptical; mouth rather small; maxillary $2\frac{3}{8}$ in head; teeth large, sharp, uniserial; eyes very small, 5 in head, separated by a broad, flat, scaly interspace; gill-rakers slender, X + 14; scales very small, ctenoid, adherent; accessory lateral line long; first rays of dorsal exserted, the longest 3 in head; head 4; depth $2\frac{1}{3}$; D. 85, A. 60, Lat. l. 112; vertebræ 11+29=40; color dark grayish brown, everywhere finely speckled with darker .... MELANOSTICTUS, 8.

8. PSETTICHTHYS MELANOSTICTUS.

[Plate VI.]

Psettichthys melanostictus Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 140 (San Francisco; Astoria, Oregon). Girard, U. S. Pacif. R. R. Exped., Fishes, p. 154, 1859. Günther, Cat. Fish., iv, 420, 1862 (copied). Lockington, Rep. Com. Fisheries Cal. 1878–'79, p. 40 (San Francisco; Farallone Islands). Lockington, Proc. U. S. Nat. Mus., 1879, p. 76 (San Francisco). Jordan and Gilbert, Proc. U. S. Nat. Mus. 1880, p. 453 (Puget Sound, San Francisco, Monterey Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, p. 67 (Monterey; Puget Sound). Jordan, Nat. Hist. Aquatic Animals, 1884, 186, pl. 51 (Monterey to Wrangel, Alaska).

Hippoglossoides melanostictus, Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 828.

Habitat.—Pacific coast of North America, from Alaska south to Montery.

This is one of the commoner flounders of the Pacific coast, being everywhere known by the name of "Sole." It lives near the shore, and reaches a length of about twenty inches.

In color this species is quite unlike the species of *Hippoglossoides*, but in most other respects the two groups are closely allied.

Genus VIII.—HIPPOGLOSSINA.

Hippoglossina Steindachner, Ichth. Beiträge, v, 13, 1876 (*macrops*).

TYPE: *Hippoglossina macrops* Steindachner.

This genus is intermediate between *Hippoglossoides* and *Paralichthys*, agreeing with the former in the insertion of the dorsal and in general appearance, and with the latter in the direction of the lateral line. Two species, the one from Japan, the other from Patagonia, have been lately referred to *Hippoglossina*. A fourth species, apparently still undescribed, is in the museum at Cambridge, from Japan. Some of these species are dextral, and perhaps all of them are normally so, or perhaps, as in the case of *Xystreurys liolepis*, all are indifferently dextral or sinistral.

ANALYSIS OF AMERICAN SPECIES OF HIPPOGLOSSINA.

a. [Eye very large, 3½ in head; body elliptical; dorsal beginning over middle of eye; pectoral of left side half head, much longer than maxillary, which is 2⅔ in head and reaches middle of eye; interorbital space a narrow ridge; teeth very small, sharp, uniserial; scales of left side all strongly ctenoid, those of blind side ciliated only on posterior third of body; head 2⅔; depth 2⅓ to 2½, D. 66 or 67; A. 52; Lat. l. 75 to 80; no anal spine. Color, brownish, with obscure darker blotches; body sinistral (in the only specimen known)] (*Steindachner*) .... MACROPS, 9.

aa. [Eye small, 4½ or more times in head; upper eye slightly before lower; snout 4½ in head; interorbital space flat, with minute scales, half vertical diameter of eye; dorsal beginning above eye, of moderate height; mouth wide, maxillary extending beyond middle of orbit; lateral line with a semicircular curve; pectoral 2 in head; ventrals well developed, symmetrical. Grayish, minutely mottled with brown. Head 3½; depth, 2⅛; D. 72; A. 56.] (*Günther*) ....MICROPS, 10.

9. HIPPOGLOSSINA MACROPS.

Hippoglossina macrops Steindachner, Ichth. Beitr., v, 13, pl. iii, 1876 (Mazatlan).

Habitat.—Pacific coast of Mexico, Mazatlan.

We know this species from the description and excellent figure published by Dr. Steindachner.

10. HIPPOGLOSSINA MICROPS.

Hippoglossina microps Günther, Voyage, H. M. S. Alert. Jan. 4, 1881 (Patagonia).

Habitat.—West coast of Patagonia.

This specimen is known only from Günther's short description of a specimen four inches in length.

Genus IX.—XYSTREURYS.

Xystreurys Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 34 (*liolepis*).

TYPE: *Xystreurys liolepis* Jordan & Gilbert.

This genus is very close to *Hippoglossina*, differing chiefly in the subsessile caudal fin and the smooth scales. In its peculiar gill-rakers it agrees with those of a Japanese species of *Hippoglossina* examined by us. The typical species, like some other Pacific coast flounders, is almost indifferently dextral or sinistral. The lately-described *Hippoglossina punctatissima* Steindachner, from Japan, seems to belong to *Xystreurys.*

ANALYSIS OF SPECIES OF XYSTREURYS.

a. Body broadly elliptical; mouth small; maxillary reaching pupil, $2\frac{2}{3}$ in head; eyes large, $4\frac{1}{2}$ in head, separated by a very narrow, blunt, scaly ridge; teeth small, conical, blunt, uniserial, those below subequal, those above larger in front. Gill-rakers very short, broad, weak, 2 + 7. Scales small, cycloid, with many accessory scales. Skin of shoulder girdle and gill arches with cup-shaped, tubercular scales. Dorsal inserted above pupil; no anal spine. Pectoral of eyed side falcate, varying much in length, usually much longer than head; anterior nostril of blind side with a short flap. Head $3\frac{2}{3}$, depth $1\frac{5}{6}$; D. 80; A. 62; Lat. l. 123; vertebræ 12 + 25 = 37. Olive-brown, mottled with darker, sometimes with very distinct round black blotches or ocelli; pectoral of colored side barred.....................LIOLEPIS. 11.

11. XYSTREURYS LIOLEPIS.

Xystreurys liolepis Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 34 (Santa Barbara). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 454 (Santa Barbara; San Pedro). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, p. 66 (Santa Barbara).
Paralichthys liolepis Jordan and Gilbert, Syn. Fish. N. A., p. 825, 1882.

This species is rather common on the coast of California, from Point Concepcion southward. It is a very variable species, the coloration and the length of the pectoral fins having a wide range of variation.

Genus X.—PARALICHTHYS.

Paralichthys Girard, U. S. Pac. R. R. Surv., Fish., 1859, 146 (*maculosus* = *californicus*).

Pseudorhombus Bleeker, Comptes Rendus, Acad. Sci. Amsterd., xiii, 1862, notice sur quelques genres de la famille des Pleuronectidæ, 5 (*polyspilos*).

Uropsetta Gill, Proc. Ac. Nat. Sci. Phila., 1862, 330 (*californicus* = *maculosus*).

Chænopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1864, 218 (*ocellaris* = *dentatus*).

TYPE: *Pleuronectes maculosus* Girard = *Hippoglossus californicus* Ayres.

This genus, as now restricted, contains a considerable number of species, inhabiting both coasts of America and the eastern and southern coasts of Asia. As indicated by the reduced number of vertebræ, the species range further southward than do those of the type of *Hippoglossoides.*

The name *Pseudorhombus* has been often used for this genus by European writers, but the preferable name of *Paralichthys* has clear priority.

ANALYSIS OF SPECIES OF PARALICHTHYS.

a. Gill-rakers in large number, about 9 + 20, as long as the eye and very slender; body elongate, rather robust; head small, $3\frac{2}{3}$ to $4\frac{1}{2}$ in length; maxillary about as long as pectoral and about half length of head; depth of body $2\frac{1}{2}$ to $2\frac{2}{3}$ in length; caudal peduncle very long; interorbital space flattish, its width less than vertical diameter of eye; scales moderate, somewhat ciliated, about 100 pores in the lateral line; arch of lateral line $3\frac{1}{2}$ in straight part; dorsal rays 67 to 71; anal rays 51 to 57; vertebræ 10 + 25 = 35; color grayish brown, uniform, or mottled with blackish and pale, the head sometimes sprinkled with black dots; young brownish, with spots of light bluish. (Eyes and color normally sinistral, but reversed examples almost equally common.) .... CALIFORNICUS, 12.

aa. Gill-rakers in moderate number (6 + 13 to 5 + 16), rather long and slender.

b. Dorsal rays 70 to 75; anal rays 54 to 60.

c. Scales not very small, about 100 in the course of the lateral line; head small, 4⅓ in length; depth, 2⅓; interorbital space rather broad and flattish, ⅜ diameter of eye; eyes small, 5⅗ in head; gill-rakers rather short, 4 + 15, the longest about ⅔ eye; pectoral 1⅓ in head; curve of lateral line high and short, 4 in straight part, its height 1⅖ in its length; mouth moderate, the maxillary 2⅓ in head; teeth rather few, the anterior canines large; color dark brown, more or less mottled and spotted with paler .... BRASILIENSIS, 13.

cc. Scales very small, about 120 in the lateral line; head 3½ in length; depth, 2¼; eyes small, wide apart; gill-rakers X + 17; curve of lateral line nearly 5 in straight part, barely twice as long as high; maxillary 2⅓ in head; color brownish-gray, thickly mottled with many larger and smaller spots, points and rings; side with three or four larger spots of irregular form and ocellated with paler .... ADSPERSUS, 14.

bb. Dorsal rays, 85 to 93 in number; anal rays, 67 to 73; gill-rakers, 5 + 15 or 16 in number, long and slender, the longest ⅗ length of eye; body ovate, the depth about 2⅓ in length; head about 3⅗; caudal peduncle long; maxillary about half head, reaching past posterior margin of eye; mouth large, oblique, the gape curved; canines large, conical, wide-set; interorbital area a rather flattish ridge, in the adult about equal to vertical diameter of eye, narrower in the young, forming a bony ridge; scales cycloid, each with numerous small, accessory scales; lateral line with about 95 pores, its arch 4 times in straight part; color brownish olive, always with numerous paler and darker spots of various sizes and with obscure ocelli; vertebræ 11+30=41 .. DENTATUS, 15.

aaa. Gill-rakers few, shortish, wide set, the numbers 2 + 8 to 3 + 10.

d. Body ovate, more or less compressed, and opaque; the depth about 2⅓ in length; no distinct, definitely-placed ocelli; scales cycloid.

c. Dorsal rays in large number (85 to 93, as in *P. dentatus*); anal rays 65 to 73; pores of the lateral line about 100; accessory scales few; gill-rakers 2 + 10, lanceolate, dentate, wide-set, and much shorter than the eye; eyes small; interorbital space in adult broad, flattish, and scaly, as wide as length of eye; caudal peduncle rather long; depth about 2⅓ in length; head about 3⅗; length of arch of lateral line nearly one-third that of straight part; color dusky olive, darker than in *P. dentatus*, and with very few darker mottlings or spots .. LETHOSTIGMA, 16.

cc. Dorsal rays in moderate number (70 to 80); anal rays 54 to 61.

f. Scales very small, about 120 in the lateral line; depth of body about half length; head 3⅔ in length; gill-rakers roughly toothed, 3 + 9 in number; arch of lateral line 4⅓ in straight portion; mouth very large, oblique, the broad maxillary more than half head, and reaching past eye; D. 78, A. 59; coloration brownish, the body and fins spotted with darker .... SQUAMILENTUS, 17.

ff. Scales moderate, 90 to 100 pores in the lateral line.

g. Interorbital width about equal to length of eye; dorsal rays 75 to 81; anal rays 59 to 61; gill-rakers 2 or 3+9 or 10; coloration grayish-brown, with numerous (more or less distinct) whitish blotches, which are rarely obsolete; vertebræ 10 + 27 = 37 .... ALBIGUTTA, 18.

gg. Interorbital width not half the length of the eye; dorsal rays 76; anal rays 60; form of *P. albigutta*; eye large (4⅗ in head); maxillary

$2\frac{1}{3}$ in head (as long as pectoral); teeth rather small; arch of lateral line a little longer than high, its length $5\frac{1}{10}$ in the straight part; gill-rakers 3+11, shorter and thicker than in *P. brasiliensis*, the longest about half eye; color brown, the body and fins irregularly blotched and with obscure ocelli; pectorals barred; eyes speckled.
PATAGONICUS, 19.

dd. Body oblong, strongly compressed, semi-translucent; scales weakly ciliated; about 93 pores in lateral line; curve of lateral line about $3\frac{2}{3}$ times in straight part; mouth large, oblique; maxillary narrow, its length $2\frac{1}{4}$ in head; interorbital area a very narrow, bony, scaleless ridge; head $3\frac{2}{3}$ to 4 in length; depth $2\frac{1}{4}$; gill-rakers 2+8 in number, about half as long as eye; D. 77, A. 62; coloration light grayish, thickly mottled with darker; four large horizontally oblong, black ocelli, each surrounded by a pinkish area; one just behind middle of the body, below the dorsal; one opposite this, above anal; two similar smaller spots below last rays of dorsal and above last of anal; vertebræ, 11+30=41 ....OBLONGUS, 20.

12. PARALICHTHYS CALIFORNICUS.

(BASTARD HALIBUT; MONTEREY HALIBUT.)

Pleuronectes maculosus Girard, Proc. Acad. Nat. Sci. Phila., 1854, 155 (young, San Diego).
Paralichthys maculosus Girard, U. S. Pacif. R. R. Exped., Fishes, p. 147, 1859 (not *Rhombus maculosus* Cuvier, also a species of *Paralichthys*). Günther. Cat. Fish., iv, 431, 1862 (copied). Gill, Proc. Acad. Nat. Sci., Phila., 1864, p. 197. Lockington, Rep. Com. Fisheries, California, 1878-'79, p. 41 (Monterey; Tomales Bay). Lockington, Proc. U. S. Nat. Mus., 1879, p. 79 (San Francisco). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 454. (San Francisco, Monterey Bay, San Luis Obispo, Santa Barbara, San Pedro, San Diego.) Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 66 (Tomales Bay; Monterey; San Diego). Jordan, Nat. His. Aquat. Anim., 1884, 182.
Hippoglossus californicus Ayres, Proc. Cal. Acad. Nat. Sci., 1859, p. 29, and 1860, fig. 10 (adult, San Francisco).
Pseudorhombus californicus Günther, Cat. Fish., iv, 426, 1862 (copied).
Uropsetta californica Gill, Proc. Acad. Nat. Sci. Phila., 1862, 330. Gill, Proc. Acad. Nat. Sci. Phila., 1864, 198.
Paralichthys californicus Jordan and Gilbert, Syn. Fish. N. A. 1882, 821.

Habitat.—Coast of California; Tomales Bay to San Diego..

This large flounder is one of the common food-fishes of the Pacific coast, where it takes the place occupied on the Atlantic side by *Paralichthys dentatus*. It reaches a length of three feet and a weight of sixty pounds. From its resemblance to the halibut, it usually goes by the name of bastard halibut. It is readily distinguished from the Atlantic members of the same genus by its fewer fin-rays and by its more numerous gill-rakers.

The specific name *californicus* must be used for this fish, the earlier name, *maculosus*, being preoccupied in the genus *Paralichthys*. As was first shown by Mr. Lockington, the small fish, called *Paralichthys maculosus*, is simply the young of the larger fish, then called *Uropsetta californica*. Unlike other species of the genus, *Paralichthys californicus* is almost as frequently dextral as sinistral.

13. PARALICHTHYS BRASILIENSIS.

Hippoglossus brasiliensis Ranzani, Nov. Spec. Pisc., 10, tab. iii, 1840 (Brazil).
Pseudorhombus brasiliensis Günther, Fishes Centr. Amer, 473, 1869 (Brazil, Guatemala).
Platessa orbignyana Valenciennes, D'Orbigny Voy. S. Amer. Mérid. Poiss., pt. 5, pl. 16, f. 1, 1847.
Rhombus aramaca Castelnau, Anim. nouv. ou rares, Poiss., 78, pl. 40, f. 3 (not of Cuvier).
Pseudorhombus vorax Günther, Cat. Fish. Brit. Mus., iv, 1862, 429 ("South America").

Habitat.—South America, said to range northward to Guatemala. This species is known to us from numerous specimens from Rio Janeiro and from Maldonado, in the Museum of Comparative Zoology.

The locality "Guatemala" given by Günther seems to be somewhat doubtful, and the species may not occur in West Indian waters at all.

14. PARALICHTHYS ADSPERSUS.

? *Hippoglossus kingi* Jenyns, Voyage Beagle, Fishes, 1842, 128, pl. 26. (Valparaiso: from a drawing only.)
Pseudorhombus adspersus Steindachner, Ichthyol. Notizen, v, 1867, 9, Plate II. (Chinchas Islands.)
Paralichthys adspersus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 370. (Cape San Lucas.) Jordan and Gilbert, Bull. Fish. Com., 1882, pp. 108 and 111. (Mazatlan, Panama.) Jordan, Cat. Fish. N. A., 1885, 133.

Habitat.—Pacific coast of tropical America. Cape San Lucas to Peru. Numerous specimens of this species were obtained by Professor Gilbert at Mazatlan and Panama. As all these have been destroyed by fire, we have taken our description from Callao specimens in the Museum of Comparative Zoology. The species is very close to *P. brasiliensis*, differing chiefly in the smaller scales. This may prove identical with the remarkable *H. kingi* of Jenyns, in which case it must stand as *Paralichthys kingi.*

15. PARALICHTHYS DENTATUS.

(THE SUMMER FLOUNDER.)

Pleuronectes dentatus Linnæus, Syst. Nat., 1, 458, 1766, and of numerous copyists. Mitchill, Trans. Lit. & Phil. Soc. N. Y., p. 390, 1815 (New York).
Platessa dentata Storer, Hist. Fish. Mass., p. 143, 1839.
Pseudorhombus dentatus Goode and Bean, Proc. U. S. Nat. Mus., 1879, 123.
Paralichthys dentatus Goode, Nat. Hist. Aquat. Anim., 1884, 178. (Detailed account; includes *P. lethostigma.*) Jordan, Cat. Fish. N. A., 1885, 134.
Pleuronectes melanogaster Mitchill, Trans. Lit. and Phil. Soc. N. Y., p. 390, 1815. (Doubled example.)
Platessa ocellaris DeKay, N. Y. Fauna, Fishes, 1842, 300, Pl. 47, fig. 152.
Pseudorhombus ocellaris Günther, iv, 430, 1862 (copied). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1878, 370 (Beaufort).
Chænopsetta ocellaris Gill, Proc. Ac. Nat. Sci., 1864, 218.
Paralichthys ocellaris Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 617 (Charleston).
Paralichthys ophryas Jordan and Gilbert, Syn. Fish N. A., p. 822, 1882 (Charleston).

Habitat.—Atlantic coast of United States from Cape Cod to Florida.

This species is the common flounder of the coasts of the Northern States, its range apparently not extending much south of Charleston. Of the species found in that region it is the most important from a commercial point of view. It reaches a length of about 3 feet and a weight of about 15 pounds.

It has been confounded by nearly all writers with the more southern species now called *lethostigma*, from which it is best distinguished by its much greater number of gill-rakers and by its mottled coloration. On account of this confusion it is impossible wholly to disentangle its synonymy from that of *P. lethostigma.*

So far as the proper nomenclature of the two is concerned, this confusion makes little difference. There is no doubt that this is the original *Pleuronectes dentatus* of Linnæus, as the original Linnæan type is still preserved in London. This has been examined by Dr. Bean and its identity with the present species fully established.

It seems also certain that this is the *Platessa ocellaris* of DeKay, who properly distinguishes his *ocellaris* from his *oblonga*, the latter being *P. lethostigma.*

A little doubt must be attached to the *melanogaster* of Mitchill, very scantily described from a doubled (black-bellied) example of this species or of *P. lethostigma.* As the former species is much more common about New York than the latter it is probable that Mitchill's fish belonged to it. We have also received a doubled example from New York corresponding exactly to Mitchill's description. We may therefore regard the name *melanogaster* as a synonym of *dentatus.*

The differences in the gill-rakers of these species was first noticed by Jordan and Gilbert in 1883. These authors erroneously referred all these synonyms to the species with the few gill-rakers and described the present one as new under the name of *Paralichthys ophryas.* The discovery of the Linnæan type of *Pleuronectes dentatus* has rendered a reconsideration of this matter necessary, and it is evident that to the "*P. ophryas*" belong also the prior names of *dentatus*, *melanogaster*, and *ocellaris.*

The name *Platessa orbignyana* Valenciennes, applied to a South American example and doubtfully referred by Dr. Günther to his *Pseudorhombus dentatus*, belongs to *Paralichthys brasiliensis.*

16. PARALICHTHYS LETHOSTIGMA.

(The Southern Flounder.)

[Plate VII.]

Platessa oblonga DeKay, New York Fauna, Fishes, p. 299, pl. 48, fig. 156, 1842. (New York; not *Pleuronectes oblongus* Mitchill.) Storer, Syn. Fish. N. A., 1846, p. 477.

Pseudorhombus oblongus Günther, Cat. Fish., iv, 426, 1862 (copied).

Pseudorhombus dentatus Goode, Proc. U. S. Nat. Mus., 1879, 110. (St. John's River, St. Augustine.) Goode and Bean, Proc. U. S. Nat. Mus., 1879, 123 (Pensacola).

Chænopsetta dentata Gill, Proc. Acad. Nat. Sci. Phil., 1864, 218.

Paralichthys dentatus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 302. (Galveston, New Orleans, Pensacola.) Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 617. (Charleston.) Bean, Cat. Col. Fish, U. S. Nat. Mus., 1883, p. 45 (Galveston).

Paralichthys dentatus Jordan and Gilbert, Synopsis Fish. N. A., 1882, 822.

Paralichthys lethostigma Jordan and Gilbert, Proc. U. S. Nat. Mus., 1884, 237 (Jacksonville, Florida).

Habitat.—South Atlantic and Gulf coast of United States, north to New York.

This species is the common large flounder of the South Atlantic and Gulf coasts of the United States, ranging as far north as New York. It very closely resembles *Paralichthys dentatus*, with which it has been repeatedly confounded. It is, however, sharply distinguished by the character of the gill-rakers. It is also always darker in color, and almost uniform, while the *dentatus* is usually profusely spotted. Its only tenable name is the very recent one of *Paralichthys lethostigma.*

17. PARALICHTHYS SQUAMILENTUS.

Paralichthys squamilentus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 303 (Pensacola). Jordan and Gilbert, Syn. Fish. N. A., p. 823, 1882 (Pensacola, Charleston). Bean, Cat. Coll. Fish, U. S. Nat. Mus., 1883, p. 45 (Pensacola).

Habitat.—South Atlantic and Gulf coasts of United States.

This species is very close to *Paralichthys albigutta*, from which it differs chiefly in the small scales. It seems to be rather rare. Besides the original types from Pensacola another referred to the same species is in the National Museum from Charleston.

18. PARALICHTHYS ALBIGUTTA.

Pseudorhombus dentatus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 370 (Beaufort).

Paralichthys albigutta Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 302 (Pensacola; Beaufort). Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 823. Jordan and Swain, Proc. U. S. Nat. Mus., 1884, p. 233 (Cedar Keys).

Habitat.—South Atlantic and Gulf coast of the United States.

This species is common on the South Atlantic and Gulf coasts. It has the few gill-rakers of *Paralichthys lethostigma*, the mottled coloration of *Paralichthys dentatus*, while from both it is distinguished by its smaller number of dorsal and anal rays. In the number of its vertebræ it agrees with *P. lethostigma.* It seems to reach a smaller size than either of these species.

19. PARALICHTHYS PATAGONICUS.

Pseudorhombus dentatus Günther, Cat. Fish. Brit. Mus., iv, 425, 1862 (Port Famine).

Paralichthys patagonicus Jordan, sp. nov. (east coast of Patagonia).

This species is extremely close to *P. albigutta*, from which it is separated only by characters of slight importance. The locality inhabited by it is, however, widely distant. The types of the species are in the Museum of Comparative Zoology. There are three specimens, the largest about 8 inches long, No. 11399, from the east coast of Patagonia.

20. PARALICHTHYS OBLONGUS.

(THE FOUR-SPOTTED FLOUNDER.)

[Plate VIII.]

Pleuronectes oblongus Mitchill, Trans. Lit. and Phil. Soc., 1, 391, 1815 (New York).
Chænopsetta oblonga Gill, Proc. Acad. Nat. Sci. Phila., 1864, p. 218.
Paralichthys oblongus Goode, Proc. U. S. Nat. Mus., 1880, p. 472 (Southern New England). Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 824 (specimens from Wood's Holl, Mass.).
Platessa quadrocellata Storer, Proc. Boston Soc. Nat. Hist., 1847, p. 242. Storer, Hist. Fish. Mass., p. 397, pl. 31, fig. 3 (Provincetown).

Habitat.—Coasts of New England and New York.

This species is rather common on the coast of Cape Cod and the neighboring islands, but it has been rarely noticed elsewhere. The limits of its range are not yet definitely known.

It is a very strongly marked species. Its translucency of coloration indicates that it lives in deeper water than the other species of the genus.

Genus XI.—ANCYLOPSETTA.

Ancylopsetta Gill, Proc. Acad. Nat. Sci. Phil., 1864, 224 (*quadrocellata*).
Notosema Goode & Bean, Bull. Mus. Comp. Zool., XIX, 193, 1883 (*dilecta*).

TYPE: *Ancylopsetta quadrocellata* Gill.

This genus is also very close to *Paralichthys*, differing in the subsessile caudal fin, the short gill-rakers, the rough scales, and in the prolongation of the anterior rays of the dorsal fin. These characters are found in *quadrocellata* as well as in *dilecta*, the distinctions of the supposed genus, *Notosema*, being chiefly of degree. Besides the two species here mentioned, a third as yet undescribed, the types having been accidentally destroyed, was obtained by Professor Gilbert at Panama.

ANALYSIS OF SPECIES OF ANCYLOPSETTA.

a. Anterior (produced) rays of dorsal shorter than head; pectoral of eyed side about two-thirds length of head. Body oval, very deep. Depth of caudal peduncle half length of head; head 4 in length; depth, 1⅗. Gill-rakers very short, 2+6 or 7. Mouth small; maxillary reaching middle of eye, 2½ to 2⅔ in head; teeth small, the canines scarcely differentiated; eyes moderate, separated by a very narrow, sharp, scaly ridge; scales of both sides ctenoid; ventral of eyed side produced, about half as long as head; no anal spine; color dark olive, with four large oblong ocellated blackish spots, the first above the arch of the lateral line, the three posterior forming an isosceles triangle, the hindmost being on the lateral line. D. 70; A. 55; Lat. l. 85—58 pores in straight part; vertebræ, 9+26=35.
QUADROCELLATA, 21.

aa. [Anterior (produced) rays of dorsal longer than the head, the longest half depth of body, pectoral of eyed side nearly as long as head; body elliptical; head 3½ in length, depth 2; gill-rakers subtriangular, moderately numerous; mouth moderate, the maxillary 2½ in head; teeth unequal, those in front much largest; eyes large, 3 in head, the interorbital space very narrow; scales highly ctenoid; ventral of eyed side produced, more than three times length of right ventral; color dark brown, speckled with darker, three large subcircular ocellated spots nearly as large as eye, with white center, dark iris, narrow, dark margin, and a brown encircling outline, these arranged in an isosceles triangle, the apex on the lateral line, the others before it and distant from the lateral line a distance equal to their own diameter. D. 69, A. 56, Lat. l, with 48 pores in straight part.] (*Goode & Bean*) .... DILECTA, 22.

21. ANCYLOPSETTA QUADROCELLATA.

Ancylopsetta quadrocellata Gill, Proc. Acad. Nat. Sci. Phil., 1864, p. 224 (Pensacola). (Not *Platessa quadrocellata* Storer).

Pseudorhombus quadrocellatus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, p. 370 (Beaufort).

Paralichthys ommatus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, p. 616 (Charleston). Jordan & Gilbert, Syn. Fish. N. A., p. 824, 1882. Jordan & Swain, Proc. U. S. Nat. Mus., 1884, p. 234 (Cedar Keys).

Habitat.—South Atlantic and Gulf coasts of the United States.

This species is not rare along the South Atlantic and Gulf coasts of the United States. On referring the species to the genus *Paralichthys* it became necessary to change the specific name *quadrocellatus*, preoccupied in the latter genus. We, however, now consider it best to retain *Ancylopsetta* as a group distinct from *Paralichthys*.

22. ANCYLOPSETTA DILECTA.

Notosema dilecta Goode & Bean, Bull. Mus. Comp. Zool., xix, 193, 1883 (Gulf Stream, off the coast of South Carolina).

Ancylopsetta dilecta Jordan, Cat. Fish. N. A., 1885, 134.

Paralichthys stigmatias Goode, Nat. Hist. Aquat. Anim., 1884, 182 (name only, by inadvertence for *dilectus*).

Habitat.—Gulf Stream.

This species is known from the original types obtained in the deep waters (75 fathoms) of the Gulf Stream, off the Carolina coast.

Genus XII.—PHRYNORHOMBUS.

Phrynorhombus Günther, Catal. Fishes Brit. Mus., iv, 414, 1862 (*unimaculatus*).

TYPE: *Rhombus unimaculatus* Risso=*Pleuronectes regius* Bonnaterre.

This genus is allied to *Zeugopterus*, from which it differs chiefly in the separation of the ventral and anal fins. It is, in our opinion, worthy of separation. But a single species is known. The peculiar flannel-like character of the scales is similar to that of *Monochirus hispidus*.

ANALYSIS OF SPECIES OF PHRYNORHOMBUS.

a. First ray of dorsal produced in a filament, about one-third as long as head; first ray of pectoral sometimes filamentous; scales small, each with about four long spinules; eyes moderate, separated by a high, narrow scaly ridge; snout short, abruptly projecting; gill-rakers short, about X + 10; mouth curved, the maxillary not quite half head. Depth, 2 in length; head 3¼; D. 78 to 79, A. 67, Lat. l. 70; vertebræ 10+25 =35; color, dark gray, with dusty marblings and black spots, one at the end of the curve of the lateral line; a reddish ocellus edged with black on middle of tail; fins much blotched .... REGIUS, 23.

23. PHRYNORHOMBUS REGIUS.

(THE TOP-KNOT.)

La Petite Limandelle, Duhamel, "Traité sur la Pesche, iii, sect. 9, p. 270, pl. 6, f. 5."
Pleuronectes regius, "la Calimande royale" Bonnaterre, Encyclopédie Méthodique, 1788 (after Duhamel).
Pleuronectes calimanda Lacépède, Hist. Nat. Poiss., iv, 1803 (after Duhamel).
Pleuronectes punctatus "Fleming, Werner, Mem., ii, 241" (not of Bloch.)
Rhombus unimaculatus Risso, Europe Méridionale, iii, 252, f. 35, 1826 (Nice).
Phrynorhombus unimaculatus Günther, iv, 414, 1862 (Dalmatia; Plymouth).
Scophthalmus unimaculatus Steindachner, Ichth. Bericht., vi, 1868, 49 (Barcelona).
Zeugopterus unimaculatus Day, Fish. Great Britain, ii, 17, pl. xcix (Belfast).
Rhombus unioccllatus Nardo, Prodr. Ichth. Adriat., 135, 1827.

Habitat.—Coasts of Southern Europe, north to England.

This small flounder reaches a length of 5 or 6 inches. Our specimens are from Venice. We adopt the earliest name, *regius*, for this species, as it seems to belong to this fish without doubt.

Genus XIII.—ZEUGOPTERUS.

Zeugopterus Gottsche, Wiegmann's Archiv, 1835, 178 (*hirtus*).
Scophthalmus Bonaparte, Catologo Metodico dei Pesci Europei, 1846, 49 (*hirtus*). (Not of Rafinesque.)
Zeugopterus Steenstrup, Oefvers. Dansk. Vidensk. Selsk. Forhandl., 1865, 95–112.

TYPE: *Pleuronectes hirtus* Abilgaard=*Pleuronectes punctatus* Bloch.

This genus is distinguished from *Pleuronectes* both by the union of the ventral and anal fins, and by the perforation instead of emargination of the septum of the gill-cavity. This latter character was first noticed by Professor Steenstrup, who used it to define his genus *Zeugopterus*, which is equivalent to *Lepidorhombus*, *Zeugopterus*, and *Phrynorhombus* of the present paper. But one species is known, widely diffused in Northern Europe.

ANALYSIS OF SPECIES OF ZEUGOPTERUS.

a. Body ovate, covered with small but very rough shagreen-like scales; blind side smooth; caudal peduncle very short, the last rays of dorsal and anal inserted on the left side of it almost meeting across the base of the caudal fin; none of the dorsal rays exserted; lateral line indistinct; eyes large, separated by a very narrow, scaly ridge; snout very short; gill-rakers short, thickish; lips thick; maxillary half as long as head. Left ventral inserted at chin, fully confluent with anal; right ventral long. Brown, with round black spots, one behind the curve of the lateral line, and one behind this on the straight portion; one near upper edge of gill opening, and one above upper eye; an oblique band from lower eye to subopercle. Depth 2 in length; head 3; D. 93 to 99; A. 70 to 80. Vertebræ 12+25=37. PUNCTATUS, 24.

24. ZEUGOPTERUS PUNCTATUS.

(THE BLACK FLUKE.)

Pleuronectes punctatus Bloch, Ausländische Fische, iii, 31, tafel 189, 1787. Gmelin, Syst. Natura, p. 1235, 1788. Bloch & Schneider, Systema Ichth., 1801, p. 155.
Zeugopterus punctatus Collett, Norges Fiske, 1875, 139. Day, Fishes Great Britain, vol. ii, p. 18, plate 6.

Pleuronectes hirtus Abildgaard, Müller, Zoöl. Danica, 1788, III, 36, taf. 103.
Rhombus hirtus Yarrell, Brit. Fish., ed. 2, ii, 334. Günther, iv, 413, 1862, and of several authors.
Pleuronectes kitt Bloch & Schneider, Systema Ichthyologiæ, 1801, 162.

Habitat.—Coasts of Northern Europe, south to France.

The specimens of this species which we have examined are from the North Sea.

Genus XIV.—LEPIDORHOMBUS.

Lepidorhombus Günther, Catal. Fishes, iv, 411, 1862 (*megastoma*).

TYPE: *Pleuronectes megastoma* Donovan = *Pleuronectes whiff-iagonis* Walbaum.

This genus contains one or two European species, related to *Zeugopterus*, but in general appearance resembling the species of *Arnoglossus*.

ANALYSIS OF SPECIES OF LEPIDORHOMBUS.

a. Dorsal rays, 85 to 87; anal rays, 67 to 69; depth, 2½ in length; head, 3½; interorbital space a very narrow scaly ridge; mouth very large, the maxillary 2¼ in head; the anterior teeth hooked backwards, about 4 in head; eyes very large, the lower somewhat before the other; anterior rays of dorsal short, but considerably exserted; scales small, very deciduous. Lat. l. about 100. Vertebræ 11+30=41. Color, yellowish brown, dorsal and anal with some dark blotches...... WHIFF-IAGONIS, 25.

aa. Dorsal rays, 78 to 80; anal rays, 58 to 64; depth, 2½ in length; otherwise essentially as in the preceding, of which it is probably a variety...... NORVEGICUS, 26.

25. LEPIDORHOMBUS WHIFF-IAGONIS.

(THE WHIFF, MERRY SOLE, OR SAIL FLUKE.)

Passer Cornubiensis, "Jago in Ray, Syn. Pisc., 163, f. 2," 1713.
Whiff Pennant, "British Zoology, iii, 238, 1776."
Pleuronectes whiff-iagonis Walbaum, Artedi Piscium, iii, 120, 1792 (after Pennant).
Pleuronectes megastoma Donovan, "Brit. Fish., iii, pl. 41, 1802," and of many authors.
Rhombus megastoma Günther, iv, 411, and of numerous authors.
Zeugopterus megastoma Collett, Norges Fiske, 138, 1875.
Arnoglossus megastoma Day, British Fishes, iv, 21.
Pleuronectes bosci Risso, Ichth. Nice, 1810, 319, pl. vii, f. 33 (Nice).
Arnoglossus bosci Günther, iv, 416.
Pleuronectes pseudopolus "Pennant, British Zool., iii, 324, pl. 411, ed. of 1812."
Rhombus cardina Cuvier, Règne Animal, ed. 2, 1828 (excl. syn. pars), based on the Whiff of Ray and la Petite Limandelle of Duhamel.
Zeugopterus velivolans (Richardson) "Yarrell, Brit. Fish., ed. 3, 1, 656," 1859.
Zeugopterus gottsche "Winther, Ichth. Dan. Mar., 38."

Habitat.—Coasts of Europe, most abundant northward.

This species is not uncommon in Northern Europe, where it is held in slight esteem as a food-fish, being thin, dry, and bony. It reaches a length of probably less than 2 feet.

Its names, "whiff," "merry sole," and "sail-fluke," are said to be derived from its habit of frequently swimming at the surface of the water "with its tail erected above the water, like a boat under sail."

Dr. Day has adopted Giglioli's determination of the identity of this species with the *Arnoglossus bosci*. The descriptions of the latter species certainly agree closely with our specimen of *Lepidorhombus*. We have therefore placed *bosci* in the synonymy of *Whiff-iagonis*. Vinciguerra apparently regards *bosci* as specifically distinct from the others, although he places both in the genus *Arnoglossus*. The appropriate specific name of *megastoma* has been usually taken for this species, but the unmusical name of *whiff-iagonis* applied to it by Walbaum has ten years' priority. This name is given in honor of the "Reverend George Jago, of Loo."

Our specimen is from the coast of France.

26. LEPIDORHOMBUS NORVEGICUS.

Pleuronectes cardina Fries, Vet. Akad. Handl., 1838, 181 (not of Cuvier).
Rhombus norvegicus Günther, Cat. Fish. Brit. Mus., iv, 1862, 139 (after Fries). Collett, Norges Fiske, 1875, 139. (Christiania; Bergen; Bodö.)

Habitat.—South coast of Norway to the Arctic circle.

This species is known to us from descriptions only. According to Professor Collett, "it is distributed, although in scanty numbers, from the south coasts up to the polar circle." It would appear to be very close to the preceding species, differing somewhat in the numbers of the fin-rays.

Genus XV.—CITHARUS.

Pleuronectes Bonaparte, Catalogo Metodico dei Pesci Europei, 1846 (*linguatula*, the only Linnæan species mentioned).
Citharus Bleeker, Comptes Rendus Acad. Sci. Amsterdam, xiii. Pleuronect., 6, 1862 (*linguatula*).

TYPE: *Pleuronectes linguatula* L.

This well-marked genus, an ally of *Lepidorhombus* and of *Arnoglossus* contains but a single species—a rather rare inhabitant of the Mediterranean.

ANALYSIS OF THE SPECIES OF CITHARUS.

a. Body elongate, with soft flesh and large caducous scales. Mouth very large, oblique; the maxillary 2 in head; lower jaw projecting; some canine teeth, especially in front of upper jaw; two or three rather large teeth on vomer; eyes large, close together; left ventral on the abdominal ridge, a little in advance of right; its base scarcely lengthened; gill-rakers slender, of moderate length, X+9; no foramen in gill septum; dorsal beginning before the eye on right side; caudal pointed; fins all high, but fragile; head, $3\frac{2}{5}$ in length; depth, $2\frac{2}{3}$; D. about 65; anal, 45; lat. l., 37; color, grayish, translucent.................LINGUATULA, 27.

27. CITHARUS LINGUATULA.

Pleuronectes linguatula Linnæus, Syst. Nat., ed. x, p. 270, 1758 (after Artedi), and of early authors.
Citharus linguatula Günther, Cat. Fish., iv, 418, 1862. Steindachner, Ichthyol. Berichte 1868, Sechste Fortsetzung, p. 51 (Barcelona, Alicante, Cadiz), and of most recent authors.

Pleuronectes citharus Spinola, "Ann. Mus., x, 166," 1807.
Pleuronectes macrolepidotus Delaroche, "Ann. Mus., xiii, 353," 1809 (and of other European writers, probably not of Bloch).
Solea limanda Rafinesque, Indice, 1810, 14 (after Linnæus).
Solea cithara Rafinesque, Indice, 1810, 52 (based on *Citharus* of Rondelet).
Pleuronectes solea var. *pataracchia*, "Naccari, Ichth. Adriat., 11."

Habitat.—Mediterranean Sea.

This species is known to us from specimens in the Museum of Comparative Zoology, from Cette (Theodore Lyman), and from Cadiz (Dr. Steindachner). It does not seem to be very common anywhere.

Genus XVI.—PLEURONECTES.

Pleuronectes Artedi, Genera Piscium, 1738 (includes all flounders).
Rhombus Klein, Pisc. Missus, IV, 34, 1740 (*rhombus;* pre-Linnæan).
Pleuronectes (Artedi) Linnæus, Syst. Nat., ed. x, 1758, 271 (includes all flounders then known).
Rhombus (Klein) Walbaum, Artedi Piscium, 1792 (*rhombus;* non-binomial).
Bothus Rafinesque, Caratteri di Alcuni Nuovi Generi, etc., 1810, 23 (*rumola*=*rhombus*), etc.
Scophthalmus Rafinesque, Indice di Ittiologia Siciliana, 1810, 53 (*rhombus; maximus*).
Rhombus Cuvier, Règne Animal, 1817, and of most writers (not of Lacépède) (first subdivision of *Pleuronectes*).
Pleuronectes Fleming, British Animals, 1828, 196 (first restriction of *Pleuronectes*, in which the name *Pleuronectes* is retained; *maximus*).
Psetta Swainson, Nat. Hist. Classif. Anim., ii, 302, 1839 (*maximus*) (not *Psettus* Cuvier).
Pleuronectes DeKay, New York Fauna, Fishes, 1842, 301 (*maximus*).
Psetta Bonaparte, Catologo Metodico dei Pesci Europei, 1846, 49 (*rhombus; maximus*).
Passer Valenciennes, Voyage de la Venus, 1855, 341 (substitute for *Rhombus*, preoccupied; type "le turbot;" not *Passer* Brisson, a genus of birds).
Lophopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1862, 216 (*maculatus*).
Bothus Jordan & Gilbert, Synopsis Fish. N. A., 1882, 815, and in Proc. U. S. Nat. Mus., 1882, 577 (*rhombus*).
Psetta Jordan & Gilbert, Proc. U. S. Nat. Mus. 1882, 577 (*maximus*).

TYPE: *Pleuronectes maximus* Linnæus.

We here include in the genus *Pleuronectes* three species, the Turbot, the Brill, and the "Window-Pane." The Turbot and the Window-Pane are both evidently very closely related to the Brill, although in size and appearance they are quite unlike each other. The Turbot differs strikingly from the other two in a single character, the reduced or rudimentary condition of the scales. This character, however, shows a considerable range of variation in the same species, some turbots being distinctly scaly and others wholly naked, and it is apparently a character which the species has acquired comparatively recently. We have therefore regarded it as of subgeneric value only. We, however, place the two scaly species in a distinct subgenus, *Bothus*, and in the view of a genus taken by many recent authors, *Bothus* and *Pleuronectes* should be regarded as sufficiently distinct. If the non-binomial names of Klein, as reprinted or revived by Walbaum in 1792, be admitted, *Rhombus* would take the place of *Bothus* as the name of this subgenus. Our reasons for considering the Turbot as the type of the genus *Pleuronectes* may be briefly stated:

In the earliest restriction of the Linnæan genus, *Pleuronectes*, in which the latter name is retained for one of the subdivisions, the Turbot has been retained as the type. We therefore find ourselves compelled to transfer the name *Pleuronectes* from the small-mouthed flounders to the present group.

The genus *Pleuronectes*, as it appears in the tenth edition of the Systema Naturæ, is intended to contain all flat-fishes, 18 of which are characterized and named.

Omitting foreign species, the following table shows the European species included by Linnæus, and the generic names which have since his time been specially based on each of these species:

Hippoglossus	*Hippoglossus* Cuvier, 1817.
Cynoglossus	*Glyptocephalus* Gottsche, 1836.
Platessa	*Platessa* Cuvier, 1817; *Pleuronectes* Swainson, 1839; *Pleuronectes* Bleeker, 1862.
Flesus	*Flesus* Moreau, 1871.
Limanda	*Limanda* Gottsche, 1835.
Solea	*Solea* Quensel, 1806.
Linguatula	*Pleuronectes* Bonaparte, 1846; *Citharus* Bleeker, 1862; *Bothus* Rafinesque, 1810; *Scophthalmus* Rafinesque, 1810.
Rhombus	*Rhombus* Cuvier, 1817 (preoccupied).
Maximus	*Pleuronectes* Fleming, 1828; *Psetta* Swainson, 1839; *Passer* Valenciennes, 1855 (preoccupied).
Passer	(An abnormal specimen of *Flesus*.)

The first subdivision of the genus *Pleuronectes*, after the removal of the soles, seems to have been that of Cuvier. Cuvier subdivides the group into three subgenera, *Hippoglossus*, *Rhombus*, and *Platessa*, retaining the name *Pleuronectes* for the group as a whole, but for none of his subdivisions.

Fleming, next after him, makes use of these subdivisions, but rejecting the name of *Rhombus*, he distinctly adopts the generic name *Pleuronectes* for the "Turbot" group. His genera are, therefore, *Pleuronectes* the "Turbot," *Solea* the "Sole," *Platessa* the "Fluke," and *Hippoglossus* the "Halibut." *Pleuronectes maximus*, the "Common Turbot," is evidently intended as the type of *Pleuronectes*, as understood by him. This is, so far as we have ascertained, the first restriction of the name *Pleuronectes*, to any group of flounders, and if it be so the name *Pleuronectes* must go with the Turbot and its relatives. In that case it would take the place of the preoccupied name *Rhombus*, and of the prior but almost forgotten name of *Bothus*, unless we see fit to place the Turbot and the Brill in different genera, in which case *Bothus* should be used for the Brill.

The next restriction seems to be that of Swainson, in 1839, who indicates *Pl. platessa* as the type of *Pleuronectes*.

Next is the restriction made by DeKay, 1842, who again makes the Turbot the type of *Pleuronectes* by adopting the then nearly obsolete name of *Pleuronectes* in place of *Rhombus*. In 1846 Bonaparte retained the name *Pleuronectes* for a group composed of *Citharus*, *Arnoglossus*, &c. The only Linnæan species mentioned by him, *linguatula*, may be regarded as his type.

In 1862 Bleeker, and following him Günther and nearly all modern authors, have regarded *Pleuronectes platessa* as the type of *Pleuronectes*.

The reason for this view lies apparently in the fact that Artedi before Linnæus had mentioned the species later called *platessa* first in his list of species of *Pleuronectes*. This reason is now regarded as an insufficient one, and the name *Pleuronectes* must retain the signification given it by the first author, who has properly restricted it. We must therefore follow Fleming* in regarding *Pleuronectes maximus* as the proper type of *Pleuronectes*.

ANALYSIS OF THE SPECIES OF PLEURONECTES.

a. Scales wanting or rudimentary, the blind side nearly or quite naked; eyed side covered with scattered bony tubercles or warts. Vertebræ, 31. (*Pleuronectes*.)

b. Body broadly ovate, thick, and opaque, the depth about 1½ in the length; head 3 in length, its tubercles much smaller than those on the body; interorbital space flattish, about as wide as eye; anal spine inconspicuous; none of the dorsal rays exserted; gill-rakers rather strong, not as long as eye, about 5+13 in number; lower pharyngeals small, narrow, each with a band of small pointed teeth. D, 62 to 69; A, 45 to 50; vertebræ 12+19=31. Color, grayish or brownish, usually sprinkled with small dark spots.............. MAXIMUS, 28.

x. Scales obsolete.. var. *maximus*, 28, (a).

x. Scales rudimentary.......................................var. *mæoticus*, 28, (b).

aa. Scales cycloid, imbricate, well developed on both sides of the body; no bony tubercles. Vertebræ 36. (*Bothus*.)

c. Anterior rays of dorsal little exserted, the longest about 4 in head; body elliptical ovate, nearly opaque; scales very small; blind side well scaled; no bony tubercles; interobital space flattish, nearly as wide as eye; gill-rakers moderate, 4+12 in number; lower pharyngeals small, narrow, each with a band of pointed teeth. Head 3 in length; depth 1⅚. D. 72 to 83; A. 53 to 61; Lat. l. about 130. Vertebræ 12+24=36. Grayish brown, with darker spots and mottlings .... RHOMBUS, 29.

cc. Anterior rays of dorsal much exserted, free for more than half their length, their length nearly half head; body broadly ovate, subtranslucent; interorbital space flattish; gill-rakers long and slender, about 8+22; blind side of body well scaled; no bony tubercles; head 3¾; depth 1⅞. D. 65; A. 52; Lat. l. about 120. Vertebræ 11+25=36. Color light olive grayish, everywhere on the left side closely spotted with paler and with blackish, the dark spots of various sizes .... MACULATUS, 30.

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*Fleming's definition is as follows:

"Gen. XLVI. PLEURONECTES, TURBOT.—Mouth entire; teeth numerous, slender: lateral line curved. Eyes on the left side." The species mentioned by him are:

P. maximus—Common Turbot.

P. rhombus—Brill.

P. megastoma—Whiff.

P. punctatus—Top-knot.

P. arnoglossus—Scald-fish.

28. PLEURONECTES MAXIMUS.

(THE TURBOT.)

[Plates IX and X.]

a. Var. *maximus.*

Rhombus aculeatus Rondelet, De Piscibus, and of early pre-Linnæan writers.
Pleuronectes maximus Linnæus, Syst. Nat., ed. x, 271, 1758, and ed. xii, 459 (and of early writers generally).
Scophthalmus maximus Rafinesque, Indice, 14.
Rhombus maximus Günther, iv, 407, 1862. Steindachner, Ichthyol. Berichte, vi, 1868, 48 (Lisbon, Vigo, Trieste, Constantinople, Odessa, Cadiz). Day, Fishes Great Britain and Ireland, vol. ii, p. 11, plate xcvi.
Psetta maxima Swainson, Nat. Hist. Fish., ii, 302, 1839.
Pleuronectes cyclops "Donovan, British Fishes, iv, pl. 90," 1801.
Pleuronectes tuberculatus Shaw, Gen'l Zool., iv, 312, 1803.
Rhombus aculeatus Gottsche, Wiegm. Archiv, 1835, 172.

b. Var. *mæoticus.*

Pleuronectes mæoticus Pallas, Zoogr. Ross. As., iii, 419, 1811.
Rhombus mæoticus Günther, iv, 409, 1862 (Erzeroum).
Rhombus stellosus Bennett, "Proc. Zool. Soc., 1835, 92" (Erzeroum).
Rhombus torosus Rathke, Fauna der Krym., 349, 1837 (Crimea).
Rhombus rhombitis Rathke, Fauna der Krym., 351, 1837 (Crimea).

Habitat.—All coasts of Europe except the extreme north. Variety *mæoticus* in the Black Sea and extending into the Mediterranean.

This species is the famous turbot of Europe, a broad, thick flounder, reaching a large size, its surface nearly scaleless and covered with rough warts. In spite of numerous statements to the contrary, the turbot has never been found in American waters. The fish so called by the Bahama and Key West fishermen, and which they often maintain is the turbot of Europe, is a trigger-fish, *Balistes carolinensis* Gmelin.

The turbot is an excellent food-fish, generally common on the coasts of Europe, and everywhere highly prized. It is the most valuable of the European flounders.

According to Dr. Steindachner, there is a complete gradation between the ordinary turbot in which the scales are obsolete and concealed, and the scaly turbot (var. *mæoticus*), which is more or less completely scaly, at least on the left side. Seindachner observes (Ichth. Berichte, ii, 48, 1868):

"Completely scaled on the sides of the body and the head (in part also on the blind side) is a very large individual from Lisbon and two smaller ones from Vigo, and from the Baltic Sea; for the greater part scaly on four examples from Trieste; only here and there on two examples from Odessa and Constantinople, and finally naked on numerous examples from Trieste, Cadiz, and the German Ocean."

The turbot reaches a weight of 40 to 50 pounds or more.

Rhombus torosus Rathke, described from the Crimea, is apparently a local variety of *Pl. maximus*, having the warts on the body elliptical and the blind side wholly smooth, which is said not to be the case in var. *mæoticus*. *Rhombus rhombitis* is much the same, but sparsely covered with conoid warts.

We find also references to *Rhombus hybridus* Malm (Goteborg, Mus. Arsskr., iii, 1881, 24). We have not seen the original description.

29. PLEURONECTES RHOMBUS.

(THE BRILL.)

Rhombus lævis Rondelet, De Piscibus, and of many early non-binomial writers.

Pleuronectes rhombus Linnæus, Systema Naturæ, ed. x, 271, 1758 (after Artedi), and of early writers generally.

Scophthalmus rhombus Rafinesque, Indice di Ittiologia Siciliana, 1810, 53.

Psetta rhombus Bonaparte, Pesc. Europ., 49.

Pleuronectes cristatus Lichtenstein, in Bloch & Schneider, Syst. Ichth., 1801, 153 (European Ocean).

Bothus rumolo Rafinesque, Caratteri di Alcuni Nuovi Generi, &c., 1810, 23 (Sicily).

Rhombus vulgaris Cuvier, Règne Animal, 1817 (and of various authors).

Pleuronectes lioderma Nardo, Ichth. Adriat. No. 132 (Venice).

Rhombus barbatus Risso, Eur. Merid., iii, 251, 1826 (Nice).

Rhombus lævis Gottsche, Wiegm. Archiv, 1835, 175. Günther, iv, 410, 1862. Steindachner, Ichthyol. Berichte, vi, 1868, 48 (Bilbao, Corunna, Vigo, Lisbon, Cadiz, Malaga). Day, Fishes Great Britain, ii, 14, pl. xcvii, and of most recent authors.

Pleuronectes passer Gronow, Syst. ed. Gray, 1854, 90.

Rhombus linnæi Malm, Bohusläns Fauna, 513 (Sweden).

Habitat.—All coasts of Europe, except the very extreme north.

The brill is a common food-fish of Europe, especially southwards. It is less esteemed than the turbot and reaches a very much smaller size. It rarely exceeds 8 or 10 pounds in weight.

30. PLEURONECTES MACULATUS.

(THE WINDOW-PANE.)

Pleuronectes maculatus Mitchill, Rept. in Part. Fish. N. Y., 1814, 9 (New York). De Kay, New York Fauna, Fishes, p. 301, tab. 47, fig. 151, 1842. Storer, Syn. Fish. N. A., 1846, p. 479. Storer, Hist. Fish. Nat. Mass., 1867, 204 (Provincetown, Holmes' Hole).

Lophopsetta maculata Gill, Proc. Acad. Nat. Sci. Philad., 1862, 216, and 1864, p. 220. Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, p. 371 (Beaufort).

Bothus maculatus Jordan & Gilbert, Syn. Fish. N. A., 1882, p. 815.

Pleuronectes aquosus Mitchill, Trans. Lit. and Phil. Soc., 1, 389, pl. 2, fig. 3, 1815 (New York).

Rhombus aquosus Cuvier, Règne Animal. Günther, Cat. Fish., iv, 411, 1862 (New York).

Habitat.—Atlantic coast of United States, from Cape Cod to South Carolina.

This small flounder much resembles the European Brill, but is smaller, thinner, and more translucent in body. Its weight rarely exceeds a pound or two, and its value as a food-fish is but slight; nevertheless, it is a near ally of the European Turbot, and in its technical character it very closely agrees with the latter species.

Genus XVII.—ARNOGLOSSUS.

Arnoglossus Bleeker, Comptes Rendus Acad. Sci. Amsterd., xiii, 1862, 6 (*Arnoglossus laterna*).

TYPE: *Pleuronectes arnoglossus* Bloch & Schneider=*Pleuronectes laterna* Walbaum.

This genus is composed of several species of small translucent flounders, found in the Mediterranean and the East Indies. They much resemble the species of *Citharichthys*, which they represent in the Old World fauna, the arch of the lateral line in *Arnoglossus* constituting the chief difference. The characters of the different European species have not been well set forth by authors, and possibly all the nominal species are reducible to two or three.

We find also in the Zoological Record a reference to *Arnoglossus soleiformis* Malm, Goteborg. Mus., Arsskr., iii,1881, 24. We have not seen the original description of the fish briefly noticed in this paper, and know nothing of the species thus named. We have also provisionally placed in *Arnoglossus* two American species which we have not seen. These have been referred by their describers to other genera, *Hemirhombus* and *Citharichthys;* but as both have uniserial teeth and an arched lateral line, they would belong technically to *Arnoglossus* rather than to either of these groups. But the one (*fimbriatus*) differs from *Arnoglossus* in the small scales and tubercular gill-rakers, while the other has small, firm, strongly ctenoid scales, nothing being said of its gill-rakers. Possibly the two should constitute one or two additional genera between *Arnoglossus* and *Azevia;* but we do not wish to attempt to define these groups without having seen any of their species.

Bleeker has questioned the propriety of distinguishing *Arnoglossus* from *Platophrys*, as the broad interorbital characteristic of *Platophrys* is subject to much variation. As the two genera differ also in various other respects of form, dentition, squamation, &c., we think it best to keep them separate.

ANALYSIS OF SPECIES OF ARNOGLOSSUS.

a. Mouth small, the maxillary reaching front of pupil, its length about 3 in head; scales rather large, thin, and caducous, weakly ctenoid; 40 to 60 in the lateral line; gill-rakers slender. (*Arnoglossus.*)

b. [Dorsal fin with four anterior rays produced. D. 95, A. 77, lat. l. 60. Maxillary 3½ in head; interorbital space a very narrow, sharp ridge. Depth 2⅔ in length. Color uniform grayish.] (*Günther*) .... LOPHOTES, 31.

bb. Dorsal fin with its second ray much produced, nearly as long as head; body rather deep, the depth 2¼ in length; maxillary about reaching front of pupil, 3 in head; eye large, 4 in head; interorbital space not very narrow, with a median groove; D. 80 to 90 (83 in specimens examined), A. 60 to 67 (63 in our specimens); lat. l. about 55. Curve of lateral line 3½ in straight part; gill-rakers slender and weak, X+6. Vertebræ 10+28=38. Color dark brown, with darker markings; fins spotted .... GROHMANNI, 32.

aa. Mouth larger, the maxillary reaching middle of eye, its length 2½ to 2⅔ in head; none of the dorsal rays much produced; body more elongate, the depth 2⅔ in length. Dorsal rays 86 to 90; anal rays 67 to 70; Lat. l. about 50.

c. [Maxillary nearly 3 in head; color grayish, dotted with brown.] CONSPERSUS, 33.

cc. Maxillary 2½ in head; eye large, 4 in head, the interorbital space very narrow, without median groove; curve of lateral line 3⅔ in straight part; gill-rakers slender and weak, about X+7 in number; vertebræ 10+28=38; color nearly uniform translucent grayish........................LATERNA, 34.

aaa. Mouth very large, the maxillary about half length of head; scales small, 65 to 70 in the lateral line; species of uncertain position.

d. [Scales cycloid; mouth very large, the maxillary half length of head; teeth uniserial, those in front of jaws larger, those below largest; some of the teeth depressible; eye 5 in head, the interorbital ridge low, about one-fourth width of eye; gill-rakers tubercular, X+9; anterior nostril with a filament one-third length of snout; first ray of dorsal longer than second; lateral line with a slight arch, its length 3½ in the straight portion, none of the dorsal rays produced; head 3½; depth nearly 2; D. 80; A. 60; Lat. l. 70; color grayish-brown; the dorsal and anal fins each with two roundish dark blotches on their posterior half, each larger than the eye; a similar dark blotch on base of caudal; pectoral with a dark band at base, its outer half marked with a dark blotch, which is reticulated and mottled with lighter; the intervening part of the fin pearly white, with dark specks on the rays] (*Goode & Bean*)...FIMBRIATUS, 35.

dd. [Scales strongly ctenoid, firmly fixed; lateral line with the "curved portion bold and sharply defined"; eye large, 3⅔ in head, about eight times the diameter of the interorbital space, which is very narrow and scaleless; maxillary nearly half length of head; dorsal fin beginning on the blind side, before the eyes; pectoral about as long as head; caudal fin subsessile; ventral of eyed side enlarged in the male, its length 3½ in body, about three times length of right ventral; head 4; depth 2⅓; D. 93; A. 73; Lat. l. 66 (20+46); color light brownish-gray; a dark blotch as long as eye on anterior rays of anal; another paler at end of curve of lateral line; a few obscure dusky blotches elsewhere on body] (*Goode & Bean*)........................VENTRALIS, 36.

31. ARNOGLOSSUS LOPHOTES.

? *Bothus imperialis* Rafinesque, Caratteri, 1810, 23 (Palermo).
Arnoglossus lophotes Günther, iv, 417, 1862 (European, probably British).

Habitat.—Mediterranean Sea.

We do not know the species called *Arnoglossus lophotes*. In fact only the original types, dried skins from unknown locality, seem to be known as yet. Among the Mediterranean fishes, this one approaches most nearly to the description given by Rafinesque of his *Bothus imperialis*. The name *imperialis* should therefore perhaps be adopted in place of *lophotes*. According to Doderlein, the "Tappa or Linguata Impiriali" of the Sicilian fishermen is *Arnoglossus bosci*. This, according to Day, would be *Lepidorhombus whiff-iagonis*, but Rafinesque's description cannot well be applied to the latter species. The following is a translation of Rafinesque's description:

"*Bothus imperialis.*—Almost three times longer than broad, dorsal fin beginning before the eyes; lateral line arched at the base; left side smooth olive, clouded with dusky; right side white; tail even. It is called *Tappa Impiriali* or *Linguata Impiriali*. It is still better than the Linguata to eat. It is rarely taken, because it lives on the sandy or muddy bottoms of the sea, where it creeps under the sand or the mud. It is very distinct from the preceding (*B. tappa*) being larger; it has the following numbers of fin-rays, that is, dorsal nearly 100; anal nearly 80; ventrals 8; pectorals 12; caudal 15."

According to Day, Proc. Zool. Soc. Lond., 1882, 748, pl. 53, as quoted in the Zoological Record for 1882, this *Arnoglossus lophotes* is identical with *Arnoglossus grohmanni*. If so the latter species may have been the original *Arnoglossus imperialis*.

32. ARNOGLOSSUS GROHMANNI.

?? *Bothus imperialis* Rafinesque, Caratteri di alcuni nuovi generi e specie, 1810, 23 (Palermo).

Pleuronectes grohmanni Bonaparte, Fauna Ital., Pesci, 1837.

Arnoglossus grohmanni Günther, Cat. Fish., iv, 417, 1862. (Mediterranean.) Steindachner, Ichthyol. Bericht. Akad. Wissen. Wien, 1868, Sechste Fortzetzung, p. 50. (Barcelona, Cadiz, Malaga.)

This small flounder seems to be rather common in the Mediterranean. It reaches a larger size than A. *laterna*, and it is less transparent than the latter. The numerous specimens examined by us were collected by Dr. Jordan at Venice.

33. ARNOGLOSSUS CONSPERSUS.

Arnoglossus conspersus Canestrini, "Archiv Zool., i, 10, tav. 1, f. 2, 1861." Günther, iv, 416 (copied). Steindachner, Ichthyol. Bericht. Akad. Wissen. Wien, 1868, Sechste Fortzetzung, p. 50 (Malaga). Vinciguerra, Risultate Ittiol. del Violante, 1883, 104 (Genoa).

Habitat.—Mediterranean Sea.

We have not seen this species, and regard it as distinct from *Arnoglossus laterna*, chiefly because it is so considered by Dr. Steindachner. Dr. Vinciguerra gives a comparison of the two species, thinking them very doubtfully distinct, but without reaching a positive conclusion.

34. ARNOGLOSSUS LATERNA.

(THE SCALD-FISH.)

Arnoglossus (Perpeire) Rondelet, De Piscibus, xi, c. 14, 324, 1554.

Pleuronectes laterna Walbaum, Artedi Piscium, 204, 1792 (after Rondelet).

Arnoglossus laterna Günther, Cat. Fish., iv, 415, 1862. (Cannes, Broxham, Plymouth.) Steindachner, Ichthyol. Bericht. Akad. Wissen. Wien, 1868, Sechste Fortsetzung, p. 50. (Barcelona, Alicante, Malaga.) Day, Brit. Fishes, vol. ii, p. 22, plate xcix, fig. 2.

Pleuronectes arnoglossus Bloch and Schneider, 1801, p. 157.

Pleuronectes diaphanus Shaw, Gen'l Zool., iv, 309, 1803.

Pleuronectes casurus Pennant, "Brit. Zool., 1812, iii, 325, pl. 53."

Pleuronectes leotardi Risso, Ichth. Nice, 318, 1810.

? *Bothus tappa* Rafinesque, Caratteri, 1810, 23 (Palermo).

Solea arnoglossa Rafinesque, Indice, 1810, 52 (after Perpeire of Rondelet).
Rhombus nudus Risso, Eur. Mérid., iii, 251, 1826.
Pleuronectes pellucidus Nardo, Ichth. Adriat., 134, 1824.

Habitat.—Coasts of Southern Europe, north to England.

This small flounder reaches a length of about six inches. It is common in the Mediterranean and as far north as the English coast. Our specimens were collected by Dr. Jordan in Venice.

35. ARNOGLOSSUS (?) FIMBRIATUS.

Hemirhombus fimbriatus Goode & Bean, Proc. U. S. Nat. Mus., 1885, 591. (Deep waters of the Gulf of Mexico.)

Habitat.—Deep waters of the Gulf of Mexico.

We know this species from the original description only. As the authors of the species say that "the teeth are uniserial in both jaws" we are unable to see why they have placed it in *Hemirhombus*. So far as the description goes it agrees better with *Arnoglossus*, in which genus we have provisionally placed it. But the gill-rakers in *fimbriatus* are said to be tubercular, as in *Azevia*, while those of *Arnoglossus* are slender. The proper position of the species is therefore uncertain.

36. ARNOGLOSSUS (?) VENTRALIS.

Citharichthys ventralis Goode & Bean, Proc. U. S. Nat. Mus., 1885, 592. (Deep waters of Gulf of Mexico.)

Habitat.—Deep waters of Gulf of Mexico.

We know this species from the original description only. It is certainly not a *Citharichthys*. Among the known genera it seems to come nearest *Arnoglossus* or to *Lepidorhombus*, but the latter genus has a pedunculate caudal and teeth on the romer, while the former has cycloid or scarcely ctenoid deciduous scales.

Genus XVIII.—PLATOPHRYS.

Solea Rafinesque, Indice di Ittiologia Siciliana, 1810, 52 (*rhomboide*) (not of Quensel, 1806).

Platophrys Swainson, Nat. Hist. Class'n Fishes, ii, 1839, 302 (*ocellatus*).

Peloria Cocco, Intorno ad Alcuni Pesci del mar di Messina, Giorn. del Gabin., 1844, pp. 21-30, Lettere di Messina (*heckeli*, a larval form of *P. podas*) (not *Pelorus* of Montfort, 1808).

? **Coccolus*** (Bonaparte) Cocco, l. c. (*annectens*: larval form—probably of *P. podas*, with the right eye in transitu to the left side).

Bothus Bonaparte, Catologo Metodico, 1846, 49 (*podas*) (not of Rafinesque).

Rhomboidichthys Bleeker, Act. Soc. Sci. Indo-Nederl. Manad. & Makassar, 67 (*myriaster*), 1857-'8.

Platophrys Bleeker, Comptes Rendus Acad. Sci. Amsterd., 1862, xiii *Pleuron*, 5 (*ocellatus*).

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* "Parvus mole et pleuronectiformis, medius inter *Pleuronectidas* et Bibroniinos hic piscis videtur! Attamen dum illi oculos unilaterales habeant, iste vero bilaterales; in hoc novo genere oculi, alter a latere, altero in vertice vix ad appositum latus convenus positi sunt." (Bonaparte: quoted by Facciolà, Su di Alcuni Rari Pleuronettidi.)

TYPE: *Rhombus ocellatus* Agassiz.

This well-marked genus is widely diffused in the warm seas. The sexual differences are greater than usual among flounders, and the different sexes have often been taken for different species. As a rule, in the males the pectoral fin of the left side is much prolonged, the interorbital area is much widened and very concave, and there are some tubercles about the snout and lower eye. The young fishes, as is usually the case, resemble the adult females. This genus has been generally called *Rhomboidichthys*, but the appropriate name, *Platophrys*, is earlier, as Bleeker has already noticed.

Lately Dr. Emery has shown that the larval flounder, known as *Peloria heckeli*, is in all probability the young of *Pleuronectes podas*.

The generic name *Coccolus*, based on forms slightly more mature than those called *Peloria*, probably belongs here also.

We have seen no larval forms so young as those which have been described as *Peloria heckeli*. We have, however, examined small transparent flounders, one with the eyes quite symmetrical, taken in the Gulf Stream, and another with the eyes on the left side, taken at Key West. Both these may be larvæ of *Platophrys ocellatus*. The figures published by Emery seem to make it almost certain that the corresponding European forms belong to *P. podas*, although some doubt as to this is expressed by Facciolà.

The species of *Platophrys* are widely distributed through the warm seas, no tropical waters being wholly without them. The group called *Engyprosopon* seems to be worthy of generic distinction from *Platophrys*, as its scales are large and rough ctenoid. All the known species of *Engyprosopon* are Asiatic.

All the species of *Platophrys* are extremely closely related and can be distinguished with difficulty. On the other hand the variations due to differences of age and sex are greater than in any other of our genera.

A species apparently belonging to *Platophrys* has been scantily described by Schneider (Systema Ichthyologia, 1801, 156) under the name of *Pleuronectes surinamensis*. His types were small, smooth individuals ("exampla satis parva et glabra"), with the fins scaly, the mouth small, the lateral line arched in front, and the dorsal rays 96, the anal rays 55. These may be the young of any of the West Indian species, possibly of *P. lunatus* or *ocellatus*.

The following analysis of the species of *Platophrys* will doubtless be found to be very unsatisfactory. There are certainly three species (*podas*, *maculifer*, and *lunatus*) which are known to be distinct in their adult state. The young forms of *maculifer* and *lunatus* are not well known, nor is it known how they differ from *ocellatus*, *spinosus*, and other species which presumably reach a smaller size. Only a thorough study of the species, in all stages of development, in their native waters can give us the characters by which the species can be really discriminated.

ANALYSIS OF SPECIES OF PLATOPHRYS.

a. Anal rays—at least anteriorly—each with a spinule at base (these are formed by a slight widening of the tip of the interhæmal spines, each being covered by a little rough scale); front of dorsal with similar projections.

b. Color brownish, more or less marked with spots of light blue and brownish, which are usually edged with darker, these usually arranged in rings; a large black blotch on the lateral line; mouth small, the maxillary 4 in head; interorbital width ranging with age and sex from $2\frac{1}{2}$ to $4\frac{1}{2}$ in head; snout short, scarcely forming a re-entrant angle at its base; an angle opposite upper eye; depth $1\frac{7}{8}$ in length, D. 85 to 91, A. 70. PODAS, 37.

bb. Color brown, covered with pale rounded spots; fins dotted with brown; a faint dark spot at first third of lateral line; snout with horny points; mouth small, the maxillary reaching front of eye. Eyes very wide apart, $2\frac{2}{3}$ in head; the interorbital space $1\frac{1}{3}$ in head; pectoral fin short; curve of lateral line 5 in straight part. Depth $1\frac{2}{3}$ in length. D. about 74; anal about 57. Scales about 80. (Described from specimens $4\frac{1}{4}$ inches long, which have been partly dried before being placed in alcohol) ....SPINOSUS, 38.

aa. Anal rays without spinules at their base.

c. Anterior profile of head convex before the interorbital area, the very short snout scarcely forming a re-entrant angle at its base; form elliptic-ovate, the outlines more regular than in *Pl. lunatus.*

d. Dorsal rays 85 to 95.

e. Scales not very small, about 75 pores in the lateral line. (No blue markings, at least in young specimens.)

f. Mouth small, the maxillary 3 in head; no spines about the snout; eye $3\frac{1}{3}$ in length; interorbital width 3 in head (in types); pectoral short; curve of lateral line 6 times in straight part; color dark brown, with numerous stellate white spots, the most distinct of them with darker edgings; these generally scattered over the body, but some of them on sides of body are gathered together in little rings. (Perhaps these spots are blue rather than white in life.) Fins mottled with dark brown, the pectoral finely barred. Head 4 in length; depth $1\frac{1}{2}$; D. 89, A. 65, scales 75. Specimens examined, $3\frac{1}{2}$ inches long..CONSTELLATUS, 39.

ff. Mouth smaller, the maxillary $3\frac{2}{3}$ in head; eye $3\frac{1}{6}$ in head; interorbital space $2\frac{2}{3}$; teeth small, biserial above; arch of lateral line 2 in head. Head 4 in length; depth $1\frac{1}{2}$. D. 85 to 90. A. 64 to 67. Lat. l. 72 to 78. Color light grayish, tinged with reddish, with small round spots of darker gray, and with lighter rings inclosing spaces of the ground color; vertical fins, similarly colored, with a small black spot at base of each 9th or 10th ray; two black spots on lateral line; some other black spots on body and on caudal fin. Vertebræ, 37........OCELLATUS, 40.

ee. Scales smaller, 90 to 95 pores in the lateral line. Mouth small, oblique, the maxillary $3\frac{2}{5}$ in head; teeth in both jaws in two irregular series; arch of lateral line $2\frac{2}{3}$ in head. Head 4; depth $1\frac{5}{6}$. D. 90 to 95. A. 70. Lat. l. 90 to 95. Color of adult reddish gray, the body everywhere covered with rings formed of round, sky-blue spots, which are not confluent and are not edged with black; besides these, very few detached spots or other blue markings; head with similar blue spots, but no rings; area inclosed in the blue rings not different from the ground color; caudal with blue spots, other fins with none; dorsal and anal mottled; a large, diffuse, dusky spot at front of straight part of lateral line, one better defined on middle of lateral line; a faint one farther back; pectorals grayish, with dark bars....MACULIFER, 41.

dd. Dorsal rays, 105; anal rays, 80; pectoral short; interorbital space $2\frac{2}{3}$ in head; depth $1\frac{3}{4}$ in length; scales 91; body deep; color (specimen $4\frac{3}{4}$ inches long) grayish, much spotted and mottled with whitish; no blue (in young example)....................................ELLIPTICUS, 42.

cc. Anterior profile of head strongly concave before interorbital area, the projecting snout leaving a marked re-entrant angle above it.

g. Mouth not very small; the maxillary 3 in head; head $3\frac{1}{4}$ in length; depth 2; D. 95; A. 70; lat. l. 90. Teeth small, in an irregular double series in each jaw; color dark olive, with many rings, curved spots, and small round dots of sky-blue edged with darker on body, these largest near middle of sides, where some are as large as the eye; three obscure dark blotches on straight part of lateral line; head and vertical fins with sharply defined blue spots, which are mostly round; spots on opercles, larger and curved; pectorals with dark bars; vertebræ 9+30=39. LUNATUS, 43.

gg. Mouth small; the maxillary $3\frac{1}{2}$ in head; head $3\frac{2}{3}$; depth $1\frac{4}{5}$; D. 86 to 88; A. 62 to 67; lat. l. 80; teeth very small, biserial above; color highly varigated with different shades of gray, the pale blotches rounded, very irregular in size and position; no blue spots; no black spots along lateral line; a large whitish cloud between the eyes. LEOPARDINUS, 44.

37. PLATOPHRYS PODAS.

Rhomboides Rondelet, De Piscibus, 1554.

Pleuronectes podas Delaroche, "Ann. Mus., xiii, 354, tab. 24, fig. 14, 1809."

Rhomboidichthys podas Günther, Cat. Fish., iv, 432, 1862. (Sicily.) Vinciguerra, Risultati Ittiologici del Violante, 1883, 106. Emery, Contribuzioni all' Ittiologi, 405. (Interesting discussion of larval forms.)

Bothus podas Steindachner, Ichthyol. Bericht., 1868, Sechste Fortsetzung, p. 51. (Barcelona, Cadiz, Gibraltar, Santa Cruz de Teneriffe.)

Solea rhomboide Rafinesque, Indice, 1810, 52 (after Rondelet).

Bothus rhomboides Bonaparte, Catologo Metodico, 1836, 49.

Pleuronectes argus Risso, Ichth. Nice, 1810, 317 (not of Gmelin).

Pleuronectes mancus Risso, Ichth. Nice, 1810, 317 (not of Broussonet, whose species was from the Pacific Ocean = *Platophys mancus*).

Rhomboidichthys mancus Günther, iv, 432, and of many European writers.

Rhombus diaphanus Rafinesque, 1814 (larval form). Ricchiardi, "Soc. Toscana Sci. Nat., 1881."

Rhombus candidissimus Risso, Europe Méridionale, iii, 253, 1826 (larval form).

Rhombus gesneri Risso, Europe Mérid., 1826, iii, 254.

Rhombus heterophthalmus Bennett, "Proc. Comm. Zool. Soc., 1831, 147."

Rhombus madeirensis Lowe, "Proc. Zool. Soc., 1833, 143." (Madeira.)

Peloria heckeli Cocco, "Alcuni Pesci del mar di Messina," 1844, 20 (larval form).

? *Coccolus annectens* (Bonaparte) Cocco, l. c. (larva).

Rhombus serratus Valenciennes, "Webb & Berthelot, Iles Canar. Poiss., 82, pl. 18, fig. 1," 1835–'50.

Pleuronectes cuspidatus "Machado, Catalogo, 26" (fide Steindachner).

Habitat.—Mediterranean fauna.

This species is not rare in the Mediterranean and adjacent islands. The specimens examined by us are from Genoa and Fayal. The two species mentioned by numerous authors under the names of *podas* and *mancus* have been shown by Dr. Steindachner to be the two sexes of the same fish, while Dr. Emery has shown that the translucent fish, *Peloria heckeli* = *Rhombus candidissimus* = *Rhombus diaphanus*, is the larva of the same form, as is probably also the *Coccolus annectens* of Bonaparte.

38. PLATOPHRYS SPINOSUS.

Rhomboidichthys spinosus Poey, Synopsis, p. 409, 1868. Poey, Enum. Pis. Cub., p. 139, 1875.

Habitat.—West Indian fauna.

The original description of this species is a very scanty one. In all respects, unless it be the color, it agrees with the European *Pl. podas.*

We have found two small specimens sent by Professor Poey to the Museum of Comparative Zoology, which may be the types of this species. They are 4¼ inches long, and have been partly dried in the sun. A result of this has been to increase the prominence of the interhæmal spines. Whether these be the original types or not, the species is an extremely doubtful one. The eyes are farther apart in these specimens than in any of *P. ocellata* which we have examined. They agree in this respect with Agassiz's figure of *Rhombus ocellatus.*

39. PLATOPHRYS CONSTELLATUS.

Platophrys constellatus Jordan, sp. nov.

Habitat.—Galapagos Archipelago.

This species is described from three specimens, the largest 3½ inches long, numbered 11146 on the register of the Museum of Comparative Zoology. They are from James Island, in the Galapagos. The species is closely related to *P. ocellatus* and others, but in color, at least, it is different, and its habitat is remote.

40. PLATOPHRYS OCELLATUS.

Rhombus ocellatus Agassiz, Spix Pisc. Brasil., 1829.
Platophrys ocellatus Swainson, Nat. Hist. Class'n Fishes, ii, 1839. (Name only.)
Rhomboidichthys ocellatus Günther, Cat. Fish. Brit. Mus., 1862, iv. (Bahia, Cuba.)
Poey, Synopsis, 1868, 408. (Havana.)
Rhombus bahianus Castelnau, Anim. nouv. rares Amérique du Sud, 1855. (Bahia.)
Platophrys nebularis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 31, 143. (Key West.)

Habitat.—Tropical America; sandy shores from Long Island to Rio Janeiro.

We know this species from the numerous small specimens taken by Dr. Jordan at Key West, which have been described as *Platophrys nebularis.* A specimen similar to these has been taken by Dr. Bean on the south coast of Long Island.

This seems to be the same as the Cuban species called *Rhomboidichthys ocellatus* by Poey, and some of the specimens sent by Poey to the Museum of Comparative Zoology are apparently identical with the types of *nebularis.*

In the Museum of Comparative Zoology we have compared specimens of the real *Platophrys ocellatus* (No. 11423, Rio Janeiro, Agassiz), with a representative specimen of *P. nebularis* (No. 26147, from the Tortugas, Florida), and are unable to find any differences.

We adopt, therefore, the name *Platophrys ocellatus* for all, and regard it as one of the widely-distributed flounders, like *Etropus crossotus* and *Citharichthys spilopterus*.

41. PLATOPHRYS MACULIFER.

? *Pleuronectes maculiferus* Poey, Mem., ii, p. 316, 1860. (Cienfuegos.)

? *Rhomboidichthys maculiferus* Poey, Synopsis, p. 408, 1868. Poey, Enum. Pis.Cub., p. 139, 1875.

Platophrys ellipticus Jordan, Proc. U. S. Nat. Mus., 1886, 51 (Havana) (not of Poey ?).

We identify specimens taken by Dr. Jordan at Havana and by him described as *Platophrys ellipticus*, with this species simply because we cannot place them anywhere else. In the Museum of Comparative Zoology are other specimens similar to these, sent to Cambridge by Poey.

In several respects these species agree fairly with Poey's *ellipticus*, but that species is said to have 104 dorsal rays.

42. PLATOPHRYS ELLIPTICUS.

? *Pleuronectes ellipticus* Poey, Memorias, ii, 315, 1860. (Cuba.)

? *Rhomboidichthys ellipticus* Günther, iv, 434, 1862 (copied). Poey, Synopsis, 408, 1868. Poey, Enumeratio, 139, 1875.

Habitat.—West Indian fauna.

Poey describes his *Pl. ellipticus* as having 104 dorsal rays. In none of our other species does the number of these rays reach 100. Among the specimens sent by Poey to the museum at Cambridge is one, $4\frac{3}{4}$ inches long, which has 105 dorsal rays. We have therefore assumed that the species to which this specimen belongs is the real *ellipticus*, and that the one heretofore called *ellipticus* is Poey's *maculifer*. Both these assumptions are open to considerable doubt.

43. PLATOPHRYS LUNATUS.

Solea lunata et punctata (THE SOLE) Catesby, Nat. Hist. Carolina, tab. 27, 1725 (Bahamas).

Pleuronectes lunatus Linn., Syst. Nat., ed. x, 269, 1758 (based on Catesby), and of the various copyists.

Rhomboidichthys lunatus Günther, Cat. Fish., vol. iv, p. 433 (Jamaica). Poey, Synopsis, p. 408, 1868.

Rhomboidichthys lunulatus Poey, Enum. Pis. Cub., p. 138, 1875.

Platophrys lunatus Jordan, Proc. U. S. Nat. Mus., 1886, 51 (Havana).

Pleuronectes argus Bloch, Ichthyol., tab. 48, 1783.

? *Pleuronectes surinamensis* Bloch & Schneider, Syst. Ichth., 1801, 156 (Surinam); and of copyists.

Habitat.—West Indian fauna.

This handsome and curiously colored species is not rare in the waters of the West Indies. The specimens examined by us are from Cuba, Sombrero, St. Thomas, and other localities in the West Indies. The original figure of this species published by Catesby is a very good one and leaves no room for doubt as to the species intended. The figure of Bloch, called *Pleuronectes argus*, is also fairly accurate, and can refer to no other species.

This species reaches a length of some 18 inches, and is the largest in size of the American species of *Platophrys*. We have never seen any young examples which certainly belong to it, and till its development is traced some of the species known from small examples only must be doubtful.

44. PLATOPHRYS LEOPARDINUS.

Rhomboidichthys leopardinus Günther, Cat. Fish., iv, 1862, 434 (locality unknown).
Platophrys leopardinus Jordan, Proc. U. S. Nat. Mus., 1884, p. 260 (Guaymas).

Habitat.—Gulf of California.

This species is known only from the orignal type from unknown locality, and from a single specimen in the U. S. National Museum, taken by Mr. H. F. Emeric, at Guaymas.

Genus XIX.—SYACIUM.

Syacium Ranzani, Novis Speciebus Piscium, Diss. Sec., 1840, 20 (*micrurum*).
Hemirhombus Bleeker, Comptes Rendus Acad. Sci. Amsterd., xiii, Pleuron, 4 (1862), (*guineënsis*).
Aramaca Jordan & Goss, Cat. Fish. N. A., 1885, 133 (*pætula*).

TYPE: *Syacium micrurum* Ranzani.

This genus contains a considerable number of species, mostly American and African, which form a transition from *Platophrys* to *Citharichthys*. They fall readily into two groups or subgenera, distinguished by the width of the interorbital space. As this width is dependent on age and as it is subject to various intergradations, the group *Aramaca* founded on it cannot be admitted as a distinct genus.

The name *Syacium*, based especially on *Syacium micrurum*, must take the place of *Hemirhombus*.

ANALYSIS OF SPECIES OF SYACIUM.

a. [Snout before upper orbit with three conspicuous spinous processes; maxillary reaching beyond eye, 2½ in head; interorbital space scaly, concave, 2 in eye (in specimens of 3½ inches); eye 2½ in head; spines on snout about 3 in eye; no produced fin rays; pectoral as long as head without snout; head blunt, higher than long, the profile straight; lateral line without arch; head 3; depth 2; D. 78, A. 62; scales 48; color grayish, with large distant black blotches on dorsal and anal; one or two on basal half of caudal and on end of caudal peduncle; pectoral with dark bands.] (*Günther*) ....CORNUTUM, 45.

aa. Snout and orbits without spines or spinous processes.

b. Scales larger, 50 to 57 in the lateral line; interorbital space very broad, greater than the long diameter of the eye in the males, about equal to the vertical diameter in the females; accessory scales very numerous; maxillary 2½ in head; its tip scaly; anterior teeth canine-like: gill-rakers short, strong, not one-third length of eye; first rays of dorsal nearly on median line, their tips much exserted; pectoral fin in males 1¼ to 2 times length of head; eye large, 4⅜ in head; head 3⅝; depth 2⅜; D. 81 to 88, A. 63 to 70; vertebræ 10 + 26 = 36; color nearly plain brown, with darker dots or mottlings, no ring-like spots or ocelli; fins mottled; left pectoral barred; blind side sometimes wholly or partly dusky, especially in Northern specimens .... PAPILLOSUM, 46.

bb. Scales rather small, 60 to 70 in the lateral line.

c. Color dark brown, with many rings and spots of light gray and blackish, some of the dark rings with a black central spot; a diffuse dusky blotch on lateral line above pectoral, and one near base of caudal peduncle; fins with numerous inky spots and dark markings; blind side pale; scales small, firm, moderately ctenoid; eyes large, 4 in head, nearly even in front, the male with the interorbital space deeply concave; its width two-thirds the vertical depth of the eye; female with interorbital area much narrower, with a more or less perfect median groove; its width about equal to depth of pupil; maxillary 2⅓ to 3 in head; the outer teeth canine-like; gill-rakers very short and thick, about X + 7 in number; head 3⅘ in length; depth, 2⅘; D. 87 to 92, A. 54 to 68; scales 65 to 70 pores; vertebræ 9 + 24 = 33; pectoral 1⅓ in head in the female, reaching nearly to base of caudal in the male .... MICRURUM, 47.

cc. Color light brown, with grayish and light bluish dots, some darker areas and a few round brown spots ocellated with lighter; interorbital space with a vertical brown bar bordered by lighter; fins mottled and spotted; interorbital space in adult male broader than eye; insertion of dorsal on blind side of head; pectoral fins in males about 3 in body; head, 4 in length; depth, 2½; D. 92, A. 72, Lat. l. 60; gill-rakers short and broad, X + 7; maxillary 2½ in head, its tip scaly .... LATIFRONS, 48.

ccc. Color light olive-brown, nearly uniform, the vertical fins with elongate dark spots; eyes 4½ in head, the lower slightly advanced; interorbital space very narrow, as broad as pupil (in both sexes?), somewhat concave; maxillary 2⅜ in head; pectoral 1⅓ in head; head 3⅜ in length; depth 2⅛; D. 86, A. 69, Lat. l. 58 .... OVALE, 49.

45. SYACIUM CORNUTUM.

Rhomboidichthys cornutus Günther, Shore Fishes Challenger, 1880, 7, pl.

Habitat.—Coast of Brazil, in deep water.

This species is known from Günther's description and figure. In very young examples the conspicuous processes about the head are undeveloped.

46. SYACIUM PAPILLOSUM.

Aramaca Marcgrave, Hist. Brasil., 1648, 181.

Pleuronectes papillosus Linnæus, Syst. Nat., x, 271, 1758 (based on Marcgrave), and of the earlier copyists.

Aramaca papillosa Jordan, Proc. U. S. Nat. Mus., 1886, 602 (synonymy confused with *S. micrurum*).

? *Pleuronectes macrolepidotus* Bloch, Ausländische Fische, vi, 25, tab. 190, 1787 (and of some copyists) (apparently based on Marcgrave).

Pleuronectes aramaca Donndorf, Beyträge zur xiii Ausgabe des Linnæischen Natursystems, 1798, 386 (after Marcgrave).

Rhombus aramaca Cuvier, Règne Animal, ed. ii, 1827 (after Marcgrave).

Citharichthys aramaca Jordan and Gilbert, Synopsis Fish., N.A., 1882, 816. (Pensacola.)

Rhombus soleæformis Agassiz, Spix Pisc. Brasil., 86, tab. 47, 1829. (Atlantic Ocean.)

Hemirhombus soleæformis Günther, Cat. Fish., iv, 423, 1862. (Copied.)

Aramaca soleæformis Jordan, Proc. U. S. Nat. Mus., 1886.

Hippoglossus intermedius Ranzani, Novis Speciebus Piscium Dissertatio Secundo, 1840, 14, pl. 4. (Brazil.)

Hemirhombus pœtulus Bean MSS, Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 304. (Pensacola.) Goode and Bean, Proc. U. S. Nat. Mus., 1882, p. 414. (Pensacola.) Bean, Cat. Col. Fish U. S. Nat. Mus., 1883, p. 45. (Pensacola.)

Citharichthys pœtulus Jordan and Gilbert, Syn. Fish. N. A., p. 964, 1882, addenda. Jordan, Proc. U. S. Nat. Mus., 1884, p. 38. (Pensacola.)

Habitat.—West Indian fauna. Charleston to Rio Janeiro.

Of the species found in the deep waters about Pensacola and called by Dr. Bean *Hemirhombus pœtulus* we have numerous specimens. Lately we have received from Mr. Charles C. Leslie, of Charleston, a specimen which shows its presence also in Carolina waters. It has not yet been recorded from Cuba, but in the Museum of Comparative Zoology is a specimen (26104) taken by Mr. Samuel Garman at Kingston, Saint Vincent. But its range extends much farther to the southward, for among the collections made by Professor Agassiz at Rio Janeiro there are many specimens (11375, 4666), the largest about a foot long. These seem to be completely identical with Florida examples, differing only in having the blind side pale, it being usually partly blackish in northern examples.

These Brazilian specimens agree very closely with the figure of *Rhombus soleœformis*, except that Agassiz has represented that species as having a dusky blotch at the shoulder. No such marking is apparent in any of our specimens. The coloration and the breadth of the interorbital both render it unlikely that Agassiz's *soleœformis* could have been *micrurum*.

The *Aramaca* of Marcgrave, which is the sole basis of *Pleuronectes papillosus*, *Pleuronectes macrolepidotus*, and *Rhombus aramaca*, cannot well be any known species other than the present one.

According to Marcgrave's rude figure and his description, this species has the form of a sole, the eyes wide apart, the left pectoral produced, the mouth very large, the body oblong, and the coloration stone-like (sand-color) on the left side and white on the eyed side. *Micrurum* is not colored in that way, and its eyes are not noticeably far apart.

We therefore adopt for this species the oldest name of *Syacium papillosum*.

The species is common in the deep waters of the Gulf of Mexico, and reaches a length of more than a foot.

47. SYACIUM MICRURUM.

Syacium micrurum Ranzani, Nov. Spec. Pisc. Diss. Sec., 1840, 20, pl. 5. (Brazil.)

Hippoglossus ocellatus Poey, Memorias, ii, 314, 1860. (Cuba.)

Hemirhombus ocellatus Poey, Synopsis, 407, 1868. Poey, Enumeratio, 138, 1875.

Citharichthys ocellatus Jordan and Gilbert, Syn. Fish. N. A., 964, 1882. (Key West.) Jordan, Proc. U. S. Nat. Mus., 1884, 143. (Key West.)

Hemirhombus aramaca Günther, iv, 42, 1862. (Cuba; Jamaica.) (Not *Rhombus aramaca* Cuvier.)

Citharichthys æthalion Jordan, Proc. U. S. Nat. Mus., 1886, 52. (Havana.)

Hemirhombus æthalion Jordan, Proc. U. S. Nat. Mus., 1886, 602.

Habitat.—West Indian fauna. Key West to Rio Janeiro.

We have found in the Museum of Comparative Zoology specimens purporting to be the types of *Hemirhombus ocellatus* Poey (No. 11144; Poey's number, 88). These are female specimens, and they differ from the types of *Hemirhombus æthalion*, also from Cuba, only in their greater size.

Numerous specimens (11373) from Rio Janeiro belong to the same species. Among these are males, which have the interorbital space much broader than in the types of *ocellatus* and *æthalion*. Besides these specimens, we have examined others from Hayti, Cuba, and Key West, and there can be no reasonable doubt of their identity, and that all are identical with Günther's *Hemirhombus aramaca*.

This fish is described and fairly well figured by Ranzani under the name of *Syacium micrurum*. It is the type of his genus *Syacium*, a generic name which, strangely enough, has received no notice from subsequent authors until the present time.

48. SYACIUM LATIFRONS.

Citharichthys latifrons Jordan and Gilbert, Bull. U. S. Fish Comm., 1881, 334. (Panama.)

Habitat.—Pacific coast of tropical America. Panama.

This species is known only from the original types, taken by Professor Gilbert at Panama. The several variations in this species have not been studied.

49. SYACIUM OVALE.

Hemirhombus ovalis Günther, Proc. Zool. Soc., 1864, p. 154. Günther, Fish. Central America, p. 472, 1869, plate lxxx, fig. 1. (Panama.) Jordan & Gilbert, Bull. U. S. Fish Com., 1882, p. 108–111. (Mazatlan; Panama.)

Citharichthys ovalis Jordan, Proc. U. S. Nat. Mus., 1885; 391. (Mazatlan; Panama.)

Habitat.—Pacific coast of tropical America: Mazatlan to Panama.

This well-marked species has been well figured by Dr. Günther, from whose account our analysis has been taken. Numerous specimens have been collected at Mazatlan and Panama by Dr. Gilbert. The sexual changes in this species have not been reported.

Genus XX.—AZEVIA.

Azevia Jordan (genus novum). (*Panamensis.*)

TYPE: *Citharichthys panamensis* Steindachner.

This genus is proposed to include a single species hitherto referred to *Citharichthys*, but distinguished by its tubercular gill-rakers, as also by its small, firm scales, and other characters of minor importance.

A second species of this genus was obtained by Professor Gilbert at Mazatlan, and at first recorded by us under the name of *Citharicthys panamensis*. The specimens have, however, all been destroyed by fire.

The name *Azevia* is a Portuguese name for the sole, used at Lisbon, according to Brito-Capello. It probably corresponds to the Cuban name *Acedia*.

ANALYSIS OF SPECIES OF AZEVIA.

a. Scales quite small, about 75 in the lateral line, ctenoid, and adherent. Body rather elongate. Mouth large, the maxillary about half length of head, the upper jaw somewhat hooked over the lower; about three front teeth in upper jaw, enlarged and hook-shaped; canines strong. Anterior profile gently and evenly convex. Eyes large. Pectoral 1½ in head. Head 4 in length; depth 2⅔. D. 95 or 96. A. 76 to 78. Scales 73 to 78. Vertebræ 33. Gill-rakers tubercle-like, broader than high. Color brownish, sprinkled with dark dots, and with some whitish rings; large vaguely-defined oval spots on head and body; dorsal with five or six, anal with three dark spots .... PANAMENSIS, 50.

50. AZEVIA PANAMENSIS.

Citharichthys panamensis Steindachner, Ichth. Beitr., iii, 62, 1875. (Panama.) Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 108 and 111. (Panama.) Gilbert, Bull. U. S. Fish Com., 1882, p. 112. (Punta Arenas.)

Habitat.—Pacific coast of Central America.

Our description of this species is taken from the specimens from Panama in the museum at Cambridge, a part of the series of Dr. Steindachner's original types. The species is apparently not uncommon on the west coast of Central America.

Genus XXI.—CITHARICHTHYS.

Citharichthys Bleeker, Comptes Rendus Acad. Sci. Amsterd., xiii, *Pleuron*, 6, 1862. (*Cayennensis* = *Spilopterus*.)
Orthopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1862, 330. (*Sordidus*.)
Metoponops Gill, Proc. Ac. Nat. Sci. Phila., 1864, 198. (*Cooperi* = *Sordidus*.)

TYPE: *Citharichthys cayennensis* Bleeker = *Citharichthys spilopterus* Günther.

This genus includes small flounders of weak organization, especially characteristic of the sandy shores of tropical America. The subgenus *Orthopsetta* includes species of more northern range and somewhat different in form, and especially noteworthy as having an increased number of vertebræ.

We are not certain that *Citharichthys* has priority over *Orthopsetta*, the two having the same ostensible date.

ANALYSIS OF SPECIES OF CITHARICHTHYS.

a. Vertebræ about 40; interorbital ridge sharply elevated; the head not closely compressed; eyes large. (*Orthopsetta* Gill.)

b. Dorsal rays 95; anal rays 77; lateral line 65 to 70; head 3⅔ in length; depth 2⅓; eyes large, 3½ in head, the interocular space scaly, concave, 4 in eye; a sharp elevated ridge bounding the lower eye; mouth not large; the maxillary 3 in head; teeth sharp, subequal anteriorly, smaller behind; lower pharyngeals narrow, each with a row of slender teeth; gill-rakers slender, close-set, 7+14; scales large, thin, deciduous, slightly ciliate; numerous accessory scales present; pectorals long, 1½ in head; flesh soft. Color dull olive-brownish, the males with spots and blotches of dull orange, the dorsal and anal blackish, similarly mottled with dull orange; females paler, nearly plain. Vertebræ, 11 + 29 = 40 .... SORDIDUS, 51.

bb. Dorsal rays 85 to 90; anal 68 to 72; lat. l. 55 to 60; head 3⅗ in length; depth 2⅓; eyes large, separated by a sharp, scaleless ridge; maxillary 2⅘ in head; teeth slender, rather long; gill-rakers short, rather slender; pectoral 1⅗ in head; color olivaceous, the scales edged with darker; fins dusky; a small ink-like spot on the middle of each seventh to tenth ray of each of the vertical fins.....STIGMÆUS, 52.

aa. Vertebræ 33 to 36; interorbital ridge low and narrow, the head closely compressed (*Citharichthys*).

c. Eyes large, 3 to 4½ times in the head.

d. [Head large, 3⅓ in length; pectoral of left side elongate, one-third longer than head; maxillary 2¼ in head; "lateral line slightly curved over the pectoral"; scales thin, deciduous, cycloid; eye 3⅓ in head, five times interorbital space, which is a rather prominent narrow sharp ridge; a strong spine on the snout over the upper lip, above this another shorter spine; caudal fin subsessile; head, 3⅓; depth, 2⅓; D. 91; A. 73; Lat. l. 48. Color grayish-brown.] (*Goode & Bean*)..DINOCEROS, 53.

dd. Head smaller, about 4 in length.

e. Body comparatively elongate, the depth about 2⅓ in length; mouth very small; the maxillary 3⅓ in head; teeth very small, the anterior scarcely enlarged; eyes large, 4 in head, separated by a very narrow, sharp scaleless ridge, one-sixth diameter of the eye; snout with a small blunt spine; rays of vertical fins all exserted; left pectoral twice length of right. Head, 4 in length; depth, 2⅓; D. 83; A. 67; Lat. l. 40. Color light brown ....ARCTIFRONS, 54.

ee. Body comparatively broad, the depth about half the length; mouth larger.

f. [Snout with a strong sharp spine on eyed side, above upper lip. Eyes large, 3 in head; greatest depth of body over the pectorals; interorbital space with a wide ridge, about half diameter of eye; teeth minute, close-set, stronger on blind side; body extremely thin; D. 73 to 75, A. 60, Lat. l. 40. Ashy gray, with dark lateral line. Deep-water species with loose scales.] (*Goode*) ....UNICORNIS, 55.

ff. Snout without distinct spine. Eyes moderate, 3½ to 4½ in head; greatest depth of body under middle of dorsal; interorbital space a narrow, scaly ridge with a slight median groove; maxillary 2⅓ in head; teeth small, those in front slightly enlarged; body not very thin; gill-rakers moderate, 6+13.

g. Dorsal rays 80; anal 56; scales large, cycloid; no accessory scales; head 4 in length; depth 2; D. 80, A. 56, Lat. l. 41. Vertebræ 9+25=34. Eye 3⅗ in head. Color light olive-brown, with some 20 dark brown spots, the largest about as large as eye; four of these spots arranged at equal intervals along the lateral line, the second being most prominent; dorsal and anal with round dark spots, one on the middle of each sixth to seventh ray, besides smaller, irregular spots and mottlings; caudal spotted; two brown spots, one above the other, at base of caudal; shallow-water species.
MACROPS, 56.

gg. Dorsal rays 68; anal 52; scales smaller, the lateral line with about 53 pores; outline regularly oval, without angle; eyes moderate, 4½ in head, close together, the orbital ridges coalescent, the lower larger. Teeth small, uniserial; maxillary 2⅓ in head; gill-rakers short and very slender, X+12. Color dark brown, with whitish blotches, the fins mottled ....UHLERI, 57.

cc. Eyes quite small, 5 to 6 in head; snout short, forming an angle with the profile; mouth moderate, oblique, the maxillary 2¼ to 2⅖ in head; teeth small, the anterior somewhat enlarged.

h. Scales not very large, 45 to 48 in the lateral line; interorbital area a low narrow ridge which is divided only anteriorly (in Atlantic specimens, usually grooved for its whole length in Pacific coast examples); gill-rakers short and strong, X + 13; pectorals about half head; no distinct spine on snout; head 3¾; depth 2⅛; D. 75 to 80; A. 58 to 61; vertebræ, 34; color olive-brownish, somewhat translucent, with darker dots and blotches; a series of distant obscure blotches along bases of dorsal and anal .... SPILOPTERUS, 58.

hh. Scales large, 40 to 42 in the lateral line; interorbital area ⅔ diameter of eye, which is 5 in head; gill-rakers short and slender, about equal to pupil; teeth rather smaller than in *C. spilopterus;* maxillary 2⅔ in head; head 3⅔; depth 2 to 2⅙; D. 77 to 82; A. 59 to 61; color light gray, everywhere soiled and freckled, peppered with black specks; pectoral fin much mottled, the caudal less so. SUMICHRASTI, 59.

51. CITHARICHTHYS SORDIDUS.

Psettichthys sordidus Girard, Proc. Acad. Nat. Sci. Phila., vii, 1854, 142. Girard, Proc. U. S. Pacif. R. R. Exped., Fishes, 1859, 155. (San Francisco; Tomales Bay.)

Orthopsetta sordida Gill, Proc. Ac. Nat. Sci. Phila., 1862, 330.

Citharichthys sordidus Lockington, Rep. Com. Fisheries of California, 1878–'79, 42. Lockington, Proc. U. S. Nat. Mus. 1879, 83 (San Francisco). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 453 (Puget Sound, San Francisco, Monterey Bay, San Luis Obispo, Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 67. Jordan & Gilbert, Synopsis Fish. N. A., p. 817, 1882. Bean, Proc. U. S. Nat. Mus., 1883, p. 353 (Johnston Strait, Safety Cove, British Columbia.)

Metoponops cooperi Gill, Proc. Acad. Nat. Sci. Phila., 1864, 198 (Santa Barbara).

Habitat.—Pacific coast of North America, in water of moderate depth; British Columbia to Lower California.

This small flounder is one of the commonest species on the Pacific coast, being found in water of ten fathoms or more depth, in all localities from the Mexican boundary to British Columbia. It rarely exceeds two pounds in weight. In its deciduous scales and soft flesh it much resembles *Lyopsetta exilis* and *Atheresthes stomias*, two species of which are often taken in company with it. Of all the species allied to *Citharichthys*, this one has the most extended range to the northward.

52. CITHARICHTHYS STIGMÆUS.

Citharichthys stigmæus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 410, 411 (Santa Barbara). Jordan & Gilbert, Syn. Fish. N. A., 1882, 965.

Habitat.—Coast of Southern California.

The original type of this species is a young example, taken near Santa Barbara by Capt. Andrea Larco. In the Museum of Comparative Zoology are other specimens collected by Mr. Cary at San Francisco. These have 72 anal rays, while the original type had but 68. In this and other ways they approach *C. sordidus.* Were it not that some of these are full of spawn at a length of five inches, we should regard them without much hesitation as the young of *C. sordidus*. As it is, it is not unlikely that *C. stigmæus* will prove to be simply the young of the latter species.

53. CITHARICHTHYS DINOCEROS.

Citharichthys dinoceros Goode & Bean, Bull. Mus. Comp. Zool., xxviii, 1886, 156 (off Martinique, St. Lucie, and Barbadoes).

Habitat.—Deep waters of Gulf of Mexico.

This species is known to us from the original description only.

54. CITHARICHTHYS ARCTIFRONS.

Citharichthys arctifrons Goode, Proc. U. S. Nat. Mus., 1880, 341, 472 (Gulf Stream off Southern New England coast). Goode & Bean, Bull. Mus. Comp. Zoology, xix, p. 194 (stations 313, 314, 311, and 336). Jordan & Gilbert, Syn. Fish. N. A., 818, 1882.

Habitat.—Deep waters of the Gulf Stream.

This species is known to us from a small specimen obtained in the Gulf Stream southeast of Martha's Vineyard, and from the descriptions published by Goode & Bean.

55. CITHARICHTHYS UNICORNIS.

Citharichthys unicornis Goode, Proc. U. S. Nat. Mus., 1880, 342 (Gulf Stream southeast of New England). Jordan and Gilbert, Syn. Fish. N. A., p. 818, 1882.

Habitat.—Deep waters of the Gulf Stream.

This species is known to us from descriptions only.

56. CITHARICHTHYS MACROPS.

Citharichthys macrops Dresel, Proc. U. S. Nat. Mus., 1884, p. 539 (Pensacola). Jordan, Proc. U. S. Nat. Mus., 1886, 29 (Beaufort, N. C.).

Habitat.—South Atlantic and Gulf coasts of the United States.

This species is known to us from several specimens dredged in the harbor of Beaufort, N. C., by Prof. Oliver P. Jenkins.

57. CITHARICHTHYS UHLERI.

Citharichthys uhleri Jordan, sp. nov.

Habitat.—West Indian fauna.

This species is based on a single specimen in the Museum of Comparative Zoology. It is 4½ inches in length, and was brought from Hayti by Mr. P. R. Uhler, the well-known entomologist, for whom we have named the species.

The species is close to *Citharichthys macrops*, but its fin-rays and scales are considerably more numerous than in the latter.

58. CITHARICHTHYS SPILOPTERUS.

Citharichthys spilopterus Günther, iv, 1862, 421 (New Orleans, San Domingo, Jamaica). Günther, Fish. Central America, p. 471, 1869, pl. lxxx, fig. 2, (Chiapam). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 382 (Panama). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 618 (Charleston). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, p. 630 (Panama). Jordan and Gilbert, Bull. U. S. Fish Com., 1882, p. 108–111 (Mazatlan and Panama). Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 817. Jordan, Proc. U. S. Nat. Mus. 1886, 53 (Havana).

Citharichthys cayennensis Bleeker, Comptes Rendus Acad. Sci. Amsterd., xiii, 1862, 6 (Cayenne) (name only).

Citharichthys guatemalensis Bleeker, Neder. Tydschr. Dierk, 1864, 73 (Guatemala). Günther, Fish. Central America, 472, 1869 (copied).

Hemirhombus fuscus Poey, Synopsis, 406, 1868. Poey, Enumeratio, 1875, 138.

Habitat.—Both coasts of tropical America, north to New Jersey and Mazatlan.

This little flounder is almost everywhere abundant on the sandy shores of tropical America, in shallow water. Careful comparison of specimens from South Carolina, Brazil, Mazatlan, and Panama shows no tangible difference, and we are compelled to regard all as forming a single species.

It rarely exceeds 5 or 6 inches in length. It usually comes into the markets mixed with other shore-fishes and it nowhere receives any notice as a food-fish.

This species is common in the markets of Havana, and it is evidently the original of Poey's *Hemirhombus fuscus*, although in Poey's description there seems to be some confusion, because the teeth are said to be biserial above, and 60 scales are counted in the lateral line.

A specimen from Poey in the museum at Cambridge is labeled "*Hemirhombus fuscus* type." Collector's number, 87. This belongs to *C. spilopterus*, and it has 48 scales in the lateral line.

Bleeker's *Citharichthys guatemalensis* agrees in all respects with *Citharichthys spilopterus*. We are unable to find any description of *Citharichthys cayennensis*, if, indeed, the species has ever been described.

Specimens of *Citharichthys spilopterus* are in the museum at Cambridge from Panama, Cuba, Pará, Sambaia, Pernambuco, Camaru, Rio das Velhas, Rio Janeiro, and San Matheo.

59. CITHARICHTHYS SUMICHRASTI.

Citharichthys sumichrasti Jordan, sp. nov.

Habitat.—Pacific coast of tropical America.

This species is close to *C. spilopterus*, differing chiefly in the larger scales and in the different coloration. The type, No. 25299, in the Museum of Comparative Zoology, was collected in Rio Zanatenco, Chiapas, by Prof. Francis E. Sumichrast. Another specimen is in the museum labeled Panama: Pitkins.

Genus XXII.—ETROPUS.

Etropus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 364. (*Crossotus.*)

TYPE: *Etropus crossotus* Jordan & Gilbert.

This genus is very close to *Citharichthys*, from which it differs only in the very small size of the mouth, and in the correspondingly weak dentition. The three known species are similar in appearance to the species of *Citharichthys*, and they inhabit the same waters. Another genus extremely close to *Etropus* and *Citharichthys* is *Thysanopsetta*. The teeth in *Thysanopsetta* are, however, arranged in a band.

ANALYSIS OF SPECIES OF ETROPUS.

a. Body comparatively elongate, the head anteriorly acute; dorsal rays 91; anal rays 73; scales in the lateral line 54; back less elevated than in other species; head small, the profile forming an angle at the posterior part of upper eye, the snout being abruptly pointed; eyes large, 4½ in head, the lower being before the upper; interorbital space elevated, with two prominent ridges, the space between them concave; ridge above lower eye higher than upper and joining the latter behind upper eye, to form a sharp ridge; upper eye with some vertical range; mouth very small, the maxillary 4 in head, not reaching front of pupil; teeth bluntish, close-set, in one row, chiefly on the blind side; scales and fins much as in *E. crossotus*; the edge of the subopercle on the blind side fringed with white cirri, as in the latter species; scales large, loose, little ciliate; gill-rakers very short and slender; gill membranes broadly united; caudal fin rhombic, rather pointed; pectoral 1¼ in head; fin rays scaly; head 5 in length; depth 2⅙; color light olive-brown, with vague spots and darker markings; fins similarly marked. ECTENES, 60.

aa. Body deeper, the head not acute in profile; dorsal rays 76 to 85; anal 56 to 67; scales 38 to 48; teeth sharp, close-set, uniserial.

b. Body somewhat elongate, pear-shaped, the depth not more than half the length, the body thinner and more compressed than in *E. crossotus*; mouth very small, the maxillary 4½ in head; eye 3 to 3½ in head; interorbital space a narrow, sharp ridge; cirri on subopercle rather few and long; D. 77 to 78; A. 57 to 61; lat. l. 38 to 41. Head 4 in length; depth 2¼ to 2. Vertebræ $9 + 25 = 34$. Color grayish, with a few irregular vague dark blotches, none of them larger than the eye; fins speckled; two dark spots at base of caudal............ MICROSTOMUS, 61.

bb. Body very deep, the depth rather more than half the length; eye 3¾ in head; interorbital space a narrow, sharp ridge, divided anteriorly; maxillary about 4 in head; head 4¾; depth 1⅘ to 2 (1⅘ in Atlantic specimens). D. 76 to 85; A. 56 to 67; lat. l. 48 (42 to 45 in Atlantic specimens). Vertebræ $9 + 25 = 34$; cirri on subopercle of blind side numerous, white; color light olive-brown, with some darker blotches; vertical fins finely mottled and speckled with black and gray. CROSSOTUS, 62.

60. ETROPUS ECTENES.

Etropus ectenes Jordan, sp. nov.

Habitat.—Pacific coast of South America.

The types of this species are two examples (11605, Mus. Comp. Zool.) collected at Callao, Peru, by Dr. Jones. There are also a large number of young examples in the collection (11145) obtained at Paraca Bay by the Hassler Expedition.

The species is very readily distinguished from *E. crossotus* by its elongate form, acute head, and by the larger numbers of its fin-rays and scales.

61. ETROPUS MICROSTOMUS.

Citharichthys microstomus Gill, Proc. Ac. Nat. Sci. Phila., 1864, 223. (Beesley's Point, N Jersey.)

Etropus rimosus Goode & Bean, Proc. U. S. Nat. Mus., 1885, 593. (Coast of Florida, between Pensacola and Cedar Keys, dredged at the depth of 21 fathoms.)

Etropus crossotus Jordan & Evermann, Proc. U. S. Nat. Mus., 1886. (Pensacola.)

Habitat.—Gulf of Mexico.

On re-examining our specimens of *Etropus*, we find that those obtained by Jordan & Evermann from Pensacola differ from the others in the greater elongation of the body and in the somewhat grayer coloration. These correspond fairly to the description of *Etropus rimosus*. All other specimens from the United States coast collected by Dr. Jordan and his associates, are, in our opinion, referable to *Etropus crossotus*.

The original description of *Citharichthys microstomus* Gill, fits this species better than any other known. The fish in question is much too elongate for *Etropus crossotus* (depth 2⅝ in total length), and the mouth is too small for any of the known species of *Citharichthys* (maxillary 4 in head; mandible 2½).

In the Museum of Comparative Zoology are numerous young specimens collected at Somers Point, New Jersey, by Dr. Stimpson. These seem to belong to the genus *Etropus*. The teeth are equal; the scales are 44, and the depth of the body is 2⅙ in its length. The eye is 4 in head, the dorsal rays 75 to 80, and the anal rays 56 or 57. The color is light brown, mottled and spotted with darker.

These certainly represent the *Citharichthys microstomus* of Gill, collected in the same neighborhood by the same naturalist. We are unable to distinguish them from *Etropus rimosus*.

62. ETROPUS CROSSOTUS.

Etropus crossotus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 364 (Mazatlan). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 305 (Lake Pontchartrain; Mazatlan; Panama; Galveston). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1882, 618 (Charleston). Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 108–111 (Mazatlan; Panama). Jordan & Gilbert, Syn. Fish. N. A., 1882, 839. Bean, Cat. Fish. Intern. Exh., 1883, 44 (St. John's River). Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 234 (Cedar Keys).

Etropus microstomus Jordan, Proc. U. S. Nat. Mus., 1886, 29. (Beaufort, N. C.) (Not *Citharichthys microstomus* Gill.)

Habitat.—Both coasts of tropical America, north to North Carolina.

This little fish seems to be abundant in all warm and sandy shores of tropical America. It is the smallest and feeblest of all our flounders, and has therefore been generally overlooked by collectors. Its range will doubtless prove to be coextensive with that of its near ally, *Citharichthys spilopterus*.

In the Museum of Comparative Zoology are specimens of this species from Rio Janeiro, Santos, Victoria, Para, and Sambaia, in Brazil. The largest of these is 6 inches in length. Head 5 in length, depth, $1\frac{9}{10}$; scales, 44; D. 85; A. 67.

A re-examination of the specimens collected by Prof. O. P. Jenkins at Beaufort, N. C., and described by Dr. Jordan under the name of *Etropus microstomus*, shows that these are identical with the specimens of *Etropus* from Charleston, Cedar Keys, New Orleans, and Galveston. These differ from the types of *Etropus crossotus* only in the slightly greater depth of the body, and in the slightly larger size of the scales. We now refer them to the latter species without much hesitation, hardly regarding them worthy of even subspecific distinction.

Genus XXIII.—THYSANOPSETTA.

Thysanopsetta Günther, Voyage Challenger, Shore Fishes, 1880, 22 (*naresi*).

TYPE: *Thysanopsetta naresi* Günther.

We have not seen the typical species of Thysanopsetta. From the figure and description it would seem that the genus differs from *Etropus* only in having the teeth in villiform bands.

ANALYSIS OF SPECIES OF THYSANOPSETTA.

a. [Body oblong; head small; eyes $3\frac{1}{2}$ in head, well separated, the interorbital space being flat and scaly; mouth moderate, the maxillary more than one-third head; teeth in villiform bands; scales adherent, ctenoid; a fleshy lobe behind ventrals; lateral line straight; head, 5; depth, $2\frac{1}{2}$; D. 87; A. 59; lat. l. 76 (in plate); color, nearly uniform brownish, the body and fins mottled.] (*Günther*) ....NARESI, 63.

63. THYSANOPSETTA NARESI.

Thysanopsetta naresi Günther, Voyage Challenger, Shore Fishes, 1880, 22. (Cape Virgin, Straits of Magellan.)

Habitat.—Straits of Magellan.

We know this species from the original figure and description only.

Genus XXIV.—MONOLENE.

Monolene Goode, Proc. U. S. Nat. Mus., 1880, 337 (*sessilicauda*).

TYPE: *Monolene sessilicauda* Goode.

This peculiar genus of deep-sea flounders is probably allied to *Arnoglossus* and *Citharichthys*. Of this we cannot speak with certainty, not having examined any members of the group, and the insertion of the ventral fins has not been described in either of the two known species.

ANALYSIS OF SPECIES OF MONOLENE.

a. [Dorsal rays, 99 to 103; anal rays, 79 to 84; scales of blind side ctenoid, 23–92–25; head everywhere closely scaly, even to the lips and front of snout; mouth oblique, the maxillary less than one-third length of head; teeth, uniserial, subequal; eyes very close together, the interorbital space a very narrow ridge; arch of lateral line very peculiar, the curve having two angles; head 5 in length; depth, $2\frac{3}{4}$; ashy brown, with spots of darker brown; pectoral barred; vertebræ 43.] (*Goode*) SESSILICAUDA, 64.

aa. [Dorsal rays, 124; anal rays, 100; scales of blind side scarcely ctenoid, 30–105–32; snout and lips not scaly; maxillary 3 in head; eyes, large, 2⅖ in head, separated by a very narrow ridge; head 4⅓ in length; depth about 3; light brownish gray, the fins dusky, the pectoral black.] (*Goode & Bean*) .... ATRIMANA, 65.

64. MONOLENE SESSILICAUDA.

Monolene sessilicauda Goode, Proc. U. S. Nat Mus., 1880, pp. 337, 338 (deep sea south of New England). Goode, Proc. U. S. Nat. Mus., 1880, 472 (deep sea southern coast of New England, stations 870, 871, 876, 877). Jordan & Gilbert, Syn. Fish. N. A., 1882, p. 841. Goode and Bean, Bull. Mus. of Comp. Zoology, xix, p. 184 (station 314; South Carolina).

Habitat.—Deep waters of the Gulf Stream.

This species is known to us from the accounts of Goode & Bean.

65. MONOLENE ATRIMANA.

Monolene atrimana Goode & Bean, Bull. Mus. Comp. Zool., xii, 155, 1886 (deep waters off Barbadoes).

Habitat.—Deep waters of the Caribbean Sea.

This species is known to us from the original description.

Genus XXV.—ONCOPTERUS.

Oncopterus Steindachner, Ueber eine neue Gattung und Art aus der Familie der Pleuronectoiden, 1874, 1 (*darwini*).

TYPE: *Oncopterus darwini* Steindachner.

This singular genus is based on a single species found on the shores of East Patagonia. It has no near allies among the American flounders, but it has several points of resemblance to the genera *Rhombosolea*, *Ammotretis*, and *Peltorhamphus* of the Australian fauna, and we have ventured to associate the four in a subfamily, which may be called *Oncopterinæ*. The *Oncopterinæ* agree in having some sort of peculiar appendage on or near the snout, apparently connected with the first interspinal. They agree with the *Platessinæ* in the general form, the dextral portion of the eyes, and in the structure of the mouth. Their nearest ally in this group is *Pleuronichthys*. In the insertion of the ventrals, they agree with the *Pleuronectinæ* and with the genus *Achirus* of the *Soleinæ*. In both *Peltorhamphus* and *Rhombosolea*, the ventral is continuous with the anal as in *Zeugopterus* and *Achirus*, but in *Oncopterus* the two fins are separate. In *Peltorhamphus* and *Rhombosolea*, the bone connected with the the first interspinal extends forward as a sort of nose, meeting the chin (much as in *Achiropsis* and *Apionichthys*). In *Oncopterus* this bone is twisted to the blind side, and has a very peculiar position, described below. The scales are smooth and cycloid in *Oncopterus* and *Rhombosolea*, ctenoid in *Peltorhamphus*. In *Peltorhamphus* and *Oncopterus* the left ventral is present. It is wanting in *Rhombosolea*. *Ammotretis* we have been unable to examine. In *Oncopterus* the lateral line has an anterior arch and many accessory branches. It is straight and simple in the other genera. In all the teeth are sharp, close set, in a band, and chiefly on the blind side.

ANALYSIS OF SPECIES OF ONCOPTERUS.

a. Body broadly ovate, with regular outlines; mouth small, twisted toward the blind side; its teeth small and in bands; maxillary 3¼ in head; eye 5½, twice the concave interorbital area; gill-rakers short and slender; left side above eye with a deep horizontal groove, in which lies a depressible curved bone as long as the maxillary. This seems to be attached to the first interneural, and is probably a modified fin-ray. On its upper edge on either side is a fringe of short fleshy projections resembling the gill fringes, but much shorter. Scales small, mostly smooth. Lateral line with a long, low arch, from which four accessory branches extend vertically upward. Another branch behind curve, and about 6 on head; blind side similar; no anal spine. Right ventral of six rays, placed wide apart along the ridge of the abdomen, but not joining the anal and not extending forward of the isthmus. Left ventral lateral, with narrow base. Color dark brown, everywhere covered with whitish stellate spots. Head 3⅗ in length. Depth, 2. D., 61. A., 45. V., 6. Scales, 115 .... DARWINI, 66.

66. ONCOPTERUS DARWINI.

Rhombus sp. Darwin, Jenyns, Voyage of the Beagle, Fishes, 1842 (east coast of Patagonia).
Oncopterus darwini Steindachner, Ueber Eine neue Gattung; etc, Pleuronectoiden, 1874, 1 (San Mathias Bay, Eastern Patagonia).

Habitat.—Eastern coast of Patagonia.

Of this species we have examined numerous specimens in the Museum of Comparative Zoology. Nos. 11397 and 11398 are adult examples from San Mathias Bay. To this lot belong Dr. Steindachner's original types. There is also a bottle of young examples (11311, M. C. Z.) from Rio Grande do Sul.

Genus XXVI.—PLEURONICHTHYS.

Pleuronichthys Girard, Proc. Ac. Nat. Sci. Phila., 1851, 139 (*cœnosus*).
Heteroprosopon Bleeker, Comptes Rendus Acad. Amsterdam, xiii, 1862, 8 (*cornutus*).
Parophrys Günther, Cat. Fishes, iv, 454, 1862 (not of Girard).

TYPE: *Pleuronichthys cœnosus* Girard.

This well-marked genus contains three American species, which are very closely related to each other. The Asiatic species, *Platessa cornuta* Schlegel, of the coasts of China and Japan, is also a member of this group, having an accessory branch to the lateral line as in the American species. This species bears some resemblance to *Pl. verticalis.*

The species of *Pleuronichthys* are herbivorous. They spawn in the spring, and live in comparatively deep water.

ANALYSIS OF SPECIES OF PLEURONICHTHYS.

a. Dorsal fin beginning on the level of the lower lip, its first nine rays on the blind side; a blunt tubercle at front of upper eye, another at each end of the narrow interorbital ridge, the posterior largest but usually not spine-like; two or three above the latt r, behind the upper eye; some prominences above the opercle; head 3⅜; depth 1⅞; D. 72; A. 40; vertebrae 14 + 26 = 40; color brownish, usually much mottled with brown and gray, often finely speckled on body and fins .... DECURRENS, 67.

aa. Dorsal fin beginning on level of upper lip, about five rays being on the blind side.

b. Interorbital ridge posteriorly with a very strong, backward directed spine; some tubercles on interorbital ridge; head 4; depth 1⅞; D. 65 to 72, A. 45 to 48; vertebræ 13+25=38; color dark olive brown, much mottled and sometimes with grayish spots; middle of sides often with dark ocellus. .VERTICALIS, 68.

bb. Interorbital ridge prominent, but without spines or conspicuous tubercles; right side of lower jaw with a narrow band of teeth; head 4¼; depth 1⅔; D. 68, A. 48 to 50; color light brown, usually profusely mottled, the colors variable ....CŒNOSUS, 69.

67. PLEURONICHTHYS DECURRENS.

Pleuronichthys cœnosus Lockington, Proc. U. S. Nat. Mus., 1879, 97 (San Francisco) (not *Pleuronichthys cœnosus* Girard).

Pleuronichthys quadrituberculatus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 50 (not of Pallas). Jordan, Nat. Hist. Aquat. Anim., 1884, 189 (Monterey, Point Reyes, Farallones).

Pleuronichthys decurrens Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (San Francisco; Monterey Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, p. 69 (Monterey, San Francisco, Farallones). Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 829.

Habitat.—Pacific coast of United States, south to Monterey.

This species is rather scarce along the California coast, being taken chiefly in deep water. It reaches a larger size than either *P. verticalis* or *P. cœnosus.*

68. PLEURONICHTHYS VERTICALIS.

Pleuronichthys verticalis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 49 (San Francisco). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 169. Jordan & Gilbert, Synopsis Fish. N. A., 1882, 829. Jordan, Nat. Hist. Aquat. Anim., 1884, 189 (Monterey, Point Reyes, Farallones).

Habitat.—Coast of California, in deep water.

This species agrees in habits and general characters with *Pleuronichthys decurrens.*

69. PLEURONICHTHYS CŒNOSUS.

Pleuronichthys cœnosus Girard, Proc. Phil. Acad. Sci., 1854, 139 (San Francisco). Girard, U. S. Pacif. R. R. Exped., Fish., 1859, 151 (San Francisco). Lockington, Rep. Com. Fisheries California, 1878–'79, 45 (Farallones). Lockington, Proc. U. S. Nat. Mus., 1879, 97 (San Francisco). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 50 (Santa Catalina Island, San Luis Obispo). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 453 (Puget Sound, San Francisco, Monterey Bay). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 68 (San Diego, Puget Sound). Jordan and Gilbert, Syn. Fish. N. A., 1882, 830. Jordan, Nat. Hist. Aquat. Anim., 1884, 189 (San Diego to Aleutian Islands).

Parophrys cœnosa Günther, iv, 456, 1862.

Habitat.—Pacific coast of America, from the Aleutian Islands to San Diego.

This species is comparatively common in rather deep water and about rocks from Alaska southward, being most common about Puget Sound.

Its apparent abundance as compared with the other species of the genus is doubtless due to its inhabiting shallower waters than they.

Genus XXVII.—HYPSOPSETTA.

Hypsopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1864, 195 (*guttulatus*).

TYPE: *Pleuronichthys guttulatus* Girard.

This genus consists of a single species, abundant on the coast of California. It is very close to *Pleuronichthys*, from which it differs only in a few characters of comparatively minor importance. Its range is in shallower and warmer water than that of the species of *Pleuronichthys*, and, in accordance with this fact, its flesh is firmer and its number of vertebræ less than in the latter genus.

ANALYSIS OF SPECIES OF HYPSOPSETTA.

a. Head without spines or tubercles; accessory lateral line half length of body; outline of body very broadly rhombic; head, $3\frac{3}{4}$; depth, $1\frac{5}{8}$; D. 68, A. 50, lat. l. 95. Vertebræ, $11 + 24 = 35$. Brown, with numerous pale bluish blotches, fading in spirits; blind side largely yellow in life..........................GUTTULATA, 70.

70. HYPSOPSETTA GUTTULATA.

(THE DIAMOND FLOUNDER.)

Pleuronichthys guttulatus Girard, Proc. Acad. Nat. Sci. Phila., 1856, p. 137. Girard, Jour. Boston Soc. Nat. Hist., 1857, pl. 25, figs. 1–4. Girard, U. S. Pacif. R. R. Exped., Fishes, p. 152, 1859 (Tomales Bay). Lockington, Rep. Com. Fisheries California, 1878–'79, p. 44. Lockington, Proc. U. S. Nat. Mus., 1879, p. 94 (San Fransisco).

Pleuronectes guttulatus Günther, Cat. Fish., iv, 445, 1862 (copied).

Hypsopsetta guttulata Gill, Proc. Ac. Nat. Sci. Phila., 1864, 195. Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 453 (San Francisco, San Luis Obispo, Santa Barbara, San Pedro, San Diego). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 68 (Tomales, San Diego). Jordan and Gilbert, Syn. Fish. N. A., 1882, 830. Jordan, Nat. Hist. Aquat. Anim., 1884, 185.

Parophrys ayresi Günther, Cat. Fish. Brit. Mus., iv, 1862, 457 (San Francisco).

Habitat.—Coast of California; Cape Mendocino to Magdalena Bay.

This species is one of the most abundant in the shore waters of the California coast. It is a food-fish of fair quality.

Genus XXVIII.—PAROPHRYS.

Parophrys Girard, Proc. Ac. Nat. Sci. Phila., 1854, 139 (*vetulus*).

TYPE: *Parophrys vetulus* Girard.

This genus consists of a single species, common on the Pacific coast of the United States.

The narrow interorbital space and the vertical range of the upper eye give it a peculiar physiognomy, but in most regards it is not very different from some of the species of *Platessa*.

ANALYSIS OF SPECIES OF PAROPHRYS.

a. Body elongate-elliptical; snout very prominent, forming an abrupt angle with the descending profile; eyes large, 4½ in head, separated by a very narrow, high ridge, the upper eye encroaching on the dorsal outline; teeth small, trenchant, widened at tip; fin-rays scaleless; scales cycloid, those on cheeks usually ciliated, especially in northern specimens; head 3½; depth 2½; D. 74 to 86; A. 54 to 68; lat. l. 105; vertebræ 11 + 33 = 44; uniform light olive-brown; the young sometimes spotted with blackish .... VETULUS, 71.

71. PAROPHRYS VETULUS.

Parophrys vetulus Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 140 (California). Günther, Cat. Fish., iv, 455 (copied). Lockington, Rep. Com. Fish. Cal., 1878–9, p. 45. Lockington, Proc. U. S. Nat. Mus., 1879, p. 100 (San Francisco). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (Puget Sound, San Francisco, Monterey Bay, Santa Barbara). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 68 (Santa Barbara, Monterey, Puget Sound). Jordan, Nat. Hist. Aquat. Anim., 1884, 185 (Santa Barbara to Alaska).
Pleuronectes vetulus Jordan and Gilbert, Synopsis Fish. N. A., 1882, 831.
Pleuronectes digrammus Günther, Cat. Fish., iv, 445, 1862 (Victoria).
Parophrys hubbardi Gill, Proc. Ac. Nat. Sci. Phila., 1862, 281 (San Francisco).

Habitat.—Pacific coast of North America, Alaska to Santa Barbara.

This small flounder lives in waters of moderate depth. It is, next to *Platichthys stellatus*, probably the most abundant of the flounders of the California coast.

Genus XXIX.—INOPSETTA.

Inopsetta Jordan & Goss, Cat. Fish. N. A., 1885, 136 (*ischyrus*).

TYPE: *Parophrys ischyrus* Jordan & Gilbert.

This genus contains a single species, closely allied to *Platichthys stellatus*, but separated from it by the curious character common to many of our Pacific coast flounders, of having an accessory branch to the lateral line. In technical characters there is not very much to separate *Inopsetta* from *Parophrys*, though the resemblance between *I. ischyra* and *P. vetulus* is not very close.

ANALYSIS OF SPECIES OF INOPSETTA.

a. Body oblong, robust; snout projecting, forming an angle with the profile; teeth narrow incisors; interorbital space rather broad, scaly; eyes large; lower pharyngeals each with two rows of coarse, blunt teeth; scales thick, firm, adherent, loosely imbricated, all ctenoid on both sides of body, those on head roughest; accessory lateral line short. Head 3½; depth 2. D. 70 to 76; A. 52 to 57; lat. l. 85. Light olive-brown, with dusky blotches, blind side more or less spotted or tinged with rusty .... ISCHYRA, 72.

72. INOPSETTA ISCHYRA.

Parophrys ischyrus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, 276 and 453 (Puget Sound). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, 67 (Seattle). Jordan, Aquat. Anim., 1884, 185 (Seattle).
Pleuronectes ischyrus Jordan and Gilbert, Syn. Fish. N. A., 1882, 831.
Isopsetta ischyra Jordan, Cat. Fish. N. A., 1885, 136.

Habitat.—Puget Sound (probably northward to Alaska).

This species is known only from four specimens taken by Dr. Jordan at Seattle in 1880. It is a large rough flounder, with firm white flesh.

Genus XXX.—ISOPSETTA.

Isopsetta Lockington, MSS., Jordan & Gilbert, Synopsis Fish. N. A., 1883, 832 (*iso lepis*).

TYPE: *Lepidopsetta isolepis* Lockington.

This genus consists of a single species found on the coast of California. It approaches in many respects very close to the large-mouthed flounders of the type of *Hippoglossoides*, and it may fairly be said to be intermediate between *Psettichthys* and *Lepidopsetta*. Its affinities on the whole seem to be nearest the latter.

ANALYSIS OF SPECIES OF ISOPSETTA.

a. Body elliptical, much compressed, its outlines very regular; eyes rather large, the upper 4½ in head, the interorbital space broad, flattish, and scaly. Scales rather large, ctenoid, closely imbricated; maxillary 3⅗ in head; teeth bluntish, conical, close-set, but not forming a cutting edge. Lower pharyngeals each with two rows of bluntish teeth; lateral line with a slight arch in front, and an accessory branch nearly as long as head. Head 4; depth 2¼. D. 88; A. 65; lat. l. 88. Color dark-brown, mottled and blotched with darker. Vertebræ $10 + 32 = 42$.
ISOLEPIS, 73.

73. ISOPSETTA ISOLEPIS.

Lepidopsetta umbrosa Lockington, Proc. U. S. Nat. Mus., 1879, 106. (San Francisco; not of Girard.)
Lepidopsetta isolepis Lockington, Proc. U. S. Nat. Mus., 1880, 325. (San Francisco.)
Parophrys isolepis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 453, 1881, 67 (Puget Sound, San Francisco). Jordan & Gilbert, Syn. Fish. N. A., 1882, 832. Jordan, Nat. Hist. Aquat. Anim., 1884, 186 (Monterey to Puget Sound).
Isopsetta isolepis Jordan, Cat. Fish. N. A., 1885, 136.

Habitat.—Puget Sound to Point Concepcion, in rather deep water.

This small flounder is rather common off the coast of California, where it reaches a length of about 15 inches. It much resembles *Psettichthys melanostictus*, but its small mouth and blunt dentition indicates a real affinity with the small-mouthed flounders, among which it is here placed. Its nearest relative among our species is doubtless *Lepidopsetta bilineata*.

Genus XXXI.—LEPIDOPSETTA.

Lepidopsetta Gill, Proc. Ac. Nat. Sci. Phil., 1864, 195 (*umbrosus*).

TYPE: *Platichthys umbrosus* Girard = *Platessa bilineata* Ayres.

This genus probably contains but a single species, abundant on the Pacific coasts of North America. It is close to *Inopsetta*, from which it is separated by the arch of the lateral line, and still closer to *Limanda*, from which the accessory branch of the lateral line alone separates it.

Pleuronectes variegatus Schlegel, from Japan, may belong to *Lepidopsetta.*

The same name, *Lepidopsetta*, has been lately given by Dr. Günther to a very different genus of flounders. For the group so-called the name *Mancopsetta* of Gill should be used.

ANALYSIS OF SPECIES OF LEPIDOPSETTA.

a. Body broadly ovate, thickish; teeth bluntish, subconical: lower pharyngeals with two rows of blunt teeth. Snout projecting, forming an angle; eyes large, separated by a prominent scaly ridge. Scales small, mostly ctenoid, those on the head very rough, especially in northern specimens (var. *umbrosa*); scales of the blind side smooth; accessory lateral line half length of head. Anal spine present. Head 3⅗; depth 2½. D. 80; A. 60; lat. l. 85. Vertebræ, 11+29=40. Yellowish brown, with numerous round pale blotches ....BILINEATA, 74.

74. LEPIDOPSETTA BILINEATA

[Plate XI.]

Platessa bilineata Ayres, Proc. Acad. Nat. Sci. Cal., 1855, p. 40 (San Francisco).
Pleuronectes bilineatus Günther, Cat. Fish., 444, 1862 (copied). Jordan & Gilbert, Syn. Fish. N. A., 1882, 833.
Lepidopsetta bilineata Gill, Proc. Ac. Nat. Sci. Phila., 1864, 195. Lockington, Proc. U. S. Nat. Mus., 1879, p. 103 (San Francisco). Lockington, Rep. Com. Fisheries California, 1878–'79, p. 46 (Farallone Islands). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (Puget Sound, San Francisco, Monterey Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 68 (Monterey, Puget Sound). Bean, Proc. U. S. Nat. Mus., 1881, p. 241 (Monterey Bay, San Francisco, Puget Sound). Bean, Cat. Col. Fish. U. S. Nat. Mus., p. 19, 1883 (Port Chatham, Cook's Inlet). Bean, Proc. U. S. Nat. Mus., 1883, p. 353 (Carter Bay, British Columbia). Jordan, Nat. Hist. Aquat. Anim., 184, pl. 50 (Monterey to Alaska).
Platichthys umbrosus Girard, Proc. Ac. Nat. Sci. Phila., 1856, 136. (Puget Sound.)
Pleuronectes umbrosus Günther, iv, 1862, 454. (Esquimault Harbor.)
Pleuronectes perarcuatus Cope, Proc. Ac. Nat. Sci. Phila., 1873. (Alaska.)

Habitat.—Pacific coast of North America, Alaska to Monterey.

This species is one of the commonest of the flounders of the Pacific coast, its abundance apparently increasing towards the northward. It reaches a weight of five or six pounds and is an inhabitant of shallow waters. Specimens from Puget Sound and northward are rougher than Southern specimens and constitute a slight geographical variety, for which the name of *Lepidopsetta bilineata umbrosa* may be used. Th's is the same as the *perarcuatus* of Cope.

Genus XXXII.—LIMANDA.

Limanda Gottsche, Wiegmann's Archiv, 1835, 100 (*limanda*).
Myzopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1864, 217 (*ferruginea.*)

TYPE: *Pleuronectes limanda* Linnæus.

This genus is closely allied to *Pseudopleuronectes*, from which it differs only in the presence of an arch on the anterior part of the lateral line. Four species of *Limanda* are now recognized.

ANALYSIS OF SPECIES OF LIMANDA.

a. Head comparatively large, 3¾ to 4½ in length.

b. Scales rather small, 90 to 100 in the course of the lateral line; scales of right side ctenoid, closely imbricated; those of blind side mostly smooth.

c. Teeth conical, close-set, forming a continuous series, about 11 + 30 in the lower jaw; snout abruptly projecting, forming in front of upper eye a sharp angle with the descending profile; head rather long; eyes large, separated by a high and very narrow ridge, which is continued in long rugose prominences above the opercle. Head 4; depth 2⅛; D. 85; A. 62; lat. l. 100; color brownish olive, with numerous irregular reddish spots; fins similarly marked; blind side largely lemon-yellow.. FERRUGINEA, 75.

c. Teeth less conical, less closely set, in an irregular series, about 10 + 20 in lower jaw; snout less prominent, forming a slight angle with the profile; head rather smaller; eyes separated by a moderate ridge, broader and lower than in *L. ferruginea;* no rugose prominences above opercle. Head 4½; depth 2¼; D. 65 to 78; A. 50 to 62; scales 86 to 96; vertebræ 40; color brownish, with some cloudy markings or dusky spots.. LIMANDA, 76.

bb. Scales larger, wide apart, about 80 in the course of the lateral line, each scale with 1 to 4 spinules, those mostly erect; scales of blind side more or less rough; lower pharyngeals narrow, with bluntish teeth; interorbital space narrow, scaly; head large; snout not forming a distinct angle with the profile; teeth small, subconical. Head, 3¾; depth 2; D. 69 to 74; A. 53 or 54; lat. l. about 80. Color brown, nearly plain, the blind side with tinges of yellow. ASPERA, 77.

aa. [Head very short, 5½ in length; snout very short; interorbital space very narrow; teeth small, apparently biserial, chiefly on the blind side; curve of lateral line half as deep as long, as long as head; scales strongly ctenoid, those on blind side smaller and cycloid. Head, 5½; depth, 2⅜; D. 64; A. 63; lat. l. 88 =(27+61). Color grayish, mottled with darker, a conspicuous black blotch on outer rays of caudal on each side.] (*Goode*).............................. BEANI, 78.

75. LIMANDA FERRUGINEA.

(THE RUSTY DAB.)

[Plate XII.]

Platessa ferruginea D. H. Storer, Fish. Mass., 1839, 141, pl. 2 (Cape Ann). DeKay, New York Fauna, Fishes, 1842, 297, pl. 48, f. 155 (New York). Storer, Syn. Fish. N. A., 1846, 476.

Pleuronectes ferrugineus Günther, iv, 447, 1862 (Boston). Jordan & Gilbert, Syn. Fish. N. A., 1882, 834.

Myzopsetta ferruginea Gill, Proc. Ac. Nat. Sci. Phila., 1864, 217.

Limanda ferruginea Goode, Proc. U. S. Nat. Mus., 1880, 472 (New England). Goode, Hist. Aquat. Anim., 1884, pl. 49.

Platessa rostrata H. R. Storer, Bost. Journal Nat. Hist., vi, 268, 1850 (Labrador).

Limanda rostrata Gill, Proc. Ac. Nat. Sci. Phila., 1864, 217.

Habitat.—Atlantic coast of North America, Labrador to New York.

This species is rather common northward on our Atlantic coast. It is allied to the European Dab, but has smaller scales and a more prominent snout. Our specimens are from the east coast of Massachusetts.

76. LIMANDA LIMANDA.

(THE DAB.)

Pleuronectes limanda Linnæus, Syst. Nat., ed. x, p. 270, 1758 (after Artedi) (and of the early copyists). Günther, Cat. Fish., iv, 446, 1862 (Firth of Forth; Plymouth). Day, Brit. Fishes, vol. ii, p. 31, plate civ.

Pleuronectes limandula Lacépède, Hist. Nat., Poiss., iv, 1803 (after "la Limandelle". Duhamel, ix, ch. 1, p. 268, pl. 6, f. 3, 4.)

Limanda vulgaris Gottsche, "Wiegmann's Archiv, 1835, 100."

Limanda oceanica Bonaparte, Catologo, 48, 1846. (*Platessa limanda* L.)

? *Limanda pontica* Bonaparte, l. c., 48, 1846 (Black Sea, after Pallas).

Pleuronectes linguatula Gronow, Syst., ed. Gray, 1854, 88 (not of L.).

Habitat.—Northern coasts of Europe, south to France.

This small flounder is abundant on the coasts of Northern Europe and southward to the coasts of France. Our specimens are from the market at Paris.

Günther speaks of other specimens, more elongate, the depth being but two-fifths the length without caudal. The synonym *Pleuronectes limandula* would appear to belong to this latter type.

77. LIMANDA ASPERA.

[Plate XIII.]

Pleuronectes asper Pallas, Zoogr. Rosso.-Asiat., 1811, iii, 425 (east coast of Siberia). Günther, iv, 454, 1862 (copied). Steindachner, Pleuronectiden, etc., aus Decastris Bay, 1870-'5 (Decastris Bay). Jordan and Gilbert, Synopsis Fish. N. A., 1882, 835. (Description from Alaskan specimens collected by Dr. Bean.)

Limanda aspera Bean, Proc. U. S. Nat. Mus., 1881, p. 242 (Sitka, St. Paul, Humboldt Harbor, Shumagins, Port Clarence, Plover Bay, Siberia; Indian Point, Siberia). Bean, Cat. Col. Fish, U. S. Nat. Mus., 1883, p. 20. (Sitka, Alaska.) Bean, Proc. U. S., Nat. Mus., 1883, p. 354 (Port Simpson, Cardenas Bay, British Columbia). Bean, Hist. Aquat. Anim., 1884, 184, pl. 48. (Gulf of Alaska, Unalashka, Sitka, Wrangel.)

Habitat.—Coasts of Alaska and Kamtschatka.

This species is chiefly known from the accounts given by Dr. Bean, who has collected it in various localities in Alaska. Its scales are larger and rougher than in *L. ferruginea* which, in many respects, it resembles. A specimen from the island of Saghalien is in the museum at Cambridge.

78. LIMANDA BEANI.

Limanda beani Goode, Proc. U. S. Nat. Mus., 1880, 473 (southern coast New England, deep-sea stations, 875, 876).

Pleuronectes beani Jordan and Gilbert, Syn. Fish. N. A., p. 835, 1882.

Habitat.—Deep water off the coasts of New England.

We know this species only from the accounts given by Professor Goode.

Genus XXXIII.—PSEUDOPLEURONECTES.

Pseudopleuronectes Bleeker, Comptes Rendus Acad. Amst., Pleuron., 7, 1862 (*planus*).

TYPE: *Pleuronectes planus* Mitchill=*Pleuronectes americanus* Walbaum.

This genus is distinguished from *Platessa* chiefly by the well-imbricated ctenoid scales, and from *Limanda*, which it more closely resembles, by the want of arch to the lateral line. Besides the typical species, we refer to this genus a second from the North Pacific.

ANALYSIS OF SPECIES OF PSEUDOPLEURONECTES.

a. Dorsal rays 65; anal rays 48. Body regularly elliptical; a very slight angle above eye; interorbital space rather broad, convex, half as wide as eye, and entirely scaly; a low granular ridge above opercle. Head 4; depth 2¼; lat. l. 83. Vertebræ 10 + 26 = 36. Color dark rusty brown, plain or mottled with darker; fins nearly plain .... AMERICANUS, 79.

aa. [Dorsal rays 58; anal 38. Body subelliptical, the snout rather pointed, and not forming an angle above eye; interorbital space rather broad, half width of eye; a rather prominent rugose ridge above opercle, with a smaller similar ridge behind it; both sides of jaws with teeth. Head 3⅗; depth 2⅛; lat. l. 70. Color brown, with vague dusky spots; six or seven blackish vertical bars on dorsal and anal; similar lengthwise blotches on caudal.] (*Steindachner*). PINNIFASCIATUS, 80.

79. PSEUDOPLEURONECTES AMERICANUS.

(THE COMMON FLAT-FISH OR WINTER FLOUNDER.)

[Plate XIV.]

Flounder, Schöpf, "Schrift. Gesellschaft Naturforschender Freunde, viii, 1788, 148." (New York.)

Pleuronectes americanus Walbaum, Artedi, Piscium, 1792, 113 (based on the "Flounder" of Schöpf). Bloch & Schneider, Syst. Ichth., 1801, 150 (copied). Günther, iv, 443, 1862 (New York). Jordan & Gilbert, Synopsis, 1882, 837. Stearns, Proc. U. S. Nat. Mus., 1883, 125 (Labrador).

Pseudopleuronectes americanus Gill, Proc. Ac. Nat. Sci. Phila., 1864, 216. Goode, Nat. Hist. Aquat. Anim., 1884, 182, pl. 44 (Chesapeake Bay to Bay of Chaleur).

Platessa plana Storer, Fishes Mass., 1839, 140. DeKay, New York Fauna, Fishes, 295, pl. 49, f. 158, 1842 (New York). Storer, Synopsis, 1846, 476.

Pseudopleuronectes planus Bleeker, Comptes Rendus Amsterd., xiii, 1862, 7.

Platessa pusilla DeKay, New York Fauna, Fishes, 1842, 296, pl. 47, f. 153 (New York). Storer, Synopsis, 1846, 477.

Habitat.—Atlantic coast of North America from Labrador to Chesapeake Bay.

This small flounder is one of the most abundant of the group on our Atlantic coast. It reaches a length of about 15 inches and a weight of less than two pounds. It is a very good food-fish and sells readily in the markets. Along the south coast of Massachusetts this species is more abundant than any other of the flat-fishes.

The specimens examined by us are from Labrador, Cape Breton, Anticosti, Grand Menan, Boston, Provincetown, Wood's Holl, New Bedford, and Somers Point, New Jersey.

80. PSEUDOPLEURONECTES PINNIFASCIATUS.

Pleuronectes pinnifasciatus (Kner) Steindachner, Ueber einige Pleuronectiden, etc., aus Decastris Bay, 1870, 2, pl. 1, f. 1 (Decastris Bay).

Habitat.—Sea of Kamtschatka, Decastris Bay.

This species is known to us only from Dr. Steindachner's description and excellent figure. From this we conclude that it belongs to the group called *Pseudopleuronectes*, although its pharyngeals have not been described. It seems to us nearer to *P. americanus* than to *Liopsetta glacialis.*

Genus XXXIV.—PLATESSA.

Pleuronectes Artedi, Genera, etc., in part.

Pleuronectes Linnæus, Syst. Nat., ed. x, 268, 1758 (includes all known *Pleuronectidæ*).

Platessa Cuvier, Règne Animal, ii, 1817 (*platessa*), (first subdivision of *Pleuronectes* L.).

Platessa Fleming, Brit. Anim., 1828, 198 (*vulgaris=platessa*), (first restriction of *Pleuronectes* L. to *Pl. maximus* and relatives).

Pleuronectes Swainson, Nat. Hist. Class'n Anim., ii, 1839 (*platessa*), (second restriction of *Pleuronectes*).

Platessa DeKay, New York Fauna, Fishes, 1842 (*platessa*).

Pleuronectes Bleeker, Comptes Rendus Acad. Amsterd., xiii, 1862 (*platessa*), (and of most recent authors).

Flesus Moreau, Poissons de France, 1881, 299 (*flesus*).

TYPE: *Pleuronectes platessa* Linnæus.

The reasons for retaining for this genus the name *Platessa* instead of *Pleuronectes* have been given under the head of the latter genus.

It is possible that the numerous related groups or genera, *Pseudopleuronectes*, *Platichthys*, and *Liopsetta*, should not be separated from *Platessa*. Convenience in definition of the groups seems, however, best served by regarding each of these types as forming a distinct genus, though whether they are called genera or subgenera is a matter of minor importance. The group *Flesus* is fairly well defined, and may, perhaps, also merit generic rank.

ANALYSIS OF SPECIES OF PLATESSA.

a. Teeth incisor-like, compressed, close set, forming a continuous cutting edge; no stellate scales at bases of dorsal and anal rays; lower pharyngeals narrow, the teeth almost uniserial. (*Platessa.*)

b. Snout projecting, forming a distinct angle above eye.............PLATESSA, 81.

x. Scales all cycloid, no ciliated scales anywhere; a series of about six small, bony tubercles on ridge above opercles; a small tubercle behind upper eye, and one before lower; interorbital space narrow, smooth. Head, $3\frac{1}{4}$; depth, 2. D. 67 to 77. A. 50 to 57. Vertebræ, $14 + 29 = 43$. Color, brownish or dusky, with rather large, round yellowish spots, which fade in spirits. (These spots rarely black, and persistent.)...Var. *platessa*, 81 (*a*).

xx. Scales not all cycloid, some of those along lateral line, along the base of dorsal and anal and on sides of head and abdomen ciliated, otherwise as in the preceding. D. 62 to 66. A. 46 to 48. Light brownish, with yellow spots. (*Gottsche*)..................................Var. *pseudoflesus*, 81 (*b*).

bb. Snout not projecting, not forming a distinct angle above eye; tubercles on ridge above opercle at base of lateral line, coarser than in *Pl. platessa*, and about five in number; a small tubercle behind upper eye; scales small, cycloid in all specimens examined. Head, 3⅗; depth, 2. D. 68. A. 50. Lat. l. 78. Color, grayish, mottled with paler and with round black spots; fins very dark ....................................QUADRITUBERCULATA, 82.

aa. Teeth in jaws small, conical, well-separated, not forming a continuous cutting edge; a stellate scale or tubercle at the base of each ray of dorsal and anal; lower pharyngeals rather narrow, each with four or five rows of teeth. (*Flesus* Moreau.)

c. Body oblong-elliptical, a small angle above eye. Head, 3¼ in length; depth, 2¼; vertebræ 12 + 24 = 36..FLESUS, 83.

y. Sides of head and anterior portion of lateral line with coarse stellate scales or tubercles; smaller ones on sides of abdomen, the scales otherwise cycloid; granular ridge above opercle usually without tubercles. D. 60 to 62. A. 39 to 45. Color brownish, irregularly mottled, the blind side rarely spotted with darker ....Var. *flesus*, 83 (*a*).

yy. Sides of head and lateral line nearly or quite destitute of tubercles, the scales all cycloid except those at the bases of the fin-rays and a few about the eyes; ridge above opercle usually with one or two rugose prominences. D. 62 to 64. A. 41 to 48. Color, dark-brown, often marbled with darker, the blind side usually with irregular dark spots........ *Var. glabra*, 83 (*b*).

81. PLATESSA PLATESSA.

(THE PLAICE.)

[Plate XV.]

a. Var. *platessa.*

Pleuronectes No. 1, Artedi, Genera, etc.

Pleuronectes platessa Linnæus, Syst. Nat., ed. x, 1758, 269 (after Artedi) (and of the early copyists). Günther, iv, 440 (Firth of Forth; Brighton; Bohuslän). Day, Fish. Great Britain, ii, 25, pl. ci (and of recent writers generally).

Scophthalmus diurus Rafinesque, Indice di Ittiologia Siciliana, 1810, 53 (based on the Quarrelet of Rondelet).

Platessa vulgaris Fleming, British Anim., 198, 1828 (and of numerous authors).

Pleuronectes latus Cuvier, Règne Animal, ed. ii, 1828 (deformed example, France).

Pleuronectes borealis "Faber, Isis, 1828, 863" (Iceland).

b. Var. *pseudoflesus* (variety?).

Platessa pseudoflesus Gottsche, Wiegmann's Archiv, 1835, 143 (German Ocean).

Pleuronectes pseudoflesus Günther, iv, 441 (copied).

Habitat.—Coasts of northern Europe, south to Italy.

This is one of the most common of the flat-fishes of Europe, and is, next to the halibut and the turbot, the one of most importance as a food-fish. It reaches usually a weight of five or six pounds, although specimens of 15 pounds have been recorded. It is rather more northerly in its range than the mud-flounder, it being a comparatively rare species in the Mediterranean.

Our specimens of this species are from the markets of Paris. We have examined others in the Museum at Cambridge, from various localities in France, England, Holland, and Scandinavia. There are also a number of specimens from Trieste (Coll. Salmin). In one lot of these there are large black rounded blotches, inky in color, and permanent in alcohol. These take the place of the usual orange spots, which are evanescent in alcohol. Others from the same locality have the usual coloration.

We know nothing of the species called, "*pseudoflesus*." It seems to us likely that it is a variety, or perhaps accidental variation, of *Platessa platessa*, the chief difference consisting in the presence of ciliated scales on the head and other parts of the body. It must be regarded as a very doubtful species at the best.

The alleged species *Platessa borealis* is also unknown to us. It is said to differ in having smaller teeth—31 on the blind side of the premaxillary.

82. PLATESSA QUADRITUBERCULATA.

Pleuronectes quadrituberculatus Pallas, Zoogr. Rosso-Asiat., iii, 423, 1811 (sea between Kamtschatka and Alaska). Bean, Proc. U. S. Nat. Mus., 1881, 241 (Kodiak). Jordan & Gilbert, Syn. Fish. N. A., 1882, 836 (from specimens collected by Dr. W. J. Fisher).

Parophrys quadrituberculatus Günther, iv, 456 (copied).

Pleuronectes pallasi Steindachner, Ichth. Beitr., viii, 45, 1879, plate (Kamtschatka).

Habitat.—Behring Sea.

This small flounder is known to us only from descriptions and from a specimen (28025) collected by Mr. W. J. Fisher at Kodiak, described by Jordan and Gilbert. It seems to be a rare species even in the remote regions it inhabits. Although its pharyngeal teeth have not been examined, there can be little doubt that it will prove a near ally of *Platessa platessa.*

83. PLATESSA FLESUS.

(THE MUD-FLOUNDER OR FLUKE.)

a. Var. *flesus.*

Pleuronectes flesus Linnæus, Syst. Nat., ed. x, 270, 1758 (after Artedi, and of copyists). Günther, iv, 450, 1862. Steindachner, Ichthyol. Bericht., Sechste Fortsetzung, 53, 1868 (Bilboa, Coruña, Vigo, Barcelona, Cadiz, Gibraltar, Rio Miño, Pomerania, Kattegat; unites *flesus* and *glabra;* Spanish localities belong to the latter). Day, Fish. Great Britain, vol. ii, 33, pl. cv, and of recent authors generally.

Platessa flesus Fleming, British Anim., 1828, 198, and of numerous writers.

Pleuronectes passer Linnæus, Syst. Nat., ed. x, 271, 1758 (reversed example).

Pleuronectes flesoides Pontoppidan, "Hist. Nat. Daniæ, 158, tab. 15," 1765 (reversed example).

Pleuronectes roseus Shaw, "Nat. Misc., vii, 238," 1800 (albino example).

Pleuronectes luscus Pallas, Zoogr. Rosso-Asiat., iii, 427, 1811 (Black Sea). "Nordmann, in Demidoff, Voy. Russ. Mérid., iii, 532, Pisc., tab. 27" (Black Sea). Günther, iv, 452 (copied).
Pleuronectes carnaria Brown, "Edinburgh Journal, Nat. and Geol., ii, 99, t. ii" (albino example), 1830.
Platessa melanogaster Higgins, "Zoologist, xiii, 1855, 4596" (doubled example).
Pleuronectes bogdanovi Sandeberg, Bull. Sci. Mosc., lii, pt. 2, p. 236, 1878 (White Sea).
Flesus vulgaris Moreau, Poiss. de France, 1881, iii, 299.

b. Var. *glabra.*

Platessa glabra Rathke, Fauna der Krym., 352, 1837 (Crimea).
Platessa passer Bonaparte, Fauna Italica, Pesci, 1838–1840.
Pleuronectes italicus Günther, Cat. Fish. Brit. Mus., iv, 1862, 452 (Dalmatia).

Habitat.—All coasts of Europe, ascending the streams; the typical form in northern Europe; var. *glabra* in the Mediterranean,

This small species is the common "flounder" or "fluke" of Europe. It is almost everywhere very abundant, but it is held in low esteem as a food-fish. It reaches a length of less than a foot. Our specimens of the typical form, *flesus*, are from the markets of Paris, but we have examined others from various localities in northern Europe. The form called *lusca*, from the Black Sea, we have not seen, and do not know whether it differs at all from the typical *flesus* or not.

The common Mediterranean form called *glabra* (*italica*) differs a good deal in appearance from the ordinary *flesus*, but this difference lies mainly in the greater smoothness of the scales about the head.

The numerous specimens before us from Venice and Trieste differ from those of *flesus* only in the entire absence of the stellate tubercles which cover the head and the neighborhood of the lateral line in that species. Steindachner regards the two as unquestionably identical. Still it seems best to regard them as distinct subspecies, especially as no intermediate specimens have come to our notice. Rathke's description of *Platessa glabra* evidently belongs to the form called *italicus* by Dr. Günther. Rathke's *lusca* agrees with the typical *flesus*. The *Pleuronectes bogdanovi* of Sandeberg from the White Sea seems to be nearly the same as the typical *flesus*. It is said to be deeper (depth 2 in length), smoother, with shorter pectorals (2 in head). Teeth truncate, close-set. Body smooth, except for a row of tubercles on eyed side on bases of dorsal and anal, and two or three similar rows on front of lateral line. D, 53 to 56; A, 37 or 38.

Genus XXXV.—LIOPSETTA.

Liopsetta Gill, Proc. Ac. Nat. Sci. Phila., 1864, 217 (*glaber*) (females).
Euchalarodus Gill, Proc. Ac. Nat. Sci. Phila., 1864, 222 (*putnami*) (males).

TYPE: *Platessa glabra* Storer = *Euchalarodus putnami* Gill.

This genus comprises one, two, or three species of small flounders of the Arctic seas. The genus is distinguished by the large, half-united pharyngeals, as also by the peculiar squamation, the scales in the males being very rough, in the females smooth. This difference has given rise to the nominal genus *Euchalarodus* based on the males, while *Liopsetta* was based on the smoother females, which were erroneously supposed to be scaleless.

The following analysis gives the supposed differential characters of these species, but these characters are of very slight importance, and it is probable that the three nominal species are all varieties of *Liopsetta glacialis*.

ANALYSIS OF SPECIES OF LIOPSETTA.

a. [Ridge above opercle ending in two obtuse tubercles; scales of blind side smooth, those of the eyed side ciliated (probably in males only); interorbital ridge prominent, acute; head, 4½ in total with caudal; depth, 2⅜. D., 50 to 57; A., 36 to 41.] (*Lilljeborg*)........DVINENSIS, 84.

aa. Ridge above opercle coarsely rugose, divided toward its end, but without distinct tubercles; scales ctenoid on both sides in males, those of the blind side smoother.

b. Pectoral fin long, about half length of head in the females. two-thirds head in the males. Head, 3½; depth, 2. D., 55; A., 40; Lat. l., 70. Color, grayish brown, mottled with darker; fins with blackish spots. (Probably identical with the next)........PUTNAMI, 85.

bb. Pectoral fin short, barely half length of head even in the males; head, 4; depth, 2; D., 56; A., 37 to 42. Vertebræ, 13+27=40. Color, dark brown, the fins spotted. GLACIALIS,* 86.

84. LIOPSETTA DVINENSIS.

Platessa dvinensis "Lilljeborg, Vet.-Akad. Handl., 1850, p. 360, tab. 20" (mouth of River Dwina). Nilsson, "Skand. Fauna, iv, 617."

Pleuronectes dvinensis Günther, iv, 442 (copied).

Habitat.—Arctic coasts of Russia.

This species is known to us only from the description copied by Günther from Lilljeborg. It is apparently a species very closely related to *Liopsetta glacialis*, and it is most likely identical with the latter.

85. LIOPSETTA PUTNAMI.

(THE EEL-BACK FLOUNDER.)

[Plate XVI.]

Platessa glabra Storer, Proc. Boston Soc. Nat. Hist., p. 130, 1843 (female). Storer, Syn. Fish. N. A., p. 477, 1846. Storer, Hist. Fish. Mass., 1867, p. 199, pl. xxxi, fig. 1. Putnam, Bull. Essex Inst., vi, 1874, p. 12 (not of Rathke, 1837).

Liopsetta glabra Gill, Proc. Acad. Nat. Sci. Phila., 1864, p. 217.

Pleuronectes glaber Gill, in Report U. S. Com. Fish and Fisheries, 1873, p. 794. Goode and Bean, Amer. Jour. Sci. and Arts, xiv, 1877, p. 476; xvii, 1879, p. 40. Goode and Bean, Proc. U. S. Nat. Mus., 1878, 347 (Casco Bay, Beverly Bridge, Salem, Bucksport, Me.). Jordan and Gilbert, Syn. Fish. N. A., 1882, p. 836. Goode, Nat. Hist. Aquat. Anim., 1884, p. 183, pl. 45.

Euchalarodus putnami Gill, Proc. Acad. Nat. Sci. Phil., 1864, p. 216-221 (Salem, Mass.) male. Gill, Report U. S. Com. Fish and Fisheries, 1873, p. 794. Goode and Bean, Amer. Jour. Arts and Sci., xiv, 1877.

Habitat.—Atlantic coast of North America, from Cape Cod northward to Labrador and beyond.

* The pharyngeals in *dvinensis* and *glacialis* have not been examined.

This species is rather common along the coast of Northern Massachusetts and northward to Labrador. Specimens are frequently found in the markets, mixed with those of *Pseudopleuronectes americanus.* The numerous specimens in our possession were found in the markets of Indianapolis, having been sent thither from Boston.

The remarkable sexual differences in the species have been fully discussed by Dr. Bean (Proc. U. S. Nat. Mus., 1878, 345), the form formerly called *Euchalarodus putnami* being the male, and that called *Pleuronectes glaber* being the female of the same species. These conclusions of Dr. Bean are fully corroborated by our series of specimens in which both sexes are fully represented.

As the name *Platessa glabra* is preoccupied by Rathke (1837), we must adopt the specific name *putnami* for this species if it be regarded as distinct from *Liopsetta glacialis.* Taking our own notes and the published plate of the latter species as a guide, we can see no difference whatever by which *Liopsetta putnami* may be separated from it. It is possible, however, that differences would appear on actual comparison of specimens. In view of the wide distance between the habitats of the two species, we here leave them separate for the present. Although *Liopsetta putnami* is abundant where found, its ascertained range is somewhat limited. The specimens in the U. S. National Museum represent localities from Salem, Mass., to Belfast, Me. In the Museum of Comparative Zoology the localities represented are Providence, Boston, Salem, Grand Manan, and Labrador.

86. LIOPSETTA GLACIALIS.

[Plate XVII.]

Pleuronectes glacialis Pallas, "Itin., iii, App., 706" (mouth of river Obi). Bloch and Schneider, Syst. Ichth., 1801, p. 150 (copied). Pallas, Zoogr. Ross.-Asiat., iii, 424, 1811 (mouth river Obi). Richardson, Fauna Bor. Amer., Fish., 258, 1836 (copied). DeKay, N. Y. Fauna, Fishes, p. 302, 1842 (copied). Storer, Syn. Fish. N. A., 1846, p. 479 (copied). Bean, Proc. U. S. Nat. Mus., 1881, p. 241 (Kotzebue Sound, Northern Alaska). Jordan and Gilbert, Syn. Fish. N. A., 1882, 837 (from specimens taken by Dr. Bean). Bean, Cat. Col. Fish U. S. Nat. Mus., 1883, p. 20 (Kotzebue Sound, Alaska). Bean, Nat. Hist. Aquat. Anim., 1884, 184, pl. 47 (Saint Michael's).

Pleuronectes cicatricosus Pallas, Zoogr. Ross.-Asiat., iii, 424, 1811 (male) (sea between Kamtschatka and Alaska).

Pleuronectes franklinii Günther, Cat. Fish., iv, 442, 1862 (Arctic seas of America) (female). Bean, Proc. U. S. Nat. Mus., 1881, p. 241.

Habitat.—Arctic Ocean south to Saint Michael's.

This small flounder is known to us only from the specimens taken by Dr. Bean. It is said to be abundant in the Arctic Ocean, and as far south as Saint Michael's, "although small, its great abundance and fine flavor make it important as an article of food."

The male is the rough fish described by Pallas as *P. cicatricosus*. The smoother female is Dr. Günther's *Pleuronectes franklinii*, the sexual differences being much as in *Liopsetta putnami*.

Indeed, as already intimated, we have little doubt that the *Liopsetta putnami* of the Atlantic is wholly identical with *Liopsetta glacialis* of the Arctic Ocean, and with *Liopsetta dvinensis* of the northern coasts of Russia.

Genus XXXVI.—PLATICHTHYS.

Platichthys Girard, Proc. Ac. Nat. Sci. Phila., 1854, 136 (*rugosus*=*stellatus*).

TYPE: *Platichthys rugosus* Girard=*Pleuronectes stellatus* Pallas.

This genus is composed of a single species, the largest of the small-mouthed flounders, and distinguished from related forms chiefly by the development of coarse stellate tubercles instead of scales.

ANALYSIS OF SPECIES OF PLATICHTHYS.

a. Body broad and short, very robust, the snout forming a slight angle with the profile; interocular space broad, with very rough scales; tubercles or scales coarsest on head and along bases of fin-rays; lateral line without scales; ridge above opercle rough; head 3⅗; depth, 2; D. 58; A. 42; vertebræ 34; color dark brown, with lighter markings; fins reddish-brown, dorsal and anal each with four or five black vertical bands; caudal with three or four black longitudinal bands..STELLATUS, 87.

87. PLATICHTHYS STELLATUS.

(THE CALIFORNIA FLOUNDER.)

[Plate XVIII.]

Pleuronectes stellatus Pallas, Zoographia Rosso-Asiatica, iii, 1811, 416 (Alaska). Günther, Cat. Fish., iv, 443, 1862 (Vancouver Islands, Behring Strait, Fraser River, Coronation Gulf). Steindachner, Pleur. von Decastris Bay, 1870, 1, (Decastris Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (San Francisco, Puget Sound, Columbia River, Monterey Bay, San Luis Obispo). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 68 (San Luis Obispo). Bean, Proc. U. S. Nat. Mus., 1881, 240 (San Luis Obispo, Monterey, San Francisco, Columbia River, Puget Sound). Jordan and Gilbert, Syn. Fish. N. A., 1882. Bean, Proc. U. S. Nat. Mus., 1883, p. 353 (Port Simpson, Brit. Col.). Bean, Cat. Col. Fish. U. S. Nat. Mus., 1883, p. 20 (Yakutat Bay, Alaska). Jordan, Nat. Hist. Aquat. Anim., 1884, 184, pl. 46 (San Luis Obispo to Kamtschatka).

Platessa stellata DeKay, N. Y. Fauna, Fishes, p. 301, 1842 (copied). Storer, Syn. Fish. N. A., 1846, p. 478 (copied).

Platichthys stellatus Lockington, Rep. Com. Fish. Cal., 1878-79, p. 43 (San Francisco Bay, Humboldt Bay). Lockington, Proc. U. S. Nat. Mus., 1879, p. 91 (San Francisco).

Platichthys rugosus Girard, Proc. Acad. Nat. Sci. Phila., 1854, pp. 139, 155. Girard, U. S. Pacif. R. R. Sur., Fish., 148, 1859 (San Francisco, Presidio, Petaluma).

Habitat.—Pacific coast of America, from Point Concepcion to the Arctic Ocean and south to Saghalien.

This is one of the largest of the American flounders, reaching a weight of 15 to 20 pounds. Of the small-mouthed flounders, it is considerably the largest species known. It is an excellent food-fish, and from its size and abundance it is one of the most important of the group in the region where it is found, constituting half the total catch of flounders on our Pacific coast. It lives in shallow water and sometimes ascends the larger rivers. It is one of the most widely distributed of all the flounders, its range extending from San Luis Obispo, where it was obtained by Jordan and Gilbert, to the mouth of the Anderson and Colville Rivers on the Arctic coast, where it was observed by Dr. Bean. A specimen from the island of Saghalien in Asia is in the museum at Cambridge.

Genus XXXVII.—MICROSTOMUS.

Microstomus Gottsche, Wiegmann's Archiv, 1835, 150 (*latidens*) (not *Microstoma* Risso, 1826).

Cynicoglossus Bonaparte, Fauna Italica, 1837, fasc., xix (*cynoglossus* Nilsson, not of L).

Cynoglossa Bonaparte, Catalogo Metódico Pesci Europei, 1846, 48 (*microcephalus*), not *Cynoglossus* Hamilton, 1822).

Brachyprosopon Bleeker, Comptes Rendus Acad. Sci. Amsterd., xiii, Pleuron, 7, 1862 (*microcephalus*).

Cynicoglossus Jordan and Gilbert, Syn. Fish. N. A., 1882, 460 (*microcephalus*).

TYPE: *Microstomus latidens* Gottsche=*Pleuronectes kitt* Walbaum.

This genus is widely separated from *Platessa* and its allies by its greatly increased number of vertebræ, a character accompanied by a similar increase in the number of fin-rays. It is close to *Glyptocephalus*, but the lack of the cavernous structure of the bones of the head, a structure peculiar to the species of that genus, sufficiently distinguishes it. Two species are known, small flounders of the Arctic seas, inhabiting considerable depths.

We here retain the generic name *Microstomus*, although in accordance with recent usage of most ornithologists and ichthyologists, it should be suppressed, as identical with *Microstoma*. The two words are from the same root and differ only in the termination. But is not this difference enough? The code of nomenclature of the American Ornithologists' Union very properly declares that "a name is only a name and has no necessary meaning," and, therefore, no necessarily correct spelling, except the spelling selected by the writer from whom it dates its origin. As a result of this, the original spelling of each generic name is (undoubted misprints aside) the orthography to be adopted, regardless of all questions as to the correct etymology of the word. As a necessary sequence, it seems to us that all generic names, not actually preoccupied by names spelled in the same way, should be tenable. There is no other certain boundary line between names tenable and names untenable. We propose therefore to regard all generic names as available unless used in zoology earlier and in exactly the same orthography. Among American genera of fishes we may therefore use the following, notwithstanding their earlier analogues:

Microstomus for	*Cynicoglossus* notwithstanding the prior	*Microstoma.*
Heterodontus	*Cestracion*	*Heterodon.*
Lucania	———	*Lucanus.*
Thymallus	———	*Thymalus.*
Nebris	———	*Nebria.*
Cestreus (κεστρευς)	*Cynoscion*	*Cestræus* (κεστραιος).
Xiphidion	*Xiphister*	*Xiphidium.*
Amitra	*Monomitra*	*Amitrus.*
Scytalina	*Scytaliscus*	*Scytalinus.*
Lagochila	*Quassilabia*	*Lagocheilus.*
Auchenopterus	*Cremnobates*	*Auchenipterus.*
Ophisoma	*Congromuræna*	*Ophiosomus.*
Leucos	*Myloleucus*	*Leucus.*
Pterophryne	*Pterophrynoides*	*Pterophrynus.*
Scaphirhynchus	*Scaphirhynchops*	*Scaphorhynchus.*
Brachirus	*Synaptura*	*Brachyrus.*

If *Microstomus* be discarded, the name next in order of date is *Cynicoglossus.*

The following is Bonaparte's definition of *Cynicoglossus* as quoted by Gill (Proc. Ac. Nat. Sci. Phila., 1864, 222):

"Secondo è *Cynicoglossus* nob. che come il *Pl. cynoglossus* L. ha la linea laterale retta, la bocca piccola, i denti come quello di sopra [*Platessa*] ma la mascelle iguale, con labbra turgide, e l'ano senza spina."

Later, in his Catalogo Metodico dei Pesci Europei, Bonaparte changes this name from *Cynicoglossus* to *Cynoglossa*, giving the sole species as *Cynoglossa microcephala*, and quoting as its synonym "*Pleuronectes cynoglossus* L. Nilss." showing that his identification of the Linnæan species coincided with that of Nilsson, who at first used the name "*Pleuronectes cynoglossus*" for the present species instead of the species of *Glyptocephalus*. In Bonaparte's Catalogo, *Glyptocephalus* Gottsche is regarded by Bonaparte as synonymous with *Platessa.*

It is thus evident, as Dr. Gill has suggested, that Bonaparte meant to refer to the *Pleuronectes microcephalus* instead of *Pl. cynoglossus*, he "having followed Nilsson in his erroneous identification" of the latter with the former. In farther evidence of this we have the fact that *Cynicoglossus microcephalus* (*kitt*) has no anal spine, while such a spine is present in the species of *Glyptocephalus.* We would be, therefore, justified in the use of *Cynicoglossus* instead of the later *Brachyprosopon*, if *Microstomus* should be regarded as ineligible on account of the prior name *Microstoma.*

ANALYSIS OF SPECIES OF MICROSTOMUS.

a. Dorsal rays 85 to 93; anal rays 70 to 76. Head very small, 4⅝ to 5½ in length; depth about 2½; eyes moderate, about 4 in head; pectorals 1⅞ in head; lat. l., 130; vertebræ 13 + 35 = 48. Color dull yellowish-brown, body and fins clouded with blackish, ... KITT, 88.

aa. Dorsal rays 102; anal rays 85. Head larger, 4½ in length; depth nearly 3 in length; eyes large, 3 in. head, opercle above angle, adnate to the shoulder girdle; pectoral short, 1½ in head; lat. l. 140; vertebræ 12+40=52. Olive-brown, blotched on body and fins with darker .... PACIFICUS, 89.

88. MICROSTOMUS KITT.

(THE SMEAR DAB.)

Rhombus lævis cornubiensis Jago in Ray, "Syn. Pisc., 162, tab. 1, f. 1."
The Smear Dab Pennant, British Zoology, iii, p. 230, pl. 41, 1776."
Pleuronectes kitt Walbaum, Artedi Piscium, iii, 1792, 120 (after Ray; the description in part confused with that of *Lepidorhombus*).
Pleuronectes kitt Bloch & Schneider, Systema Ichthyologia, 1801, 162 (after Ray).
Pleuronectes microcephalus Donovan, "British Fishes, ii, pl. 42, 1801." Günther, iv, 447. Steindachner, Ichth. Beitr., viii, 47 (Edinburgh). Day, Fishes Great Britain, ii, 28, pl. 102. Collett, Norges Fiske, 145, and of recent European writers generally.
Platessa microcephala Fleming, British Anim., 198, 1828, and of numerous writers.
Cynoglossa microcephala Bonaparte, Catalogo Metodico Pesci Eur., 1845, 48.
Pleuronectes lævis Shaw, Gen'l Zool., iv, 299, 1803.
Pleuronectes quenseli Hölböll, "Bohusläns Fiske, iv, 59."
Pleuronectes quadridens Fabricius, "Kongl. Dansk. Vid. Selsk. Afhandl., i, 39."
Pleuronectes microstomus "Faber, Isis, 1828, 886."
Microstomus latidens Gottsche, Wiegmann's Archiv, 1835, 150.
Pleuronectes gilli Steindachner, Ichth. Notizen, 1868, vii, 40. (Polar Sea, north of Iceland.)

Habitat.—Seas of the north of Europe in rather deep water, south to Cornwall.

This small flounder is rather common in the waters of Northern Europe. It reaches the length of a foot or more, and is said to be excellent as food. We have no specimens at hand, and have therefore relied chiefly on the figure and description given by Dr. Day, in our comparison of this species with *M. pacificus*. Like its congener, *M. pacificus*, this species is often very slimy in life.

This species is recorded by Day, on the authority of Dr. Steindachner, as occurring in Kamtschatka. This reference probably belongs to *M. pacificus*.

The specific name "*kitt*," given by Walbaum on the authority of Jago's description, seems to be the one which should be adopted for this species. According to Day, the species is still called "*kitt*" on the coast of Cornwall.

Pleuronectes gilli, as described by Dr. Steindachner, seems to differ from *Microstomus kitt* only in the larger head, which is but $4\frac{2}{5}$ in the length to base of caudal. It is probably not specifically distinct from the latter. Only a single specimen $10\frac{1}{2}$ inches long is known.

89. MICROSTOMUS PACIFICUS.

(THE SLIPPERY SOLE.)

Glyptocephalus pacificus Lockington, Rep. Com. Fisheries, 1878–'79, p. 43 (off Point Reyes). Lockington, Proc. U. S. Nat. Mus., 1879, p. 86 (San Francisco). Jordan, Nat. Hist. Aquat. Anim., 1884, 188.
Cynicoglossus pacificus Jordan and Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (Puget Sound, San Francisco, Monterey Bay). Jordan and Gilbert, Proc. U. S. Nat. Mus., 1881, p. 68 (Seattle). Jordan and Gilbert, Synopsis Fish. N. A., 1882, 838.

Habitat.—Pacific coast of North America, Monterey to Vancouver's Island, and probably northward.

This small flounder abounds in deep water about San Francisco, but comes near the shore farther north. It is exceedingly slimy when first taken. The large specimens are considered excellent as food, the smaller are thrown away. It rarely reaches the weight of a pound.

Genus XXXVIII.—GLYPTOCEPHALUS.

Glyptocephalus Gottsche, Wiegmann's Archiv, 1835, 156 (*saxicola* = *cynoglossus*).

TYPE: *Glyptocephalus saxicola* Gottsche = *Pleuronectes cynoglossus* L.

This genus is one of the most strongly marked in the family, being distinguished from most of the genera by the greatly increased number of vertebræ, and from all of them by the remarkable cavernous structure of the bones of the head.

There are two species known, found in the deep waters of the northern seas, the one in the Pacific, the other in the Atlantic.

ANALYSIS OF SPECIES OF GLYPTOCEPHALUS.

a. Pectoral fins very short, not falcate, that of right side about half length of head. Eyes large, about 3 in head, close together. Head 5 in length, depth $2\frac{3}{4}$ ($2\frac{1}{2}$ to 3). D. 101 to 11-. A. 87 to 99. Lat. l. 125. Vertebræ 58. Color grayish-brown; fins with dark spots; tip of pectoral dusky above .... CYNOGLOSSUS, 90.

aa. Pectoral fin of colored side falcate, longer than head. Eyes large, $3\frac{2}{7}$ in head, close together. Head $4\frac{2}{3}$ in length, depth 3. D. 94 to 106; A. 79 to 89; Lat. l. 138. Vertebræ 13 + 52 = 65. Color uniform brown, the fins darker, the blind side dusted with dark points .... ZACHIRUS, 91.

90. GLYPTOCEPHALUS CYNOGLOSSUS.

(THE CRAIG FLUKE.)

[Plate XIX.]

Pleuronectes, sp., Gronow, Museum Ichthyol., 1, iv, 39, &c. (Belgium.)

Pleuronectes cynoglossus Linnæus, Syst. Nat., ed. x, 1758, 269 (after Gronow). Günther, iv, 449. Day, Fishes Great Britain, ii, 30, pl. 103. (Lofoten, Finmark) (and of European writers generally.)

Glyptocephalus cynoglossus Gill, Proc. Acad. Nat. Sci. Phila., 360, 1873. Goode & Bean, Proc. U. S. Nat. Mus., 1878, p. 21. (Salem, Mass.; Halifax; La Have Bank; Bedford Basin, Halifax; Eastport, Me.) Goode, Proc. U. S. Nat. Mus., 1880, 337. (Deep sea, south coast New England.) Goode, Proc. U. S. Nat. Mus., 1880, p. 475. (Deep sea, New England coast.) Collett, Norske Nord-Havs Expd., 1880, p. 150. (Lofoten; Tana Fjord, Finmark.) Goode & Bean, Bull. Mus. Comp. Zoology, xix, 1883, 195. (Station 343.) Jordan & Gilbert, Syn. Fish. N. A., 1882, 838. Goode, Nat. Hist. Aquat. Anim., 1884.

Solea cynoglossa Rafinesque, Indice di Ittiologia Siciliana, 1810, 53 (based on the Pole or *Cynoglossum* of Rondelet).

Platessa pola Cuvier (Règne Animal, 1817). Lacépède, Hist. Nat., Poiss., edition of 1832, vi, 50, and of several authors.

Pleuronectes saxicola Faber, "Tidsskr. f. Naturv., 5 B., 244, 1828."

Glyptocephalus saxicola Gottsche, Wiegmann's Archiv, 1835, 156.

Platessa saxicola Kröyer, "Danmark's Fiskø, 1843, 338."

Pleuronectes nigromanus Nilsson, "Prodr. Ichth. Scand., 1832, 55."
Platessa elongata Yarrell, "Supplement Brit. Fish., 1839."
Pleuronectes elongatus Günther, iv, 450 (copied).
Glyptocephalus elongatus Gill, Proc. Acad. Nat. Sci. Phila., 1873, 362.
Glyptocephalus acadianus Gill, Proc. Acad. Nat. Sci. Phila., 1873, 360 (Nova Scotia).

Habitat.—North Atlantic, chiefly in deep water, south to Cape Cod and France.

This species is found in rather deep water on sandy bottoms. It reaches a length of 12 to 18 inches. It is considered a fair food-fish.

The nominal species, *acadianus* and *elongatus*, have been shown by Goode and Bean to be identical with *cynoglossus*. Beyond this the synonymy needs no special remarks.

This flounder has been taken in great numbers with the beam trawl in deep water off our New England coast. It is pronounced by the U. S. Fish Commission to be not inferior as a food-fish to the European sole.

91. GLYPTOCEPHALUS ZACHIRUS.

Glyptocephalus zachirus Lockington, Proc. U. S. Nat. Mus., 1879, p. 88 (San Francisco). Lockington, Rep. Com. Fisheries California, 1878–'79, p. 42 (off Point Reyes). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, p. 453 (San Francisco; Monterey Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, p. 68 (San Francisco; Monterey). Jordan & Gilbert, Syn. Fish. N. A., 1882, p. 838. Jordan, Nat. Hist. Aquat. Anim., 1884, 188 (deep waters about San Francisco).

Habitat.—Deep waters of the Northern Pacific; thus far known only from about San Francisco.

This species is a thin, dry flounder, reaching a length of something over a foot. It is taken in the sweep-nets in deep water about San Francisco, and thus far has been known from no other locality. It is readily known by its long pectoral fin.

Genus XXXIX.—SOLEA.

Solea Klein, Pisces (non-binomial).
Solea Quensel, Vet. Akad. Handl., 1806, 230 (*solea*).
Pegusa Günther, Cat. Fish. Brit. Mus., 1862. iv, 462 (*aurantiaca*).

TYPE: *Solea vulgaris* Quensel=*Pleuronectes solea* L.

As now understood by us, this genus includes some six or seven species of soles, most of them belonging to the European fauna. The genus is distinguished especially in the group to which it belongs by the elongate body, this elongation being connected with a much increased number of vertebræ. The soles of this genus are the only ones having much value as food. They reach a considerably larger size than any others of the species found in America or Europe, and as food-fishes they are especially excellent. The European sole (*Solea solea*) is the most highly esteemed of them all.

The subgenus *Pegusa* cannot well be separated from the true soles, as *Solea kleini* is intermediate between the two groups.

In the waters of the East Indies the related genus *Pardachirus* Günther (= *Achirus* Kaup, not Cuvier) takes the place of *Solea*. Its species are destitute of pectoral fins. There is a conspicuous pore at the base of each ray of the dorsal and anal, and on the blind side there is an accessory half lateral line.

ANALYSIS OF SPECIES OF SOLEA.

a. Nostril of blind side simple, not forming a distinct tube, its edge scantily fringed; black spot on pectoral fin at its tip. (*Solea.*)

b. Pectoral of eyed side about one-third length of head, that of blind side a very little shorter; eyes well separated, the upper considerably in advance of lower; scales small, ctenoid on both sides; those of blind side of head with few fringes; color dark brown, with darker mottlings, rarely plain brown, immaculate (var. *cinerea*); vertical fins with darker edgings; tip of pectoral jet black. D. 73 to 80; A. 61 to 69; lat. l. 140 to 150. Vertebræ $9 + 40 = 49$. Head, 3 in length; depth, about 4 .... SOLEA, 92.

bb. [Pectoral of eyed side less than one-third length of head, that of blind side similar; eyes well separated; scales small, ctenoid on both sides; color clear brown, thickly covered with pale and dark brown spots and dots; fins similarly spotted; vertical fins without dark edgings; tip of pectoral black. D. 80 to 92; A. 75 to 76; lat. l. 128 to 150. Head, 4½ in length; depth, 2⅗.] (*Steindachner*) .... CAPELLONIS, 93.

bbb. [Pectoral of eyed side as long as snout to eye. Form elongate; lower jaw included; teeth sharp, in three rows. Posterior nostril concealed; anterior in a short tube; color uniform blackish. D. 84. A. 65. P. 8. V. 4. C. 21.] (*Kaup*) .... BRASILIENSIS,* 94.

aa. Nostril of blind side with its margin produced into a tube, which is more or less conspicuously fringed. (*Pegusa* Günther.)

c. Scales of blind side cycloid; nasal tube moderate, its fringes few and short; scales of blind side of head with few fringes; pectoral fin with its black ocellus near the base, the fin short, that of the eyed side not one-third length of head. Eye rather large, the interorbital space moderate; scales rather small, those on the blind side cycloid. Pectoral fin black at base, its tip and margin whitish; coloration of body subject to many variations, usually gray, profusely dotted and speckled with black and whitish, sometimes very finely mottled and sometimes nearly plain; vertical fins broadly edged with black. Head, 4⅘; depth, 3½. D. 74 to 82; A. 59 to 64; lat. l. 100 to 110. Vertebræ, $10 + 38 = 48$ .... KLEINI, 95.

cc. Scales of left side of body ctenoid; nasal tube broad, well fringed, scales of eyed side with fringes; black ocellus on pectoral near the tip of the fin.

d. [Fringes of left nostril comparatively few, the margin of the nostril very broad; pectoral fin comparatively long, about 2½ in head, the black ocellus on its posterior half; eye small, its diameter equal to the interorbital space; scales small; color yellowish, marbled with round brownish blotches, and speckled with black. Head 5¼; depth 2⅔. Dorsal 81 to 89; anal 66 to 68. Lat. l. 117. Vertebræ 46.] (*Günther: Steindachner*) .... AURANTIACA, 96.

dd. Fringes of left nostril very numerous; longer than the diameter of the nasal tube.

e. Scales of lateral line 110 to 140.

f. [Dorsal rays 80 to 89; anal rays 61 to 68. Lat. l. 120 to 140. Pectoral fin 2 to 2½ in head. Depth 3 in length. Head 5. Color ashy gray with a dark brown point at the base of each scale; vertical fins with dark dots; pectoral with a large round black spot near its tip, this spot edged with paler anteriorly.] (*Steindachner*) .... LASCARIS, 97.

* D. 96; A. 84. Head 6 in length; depth 3; middle of pectoral and end of caudal black, according to Agassiz. Possibly two species are confounded under this name.

ff. [Dorsal rays 75 to 76; anal rays 59 to 61. Lat. l. 112 to 118; pectoral fins about 2½ in head; depth 2⅝. Head 4½ in length; color brown, with numerous obscure dusky cloudings; pectoral with a black ocellus in the middle of its posterior half.] (*Steindachner: Günther*) .... THEOPHILA, 98.

ee. [Scales in lateral line 90 to 95; D. 83 or 84. A. 65. Head 5½ in length; depth 3. Eye 5 in head, equal to interorbital width; nasal tube of left side long and much fringed; lips not fringed; blind side of head with many fringes; right pectoral 3 in head. Color grayish, very much mottled and spotted on body and fins; base of caudal dark; pectoral black, edged with paler.] (*Kner*) .... VARIOLOSA, 99.

92. SOLEA SOLEA.

(THE COMMON SOLE.)

[Plates XX and XXI.]

Pleuronectes solea Linnæus, Systema Naturæ, ed. x, 1758, 270 (and of the earlier copyists).

Solea vulgaris Quensel, Vet. Akad. Handl., 1806, 230, and of nearly all later writers.

Solea buglossa Rafinesque, Indice, 1810, 45.

Solea cinerea Guichenot, Explor. Alger., Poiss., 1850, 106 (plain brown variety).

Solea angulosa Kaup, Wiegmann's Archiv, 1858, 95. (Algiers; Rochelle) (= *P. angulata*, MSS. Paris Museum.)

Solea azevia Capello, Journ. Acad. Sci., Lisboa, i, 1867, 166, fig. 2 (plain brown variety).

Solea vulgaris var. *azevia* Steindachner, Ichthyol. Berichte, vi, 1868, 54, with plate.

Solea linnæi Malm, Bohusläns Fauna, 532 (about 1860).

Habitat—All coasts of Europe, except the extreme north.

This species is the famous sole of Europe, one of the most prized of all food-fishes. It abounds on almost all coasts of central and southern Europe, preferring sandy or gravelly shores, and it is usually captured, according to Dr. Day, with the trawl. It usually reaches a length of 12 to 18 inches.

No specimens of the European sole have yet been taken on the American coasts. Several attempts have been made by the United States Fish Commission to introduce the species into our waters, but thus far without evident success.

The *Solea azevia* of Capello is considered by Steindachner to be an unspotted variety of the common sole. The *Solea cinerea*, scantily described by Guichenot, seems to be the same form.

Solea angulosa Kaup is said to have D. 84; A. 71; P. 7; V. 7–6; C. 19; the pectoral as long as the distance from its root to the lower eye. It may be a common sole, with the number of fin-rays slightly increased.

93. SOLEA CAPELLONIS.

Solea capellonis Steindachner, Ichthyol. Berichte, vi, 56, 1868 (with plate) (Gibraltar; Dalmatia).

Habitat.—Mediterranean Sea.

This species is evidently very closely related to the common sole, of which, it seems to us, it may be a mere local variety, with unusually variegated coloration. Steindachner, however, compares it with *Solea kleini*, which it much resembles in color, but from which it differs in numerous respects. We have not seen the species.

94. SOLEA BRASILIENSIS.

Solea brasiliensis (Cuvier Mss.) Agassiz, Spix Pisc. Brasil., 1829, 87 (Brazil). Kaup, Wiegmann's Archiv, 1858, 95 (Montevideo).

Hàbitat.—Coast of Brazil.

We know this species only from the descriptions of Agassiz and Kaup. These two accounts do not agree very well and may refer to different fishes. It would appear to be very close to the European sole. None of the collections from Brazil in the museum at Cambridge contain any species of *Solea.*

95. SOLEA KLEINI.

Rhombus kleinii Risso, "Europe Méridionale, iii, 1826, 255."
Solea kleinii Günther, Cat. Fish. Brit. Mus., 1862, iv, 464, and of numerous writers.
Solea luctuosa Guichenot, Explor. Algérie, Poissons, 1850, 107.

Habitat.—Mediterranean Sea.

This species is subject to great variations in color, some of our specimens being excessively spotted, others almost plain. In all cases, however, the coloration of the pectoral is distinctive. Our specimens are from Venice and from Palermo.

96. SOLEA AURANTIACA.

(The Lemon Sole.)

Solea aurantiaca Günther, Cat. Fish. Brit. Mus., iv, 1862, 467.

Habitat.—Coasts of Europe, north to England.

We have not seen this species. According to Dr. Day it is identical with *Pleuronectes nasutus* Pallas, and he regards both as the same as the original *Pleuronectes lascaris* Risso. Day therefore adopts for the Lemon Sole the name of *Solea lascaris.* Knowing none of these fishes from autopsy we can have no opinion of value in this matter, but it would seem to us that the *Solea aurantiaca* of Günther and also the *Pl. lascaris* of Risso correspond better to the species called *lascaris* in the present paper than to the *Pleuronectes nasutus* of Pallas, which is the *Solea theophila* of this paper.

97. SOLEA LASCARIS.

Pleuronectes lascaris Risso, Ichth. Nice, 1810, p. 311, tab. 7, f. 32.
Solea lascaris Günther, iv, 467. Steindachner, Ichth. Berichte, vi, 1868, 59.
Rhombus polus Risso, "Europe Méridionale, iii, 249," 1826 (not *Pleuronectes polus* Cuvier).
Solea scriba Valenciennes, Webb & Berthelot, Iles Canaries, Poissons, 84, pl. 18, f. 3.

Habitat.—Mediterranean Sea.

We have not seen this species, and we take the above synonymy from Günther. According to Dr. Day the name *lascaris* belongs to *Solea aurantiaca*. This species should stand in that case, perhaps, as *Solea scriba*.

98. SOLEA THEOPHILA.

Pleuronectes theophilus Risso, Ichth. Nice, 1810, 313.
Pleuronectes nasutus Pallas, Zoogr. Rosso-Asiatica, iii, 1811, 427.
Solea nasuta Steindachner, l. c., 58.
Solea impar Bennett, "Proc. Comm. Soc. Zool., i, 147," 1831. Günther, iv, 468.

Habitat.—Mediterranean Sea.

We do not know this species. According to Dr. Day it is identical with *Solea aurantiaca*, and should receive the name of *Solea lascaris*. Notwithstanding the close relation of *S. theophila* and *S. aurantiaca*, it would seem that the two are different, as the number of fin-rays is considerably smaller in the present species than in *S. aurantiaca*, or than in the species called by us *S. lascaris*.

The Italian naturalists should be able to settle these questions of synonymy. Judging from the literature alone, these three species would appear to be valid. *S. aurantiaca* would seem to be distinguished by the little development of its nasal fringes, its fin-rays being "D. 81 to 89; A. 66 to 68." *S. lascaris* has the nostril with a wreath of fringes and the fin-rays substantially similar, and *S. theophila* (=*nasuta*=*impar*) has the nostril well fringed and the fin-rays fewer; "D. 75 to 76; A. 59 to 61."

Risso says of his *Solea lascaris* that its dorsal rays are 85, anal 68. This agrees with our *S. lascaris*, which is that of Günther, and differs from our *theophila*, the *impar* of Günther, with which Day has identified Risso's *lascaris*.

Risso further says that his *Solea theophila* (named for M. Théophile Rainaut, of Sospello) has 75 dorsal and 64 anal rays. This corresponds with the *Solea impar* of Günther, and as the name *theophila* has priority over *impar* we have adopted it. Possibly all three are forms of a single species, *Solea lascaris* Risso.

99. SOLEA VARIOLOSA.

Solea variolosa Kner, Novara Fische, 1869, 289 (Rio Janeiro).

Habitat.—Coast of Brazil.

This species is known to us from the account given by Professor Kner.

Genus XL.—MONOCHIRUS.

Monochirus Rafinesque, "Précis des Découvertes Somiologiques, 1814" (*hispidus*) (*fide* Bonaparte).
Monochirus Cuvier, Règne Animal, ed. i, 1817 (*microchirus*.) (Not of Rafinesque.)
Monochir Cuvier, Règne Animal, ed. ii, 1828 (*microchir*.) (Modified orthography of *Monochirus*.)

Monochirus Swainson, Nat. Hist. Class'n Fishes, ii, 1839, 303 (*linguatula*).
Microchirus Bonaparte, Catalogo Metodico dei Pesci Europei, 1845-'50 (after Swainson: *lingula*).
Buglossus Günther, Cat. Fish. Brit. Mus., iv, 1862, 462 (*variegata*).
Monochir Günther, Cat. Fish. Brit. Mus., iv, 1862, 462 (*monochir*).
Quenselia Jordan, Subgenus novum (*ocellata*).

TYPE: *Monochirus hispidus* Rafinesque.

This small group of European soles seems to be worthy of generic distinction from *Solea*, not so much from the reduction of the pectoral fins as on account of the reduced number of vertebræ, which forms a step in the direction of the genus *Achirus*.

The species are, however, much more nearly related to *Solea* than to *Achirus*. Three subgeneric groups are included under the head of *Monochirus* as understood by us, and these might perhaps with no great impropriety be taken as distinct genera. We think it better, however, to place all together in one group, for which the name of *Monochirus* has priority. We have not seen the paper of Rafinesque in which this name is said to occur, but have taken our quotation from Bonaparte.

For the second subgenus, the same name, *Monochirus*, was proposed by Cuvier, but this is antedated by *Monochirus* of Rafinesque. The name *Microchirus* given by Bonaparte to the same group has priority over Günther's name *Buglossus*. For the third group, we have suggested the new name *Quenselia* in honor of the Swedish naturalist who first separated the soles generically from the flounders.

ANALYSIS OF SPECIES OF MONOCHIRUS.

a. Vertebræ 37 to 40; scales normal, strongly ctenoid.
b. Pectoral of both sides well developed, that of the eyed side not quite half head, that of blind side not quite a third; vertebræ 37. (*Quenselia* Jordan.)
c. Interorbital space very narrow, the eyelids thick, covered with rough scales; blind side of head with conspicuous fringes; scales sub-villous, the spinules conspicuous, though less so than in *Monochirus hispidus*; color dark gray, with some vague dusky blotches behind the gill opening; 4 round jet-black spots ocellated with white and about as large as eye disposed in a quadrangle behind the middle of the body; a black bar across base of caudal; fins dusky; pectoral mostly blackish. Vertebræ 9+28=37. Head 4 in length; depth 2½; D. 66 to 67. A. 52 to 54. P. 5-5. Lat. l. 70 to 75 .... OCELLATUS, 100.
bb. Pectoral fin of blind side minute, that of eyed side small, not twice as long as eye. (*Microchirus* Bonaparte.)
d. Scales in the lateral line 55 to 60. Depth 2⅓ in length; head 4⅓; color nearly uniform brownish, sometimes spotted with darker; a few dark spots on dorsal and anal fins, each involving part or all of the membrane of about every fourth ray; pectoral mostly black, its length not quite half more than that of eye .... LUTEUS, 101.
dd. Scales in the lateral line 75 to 80. D. 63 to 73. A. 53 to 57. P. 5-3. Vertebræ, 10 + 30 = 40. Depth 3 in length; head 4⅔; color brownish gray, with broad irregular dark cross-bands which are darkest on the dorsal and anal fins; pectoral partly dusky, its length not greater than that of eye. VARIEGATUS, 102.

ddd. [Scales very small, 112 to 118; D. 72 to 79; A. 56 to 62. Depth, 2⅞; head, 4½ in length; colors of *Monochirus luteus*, each sixth or seventh ray of dorsal and anal blackish brown; caudal with brown spots; posterior half of dorsal and anal with narrow, dark brown cross-spots.] (*Steindachner*) MINUTUS, 103.

aa. Vertebræ 34; pectoral fin of eyed side more than half length of head, that of blind side wanting; scales sub-concave, elongate, and with the free margin somewhat erected; each scale with several long spinules, giving the body a villous appearance (as in *Phrynorhombus*); (*Monochirus*).

c. Scales of blind side with shorter spinules; scales on head slightly reduced; eyes rather large, with thick scaly eyelids; head 4½ in length; depth 2½; D. 52 ("56 to 61," *Günther*). A. 41 (44 to 49, *Günther*). P. about 7; lat. l. 54 (63, *Günther*). Vertebræ 9 + 25 = 34. Color, brown with irregular dark marblings on body and fins; dorsal and anal mostly dark; caudal abruptly pale, with light brownish cross-streaks...........HISPIDUS, 104.

100. MONOCHIRUS OCELLATUS.

Pleuronectes ocellatus Linnæus, Syst. Nat., ed. x, 1758, 269 ("Surinam").
Solea ocellata Günther, iv, 465.
Quenselia ocellata Jordan, MSS.
Pleuronectes pegusa Lacépède, Hist. Nat., Poiss., iv, 639, 1803.
Pleuronectes rondeleti Shaw, Gen'l Zool., iv, 307, 1803.
Solea oculata Risso, Europe Méridionale, iii, 248, 1826, and of numerous writers.

Habitat.—Mediterranean Sea; Madeira Islands.

Our specimens of this pretty species are from Palermo, where they were collected by Professor Doderlein.

This species, with some other African and Asiatic species, marks a transition between the typical forms of *Monochirus* to those of *Solea.* It may be regarded as forming the type of a new subgenus for which the name *Quenselia* is suggested.

101. MONOCHIRUS LUTEUS.

Pleuronectes luteus Risso, Ichth. Nice, 1810, 312.
Monochirus luteus Costa, "Fauna Napoli, ii, 49."
Solea lutea Günther, iv, 469, 1862, and of most recent writers.

Habitat.—Mediterranean Sea.

Our numerous specimens of this species were collected by Professor Doderlein at Palermo, and by Professor Jordan at Venice.

102. MONOCHIRUS VARIEGATUS.

Pleuronectes variegatus Donovan, British Fishes, 1801, pl. 117.
Solea variegata Günther, iv, 469.
Pleuronectes microchirus Delaroche, Ann. Mus., xiii, 356, f. 2, 1809.
Pleuronectes mangili Risso, Ichth. Nice, 1810, 255.
Pleuronectes lingula "Hamner in Pennant, Brit. Zool., ed. of 1812, iii, 313, pl. 48."
Pleuronectes fasciatus Naccari, "Giornale Fis. Pav., iii, Adr. Ittiol., 9, 1822."

Habitat.—Mediterranean Sea.

Our specimens of this species were collected at Palermo by Professor Doderlein. Most of the synonymy given above is copied from Günther and Bonaparte, and has not been verified by us.

103. MONOCHIRUS MINUTUS.

Monochirus minutus Parnell, Mag. Zool. and Bot., i, 527, 1837.
Solea minuta Günther, iv, 470. Steindachner, Ichth. Berichte, vi, 1868, 61.

Habitat.—Mediterranean Sea.

We know nothing of this species. According to Dr. Day, it is identical with *Monochirus luteus.* Steindachner, however, regards the two as distinct, and describes *M. minutus* as having 112 to 118 scales in the lateral line—a number nearly double that found in his specimens as well as in our specimens of *M. luteus.* If this count is correct, the two species must be different.

104. MONOCHIRUS HISPIDUS.

Pleuronectes pegusa Risso, Ichth. Nice, 1810, 310 (not of Lacépède).
Monochirus hispidus Rafinesque, "Précis des Découvertes 1814" (*fide* Bonaparte, Catalogo Metodico, 1845, 50).
Solea monochir Bonaparte, "Fauna Italica," about 1840. Günther, iv, 470, 1862.

Habitat.—Mediterranean Sea.

Our specimens of this curious species are from Palermo and from Venice, the former collected by Professor Doderlein, the latter by Dr. Jordan.

Genus XLI.—ACHIRUS.

Achirus Lacépède, Hist. Nat., Poiss., iv, 659, 1803 (*fasciatus*, etc.).
Achirus Cuvier, Règne Animal, 1828, (restriction to *fasciatus*, etc.).
Trinectes Rafinesque, Atlantic Journal and Friend of Knowledge, i, 1832 (*scabra*).
Grammichthys Kaup, Wiegmann's Archiv, 1858, 94 (*lineatus, fasciatus*) (*Achirus* being restricted to *Pardachirus barbatus*, etc.).
Monochirus Kaup, l. c. (*maculipinnis*).
?**Aseraggodes** Kaup, l. c., 1858, 103 (*guttulata*).
Baiostoma Bean, Proc. U. S. Nat. Mus., 1882, 413 (*brachiale*).
Bæostoma Jordan & Gilbert, Syn. Fish. N. A., 1882, 965 (amended orthography).

TYPE: *Achirus fasciatus* Lacépède.

This strongly-marked genus contains numerous species, all very closely related, and nearly all American. It has been united by Dr. Günther with *Solea*, but apparently for no good reason, as the number of vertebræ is very much less than in the European soles, and the right ventral fin is decurrent along the abdomen and united with the anal in the American soles, while it is short and wholly free in all the European forms. It is also worth noticing that the name *Achirus* is prior in date to that of *Solea.* The species with rudimentary pectoral fins have been set apart by Dr. Bean to form the genus *Baiostoma*, but the very slight development of these organs in some of the species, and the evidently very close relationship of them all, leads us to regard *Baiostoma* as a subgenus only. If we follow Kaup in restricting the name *Achirus* to the Asiatic group called *Pardachirus*, the present genus would receive the name of *Trinectes.* It seems to us that both Lacépède and Cuvier regarded the species called by us *fasciatus* as the type of their genus *Achirus*.

ANALYSIS OF SPECIES OF ACHIRUS.*

a. Pectoral fins small; present at least on the right side. (*Baiostoma* Bean.)

b. Pectoral fin present on both sides, that of the left side rudimentary, of a single ray; that of the eyed side with about 3.

c. [Dorsal rays 60 to 67; anal rays about 48; lat. l. 80; depth 1⅗ in length; color brownish, irregularly spotted with darker, and with about 10 black vertical lines crossing the lateral line.] (*Günther*) ....ACHIRUS, 105.

cc. Dorsal rays 53 to 57; anal rays 40 to 42; lat. l. 75 to 80; depth 1⅔ in length; scales smaller and less rough than usual in this genus, those of nape scarcely enlarged on eyed side, those of blind side much fringed; scales of colored side with scattered, hair-like appendages, some black, others pale; color olivaceous; head, body, dorsal, and anal fins covered with a network of dark lines; traces of about 8 dark cross-streaks sometimes present; caudal fin yellowish, nearly plain, or with a few dark dots or reticulations; its base dusky. Vertebræ 8 + 20 = 28...................INSCRIPTUS, 106.

bb. Pectoral of right side only present.

d. Dorsal rays 65 to 66; anal rays 48 to 51.

e. Pectoral well developed, with about 6 rays. Scales of eyed side without hair-like filaments; scales of lateral line 77 to 80; chin little prominent; dorsal rays 65; anal rays 51; depth 1¾ in length; head 3⅗; right lower lip fringed. Color brownish, with 9 or 10 narrow blackish cross-lines; small rounded blackish spots on the membranes of each of the vertical fins, much as in *A. lineatus*....KLUNZINGERI, 107.

ee. Pectoral fin small, its rays about 2 in number; scales of eyed side with numerous hair-like filaments; scales of lateral line about 70; chin prominent, protruding beyond upper jaw; D. 66, A. 48 to 50; depth 1⅗ in length; pectoral black, not much longer than eye; eyes rather large, the upper not in advance of lower; color brown, with traces of dark cross-bands; numerous irregular blackish clouds and blotches on the body and fins; no small spots..........MENTALIS, 108.

dd. Dorsal rays, 50 to 58; anal rays, 35 to 47.

f. Pectoral fin of 4 to 6 rays, considerably longer than eye; body with 8 to 10 narrow vertical dark bars, these sometimes obsolete with age.

g. Vertical fins, all with round dark spots, these usually especially distinct on the caudal fin; some of the scales of eyed side with black, hair-like appendages; pectoral fin with 5 or 6 rays, about 3 in head; its length equal to that from outer edge of one eye to outer edge of another; head 3¼ in length; depth about 1½; color brown, the young spotted with whitish, the adult sometimes with darker; body with about 8 narrow vertical cross-streaks of blackish. LINEATUS, 109.

x. Dorsal rays 49 to 58; anal rays 38 to 44; scales 70 to 85. Var. *lineatus*, 109 (*a*).

* Besides the species here mentioned, another, *Achirus lorentzi* Weyenbergh (Algunos Nuevos Pescados del Museo Nacional y Algunas Noticias Ictiologicas 1877, 13, pl. 1, f. 1—Buenos Ayres), has been described from Santa Fé, Uruguay. We have not seen the description.

xx. Dorsal rays 50 to 51; anal rays 35 to 37.

y. Scales 75 to 77 .... Var. *brachialis*, 109 (*b*).

yy. Scales 55 to 67 .... Var. *cornifer*, 109 (*c*).

gg. Vertical fins dark, without distinct markings. Body broad, ovate, the depth about 1¼ in length; pectoral fin with 4 rays; scales of right side with numerous black hair-like appendages; color brownish, with 8 or 9 narrow vertical black bars; fins dark, without distinct markings; D. 56, A. 42, lat. l. 70 .... MAZATLANUS, 110.

ff. Pectoral fins of 2 or 3 rays, about as long as eye.

h. Body with 6 to 12 narrow dark bands; these sometimes obsolete.

i. [Body rather narrowly ovate, its depth 1⅝ in length; pectoral fin very small, of about 2 rays, not much longer than eye; color brownish olive, with six pairs of deep brown vertical lines extending on the dorsal and anal fins. D. 58, A. 44, lat. l. 85.] (*Günther*) .... FONSECENSIS, 111.

ii. Body broadly ovate; the depth 1⅞ in length; pectoral as long as eye; fringes on lip of right side, few and small, inconspicuous; scales on blind side moderately enlarged; hair-like appendages on scales few or none; D. 56. A. about 39. Scales about 76; color brown, finely mottled and speckled with darker, and with about a dozen narrow, very faint cross-streaks; fins with similar dark spots; scales all finely dotted under the lens .... PUNCTIFER, 112.

hh. Body with very numerous (20 to 40) black cross-bands, which are as broad as the interspaces.

j. [Blind side of snout with few fringes; pectoral rays 3; depth 1½ in length; D. 55, A. 48, lat. l. 80. Color grayish; head, body, and fins with numerous blackish, irregular wavy bands, broader than the interspaces; caudal fin with deep black spots.] (*Günther*) .... SCUTUM, 113.

jj. Blind side of head profusely covered with fringes; scales on body very rough, those of the eyed side of head enlarged and with long spinules; numerous patches on body covered with appendages like short, coarse black hairs; lower lip with fringes on eyed side nearly half as long as eye; pectoral small, not longer than eye, which is rather large, about 5 in head; lower jaw included; upper eye largest and much advanced; anterior rays of dorsal, with fringes of cirri. Head 3⅜ in length; depth 1⅘; D. 55, A. 47. Scales 77 to 80. Color dark-brown, with numerous (about 40) close-set, straight, black cross-bars, each about as wide as the interspaces; vertical fins, with about three elongate black spots on the membrane between each pair of rays. GARMANI, 114.

aa. Pectoral fins wholly wanting. (*Achirus*.)

k. [Dorsal rays 46; anal rays 33; right lower lip with serrated fringes; nostril in a fringed tube; depth 1½ in length; head 3; color brown, head and body with numerous large, rounded, or kidney-shaped white spots, edged with dark brown. Lat. l. 70.] (*Günther*) .... FIMBRIATUS, 115.

kk. Dorsal rays 50 to 55; anal rays 37 to 46; right lower lip fringed; left nostril with some fringes; depth 1⅔ in length; head 4; none of the scales of eyed side with hair-like appendages; color dusky olive, more or less mottled and with about eight dark vertical stripes, these varying very much in width and in number; vertical fins with the membrane of every second or third pair of rays blackish, besides dark cloudings at base of fin; caudal with numerous longitudinally oblong spots; blind side often with round, dark spots, especially in northern specimens, usually immaculate in southern ones (var. *browni*). Lat. l. 66 to 75; vertebræ 8 + 20 = 28....................... FASCIATUS, 116.

kkk. Dorsal rays 59 or 60; anal rays 41 to 45.

l. [Snout and chin without evident fringe or barbel; right lower lip fringed; head 4 in length; depth 1⅗; D. 59, A. 45; scales 63 to 65; color brown; about 12 dark cross-bands on head and body; between these faint, paler cross-bands, which form spots on dorsal and anal; caudal similarly spotted, the spots forming obscure cross-bands. (*Steindachner*)................................PANAMENSIS, 117.

ll. Snout with a fringe-like barbel near its tip, as long as eye; a shorter one on the chin; eyed side with some patches of black hairs; scales of blind side of head scarcely enlarged or fringed; scales small, not very rough; head 3½ in length; depth 1½. D. 60, A. 41; scales 80; color pale, the eyed side with small scattered black points and blotches of varying size; a few narrow obscure dark cross-streaks; blind side immaculate.................................JENYNSI, 118.

105. ACHIRUS ACHIRUS.

Pleuronectes oculis dextris, corpore glabro, pinnis pectoralibus nullis Gronow, Museum, i, No. 42. (Surinam.)

Pleuronectes achirus Linnæus, Syst. Nat., ed. x, 1758, 268 (based on Gronow).

Solea gronovii Günther, Cat. Fish. Brit. Mus., iv, 1862, 472 (Surinam).

Achirus gronovii Jordan, Proc. U. S. Nat. Mus., 1886, 602. (Name only.)

Habitat.—Coasts of Guiana.

We know this species only from Dr. Günther's description. We place *Achirus gronovii* in the synonymy of the Linnæan species *Pleuronectes achirus*. *Pleuronectes achirus* is based on a description by Gronow of some *Achirus* from Surinam. Gronow's fish agrees with the present species in having 60 dorsal rays and 48 anal rays, in being brown, with transverse black bands, with dark spots on the fins, as well as in coming from Surinam. But Gronow explicitly denies the presence of pectorals, and the present species has rudimentary pectoral fins on both sides. Probably these were overlooked by Gronow, and as no other species found in the same region has so large a number of rays, we feel justified in the use of the name *Achirus achirus* for this species.

106. ACHIRUS INSCRIPTUS.

Achirus inscriptus Gosse, Nat. Sojourn Jamaica, 52, pl. 1, f. 4, 1851 (Jamaica). Jordan, Proc. U. S. Nat. Mus., 1884, 143 (Key West).

Solea inscripta Günther, iv, 1862, 473 (Jamaica).

Monochir reticulatus Poey, Memorias, ii, 1861, 317 (Cuba); Synopsis, 409; Enumeratio, 139.

Solea reticulata Günther, iv, 472 (copied).

Bæostoma reticulatum Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 152 (Jamaica).

Habitat.—West Indian fauna, north to Key West.

This species is known to us from numerous specimens taken by Dr. Jordan at Key West, and from specimens from Hayti, in the museum at Cambridge. These specimens belong undoubtedly to the species called *reticulatus* by Poey, and this is apparently not different from the *inscriptus* of Gosse, as the agreement with the latter is even closer than with the former description.

107. ACHIRUS KLUNZINGERI.

Solea klunzingeri Steindachner, Zur Fische des Cauca und der Flüsse bei Guayaquil, 1879, 44 (Guayaquil).
Achirus klunzingeri Jordan, Proc. U. S. Nat. Mus., 1885, 391 (Panama).

Habitat.—Pacific coast of tropical America. Panama to Guayaquil.

This species is known from Dr. Steindachner's description. A specimen, since destroyed, was obtained by Professor Gilbert at Panama.

108. ACHIRUS MENTALIS.

Solea mentalis Günther, Cat. Fish. Brit. Mus., iv, 475, 1862 (Para).

Habitat—Coast of Brazil.

This species is known to us from a specimen, 3 inches long (No. 11449, Mus. Comp. Zool.). It was obtained at Para.

109. ACHIRUS LINEATUS.

a. Var. *lineatus.*

Pleuronectes fuscus subrotundus glaber "Brown, Jamaica, 445" (Jamaica).
Passer lineis transversis notatus Sloane, Jamaica, 2, 77, pl. 246, f. 2 (Jamaica).
Pleuronectes lineatus Linnæus, Syst. Nat., ed. x, 1758, 268 (based on Brown and Sloane; not of ed. xii, which is *Achirus fasciatus*).
Monochir lineatus Quoy & Gaimard, Voy. Uranie, Zool., 238, 1824 (Rio Janeiro, D. 52, A. 42).
Achirus lineatus D'Orbigny, Voyage Amér. Merid. Poiss., pl. 16, f. 2, 1847 (Cayenne).
Monochir maculipinnis Agassiz, Spix Pisc. Brasil., 88, pl. 49, 1829 (Brazil). Poey, Synopsis, 1868, 409 (Cuba).
Solea maculipinnis Günther, iv, 473 (Cuba, Jamaica, Brazil). Kner, Novara Fische, iii, 289 (Rio Janeiro).
Achirus maculipinnis Jordan, Proc. U. S. Nat. Mus., 1886, 602 (name only).

b. Var. *brachialis.*

Baiostoma brachialis Bean, Proc. U. S. Nat. Mus., 1882, 413 (South Florida).
Bæostoma brachiale Jordan & Gilbert, Synopsis Fish. N. A., 1882, 965 (copied).
Achirus brachialis Jordan, Proc. Ac. Nat. Sci. Phila., 1883. (Egmont Key.) Jordan, Proc. U. S. Nat. Mus., 1884, 149.

c. Var. *comifer.*

Achirus comifer Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 31, 143 (Key West).

Habitat.—West Indian fauna—Key West, and Egmont Key to Uruguay.

The *Pleuronectes lineatus* of the tenth edition of the Systema Naturæ is based wholly on the description of Brown and the figure and description of Sloane in their works on Jamaica. It is very evident from Sloane's figure that the species he had in view was the *Achirus maculipinnis*. So far as we know, but two species of *Achirus* (*inscriptus* and *maculipinnis*) are found in the waters of the Antilles. There seems to be, then, no doubt that the *maculipinnis* of Agassiz is the original *Pleuronectes lineatus* of Linnæus. If it be so, it must stand as *Achirus lineatus*.

The *Pleuronectes lineatus* of the twelfth edition of the Systema Naturæ is described from a fish sent from Charleston by Dr. Garden. This is *Achirus fasciatus*.

We have placed the Florida species, *comifer* and *brachialis*, in the synonymy of *lineatus*. They differ from the latter only in the slightly smaller numbers of the scales and fin-rays.

The following table shows our count of a number of specimens from different localities:

Locality.	D.	A.	Scales.
Key West (*comifer*)	50	35	55 to 67
Pensacola (*brachialis*)	51	37	75 to 77
Cienfuegos (*lineatus*)	54	43	85
Rio Janeiro (*maculipinnis*)	57	42	85
Do (*maculipinnis*)	54	44	72
Rio Grande do Sul (*maculipinnis*)	49	38	70
Coary (*maculipinnis*)	53	40	68
Manacapuru (*maculipinnis*)	55	42	75

It is evident from this table that neither the fin-rays nor the scales form characters by which the subspecies can be absolutely distinguished. It is evident also, from the examination of large series of specimens, that the coloration is subject to very great variations—as great as in *Achirus fasciatus*. In some of these the caudal is dark and immaculate, in others pale and usually profusely spotted. In some the ground color is nearly plain blackish, in others it is pale, usually with narrow dark cross-bands, but sometimes closely spotted everywhere.

The specimens examined by us are from Pensacola and Egmont Key (*brachialis*), Key West (*comifer*), Cienfuegos (Cuba, Poey), Coary, Teffy, Tapajos, Porto Alegre, Pernambuco, Cannarivieras, Manacapuru, Porto do Moz, Rio Grande do Sul, Rio Janeiro, San Matheo, Rosario, Itabapuana, Obidos, Xingu, Gurupa, Jutaby, Curuça, Parà, Bahia, Santarem, Iça, Fonteboa, San Paolo, Rio Trompetas, Sambaia, Manes, Javary, and Tabatinga.

The species would appear to be one of the commonest in Brazil.

110. ACHIRUS MAZATLANUS.

(MEXICAN SOLE; TEIPALCATE.)

Solea mazatlana Steindachner, Ichth. Notizen, ix, 23, 1869 (Mazatlan). Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 108 (Mazatlan).

Achirus mazatlanus Jordan, Proc. U. S. Nat. Mus., 1885, 391 (Mazatlan).

Solea pilosa Peters, Berliner Monatsber., 1869, 709 (Mazatlan).

Habitat.—Pacific coast of tropical America.

This species is not rare on the west coast of Mexico. We have examined numerous specimens collected by Professor Gilbert at Mazatlan. The *Solea pilosa* of Peters, as Dr. Steindachner has already indicated, is the same fish. The date of Steindachner's paper is said to be a little earlier than that of Professor Peters.

A specimen of this species is in the museum at Cambridge, collected by Professor Sumichrast at Chiapas.

111. ACHIRUS FONSECENSIS.

Solea fonsecensis Günther, Cat. Fish. Brit. Mus., iv, 1862, 475 (Gulf of Fonseca).

Habitat.—Pacific coast of tropical America (Gulf of Fonseca).

Only the original type of this species, obtained by Sir John Richardson, is yet known.

112. ACHIRUS PUNCTIFER.

Monochir punctifer Castelnau, Animaux Nouv. ou Rares, Amérique du Sud, 1855, 80, pl. 41, f. 3 (Rio Janeiro).

Habitat.—Coast of Brazil.

We refer a sole (11436, M. C. Z.) from Itabapuana to *Monochir punctifer* Castelnau, although the figure published by this author does not represent it very well. The black pepper-like spots are much smaller in nature than in the picture. The following is Castelnau's description: "Longueur totale, 12 centimètres; plus grande largeur sans les nageoires, 7 centimètres; avec les nageoires, 9 centimètres. Nageoire dorsale de 48 rayons; anale de 42 rayons; caudale de 16 rayons. Les écailles sont fines et âpres, surtout celles de la tête. Le poisson est entièrement d'un brun vert et couvert, ainsi que les nageoires, de points noirs nombreux et assez rapprochés les uns des autres; en dessous il est d'un brun rougeâtre. J'ai trouvé une seule fois ce *Monochir* au marché de Rio."

113. ACHIRUS SCUTUM.

Solea scutum Günther, Cat. Fish. Brit. Mus., iv, 1862, 475 (Gulf of Fonseca, Panama).

Habitat.—Pacific coast of tropical America.

All that we know of this species is included in the description of Dr. Günther.

114. ACHIRUS GARMANI.

Achirus garmani Jordan, sp. nov. (Rio Grande do Sul).

Habitat.—Coast of Brazil.

The type of this species is an example in good condition, 6 inches long (11246, M. C. Z.), from "the Rio Grande in South America." I have taken pleasure in naming it for my friend Mr. Samuel Garman, curator of ichthyology in the Museum of Comparative Zoology, to whose kindly aid I have been much indebted in my studies of the South American fishes. (D. S. J.)

115. ACHIRUS FIMBRIATUS.

Solea fimbriata Günther, Cat. Fish. Brit. Mus., iv, 1862, 477 (Gulf of Fonseca).

Habitat.—Pacific coast of tropical America (Gulf of Fonseca).

This species is known from Günther's description of a specimen taken by Sir John Richardson.

116. ACHIRUS FASCIATUS.

(THE AMERICAN SOLE; HOG-CHOKER.)

(Plates XXII and XXIII.)

Pleuronectes lineatus Linnæus, Syst. Nat., ed. xii, 458 (on a specimen from Charleston, received from Dr. Garden), (not *Pleuronectes lineatus* of edition x). Gronow, Systema, ed. Gray, 1854, 90 (in part, chiefly based on Linnæus).

Achirus lineatus Cuvier, Règne Animal, 1828. Gill, Cat. Fishes East Coast N. Am., Rept. U. S. F. C., 1872-'73. Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 368 (Beaufort; Neuse R.). Goode, *op. cit.*, 1879, 110 (St. John's R.). Goode & Bean, *op. c.*, 1879, 123 (Pensacola, Potomac R.). Bean, *op. c.*, 1880, 77 (Potomac R., New Bedford, Tompkinsville, N. Y., Newport, Chesapeake Bay, Providence). Jordan & Gilbert, *op. cit.*, 1882, 618 (Charleston). Bean, *op. cit.*, 1883, 365 (Havre de Grace).

Grammichthys lineatus Kaup, Wiegmann's Archiv, 1858, 101.

Achirus fasciatus Lacépède, Hist. Nat., Poiss., iv, 659, 662, 1803 (excl. syn.; description based entirely on the Linnæan account of the fish sent by Garden).

Pleuronectes mollis Mitchill, Trans. Lit. and Phil. Soc. N. Y., i, 1815, 388, pl. 2, f. 4 (New York).

Achirus mollis Storer, Synopsis, 1846, 228. Storer, Hist. Fish. Mass., 1867, 206, pl. 32 (Charles River, Holmes' Hole, Mass.). DeKay, New York Fauna, Fishes, 1842, 303, pl. 49, f. 159 (New York, ascending the Hudson River to Peekskill).

Achirus achirus mollis Jordan, Cat. Fish. N. A., 1885, 137.

Pleuronectes apoda Mitchill, Amer. Monthly Mag. and Crit. Rev., Feb'y, 1818, 244 (Straits of Bahama), (perhaps *A. lineatus*).

Trinectes scabra Rafinesque, "Atlantic Journal and Friend of Knowledge, i, 1832 (Pennsylvania, in fresh water)."

Solea achirus Günther, iv, 476, 1862 (New York) (not *Pleuronectes achirus* L.).

Achirus achirus Jordan, Proc. U. S. Nat. Mus., 1885, 19. Jordan, Cat. Fish. N. A., 1885, 137.

Solea browni Günther, iv, 477, 1862 (New Orleans, Texas).

Achirus lineatus var. *browni* Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 305 (Pensacola, Galveston).

Habitat.—Atlantic coast of the United States, from Cape Cod to Texas, often ascending streams.

This species is the best known of the American soles, and it is common along our coast from Cape Cod to Texas, often ascending the rivers for a considerable distance above tide-water. It seldom exceeds 5 or 6 inches in length, and is of but little value as food on account of its small size. It was first described in the twelfth edition of the Systema Naturæ from a specimen sent to Linnæus by Dr. Garden. This specimen received the name of *Pleuronectes lineatus*, but the *Pleuronectes lineatus* of the tenth edition was a different fish, the name being originally based on a description of an *Achirus* found by Brown and Sloane in Jamaica, a region in which the present species does not occur.

The specific name next in date to *lineatus* is that of *Achirus fasciatus* Lacépède. Lacépède quotes in his synonymy only the *Pleuronectes achirus* of the tenth edition of the Systema, which is a species from Surinam. His description of *Achirus fasciatus* is however wholly taken from the account given by Linnæus of the fish sent by Garden. It therefore belongs to the present species, for which *fasciatus* seems to be the oldest tenable name.

The *Pleuronectes apoda* of Mitchill seems to be this species, as Mitchill expressly states that it has no pectoral fins. DeKay, however, speaks of it as a species of *Monochirus*. If DeKay examined Mitchill's specimen we may infer that the latter belonged to *A. lineatus* rather than to *A. fasciatus*.

This species has not yet been recorded from the West Indies. The form found along the Gulf coast has been described as a distinct species under the name of *Solea browni*. The differences are not very evident. We have compared a number of specimens from Boston (*fasciatus*) with others from Pensacola, and find the following differences, none of which are constant: In the Gulf variety (*browni*) the blind side is always immaculate, while in almost all Atlantic examples (*fasciatus*) the blind side is profusely covered with round dark spots. In one specimen, however (11360, Boston), the blind side is immaculate. The darker cross-streaks on the eyed side are usually broader and more numerous in southern specimens, and the scales on the blind side of the head rougher. There are no constant differences either in the fin-rays or in the scales.

We have examined specimens of this species from Boston, Chestertown, Tarrytown, New York, Port Monmouth, Havre de Grace, Potomac River, Neuse River, Beaufort, Charleston, Pensacola, Mobile, and Galveston. In one large specimen from Pensacola (11482 M. C. Z.) there is a rudiment of a pectoral fin on the eyed side. It consists of a single ray two-thirds as long as the eye.

117. ACHIRUS PANAMENSIS.

Solea panamensis Steindachner, Ichthyol. Beiträge, v, 10, 1876, Taf. ii (Panama).

Habitat.—Pacific coast of tropical America, Panama.

Our knowledge of this species is derived from the description and excellent figure of Dr. Steindachner. The species is evidently very closely related to *Achirus fasciatus*, which it closely resembles in form and color.

118. ACHIRUS JENYNSI.

Achirus lineatus Jenyns, Voyage Beagle, Fishes, 1842, 139 (Rio de la Plata) (not *P. lineatus* L.).

Solea jenynsi Günther, Cat. Fish. Brit. Mus., iv, 476, 1862 (after Jenyns).

Habitat.—Region about Rio de la Plata.

The Museum of Comparative Zoology contains a single specimen (11425, 3 inches long) of this species. It was obtained in the Uruguay River by Prof. Jeffries Wyman. It is near *A. fasciatus*, from which species it differs mainly in having fewer fringes on the scales of the left side of head, and in having rather conspicuous cirri on the snout and chin.

Genus XLII.—GYMNACHIRUS.

Gymnachirus Kaup, Uebersicht der Soleinæ, Wiegmann's Archiv, 1858, 101 (*nudus*).

TYPE: *Gymnachirus nudus* Kaup.

We have examined none of the species of this singular genus. All that we know of it is drawn from the descriptions of Kaup and Günther. Two species have been described.

ANALYSIS OF SPECIES OF GYMNACHIRUS.

a. [Pectoral fin of right side present, very small, of two rays only, one-third as long as eye; jaws hidden in thick skin; lips slightly fringed; left side of head with a network of fringes; gill opening not reaching upward as far as pectoral; vertical fins covered with thick skin; caudal as long as head; head 5½ (with caudal); depth 2; D. 68, A. 50; color yellowish olive, with 14 brown bands, as broad as the interspaces, which again are crossed by narrower bands, all these bands extending over the dorsal and anal, the first crossing the snout, the second and third the eye; caudal with three brown bands.] (*Günther*)............ FASCIATUS, 119.

aa. [Pectoral fins both wanting. Body somewhat longer than high. D. 51; A. 42. Body with 14 black cross-bands; concentric rings about eyes; caudal with two black bands and a pale margin.] (*Kaup*)........................ NUDUS, 120.

119. GYMNACHIRUS FASCIATUS.

Gymnachirus fasciatus Günther, Cat. Fish. Brit. Mus., iv, 488, 1862 (locality unknown).

Habitat.—Unknown, probably Brazil.

We know this species from Dr. Günther's description only. Possibly *Gymnachirus nudus* may be the same species carelessly described by Dr. Kaup.

120. GYMNACHIRUS NUDUS.

Gymnachirus nudus Kaup, Wiegmann's Archiv, 1858, 101 (Bahia). Günther, iv, 488 (copied).

Habitat.—Coast of Brazil.

The scanty description of Kaup gives all that is known of this species.

Genus XLIII.—ACHIROPSIS.

Achiropsis Steindachner, Ichth. Beiträge, v, 110, 1876 (*nattereri*).

TYPE: *Solea nattereri* Steindachner.

This is another of the remarkable genera found in the fresh waters of South America. Although its species bear a strong general resemblance to the species of *Achirus*, they differ remarkably from the latter in some details of structure, and their real relations are with *Apionichthys*. *Achiropsis* differs from *Apionichthys* chiefly in the development of the left ventral fin. This is rudimentary in *Apionichthys* and perfect in *Achiropsis*.

ANALYSIS OF SPECIES OF ACHIROPSIS.

a. [Gill-opening on both sides present, but reduced to a short slit as long as eye next to the upper end of the opercular margin; eye very small; snout with a proboscis-like prolongation beyond the mouth; blind side anteriorly covered with fringes, but without true scales; scales on body ctenoid; fins scaly. Dorsal and anal fins slightly joined to the caudal; ventral of right side continuous with the anal. Body oblong. Color grayish brown. Head 5 in length; depth 2½. D. 82. A. 61. V. 5-5. P. 0., 37 to 40 scales in an oblique series above lateral line.] (*Steindachner*) .... NATTERERI, 121.

aa. Gill-opening of eyed side wanting, the gill-membrane being throughout adnate to the shoulder-girdle; gill-opening of blind side an oblique slit just below posterior angle of opercle, its length 4½ in head. Eyes small, close together, the upper considerably in advance of lower, their diameter equal to the interorbital width; snout protruding over the mouth, proboscis fashion, making the anterior profile a regular curve. Snout 2⅔ in head. Scales small (larger than in *A. nattereri*), not as rough as in *Achirus*, those on the blind side of the head wanting anteriorly, their place taken by cirri and fringes of moderate length; lateral line distinct, straight; fin-rays scaly; lower lip slightly fringed on eyed side, not on blind side. Nostril as in *Achirus*, a round foramen in front of interorbital space, not produced into a tube. Dorsal beginning on the snout, the dorsal and anal slightly joined to the caudal; ventral fin beginning at the chin, in front of the isthmus, the tip of the snout being in contact with its first ray; ventral of right side with extended base, wholly continuous with the anal; left ventral lateral, normally placed, its five rays opposite the 3d, 4th, and 5th rays of the right ventral; no pectoral fins. Body oblong, less deep than in *Achirus*. Color sand-color, with faint traces of about 8 narrow cross-bands; body and fins profusely and finely mottled and speckled with darker. Head, 4½; depth, 2½. D. 60. A. 44. V. 5-5. P. 0. Scales 70, about 28 in an oblique series above lateral line. ASPHYXIATUS, 122.

121. ACHIROPSIS NATTERERI.

Solea (Achiropsis) nattereri Steindachner, Ichth. Beiträge, v, 110, 1876 (Rio Negro).

Habitat.—Rivers of Northern Brazil.

We know this species from Steindachner's description only.

122. ACHIROPSIS ASPHYXIATUS.

Achiropsis asphyxiatus Jordan, sp. nov. (Goyaz, Brazil).

Habitat.—Rivers of Brazil.

The type of this species is a female specimen in good condition, 4⅝ inches long (11106 M. C. Z.), from Goyaz, Brazil. It differs from all other flounders in having but a single gill-opening. Possibly this character is only accidental in the individual, and that a small gill-opening may normally be present on both sides. It is certainly not present on the eyed side in the typical example.

Genus XLIV.—APIONICHTHYS.

Apionichthys Kaup, Wiegmann's Archiv, 1858, 104 (*dumerili*).
Soleotalpa Günther, Cat. Fish. Brit. Mus., iv, 489, 1862, (*unicolor*).

TYPE: *Soleotalpa unicolor* Günther = *Apionichthys dumerili* Kaup.

Besides the species here mentioned, we find in the Zoological Record a reference to *Apionichthys bleekeri* Horst, Nederl. Tijdschr. Dierk. Verh., iv, 30, 1878. It is decribed from a specimen from unknown locality in the museum at Utrecht.

This genus is a near ally of *Achiropsis*, from which it is only to be separated by the rudimentary character of the left ventral fin. Although it bears some external resemblance to *Symphurus*, its affinities are with *Achirus*. The species, if more than one really exists, have yet to be exactly defined.

ANALYSIS OF SPECIES OF APIONICHTHYS.

a. Left ventral reduced to two minute rays; body ovate-lanceolate, slender, and thinner than in *Achiropsis*, the eyes much smaller, reduced to mere points; scales very small, rough, those on head enlarged a little and fringed; upper eye in advance of lower, almost in the middle of the length of the head; gill-openings small, about equal on the two sides; right ventral beginning at the chin, and extending along the abdominal ridge so that it is continuous with the anal (left ventral destroyed in specimen examined); dorsal and anal slightly connected with caudal; color brown, rather pale, the body and fins profusely covered with round, dark spots of varying sizes, the largest as wide as from eye to eye. Head 4½; depth 2⅝. * D. 78. A. 56. Scales about 100 .... UNICOLOR, 123.

aa. [Left ventral wholly obsolete; scales ctenoid, cycloid on blind side; fin-rays scaly; depth, 2⅞; head, 4¼. D. 70 to 73. A. 52 to 54. V. 5-0. Lat. l. 87 to 90. Color clear brownish yellow.] (*Steindachner*) .... OTTONIS, 124

123. APIONICHTHYS UNICOLOR.

Apionichthys dumerili Kaup, Wiegmann's Archiv, 1858, 104. (No locality; no description.)
Soleotalpa unicolor Günther, Cat. Fish. Brit. Mus., iv, 1862, 489. (West Indies.) (?)
Apionichthys unicolor Jordan, Proc. U. S. Nat. Mus., 1886, 603. (Name only.)
Apionichthys dumerili Bleeker, Nederl. Tydschr. voor Dierkunde, ii, 1865, 305. Steindachner, Ichth. Beitr., viii, 1878, 48. (Surinam.)
Apionichthys nebulosus Peters, Berliner Monatsberichte, 1869, 709. (Surinam.)

Habitat.—Brazilian fauna.

We have examined a single specimen of this species (4677 M. C. Z.) 2½ inches long, from Obydos, in Brazil. It evidently corresponds to the *Apionichthys dumerili* of Bleeker and Steindachner, and apparently also to the *Apionichthys nebulosus* of Peters, although Peters failed to find the rudimentary left ventral fin. This fin, in fact, is not present in the specimen examined by us, it having been destroyed in attaching the metallic tag.

Günther's *Soleotalpa unicolor* may be the same, but the account of the coloration does not accord with the specimen examined by us, nor

* D. 76. A. 57. Scales 92. Color uniform brownish gray (*Günther*). D. 72. A. 53. Scales 95. Color brownish, mottled with darker spots (*Steindachner*).

with the statements of other authors. Perhaps the plain coloration may be due to age, or to the poor condition of the typical specimen.

Kaup's *Apionichthys dumerili* has not been described at all, but simply mentioned as the type of the genus. As his species cannot be identified, its name should not be used.

124. APIONICHTHYS OTTONIS.

Apionichthys ottonis Steindachner, Ichth. Notizen, vii, 41, 1868 (Sicily).

Habitat.—Mediterranean Sea.

This species is unknown to us. Judging from the published descriptions, it must be very close to *Apionichthys unicolor*, and only the different locality would appear to indicate specific distinction.

Genus XLV.—BRACHIRUS.

Brachirus Swainson, Nat. Hist. Class'n Fishes, 1839, ii, 303 (*orientalis, zebra, commersoniana,* etc.) (not *Brachyrus* Swainson, nor *Brachyurus* Fischer, both prior names).

Synaptura Cantor, Catal. Malayan Fishes, 1850, 232 (*commersoniana, zebra*) (name a substitute for *Brachirus*, preoccupied by *Brachyurus*, which is regarded as the correct orthography).

Solenoides Bleeker (*fide* Kaup).

? **Euryglossa** Kaup, Wiegmann's Archiv, 1858, 99 (*orientalis*).

? **Eurypleura** Kaup, l. c. (substitute for *Achiroides*).

? **Achiroides** Bleeker, Verh. Bataav. Genootsch., xxiv, Pleuron., 6, 1862 (*melanorhynchus*).

? **Anisochirus** Günther, Cat. Fish. Brit. Mus., iv, 1862, 486 (*panoides*).

TYPE: *Pleuronectes zebra* Bloch (as restricted by Swain., Proc. Ac. Nat. Sci. Phila., 1883).

We have had opportunity to study but few of the numerous species referred to this genus, and have no opinion as to the proper limitation of the group. Possibly neither of the European species should be referred to it.

We retain the name *Brachirus* (*i. e.*, *Brachychirus*), notwithstanding the priority of the name *Brachyrus*, which seems to have the same meaning. If, however, this name of Swainson be rejected, that next in order of date is *Synaptura*, which has now the advantage of general usage.

ANALYSIS OF THE SPECIES OF BRACHIRUS.

a. [Pectoral fins subequal; one of the nostrils of the blind side large, round, much dilated; depth, 3 in length, with caudal; head, 5; upper jaw overhanging; pectorals both present, equal in length, their length equal to their distance from the eye; color greenish brown, marbled with darker. D. 72; A. 58 to 60; P. 8. (*Kaup*) .... SAVIGNYI, 125.

aa. [Pectoral fins unequal, the right pectoral ½ its distance from the eye; nostril on each side dilated, trumpet-like; lateral line straight; ventral not inserted at chin; body rather elongate, depth 3½ to 4. D. 72 to 76; A. 58 to 60. Color chestnut, much spotted and variegated; three rows of pale ocelli bordered with dark along side of body.] (*Capello*) .... LUSITANICUS, 126.

125. BRACHIRUS SAVIGNYI.

Synaptura savignyi Kaup, Wiegmann's Archiv, 1858, 97 (Naples). Günther, iv, 480. 1862 (copied).

Habitat.—Mediterranean Sea.

We know nothing of this species, except what is contained in the scanty description of Kaup. According to Professor Giglioli, none of the Italian naturalists have seen this species.

126. BRACHIRUS LUSITANICUS.

Synaptura lusitanica Capello, Jorn. Ac. Sci. Lisb., v, 1868, 92, and vi, 1869, 153, tab. 9, f. 1 (Lisbon).

Habitat.—Coast of Portugal.

We have not examined this species, and know it from Capello's description only.

Genus XLVI.—SYMPHURUS.

Symphurus Rafinesque, Indice all' Ittiologia Siciliana, 1810, 52 (*nigrescens*).
Bibronia Cocco, Alcuni Pesci del mare di Messina, 1844, 15 (*ligulata;* larval form).
Plagusia Cuvier, Règne Animal, ed. ii, 1828 (based on *Plagusia* of Brown; name preoccupied in Crustaceans, Latreille, 1806).
Plagiusa Bonaparte, Catalogo Metodico, 1846, 51 (*lactea;* substitute for *Plagusia* preoccupied).
Aphoristia Kaup, Wiegmann's Archiv, 1858, 106 (*ornata*).
Glossichthys Gill, Cat. Fish. E. Coast N. A., 51, 1861 (*nomen nudum: plagiusa*).
Ammopleurops Günther, Cat. Fish. Brit. Mus., iv, 1862, 490 (*lacteus* = *nigrescens*).
? **Bascanius** Schiödte, "Naturhist. Tydsskr., v, 269, 1867" (*tædifer;* larval form).
Acedia Jordan, subgenus novum (*nebulosus*).

TYPE: *Symphurus nigrescens* Rafinesque.

We have adopted for this genus the name *Symphurus* instead of *Aphoristia*, as the so-called *Ammopleurops lacteus* is a genuine member of the latter genus, and as it seems to be evident that the latter species is the original of the *Symphurus nigrescens* of Rafinesque.

The following is Rafinesque's description:

"III. Gen. *Symphurus.* Ala caudale acuta, e riunita all' ale dorsali, ed anali, occhj alla sinistra. *Osserv.* Si dovranno ragguagliare in questo genere due specie del genere *Achirus* di Lacepede, ciò gli *A. bilineatus*, e *A. ornatus.* "Sp. no. 44. *Symphurus nigrescens.* Nerastro senza fascie, allungato, una sola linea laterale da ogni lato."

This single lateral line assumed to distinguish *Ammopleurops* from *Aphoristia* is not a real lateral line, but a depression along the median line produced by the junction of the muscles.

The species of *Symphurus* are somewhat numerous and very closely allied. With the exception of the European *Symphurus nigrescens*, all of them are American.

The development of the species is imperfectly known. According to Giglioli, the larvæ called *Bibronia*, may belong to this genus, and so possibly may *Delothyris* and *Charybdia.*

The name *Plagusia* belongs properly to the present genus rather than to the type of *Plagusia bilineata*, to which it has been restricted by Kaup and Günther. It is, however, preoccupied in crustaceans, and in any case, both *Plagusia* and the substitute name *Plagiusa* are antedated by the name *Symphurus*.

One of the American species referred to *Symphurus*, *nebulosus*, seems to differ widely from the others and is probably the type of a distinct genus, or subgenus, for which we have suggested the name *Acedia*. This name is applied by the Cuban fishermen to *Symphurus plagusia*.

ANALYSIS OF SPECIES OF SYMPHURUS.

a. Scales ctenoid, not keeled. (*Symphurus*.)

b. Scales small, moderately ctenoid; the number in a longitudinal series from 75 to 105.

c. Dorsal and anal fins chiefly black anteriorly and posteriorly, with paler edgings; body moderately elongate, the depth 3⅞ in length; the head 4½. Scales rather small, not very rough, about 80 in a longitudinal series. D. 90; A. 73 to 75. Color rather pale, plain or more or less mottled with darker, but without cross-bars; fins chiefly black with paler edgings ....NIGRESCENS, 127.

cc. Dorsal and anal pale anteriorly, becoming more or less abruptly black posteriorly.

d. [Caudal fin abruptly pale; depth 4½ in length; head, 5½. D. 96 to 100; A 86 to 87. Scales, 88 to 90. Color, grayish, speckled with brown; dorsal and anal fins black on last tenth, the caudal abruptly pale; tips of fin-rays vermilion.] (*Goode & Bean*) .....MARGINATUS, 128.

dd. Caudal fin black, as is a large part of the dorsal and anal; the black either continuous or in the form of large spots. Color, brownish, often mottled, usually with more or less distinct darker cross-bands, and with longitudinal streaks along the rows of scales, sometimes nearly plain brown.

e. Scales quite small, 98 to 105.

f. Body decidedly elongate, the depth about 4⅞ in length; D. 97; A. 82; scales, 98.....................................ELONGATUS, 129.

ff. Body less elongate, the depth 3⅓ in length; head, 5⅓; longitudinal streaks very distinct; D. 100; A. 80; scales about 105....ATRICAUDA, 130.

ee. Scales somewhat larger, 75 to 85; body rather elongate, the depth $3\frac{1}{10}$ to 3⅞ in length; the head 5⅓ to 5⅝; D. 90 to 95; A. 75 to 80. PLAGUSIA, 131.

ccc. Dorsal and anal pale throughout, or more or less mottled or spotted with darker; the caudal similarly colored, not distinctly black; body not very elongate, the depth 3 to 3⅓ in length. (Probably all varieties of *S. plagiusa*)..............................PLAGIUSA, 132.

x. Body with dark cross-bands more or less distinct; the fins mottled or speckled; upper eye slightly in advance of lower.

y. Dorsal rays 86 to 95; anal rays 75 to 80; head 5 in length; depth 3⅓; scales 85 to 93; cross-bands more distinct than in related species. Var. *plagiusa*, 132 (*a*).

yy. Dorsal rays 78 to 85; anal rays 70 to 72; head 5 in length; depth 3⅓; scales 80 to 90; color light brown, with darker cross-bars, which become obsolete with age...................Var. *pusillus*, 132 (*b*).

xx. [Body uniform grayish, without cross-bands; last part of dorsal and anal with 3 or 4 oblong black blotches, each somewhat larger than the eye; upper eye directly above lower; head, 5⅜ in length; scales, 85; D. 92; A. 75.] (*Goode & Bean*)
Var. *diomedeanus* 132 (*c*).

bb. [Scales rather large, very rough-ctenoid, about 65–34; depth, 3¼ in length; head, 4⅛; D. 90; A. 69 to 75; color clouded brown, somewhat blotched.] (*Goode & Bean*)....................................PIGER, 133.

aa. [Scales very small, ctenoid, each with a median keel, which is dark and prominent; snout and jaws naked; fin-rays in increased number.] (Subgenus *Acedia* Jordan.)

h. Head, 5⅔; depth, 4⅞; D. 119; A. 107; scales, 120; grayish, everywhere mottled with brown.] (*Goode & Bean*)....NEBULOSUS, 134.

127. SYMPHURUS NIGRESCENS.

Symphurus nigrescens Rafinesque, Indice all' Ittiologia Siciliana, 1810, 52 (Palermo).
Plagusia lactea Bonaparte, Fauna Ital. Pesci, about 1840.
Ammopleurops lacteus Günther, iv, 490 (copied).
Plagusia picta Cocco (*fide* Giglioli).
Bibronia ligulata Cocco, "Alcuni Pesci del mare di Messina, 1844, 390" (Messina) (larva).
? *Bascanius tædifer* Schiödte, Natur. Tydsskr., v, 269, 1867 (free-swimming oceanic larvæ).

Habitat.—Mediterranean Sea.

We have examined three specimens of this rare species, obtained at Palermo by Professor Doderlein. As already noticed, this is a genuine member of the genus usually called *Aphoristia*, having no lateral line. These three specimens have the body nearly uniform in color. They correspond to the *Ammopleurops lacteus* of European authors. A specimen in the museum at Cambridge from Naples is somewhat mottled and represents the nominal species *Ammopleurops pictus*.

128. SYMPHURUS MARGINATUS.

Aphoristia marginata Goode & Bean, Bull. Mus. Comp. Zool., xii, 153. (Off St. Vincent, etc.)

Habitat.—West Indies.

This species is known only from the original types, taken in deep water (94 to 324 fathoms) in the West Indies.

129. SYMPHURUS ELONGATUS.

Aphoristia ornata var. *elongata* Günther, Fishes Centr. Amer., 1869, 473. (Panama.)
Aphoristia elongata Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 111. (Panama.)

Habitat.—Pacific coast of tropical America.

This species is not uncommon on the Pacific coast of Central America, where it represents the closely related *Symphurus plagusia*. Its relations with *Symphurus atricauda* are still closer.

130. SYMPHURUS ATRICAUDA.

Aphoristia atricauda Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 23 (San Diego). Jordan & Gilbert, Synopsis Fish. N. A., 1882, 842. Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 380. (San José, Lower California.) Jordan, Proc. U. S. Nat. Mus., 1886, 54.

Habitat.—Lower California, north to San Diego.

This species is common in the bay of San Diego, in which locality the numerous specimens before us were taken. A small specimen 1½ inches long, with light spots on the colored side and a pale ocellation on the black of the tail, taken by Mr. L. Belding near Cape San Lucas, probably belongs to the same species.

Symphurus atricauda is very close to *S. elongatus*, and both might well be regarded as geographical varieties of *S. plagusia.*

131. SYMPHURUS PLAGUSIA.

(ACEDIA.)

Plagusia Brown, Jamaica, 445, No. 1. (Jamaica.)

Pleuronectes plagusia Bloch & Schneider, Syst. Ichth., 1801, 162 (after Brown).

Achirus ornatus Lacépède, Hist. Nat. Poiss., iv, 659, 1803 (on a specimen "presented by Holland to France").

Plagusia ornata Cuvier, Règne Animal, ed. ii.

Aphoristia ornata Kaup, Wiegmann's Archiv, 1858, 106. Günther, iv, 490 (San Domingo, Jamaica). Poey, Synopsis, 1868, 409. Poey, Enumeratio, 1875, 140 (Havana). Kner, Novara Fische, iii, 292. (D. 90; A. 75; depth 3¼ in length; Rio Janeiro.)

Plagusia tessellata Quoy & Gaimard, Voyage Uranie, Zoologie, 240, 1824 (Rio Janeiro).

Plagusia brasiliensis Agassiz, Spix Pisc. Brasil., 1827, p. 89, tab. 50. (Brazil.)

Aphoristia plagiusa Jordan, Proc. U. S. Nat. Mus., 1886, 53. (Havana.) (Not *S. plagiusa* of this paper.)

Habitat.—West Indian fauna (south to Rio Janeiro).

The numerous specimens of this species examined by us are from Havana, Pernambuco, Santos, Rio Janeiro, Curuça, and Victoria.

The synonymy of this species is somewhat doubtful. The original type of *Pleuronectes plagiusa* was sent to Linnæus by Dr. Garden, of Charleston. It would therefore appear probable that this specimen represented the species of this genus which is found on the Carolina coast. But this typical specimen is still preserved in the rooms of the Linnæan Society in London, where it has been examined by Goode and Bean.

From their notes (Proc. U. S. Nat. Mus., 1885, 196) we quote: "The type of this species may have come from Africa or India. There is considerable doubt as to its origin. (See Garden's Correspondence with Linné, page 314.) D. *ca* 92, A. *ca* 80. Scales 77. The species is more elongate than our specimens of *Aphoristia plagiusa*, so called, the depth being contained in the total length without caudal 4⅓ times and the head 6 times."

As, however, no species of this genus are yet known from Africa or India, it is rather probable that Garden's fish actually came from

Charleston. The greater slenderness of the original type is perhaps due to distortion, and the smaller number than usual of the scales does not afford a marked distinction.

On account of the fact that the West Indian species as a rule is a little slenderer than the northern one and has a little larger scales, Dr. Jordan has elsewhere adopted for the former the Linnæan name, but, on the whole, it seems more probable that the original *plagiusa* was the northern fish.

The name *ornatus* is also doubtful in its proper application. The only thing distinctive in the description of Lacépède is that the typical specimen was "given by Holland to France." Many of the species in this Dutch collection seem to have come from Surinam, and this is probably no exception. But Lacépède's description might apply as well to any other species of *Symphurus* as to this.

The name *Pleuronectes plagusia*, given by Schneider to the species described by Brown, seems to admit of no doubt, as this is the only one of the group yet known from Jamaica. If, therefore, the name *plagiusa* be used for the northern species, or dropped altogether as not identified, the present species will stand as *Symphurus plagusia.*

We have compared numerous specimens from Rio Janeiro (representing the nominal species *tessellatus* or *brasiliensis*) with others (*plagusia* = *ornata*) from Havana. There is certainly no permanent difference. The Brazilian specimens are a little more slender on an average, but there are numerous exceptions, and all variations in color are found in both.

132. SYMPHURUS PLAGIUSA.

(TONGUE-FISH.)

a. Var. *plagiusa.*

Pleuronectes plagiusa Linnæus, Syst. Nat., ed. xii, 1766, 455 (on a specimen from Dr. Garden, probably from Charleston, but the locality not quite certain; and of various copyists).

Glossichthys plagiusa Gill, Cat. Fish. E. Coast N. Am., 1861, 51 (name only).

Plagusia plagiusa Gill, Cat. Fish. East Coast N. Am., 1872–'3, 794 (name only).

Aphoristia plagiusa Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 368 (Beaufort). Jordan, *op. cit.*, 1880, 22 (St. John's River). Jordan & Gilbert, *op. cit.*, 1882, 305 (Pensacola); 1882, 618 (Charleston). Jordan & Gilbert, Synopsis Fish. N. A., 1882, 842. Jordan, Proc. U. S. Nat. Mus., 1884, 144 (Key West).

Plagusia fasciata Holbrook, MSS. De Kay, New York Fauna; Fishes, 1842, 304 (Charleston).

Aphoristia fasciata Jordan, Proc. U. S. Nat. Mus., 1886, 53.

b. Var. *pusillus.*

Aphoristia pusilla Goode & Bean, Proc. U. S. N. Mus., 1885, 590 (Gulf Stream; lat. 40°).

c. Var. *diomedeanus.*

Aphoristia diomedeana Proc. U. S. Nat. Mus., 1885, 589 (Gulf of Mexico; 24 fathoms).

Habitat.—South Atlantic and Gulf coasts of the United States.

This species is very common on the sandy shores of our South Atlantic and Gulf States. Our numerous specimens are from Beaufort, Charleston, Pensacola, and Key West.

The reasons for continuing to regard this species as the original *Pleuronectes plagiusa* of Linnæus, are given under the head of *Symphurus plagusia.*

If however, the name *plagiusa* be referred to the West Indian form or dropped as unidentifiable, the name *fasciatus* would then hold for this species.

The characters distinguishing *elongatus*, *atricauda*, *plagusia*, *plagiusa*, *pusillus*, and *diomedeanus* are of slight value, and doubtless all will ultimately prove to be varieties of a single one, the coloration of the fins being more marked in southern specimens.

A specimen nearly six inches long collected at Beaufort, N. C., by Prof. O. P. Jenkins seems referable to *pusillus* rather than to the typical *plagiusa.* It is highly mottled in coloration, the body and fins being profusely speckled and blotched with blackish besides 9 or 10 rather distinct cross-bands. D. 85, A. 72. Scales about 80. Depth 3¼ in length.

Another large specimen 7 inches long from the Florida Keys is in the museum at Cambridge. This has: D. 82, A. 72, lat. l. 76. Depth 3 in length. Color brown almost plain, except that the fins are mottled, especially posteriorly; caudal fin not black.

If these two specimens are really typical of *Symphurus pusillus*, it probably cannot be separated as a species from *S. plagiusa.*

The form called *diomedeanus* is known to us from the description only. It is certainly very similar to *S. plagiusa.* Perhaps it is identical with our Key West specimens of the latter. These are very pale, and nearly plain gray, as would be expected in fishes taken from the coral sands.

133. SYMPHURUS PIGER.

Aphoristia pigra Goode & Bean, Bull. Mus. Comp. Zool., xiii, 5, 1886, 154 (St. Kitts, Key West, Cedar Keys, in about 250 fathoms).

Habitat.—West Indies and Gulf of Mexico, in deep water.

This species is known to us from the original description. It is evidently a better-defined species than are most of the others.

134. SYMPHURUS NEBULOSUS.

Aphoristia nebulosa Goode & Bean, Bull. Mus. Comp. Zool., xix, 1883, 192 (Gulf Stream, off the coast of Carolina).
Acedia nebulosa Jordan, MSS.

Habitat.—Gulf Stream.

This species is known from the original account only. The description would indicate a species considerably unlike those forming the rest of the genus. If its scales are really keeled it may form the type of a distinct genus. The increased number of fin-rays also indicates a probability that the number of vertebræ will be found to be similarly increased. For the subgenus of which this is the type, we have suggested the name of *Acedia*.

LARVAL FORMS.

(BIBRONIÆ.)

The very young of all the *Pleuronectidæ* so far as known are transparent and with the eyes symmetrical. At a length of from one-fourth of an inch to an inch the eye of one side moves by degrees to the other side, where it becomes the upper eye. The question has been much discussed as to how this change comes about—whether by a twisting of the head so that the eye moves over the line of the profile, whether by passing from side to side beneath the frontal bone, or by passing between the frontal bone and the bases of the dorsal rays, or whether by each of these methods in different genera. The present writers have had no opportunity to make any observations on this point, the statements which follow being entirely drawn from others, chiefly from the papers of Dr. Luigi Facciolà.*

According to Prof. Japetus Steenstrup,† who has examined some "plagusiiform" specimens (*Symphurus?*) about 25 millimeters in length, the eye, by a combined movement of rotation and translation, goes from its original position to the other side by passing under the frontal bone.

In other flounders examined by Prof. Alexander Agassiz the eye is said to have crossed from side to side above the frontal bone, penetrating the space between this bone and the dorsal fin by sinking into the tissues of the head. In the species examined by Dr. Facciolà the eye was found to pass between the frontal bone and the dorsal rays, but without penetrating any tissues. During the passage of the eye the first dorsal ray formed a projection detached from the cranium, and in the notch between this and the head the eye has passed from one side to the other.

It has not been easy to determine with certainty the species to which these larval forms belong. The first of these which were known were described by Cocco as distinct genera, allied to the flounders, but distinguished from them by the symmetrical arrangement of the eyes. For the group thus defined Bonaparte has proposed the family name of Bibronidi (*Bibroniidæ*), and this name has been adopted by some of the Italian ichthyologists.

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* "Sulla Stato Giovanile del *Rhomboidichthys mancus*," Facciolà, Naturalista Siciliano, vi, 1887, and "Su di Alcuni Rari Pleuronettidi del mare di Messina," Nat. Sicil., iv, 1885.

† "Om Skjœbheden hos Flynderne og navnlig om Vandringen af det övre Oie fra Blindsiden til Ojesiden tvers igjennem Hovedet," 1864.

Lately the relations of these forms have been made the subject of careful study by Dr. Carlo Emery, Dr. Luigi Facciolà, and others of the Italian naturalists, and no doubt remains that the "*Bibroniidæ*" are larval flounders and soles.

For the sake of completeness, we give the following analysis of the nominal genera and the synonymy of the species:

ANALYSIS OF THE NOMINAL GENERA OF BIBRONIÆ OR LARVAL FLOUNDERS AND SOLES.

a. Eyes wholly sinistral; mouth toothless, shaped as in the soles; upper jaw hook-shaped; head very small; caudal fin subsessile, free from the dorsal and anal; scales small, caducous, cycloid; eyes small; pectoral fins both present, the right pectoral small; ventral fins both present, free from anal; dorsal fin of long, simple rays, their tips much exserted; body moderately elongate; the depth 3 in length; dorsal rays 100; anal rays 80. P. 12-4. DELOTHYRIS, A.

aa. Eyes partly sinistral, the one on the left side, the other on the vertex (in the act of transition); form pleuronectoid.......................COCCOLUS, B.

aaa. Eyes, one on either side of the head; strictly symmetrical (or with the right eye somewhat higher than the other), and with a notch before it, between the cranium and the dorsal fin.

b. Vertical fins scarcely or not confluent; left ventral largest, on abdominal ridge.

c. Body excessively compressed, broadly ovate, its depth 1⅞ in its length; both profiles very convex; the snout not forming an angle; no scales; none of the dorsal rays prolonged; ventral fin single (*Facciolà*); pectoral fins short, rounded, with fleshy base and fringe-like rays; D. 85; A. 65. Jaws equal, with small, acute teeth..PELORIA, C.

cc. Body more elongate; scales present or absent; pectorals adipose, with fringe-like rays.

d. Ventral fin single; first four rays of the dorsal well separated and with much exserted tips; dorsal and anal slightly joined to caudal; depth about 4½ in length; D. 4, 106; A. 100. (*Emery*)................? CHARYBDIA, D.

dd. Ventral fins both present, the left ventral with more prolonged base; dorsal with only the first ray (if any) prolonged; dorsal and anal free from caudal; depth 2⅓ to 2 in length (*Facciolà*)..................CHARYBDIA, D.

bb. Vertical fins fully confluent; form lanceolate.

e. Body linguiform, the depth 6 in length; no teeth; snout obtuse; eyes minute; ventral fins two; four or five of the dorsal rays produced; pectorals pedunculate. D. 90; A. 80..........................BIBRONIA, E.

ee. Body plagusiiform; perfectly transparent................BASCANIUS, F.

Synonymy of genera of larval Pleuronectidæ or Bibroniæ.

Bibronia Cocco, "Intorno ad alcuni Pesci del mare di Messina. Lettera al Sig. Augusto Krohn da Livonia. In Giornale del Gabinetto & Lettere di Messina. Ann. iii, tom. v, fasc. xxv. Gennaio e febbraio 1844, pag. 21-30, tav. 2" (*fide* Facciolà) (*ligulata*).

Peloria Cocco, l. c. (*hæckeli*).

Coccolus (Bonaparte) Cocco, l. c. (*annectens*).

Bascanius Schiödte, Naturhist. Tidsskr., v, 269, 1867 (*tædifer*).

Thyris Goode, Proc. U. S. Nat. Mus., 1880, 344 (*pellucidus*: name preoccupied).

Delothyris Goode, Proc. U. S. Nat. Mus., 1883, 110 (*pellucidus*).

Charybdia Facciolà, Naturalista Siciliano, iv, 265, 1885 (*rüppelli*).

Synonymy of species of Bibroniæ.

1. DELOTHYRIS PELLUCIDUS.

Thyris pellucidus Goode, Proc. U. S. Nat. Mus., 1880, 337, 344, 475. (Gulf Stream, off Rhode Island). Jordan & Gilbert, Synopsis Fish. N. A., 1882, 840 (copied).
Delothyris pellucidus Goode, Proc. U. S. Nat. Mus., 1883, 110.

This fish is unquestionably a larval form, but probably the adult is not yet known. In some respects it resembles *Monolene*, in others it seems allied to the *Cynoglossinæ*. The type was nearly three inches in length.

2. COCCOLUS ANNECTENS.

Coccolus annectens (Bonaparte) Cocco, l. c., 1844 (Messina).

This species has not yet been described in detail, but from the form of the body it would seem to resemble most closely the young of *Platophrys podas*.

3. PELORIA HÆCKELI.

Peloria hæckeli Cocco, l. c., 1844 (Messina). Emery, Contribuzione all' Ittiologia, 405 (Naples). Facciolà, Nat. Sicil., 1885, 5.

The specimens of this species described by Facciolà are 20 to 36 mm in length. According to Facciolà,* it can be confounded with no known species of Pleuronectoid. Dr. Emery has maintained that it is the young of *Platophrys podas*, and his figure and description seem to render this determination almost certain.

4. CHARYBDIA. (Species.)

Peloria rüppelli Emery, Contribuzione all' Ittiologia (Naples).

The description given by Dr. Emery of *P. rüppelli* diverges so widely from that given by Dr. Facciolà, that the identity of the two may be questioned. If, as is possible, the pectorals in the achirous forms disappear with age, this species may belong to the *Cynoglossinæ*. More likely, it is a relative of *Arnoglossus*, or of *Monolene*.

5. CHARYBDIA RÜPPELLI.

Peloria rüppelli Cocco, l. c., 1844 (Messina).
Charybdia rüppelli Facciolà, Nat. Sicil., 1885, 5 (Messina).

This is probably the young of some species as yet unknown in the adult condition. Some of its characters suggest *Arnoglossus ventralis*.

According to Facciolà, the body is naked; the form oval; the mouth as long as the eye; right eye higher than left; first dorsal ray only prolonged; no scales; left ventral with its base longer than the right; length 30 to 40 mm. D. 113, A. 91.

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*"Non è a dubitarsi che questi Pleuronettidi son giovani di altro specie più grandi. Diro soltanto che la *Peloria hæckeli* non puo confondersi con nessun Pleuronettide conosciuto." (*Facciolà.*)

6. CHARYBDIA RHOMBOIDICHTHYS.

Charybdia rhomboidichthys Facciolà, Nat. Sicil., 1885, 6 (Messina).

Form, oval; the two outlines similar; snout, obtuse, somewhat prominent; teeth, insensible; eye, $4\frac{1}{2}$ in head, the right a little above the left; none of the dorsal rays prolonged; scales, cycloid, thin; lateral line without arch; length 40 mm. D. 99, A. 74, V. 6.

This form seems to be allied to *Syacium* and *Arnoglossus*.

7. BIBRONIA LIGULATA.

Bibronia ligulata Cocco, l. c., 1844 (Messina). Facciolà, Nat. Sicil., 1885, 4 (Messina).

This form is known from specimens one-third of an inch in length. If we suppose that in *Symphurus* the pectoral fins become atrophied with age, this may well be the larva of *Symphurus nigrescens*.

8. BASCANIUS TÆDIFER.

Bascanius tædifer Schiödte, "Naturhist. Tydsskrift, v, 269, 1867" (Oceanic).

We have not seen the original description of this form, but from the references made to it by other authors it would appear to be a larval *Symphurus*.

RECAPITULATION.

The following is the list of the genera and species of flounders now recognized by us as occurring in the waters of North America and Europe:

The general distribution of each may be indicated by the following letters:

E. Europe (North of Spain).
M. Mediterranean Sea.
B. Bassalian or deep-sea fauna of the Atlantic.
G. Greenland fauna.
N. East coast of United States; Cape Cod to Cape Hatteras.
S. South Atlantic and Gulf coast.
W. West India fauna.
R. Brazilian fauna (Rio).
T. Patagonian fauna (Terra del Fuego).
P. Panama fauna.
V. Chilian fauna (Valparaiso).
C. Californian fauna.
A. Alaskan fauna.

Subfamily I.—HIPPOGLOSSINÆ.

1. Atheresthes (Jordan & Gilbert).
 1. *Atheresthes stomias* (Jordan & Gilbert). A.

2. Platysomatichthys Bleeker.
 2. *Platysomatichthys hippoglossoides* (Walbaum). G.

3. Hippoglossus Cuvier.
 3. *Hippoglossus hippoglossus* (Linnæus). E. G. A.

4. **Lyopsetta** Jordan & Goss.
   4. *Lyopsetta exilis* (Jordan & Gilbert). A.

5. **Eopsetta** Jordan & Goss.
   5. *Eopsetta jordani* (Lockington). C.

6. **Hippoglossoides** Gottsche.
   6. *Hippoglossoides platessoides* (Fabricius). E. G.
   6 (*b*). ——— ——— var. *limandoides* Bloch. E. G.
   7. *Hippoglossoides classodon* Jordan & Gilbert. A.

7. **Psettichthys** Girard.
   8. *Psettichthys melanostictus* Girard. C. A.

8. **Hippoglossina** Steindachner.
   9. *Hippoglossina macrops* Steindachner. P.
   10. *Hippoglossina microps* Günther. V.

9. **Xystreurys** Jordan and Gilbert.
   11. *Xystreurys liolepis* Jordan & Gilbert. C.

10. **Paralichthys** Girard.
   12. *Paralichthys californicus* (Ayres). C.
   13. *Paralichthys brasiliensis* (Ranzani). R. W.
   14. *Paralichthys adspersus* (Steindachner). P. V. (Possibly to be called *P. kingi.*)*
   15. *Paralichthys dentatus* (Linnæus). N. S.
   16. *Paralichthys lethostigma* Jordan & Gilbert. N. S.
   17. *Paralichthys squamilentus* Jordan & Gilbert. S.
   18. *Paralichthys albigutta* Jordan & Gilbert. S.
   19. *Paralichthys patagonicus* Jordan. T.
   20. *Paralichthys oblongus* Mitchill. N.

11. **Ancylopsetta** Gill.
   21. *Ancylopsetta quadrocellata* Gill. S.
   22. *Ancylopsetta dilecta* (Goode & Bean). B.

Subfamily II.—PLEURONECTINÆ.

12. **Phrynorhombus** Günther.
   23. *Phrynorhombus regius* Bonnaterre. M. E.

13. **Zeugopterus** Gottsche.
   24. *Zeugopterus punctatus* (Bloch). E.

14. **Lepidorhombus** Günther.
   25. *Lepidorhombus whiff-iagonis* (Walbaum). E.
   26. *Lepidorhombus norvegicus* (Günther). E. (Doubtful species.)

15. **Citharus** Bleeker.
   27. *Citharus linguatula* (Linnæus). M.

16. **Pleuronectes** (Linnæus) Fleming.

§ *Pleuronectes.*

   28. *Pleuronectes maximus* Linnæus. E. M.
   28 (*b*). ——— ——— var *mæoticus* (Pallas). M.

§ *Bothus* Rafinesque.

   29. *Pleuronectes rhombus* Linnæus. E. M.
   30. *Pleuronectes maculatus* Mitchill. N.

* *Hippoglossus kingi* is known from a drawing only, executed by unscientific hands. In all respects but one this drawing agrees well with *P. adspersus*. The first 18 of the 66 rays of the dorsal are represented as lower than the others, apparently forming a distinct portion. Depth 2 in length. Anal rays 51.

17. Arnoglossus Bleeker.

§ *Arnoglossus.*

31. *Arnoglossus lophotes* Günther. M. (Doubtful species; perhaps identical with *A. grohmanni*—perhaps with *Bothus imperialis* Rafinesque.)
32. *Arnoglossus grohmanni* (Bonaparte). M.
33. *Arnoglossus conspersus* (Canestrini). M. (Doubtful species; probably same as the next.)
34. *Arnoglossus laterna* (Walbaum). M. E.

§ ——.

35. *Arnoglossus ? fimbriatus* (Goode & Bean). B. (Probably type of a distinct genus.)

§ ——.

36. *Arnoglossus ? ventralis* (Goode & Bean). B. (Perhaps type of a distinct genus.)

18. Platophrys Swainson.

37. *Platophrys podas* (Delaroche). M.
38. *Platophrys spinosus* (Poey). W. (Doubtful species.)
39. *Platophrys constellatus* Jordan. V.
40. *Platophrys ocellatus* (Agassiz). S. W. R.
41. *Platophrys maculifer* (Poey). W. (Synonymy doubtful.)
42. *Platophrys ellipticus* (Poey). W. (Doubtful species.)
43. *Platophrys lunatus* (Linnæus). W. R.
44. *Platophrys leopardinus* (Günther). P.

19. Syacium Ranzani.

45. *Syacium cornutum* (Günther). R.
46. *Syacium papillosum* (Linnæus). S. W. R.
47. *Syacium micrurum* (Ranzani). S. W. R.
48. *Syacium latifrons* (Jordan & Gilbert). P.
49. *Syacium ovale* (Günther). P.

20. Azevia Jordan.

50. *Azevia panamensis* Steindachner. P.

21. Citharichthys Bleeker.

§ *Orthopsetta* Gill.

51. *Citharichthys sordidus* (Girard). C.
52. *Citharichthys stigmæus* Jordan & Gilbert. C. (Doubtful species.)

§ *Citharichthys.*

53. *Citharichthys dinoceros* Goode & Bean. B.
54. *Citharichthys arctifrons* Goode. B.
55. *Citharichthys unicornis* Goode. B.
56. *Citharichthys macrops* Dresel. S.
57. *Citharichthys uhleri* Jordan. W.
58. *Citharichthys spilopterus* Günther. S. W. P. R.
59. *Citharichthys sumichrasti* Jordan. P.

59 (*b*). **Citharichthys microstomus* Gill. S.

22. Etropus Jordan & Gilbert.

60. *Etropus ectenes* Jordan. V.
61. *Etropus rimosus** Goode & Bean. S.
62. *Etropus crossotus* Jordan & Gilbert. S. W. P. R.

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*We are probably in error in regarding *Etropus rimosus* as identical with *Citharichthys microstomus*. The latter has a larger mouth, the maxillary 2⅗ in head, instead of nearly 4 as in the former.

23. Thysanopsetta Günther.

63. *Thysanopsetta naresi* Günther. T.

24. Monolene Goode. (Genus of uncertain relationships.)

64. *Monolene sessilicauda* Goode. B.
65. *Monolene atrimana* Goode & Bean. B.

Subfamily III.—ONCOPTERINÆ.

25. Oncopterus Steindachner.

66. *Oncopterus darwini* Steindachner. T.

Subfamily IV.—PLATESSINÆ.

26. Pleuronichthys Girard.

67. *Pleuronichthys decurrens* Jordan & Gilbert. C. A.
68. *Pleuronichthys verticalis* Jordan & Gilbert. C. A.
69. *Pleuronichthys cœnosus* Girard. C. A.

27. Hypsopsetta Gill.

70. *Hypsopsetta guttulata* (Girard). C.

28. Parophrys Girard.

71. *Parophrys vetulus* Girard. C. A.

29. Inopsetta Jordan & Goss.

72. *Inopsetta ischyra* (Jordan & Gilbert). A.

30. Isopsetta Lockington.

73. *Isopsetta isolepis* (Lockington). A. C.

31. Lepidopsetta Gill.

74. *Lepidopsetta bilineata* (Ayres). C.
74 (*b*). ——— *umbrosa* (Girard). A.

32. Limanda Gottsche.

75. *Limanda ferruginea* (Storer). G.
76. *Limanda limanda* (Linnæus). E.
77. *Limanda aspera* (Pallas). A.
78. *Limanda beani* Goode. B.

33. Pseudopleuronectes Bleeker.

79. *Pseudopleuronectes americanus* (Walbaum). N.
80. *Pseudopleuronectes pinnifasciatus* (Kner). A. (Generic relations uncertain.)

34. Platessa Cuvier.

§ *Platessa.*

81. *Platessa platessa* (Linnæus). E. M.
81 (*b*). ——— ——— *pseudoflesus* (Gottsche). E.
82. *Platessa quadrituberculata* (Pallas). A.

§ *Flesus* Moreau.

83. *Platessa flesus* Linnæus. E. M.
83 (*b*). ——— ——— *glabra* (Rathke). M.

35. Liopsetta Gill.

84. *Liopsetta dvinensis* (Lilljeborg). E. (Doubtful species, probably identical with *L. glacialis*.)
85. *Liopsetta putnami* (Gill). N. (Probably identical with the next.)
86. *Liopsetta glacialis* (Pallas). A.

36. Platichthys Girard.

87. *Platichthys stellatus* (Pallas). A. C.

37. Microstomus Gottsche. (To be called *Cynicoglossus* if *Microstomus* be deemed preoccupied.)

88. *Microstomus kitt* (Walbaum). E.
89. *Microstomus pacificus* (Lockington). A.

38. Glyptocephalus Gottsche.

90. *Glyptocephalus cynoglossus* (Linnæus). E. G.
91. *Glyptocephalus zachirus* (Lockington). A.

Subfamily V.—SOLEINÆ

39. Solea Quensel.

§ *Solea.*

92. *Solea solea* (Linnæus). E. M.
93. *Solea capellonis* (Steindachner). M. (Doubtful species.)
94. *Solea brasiliensis* (Cuvier). R. (Species unknown to recent writers.)

§ *Pegusa* Günther.

95. *Solea kleini* (Risso). M.
96. *Solea aurantiaca* (Günther). E. (Doubtful species.)
97. *Solea lascaris* (Risso). M. (Synonymy doubtful; perhaps to be called *S. scriba.*)
98. *Solea theophila* (Risso). M. (Synonymy somewhat doubtful.)
99. *Solea variolosa* (Kner). R.

40. Monochirus Rafinesque.

§ *Quenselia* Jordan.

100. *Monochirus ocellatus* (Linnæus). M.

§ *Microchirus* Bonaparte.

101. *Monochirus luteus* (Risso). M.
102. *Monochirus variegatus* (Donovan). M. E.
103. *Monochirus minutus* (Parnell). M. (Doubtful species.)

§ *Monochirus.*

104. *Monochirus hispidus* Rafinesque.

41. Achirus Lacépède.

§ *Baiostoma* Bean.

105. *Achirus achirus* (Linnæus). W. R. (Possibly to be called *A. gronovii.*)
106. *Achirus inscriptus* (Gosse). W. S.
107. *Achirus klunzingeri* (Steindachner). P. V.
108. *Achirus mentalis* (Günther). R.
109. *Achirus lineatus* (Linnæus). S. W. R.
109 (*b*). ——— ——— *brachialis* (Bean). S.
109 (*c*). ——— ——— *comifer* (Jordan & Gilbert). S.
110. *Achirus mazatlanus* (Steindachner). P.
111. *Achirus fonsecensis* (Günther). P.
112. *Achirus punctifer* (Castelnau). R.
113. *Achirus scutum* (Günther). P.
114. *Achirus garmani* (Jordan). R.

§ *Achirus.*

115. *Achirus fimbriatus* (Günther). P.
116. *Achirus fasciatus* (Lacépède). N. S.
117. *Achirus panamensis* (Steindachner). P.
118. *Achirus jenynsi* (Günther). R.
118 (*b*). *Achirus lorentzi* (Weyenbergh). R. (Species unknown to us.)

42. **Gymnachirus** Kaup.
 119. *Gymnachirus fasciatus* (Günther). R.
 120. *Gymnachirus nudus* (Kaup). R.

43. **Achiropsis** Steindachner.
 121. *Achiropsis nattereri* (Steindachner). R.
 122. *Achiropsis asphyxiatus* (Jordan). R.

44. **Apionichthys** Kaup.
 123. *Apionichthys unicolor* (Günther). W. R. (Synonymy a little uncertain.)
 124. *Apionichthys ottonis* (Steindachner). M. (Doubtful species.)

45. **Brachirus** Swainson. (To be called *Synaptura* if *Brachirus* be regarded as preoccupied.)
 125. *Brachirus savignyi* (Kaup). M.
 126. *Brachirus lusitanicus* (Capello). M. (Species unknown to us.)

Subfamily VI.—CYNOGLOSSINÆ.

46. **Symphurus** Rafinesque.

§ *Symphurus*.

 127. *Symphurus nigrescens* (Rafinesque). M.
 128. *Symphurus marginatus* (Goode & Bean). W.
 129. *Symphurus elongatus* (Günther). P.
 130. *Symphurus atricauda* (Jordan & Gilbert). C.
 131. *Symphurus plagusia* (Bloch & Schneider). W. R.
 132. *Symphurus plagiusa* (Linnæus). S.
 132 (*b*). ——— ——— *pusillus* (Goode & Bean). S.
 132 (*c*). ——— ——— *diomedeanus* (Goode & Bean). S.
 133. *Symphurus piger* (Goode & Bean). W.

§ *Acedia* Jordan. (Probably a distinct genus.)

 134. *Symphurus nebulosus* (Goode & Bean). W.

LARVAL FORMS. (*Bibroniæ.*)

A. DELOTHYRIS Goode.

1. *Delothyris pellucidus* (Goode). B.

B. COCCOLUS Bonaparte.

2. *Coccolus annectens* (Bonaparte). M.

C. PELORIA Cocco.

3. *Peloria heckeli* (Cocco). M.

D. CHARYBDIA Facciolà.

4. *Charybdia* sp. (Emery). M.
5. *Charybdia rüppelli* (Cocco). M.
6. *Charybdia rhomboidichthys* (Facciolà). M.

E. BIBRONIA Cocco.

7. *Bibronia ligulata* (Cocco). M.

F. BASCANIUS Schiödte.

8. *Bascanius tædifer* (Schiödte). B.

INDIANA UNIVERSITY,
Bloomington, Ind., July 10, 1887.

LIST OF PLATES.

PLATE I.

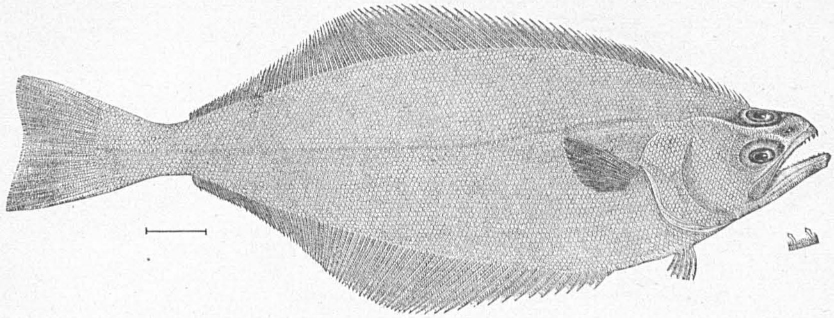


FIG. 1.—ATHERESTHES STOMIAS Jordan & Gilbert. The Arrow-toothed Halibut.
(From No. 27186: Point Reyes, California.)

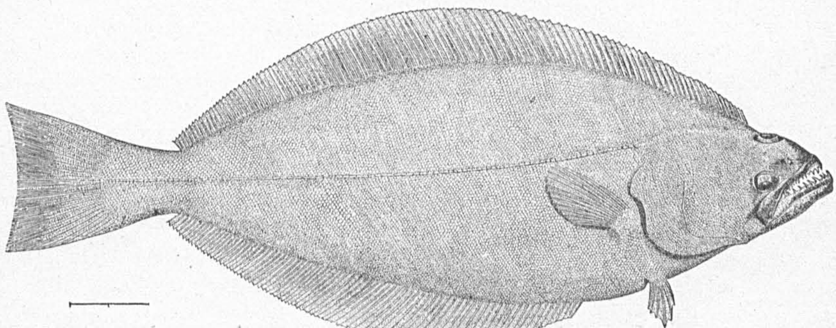


FIG. 2.—PLATYSOMATICHTHYS HIPPOGLOSSOIDES (Walbaum). The Greenland Halibut.

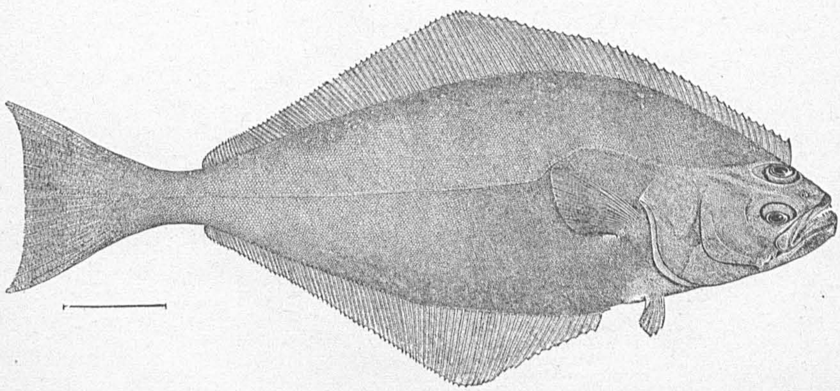


FIG. 3.—HIPPOGLOSSUS HIPPOGLOSSUS (Linnæus). The Halibut.
(No. 10439: Eastport, Maine.)

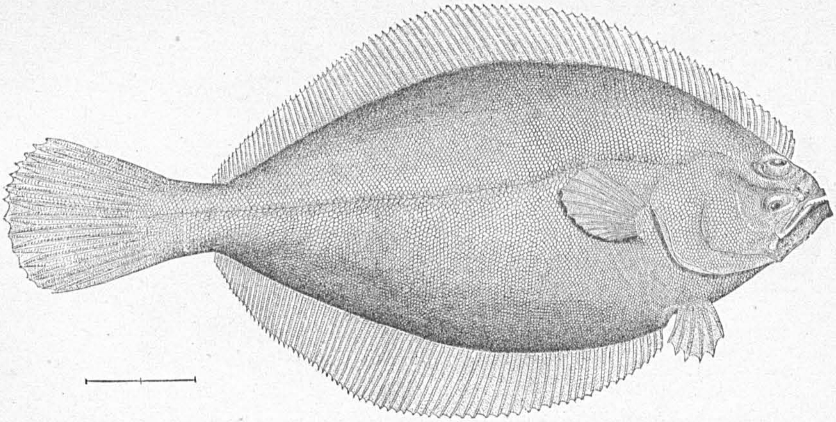


FIG. 4.—HIPPOGLOSSOIDES PLATESSOIDES (Fabricius). The Sand Dab.
(No. 21002: Le Have Bank.)

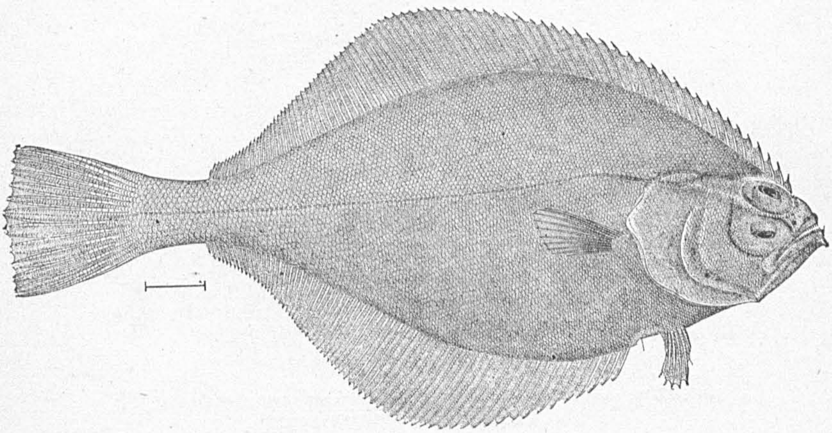


FIG. 5.—HIPPOGLOSSOIDES ELASSODON Jordan & Gilbert. The Alaska Sand Dab.
(No. 27938: Humboldt Harbor, Shumagins, Alaska.)

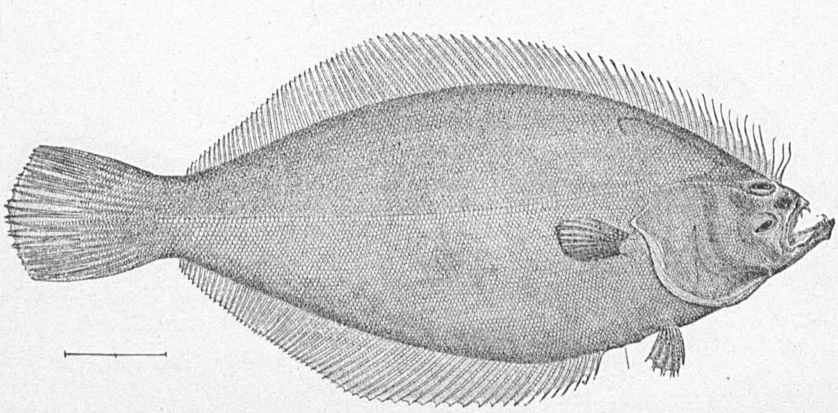


FIG. 6.—PSETTICHTHYS MELANOSTICTUS Girard. The San Francisco "Sole."
(No. 27602: San Francisco, California.)

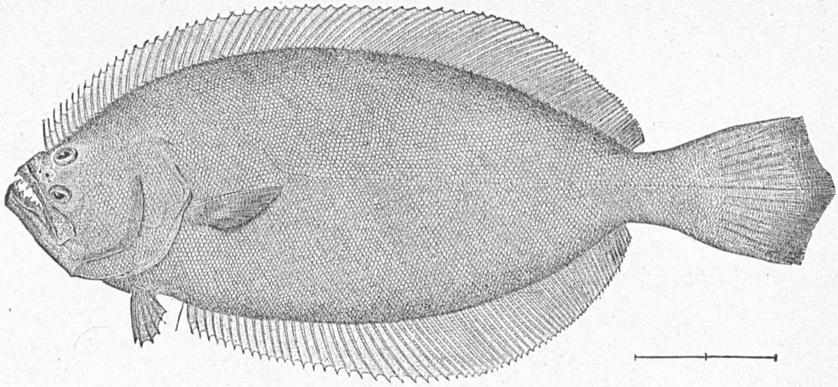


FIG. 7.—PARALICHTHYS LETHOSTIGMA Jordan & Gilbert. The Southern Flounder.
(No. 21279: Saint John's River, Florida.)

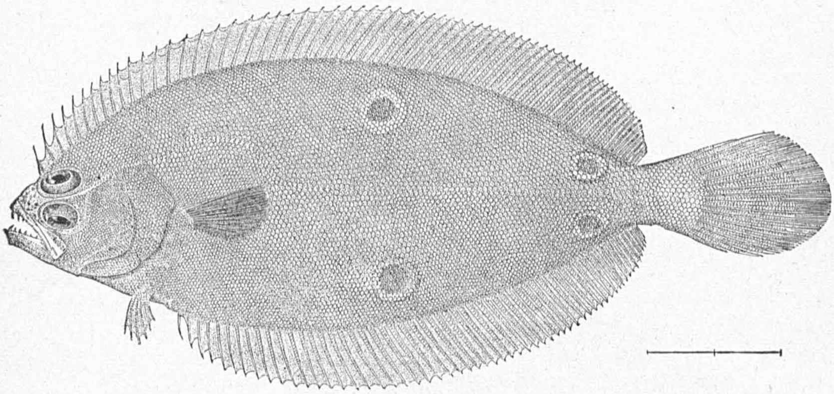


FIG. 8.—PARALICHTHYS OBLONGUS (Mitchill). The Four-spotted Flounder.
(No. 10730: Wood's Holl, Massachusetts.)

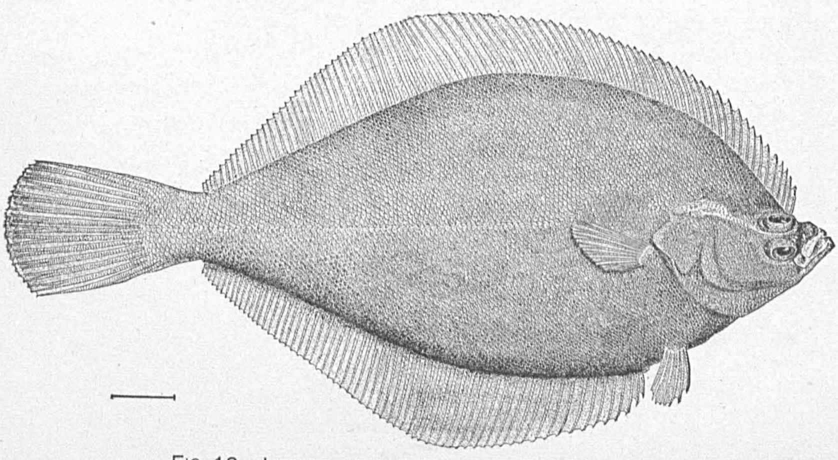
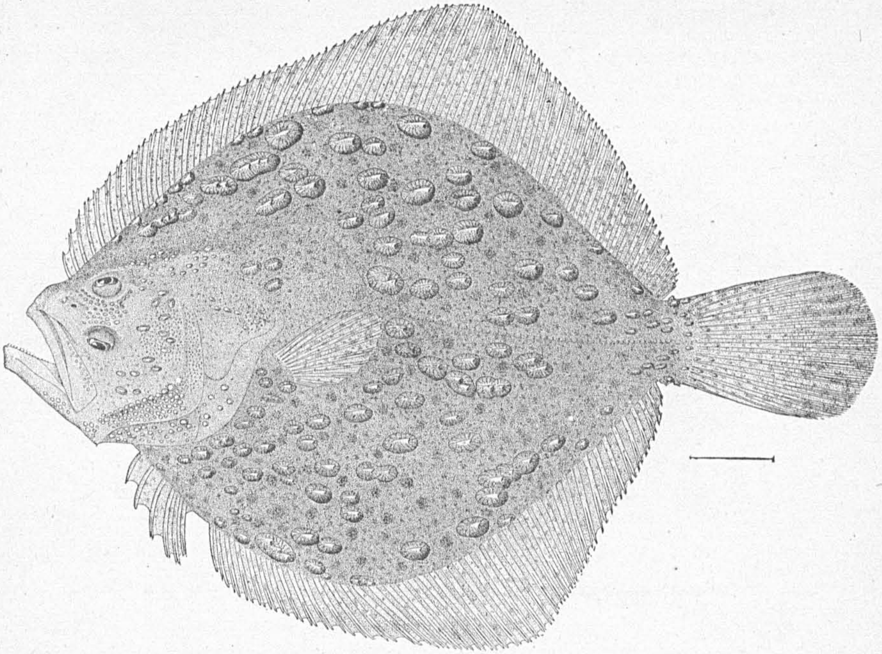
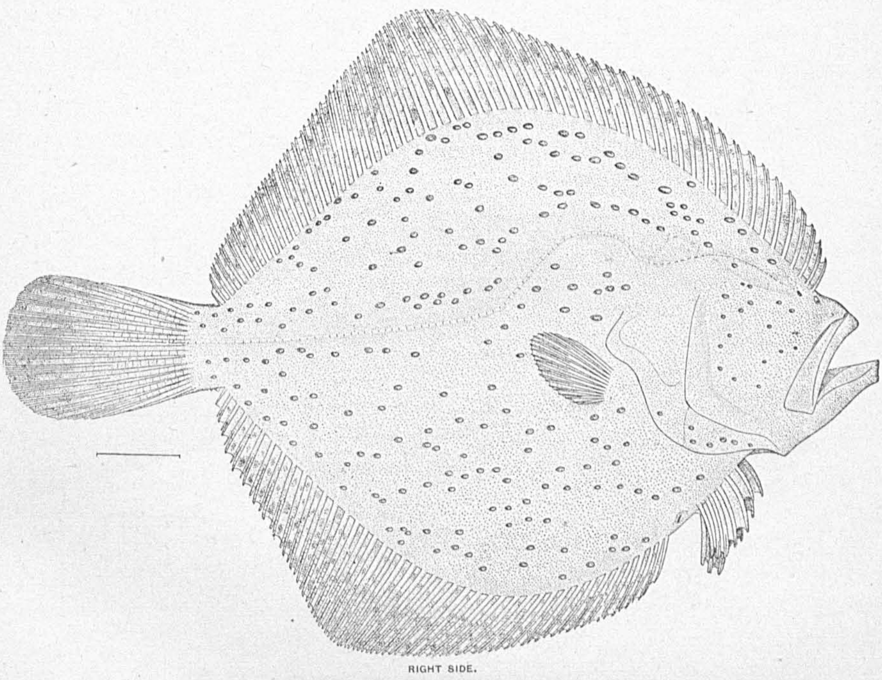


FIG. 12.—LIMANDA FERRUGINEA (Storer). The Rusty Dab.
(No. 21020: Halifax, Nova Scotia.)



LEFT SIDE.

FIG. 9.—PLEURONECTES MAXIMUS Linnæus. The Turbot.
(From No. 36902: Europe.)



RIGHT SIDE.

FIG. 10.—PLEURONECTES MAXIMUS Linnæus. The Turbot.
(From No. 36902: Europe.)

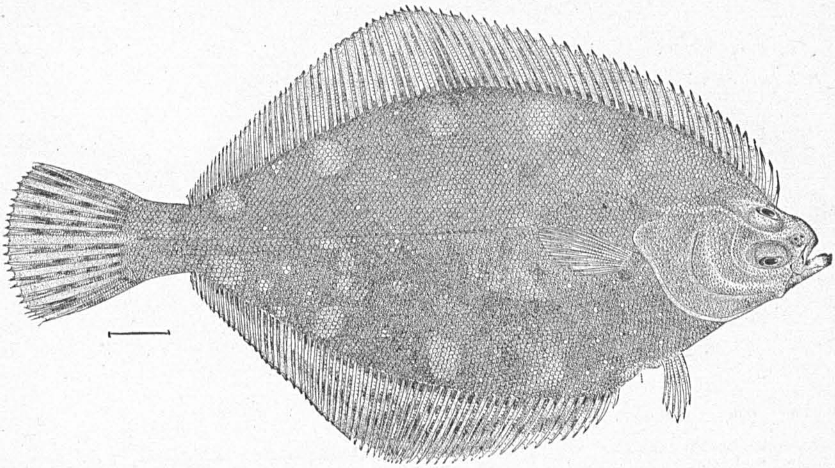


FIG. 11.—LEPIDOPSETTA BILINEATA (Ayres.) The California "Sole."
(Var. *umbrosa* Girard.)
(No. 27602: Saint Paul, Kodiak.)

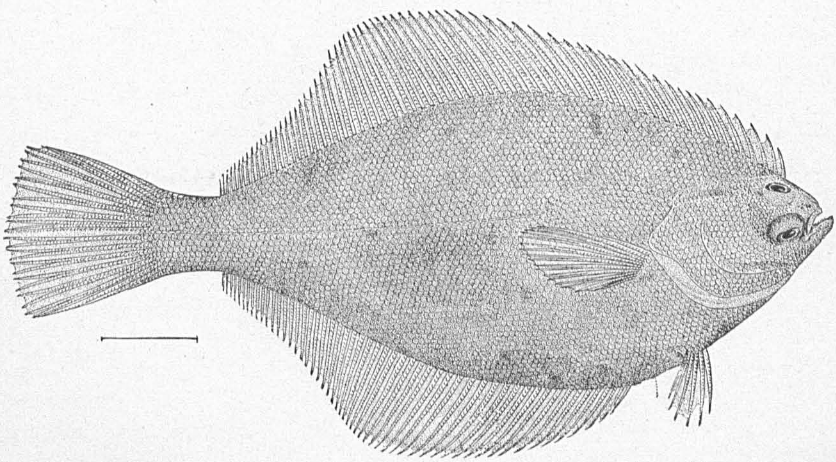


FIG. 13.—LIMANDA ASPERA (Pallas). The Alaska Rusty Dab.
(No. 27944: Sitka, Alaska.)

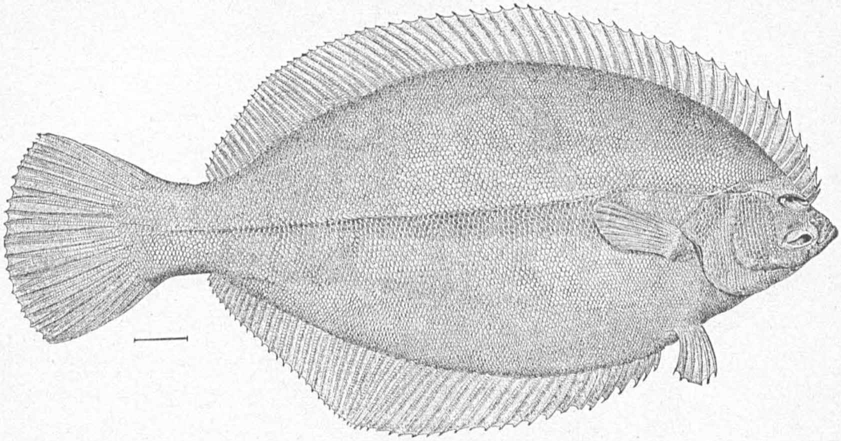


FIG. 14.—PSEUDOPLEURONECTES AMERICANUS (Walbaum). The Flat Fish, or Winter Flounder.

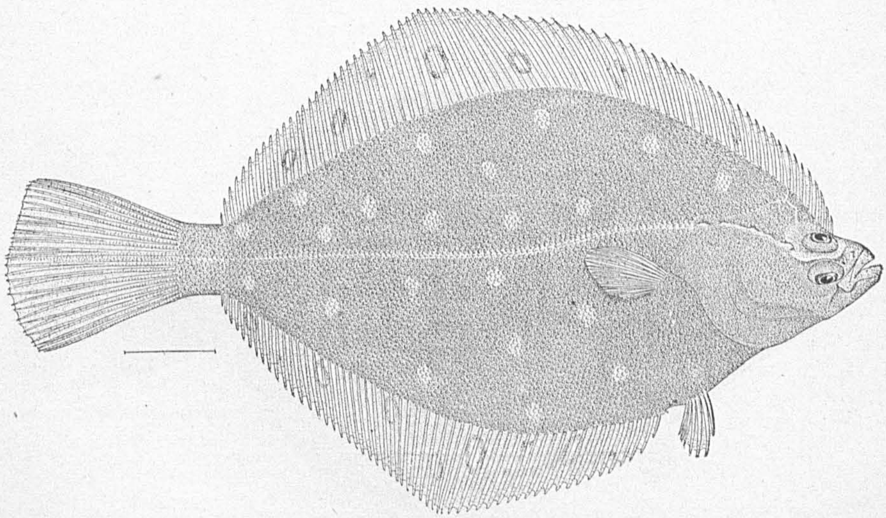


FIG. 15.—PLATESSA PLATESSA Linnæus. The Plaice.
(From No. 21175 : France.)

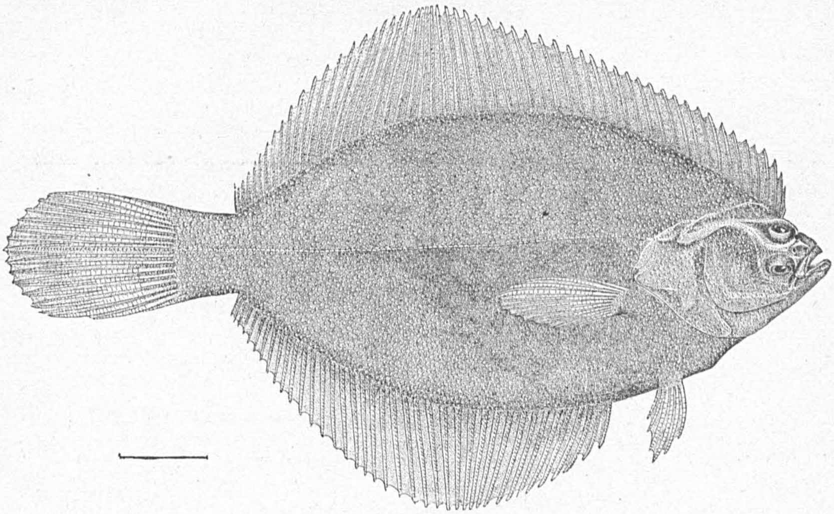


FIG. 16.—LIOPSETTA PUTNAMI (Gill). The Eel-back Flounder (male).
(No. 5368: Salem, Massachusetts.)

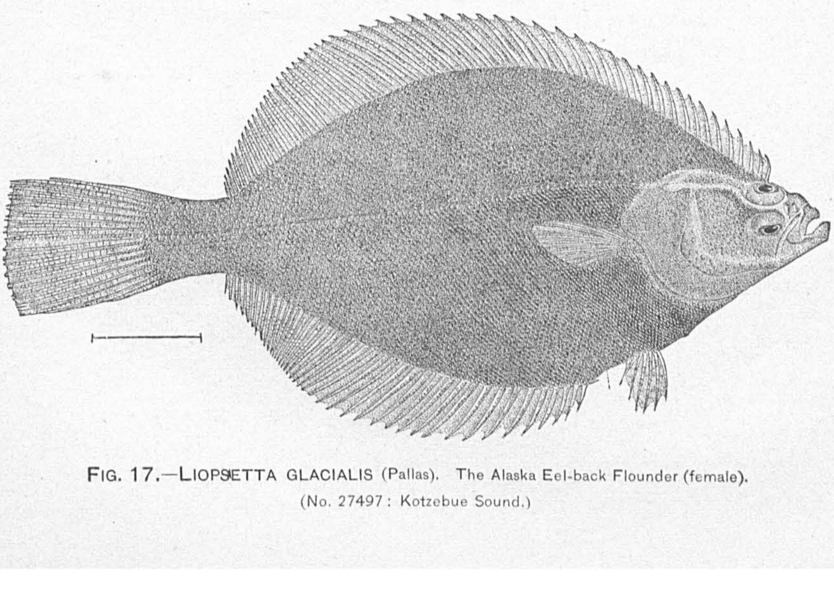


FIG. 17.—LIOPSETTA GLACIALIS (Pallas). The Alaska Eel-back Flounder (female).
(No. 27497: Kotzebue Sound.)

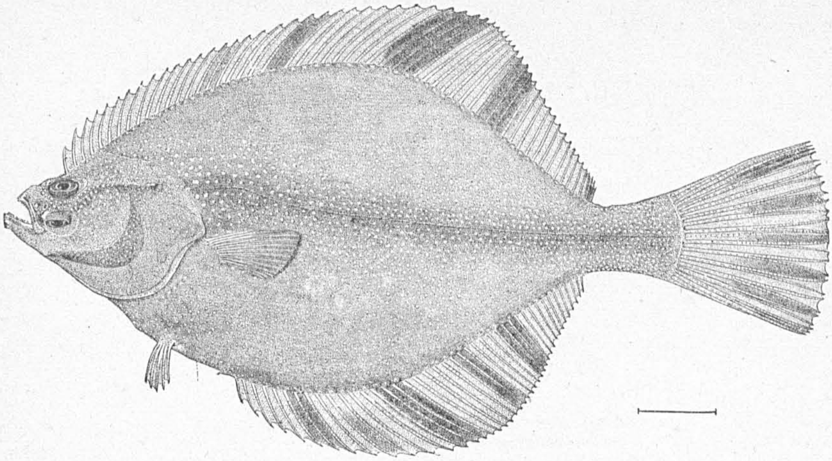


FIG. 18.—PLATICHTHYS STELLATUS (Pallas). The Great California Flounder.
(From a reversed example.)
(No. 24164: San Francisco, California.)

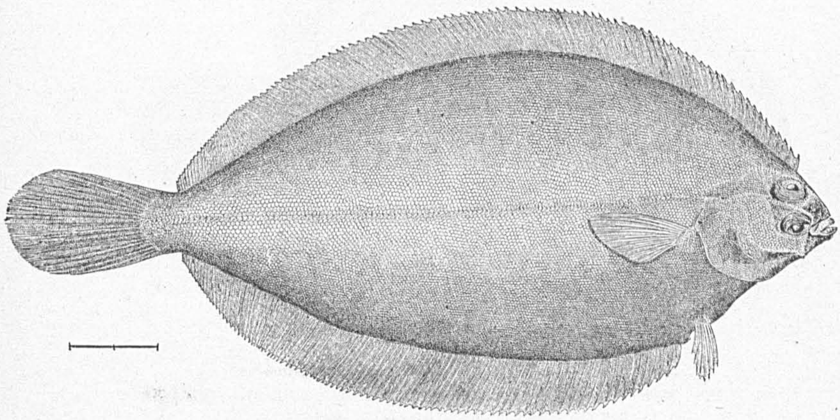
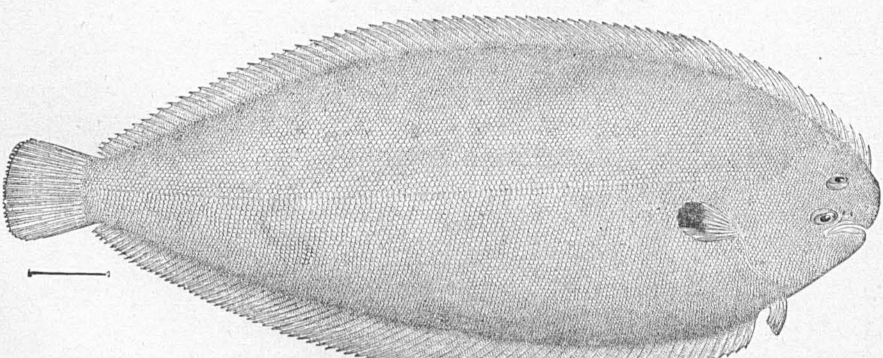
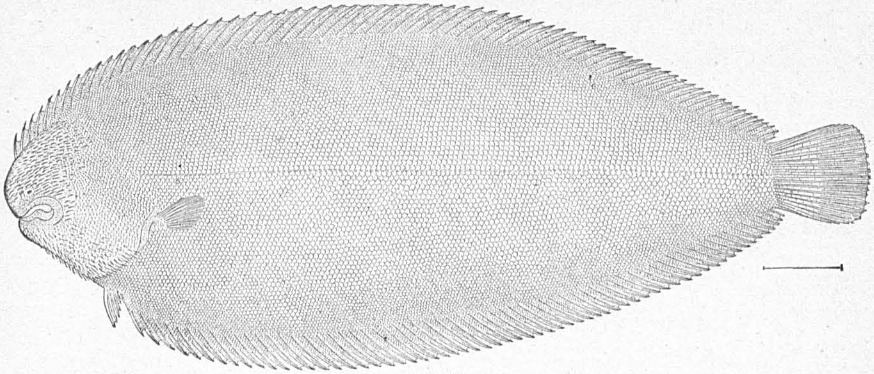


FIG. 19.—GLYPTOCEPHALUS CYNOGLOSSUS (Linnæus.) The Pole Flounder.
(Atlantic.)



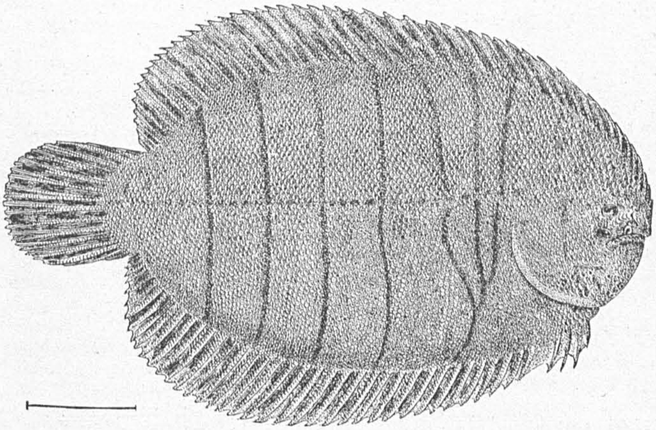
RIGHT SIDE.

FIG. 20.—SOLEA SOLEA Linnæus. The Sole.
(From No. 17324: Helsinburg, Sweden.)



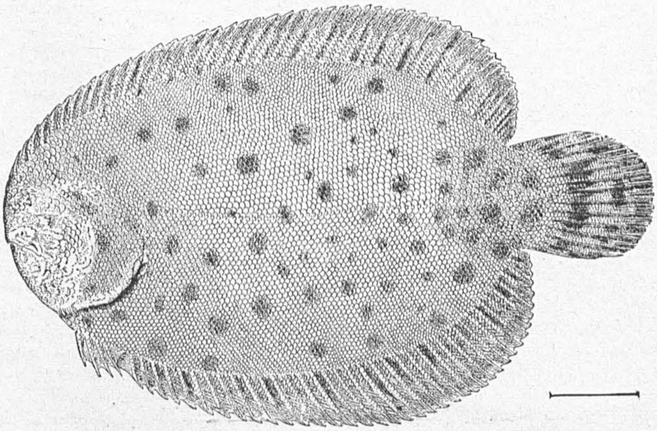
LEFT SIDE.

FIG. 21.—SOLEA SOLEA Linnæus. The Sole.
(From No. 17324: Helsinburg, Sweden.)



RIGHT SIDE.

FIG. 22.—ACHIRUS FASCIATUS Lacépède. The American Sole, or "Hog Choker."
(No. 12985: Wood's Holl, Massachusetts.)



LEFT SIDE.

FIG. 23.—ACHIRUS FASCIATUS Lacépède. The American Sole, or "Hog Choker."
(No. 12985: Wood's Holl, Massachusetts.)

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[NOTE.—The references are to page-figures in brackets.]

III.—A REVIEW OF THE SCIÆNIDÆ OF AMERICA AND EUROPE.

BY DAVID STARR JORDAN AND CARL H. EIGENMANN.

In the present paper we have attempted to give the synonymy of the species of *Sciænidæ* found in the waters of North and South America and of Europe, together with analytical keys by which the genera and species may be distinguished. The paper is based on the collections in the museum of the University of Indiana, on a large series belonging to the National Museum, the most valuable part of this series being the collections made by Professor Gilbert at Mazatlan and Panama, and on the collections in the Museum of Comparative Zoology at Cambridge, Mass. This collection is especially rich in South American forms, and nearly all of our information regarding the South American species has been drawn from it. All the representatives of this family in the museum at Cambridge have been examined by the senior author of this paper, and for all statements regarding the South American species he is responsible.

We wish to express our special obligations to Prof. Alexander Agassiz, Director of the Museum of Comparative Zoology, and to Mr. Samuel Garman, curator of the fishes, for the free use of the material in the museum, and to Dr. Tarleton H. Bean for a loan of special desiderata from the United States National Museum. Through the aid of these two great museums we have been enabled to examine nearly all the species included in the present paper. The only species not seen by us are the following: *Cestreus obliquatus*, *Larimus stahli*, *Sciæna gilli*, *Sciæna heterolepis*, *Pachyurus francisci*, *Pachyurus schomburgki*, *Pachypops trifilis*, *Umbrina reedi*, *Lonchurus lanceolatus*, and *Eques pulcher*, ten of the 113 species recognized.

There is room for much difference of opinion as to the proper subdivision of the *Sciænidæ* into genera. There are few families in which the various types are more definitely joined together by intermediate forms than in the present one. The subdivisions must be more or less arbitrary, or else the great bulk of all the species must be thrown into two genera, *Sciæna* and *Otolithus*. Such an arrangement, however, tends to obscure the inter-relations of the species, and so we have adopted as distinct genera all the subordinate groups which we are able to restrict and define by structural characters of some importance.

It is but fair to say, however, that the arrangement adopted is not entirely satisfactory to us. The genera recognized are not equivalent in value, and no subdivision is possible in which they can be made so. The species of *Sciæninæ* with long gill-rakers (*Stelliferus*, &c.), and those with short ones (*Sciæna*, &c.) form together an almost perfect series. The characters on which the first of these groups is by us subdivided into distinct genera (dentition, armature of the preopercle, &c.) cannot apparently be used for this purpose among the *Sciænæ*, as the gradation there is more perfect and the extremes less marked. It is quite true that a character may have a generic value in one section of a family and not in another, yet such generic characters of partial application should always be looked upon with question.

The *Sciænidæ* fall naturally into two suborders, which are well distinguished from each other, and, so far as we know, not connected by intermediate forms. These are the *Otolithinæ* and the *Sciæninæ*. The extremes of the former group (*Seriphus*, *Archoscion*) have been of late usually set off as a distinct subfamily—*Isopisthinæ*. Dr. Bleeker has even removed this group, *Isopisthinæ*, from the family of *Sciænidæ* altogether. There is no warrant for this arrangement. While *Seriphus* seems quite different from the other *Otolithinæ*, *Archoscion* is intermediate between *Seriphus* and *Cestreus*, and from the latter it is scarcely to be distinguished generically, so perfect is the gradation in the series of species. At the opposite end of the series the genus *Eques* represents an aberrant form of the *Sciæninæ*, and another is represented by *Aplodinotus* and *Pogonias*. The differences existing do not apparently require the recognition of either of these groups as subfamilies, and we refer all to the *Sciæninæ*.

The *Sciæninæ* constitute an irregularly graduated series, the characters changing by small and often scarcely perceptible gradations from the forms allied to *Cestreus* on the one hand to those approaching *Eques* on the other.

We begin our series with the genus *Seriphus*, which is perhaps most nearly related to the other percoid forms, and we close it with *Eques*, which stands at the opposite extreme from *Seriphus*. In passing down the series from *Nebris* and *Odontoscion*, the most *Otolithus*-like of the *Sciæninæ*, to *Sciæna*, *Menticirrhus*, *Eques*, and the other extreme forms, we find, as has been already stated, no very sharp line of division. The middle line, if we may so speak, lies between *Bairdiella chrysoleuca* and *Sciæna sciera*, two species closely allied to each other.

Nothing could be more unnatural or more ineffective than the subdivision adopted by Cuvier, whereby the *Sciæninæ* without barbels are divided into three groups, *Corvina*, *Johnius*, and *Sciæna*, solely on the strength of the second anal spine. This is large in *Corvina*, very feeble in *Sciæna*, and intermediate in *Johnius*. Günther's arrangement, by which the species referred to *Johnius* are divided between *Corvina* and

Sciæna, is no better, as very many of the species have this spine neither large nor small, and could as well be placed in the one group as the other. Bleeker divides this group into *Pseudosciæna*, species with the mouth oblique and the jaws subequal, the lower jaw with the teeth of the inner row enlarged, and *Johnius* with the mouth horizontal and the lower jaw included, the teeth of the lower jaw being in villiform bands. This arrangement is better than the other only in theory. The characters chosen are of more value as indicating relationship, but they cannot be applied in practice, as there are intermediate gradations of all sorts. The type of *Pseudosciæna* (*Sciæna aquila*) is in fact much more nearly related to the type of *Johnius* than to most of the species associated with it in *Pseudosciæna*.

As we proceed along the series of *Sciæninæ* from *Larimus* towards *Menticirrhus*, the following changes are notable: In the *Larimus* type the pores on the snout are small and few, and there are no distinct slits or lobes on the snout above the upper jaw; in the other type the pores become large and conspicuous, 4 to 6 in number, and the thickened snout above the upper jaw has two slits on each side, bounding two dermal lobes. The mouth becomes smaller, narrower, more horizontal as we proceed towards *Menticirrhus*, the lower jaw shorter, and the bands of teeth in both jaws more and more broad, those in the lower more decidedly villiform; the pores on the chin become larger and more numerous, the number rising from 2 to 5; the lower pharyngeals become larger, and their teeth larger and less acute; the preorbital becomes wider and more gibbous, the gill-rakers shorter, fewer, and more like tubercles; the anal fin is placed farther forward, and the spines of the fins generally are less slender; the scales, as a rule, become rougher, and the rows of scales less regular in their direction. The flesh, as a rule, becomes firmer, coarser, less agreeable in flavor, and of less value as food, but this, like some of the other characters mentioned above, is subject to much variation.

It may be noted that in some *Sciænidæ* the middle rays of the caudal are more produced in young specimens. In some also the serrations on the preopercle become weaker or even obsolete with age.

The two subfamilies recognized by us may be thus distinguished:

ANALYSIS OF THE SUBFAMILIES OF SCIÆNIDÆ.

a. Vertebræ typically 14 + 10, the number in the abdominal region always greater than that of the caudal; lower jaw prominent; teeth not villiform; edge of preopercle entire; second anal spine weak and adnate to the first ray; the first spine minute and often obsolete .... OTOLITHINÆ, I.

aa. Vertebræ typically 10 + 14, the number in the caudal region always greater than that in the abdominal; second anal spine usually well developed and usually joined to the first soft ray by a distinct membrane .... SCIÆNINÆ, II.

*ANALYSIS OF THE GENERA OF SCIÆNIDÆ.**

Subfamily I.—OTOLITHINÆ.

(*Sciænidæ* with the vertebræ 14 or 15 + 10 or 11, the abdominal portion of the spinal column having always more vertebræ than the caudal portion, the anal fin being posterior in its insertion; body more or less elongate, the mouth large, the lower jaw projecting, the preopercle with a crenulate, membranaceous border; snout without distinct pores or slits; preorbital narrow; gill-rakers slender, moderate, or rather long; anal fin with one or two very weak spines, the second closely connected with the first soft ray; scales small, smoothish.)

a. Anal fin long, of 15 to 21 soft rays, its length more than half that of soft dorsal; dorsal fins more or less separated (soft dorsal and anal fins closely scaled).

b. Teeth small, sharp, subequal, uniserial below, in a narrow band above; no canines; anal and soft dorsal with 20 to 22 rays each, the former but little shorter than the latter; dorsal fins well separated; body compressed; scales large, ctenoid; gill-rakers long and slender; caudal fin lunate..SERIPHUS, 1.

bb. Teeth larger, very unequal, tip of upper jaw with one or two strong canines; enlarged teeth or canines on sides of lower jaw; anal fin shorter than soft dorsal, with 15 to 18 soft rays; dorsal fins more or less separated; body compressed; scales rather small, cycloid........................ARCHOSCION, 2.

aa. Anal fin moderate, or short, of 7 to 13 soft rays; its length less than half that of second dorsal; dorsal fins contiguous.

c. Canine teeth, if present, not lance-shaped, tapering from base to tip.

d. Lower jaw without canines at its tip; some of its lateral teeth sometimes enlarged; tip of upper jaw usually with canines...............CESTREUS, 3.

dd. Lower jaw with a pair of very strong canines at its tip, larger than the canines at tip of upper jaw; lateral teeth small; body very slender; anal fin small; gill-rakers short. (Contains only Asiatic species.)......OTOLITHUS.†

cc. Canine teeth lance-shaped, widened toward the tip, then abruptly pointed; canines of front of premaxillary largest; about two canines on front of lower jaw on each side; outer teeth of upper jaw enlarged, somewhat lance-shaped; outer teeth of lower jaw compressed; air-bladder with two horn-like processes; gill-rakers moderate, slender; (soft dorsal and anal fins scaly)..ANCYLODON, 4.

Subfamily II.—SCIÆNINÆ.

(*Sciænidæ* with the dorsal fins contiguous, the soft dorsal being long, much longer than the anal; vertebræ 9 to 12 + 13 to 20, typically 10 + 14, the number of vertebræ in the abdominal part of the body being always less than in the caudal part.)

---

* For completeness' sake we include in the following analysis, besides the American genera, *Otolithus*, *Sciænoides*, *Collichthys*, and *Pseudotolithus*; the only well-defined genera without American representatives with which we are acquainted.

† *Otolithus* Cuvier, Règne Animal. Type, *Johnius ruber* Bloch. The characters here given are drawn from *Otolithus argenteus* (specimen from Hong-Kong, China).

a. Dorsal spines well separated, the first dorsal spine * attached to the third or fourth interneural, not more than two * of the spine-bearing interneurals being placed between the same pair of vertebræ; soft rays of dorsal fin 17 to 32 (37 to 40 in *Lonchurus*, 45 to 50 in *Sciænoides*); occipital crest not greatly elevated.

b. Lower pharyngeals separate.

c. Lower jaw without barbels.

d. Caudal fin moderately scaly, its distal portion usually more or less naked, the scales not numerous enough to give a thickened appearance to the fin.

e. Teeth well developed, permanent in both jaws.

f. Lower pharyngeals rather narrow; their teeth conic and mostly sharp; none of them molar; outer teeth of upper jaw more or less enlarged.

g. Gill-rakers comparatively long and slender; mouth more or less oblique, anal fin usually (but not always) inserted posteriorly; preorbital usually narrow, flat; edge of snout above upper jaw with the pores and slits little conspicuous or obsolete.

h. Preopercle without bony teeth or serrations, its membranaceous margin entire, crenulate or ciliate (two or three slender spinules present in *Collichthys*); teeth of lower jaw in few series.

i. Skull excessively cavernous, soft and spongy to the touch, the interorbital space very broad; eye very small; mouth large, oblique; preopercle with a broad membranaceous border, which is striated and fringed; scales small; spinous dorsal short and weak; anal spines weak; caudal fin pointed.

j. Pseudobranchiæ wanting; air-bladder with a lateral horn-like process on each side, this dividing into many branches in the skin of a peritoneal membrane; both jaws with small, unequal, canine-like teeth, those of the upper jaw in the outer, of the lower jaw in the inner series; forehead very convex; soft dorsal very long, of 27 to 50 rays; anal fin small; pectoral fin long; gill-rakers (X + 14) slender but rather short; lower jaw included; "vertebræ 14 + 10" (*Bleeker*); "vertebræ 12 + 12" (*Cuv. & Val.*). (Asiatic species.) SCIÆNOIDES.†

* These characters (which separate the rest of the *Sciæninæ* from *Eques*) have been verified in part of the genera only, and the statement of them may need some modification when the entire group is considered. The genus *Lonchurus* especially should be examined in this regard.

† *Sciænoides* Blyth, Journ. Asiat. Sci. Beng., 29, 1861; type *Otolithus biauritus* Cantor. The characters here given are drawn from *Sciænoides pama*. This genus seems nearest to *Nebris*, but it shows several resemblances to *Lonchurus*. If it really has vertebræ 14 + 10, as stated by Bleeker, it should be placed among the *Otolithinæ*.

jj. Pseudobranchiæ small; air-bladder with a very complex structure, having many forking branches on each side, these extending in a peritoneal membrane which surrounds the viscera; no canine teeth; dorsal rays IX–I, 25 to 30; anal rays II, 8 to II, 11; the spine small; pectoral shortish; gill-rakers slender, not very long; preopercle with two or three stiff, slender spinules near its angle; top of head very convex in all directions; occipital crest high, its edge dentate; caudal fin lanceolate. (Asiatic species.) Vertebræ 11 + 18........COLLICHTHYS.*

jjj. Pseudobranchiæ present; teeth subequal, all villiform, in narrow bands; soft dorsal long, of 30 to 35 rays; anal fin rather long; soft dorsal and anal scaly; lower jaw projecting; vertebræ 10+14; gill-rakers long and slender; air-bladder with two horns ....NEBRIS, 5.

ii. Skull firm, not excessively cavernous, interorbital space not very broad; preorbital not turgid.

k. Teeth minute, equal, chiefly uniserial or partly biserial above; snout very short; cleft of mouth very oblique or even vertical, the lower jaw projecting.................LARIMUS, 6.

kk. Teeth larger, more or less unequal, those in lower jaw mostly biserial, those of the inner series usually enlarged; cleft of mouth more or less oblique but not vertical.

l. Scales of the lateral line similar to the others, not concealed by smaller ones; anal fin inserted more or less posteriorly, its first spine usually nearer caudal than ventrals, the tip of the last ray when depressed extending beyond base of last ray of dorsal; caudal peduncle rather short; pseudobranchiæ well developed.

m. Upper jaw with a single row of teeth, some of them enlarged, forming long canines; some canines in lower jaw; lower jaw projecting ....ODONTOSCION, 7.

mm. Upper jaw with a narrow band of teeth, those of the outer row more or less enlarged; no distinct canines ....CORVULA, 8.

ll. Scales of the lateral line considerably enlarged, almost entirely concealed by smaller ones; anal fin small, inserted well forward; its first spine usually as near ventrals as

* *Collichthys* Günther=*Hemisciæna* Bleeker; type *Sciæna lucida* Günther, not of Richardson. Our specimens from Swatow, China (*Collichthys lucidus* Rich.?) agree with Bleeker's account of *Hemisciæna lucida* rather than with Günther's. This genus is certainly very close to *Sciænoides*.

caudal; caudal fin pointed, its peduncle long and slender; soft dorsal and anal scaly; scales small; pseudobranchiæ small, often obsolete on one side. (Fluviatile species.)
PLAGIOSCION, 9.

hh. Preopercle with its bony margin armed with sharp teeth or serræ.

n. Head not very broad, the interorbital space convex, scarcely spongy.

o. Preopercle with its margin simply serrate; the lower spine not enlarged; anal fin inserted well forward; caudal peduncle slender. (Species chiefly African.)
PSEUDOTOLITHUS.*

oo. Preopercle with its lowermost spine largest, directed abruptly downward. (Soft dorsal and anal fin moderately scaly.)
BAIRDIELLA, 10.

nn. Head very broad above, the interorbital space flattish, excessively cavernous, the septa reduced to thin partitions; soft dorsal and anal fin usually densely scaly; second spine of dorsal usually thickened .... STELLIFERUS, 11.

gg. Gill-rakers comparatively short and thick, usually not longer than posterior nostril; anal fin inserted farther forward; snout above lower jaw with large pores, and with two more or less distinct slits on its edge; these sometimes obsolete; preorbital more or less broad; mouth more or less inferior .... SCIÆNA, 12.

ff. Lower pharyngeals very broad, with coarse blunt molar teeth; teeth in both jaws subequal, in broad bands; preopercle with its bony margin coarsely serrate; lower jaw included; snout with pores and slits as in *Sciæna*; gill-rakers rather short and slender .... RONCADOR, 13.

ee. Teeth very small, subequal, those in the lower jaw wanting or deciduous; lower pharyngeals rather broad, with paved teeth; mouth small, inferior; snout as in *Sciæna*; preopercle entire; anal fin long, with about 12 soft rays; gill-rakers shortish, rather slender .... LEIOSTOMUS, 14.

dd. Caudal fin very densely scaly, the scales so closely set and so numerous as to hide the rays and to give a thickened appearance to the fin; mouth small, with very small, equal teeth in villiform bands; preorbital broad, more or less turgid; preopercle

* *Pseudotolithus* Bleeker, Poissons de la côte de Guinée, 1862, 59; type *Pseudotolithus typus*. The characters here given are taken from a species from Gambia.

sharply but finely serrate; gill-rakers very small, thickish; pores and slits on snout obsolete. (Fluviatile species.) .... PACHYURUS, 15.

cc. Lower jaw with one or more barbels, either at the symphysis or on the rami; snout with slits and pores as in *Sciæna*; lower jaw included; preorbital broad; lower teeth in villiform bands; gill-rakers more or less short.

p. Pseudobranchiæ well developed; pectoral fin not elongate.

q. Lower jaw with slender barbels, usually several in number.

r. Barbels mostly in a tuft at the symphysis of lower jaw; mouth very small, inferior; gill-rakers minute, thickish; dorsal spines 10 or 11.

s. Preopercle sharply but finely serrate; preorbital turgid and cavernous, more or less translucent; caudal fin rhombic. (Fluviatile species.) PACHYPOPS, 16.

ss. Preopercle without bony serræ; preorbital very broad, but less distinctly cavernous .... POLYCIRRHUS, 17.

rr. Barbels chiefly lateral, along the rami of the lower jaw, usually none at the symphysis; lower pharyngeals narrow with sharp teeth.

t. Preopercle without bony serræ; dorsal spines 14; gill-rakers short, but rather slender ..... GENYONEMUS, 18.

tt. Preopercle with its bony margin armed with strong teeth; dorsal spines 10 or 11; gill-rakers short, thickish. MICROPOGON, 19.

qq. Lower jaw with a single thickish barbel at its tip.

u. Air-bladder large; anal spines two; back more or less elevated; preopercle with its bony margin crenate or serrate; pectorals short, shorter than ventrals. (Free-swimming species.) UMBRINA, 20.

uu. Air-bladder none; anal spine single, weak; back not elevated; preopercle with its membranaceous edge crenulate; pectoral fins long, longer than ventrals. (Bottom fishes.) MENTICIRRHUS, 21.

pp. Pseudobranchiæ obsolete; body long and low; caudal pointed; pectoral fin elongate; preopercle without bony serratures.

v. Chin without barbels; a row of slender barbels along inner edge of mandible; soft dorsal with about 30 rays. PARALONCHURUS, 22.

vv. Chin with two short barbels, none on sides of mandible; soft dorsal with 37 to 40 rays ....LONCHURUS, 23.

bb. Lower pharyngeals very large, completely united, covered with coarse blunt paved teeth; lower jaw included; snout with slits and pores, as in *Sciæna;* gill-rakers rather short.

w. Lower jaw with numerous barbels along the inner edge of the rami; preopercle nearly entire. (Marine species.) ....POGONIAS, 24.

ww. Lower jaw without barbels; preopercle obscurely serrate. (Fluviatile species.) ....APLODINOTUS, 25.

aa. Dorsal spines close together, the first spine attached to the first interneural, and from 5 to 12 of the spine-bearing interneurals wedged in between the high occipital crest and the neural spine of the second vertebra on the one hand, and that of the third vertebra on the other; occipital crest much elevated. Vertebræ 10 + 14.

x. Mouth small, low, included, the teeth subequal, in villiform bands; air-bladder simple; preopercle with its membranous edge serrulate; gill-rakers short; snout above premaxillary with slit and pores essentially as in *Sciæna*; anal fin small; soft dorsal very long, of 36 to 55 rays ....EQUES, 26.

Genus I.—SERIPHUS.

Seriphus Ayres, Proc. Cal. Acad. Nat. Sci., ii, 80, 1861 (*politus*).

TYPE: *Seriphus politus* Ayres.

This genus consists of a single species, abundant on the California coast.

It is one of the most aberrant genera in the family—as compared with the typical sciænoid forms, standing at the farthest possible extreme from *Eques*, *Pogonias*, and *Menticirrhus*.

ANALYSIS OF SPECIES OF SERIPHUS.

a. Body moderately elongate, compressed; profile slightly depressed over the eyes; eyes large, 4½ in head; snout projecting, 3½ in head; mouth large and narrow, the lower jaw more or less projecting in the adult; premaxillary anteriorly about on the level of the lower margin of the pupil; maxillary 2 in head, reaching to below posterior margin of eye; lower jaw with a knob at its symphysis which fits in a notch in the upper jaw; teeth all small, subequal; those of the lower jaw in a single series, except at the symphysis, where there are two or three series; those of the upper jaw in two series, the inner ones much recurved; gill-rakers long and slender, ⅜ length of eye, 7+16; lower pharyngeals narrow, linear, fragile; scales moderate, weakly ctenoid, those about the head cycloid; lateral line straight; dorsal spines weak, the highest 3 in head; soft dorsal falcate, the anterior rays much the longer; anal similar, its base at least as long as that of the soft dorsal; interspace between dorsals 2½ in head; ventrals 2 in head; pectorals 1⅝; caudal lunate. Color bluish above, sides and belly bright silvery, finely punctate; vertical fins all pale yellow; base of pectorals blackish. Head 3½ in length; depth 4; D. VIII-I, 20; A. II, 21 or 22; scales 7-65-9 .... POLITUS,

1. SERIPHUS POLITUS.

(THE QUEEN-FISH.)

Seriphus politus Ayres, Proc. Cal. Acad. Nat. Sci., ii, 80, 1861. Gill, Proc. Acad. Nat. Sci. Phila., 1862, 18 (name only). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (San Francisco, Monterey Bay, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 48 (San Francisco southwards). Jordan & Gilbert, Syn. Fish. North Am., 582, 1882. Rosa Smith, West American Scientist, 1885, 47 (San Diego).

Habitat.—Coast of Southern California, north to San Diego.

The Queen-fish is common on the coast of Southern California. It reaches the length of about a foot, and is an excellent pan fish.

Genus II.—ARCHOSCION.

Archoscion Gill, Proc. Ac. Nat. Sci. Phila., 1862, 17 (*analis*).
Isopisthus Gill, Proc. Ac. Nat. Sci. Phila., 1862, 18 (*parvipinnis*).

TYPE: *Otolithus analis* Jenyns.

This genus as understood by us consists of two very closely related species (*Isopisthus*), and a third species (*Archoscion*) which is almost exactly intermediate between the typical *Isopisthus* and *Cestreus*.

The resemblance between *Archoscion remifer* and *A. analis* is so very close that the two cannot consistently be placed in separate genera. On the other hand, the affinities of *Archoscion analis* with certain species of *Cestreus* (as *C. bairdi*) are scarcely less definite. The separation of *Archoscion* from *Cestreus* and of the latter from *Otolithus* are justified chiefly by convenience.

ANALYSIS OF SPECIES OF ARCHOSCION.

a. Distance between dorsal fins about equal to diameter of eye; soft dorsal with 21 rays, its base about 1½ times that of anal (*Isopisthus* Gill).

b. Anal rays II, 19; depth 4 in length; pectorals rather long, the middle rays longest, 1⅛ in length of head; 75 series of scales between opercle and the tail; back not elevated; head compressed; snout not prominent, scarcely longer than the eye, which is 4½ in head; mouth large, very oblique; maxillary extending slightly beyond middle of eye, 2 in head; lower jaw strongly projecting, no pores about the chin; front of premaxillaries with two (or one) strong, recurved, movable canines; sides of upper jaw with two series of minute teeth, the outer series the larger; lower jaw with one or two series of minute teeth in front, and with a single series of larger teeth and 3 to 6 moderate canines on the sides; gill-rakers 4 + 9, those near the angle rather long and slender; dorsal and anal densely covered with small scales; base of anal, 1⅝ in head. Color in life: bluish gray above, grayish silvery below, top of snout and tip of lower jaw blackish; inside of mouth yellow, with black on lower lip within; lining of opercles black, bordered with pale orange; dorsals, caudal, and pectorals yellowish with fine black punctulations; axil brownish, the color extending on pectorals; anal white, the anterior part and the tips of most of the rays yellowish, punctate with black; a dark blotch behind the orbit and another on upper part of opercle. D. VIII-I, 20 or 21; A. II, 19; scales in the lateral line about 55 .... REMIFER, 2.

bb. Anal rays II, 16 or 17; depth 3⅞ in length; head 3½; pectorals shortish, the upper rays longest, 1½ in head; at least 100 series of scales from opercle to the caudal; body much compressed; upper canines very long, recurved; three canines on the sides of the lower jaw; caudal fin subtruncate; color dark plumbeous above, rest of body yellowish white; no axillary spot; an indistinct elongate dark blotch from behind the eye to middle of opercle. D. VIII-I, 21; A. II, 16 or 17; scales in the lateral line 52 to 54 .... PARVIPINNIS, 3.

aa. Distance between dorsals about equal to diameter of pupil; soft dorsal with about 24 rays, its base about 1⅔ times that of the anal (*Archoscion*).

c. Body more elongate than in the other species, with longer and sharper snout; base of anal fin 2½ in head; eye rather smaller than in *A. remifer*, 5½ in head; snout 4½; maxillary 2⅛, reaching middle of eye; gill-rakers rather long, X + 12; upper jaw with a large canine in front; two to four small canines on each side of lower jaw; dorsal and anal scaly; pectoral long, 1⅓ in head; longest dorsal spine 2½; caudal fin slightly lunate. Head 3⅛ in length; depth 4¼. D. IX-I, 24; A. I, 15; scales 64; color bluish, the sides and belly silvery; axil dark; opercle dusky within .... ANALIS, 4.

2. ARCHOSCION REMIFER.

Isopisthus remifer Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 320 (Panama).

Habitat.—Pacific coast of tropical America, Panama.

This species is extremely close to *Archoscion parvipinnis*, differing only in the characters mentioned in our analysis. It may perhaps prove a geographical variety of the other.

3. ARCHOSCION PARVIPINNIS.

Ancylodon parvipinnis Cuv. & Val., Hist. Nat. Poiss., v, 84, 1830 (Cayenne). Günther, Cat. Fish. Brit. Mus., ii, 312, 1860 (copied).

Isopisthus parvipinnis Jordan, Proc. Acad. Nat. Sci. Phila., 1883, 289 (Cayenne, re-examination of type). Jordan, Proc. U. S. Nat. Mus., 1886, 583 (name only).

Isopisthus affinis Steindachner, Denksch. Mat. Nat. Kais. Acad. Wiss., 1879, 43, plate 2, fig. 2 (Porto Alegre).

Habitat.—Coasts of Brazil, north to Cayenne.

Only the original type of this species in the Museum of Paris has been examined by us. This seems to be identical with the species well figured by Steindachner under the name of *Isopisthus affinis*, and from Steindachner's description and figure our account has been chiefly drawn.

4. ARCHOSCION ANALIS.

Otolithus analis Jenyns, Zool. Beagle, Fishes, 164, 1842 (Peru). Günther, Cat. Fish. Brit. Mus., ii, 307, 1860 (copied).

Otolithus peruanus Tschudi, Fauna Peruana Ichthyol., 10, 1844 (Peru).

Ancylodon altipinnis Steindachner, Ichthyol. Notizen, iii, 2, plate 1, fig. 2, 1866 (West coast South America).

Habitat.—Coast of Peru.

We have examined many specimens of this species from Callao, Peru, in the museum at Cambridge. There seems no room for doubt as to the identity of the nominal species *analis*, *peruanus*, and *altipinnis*.

The species is about as near *Cestreus* as *Isopisthus*, and its existence renders the separation of *Archoscion* as a genus from the former a matter of questionable propriety.

Genus III.—CESTREUS.

Cestreus Gronow, Cat. Fish., ed. Gray, 49, 1854 (*carolinensis* = *nebulosus*).
Cynoscion Gill, Proc. Acad. Nat. Sci. Phil., 1862, 18 (*regalis*).
Apseudobranchus Gill, loc. cit. (*toeroe* = *acoupa*).
Atractoscion Gill, loc. cit. (*æquidens*).
Otolithus species; Cuvier, Günther, &c.

TYPE: *Cestreus carolinensis* Gronow = *Otolithus nebulosus* Cuvier.

This genus is closely related to the old world genus *Otolithus*, from which it differs chiefly in the absence of canine teeth in the lower jaw. Nearly all the species referable to *Cestreus* are American.

Cynoscion, notwithstanding the existence of a prior name *Cestræus*

We use the name *Cestreus* (κεστρεύς) instead of the later name (κεστραῖος), also applied to a genus of fishes (*Mugilidæ*).

The reasons for regarding the two words as different have been already given in full by Dr. Jordan in a recent review of the *Pleuronectidæ*, and need not be repeated here. (See page 297 of this Report.)

ANALYSIS OF AMERICAN SPECIES OF CESTREUS.

a. Scales not very small, the lateral line having 55 to 75 pores, the number of transverse series ranging from 55 to 75, being not much in excess of the number of pores; head compressed, not truly conical; upper jaw with distinct canines, the band of teeth in the upper jaw rather narrow, the lower teeth small and in few series in front, larger and uniserial on the sides.

b. Soft rays of the dorsal and anal more or less closely scaled; gill-rakers comparatively long and slender, 9 to 12 on the lower part of the arch, the longest at least half the diameter of the eye.*

c. Soft dorsal of 19 to 23 rays.

d. Caudal fin rhombic, the middle rays considerably produced.

e. Mouth large, extremely oblique, the maxillary reaching considerably beyond eye, its length $2\frac{1}{6}$ in head; body robust, deeper, heavier, and with the back more elevated than in any other of our species; anterior profile depressed above the eye, so that the snout projects; snout short, not very acute, $4\frac{3}{6}$ in head; head thicker than in other species, the interorbital space equal to length of

* *Cestreus obliquatus*, a species imperfectly known, belongs presumably to this group.

snout; eye $7\frac{1}{2}$ in head; maxillary very broad, its tip 6 in head; canines two, short and stout; lateral teeth of lower jaw moderate; gill-rakers X + 10, rather long and slender, the longest $\frac{2}{3}$ eye; pseudobranchiæ often obsolete on one side; dorsal spines high, the longest $2\frac{1}{10}$ in head; soft dorsal moderately scaly, the distal half of the rays largely naked; middle rays of caudal produced; P. $1\frac{1}{2}$ in head; ventrals a trifle shorter; color pale, bluish above, silvery below, axil and inside of opercle a little dusky; head $3\frac{1}{2}$; depth 4. D. IX—I, 19; A. I, 9; scales about 65 ....PRÆDATORIUS, 5.

ee. Mouth moderate, not very oblique; the maxillary extending little beyond eye, its length about $2\frac{1}{2}$ in head.

f. Snout short, bluntish, $4\frac{2}{3}$ in head; mouth smaller and less oblique than in most of the species, the canines quite small; the lateral teeth of lower jaw smaller and more nearly equal than in others; lower jaw a little protruding; maxillary extending to posterior margin of eye, $2\frac{1}{2}$ in head; gill-rakers 3+10, those near the angle rather long, $\frac{2}{3}$ eye, the others rapidly shortened; eye large, $5\frac{2}{3}$ in head; soft dorsal and anal scantily scaled, the distal half largely naked, the fins rather high, the longest soft rays $2\frac{1}{3}$ in head; caudal pointed; pectorals $1\frac{1}{2}$ in head, not reaching tips of ventrals; color pale, with faint darker streaks along sides of back; axil pale; opercle dusky within; head $3\frac{2}{3}$; depth 4. D. X–I, 20; A. I, 8; scales 66......ACOUPA, 6.

ff. Snout long, about $3\frac{1}{2}$ in head; maxillary reaching a little beyond eye; pectoral shortish, $1\frac{2}{3}$ in head; lower jaw very prominent; lateral line becoming straight opposite front of anal; dorsal spines weak, the longest $2\frac{1}{3}$ in head; color uniform silvery, sides minutely punctulate; axil brown, ventrals yellowish; head $3\frac{1}{2}$ in length; depth 4. D. VIII–I, 21 or 22; A. II, 10; scales 10–70–23. SQUAMIPINNIS, 7.

dd. Caudal fin lunate or subtruncate, the middle rays shorter than the upper ones.

g. Coloration nearly plain, bluish above, silvery below; anal rays II, 10, maxillary reaching a little beyond eye, $2\frac{1}{2}$ in head; body rather elongate, the back somewhat elevated; head compressed, pointed, not conical; eye moderate, $6\frac{2}{3}$ in head, its width a little more than interorbital space; gill-rakers long and strong, nearly as long as eye; lateral line becoming straight under soft dorsal;

soft fins all densely covered with small scales; dorsal spines stiffish, the longest 2⅗ in head; anal spines small; ventrals 2 in head; caudal fin deeply lunate; the middle rays 2¼ in head; pectoral fins 1⅘ in head, reaching beyond tips of ventrals; color slaty bluish above, silvery below; body and fins everywhere with dark punctulations; tip of chin dark; fins yellowish, the upper all with dark edging; pectorals blackish on the posterior side; axil dusky; lining of opercle dark; head $3\frac{1}{10}$ in length; depth 4. D. IX–I, 23; A. II, 10; pores in lateral line 60; the series of scales 66.

OTHONOPTERUS, 8.

gg. Coloration not uniform, the back and sides with conspicuous continuous brown streaks along the rows of scales, those above lateral line running upward and backward, those below horizontal; belly silvery; fins plain; anal rays I, 8; body rather robust, compressed; head compressed; eye large, 5½ in head; mouth moderate, somewhat oblique, the maxillary 2¼ in head, not quite reaching line of posterior margin of eye; snout moderately pointed, 4 in head; canines moderate; lateral teeth of lower jaw moderate in size, rather numerous; chin projecting; interorbital space rather flattened and depressed, 5½ in head; gill-rakers long and slender, the longest ⅔ eye, 4 + 13 in number; scales large; lateral line becoming straight under front of soft dorsal; soft dorsal and anal low, densely scaled; longest dorsal spine 2⅓ in head; caudal subtruncate; pectorals longer than ventrals, 1⅘ in head; anal small; head 3⅓ in length; depth 4⅓. D. X–I, 19; A. I, 8; scales 54 (pores) (52 series) ...... STRIATUS, 9.

cc. Soft dorsal of 27 to 29 rays; caudal fin subtruncate, or double truncate, the middle rays but slightly produced.

h. Coloration nearly uniform silvery, somewhat darker above; snout short, scarcely longer than eye.

i. [Caudal truncate; body rather slender; eye 5 in head, the snout but little longer; maxillary reaching posterior third of eye; pectoral as long as ventral; coloration uniform silvery; head 3⅗ in length; depth 5¼. D. X–I, 27; A. I, 11; scales 60, scales of fins undescribed.] (*Sauvage*.) . OBLIQUATUS, 10

ii. Caudal weakly double concave; body rather deep; eye very large 4 in head, as long as snout, equal to interorbital width; body more compressed than in other species; the back somewhat elevated; snout rather short, not very acute, 4½ in head; mouth smaller than in related species; maxillary 2⅓ in head, reaching to below posterior margin of pupil; gill-rakers long and slender, 4 + 9, the longest half eye; lower pharyngeals very slender; dorsal fins contiguous; membrane of soft dorsal scaled to its tips; scales weakly ctenoid; lateral line much curved anteriorly, becoming straight under seventh dorsal spine; color grayish silvery, thickly punctulate above and on sides to level of pectorals, then abruptly silvery, a row of dark points marking the line of division; snout and tip of lower jaw blackish; mouth white within; lower fins white, upper dusky; head 3⅓ in length; depth 3⅔. D. X–I, 27 to 29; A. II, 9 or 10; scales 6–58 to 62–7. NOTHUS, 11.

hh. Coloration brownish silvery above, with many dark-brown spots, arranged in undulating streaks; body more or less compressed; eye moderate, 5 to 7 in head; maxillary extending to below posterior margin of eye, 2⅙ in head; canines large; color brownish silvery, with iridescent reflections, and marked with many small, rather irregular dark-brown spots, some of which form undulating lines running upward and backward; upper fins dusky, lower yellowish .... REGALIS, 12.

x. Snout not very sharp, about 4¼ (4 to 4½) in head; gill-rakers long and slender, usually 5 + 10 to 12 in number; membranes of soft dorsal and anal more or less closely scaly, the scales readily deciduous; head 3⅓; depth about 4¼. D. X–I, 26 to 29; A. II, 11 to 13; scales 6–56–11 .... Var. *regalis*, 12 (*a*).

xx. Snout very sharp, 3¾ to 3⅞ in length of head; gill-rakers shorter, rather slender, 4 + 8 or 9 in number; membrane of soft dorsal and anal with very few scales, these readily deciduous; head 3½ in length; depth 4⅔. D. X–I, 24 or 25; A. II, 10 or 11; scales 5–52–8. Var. *thalassinus*, 12 (*b*).

bb. Soft rays of the dorsal and anal scaleless; gill-rakers comparatively short and thickish, usually not longer than pupil, and but 6 to 8 on lower limb of the arch.

j. Coloration not uniform, grayish and silvery, the back with distinct darker spots, lines, or reticulations; caudal fin truncate, or slightly double concave.

k. Caudal and dorsal fins immaculate.

l. Back and sides covered with dark-brown streaks and reticulations, which obscure the ground color, especially above the lateral line; lateral line in a pale streak, bordered above and below by a darker one; lower parts silvery; fins unspotted. Body comparatively deep and compressed; head somewhat conical, the snout not very sharp, 3⅗ in head; maxillary extending to below margin of pupil, 2⅔ in head; eye 7 in head; gill-rakers shortish, 3 + 7; ventrals 1½ in pectorals; pectorals about 1⅗ in length of head; highest dorsal spine about 2½ in head; caudal double truncate. Head 3¼ in length; depth 4⅗. D. X–I, 28; A. II, 9; scales 9–60–15. RETICULATUS, 13.

kk. Caudal and soft dorsal fins with conspicuous round black spots; back and sides covered with similar spots smaller than the pupil, larger than those on the fins; anal fin dusky. Body moderately elongate, compressed; snout rather long and acute, 3⅖ in head; eye small, 6 to 7 in head; maxillary 2⅛ in head; canines strong; gill-rakers shortish, 3 + 8; lower pharyngeals narrow, with seven or eight series of sharp teeth, those of the inner series enlarged; pectorals 1½ in ventrals, 2¼ in head. Head 3¼ in length; depth 4. D. X–I, 25 to 27. A. II, 10; scales 10–70 to 75–11. NEBULOSUS, 14.

jj. Coloration nearly uniform bluish gray above, silvery below; no distinct spots on body or fins.

m. Caudal fin somewhat lunate in the adult, the middle rays shortest, although more or less produced in young specimens; pectoral fin short, not reaching tips of ventrals; maxillary extending beyond pupil, 2½ in head; canine large, usually but one present; snout rather sharp, 4 in head; gill-rakers shortish, 4 + 7; pharyngeals narrow, their teeth small, cardiform, the inner ones somewhat enlarged; color, clear steel-blue above, without stripes or spots; silvery below; a narrow dusky shade along the sides below the lateral line; axil dusky; lower fins yellowish, with dusky shading; upper fins dark; second dorsal dark edged. Head 3¼ in length; depth 4½. D. X–I, 22 or 23; A. II, 10. Scales 13–75 (pores)–14, about 95 in a longitudinal series. PARVIPINNIS, 15.

mm. Caudal fin always double truncate or double concave, the middle rays somewhat produced.

n. Pectoral fins reaching nearly or quite to the tips of ventrals, their length more than half head.

o. Scales small (12–86–X), the number of pores in the lateral line about 70; head rather long, compressed and pointed; maxillary a little more than half head, reaching just past eye; lateral line becoming straight opposite the vent; body rather slender, compressed; eye large, 6 in head; premaxillaries in front, entirely below eye; canines small, two usually present; longest dorsal spine 2 in head; longest soft ray 2⅜; middle rays of caudal considerably produced, 1½ in head; anal spine rather small and stout; ventrals little more than 2 in head; pectorals 1⅜. Color bluish above, silvery below, upper parts and especially the middle of the sides punctate with dark points; upper fins dark, their margins dusky, lining of opercle black; inside of mouth bright yellow in life. Head 3⅛ in length; depth 4⅛. D. IX–I, 20; A. II, 8. Scales 12–66 (pores)–X`; 86 rows of scales.

XANTHULUM, 16.

oo. Scales moderate (8–66–18), the pores in the lateral line about 63; head large, bluntish; the snout shorter than in *Cestreus stolzmanni*, the snout 4 to 4⅓ in head; eye 6¼ in head; maxillary nearly half head, reaching well past eye; body rather robust; lateral line becoming straight at a point well in advance of vent; dorsal spines slender, the longest 2½ in head; caudal double truncate, the middle rays longer than the head without snout; pectorals nearly reaching tips of ventrals, more than half length of head; second anal spine evident. Color white, somewhat bluish above. Head 3½ in length; depth 4. D. X–I, 21; A. II, 9; scales 8–63 (pores)–18; 66 series of scales ....ALBUS, 17.

nn. Pectoral fins short, reaching little past middle of ventrals, their length not more than half head; body elongate, somewhat compressed; mouth oblique; maxillary 2⅙ in head, extending to posterior margin of pupil; snout rather sharp, 4 in head; canines rather small; gill-rakers shortish, 4+7; body comparatively slender and elongate; scales rather large, all strongly ctenoid; lateral line becoming straight just before front of second dorsal; longest dorsal spines 2⅙ in head; soft dorsal slightly falcate, the first rays

about 2 in head; caudal large and broad, double truncate; ventrals 1$\frac{3}{8}$ in head. Color steel bluish above, lower parts silvery; no distinct markings. Head 3$\frac{3}{8}$ in length; depth 4$\frac{1}{3}$. D. IX–I, 21; A. II, 9; scales 10–60 (pores)–10.
STOLZMANNI, 18.

aa. Scales very small; the number of pores in the lateral line 70 to 90, and very much less than the number of transverse rows, which is from 85 to 150; teeth of upper jaw in a rather broad band, one to four of them usually more or less canine-like, the canines generally small,* and sometimes wholly disappearing with age; lateral teeth of lower jaw not much enlarged; gill-rakers usually small and short.†

p. Caudal fin lunate or subtruncate; scales not very small; head more or less distinctly conical, not flattened above; soft dorsal with 21 to 23 rays.

q. Soft dorsal and anal fins wholly scaleless.

r. Pectoral fin rather long, more than half head; flesh firm; scales of sides of head not silvery; head pointed, subconical, little compressed; profile rather steep; snout sharp, rather long, 3$\frac{2}{3}$ in head; maxillary extending beyond pupil; anteriorly on a level with the lower margin of the pupil, 2$\frac{1}{8}$ in head; canines small, becoming obsolete; pharyngeals long and slender, with four series of teeth, the inner series several times larger than the rest; gill-rakers short, 2+7; scales very small, those on head little imbedded and less silvery than in related species; caudal lunate, its middle rays less than half length of head; both anal spines evident, the second about half length of the rays; color bluish, little silvery; everywhere punctulate; young with three or four distinct dusky cross-bars; axil and fins dusky; a dusky blotch at base of pectoral, extending on whole inner face of the fin. Head 3$\frac{2}{3}$ in length; depth 4. D. X–I, 21 to 23; A. II, 9; scales 12–88–14 ....NOBILIS, 19.

rr. Pectoral fins short, not more than half length of head; flesh rather soft; sides of head brightly silvery; head very regularly conical, pointed, tapering, scarcely compressed; snout very acute; 3$\frac{2}{3}$ in head; canines quite small, usually but one pres-

* Rather large in *Cestreus microlepidotus.*

† Not examined in *Cestreus microlepidotus*, of moderate length in *C. steindachneri.*

ent and this disappearing with age; eye small, 7½ in head; maxillary extending to behind pupil, 2⅓ in head; body slender; subfusiform, moderately compressed; gill-rakers very short, 3+6. Scales small, all cycloid, those on head imbedded and brightly silvery; highest dorsal spine 2½ in head; pectorals and ventrals about equal, 2 in head; caudal lunate. Color grayish above, with bright reflections; silvery below; lower part of tail golden; middle of sides with dark punctulations; inside of mouth deep orange-yellow; lining of opercle black; caudal fins dusky whitish, with more or less of dark edging; lower rays of caudal yellowish; fins otherwise translucent, unmarked; axil light brownish. Head 3⅓ in length; depth 4⅞. D. IX-I, 21; A. II, 10. Scales 17-90-15; about 80 distinct pores in the lateral line.

PHOXOCEPHALUS, 20.

qq. Soft dorsal fin with its lower portion covered with small, caducous scales. Body compressed; head conic, more compressed than in *Cestreus phoxocephalus;* eye moderate, 5 to 6 in head; maxillary reaching nearly to posterior margin of orbit, 2¼ in head; lower jaw much projecting; upper teeth mostly biserial; canines small, both of them present; lateral teeth of lower jaw small; gill-rakers short and slender, 2 + 7; scales small, chiefly cycloid, those on sides of head bright silvery; lateral line becoming straight above front of anal; caudal fin subtruncate; pectoral fins moderate, 2 in head; caudal weakly double truncate; head 3½ in length; depth 4⅓; D. IX-I, 21 to 23; A. II, 10; scales 13-90-13, about 80 distinct pores.. LEIARCHUS, 21.

pp. Caudal fin rhombic or S-shaped, the middle rays produced, the upper lobe usually pointed; soft dorsal with 23 to 28 rays.

s. Soft dorsal entirely naked; anal with a few scales; body long and low, spindle-shaped, the head slender, subterete, and depressed above (suggesting the form of *Elacate*); profile from snout to dorsal weakly concave; snout long, rather pointed, 4 in head; mouth large, little oblique, the lower jaw strongly projecting, the maxillary 2⅔ in head; canine teeth 2, short and thick; lateral teeth close-set, of moderate size; eye small, 8⅓ in head; interorbital space flattish, 4⅗ in head; gill-rakers rather short, X + 8, the longest about half eye; scales on head very small and silvery; caudal S-shaped, the middle rays longest; pectoral 1⅔ in head. Color plain, rather dusky, silvery below; inside of gill cavity dusky; head 3½ in length; depth 5 to 5½; D. X–I, 28; A. I, 8. Scales 80 (pores), 125 to 130 cross-series.

VIRESCENS, 22.

ss. Soft dorsal and anal fins densely scaly throughout.

t. Sides of lower jaw without canines, the teeth all comparatively small.

u. [Scales extremely small, about 150 in a longitudinal series above the lateral line, 40 in a vertical series; snout 4 in head; eye large, 4⅝; interorbital area 5¼ in head; maxillary extending beyond eye; lower jaw projecting; upper jaw with 3 series of teeth; canines rather strong; lateral teeth of lower jaw not canine-like; dorsal spines slender, the longest 2⅓ in head; caudal fin S-shaped; pectoral slightly longer than ventral, which is slightly more than half head; lateral line becoming straight above anal; color greenish, silvery below; head 3⅞ in length; depth 4¼; D. XI–I, 23; A. II, 9; scales 155 to 160; 70 pores in the lateral line.] (*Steindachner.*)

MICROLEPIDOTUS, 23.

uu. Scales not very small, about 85 to 90 in a longitudinal series above the lateral line; body rather robust, the head small and tapering; profile of head nearly straight and rapidly descending; mouth rather small, oblique, the maxillary 2⅓ in head; chin prominent; snout short, rather pointed, 6 in head; eye large, 5½ in head; teeth all comparatively small, the bands rather broad; no distinct canines in upper jaw, the usual canine scarcely longer than the teeth around it; lateral teeth of lower jaw small; scales small, those of lateral line little enlarged; lateral line less conspicuous than in *C. virescens* or *C. bairdi*, becoming straight under front of soft dorsal; gill-rakers rather long, 4+9, the longest ⅔ eye; pectorals quite short, shorter than ventrals, 2½ in head, their tips not reaching tips of ventrals; caudal rhombic, the upper angle pointed; color silvery, darker above; faint streaks along the rows of scales on the back; head 3⅗ in length; depth 4; D. X–I, 21 to 23; A. I, 9; scales 70 (pores); about 86 series..........STEINDACHNERI, 24.

tt. Sides of lower jaw each with 4 or 5 moderate canines (the lateral teeth being larger than in any of the other species, much as in *Isopisthus*); canines of upper jaw strong; body slender, not specially compressed; head rather slender, little compressed; the upper profile straight; the interorbital area moderate (as broad as eye) and little convex; eye large, 4⅛ in head; snout short, sharp, 4⅛ in head; mouth moderate, not very oblique, the maxillary 2¼ in head and extending to beyond pupil; preorbital very narrow, not as broad as pupil; gill-rakers slender, very short and small, X+6, the longest half as long as pupil; dorsal spines slender, the longest 2¼ in head; soft dorsal and anal densely scaled; caudal fin rhombic; pectoral fins longer than ventrals, 1⅗ in head; scales of lateral line enlarged, somewhat covered by smaller scales; lateral line becoming straight just before anal; color plain silvery, darker above; head 3⅘; depth 4⅓; D. X–I, 25; A. I, 10; scales 70 pores; 150 series ....BAIRDI, 25.

5. CESTREUS PRÆDATORIUS.

(BOCCONE.)

Cestreus prædatorius Jordan & Gilbert, sp. nov. (Panama).

Habitat.—Pacific coast of tropical America, Panama.

This strongly marked species was obtained by Dr. Gilbert at Panama in 1883, and by us described in MS. at the time. Our specimens were destroyed by fire, and the species has remained unnoticed. The types of the present description are three specimens, the largest nearly 2 feet in length, obtained by Professor Agassiz at Panama. These are numbered 10901 and 10902 on the register of the Museum of Comparative Zoology. The species is known to the Panama fishermen as "Boccone."

6. CESTREUS ACOUPA.

Cheilodipterus acoupa Lacépède, Hist. Nat. Poiss., iii, 546, 1802 (Cayenne).
Cynoscion acoupa Jordan, Proc. U. S. Nat. Mus., 1886, 588 (name only).
Lutjanus cayennensis Lacépède, Hist. Nat. Poiss., iv, 196 and 245, 1802 (Cayenne)
Otolithus cayennensis Günther, Cat. Fish. Brit. Mus., ii, 309, 1860 (West Indies)

Otolithus rhomboidalis Cuvier, Règne Animal, ed. 2, 1829 (based on *Lutjanus cayennensis* Lacépède).
Otolithus toeroe Cuv. & Val., Hist. Nat. Poiss., v, 72, plate 103, 1830, Cayenne (same type as *L. cayennensis* Lac., Surinam, Brazil, Lake Maracaibo), *ibid.*, ix, 478 (Cayenne).
Apseudobranchus toeroe Gill, Proc. Acad. Nat. Sci. Phila., 1862, 18 (name only).

Habitat.—Surinam, Brazil.

There seems to be no reason to doubt that this is the *Otolithus toeroe* of Cuvier & Valenciennes, and this *toeroe* is based on the same typical examples as the prior names *rhomboidalis* and *cayennensis*.

As to the still earlier name *acoupa*, it seems to us that Cuvier and Valenciennes are right in referring it to a species of this group, as the caudal is rounded, the lower jaw projecting, the teeth unequal, and the second dorsal with 18 rays. As, according to the statements of these authors, the fish called "Toeroe" by the Dutch in Guiana is known as "Acoupa" by the Portuguese, this identification is highly probable. The specific name *acoupa* should then supersede *cayennensis*.

Our description of this species is taken chiefly from a specimen 14 inches long from Cachiura, Brazil (10892, M. C. Z.). Numerous other specimens are in the museum from Surinam, San Matheo, Curuça, Cachiura, and Rio Janeiro.

The statement is made by Dr. Günther that this species lacks pseudobranchiæ, and on this statement Dr. Gill has proposed for it the generic name of *Apseudobranchus*.

It is true in this as in other species of *Cestreus* that the pseudobranchiæ become smaller with age. Usually they become (in old specimens) obsolete on one side while they are perfectly evident on the other. This is the case with all the old specimens of this species which we have examined, and it is true also in several others of the larger species. The genus *Apseudobranchus* is therefore strictly synonymous with *Cestreus* and *Cynoscion*.

7. CESTREUS SQUAMIPINNIS.

Otolithus squamipinnis Günther, Fishes Central America, 387 and 429, 1869 (Panama). Steindachner, Neue und Seltene Fische k. k. Zool. Mus. Wien, 37, 1879 (Panama).
Cynoscion squamipinne Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (La Union, San Salvador). Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 320 (La Union).

Habitat.—Pacific coast of tropical America.

This species is known from a few specimens taken at La Union and Panama. Specimens obtained by Prof. Alexander Agassiz at Panama are in the museum at Cambridge.

8. CESTREUS OTHONOPTERUS.

Cynoscion squamipinnis Streets, Bull. U. S. Nat. Mus., vii, 49, 1877 (off San Ygnacio River, Gulf of California) (not *Otolithus squamipinnis* Günther).
Cynoscion othonopterum Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Punta San Felipe, Mexico). Jordan & Gilbert, Bull. U. S. Fish Com., 1881. 320 (copied).

Habitat.—Gulf of California.

This species is known to us from its type, a large specimen taken in the Gulf of California. The specimen—also from the Gulf—recorded by Dr. Streets under the name *squamipinnis*, seems to belong to *C. othonopterus*. The species is closely related to *C. squamipinnis*, but we believe it to be distinct.

9. CESTREUS STRIATUS.

Guatucupa Marcgrave, Hist. Brazil, 1648.
Otolithus striatus Cuvier, Règne Animal, ed. 2, 1829 (based on *Guatucupa* of Marcgrave).
Otolithus guatucupa Cuv. & Val., Hist. Nat. Poiss., v, 75, plate 104 (Montevideo). Günther, Cat. Fish. Brit. Mus., ii, 309 (copied). Günther, Shore Fishes, 13, 1880 (mouth of the Rio de la Plata). Jenyns, Zool. Beagle, Fishes, 41, 1842 (Maldonado Bay).

Habitat.—Coasts of Brazil and Argentine Republic.

This strongly marked species much resembles the northern weakfish in coloration, but it is readily distinguished by the small number of its dorsal rays.

Our description is mainly taken from a specimen 18 inches long from Buenos Ayres (434, M. C. Z.). Other specimens are in the museum from Montevideo, Maldonado, and Buenos Ayres.

10. CESTREUS OBLIQUATUS.

Otolithus obliquatus (Valenciennes MSS.) Sauvage, Bull. Soc. Philom. Paris, iii, 209, 1879 (Martinique).
Cynoscion obliquatum Jordan, Proc. U. S. Nat. Mus., 1886, 588 (name only).

Habitat.—Martinique.

This species is unknown to us. The increased number of dorsal rays leads us to place it in the neighborhood of *Cestreus nothus*, with which species the scanty description agrees in most respects. *C. nothus* has, however, not been recorded from the West Indies.

The following is the account published by Dr. Sauvage:

"Un *Otolithe* étiqueté dans la collection du Muséum *Otolithus obliquatus* de la main de Valenciennes, n'est pas décrit dans l'Histoire des Poissons. Voisine de l'*Otolithus thalassinus*, Holbr., cette espèce en diffère par le moins grand nombre d'écailles à la ligne latérale et l'œil plus grand; la forme de la caudale la sépare de l'*Otolithus nothus*, Holbr., des mêmes parages. Voici la diagnose des deux exemplaires recueillis à la Martinique par M. Plée:

"D. X, 28; A. I, 11; L. lat. 60.

"Hauteur du corps contenue cinq fois un tiers, longueur de la tête trois fois et trois quarts dans la lôngueur totale du corps; museau un peu plus long que le diamètre de l'œil, qui est contenue cinq fois dans la longueur de la tête; mâchoire inférieure plus longue que la supérieure; des canines assez fortes à la mâchoire supérieure seulement; maxillaire arrivant au niveau du tiers postérieur de l'œil; angle du préopercule arrondi et un peu rejeté en arrière; dentelures du préopercule bien visibles, plus fortes à l'angle. Caudale tronquée; pectorales de même longueur que les ventrales. Ligne latérale assez incurvée vers le milieu de sa longueur. Coloration uniforme. Longueur du corps 0,200."

11. CESTREUS NOTHUS.

(BASTARD SEA TROUT.)

Otolithus nothus Holbrook, Ichthyol. S. Carolina, 134, plate 19, fig. 1, 1860 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 308, 1860 (Jamaica).

Cynoscion nothus Goode & Bean, Proc. U. S. Nat. Mus., 1879, 131 (Pensacola). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 607 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 580, 1882. Goode, Proc. U. S. Nat. Mus., 1884, 212 (St. John's River, Fla.).

Habitat.—South Atlantic and Gulf coasts of United States.

This species is rather rare at Charleston and elsewhere along our Southern coast.

It is a very well marked species, differing in numerous respects from the others, *regalis*, *thalassinus*, *nebulosus*, found in the same waters. The specimens examined by us are from Charleston.

12. CESTREUS REGALIS.

(THE WEAK-FISH, OR SQUETEAGUE; "SEA TROUT.")

[Plate I.]

a. Var. *regalis.*

Johnius regalis Bloch & Schneider, Syst. Ichthyol., 75, 1801. Holbrook, Ichthyol. S. Carolina, 127, plate 18, fig. 1 (South Carolina).

Otolithus regalis Cuv. & Val., Hist. Nat. Poiss., v, 67 (New York, New Orleans). Richardson, Faun. Bor. Amer. Fish., 68, 1836. Storer, Report Fishes Massachusetts, 33, 1839 ("no longer found on the coast"). Storer, Hist. Fish. Mass., 122, plate 9, fig. 1 (Provincetown). Ayres, Fishes of Brookhaven, L. I., 259, 1842. De Kay, New York Fauna, Fishes, 71, plate 8, fig. 24, 1842 (New York). Storer, Syn. Fish. North Am., 118, 1846 (Massachusetts). Günther, Cat. Fish. Brit. Mus., ii, 307, 1860.

Cynoscion regale Gill, Proc. Acad. Nat. Sci. Phila., 1862, 18. Uhler & Lugger, Fishes of Maryland, 98, 1876 (Chesapeake Bay). Goode & Bean, Fishes of Essex County and Massachusetts Bay, 17, 1879 (Milk Island, Cape Ann). Bean, Proc. U. S. Nat. Mus., 1880, 90 (Norfolk, Va.; Wood's Holl, Mass.). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 607 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 581, 1882. Goode, Hist. Aquat. Anim., 362, plate 120, 1884 (Wood's Holl, Mass.).

Roccus comes Mitchill, Report in part Fishes New York, 26, 1814 (New York).

Labrus squeteague Mitchill, Trans. Lit. and Phil. Soc. New York, 396, plate 2, fig. 1, 1815 (New York).

b. Var. *thalassinus.*

Otolithus thalassinus Holbrook, Ichth. South Carolina, 132, plate 18, fig. 2 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 308, 1860 (Gulf of Mexico).

Cynoscion thalassinus Jordan & Gilbert, Syn. Fish. North America, 581, 1882 (copied).

Habitat.—Atlantic and Gulf coast of the United States; var. *thalassinus* from Virginia to Louisiana.

The Weak-fish is one of the most valuable food-fishes of our Atlantic coast. It is caught in large numbers, and its flesh is very excellent for the table. Its flesh, like that of most species of the genus, is very tender and easily torn, hence the common name of Weak-fish.

On the Carolina coast it has received the very inappropriate name of "Sea Trout."

Specimens of the typical *regalis* are in the museum at Cambridge from various localities on the Atlantic coast, and from Mobile and "Florida Keys," on the Gulf coast. Its occurrence in the Gulf must be infrequent, as no specimens have been obtained by Dr. Jordan at Galveston, New Orleans, Pensacola, Cedar Keys, or Key West.

The form called *Otolithus thalassinus* by Holbrook has not been recognized by later collectors, and it has usually been considered identical with *C. regalis*.

A specimen lately sent to us by Mr. Silas Stearns from Pensacola seems to answer to Holbrook's description, and we have found two similar specimens in the museum at Cambridge, one (No. 438, M. C. Z.) from Pass Christian, Mississippi, the other from Hampton Roads, Virginia. The only differential characters which we have noted are given in the analysis of species. As *C. regalis* is subject to considerable variation, we have regarded *C. thalassinus* as an extreme form or variety rather than as a distinct species. It may, perhaps, be found to inhabit a different depth of water than that which the common Weak-fish frequents.

The following is a description of our specimen from Pensacola: Depth, $4\frac{2}{3}$ in length; head, $3\frac{1}{2}$; D. X – I, 24; A. II, 11; lateral line, 56; length, 12 inches.

Body compressed; not especially elevated; of abou t the same depth everywhere betwen the ventrals and the vent; caudal peduncle rather long and stout.

Head pointed, subconical; profile straight, scarcely descending; eye rather large, $1\frac{2}{5}$ in snout, $5\frac{1}{3}$ in head; mouth large, oblique; premaxillary anteriorly on a level with the upper margin of the pupil; maxillary extending beyond the pupil; lower jaw strongly projecting, its tip entering the profile.

Teeth of the lower jaw in two series, anteriorly in a single series; those in front small and subequal; the inner ones recurved; those of the side much larger. Teeth of the upper jaw in two series; those of the outer series scarcely decreasing in size towards the angle; those of the inner series becoming minute on the sides; canines moderate, $\frac{1}{5}$ the diameter of the eye.

Preopercle with a striated and dentated dermal margin; gill-rakers slender; those near the angle half the length of the eye.

Lower pharyngeals weak and long, grooved below; teeth at the angle several times as large as the rest, all more or less recurved; the anterior ones specially so; teeth of the upper pharyngeals unequal.

First dorsal spine inserted above the end of the first fourth of the ventrals; the spines slender; the third highest, reaching to the ninth spine, $2\frac{2}{5}$ in head; second anal spine about twice as large as the first, $2\frac{2}{3}$ in length of eye; anal rays $2\frac{2}{3}$ in head; pectorals broken; ventrals slightly less than 2 in head; soft dorsal apparently not scaly, but so mutilated that we cannot be certain of this.

Scales very weakly ctenoid; lateral line somewhat wavy anteriorly, becoming straight under the fourth or fifth dorsal ray.

Color, brownish above, lighter below; middle of sides with many dark dots; a dark blotch on upper corners of opercle and cheek; axil and inner margin of pectoral, black; spinous dorsal, black; soft dorsal and caudal, dusky; the rest of the fins pale.

The specimen from Pass Christian has no scales on dorsal or anal at present, but the marks showing their former presence on the basal parts of the fin are evident. Gill-rakers, X+8, the longest $\frac{2}{3}$ eye; snout $3\frac{3}{4}$ in head; D. X–I, 25; A. I, 10.

In the specimen from Hampton Roads the gill-rakers are X+9; snout $3\frac{4}{5}$ in head; D. X–I, 25. The coloration is essentially as in *regalis*, but in all these specimens it is more silvery, the dark markings less distinct.

13. CESTREUS RETICULATUS.

Otolithus reticulatus Günther, Proc. Zool. Soc. London, 1864, 149 (San José de Guatemala, Chiapam). Günther, Fishes Central America, 387, 388, and 430, 1869 (San José, Chiapam).

Cynoscion reticulatum Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (Acapulco, Mexico). Jordan & Gilbert, Bull. U. S. Nat. Mus., 1881, 319 (Mazatlan; Panama).

Habitat.—Pacific coast of tropical America, Mazatlan to Panama.

This is a common food-fish of the west coast of Mexico. It considerably resembles *Cestreus nebulosus*, and is similar in size, habits, and value to the latter.

14. CESTREUS NEBULOSUS.

(THE SPOTTED WEAK-FISH, OR SPOTTED "SEA TROUT.")

[Plate II.]

Labrus squeteague var. *maculatus* Mitchill, Trans. Lit. & Phil. Soc., 396, 1815 (New York) (not *Labrus maculatus* Bloch).

Cynoscion maculatum Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 285 (Pensacola, Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus.. 1882, 607 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 581, 1883. Bean, Internat. Fishery Exhib. Berlin, 55, 1883 (Pensacola, Florida). Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 233 (Cedar Key, Florida). Goode, Hist. Aquat. Anim., 362, plate 120, 1884 (Norfolk, Va.).

Otolithus nebulosus Cuv. & Val., Hist. Nat. Poiss., v, 79, 1830 (locality unknown). Jordan, Proc. U. S. Nat. Mus., 1886, 540 (note on type of Cuvier & Valenciennes).

Otolithus carolinensis Cuv. & Val., Hist. Nat. Poiss., ix, 475, 1833 (South Carolina). DeKay, New York Fauna, Fishes, 72, 1842 (New York). Storer, Syn. Fish. North Am., 318, 1846 (copied). Holbrook, "Ichthyol. S. Carolina, 133, pl. 19, fig. 2" (S. Carolina). Günther, Cat. Fish. Brit. Mus., ii, 306, 1860 (New York, Lake Pontchartrain).

Cestreus carolinensis Gronow, Cat. Fish., ed. Gray, 49, 1854 (Carolina).

Cynoscion carolinensis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort). Goode, Proc. U. S. Nat. Mus., 1879, 112 (St. John's River, Florida). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 131 (Pensacola). Bean, Proc. U. S. Nat. Mus., 1880, 92 (St. John's River, Florida; Norfolk, Virginia; Beaufort, N. C.; Fort Macon, N. C.).

Otolithus drummondi Richardson, Faun. Bor. Am. Fish., 70, 1836 (New Orleans). Storer, Syn. Fish. North Am., 318, 1846 (copied). Girard, U. S. & Mex. Bound. Survey, 12, plate vi, 1859 (New Orleans, Brazos Santiago, Indianola). Günther, Cat. Fish. Brit. Mus., ii, 307, 1860 (copied).

Habitat.—South Atlantic and Gulf Coast of the United States; New York to Texas.

This excellent food-fish is everywhere common on our Southern coast. The northernmost locality from which we have examined specimens is Beesley's Point, New Jersey.

The oldest specific name of the species is that of *Labrus squeteague* var. *maculatus* Mitchill. This name seems, however, to be ineligible, as there was already a *Labrus maculatus* Bloch. Next in order comes the *Otolithus nebulosus* of Cuvier & Valenciennes. This name apparently is the one which should be retained, although the later name *carolinensis* has been generally in use.

15. CESTREUS PARVIPINNIS.

(CALIFORNIA "BLUE-FISH.")

Cynoscion parvipinnis Ayres, Proc. Cal. Ac. Nat. Sci., 1861, 156 (coast of Lower California).

Cynoscion parvipinne Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 48 (San Pedro southward). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 274 (Guaymas, Mexico). Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 320 (San Pedro, San Diego, Gulf of California). Jordan & Gilbert, Syn. Fish. North Am., 580, 1882. Rosa Smith, Proc. U. S. Nat. Mus., 1883, 234 (Todos Santos Bay, Lower California). Rosa Smith, West American Scientist, 1885, 47 (San Diego).

Otolithus magdalenæ Steindachner, Ichthyol. Beit., iii, 1875 (Magdalena Bay, Lower California).

Habitat.—Coasts of Lower California; Guaymas to the Santa Barbara Islands.

This species is common along the coasts of Southern California, as far north as San Pedro. It is an excellent food-fish, not inferior to its relative, the weak-fish of the Atlantic coast. As in the case of the latter species, the flesh of *Cestreus parvipinnis* is soft, and the fish does not bear transportation well.

Types of *Otolithus magdalenæ*, from Magdalena Bay, are preserved in the museum at Cambridge.

16. CESTREUS XANTHULUM.

Cynoscion xanthulum Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 460 (Mazatlan). Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 319 (Mazatlan). Jordan & Gilbert, Bull. U. S. Nat. Mus., 1882, 107 (Mazatlan).

Habitat.—Pacific coast of Mexico; Mazatlan.

This species is not rare about Mazatlan. The specific name (ξανθός; οὖλον) is intended to allude to the yellow color of its lips and gums. It is closely related to *Cestreus albus*, a species which seems to replace it farther south.

17. CESTREUS ALBUS.

Otolithus albus Günther, Proc. Zool. Soc. Lond., 1864, 149 (Chiapam; Panama). Günther, Fishes Central America, 387 and 429, 1869 (Chiapam). Steindachner, Neue u. Seltene Fische k. k. Zool. Mus. Wien, 36, 1879 (Panama).
Cynoscion album Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 319 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This species is not rare at Panama. Like the others of the genus, it is a food-fish of importance. Specimens from Panama are in the museum at Cambridge.

18. CESTREUS STOLZMANNI.

Otolithus stolzmanni Steindachner, Neue u. Seltene Fische k. k. Zool. Mus. Wien, 1879, 35, plate ii, fig. 1 (Tumbez, Peru).
Cynoscion stolzmanni Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 320 (Panama).

Habitat.—Pacific coast of tropical America; Panama to Peru.

This species is not rare about Panama, where specimens were obtained by Professor Gilbert. A specimen collected by Prof. Alexander Agassiz, at Panama, is in the museum at Cambridge.

19. CESTREUS NOBILIS.

(THE "WHITE SEA BASS" OF CALIFORNIA.)

Johnius nobilis Ayres, Proc. Cal. Acad. Nat. Sci., 1860, 78 (San Francisco).
Atractoscion nobilis Gill, Proc. Acad. Nat. Sci. Phila. 1862, 17 (name only). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 48 (San Francisco southward). Jordan & Gilbert, Syn. Fish. North Am., 579 and 933, 1882.
Cynoscion nobilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (San Francisco, Monterey Bay, Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 320 (copied). Rosa Smith, West American Scientist, 1885, 47 (San Diego).
Otolithus californiensis Steindachner, Ichthyol. Beitr., iii, 31, 1875 (Lower California).

Habitat.—Coast of California, north to San Francisco.

This species is one of the largest in size of the Sciænoid fishes, reaching a weight of 60 to 70 pounds. Its flesh is more firm than that of most of the other species of *Cestreus*, but its quality is scarcely less delicate than that of the weak-fish.

The young fishes are somewhat different in color from the adult, being marked by two or three distinct dusky cross-bars on the back and sides. These young fishes are often taken by fishermen to be a distinct species, and called sea-trout. Such specimens have been described by Dr. Steindachner under the name of *Otolithus californiensis*. Typical examples of this nominal species, from San Diego, are in the museum at Cambridge.

20. CESTREUS PHOXOCEPHALUS.

Cynoscion phoxocephalum Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 318 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This species is not uncommon about Panama. It somewhat resembles *Cestreus nobilis*, but it is not known to reach the large size of the latter. The tapering form of the head reaches an extreme in this species, and the silvery luster of the scales is brighter than in any other.

A specimen of this species from Panama is in the museum at Cambridge.

21. CESTREUS LEIARCHUS.

Otolithus leiarchus Cuv. & Val., Hist. Nat. Poiss., v, 78, 1830 (Brazil; Cayenne). Günther, Cat. Fish. Brit. Mus., ii, 308, 1860 (Bahia). Jordan, Proc. U. S. Nat. Mus., 1886, 540 (note on type of Cuvier & Valenciennes).

Habitat.—Coasts of Brazil and Guiana.

This species is known to us from the examination of the type, a dried skin of a young example in the museum at Paris. The absence of the anal spine ("*leiarchus*") is due to its being covered by varnish.

The description given in our analysis is taken from an example (34500, U. S. Nat. Mus.) from unknown locality (Brevoort Coll.) and from specimens from Rio Janeiro, Porto Alegre, Bahia, and Santos, in the museum at Cambridge. *C. leiarchus* is closely related to *Cestreus phoxocephalus*, but it more strongly resembles the typical *Cestrei* than the latter species does.

22. CESTREUS VIRESCENS.

Otolithus virescens Cuv. & Val., Hist. Nat. Poiss., v, 72, 1830 (Surinam).
Cynoscion virescens Jordan, Proc. U. S. Nat. Mus., 1886, 588 (name only).
Otolithus microps Steindachner, Neue Fisch-Arten k. k. Museen Wien, Stuttgart, und Warschau, 38, plate viii, fig. 2, 1879 (Porto Alegre, Brazil).

Habitat.—Coasts of Guiana and Brazil.

We know this species from a specimen (4584, M. C. Z.) 18 inches long from Victoria, Brazil.

This specimen agrees well with Steindachner's description of *Otolithus microps*. The scanty account given by Cuvier and Valenciennes of *Otolithus virescens* agrees, so far as it goes, with *O. microps*, and with no other South American species known. We have been unable to find the type of *virescens* in the museum at Paris. There seems to be little reason for doubting the identity of the two. We have therefore taken the older name instead of *microps*.

23. CESTREUS MICROLEPIDOTUS.

Otolithus microlepidotus Cuv. & Val., Hist. Nat. Poiss., v, 79, 1830 (Surinam). Günther, Cat. Fish. Brit. Mus., ii, 311, 1860 (copied). Steindachner, Neue und Seltene Fische k. k. Zool. Mus. Wien, 39, 1879 (Maranhão).
Cynoscion microlepidotum Jordan, Proc. U. S. Nat. Mus., 1886, 588 (name only).

Habitat.—Coasts of Surinam and Brazil.

This species is known from the original discription of Cuvier and Valenciennes and from a more detailed account given by Dr. Steindachner. It would appear to be well distinguished from all the others mentioned in this paper.

24. CESTREUS STEINDACHNERI.

Cestreus steindachneri Jordan, sp. nov. (Curuça, Brazil).

Habitat.—Coasts of Brazil.

The type of this species is a specimen (10922, M. C. Z.) collected at Curuça by Professor Louis Agassiz. We have taken pleasure in naming the species for our friend, Dr. Franz Steindachner, of Vienna, who has contributed more than any one else to our knowledge of the fishes of South America.

Cestreus steindachneri seems to be allied to *C. microlepidotus*, but it is readily distinguished from that species by numerous characters. It somewhat resembles *C. acoupa*, but its scales are not half as large as in that species.

25. CESTREUS BAIRDI.

Otolithus (?) *bairdi* Steindachner, Neue Fisch-Arten k. k. Museen Wien, Stuttgart, und Warschau, 40, plate i, fig. 2, 1879 (Santos, Brazil).

Habitat.—Coast of Brazil.

We have examined a single specimen of *Cestreus bairdi*, a young example (10887, M. C. Z.) 9 inches long, from Pará.

This species has almost exactly the dentition of the species of *Archoscion*. It cannot, however, be referred to that genus, as it has the fins as in the ordinary species of *Cestreus*. The difference in the dentition is one of degree only, the lateral teeth being a little larger and more unequal than usual, and cannot be used to separate this species from the genus *Cestreus*.

Genus IV.—ANCYLODON.

Ancylodon Cuvier, Règne Animal, ed. 1, 1817 (*jaculidens* = *ancylodon*).

TYPE: *Lonchurus ancylodon* Bloch & Schneider.

This genus contains a single species, remarkable for the large size and peculiar form of its canine teeth.

ANALYSIS OF SPECIES OF ANCYLODON.

a. Body oblong, moderately compressed, the general form about as usual in *Cestreus*: mouth oblique, the lower jaw projecting; maxillary moderate, 2⅛ in head; snout rather pointed, 4½ in head; preorbital narrow; eye 6½ in head; large canine of upper jaw very long, lance-shaped, *i. e.*, widened toward the tip and then abruptly pointed; about two canines in front of lower jaw on each side, also lance-shaped, but much smaller; outer teeth of upper jaw enlarged and showing something of the same form; enlarged lateral teeth of lower jaw compressed; gill-rakers moderate, slender, 3 + 8, the longest ⅔ eye; caudal fin rhombic; spinous dorsal very weak; soft dorsal and anal scaly; pectoral 1⅞ in head; lateral line becoming straight before vent; color bluish above, silvery below; caudal lobe darker; head 3¼ in length; depth 4; D. IX-I, 28; A. II, 10; scales 75 (pores), 85 rows.

ANCYLODON, 26.

26. ANCYLODON ANCYLODON.

Lonchurus ancylodon Bloch & Schneider, Syst. Ichth., 102, plate 25, 1801 (Surinam).
Ancylodon jaculidens Cuv. & Val., Hist. Nat. Poiss., v, 81, 1830 (Cayenne). Günther, Cat. Fish. Brit. Mus., ii, 311, 1860 (Surinam; West Indies). Jordan & Gilbert, Bull. U. S. Nat. Mus., 1882, 111 (Panama).
Ancylodon atricauda Günther, Shore Fishes of the Challenger Exp., 1880, 12 (Mouth of Rio de la Plata).

Habitat.—Both coasts of tropical America; Surinam; Panama.

We have not been able to compare any specimens of this species in good condition, from Surinam, with specimens from Panama. The original types in the museum at Paris are in poor condition, but we did not see, when examining them, any characters by which we could separate them from the specimens collected by Professor Gilbert at Panama.

Our description is taken chiefly from a specimen in the museum at Cambridge from Rio Grande do Sul. Others from Guiana, Montevideo, and Rio Janeiro are in the same collection.

The specimen described by Dr. Günther as *Ancylodon, atricauda* differs from our account only in having the head 3 in length and 31 rays in the soft dorsal. It is probably identical with *A. ancylodon.*

Genus V.—NEBRIS.

Nebris Cuvier & Valenciennes, Hist. Nat. Poiss., v, 149, 1830 (*microps*).

TYPE: *Nebris microps* Cuv. & Val.

This genus is one of the most peculiar in the family. The cavernous structure of the head reaches in this genus its extreme of development, the head being more spongy to the touch than in *Stelliferus, Collichthys,* or *Pachypops.* But one species is known.

We retain the name *Nebris,* notwithstanding the prior *Nebria,* as we regard the two names as sufficiently distinct. The number of vertebræ in *Nebris* is 10 + 14. The genus, therefore, belongs to the *Sciæninæ* and not to the *Otolithinæ.*

ANALYSIS OF SPECIES OF NEBRIS.

a. Body plump, anteriorly tapering to the slender caudal peduncle; profile straight head broad, heavy, extremely spongy above, eye minute, 9½ in head, 2½ in snout, 4 in interorbital area; 1½ in width of maxillary, which is very broad; mouth very large, oblique; lower jaw projecting, premaxillary anteriorly on a level with the middle of the eye; maxillary extending to below posterior margin of orbit, 2½ in head; teeth all minute, those of the lower jaw in a single series; those in upper jaw in a band which widens backwards; tongue large and thick; head entirely scaly; margin of the preopercle indistinct, with a very wide membranous edge, which is nearly covered with scales; gill-rakers long and slender, 5 + 15; scales small, cycloid; lateral line little arched; the bases, at least of all the soft fins, densely covered with small scales; dorsal spines feeble, shorter than the dorsal rays; caudal lanceolate; pectorals 1½ in head; ventrals 1⅞; color silvery, darker above; pectorals dusky on their inner margin; head 3 in length; depth 4½. D. VIII-I, 31; A. II-13. Scales 18–50 (pores)-18 ....MICROPS, 27.

27. NEBRIS MICROPS.

Nebris microps Cuv. & Val., Hist. Nat. Poiss., v, 149, plate 112, 1830 (Surinam). Günther, Cat. Fish, Brit. Mus., ii, 316, 1860 (copied). Steindachner, Ichthyol. Beitr., iv, 10, 1875 (Bay of Panama). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 111 (Panama).

Habitat.—Both coasts of Central America, Surinam, Panama.

The specimen from which our description is taken was obtained by Professor Gilbert at Panama, where the species is not rare.

The original type of the species, from Surinam, has been examined by us, but it is not in very good condition, and no characters distinguishing it from the Panama form were noted. No direct comparison of Atlantic and Pacific specimens has yet been made. Numerous specimens from Panama are in the museum at Cambridge.

Genus VI.—LARIMUS.

Larimus Cuvier & Valenciennes, Hist. Nat. Poiss., v, 145, 1830 (*breviceps*).
Amblyscion Gill, Proc. Acad. Nat. Sci. Phila., 1863, 165 (*argenteus*).
Monosira Poey, Anales de Hist. Nat. Esp., 1881, 326 (*stahli*).

TYPE: *Larimus breviceps* Cuvier & Valenciennes.

This genus seems to be a very natural one, and well worthy of distinction, although it is very closely related to *Bairdiella* and other more typical Sciænoids. The short snout and oblique mouth reach an extreme in *Larimus argenteus*, but no definite generic line can be drawn between that species and the others. Besides the following, one other species, *Larimus peli* Bleeker, is known, from Guinea. The species called *Larimus auritus* (*Brachydeuterus auritus* Gill) is not a Sciænoid fish at all, but allied to *Pomadasis*.

ANALYSIS OF SPECIES OF LARIMUS.

a. Dorsal with 27 to 30 soft rays; mouth extremely oblique or vertical.

b. Mouth large, the cleft vertical; profile slightly convex, nearly horizontal; no traces of dark stripes along the rows of scales; snout very short, 5½ in head; eye large, 4⅗; profile slightly convex, little oblique; snout very short, 5½ in head; maxillary not extending beyond anterior margin of pupil, 2 in head; teeth all minute; preopercle with a striated and ciliated membranaceous border; gill-rakers ⅘ length of eye, 7 + 16; scales on head all cycloid; highest dorsal spine 2⅓ in head; ventrals a little shorter than pectorals, which are about as long as head; color plumbeous above, golden below and on sides; a black axillary spot; a large steel-blue opercular spot. Head 3⅓ in length; depth 3⅓. D. X-I, 27; A. II, 6. Scales 6-49-6 .... ARGENTEUS, 28.

bb. Mouth not quite vertical; upper parts with dark streaks along the rows of scales; profile slightly convex, a little oblique; snout very short, 6 in head; eye 4; maxillary extending to below front of orbit, 2 in head; teeth in lower jaw uniserial, in upper uniserial in front, in about two series laterally; preopercle with a ciliated, membranous border; gill-rakers slender and long, 10 + 21; dorsal spines weak, the highest 1⅘ in head; ventrals a little shorter than pectorals, which are as long as head; scales large, those on head chiefly cycloid; color plumbeous-silvery, with more or less conspicuous oblique blackish streaks following the rows of scales above; a black axillary spot; region about pseudobranchiæ dusky. Head $3\frac{1}{8}$; depth 3. D. X–I, 28; A. II, 6. Scales 6–48–7 .... BREVICEPS, 29.

aa. Dorsal rays 24 to 26; mouth lower and less oblique, the snout more convex and the profile descending forwards.

c. [Color white, with faint streaks and without vertical dark bars; second anal spine long, nearly 2 in head; body deep; snout short, 5 in head; eye $3\frac{1}{2}$ in head; mouth large, maxillary 2 in head, lower mandible produced and curved; a pore on each side of the symphysis; gill-rakers long and slender; teeth uniserial, numerous, and very small, those of the lower jaw slightly larger; pectorals lanceolate, reaching beyond vent, slightly longer than head. Head $3\frac{1}{3}$ in length; depth 3. D. X–I, 25; A. II, 5.] (*Poey.*) STAHLI, 30.

cc. Color grayish, silvery below, with about seven dark vertical cross-bars; second anal spine short, $3\frac{1}{4}$ in head. Body heavy forwards, much compressed, the back somewhat elevated; profile convex; snout very short and blunt, $5\frac{1}{2}$ in head; eye 4, about equal to the flattish interorbital area; mouth large, less oblique than in other species; tip of premaxillary on level of middle of pupil; maxillary 2 in head reaching to below posterior third of eye; lower mandible with a slight knob at its symphysis, a small pore on each side of it; teeth minute, firm, in a single series in each jaw; pharyngeal teeth all long and slender; the pharyngeal bones small and narrow, sub-triangular; gill-rakers extremely elongate, as long as eye, 12 + 24; preoperele with minute cilia; third and fourth dorsal spines about $2\frac{1}{4}$ in head; second anal spine short, one-fourth shorter than the first anal ray; scales large, ctenoid; anal and soft dorsal with a scaly sheath at base; color in life grayish olive above, with some silvery; below, clear silver white, back with 7 to 9 rather conspicuous darker vertical bars extending to below middle of sides; fins dusky-olive; anal fin and lower rays of caudal yellow, ventrals orange yellow, dusky towards tip; lower side of head very bright silvery; inside of mouth and lining of gill cavity, cheeks and opercles, with some light yellow. Head $3\frac{1}{2}$ in length, depth 3. D. X–I, 24 to 26. A. II, 5 to 6. Scales 5–49–9 to 11 .... FASCIATUS, 31.

28. LARIMUS ARGENTEUS.

Amblyscion argenteus Gill, Proc. Acad. Nat. Sci. Phila., 1863, 165 (West coast Central America).

Larimus argenteus Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 110 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This singular fish is not uncommon about Panama, where several specimens were obtained by Professor Gilbert. Of all the known species of *Sciænidæ* this one has the mouth most nearly vertical. There is, however, in its structure nothing to warrant its separation as a distinct genus, *Amblyscion.* Many specimens from Panama are in the museum at Cambridge.

29. LARIMUS BREVICEPS.

Larimus breviceps Cuv. & Val., Hist. Nat. Poiss., v, 146, pl. cxl, 1830 (Brazil, San Domingo). Storer, Syn. Fish. North Am., 321, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 268, 1860 (San Domingo). Günther, Fishes Central America, 387 and 425, 1869. Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 (Mazatlan). Gilbert, loc. cit., 112 (Punta Arenas). Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 158 (Jamaica).

Habitat.—Both coasts of tropical America, north to Mazatlan and San Domingo.

We have not been able to compare directly Atlantic and Pacific examples of this species, so that we cannot be quite sure as to their identity. The specimen now before us from Jamaica has the dark streaks on the scales much less sharply defined than Mazatlan examples, but we have no other evidence of difference. Specimens entirely similar to this are in the museum at Cambridge from Brazil, Porto Rico, and from Jérémie, Hayti.

30. LARIMUS STAHLI.

Monosira stahli Poey, Fauna Puerto-Riqueña, 326, plate vi, 1881 (Porto Rico).

Habitat.—West Indian Fauna, Porto Rico.

This species is known from Poey's description and figure only. The nominal genus, *Monosira*, supposed to be distinguished by the uniserial teeth, is strictly synonymous with *Larimus*, and the species is evidently very close to *Larimus breviceps*.

A specimen of *Larimus* in the museum at Cambridge (Panama, Dr. Jones) agrees better with *L. stahli* than with *L. breviceps*. It has the mouth less oblique than in the latter, and but 24 soft rays in the dorsal fin.

31. LARIMUS FASCIATUS.

Larimus fasciatus Holbrook, Ichthyology S. Carolina, 153, plate 22, fig. 1, 1860 (Charleston). Günther, Cat. Fish. Brit. Mus., ii, 269, 1860 (copied). Uhler & Lugger, Fishes of Maryland, 102, 1876. Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 578, 1883.

Habitat.—South Atlantic coast of the United States.

Our specimens of this species were procured at Charleston by Mr. Charles C. Leslie. Specimens are in the museum at Cambridge, from Charleston and from Florida.

Genus VII.—ODONTOSCION.

Odontoscion Gill, Proc. Acad. Nat. Sci. Phila., 1862, 18 (*dentex*).

TYPE: *Corvina dentex* Cuv. & Val.

As here understood, this genus consists of a single species, which may be described as a *Larimus* armed with canine teeth. It also approaches closely to *Bairdiella*, one of the species of which genus (*Bairdiella archidium*) would be placed in *Odontoscion* were it not for the plectroid spine on the preopercle.

ANALYSIS OF SPECIES OF ODONTOSCION.

a. Teeth in both jaws in a single series; the two front teeth in lower jaw large canines, some of the teeth on the side of the lower jaw also enlarged, canine-like; teeth of the upper jaw largest forward, smaller than those in the lower jaw; body oblong, compressed, the profile straight and rather steep; snout short, blunt, 4 in head; eye large, 3½ to 4 in head; preopercle rounded without any distinct spines, with crenulated membranaceous margin; highest dorsal spine 2 in head; distance from first anal spine to middle of base of caudal 3½ in length; distance from vent to first anal spine $1\frac{1}{3}$ in base of anal; mouth large, oblique, maxillary reaching beyond middle of orbit, 2 in head; preorbital very narrow, about 4 in eye; gill-rakers long and stiff, 5 + 14; lower pharyngeals small, with conical teeth; scales thin, ctenoid; soft dorsal and anal scaly; scales below lateral line in nearly horizontal series; dorsal spines long and slender, separated from soft dorsal; the spine of soft dorsal short and stout; caudal subtruncate, upper lobe longer; anal short and high, second anal spine $2\frac{1}{3}$ in head; ventrals half way to anal, pectorals $1\frac{3}{5}$ in head; color dusky silvery, everywhere soiled with dark points, which form faint streaks along the series of scales; snout and anterior part of the chin black; upper part of base of pectoral and axil black. Head 3 to $3\frac{1}{2}$ in length; depth $3\frac{1}{2}$. D. XI or XII-I, 23; A. II, 8. Scales 7-49 to 52-10..DENTEX, 32.

32. ODONTOSCION DENTEX.

(CORVINA.)

Corvina dentex Cuv. & Val., Hist. Nat. Poiss., v, 139, plate 109, 1830 (San Domingo). Storer, Syn. Fish. North Am., 320, 1846 (copied).

Larimus dentex Günther, Cat. Fish. Brit. Mus., ii, 269, 1860 (Jamaica, Trinidad).

Odontoscion dentex Gill, Proc. Acad. Nat. Sci. Phila., 1862, 18 (name only). Poey, Synopsis, 325, 1868 (Cuba); Enumeratio, 49, 1875 (Cuba). Jordan, Proc. U. S. Nat. Mus., 1886, 44 (Havana).

Habitat.—West Indian fauna.

This small species is generally common in the West Indies, where it is a food-fish of some importance. The numerous specimens before us are from Havana, where the species is known to the fishermen as *Corvina*.

Genus VIII.—CORVULA.

Corvula Jordan & Eigenmann, genus novum.

TYPE: *Johnius batabanus* Poey.

We propose the above name for four species of American Sciænoids, allied to *Bairdiella* in nearly all respects, but having the preopercle unarmed as in *Larimus*. The typical species is remarkable in form and coloration, but it is probably congeneric with the others with which we here associate it.

ANALYSIS OF SPECIES OF CORVULA.

a. Body rather short and deep; depth $2\frac{1}{4}$ to $3\frac{1}{4}$ in length; distance from insertion of ventrals to first anal spine about equal to depth of body; color silvery, usually with faint dusky streaks along the rows of scales.

b. [Dorsal rays XI-I, 26; posterior dorsal rays much shortert han the anterior ones; eye very large, $3\frac{1}{2}$ in head; dorsal outline strongly convex, somewhat elevated anteriorly; ventral outline considerably, strongly convex; snout short, 5 in head; mouth moderate, somewhat oblique, reaching to below hinder margin of pupil; tip of premaxillary little above lower margin of orbit; maxillary $2\frac{1}{4}$ in head; teeth in narrow bands, the outer series of the upper jaw enlarged; longest dorsal spine $1\frac{3}{5}$ in head; the highest (third or fourth) dorsal ray 2 in head; base of anal and soft dorsal with a scaly sheath, the membranes with minute scales; second anal spine small, $2\frac{1}{2}$ in head; color brownish, paler below; upper two-thirds of body with dark streaks along the rows of scales; pectoral and especially anal with dark points; base of spinous dorsal light yellow; numerous dark dots on belly, lower part of sides, and under side of head. Head 3 in length; depth $2\frac{1}{4}$; D. XI-I, 26; A. II, 10; scales 7-50-10.] (*Steindachner.*)................................MACROPS, 33.

bb. Dorsal rays X-1, 28; depth, 2⅝ in length; posterior rays of soft dorsal rays higher than the anterior ones; eye small, 5 in head; dorsal outline strongly and regularly convex and elevated; ventral outline straight; snout acute, not rounded, 3½ in head; mouth moderate, oblique, maxillary extending beyond pupil; its length 2½ in head; teeth of the lower jaw bluntish, in two series anteriorly, in a single series laterally; those of the inner series largest; teeth of the upper jaw in a narrow band, the outer series enlarged; preopercle with a crenulate membranous margin; gill-rakers slender, about half as long as the eye, 7 + 13; dorsal spines slender, the longest 1½ in head; soft dorsal rounded posteriorly; 16th dorsal ray highest, 2 in head; caudal convex; second anal ray 2½ in head; pectoral short and broad, slightly shorter than ventrals which are 1⅞ in head; scales large, those about the head, nape, and anterior part of breast cycloid, the remainder ctenoid; color, silvery white, darker above; sides and back with rather distinct dark lines along the scales; spinous dorsal, tips of ventrals and anal dusky; upper part of head brownish; lower part of head, cheek, and breast with numerous rusty dots, base of soft dorsal and anal rusty; head 3½ in length; depth 2⅝. D. X-I, 28; A. II, 8; scales 7-52-8 .... SIALIS, 34.

bbb. Dorsal rays X to XII-I, 23 to 25; depth of body about 3½ in length; form of *C. sialis*, but the body more elongate; jaws equal; outer teeth above enlarged lower teeth nearly uniserial; eye large, 4½ in head; snout bluntish, 4½; maxillary 2½ in head, extending to middle of pupil; preopercle with flexible serræ; second anal spine, 3⅝ in head; caudal fin subtruncate. Head 3½ in length; depth about 3½. D. XII-I, 22 to 24; A. II, 9; scales about 46; color silvery, with faint streaks along the rows of scales above .... SUBÆQUALIS,* 35.

aa. Body rather elongate and compressed, the depth 3½ in length; distance from insertion of ventrals to first anal spine half greater than depth of body; coloration dusky, with conspicuous dark streaks along the rows of scales.

c. Body oblong, compressed, the depth nearly uniform from ventrals to vent; profile nearly straight and horizontal; mouth rather wide; maxillary 2½ in head, reaching middle of eye; upper jaw with several series of minute teeth and an outer somewhat enlarged series; lower jaw with a single series of rather strong teeth, a pair of minute canine-like teeth at the symphysis; snout short, without pores, 3½ in head; chin with 5 large pores; preopercle with a crenulate, dermal border; gill-rakers slightly longer than pupil, 5 + 13; lower pharyngeals with many small teeth, some of the inner ones much elongate; eye slightly shorter than snout, 4½ in head, about equal to the interorbital area; scales large, their exposed edges much striated, the striæ ending in cilia; scales below lateral line in undulate, sub-horizontal series; lateral line slightly curved, becoming straight above anal; soft portions of vertical fins densely covered with scales; soft dorsal and anal with a scaly sheath at their base; dorsal caudal and anal rounded behind; ventrals slightly longer than pectorals, 1¼ in head. Color coppery-grayish, with many minute brown points; scales of back and sides each with a dark spot, these forming very distinct dusky stripes along the series of scales; stripes below the lateral line mostly of continuous spots, those above broken and irregular; upper part of head and fins uniform brownish with many minute points. Head 3⅞ in length; depth 3½. D. XI-I, 26; A. II, 8; scales 6-50-7 .... BATABANA, 36.

* The following is the substance of Poey's account of his *Corvina subaqualis:* Body rather elongate; eye 3½ in head; snout short, rounded; mouth moderate; maxillary extending to below anterior margin of pupil, the jaws subequal; teeth in fine bands, the outer series longer, and larger above than below; symphysis with four pores; preopercle finely dentate; dorsal fins separated; second dorsal spine stout; caudal with a salient angle; base of anal scaly; anal spine rather strong, its insertion rather posterior; color silvery; depth 3⅚ (with caudal); head 3⅚. D. X-1, 25; A. II, 7.

33. CORVULA MACROPS.

Corvina macrops Steindachner, Ichthyol. Beitr., iii, 24, fig. 2, 1875 (Panama).
Sciæna macrops Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 316 (copied). Jordan, Proc. U. S. Nat. Mus., 1885, 382 (Panama).

Habitat.—Pacific coast of tropical America, Panama.

This species is apparently rare at Panama. Specimens were obtained there by Dr. Gilbert, but as these have been destroyed we have copied our diagnosis from Steindachner. We do not find the species in the museum at Cambridge.

34. CORVULA SIALIS.

Corvula sialis Jordan & Eigenmann, sp. nov. (Key West).

Habitat.—Florida Keys.

The only specimen of this species, as yet known (No. 26575, U. S. Nat. Mus.), was collected by Mr. Silas Stearns at Key West, Fla., in 1880. We give here a detailed description of this specimen:

Depth, $2\frac{2}{3}$ ($3\frac{2}{7}$ in total); head, $3\frac{1}{7}$ ($3\frac{6}{7}$ in total); D. X–I, 28; A. II, 8. Length, $6\frac{1}{2}$ inches.

Body compressed; the back elevated, regularly rounded from snout to posterior margin of soft dorsal; ventral outline almost straight from chin to first anal spine; base of anal oblique; caudal peduncle short and thick.

Profile slightly convex posteriorly, somewhat depressed over the eyes; snout rather acute, slightly longer than eye; eye $4\frac{3}{4}$ in head, $1\frac{1}{3}$ in interorbital area; preorbital one-half as wide as eye; mouth moderate; maxillary extending past pupil, its length $2\frac{1}{5}$ in head; premaxillary anteriorly on level with the lower border of the orbit; lower jaw included; maxillary broad, not entirely concealed by the preorbital when the mouth is shut. Teeth of the lower jaw blunt, conical, in two series, those of the inner series much larger than those of the outer series; upper jaw with a narrow band of villiform teeth and an outer series of larger teeth, which are remote from each other and decrease in size towards the angle of the mouth.

Chin with five small pores; snout with six pores, arranged in a [illegible]-shaped figure.

Preopercle with a narrow, crenulate, membranous border; opercle with two scarcely distinguishable spines; scapular scale entire.

Gill-rakers moderately developed, about half as long as the eye, 5+12; pseudobranchiæ large.

Scales about the head in front of dorsal and on anterior part of breast cycloid, marked with concentric striæ; those on top of the head imbedded, indistinct; scales of the body all ctenoid; membranes of caudal, anal, and soft dorsal densely covered with minute scales nearly to their tips.

First dorsal spine short, inserted over the base of the pectoral; fourth dorsal spine highest, reaching to soft dorsal, $1\frac{1}{2}$ in head; anterior dorsal rays shorter than the middle and posterior ones; the eleventh longer than the fourth by an eye's diameter, little more than half the length of the head; soft dorsal very broadly rounded posteriorly; caudal short, broad, rounded behind; anal inserted posteriorly, the tips of the anal extending nearly as far as the tips of the dorsal; second anal spine moderate, scarcely more than two-thirds the length of the rays, little less than 3 in head; ventrals lanceolate, slightly longer than the rounded pectorals, 1⅓ in head.

Color (in spirits), light brownish above, silvery on sides and below; the centers of the scales with many dark dots, these forming horizontal lines along the series of scales below the lateral line and oblique, irregular, often interrupted, lines above the lateral line; all the fins with dark dots; spinous dorsal dusky; soft dorsal brownish for two-fifths of its height; the other three-fifths pale; anal and tips of ventrals dusky; pectoral pale; head with many minute rusty dots; these aggregated, and forming brownish spots on the maxillary and lower part of the head.

35. CORVULA SUBÆQUALIS.

Corvina subæqualis Poey, Ann. Lyc. Nat. Hist., New York, 1875, 58 (Cuba). Poey, Enumeratio, 48, 1875 (Cuba).

Habitat.—West Indian fauna.

We refer two specimens from Saint Thomas to this species, although they differ in some respects from Poey's description of *Corvina subæqualis*. The specimens are in the museum at Cambridge, and are in rather poor condition. The more elongate body and the smaller number of dorsal rays distinguish *subæqualis* readily from *sialis*.

36. CORVULA BATABANA.

Johnius batabanus Poey, Memorias, ii, 184, 1860 (Batabano, Cuba); Synopsis, 324, 1868 (Cuba); Enumeratio, 49, 1875 (Cuba); Fauna Puerto-Riqueña, 327, 1881 (Porto Rico).

Larimus batabanus Jordan, Proc. U. S. Nat. Mus., 1886, 43 (Havana).

Habitat.—West Indian fauna.

This rare species is known to us from a single specimen, obtained by Dr. Jordan in Havana, and from several specimens sent by Professor Poey to the museum at Cambridge. Its strongly marked coloration is a very unusual trait in this family. It diverges in several ways from the other species referred by us to *Corvula*, but we think that all should be placed in one genus.

Genus IX.—PLAGIOSCION.

Plagioscion Gill, Proc. Acad. Nat. Sci. Phila., 1861, 82 (a generic description only no species or type being indicated).

Diplolepis Steindachner, Beiträge zur Kenntniss der Sciænoiden Brasiliens, 1863, 2 (*squamosissimus*; name preoccupied in *Hymenoptera*).

Plagioscion Jordan & Eigenmann (*squamosissima*).

TYPE: *Sciæna squamossissima* Heckel.

This genus consists of fresh-water Sciænoids, inhabiting the rivers of South America. The genus seems to us a valid one, although closely allied to *Corvula* and *Pseudotolithus*, from both of which it is well distinguished by the peculiar squamation of the lateral line. This character suggested to Dr. Steindachner the name *Diplolepis*, a name which is, unfortunately, preoccupied. As no species of *Plagioscion* was named by the describer of that genus, we have hesitated as to the propriety of making use of that name. The original description of *Plagioscion* must, however, certainly have been based on some species of the present genus, as it agrees with no other American form. We have therefore retained the name given by Dr. Gill in preference to coining some new one for the group.

Like most fresh-water fishes, the species of *Plagioscion* are subject to many variations, especially in regard to the size of the second anal spine. But three of the numerous nominal species seem to us valid.

ANALYSIS OF SPECIES OF PLAGIOSCION.

a. Second anal spine small, scarcely longer than eye, its length 4 to 5¼ in head; teeth of lower jaw with the inner series considerably enlarged; snout of moderate length, 5 in head; eye, 5½; maxillary, 2½ in head; gill-rakers rather long, X+12; pseudobranchiæ usually small on one side and obsolete on the other; upper part of the preopercle crenulate on its bony margin; pectoral fin short, 1⅞ in head: anal spine, 4½ to 5½, its length subject to much variation; caudal convex; ventrals filamentous at tip. Color, silvery; darker above, the axil with a large black spot. Head 3⅓ in length; depth 3½. D. X–I, 31 or 32. A. II, 7. Scales (large ones or pores) 49 to 53. Lower pharyngeals narrow, armed with villiform teeth .... SQUAMOSISSIMUS, 37.

aa. Second anal spine large and strong, its length 2 to 3 in head.

b. [Teeth of lower jaw with the inner series considerably enlarged; snout very short, blunt, 5½ in head; head depressed above the eyes; mouth large, rather oblique, subinferior, the maxillary 2⅛ in head, reaching past eye; back elevated; ventral outline nearly straight; caudal peduncle slender; preorbital broad, a little narrower than eye, which is 5¼ in head; preopercle rounded, nearly or quite entire; teeth of outer series in upper jaw and inner series of lower notably enlarged; dorsal spines slender, the highest 2⅞ in head; pectoral 1⅞ in head; ventrals 1⅞; scales all ctenoid; head 3⅞; depth 3⅞; D. X–I, 31 to 33. A. II, 6. Enlarged scales in lateral line about 50; about 100 in a longitudinal series above it. Color grayish above, silvery below; upper vertical fins punctate; lower fins yellowish; axil dark.] (*Steindachner*.) .... SURINAMENSIS, 38.

bb. Teeth of lower jaw subequal, those of the inner row scarcely enlarged; head very convex above, not spongy; preopercle with a broad membranous margin, which is slightly crenulate; preorbital broad, as broad as eye; mouth large, oblique, the lower jaw slightly included, the maxillary 2¼ in head; snout bluntish, 3¾ in head; eye 6 in head; gill-rakers X + 13, slender and moderately long, the longest about ⅔ diameter of eye; outer teeth above somewhat enlarged; pectorals long, 1⅓ in head, shorter than the ventrals, which have filamentous tips; second anal spine 2½ to 2⅔ in head; dorsals connected, the soft dorsal largely scaly at base; caudal rhombic, the middle rays produced. Color plain silvery, the axil dusky. Head 3⅛; depth 3⅛. D. X–I, 34 to 36. A. II, 7. Scales 49 (pores); 80 cross-series. AURATUS, 39.

37. PLAGIOSCION SQUAMOSISSIMUS.

Sciæna squamosissima Heckel, Annalen des Wiener Museum, ii, 438, 1840. Reinhardt, Videnskab. Medd. Naturhist. Forening Kjöbenhavn, 108, 1854. Steindachner, Beitr. zur Kenntniss der Fisch-Fauna Süd-America's, 1879, 3 (Amazon, Orinoco, Rio Negro).

Pachyurus squamosissimus Günther, Cat. Fish. Brit. Mus., ii, 526, 1860 (copied).

Diplolepis squamosissimus Steindachner, Sciæn. Brasil., 2, 1863 (Brazil).

? *Sciæna rubella* Schomburgk, Naturalists' Library, Fishes of Guiana, ii, 133, 1843 (Rivers of Guiana). (D. IX, 34; A. II, 6; anal spines presumably small.)

Johnius crouvina Castelnau, Anim. Nouv. ou Rares de l'Amér. du Sud, Poissons, 11, plate v, fig. 1, about 1855 (Rio Crixas, Rio Araguay).

Sciæna crouvina Günther, Cat. Fish. Brit. Mus., ii, 287, 1860 (copied).

Johnius amazonicus Castelnau, Anim. Nouv. ou Rares de l'Amér. du Sud, Poiss., 12, plate iv, fig. 1, about 1855 (Amazon).

Sciæna amazonica Günther, Cat. Fish. Brit. Mus., ii, 284, 1860 (River Chapin, Pará).

? *Corvina monacantha* Cope,* Trans. Am. Phil. Soc., 1866, 402 (near Parimaribo, Dutch Guiana.

? *Sciæna monacantha* Jordan, Proc. U. S. Nat. Mus., 1886, 587 (name only).

Habitat.—Rivers of Guiana and Brazil.

We have examined specimens of this species from Obidos, Avary, Rio Puty, Tajaparu, Iça, Coary, Rio Trombetas, and Lake Hyanuary in Brazil. Our description is chiefly taken from 10867, M. C. Z., from Obidos, and 10857 from Coary.

We regard the *Johnius amazonicus* and *Johnius crouvina* of Castelnau as identical, and we follow Dr. Steindachner in placing both in the synonymy of the earlier *Sciæna squamosissima* of Heckel. We have seen no specimens of this species from Guiana. It seems to us, however, that the scanty descriptions published of *Sciæna rubella* and *Corvina monacantha* resemble this species more than any other, although it is not impossible that both should be referred to *Plagioscion surinamensis*. If the latter should be found to be the only species of the genus in Guiana, it should stand as *Plagioscion rubellus*.

83. PLAGIOSCION SURINAMENSIS.

Pseudosciæna surinamensis Bleeker, Arch. Néerl. Sci. Exact. et Nat., viii, 458, 1873 (Surinam).

Sciæna surinamensis Steindachner, Fisch-Fauna des Cauca, 1880, 4 (Rio Cauca). Jordan, Proc. U. S. Nat. Mus., 1886, 587 (name only).

Sciæna magdalenæ Steindachner, Zur Fisch-Fauna des Magdalenen-Stromes, 6, 1878 (Rio Magdalena).

Sciæna magdalenæ Jordan, Proc. U. S. Nat. Mus., 1886, 587 (name only).

Habitat.—Rivers of the northern part of South America.

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*The following is the substance of Professor Cope's description of *Corvina monacantha*:

First ventral ray produced as a filament which reaches past the vent; pseudobranchiæ none; eyes 5 in head; depth equal to length of head; preopercle sharply serrate on its vertical margin; pharyngeal patches of teeth small, the teeth bristly; caudal fin sublanceolate; pectorals as long as ventrals without filaments; anal spine short, single in typical specimens; color, silvery, grayish above; no spots. D. X-I, 33; A. I, 5. Scales 10-49-16.

This species is known to us from descriptions only. We can see no evident difference between the *magdalenæ* and the *surinamensis* as described by Steindachner and Bleeker. We therefore refer the former to the synonymy of the latter. As already stated, this may be the original *Sciæna rubella* of Schomburgk.

39. PLAGIOSCION AURATUS.

Johnius auratus Castelnau, Anim. Nouv. ou Rares de l'Amér. du Sud, 12, plate iv, fig. 2, 1855 (Rio Ucayala).

Sciæna aurata Günther, Cat. Fish. Brit. Mus., ii, 287, 1860 (copied).

Habitat.—Rivers of Brazil.

This species seems to be very abundant in the rivers of Brazil. We have examined specimens, old and young, from Tajapuru, Cachiura, Caneta, Pará, Rio Sao Francisco, Avary, Obidos, Rio Puty, and Teffy. A specimen (10855, M. C. Z.) from Tajapuru has especially served as the type of our description.

Genus X.—BAIRDIELLA.

Bairdiella Gill, Cat. Fish. East Coast North America, 33, 1861 (*argyroleuca*=*chrysura*).

TYPE: *Bodianus argyroleucus* Mitchill = *Dipterodon chrysurus* Lacépède.

This genus is characterized by the oblique mouth, little cavernous skull, few rows of teeth, slender gill-rakers, and the preopercle armed with a plectroid spine. It seems to us a natural group, and perhaps worthy of recognition as a distinct genus, although its relationships with *Ophioscion* and especially with *Stelliferus* are very close. The numerous species are all American, and some of them are remarkable for the great size of the second anal spine. In others, this spine is quite small. These variations among species unquestionably closely allied shows how slight is the systematic value to be attached to the size of this spine.

ANALYSIS OF SPECIES OF BAIRDIELLA.

a. Teeth of lower jaw unequal, mostly biserial, some of those of the inner series very slender, canine-like; two small canines on front of lower jaw, inserted on a symphyseal knob; second anal spine very small, 3 in head (species approaching *Odontoscion*).

b. Body moderately compressed, the back little elevated; profile somewhat concave anteriorly; snout acute, slightly longer than eye; eye 4½ to 5 in head; mouth large, terminal, very oblique; maxillary extending to below posterior margin of pupil, 2¼ in head; teeth of the upper jaw long and slender, in 3 to 4 series, the inner ones depressible backward, the outer ones enlarged and fixed; 5 or 6 distinct serræ near the angle of preopercle, the lowest a robust flattish spine directed downwards; gill-rakers slender, 6+15; longest dorsal spine 2¼ in head; anal fin small, its base slightly oblique; second anal spine shorter than the first rays, 3 in head; pectorals about as long as ventrals, 1¼ in head; scales about the head cycloid, the rest all ctenoid; membranes of soft dorsal and anal scaled for nearly half their height; color lustrous bluish gray above, silvery below; middle of sides with indistinct lengthwise streaks formed by clusters of dark dots in the centers of the scales; snout and tip of lower jaw blackish; a dark blotch on opercle above; sides of head bright silvery; fins light straw color; upper half of pectorals dusky; spinous dorsal finely speckled with black; axil brown above; lining of opercle black above; iris bright yellow; head 3 in length; depth $3\frac{1}{2}$; D. X-I, 24 or 25; A. II, 8. Scales 9-52-7 .... ARCHIDIUM, 40.

aa. Teeth of the lower jaw unequal, chiefly biserial, those of the inner series somewhat enlarged; no distinct c anines; second anal spine moderate or large; preorbital narrow (*Bairdiella*).

c. Second anal spine moderate, $2\frac{1}{3}$ in head, not as long as the soft rays, not reaching to tip of last ray when depressed; mouth large, somewhat oblique, the premaxillary on the level of lower part of the eye; maxillary reaching middle of eye, $2\frac{2}{5}$ in head; body oblong, compressed, the back a little elevated, the profile depressed over the eyes; snout prominent, bluntish, as long as eye, which is $4\frac{1}{4}$ in head; upper teeth in two series, the outer row slender, enlarged; lower teeth in two series, the inner larger, similar to the outer in upper jaw; preopercle serrate, the teeth near the angle larger; the lowest and largest directed downward; gill-rakers slender, rather long, 8 + 16; scales on head cycloid; base of anal little oblique; ventral outline rather regularly rounded; dorsal spines slender, the highest $2\frac{1}{4}$ in head; caudal long, double truncate; pectorals about as long as the ventrals, $1\frac{3}{5}$ in head; soft dorsal and anal scaled at least half their height. Color greenish above, silvery below; back and sides more or less densely punctate with dark dots (especially in northern specimens), these forming narrow, somewhat irregular streaks along the sides; fins plain, mostly yellow in life. Head 3 in length; depth 3. D. XI-I, 22; A. II, 10. Scales 8-52-8. CHRYSURA, 41.

cc. Second anal spine very long, nearly or quite $\frac{3}{4}$ length of head, reaching when depressed beyond the tip of the last soft ray; base of anal fin very oblique, making an abrupt angle with the straightish ventral outline.

d. Mouth terminal, very oblique, the premaxillary anteriorly on the level of the middle of the eye; body subrhomboidal and angular in outline; profile steep, slightly convex; snout short, 5 in head; mouth moderate, the maxillary reaching middle of eye, $2\frac{2}{5}$ in head; teeth in upper jaw in two or three series, the outer considerably enlarged, all of them more or less depressible; gill-rakers long, 8 + 16; dorsal spines stout, the highest about 2 in head; second anal spine enorm•us, larger than in any other species, $1\frac{2}{7}$ in head; longer than any of the rays; second anal spine and the anterior rays extending beyond the tips of the last rays; the margin of the fin concave, ventrals slightly longer than pectorals, $1\frac{1}{5}$ in head; opercular scales and some of the scales of the cheek and top of the head ctenoid, those of the interorbital space and a few on the lower parts of the cheek and opercle cycloid; color bluish-gray above and on sides, silvery below; a dark, ill-defined bluish-gray blotch on opercle; mouth yellow within; black towards the tip of the lower jaw; spinous dorsal with black punctulations and a black margin, soft dorsal dusky yellow; caudal and anterior rays of the anal brighter yellow; caudal and membrane between anal spine and first ray with black dots; axil of pectorals and inner membrane of the upper rays of the pectoral brownish. Head $3\frac{1}{3}$ in length; depth $3\frac{1}{3}$. D. X-I, 23; A. II, 8. Scales 8-49-9 .... ENSIFERA, 42.

dd. Mouth not quite terminal, the premaxillary anteriorly scarcely on level of lower margin of orbit; preorbital narrow, but broader than in the preceding species.

e. Dorsal rays X-I, 28; dorsal spines very slender, the highest 1⅓ in head; dorsal outline convex, especially anteriorly; ventral outline straightish; profile straightish anteriorly; eye moderate, as long as snout, 4½ in head; maxillary 2⅓ in head, reaching much beyond middle of eye; teeth in the upper jaw in a narrow band, the outer series enlarged; gill-rakers 8 + 19; basal half of soft dorsal scaly; anal spine very strong, its tip reaching past tip of last anal ray; pectorals about equal the ventrals, 1⅓ in head; color grayish silvery above, silvery on sides and below; dorsal region with faint streaks produced by the darker centers of the scales; sides without dots; spinous dorsal blackish; ventrals and pectorals pale; a dark axillary spot; lining of gill cavity with dusky blotches. Head 3¼ in length; depth 3½. D. X-I, 28; A. II, 8. Scales 8-51-10 .... ICISTIA, 43.

ee. Dorsal rays X-I, 23; dorsal spines rather stiff, the highest 2 in head; second anal spine rather strong, curved, 1⅜ in head, as long as first soft ray, and reaching beyond tips of other rays; body oblong, compressed, scarcely angular in outline; profile straight, rather steep, the snout short and rather acute; eye as long as snout, 4½ in head; mouth moderate, nearly horizontal; premaxillary on level of lower part of orbit; maxillary reaching beyond middle of eye, 2⅜ in head; teeth as in *B. icistia;* preopercle strongly serrate; gill-rakers 9 + 18. Ventrals slightly longer than pectorals, which are 1⅗ in head; caudal truncate; color soiled grayish above, silvery below; faint, dark streaks along the rows of scales; spinous dorsal and anterior part of anal densely covered with dark dots; head 3⅓ in length; depth 3⅓. D. X-I, 23; A. II, 8. Scales 7-50-8 .... RONCHUS, 44.

aa. Teeth of the lower jaw subequal in a rather narrow villiform band; mouth inferior or subinferior, little oblique; preorbital broader, gill-rakers shorter, and pores and slits on snout more conspicuous than in other species. (Species approaching *Ophioscion.*)

f. Snout sharp, the head slender, narrow above, the interorbital space not broader than eye; anal spine very long and strong, 1⅖ in head; pectoral fin short, 1⅓ in head; form of body irregularly rhomboidal, the base of the anal fin being oblique; profile almost straight anteriorly; eye moderate, slightly shorter than snout, 4⅗ in head; snout 4⅓ in head; mouth large, inferior, almost horizontal, maxillary reaching beyond pupil, 2⅔ in head; upper jaw with a band of villiform teeth and an outer series of enlarged teeth; lower teeth in a moderate band, the inner series slightly enlarged, especially in young examples; gill-rakers comparatively short, 8 + 15; dorsal spines short and stout, slightly more than 2 in head; caudal rounded; anal spine 1⅗ in head; basal half of the soft dorsal and anal covered with scales; color, bluish above, silvery below, a rather broad area from snout to caudal covered with brownish dots; upper fins and anterior half of anal with many dots. Head 3 in length; depth 3; D. XI-I, 21; A. II, 8. Scales 7-51-8. ARMATA, 45.

ff. Snout bluntish; the head rather stout and broad above; the interorbital space more or less broader than eye; second anal spine stout, shortish, about half length of head.

g. Dorsal rays X-I, 18; scales large, about 44 in the lateral line; pectoral not longer than caudal, which is 1⅓ in head; body rather elongate; back a little elevated and compressed; profile somewhat depressed over eyes; snout rather truncate, about 4 in head; eye about 4 in head; lower jaw much shorter than upper; mouth horizontal, maxillary extending scarcely beyond middle of eye; teeth in upper jaw in a villiform band, the outer series somewhat enlarged; gill-rakers about as long as pupil; longest dorsal spine little more than half length of head; second anal spine about 2 in head, $\frac{3}{4}$ the height of the soft rays; caudal fin long, double truncate, the middle rays produced; ventrals reaching vent; color light reddish-brown, with dark punctulations; caudal yellow; anal almost black; lining of gill-cavity dusky; head $3\frac{7}{8}$ in length; depth $3\frac{1}{4}$. D. X–I, 18; A. II, 8; scales 5–44–X.

ALUTA, 46.

gg. Dorsal rays X–I, 21 or 22; scales moderate, 50 to 55 in the lateral line; pectoral $1\frac{1}{3}$ in head; caudal $1\frac{3}{8}$ in head; back somewhat elevated, the form of the body much as in *Sciæna sciera* and related species; preorbital broader than in other species of *Bairdiella*, $\frac{4}{7}$ width of eye; eye 5 in head; snout bluntish $4\frac{2}{3}$; interorbital space $3\frac{5}{8}$; head thick, somewhat more cavernous than in related forms; premaxillary entirely below level of eye; maxillary $2\frac{2}{3}$ in head; teeth of outer series of upper jaw enlarged; lowest serræ on preopercle smaller and less turned forward than in the other species; dorsal spines rather stout, the second strong, the third longest, $1\frac{3}{4}$ in head; second anal spine shorter than the soft rays, $2\frac{1}{4}$ in head; the form and size of these spines very variable; gill-rakers short and slender, X + 15, the longest not as long as pupil; caudal fin double truncate; color soiled brassy, irregularly mottled, with large patches of shining golden brown; faint dark stripes along the rows of scales above, those below lateral line nearly horizontal, those above oblique; head $3\frac{1}{6}$ in length; depth 3. D. X–I, 21 or 22; A. II, 9; scales, 6–50 to 55–13....CHRYSOLEUCA, 47.

40. BAIRDIELLA ARCHIDIUM.

Odontoscion archidium Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 317 (Panama). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 111 (Panama).

Habitat.—Pacific coast of tropical America, Panama.

This species is not very common about Panama, where three specimens were taken by Dr. Gilbert. Although it bears a very strong resemblance to *Odontoscion dentex*, it should, we think, rather be placed in *Bairdiella* than in *Odontoscion*. It has the very small anal of *Odontoscion* and the spur-like preopercular spine of *Bairdiella*, while in its dentition it is intermediate.

41. BAIRDIELLA CHRYSURA.

(THE MADEMOISELLE; YELLOW-TAIL.)

[Plate III.]

Perca punctata Linnæus, Syst. Nat., ed. xii, 482, 1766, in part (South Carolina) (not *Perca punctatus* of ed. x, which is *Enneacentrus fulvus*). Bonnaterre, Encycl. Méth., 1788, 126. Goode & Bean, Proc. U. S. Nat. Mus., 1885, 201 (notes on Linnæan Fishes).

Bairdiella punctata Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort).

Sciæna punctata Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 280 (Pensacola; Galveston). Jordan & Gilbert, Syn. Fish. North Am., 570, 1883.

Dipterodon chrysurus Lacépède, Hist. Nat. Poiss., iii, 64, 1802 (after Linnæus).
Sciæna chrysura Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Syn. Fish. North America, 933, 1883. Swain, Proc. U. S. Nat. Mus., 1884, 233 (Cedar Key, Florida).
Bairdiella chrysura Goode, Hist. Aquat. Anim., 375, plate 126, 1884.
Bodianus argyroleucus Mitchill, Trans. Lit. & Phil. Soc. New York, 417, plate 6, fig. 3, 1815 (New York).
Corvina argyroleuca Cuv. & Val., Hist. Nat. Poiss., v, 105, 1830 (Martinique (?), United States). DeKay, New York Fauna, Fishes, 74, plate 18, fig. 51, 1842 (New York). Storer, Syn. Fish. North Am., 319, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 299, 1860 (copied).
Bairdiella argyroleuca Goode, Proc. U. S. Nat. Mus., 1879, 113 (St. John's River, Florida). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 131 (Pensacola). Bean, Proc. U. S. Nat. Mus., 1880, 93 (Brunswick, Ga.; St. John's River, Florida).
Bodianus pallidus Mitchill, Trans. Lit. & Phil. Soc., 1, 420, 1815 (New York).
Homoprion xanthurus Holbrook, Ich. S. Car., ed. 1, 1856, 170, pl. 24 (not *Leiostomus xanthurus* Lacépède.
Homoprion subtruncatus Gill, Cat. Fish. E. Coast, 1861, 33 (after Holbrook).

Habitat.—South Atlantic and Gulf coasts of the United States, north to New York.

This species is very abundant on our sandy shores from Long Island to Texas. It reaches but a small size, hence, although an excellent pan fish, it has no great economic value.

Unlike most of the other species of the genus, its second anal spine is little enlarged.

The oldest name of this species, *Perca punctata* L., is not available, as there was at that time already another *Perca punctata*, also named by Linnæus. The appropriate name, *chrysura*, being next in order of date, must, therefore, be adopted.

42. BAIRDIELLA ENSIFERA.

Corvina armata Steindachner, Ich. Beitr., iii, 28, 1875 (Panama) (not of Gill).
Sciæna ensifera Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 313 (Bay of Panama). Gilbert, Bull. U. S. Fish Com., 1882, 112 (Punta Arenas).
Corvina fulgens Vaillant, Miss. Sci. au Mexique, 164, 1883 (Pacific coast of Mexico).

Habitat.—Pacific coast of tropical America.

This species is not uncommon about Panama. Of all the American Sciænoids this species has the largest anal spine in proportion to the size of the body. The *Corvina fulgens*, lately described by Dr. Vaillant, seems to be identical with *Bairdiella ensifera*.

Numerous specimens of this species from Panama are in the museum at Cambridge. They had been wrongly identified as "*Corvina armata*" by Dr. Steindachner.

43. BAIRDIELLA ICISTIA.

(CORBINETA.)

Sciæna icistia Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 356 (Mazatlan). Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 316 (Mazatlan). Jordan & Gilbert, Bull. U. S. Fish. Com., 1882, 107 (Mazatlan).

Habitat.—Pacific coast of Mexico, Mazatlan.

This species is rather common about Mazatlan, where numerous specimens were taken by Dr. Gilbert. It is readily distinguished from other species by the weakness of its dorsal spines, as well as by the large number of the anal rays.

44. BAIRDIELLA RONCHUS.

(RONCO; CORVINA.)

Corvina ronchus Cuv. & Val., Hist. Nat. Poiss., v, 107, 1830 (Maracaibo; Surinam). Storer, Syn. Fish. North Am., 320, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 299, 1860 (San Domingo, Jamaica, Bahia). Günther, Fishes Central America, 387, 1869 (Atlantic coast Central America). Cope, Ichthyol. Lesser Antilles, 471, 1870 (St. Martin).

Bairdiella ronchus Poey, Synopsis, 324, 1868 (Cuba). Poey, Enumeratio, 48, 1875 (Cuba). Poey, Fauna Puerto-Riqueña, 326, 1881 (Porto Rico).

Sciæna ronchus Jordan, Proc. U. S. Nat. Mus., 1886, 44 (Havana).

Habitat.—Atlantic coasts of tropical America.

This species seems to be generally common in the West Indies and along the coast of Brazil.

The numerous specimens before us are from Havana. The species is called *Corvina* in the Havana markets, where it is a food-fish of some importance.

Many specimens from Rio Janeiro and from Havana are in the museum at Cambridge. There is considerable individual variation, but there seems to be no specific difference between Cuban and Brazilian examples.

A number of specimens in poor condition are also in the museum, supposed to have been obtained by Captain Perry at Vera Cruz. These have the snout longer, the eye smaller, and the fins higher than usual in *ronchus*, and they may represent a different species. In these the snout is 4 in head, the eye $4\frac{1}{2}$, the longest dorsal spines $1\frac{3}{4}$, the second anal spine $1\frac{3}{7}$. D. X–I, 24.

45. BAIRDIELLA ARMATA.

Bairdiella armata Gill, Proc. Acad. Nat. Sci. Phila., 1863, 164 (west coast Central America). Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 156 (Jamaica).

Corvina armata Günther, Fishes Central America, 387 and 428, 1869 (Pacific coast of Central America).

Sciæna armata Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 316 (Panama). Gilbert, Bull. U. S. Fish Com., 1882, 112 (Punta Arenas). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 276 (Panama).

Corvina acutirostris Steindachner, Ichthyol. Beitr., iii, 28, 1875, plate 4 (Panama).

Corvina (Homoprion) acutirostris Steindachner, Zur Fisch-Fauna des Magdalenen-Stromes, 9, 1878 (Caiman on Rio Magdalena).

Habitat.—Both coasts of tropical America.

This species is not uncommon on the Pacific coast about Panama, and it is equally abundant on the Atlantic coast, where it seems to ascend the rivers.

There is no doubt of the identity of *Corvina acutirostris* with *Bairdiella armata*, the type of the latter having been examined by Dr. Gilbert.

Bairdiella armata is close to *B. ronchus*, and the character of the dentition of the lower jaw, which we have used to divide *Bairdiella* into minor groups, becomes here of slight importance.

We have examined specimens of this species from Panama, Rio Magdalena, San Matheo, Camaru, Cannarivieras, Curuça, Bahia, Pernambuco, Maranhão, and Itabapuana. The specimen from the latter locality (10837, M. C. Z.) is nearly a foot long, and has the spines a little shorter and stouter than in Panama examples.

46. BAIRDIELLA ALUTA.

Sciæna aluta Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (La Union, San Salvador.

Habitat.—Pacific coast of Central America.

This species is known only from the original type collected by Captain Nichols at La Union.

This specimen strongly resembles *Bairdiella chrysoleuca*, apparently differing only in the larger scales, fewer dorsal rays, longer caudal fin, and larger eyes. The two characters last mentioned may be due to youth, the type of *aluta* being smaller than any *chrysoleuca* examined by us. The other characters are possibly results of extreme variation. It is, therefore, probable that the two nominal species will prove to be identical.

47. BAIRDIELLA CHRYSOLEUCA.

Corvina chrysoleuca Günther, Fish. Central America, 387 and 427, plate 67, fig. 1, 1869 (Panama).
Sciæna chrysoleuca Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 316 (Panama).
? *Sciæna aluta* Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 232 (La Union).

Habitat.—Pacific coast of tropical America.

A few specimens of this species were obtained at Panama by Professor Gilbert. Two others are in the museum at Cambridge (No. 10826, from Panama). The species is quite variable, especially in the armature of its preopercle.

This species, although technically a *Bairdiella*, shows numerous affinities with *Sciæna sciera* and other species of *Ophioscion*. It marks the transition from one group of Sciænoids to the other, from those related to *Larimus* to those allied to *Sciæna*, *Pogonias*, and *Eques*.

Genus XI.—STELLIFERUS.

Les Stellifères Cuvier, Règne Animal, ed. i, 1817, 283 (*stellifer*).
Stelliferus Stark, "Elements Nat. Hist., i, 459, 1828" (*stellifer*) (*fide* Gill).
Homoprion Holbrook, Ichth. S. Carol., 1st ed., 1856, 168 (*lanceolata*).

TYPE: *Bodianus stellifer* Bloch.

This group is composed of small species, all American, allied to *Bairdiella* and *Ophioscion*, but distinguished by the remarkably spongy and cavernous structure of the bones of the skull. The septa are reduced to the thinness of the walls of honeycomb. The skull is also very broad and much depressed between the eyes.

The generic name *Homoprion* was based on a species each of *Stelliferus* and *Bairdiella*. It was restricted by Gill to the former group, and should therefore be regarded as a synonym of *Stelliferus*. We have not examined the paper of Stark, but we understand that *Stelliferus* is a latinization of Cuvier's "Les Stellifères," based on *Bodianus stellifer*.

ANALYSIS OF SPECIES OF STELLIFERUS.

a. Preopercle with two spines only, the upper directed backward, the lower more or less downward.

b. Jaws subequal, the mouth very oblique; teeth of lower jaw unequal, not villiform, those of the inner series enlarged; mouth very large, oblique, the jaws equal, the snout not projecting beyond the premaxillaries, which are on the level of the eye; maxillary 2 in head, extending beyond eye; interorbital width nearly half head; preopercle with two spines only, the upper directed backward, the lower downward; body robust, subrhomboidal; profile steep, straightish; snout short, prominent, as long as eye, 4⅗ in head; teeth of the upper jaw anteriorly in two separated series, the outer of which is composed of enlarged teeth; posteriorly in a broad band of villiform teeth; gill-rakers long and slender, scarcely shorter than eye, 21 + 27; dorsal spines low, the first two and last two somewhat thickened, the rest slender; highest spine 2 in head; caudal rounded, shorter than head, 1⅓ in head; second anal spine robust, 1⅓ in head; ventrals 1⅓ in pectorals, which are slightly longer than the head; scales about head, on breast, antedorsal region, and several series along the base of the dorsals cycloid, the rest ctenoid; bases of anal and soft dorsal densely scaly; a series of scales on membrane of each spine in the dorsal fin. Color dusky above, pale below, with some silvery luster; middle of sides conspicuously punctulate; upper fins all brownish, punctulate with darker; ventrals, anal, and pectoral pale, the anal and pectoral dusted with dark points; opercle blackish within; head 3⅗ in length; depth 4⅕. D. XI-I, 24; A. II, 8; scale s7-48-6........OSCITANS, 48.

bb. Jaws not equal, the lower jaw included; mouth less oblique; teeth of lower jaw subequal, in a narrow, villiform band.

c. Mouth large, maxillary 2 in head; lower preopercular spine directed downward and backward; body moderately deep, the anterior profile straightish and steep, a little depressed over the eyes; eye rather large, 4½ in head; snout 4⅓; interorbital area broad and flattish, its width 2⅝ in head; head narrower and less depressed than in *S. fürthi;* mouth oblique, the lower jaw included, the premaxillary in front a little above lower edge of pupil; maxillary 2 in head, reaching to posterior margin of eye; teeth of lower jaw in a narrow band of about 3 series, those of the inner series very slightly enlarged; gill-rakers extremely long and slender, about X + 30, the longest slightly less than eye; preopercle strongly rounded, the lower spinule directed backward and downward; scales large; lateral line becoming straight over the anal spine; caudal pointed; longest dorsal spine $1\frac{5}{6}$ in head; second anal spine $2\frac{1}{6}$; pectoral $1\frac{1}{5}$; head $3\frac{1}{5}$ in length; depth $3\frac{1}{5}$; D. XI-I, 21; A. II, 9; scales 48 (pores); color rather pale, the pectoral with dark points; gill cavity dark within .... RASTRIFER, 49.

cc. Mouth moderate, the maxillary reaching to behind pupil, $2\frac{1}{3}$ in head; lower spine of preopercle directed downward and forward; bones of side of head little cavernous; interorbital width more than $\frac{1}{3}$ head; mouth low, little oblique, the maxillary reaching to behind pupil, $2\frac{1}{2}$ in head; eye $4\frac{2}{3}$ in head; gill-rakers shorter and fewer than in *S. rastrifer*; snout short, thick, and blunt, protruding beyond the premaxillaries which are on the level of the eye; profile steep; body rather short and deep, the back elevated; highest dorsal spine $1\frac{2}{3}$ in head; second anal spine small, $2\frac{1}{4}$ in head, shorter than soft rays; ventrals $2\frac{1}{2}$ in head; pectorals scarcely shorter than head; color dull silvery, darker above; lower fins pale; head $3\frac{3}{5}$ in length; depth $2\frac{4}{5}$ to 3; D. XI-I, 23; A. II, 9; scales 6 — 46 — 10 .... FÜRTHII, 50.

aa. Preopercle with numerous (6 to 20) serræ, those near the angle more or less enlarged; lower teeth subequal, in a narrow band.

d. Lowermost spinule of preopercle enlarged, directed downward (as in *Bairdiella*); caudal fin subtruncate; body deep, robust, moderately compressed; nuchal region compressed; profile steep, depressed over the eye, the snout projecting; head broad, flattish, and soft above, but less cavernous than in the other species; interorbital space 3 in head; a sharp ridge above orbits as in other species; snout very blunt, short, and thick, $4\frac{1}{2}$ in head; mouth oblique, the lower jaw included; maxillary reaching middle of pupil, $2\frac{1}{2}$ in head; eye $4\frac{1}{2}$ in head; gill-rakers long and slender, X + 21, the longest, $\frac{2}{3}$ eye; preopercle with 6 or 7 sharp teeth above, the one at the angle enlarged and turned downward; dorsal spines moderate; second anal spine short, stoutish, $\frac{2}{3}$ length of first soft ray, 3 in head; caudal subtruncate, the upper lobe slightly produced; pectorals rather long, $1\frac{1}{12}$ in head, reaching beyond tips of ventrals; color soiled silvery, with faint darker streaks along the rows of scales; dorsal with dark points; other fins pale; head $3\frac{1}{4}$; depth 3; D. XIII-I, 22; A. II, 11; scales 51 .... MINOR, 51.

dd. Lowermost spinule of preopercle not directed downwards; caudal fin pointed.

e. Mouth large, oblique, the maxillary 2 to $2\frac{1}{4}$ in length of head; snout very short, little projecting.

f. Preopercle with three or four spines next the angle, divergent, considerable larger than the others.

g. Pectoral fin long, $1\frac{1}{6}$ in head; body deep, compressed; head short, deep, more compressed than in related species, the interorbital space less depressed, its width $3\frac{1}{3}$ in head, the supraocular ridges less prominent; anterior profile evenly convex; eye rather large, $4\frac{1}{2}$ in head; snout very short and blunt, $4\frac{1}{6}$; mouth oblique, large, the maxillary 2 in head, reaching posterior border of eye; the premaxillary on the level of lower part of eye; preopercle very convex, forming an arc of a circle; gill-rakers long and slender, X + 18, the longest $\frac{2}{3}$ eye; dorsal spines slender, rather low, the longest $1\frac{2}{3}$ in head; second anal spine long and rather stout, $1\frac{2}{3}$ in head; color dull silvery, the fins not very dark; head $3\frac{1}{4}$ in length; depth $3\frac{1}{5}$; D. XI-I, 19; A. II, 8; scales 48 .... STELLIFER, 52.

gg. Pectoral fin short, about $1\frac{2}{3}$ in head; interorbital space 3 in head; second anal spine $2\frac{1}{4}$; body rather slender; snout as long as eye, $4\frac{1}{2}$

in head; mouth moderate, oblique, the maxillary not quite half length of head, extending just past pupil; premaxillary in front on level of lower margin of pupil; teeth above in broad bands, the outer row enlarged; gill-rakers 13 + 22, about ⅘ length of eye; scales on head cycloid; dorsal spines slender, the first two somewhat stronger, the highest about 2 in head; caudal long, lanceolate, 1⅓ in head; second anal spine little shorter than the highest dorsal spine; first ventral ray filiform; pectoral about as long as ventral, 1⅝ in head; color grayish olive above, silvery below; fins all nearly uniform dusky; the ventrals margined with white; many black dots along the sides; base of anal fin and inner lining of opercle dusky; head 3¼ in length; depth 3½; D. XI–I, 20 to 23; A. II, 7 or 8; scales 5 — 47 to 50 — 8.......................................LANCEOLATUS, 53.

ff. Preopercle with numerous short, straight spinules, which decrease in size regularly from angle upwards; eye small; mouth terminal, moderate, the maxillary extending past the pupil, its length 2⅗ in head; premaxillaries anteriorly opposite lower margin of orbit, the snout scarcely projecting beyond them; head extremely spongy and cavernous; interorbital width less than ⅕ head; profile straight; snout short, blunt, 5 in head, equal to diameter of eye; upper jaw with a band of villiform teeth, the outer series enlarged; margin of preopercle rounded, its spines all small; gill-rakers ⅘ length of eye, 11 + 18 in number; first two dorsal spines stout, the highest 2 in head; second anal spine 2 in head; pectorals as long as ventrals, 1½ in head; scales on cheeks mostly ctenoid, on top of head cycloid; color dark brownish above, everywhere soiled with dark points; a dark temporal blotch; lower jaw black within, behind the front teeth; lower fins dusky; head 3⅓ in length; depth 3⅓; D. XII–I, 23; A. II, 7 or 8; scales 5—48—7.......................................ERICYMBA, 54.

ee. Mouth small, inferior, nearly horizontal; the maxillary 3 to 3½ in head; the snout thick, blunt, and protuberant, the premaxillaries entirely below the level of the eye; lower jaw cavernous.

h. Eye large, 3⅓ in head; lower teeth on preopercle enlarged; preorbital moderate; its width about half diameter of eye; body moderately elongate; anterior profile straight and rather steep; interorbital area flattish, very spongy, narrower than in *S. microps;* its width 3¼ in head; snout thick, blunt, protruding, 4½ in head; eye very large; mouth small, inferior, horizontal, the maxillary extending to posterior border of pupil, 3⅓ in head; teeth as in related species, in moderate bands, those above slightly enlarged; preopercle rounded, sharply serrate, the serræ largest near the angle, some 12 of them present; gill-rakers rather long, very slender, about X + 18; dorsal spines slender, the longest 1⅗ in head; soft dorsal less scaly than in other species, lower than in *S. microps*, the longest ray 2¼ in head; second anal spine 2 in head; pectoral 1¼; color soiled grayish above, with faint dark streaks along the rows of scales; silvery below; fins somewhat punctulate; head 3⅗; depth 3½; D. XI–I, 20; A. III, 7; scales 48.......................................NASO, 55.

hh. Eye small, 5 to 6 in head; teeth on preopercle subequal; preorbital thick and swollen, much broader than eye; body moderately elongate; snout thick, blunt, convex, and protuberant; head above less cavernous than usual in the genus, more so below; preopercle (as usual in this genus) forming the arc of a circle; mouth rather small, the maxillary 3 in head; snout 4; gill-rakers about X + 16, shorter than in *S. rastrifer*, about ½ diameter of eye; no pores or slits at end of snout; interorbital space $2\frac{3}{8}$ in head; dorsal spines low, the longest $1\frac{3}{8}$ in head; soft dorsal high, the longest ray $2\frac{1}{6}$ in head; second anal spine rather large, $1\frac{3}{8}$ in head; pectoral $1\frac{1}{6}$. Color pale, nearly plain; faint oblique streaks along the rows of scales, those below lateral line running obliquely upward and backward; scales of sides with many brown dots. Head $3\frac{1}{3}$; depth $3\frac{1}{4}$. D. X–I, 19; A. II, 8. Scales 51..MICROPS, 56.

48. STELLIFERUS OSCITANS.

Sciæna oscitans Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 312 (Bay of Panama); 1882, 111 (Panama); Proc. U. S. Nat. Mus., 1882, 376 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This species is not uncommon about Panama; numerous specimens from that locality are in the museum at Cambridge. In the dentition and form of its mouth it differs from the other species, approaching the genus *Bairdiella*.

49. STELLIFERUS RASTRIFER.

Stelliferus rastrifer Jordan, sp. nov.

Habitat.—Coast of Brazil.

This species seems to be generally common on the coast of Brazil. Specimens are in the museum at Cambridge from Rio Janeiro, Santos, Maranhão, Bahia, Cachiura, and Abrolhos Islands. The specimen specially described (10815, M. C. Z.) is $5\frac{1}{2}$ inches in length and was obtained at Santos.

The species is allied to *Stelliferus fürthi*, from which it is distinguished, among other things, by the long and numerous gill-rakers (hence the name—*rastrum*, a rake).

50. STELLIFERUS FÜRTHI.

Corvina (Homoprion) fürthi Steindachner, Ichthyol. Beitr., iii, 26, fig. 3, 1875 (Panama).

Sciæna fürthi Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 315 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

One specimen of this species was taken by Professor Gilbert at Panama. Several others from the same locality are in the museum at Cambridge.

51. STELLIFERUS MINOR.

Corvina minor Tschudi, Fauna Peruana, Ichthyol., 8, 1844 (Peru).

Sciæna minor Günther, Cat. Fish. Brit. Mus., ii, 295, 1860 (copied).

Corvina (Homoprion) agassizi Steindachner, Ichthyol. Beiträge, ii, 26, 1875 (Caldera, Callão, Payta).

Habitat.—Pacific coast of South America.

The specimens of this species in the museum at Cambridge are from Callão, in Peru. There seems to be no doubt of the identity of *Corvina* *agassizi* with the *Corvina minor* of Tschudi. The name *minor* was given to indicate the small size of the species as compared with *Corvina deliciosa*. The name seems a little unfortunate, as this species reaches a larger size than any other in the genus *Stelliferus*. It bears a considerable resemblance to the species of *Bairdiella*, but its nearest affinities are with *Stelliferus stellifer*.

52. STELLIFERUS STELLIFER.

Bodianus stellifer Bloch, Ichthyologia, plate 231, 1790 ("Cape of Good Hope"). Bloch & Schneider, Syst. Ichth., 331, 1801 (copied).

Sciæna (*Stelliferus*) *stellifera* Jordan, Proc. U. S. Nat. Mus., 1886, 540 (notes on type of *trispinosa*).

Corvina trispinosa, Cuv. & Val., Hist. Nat. Poiss., v, 109 (Brazil; Cayenne). Steindachner, Sciænoiden Brasiliens, 14, 1863 (Pará).

Habitat.—Coasts of Guiana and Brazil. Our description of this species is taken from specimens in the museum at Cambridge, from Bahia.

We have also examined the original type of *Corvina trispinosa* in the museum at Paris. It is doubtless true that Bloch's type of *Bodianus stellifer* came from Surinam rather than from Africa. His figure represents some species of *Stelliferus*, and Cuvier and Günther are probably right in identifying this figure with *Corvina trispinosa*. Still this identification is not free from doubt, and it may be better to call the species *Stelliferus trispinosus*.

53. STELLIFERUS LANCEOLATUS.

Homoprion lanceolatus Holbrook, Ichthyol. S. Carolina, ed. 1, 168, plate 23, 1856 (Port Royal Sound). Girard, U. S. and Mex. Bound. Survey, 11, 1859 (Saint Joseph's Island, Texas).

Sciæna lanceolata Günther, Cat. Fish. Brit. Mus., ii, 289, 1860 (copied). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 605 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 931, 1883.

Stelliferus lanceolatus Goode, Proc. U. S. Nat. Mus., 1881, 113 (Saint John's River, Florida). Bean, Internat. Fishery Exhib. Berlin, 55, 1883 (Matanzas River Inlet, Florida).

Sciæna stellifera Jordan & Gilbert, Syn. Fish. North America, 569, 1883 (Pensacola).

Habitat.—South Atlantic and Gulf Coast of the United States, Charleston to Texas.

This small fish is rather rare on our coast, the specimens seen by us being few and all from rather deep water; the one here described was obtained at Charleston by Dr. Gilbert.

54. STELLIFERUS ERICYMBA.

Sciæna ericymba Jordan & Gilbert, Bull. U. S. Fish. Com., 1881, 311 (Bay of Panama).

Habitat.—Pacific coast of tropical America; Panama.

This small species is rather common about Panama. The cavernous character of the head is more marked in this species than in any other.

55. STELLIFERUS NASO.

Stelliferus naso Jordan, MSS.

Habitat.—Coast of Brazil.

This species is represented in the museum at Cambridge by many young specimens from Cachiura, the longest about 4 inches in length. The label of the bottle, in Dr. Steindachner's handwriting, indicates that he has regarded it as a species distinct from *S. microps*, although he has published no description of the species.

56. STELLIFERUS MICROPS.

Corvina stellifera Günther, Cat. Fish. Brit. Mus., ii, 299, 1860 (West Indies). (Not *Bodianus stellifer* Bloch.)

Corvina microps Steindachner, Ichthyol. Not., i, 6, plate ii, fig. 1, 1864 (Guiana).

Habitat.—Coast of Brazil and Guiana.

The specimens of this species (4581, M. C. Z.) examined by us, were collected at Pará by Dr. Steindachner. The largest is 3½ inches in length.

Genus XII.—SCIÆNA.

Sciæna part Artedi, Genera Piscium, 1738. (Includes *umbra* and *cirrosa*.)

Sciæna Linnæus, Systema Naturæ, ed. x, 289, 1758 (*umbra*; *cirrosa*).

Johnius Bloch, Ichthyologia, x, 107, 1793 (*carutta*, &c., later restricted by Gill to *Johnius carutta*).

Sciæna Cuvier, Règne Animal, ed. i, 297, 1817 (restricted to *Sciæna umbra*, a Linnæan species, and to *Sciæna aquila*, a non-Linnæan one) (not of Règne Animal, ed. ii, which is *Pseudosciæna*).

Bola Francis Hamilton, Fishes of the Ganges, 1822 (*coitor chaptis*, &c.).

Sciæna Cuvier, Règne Animal, ed. ii, 1829 ("*umbra*" = *aquila*; and of all subsequent authors except Bleeker; not of Linnæus, nor of Artedi, to both of whom *Sciæna aquila* was unknown; not of the first edition of the Règne Animal).

Corvina Cuvier, Règne Animal, ed. ii, 1829 (*nigra* = *umbra*).

Cheilotrema Tschudi, Fauna Peruana, Fische, 1845, 13 (*fasciatum*).

Rhinoscion Gill, Proc. Ac. Nat. Sci. Phila., 1861, 85 (*saturnus*).

Pseudosciæna Bleeker, Nederland. Tydsskr. f. Dierkunde, i, 1863 (*aquila*).

Sciænops Gill, Proc. Ac. Nat. Sci. Phila., 1863, 30 (*ocellata*).

Ophioscion Gill, Proc. Ac. Nat. Sci. Phila., 1863, 164 (*typicus*).

Callaus Jordan, subgenus novum (*deliciosus*).

TYPE: *Sciæna umbra* Linnæus.

We are compelled to place in a single genus the great bulk of those *Sciænidæ* which have short gill-rakers, inferior mouth, and no barbels on the lower jaw. In spite of the marked differences between the extremes of the series, the intergradation in characters is so perfect that we are unable to draw any sharp distinctive lines among them. This is especially true when the Asiatic species, forming the groups called *Bola* and *Johnius*, are taken into account. It is also true that one of the species of *Bairdiella* (*chrysoleuca*) is very close to some of the members of the present group. In this case, however, there is really one difference—the length of the gill-rakers, which, though small, is constant, and holds good in all the known species.

With a view to the discovery of a basis for generic subdivision, we have especially compared the following species: *Sciæna* (*Sciænops*) *ocellata*, *Sciæna* (*Pseudosciæna*) *aquila*, *Sciæna* (*Bola*) *diacantha*, and *Sciæna* (*Callaus*) *deliciosa*. If these species could be satisfactorily arranged in different genera, it would be comparatively easy to find characters on which to detach the rather more aberrant types of *Sciæna* (*umbra*), *Cheilotrema* (*saturna* and *fasciata*), *Ophioscion*, and *Johnius*.

The four species first mentioned agree in the position of the anal fin. Its second spine is very weak in *aquila* and adnate to the first ray. It is somewhat so in the others and it is not large in any. In *Johnius* (*dussumieri*) it is also small, but in *Sciæna*, *Cheilotrema*, and *Ophioscion* it is considerably enlarged.

The scales are smallest in *aquila*, largest in *ocellata*, but the difference is not sharp enough to warrant generic division. In all four of the species first mentioned the preorbital is flat and rather broad, broadest in *deliciosa* (7 in head) and narrowest in *aquila*—10½. In the other forms it is generally still broader and more gibbous.

The slits and pores about the snout are distinct in *ocellata* and *deliciosa*, little marked in *diacantha* and nearly or quite obsolete in *aquila*. In *Johnius*, *Sciæna*, *Cheilotrema*, and *Ophioscion* these are more or less distinct.

In all the four species the mouth is of moderate size, slightly oblique, with the lower jaw included, the maxillary reaching to opposite the posterior border of the eye. The mouth is largest in *ocellata*, smallest in *aquila*. In all the others (*Ophioscion*, &c.) the mouth is still smaller. The upper teeth are nearly alike in all of these; of the four mentioned they are largest in *diacantha*, smallest in *deliciosa*. In some East Indian species (referable to *Bola?*) these teeth are still larger, some of them almost canine-like.

The lower teeth are rather large, and chiefly uniserial in *diacantha* and other species of *Bola*; in two or three rows, the inner enlarged in *deliciosa* and *aquila*; in a broad band, some of the inner enlarged in *ocellata*. In *Johnius*, *Cheilotrema*, *Sciæna*, and most of the species of *Ophioscion*, the lower teeth are in a broad band and equal.

The preopercle is sharply serrate in youth, becoming entire with age in *ocellata*. In *aquila* it is vaguely crenulate in youth, becoming finally entire. In *diacantha* it remains more or less crenulate. In *deliciosa* the preopercle is edged by fine flexible serræ. In *Ophioscion* the preopercle is always sharply serrate. In *Sciæna*, *Cheilotrema*, and *Johnius* it is always entire or at least without bony serratures.

Among the four species first mentioned, the gill-rakers are smallest in *diacantha* (X + 7), when they are short and thick, the longest not half the pupil. They are longest in *deliciosa*; when they are slender (X + 12) as long as pupil. In *aquila* and *ocellata* they are X + 8 or 9, rather slender and short, about ⅜ length of pupil. In most of the species of the other groups (*Ophioscion*, &c.), they are very few, short and thickish, usually not more than half the length of the pupil. The form of the body offers nothing which can be used for generic distinction, as the intergradations are very perfect. The same can be said of the form and the squamation of the fins.

We may, however, recognize for convenience' sake a number of subgenera, all but one (*Bola*) of them being represented by species occurring within our limits.

We think that there is no doubt that the generic name, *Sciæna*, should go with *Sciæna umbra* (the type of *Corvina* Cuvier), if the laws of nomenclature followed by us be admitted.

There are three members of the present family found in European waters. Two of these, *cirrosa* and *umbra*, were known to Linnæus and to Artedi, and on these the genus was primarily based. The third, *aquila*, was unknown to these authors, and could not therefore with any sort of propriety be taken as the type of a Linnæan genus. The group was first knowingly subdivided by Cuvier in 1817. First separating *cirrosa* as the type of the genus *Umbrina*, he retains in *Sciæna* proper ("les Sciènes proprement dites") two species ("*Sciæna umbra* L." and "*Sciæna aquila* nobis"). This is a perfectly proper arrangement, and of this genus, *Sciæna*, as thus restricted by Cuvier, *Sciæna umbra* must be regarded as the type.

Later, in 1829, this *Sciæna umbra* was made the type of the new genus *Corvina*, as *Corvina nigra* Cuvier, while the non-Linnæan species "*aquila*" was left as the type of *Sciæna*. This arrangement has been followed by nearly all recent writers, but it is manifestly inadmissible, except to authors to whom, as to Cuvier, all laws of nomenclature are subordinate to personal caprice or convenience.

Recently Dr. Bleeker has proposed to take, as the type of *Sciæna*, the *Umbrina cirrosa*, because this is the species mentioned first by Artedi. In the rules now generally followed, this matter of being placed first in the genus is not regarded as an element of any importance. The restriction proposed by Bleeker must therefore give way to the earlier one of Cuvier, and the name *Sciæna* must be regarded as synonymous with *Corvina*. There is the less to be regretted from the fact that *Corvina* has usually been regarded as a generic name for all Sciænoids with conspicuous anal spines, and members of a dozen different genera have been from time to time referred to it.

ANALYSIS OF SPECIES OF SCIÆNA.

a. Preopercle, with its bony margin armed with strong persistent spines, which do not disappear with age; (caudal fin not lunate; soft dorsal and anal scaly; species of small size). (*Ophioscion* Gill.)

b. Caudal fin convex or lanceolate, the middle rays longest, often nearly as long as head; soft dorsal with 16 to 23 rays; head low, the snout somewhat projecting.

c. Anterior profile of head nearly straight; maxillary about 3 in head.

d. [Maxillary not extending to front of eye; depth of body $4\frac{1}{12}$ in total (with caudal); head $4\frac{3}{5}$; eye 4 in head; snout 3; preopercle with larger teeth at the angle; mouth longer than broad; mouth inferior, the snout extending beyond the premaxillary; teeth all alike and minute; maxillary extending to below posterior nasal opening; profile ascending uniformly to first dorsal, convex at the snout and nape; highest dorsal spine $1\frac{5}{6}$ in head; highest dorsal rays not half head; second anal spine robust, scarcely half as long as head; first anal ray $1\frac{3}{4}$ in head; caudal rhomboidal $\frac{9}{11}$ in head; soft dorsal scaly for half its height; pectoral equals ventral, $1\frac{1}{2}$ in head; membranes of fins with numerous dark points; D. X–I, 16; A. II, 7; scales 11–52–16.] (*Steindachner.*) .... GILLI, 57.

dd. Maxillary extending to opposite posterior edge of pupil; its length $3\frac{1}{3}$ in head; body compressed, moderately deep, the head low, subconic, acutish but blunted at tip; snout projecting, the usual slits and pores well developed; its length $4\frac{1}{2}$ in head; eye small, $4\frac{2}{3}$ in head; mouth small, inferior, horizontal; teeth in lower jaw equal, in the upper nearly so, the outer row a little enlarged; preopercle with a vertical limb and rounded angle, the latter with about 8 rather strong teeth on it; interorbital space $3\frac{1}{3}$ in head; preorbital wide, about as broad as eye; gill-rakers very short, thicker than high; scales regularly arranged, those below lateral line in horizontal series; lateral line becoming straight before anal; dorsal spines rather stout, the longest $1\frac{1}{2}$ in head; second anal spine shortish and very stout, 2 in head; longest soft ray of dorsal 3 in head; caudal rounded, shorter than head; pectoral $1\frac{1}{3}$ in head. Color, soiled brassy; a faint small dark spot on each scale of back and sides, these forming dusky streaks along the rows of scales; fins all dark with dark points. Head $3\frac{3}{5}$ in length; depth $3\frac{1}{3}$; D. X–I, 22 to XI–I, 23; A. II, 7; scales 51. ADUSTA, 58.

cc. Anterior profile more or less concave, especially in old examples, the head being very low and slender; caudal fin lanceolate, almost as long as head; snout short and bluntish, projecting a little beyond the premaxillaries, about as long as eye; eye $3\frac{3}{4}$ in head; mouth small, low, maxillary not extending to below middle of eye, $2\frac{1}{2}$ in head; teeth in both jaws in moderate bands, the outer series of the upper jaw enlarged; highest dorsal spine $1\frac{1}{2}$ in head; anal spine very thick, strong; as long as the rays, $1\frac{1}{2}$ in head; pectorals about as long as ventrals; first ventral ray filiform. Color, grayish; anal and ventral fins largely black. Head $3\frac{1}{3}$ in length; depth $3\frac{1}{3}$; D. X–I, 22; A. II. 7; scales 5—50—7 .... TYPICA, 59.

bb. Caudal fin irregularly double truncate or *f*-shaped, much shorter than the head; soft dorsal with 24 or 25 rays.

e. Teeth in the lower jaw equal, in a broad villiform band.

f. Snout much projecting beyond the premaxillaries; head low, slender, blunt, somewhat spongy; body rather deep, compressed; the back considerably elevated; profile steep, concave over the head; snout shorter than the eye, which is $4\frac{1}{2}$ in head; mouth small, maxillary reaching to below middle of eye, 3 in head; outer series of teeth in the upper jaw slightly enlarged; highest dorsal spine slightly more than half length of head; anal spine moderate, shorter than the rays, $2\frac{1}{3}$ in head; first ventral ray filamentous pectorals much longer than the ventrals, scarcely shorter than the head. Color, dull brown above, lighter below; upper fins brown; spinous dorsal dusky at tip; anal black; ventrals and pectorals dusky. Head $3\frac{1}{2}$ in length; depth 3; D. XI–I, 25; A. II, 8; scales 5–51–8.................IMICEPS, 60.

ff. Snout scarcely projecting beyond the premaxillaries; head not very slender; body robust; profile steep; snout rather acute, somewhat longer than eye, which is about $5\frac{1}{4}$ in head; mouth moderate; maxillary 3 in head, reaching beyond middle of orbit; teeth in broad villiform bands, the outer series in upper jaw larger; highest dorsal spines, 2 in head; caudal irregularly double truncate, the median rays longest, $1\frac{3}{8}$ in head; the upper angle not produced; second anal spine stout, scarcely shorter than the rays, 2 in head; pectorals as long as the ventrals, $1\frac{1}{4}$ in head. Color, steel gray above, dull silvery below, everywhere densely covered with brown points, these becoming more numerous and larger below; narrow, very distinct dark lines following the series of scales, those below the lateral line horizontal, those above extending obliquely upward and backward; fins plain; edge of the spinous dorsal and the whole of the anals and ventrals blackish. Head $3\frac{3}{5}$ in length; depth $3\frac{1}{4}$; D. X–I, 24; A. II, 7; scales 6–50–9..............................SCIERA, 61.

ee. Teeth in lower jaw unequal, a series of larger ones being present besides those of the villiform band; upper lobe of caudal produced, acute, the lower lobe rounded; form of *S. sciera;* [head somewhat compressed, the snout obtuse, a little longer than eye, which is about 5 in head; premaxillaries below level of eye, the snout projecting beyond them; margin of preopercle with wide-set spinous teeth; preorbital nearly as wide as eye; maxillary reaching beyond middle of eye $3\frac{2}{3}$ in head; third dorsal spine $1\frac{1}{2}$ in head; second anal spine very strong, 2 in head. Color, dusky silvery, with distinct purplish brown streaks along the series of scales; fins, brown. Head $3\frac{1}{2}$ in length; depth 3; D. X–I, 25; A. II, 8; scales 6–?–15.] (*Günther.*)........................VERMICULARIS, 62.

aa. Preopercle, with its bony margin sharply serrate in young examples, becoming entire with age; body rather elongate, not much compressed. (*Sciænops* Gill.)

i. Caudal fin slightly concave, about half as long as head; a large black ocellus at its base above. Body elongate, rather robust, back somewhat arched; profile rather steep, somewhat convex; head long, rather low; eye small, 7 in head; snout bluntish, rather long, 4 in head; mouth large, nearly horizontal; maxillary not quite reaching posterior border of orbit, 2½ in head; teeth in both jaws in villiform bands, the outer series of the upper jaw much enlarged; lower teeth subequal; gill-rakers 5 + 7, shorter than the diameter of the pupil; longest dorsal spine 2⅛ in head; second anal spine 1⅞ in the longest ray, 3⅝ in head; pectorals as long as ventrals, 2 in head; scales of the breast imbedded, cycloid; soft dorsal scaleless; color grayish-silvery, iridescent; each scale with a center of dark points, these forming rather obscure, irregular, undulating brown stripes along the rows of scales; a jet black ocellated spot about as large as eye at base of caudal above; this sometimes duplicated; the body occasionally covered with ocelli. Head 3⅛ in length; depth 3½. D. X–I, 24; A. II, 8. Scales 4–50–7 .... OCELLATA, 63.

aaa. Preopercle, with its bony margin entire or irregularly crenulate or ciliate, never distinctly serrate.

j. Second anal spine small and slender, 3¼ to 4½ in head; mouth small, the back not greatly elevated.

k. Body more or less elongate, little compressed, formed as in *Ophioscion;* teeth of lower jaw equal (*Johnius* Bloch).

l. [Caudal rhombic, its length ⅔ that of head; no black ocellus at its base. Body rather elongated, the form much as in *Sciæna* (*Ophioscion*) *typica*, but the head less depressed; profile, depressed above eye; eye 4 in head, as long as the snout, which is rather long, bluntish at tip; preorbital, ⅔ length of eye; mouth moderate, horizontal; maxillary extending to below middle of eye, 2½ in head; teeth in many series; outer series of the upper jaw somewhat longer, those of the lower jaw all subequal; preopercle entire (in the figure); scales of the cheek cycloid; those of the opercle and body ctenoid; 46 series of scales above the lateral line; 40 below it; spinous dorsal little longer than high, the spines slender, scarcely flexible, the third longest, 2 in head; soft dorsal densely scaly, the longest ray 2¾ in head; second anal spine small, little longer than the eye, 3½ in head; pectorals 1⅝ in head. Color, greenish or bluish gray above, silvery below; fins yellowish. Head 3⅛ to 3½; depth 3½ to 3⅞; D. X–I, 28 or 29; A. II, 7; lateral line, 45.] (*Bleeker.*) .... HETEROLEPIS, 64.

kk. Body rather elongate, considerably compressed; teeth in lower jaw unequal, those of the inner series more or less enlarged; mouth rather large; preopercle with flexible serræ.

m. Slits and pores of snout anteriorly obsolete, or nearly so (*Pseudosciæna* Bleeker).

n. Caudal peduncle long, the caudal fin subtruncate; profile rather steep, the snout pointed, 4 in head; eye small, 5 to 6; preorbital narrow, about 2½ in eye; mouth rather large, little oblique, the maxillary reaching beyond pupil, 2½ in head; teeth above in a narrow band, the outer enlarged; teeth in lower jaw in few series, some of those in the inner considerably larger; lower jaw included; snout 3⅗ in head; preopercle serrulate, the teeth all membranaceous, becoming obsolete with age; gill-rakers 4 + 8, short and slender; scales small, those below lateral line in oblique series, as well as those above; dorsal spines weak, the longest 2⅔ in head; pectoral short, 1⅗ in head; second anal spine very small, 4⅗ in head, about half as long as soft rays, the insertion well forward; caudal subtruncate; soft dorsal scaleless. Color grayish, darker above; a gray blotch on opercle; fins reddish. Head 4 in length; depth 4½; D. X-I, 26 to 29; A. II, 7. Scales 8–52 to 55–18.

AQUILA, 65.

mm. Slits and pores on snout anteriorly well developed (*Callaus* Jordan).

o. Head and body compressed, the back arched, the outline oblong-elliptical; profile straightish, rather steep; head bluntish, the snout 4½ in head; eye rather large, 5½ in head, as wide as the broad preorbital; maxillary extending to middle of pupil, 3½ in head; mouth rather large, a little oblique, the lower jaw slightly included; preopercle finely and evenly serrate, the serræ flexible and not bony; gill-rakers slender and very short, scarcely as long as pupil, X + 12 in number; teeth in moderate bands, some of the outer moderately enlarged above, some of the inner ones below, these smaller than those of the upper jaw; soft dorsal and anal scaled at base only; dorsal spines moderate; second anal spine small, 4½ in head; caudal lunate, its upper lobe the longer; pectoral long, 1⅙ in head; color bluish above with faint dark horizontal streaks, following the rows of scales; axil dark; fins pale; head 3 in length; depth 3$\frac{1}{10}$; D. X-I, 23; A. II, 9. Scales 50.....DELICIOSA, 66.

ij. Second anal spine long and stout, its length 2 to 3 in head; back elevated; mouth small, inferior; snout with conspicuous slits and pores.

p. Vertical fins high; membranes of dorsal and anal scaleless; caudal fin subtruncate, its middle rays the longest (*Sciæna*).

q. Dorsal spines slender and weak, the 4th to 6th subequal, 1⅗ in length of head; ventrals long and lanceolate, the outer rays reaching almost to vent, scarcely shorter than head; body rather short and deep, the back elevated, profile steep, depressed above the eye; ventral outline slightly arched; snout blunt, scarcely longer than eye, $4\frac{2}{3}$ in head; eye $5\frac{3}{8}$ in head; preorbital broad, nearly as wide as eye; mouth rather small, inferior, maxillary reaching middle of eye, $2\frac{2}{3}$ in head; teeth in both jaws in broad, villiform bands, the outer series above somewhat enlarged; pharyngeal teeth all more or less conical, the inner series somewhat rounded and molar-like; gill-rakers short, flattened, 5 + 8; preopercle with an irregular entire border; dorsal spines all thin and slender; middle rays of soft dorsal highest $1\frac{2}{3}$ in head; caudal subtruncate, the middle rays longest; second anal spine stout and long, about 2 in head, reaching when depressed beyond the last ray; first and second soft rays elongate $1\frac{7}{8}$ in head, the rest rapidly decreasing in length; pectorals $1\frac{1}{4}$ in head; scales strongly ctenoid, those about the head cycloid; a scaly sheath at base of anal and soft dorsal. Color dark golden, each scale with many blackish dots, these forming stripes along the rows of scales; rows of scales below lateral line undulating; membranes of dorsal spines blackish; anal black, the last two rays pale; ventrals black, their first rays with the outer border white, caudal edged with dusky below and behind. Head $3\frac{1}{2}$ in length; depth 3. D. X–I, 23; A. II, 7. Scales 8–60–17 .... UMBRA, 67.

pp. Vertical fins low, the membranes of the dorsal and anal closely scaled; caudal fin lunate, the upper lobe the longer. (*Cheilotrema* Tschudi.)

r. Dorsal rays X–I, 27 or 28; snout moderately blunt; second anal spine $2\frac{1}{8}$ in head; dorsal spines gradually shortened behind the third, which is $2\frac{1}{8}$ in head; ventrals short, $1\frac{1}{8}$ in head; body oblong, the back considerably elevated; profile steep, the nape convex; snout short and blunt, but less so than in *S. fasciata*, $3\frac{1}{2}$ in head; eye, 5; preorbital broad, nearly as wide as eye; teeth as in *Sciæna umbra*, the bands broader; pharyngeal teeth all conic, the inner series enlarged; gill-rakers short, thick, 6 + 9; middle rays of soft dorsal longest, $2\frac{2}{3}$ in head; second anal spine long and stout, $2\frac{1}{8}$ in head, not reaching nearly to tip of last ray; first anal rays scarcely elongate, about 2 in head; pectorals broad, $1\frac{1}{8}$ in head; all scales of of head strongly ctenoid; a scaly sheath at base of anal and soft dorsal. Color blackish, with coppery luster, each scale with a cluster of dark points, an obscure, broad, pale cross-band extending downward from front of soft dorsal to tips of ventrals; fins rather dark, belly silvery, dusted with dark specks; suborbital region coppery, with round, dark dots; membrane about angle of opercle jet black; tips of ventral and anal black;. young ("*Corvina jacobi*") with three broad longitudinal dark bands. Head $3\frac{2}{3}$ in length; depth $2\frac{1}{8}$. D. X–I, 27; A. II, 7. Scales, 10–55 to 60–17 .... SATURNA, 68.

rr. Dorsal rays XI–I, 23; snout extremely short and blunt; second anal spine 2⅔ in head. Body deep, the back elevated; anterior profile very steep and somewhat convex; the back a little compressed; snout low, thick, blunt, and short, 3⅗ in head, its pores and slits conspicuous; mouth inferior, horizontal, the maxillary reaching middle of eye, 3 in head; teeth in broad bands, the outer above somewhat enlarged; preopercle with membranaceous serræ; preorbital very broad, as broad as eye; gill-rakers very short and thick, rough, as long as high, 5 or 6 of them developed; eye 5½ in head; dorsal spines moderate, the longest 2⅓ in head; second anal spine stout and rather shorter than in related species; longest soft ray of dorsal 2½ in head; pectoral shortish, 1⅔. Color dusky, the young with two or three vague blackish cross-bands; fins all dusky. Head 3⅓ in length; depth 2½. D. XI–I, 23; A. II, 8. Scales 57.

FASCIATA, 69.

57. SCIÆNA GILLI.

Corvina gilli Steindachner, Ichthyol. Notizen, vi, 29, 1867 (Rio de la Plata).

Habitat.—Atlantic coast of South America.

We know this species from the account given by Dr. Steindachner. It is very close to *Sciæna adusta*, and may prove to be the same, but the description seems to indicate some differences.

58. SCIÆNA ADUSTA.

Sciæna (*Corvina*) *adusta* Agassiz, Spix Pisc. Bras., 126, plate 70, 1829 (Montevideo). Jenyns, Zool. Beagle, Fishes, 42, 1842 (Maldonado; Montevideo). Günther, Cat. Fish. Brit. Mus., ii, 289, 1860 (South America).

Habitat.—Coast of Brazil and the West Indies.

We refer to this species several specimens in the museum at Cambridge from Pernambuco, Fonteboa, and Jérémie, Hayti. Our description is drawn chiefly from the largest example (22417, M. C. Z., 7 inches long) collected at Pernambuco by Rev. J. C. Fletcher. These specimens agree almost perfectly with the figure of *Sciæna adusta*, given by Agassiz, the only discrepancy being that the second anal spine is a little longer than is shown in the figure. They agree fairly with the descriptions of Jenyns and Günther, except in the number of rays in the soft dorsal. In Agassiz's text, as well as by Jenyns and Günther, 28 soft rays are enumerated. We count 22 and 23 in different specimens. But in Agassiz's plate but 19 or 20 are shown, and it has occurred to us that the number 28 in the description was a misprint for 18 or for 20, and that possibly this number, 28, may have been copied without verification by Jenyns and by Günther. If this is not so Agassiz's description must refer to one species, the one examined by Günther and Jenyns, and his figure to another, the one examined by us. In that case our species must receive a new name. But we regard this as highly improbable, and refer all these accounts to the synonymy of *Sciæna adusta*.

59. SCIÆNA TYPICA.

Ophioscion typicus Gill, Proc. Acad. Nat. Sci. Phila., 1863, 165 (west coast Central America).
Corvina ophioscion Günther, Fish. Central America, 387 and 428, 1866 (Panama).
Sciæna ophioscion Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 315 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This species is not uncommon about Panama. In its slender head and lanceolate caudal fin it would seem to differ widely from most of the related forms. Its relations with *S. sciera* are, however, close, and *S. imiceps* is evidently intermediate.

The undesirability of such words as "*typicus*" as specific names is very evident in this case. If we follow the law of priority we have a name which is self-contradictory, as this is one of the species most unlike the real type of *Sciæna*.

60. SCIÆNA IMICEPS.

Sciæna imiceps Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 309 (Bay of Panama).

Habitat.—Pacific coast of tropical America; Panama.

This small species is not rare at Panama. It resembles the species of *Stelliferus*, and it has real affinities with the latter group. The head is, however, different, being low and narrow, and little cavernous, while the gill-rakers are very short, as in the other species referred to *Ophioscion*.

61. SCIÆNA SCIERA.

(CORBINETA.)

Sciæna vermicularis Jordan & Gilbert, Bull. U. S. Fish Com., 1881, 315 (Mazatlan; Panama) (not *Corvina vermicularis* Günther). Gilbert, l. c., 1882, 112 (Punta Arenas).
Sciæna sciera Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 480 (Panama).

Habitat.—Pacific coast of tropical America.

This species is one of the most abundant of the Sciænoid fishes on the Pacific coast of Mexico. It was at first taken by Jordan and Gilbert for the *Corvina vermicularis* of Günther, but the latter species is well distinguished by the enlarged teeth * of the lower jaw and by the sharp upper lobe of the caudal.

62. SCIÆNA VERMICULARIS.

Corvina vermicularis Günther, Fish. Central America, 387 and 427, plate 67, fig. 2, 1869 (Panama).
Sciæna vermicularis Jordan, Proc. U. S. Nat. Mus., 1885, 381 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

This species is rare about Panama. One specimen was obtained by Dr. Gilbert in 1883. Besides this, only Dr. Günther's original type is on record.

* This character is not mentioned in the description of *S. vermicularis*. We give it on the strength of our remembrance of the species, as no specimens of the species now exist in any American museum.

63. SCIÆNA OCELLATA.

(THE RED DRUM, OR CHANNEL BASS; "RED-FISH.")

[Plate IV.]

Perca ocellata Linnæus, Syst. Nat., ed. xii, 483, 1766 (South Carolina). Goode & Bean, Proc. U. S. Nat. Mus., 1885, 202 (examination of Linnæan types).

Centropomus ocellatus Lacépède, Hist. Nat. Poiss., iv, 257, 279, 1802.

Corvina ocellata Cuvier & Val., Hist. Nat. Poiss., 134, plate 108, 1830 (New Orleans). DeKay, New York Fauna, Fishes, 75, plate 21, fig. 61, 1842 (New York). Storer, Syn. Fish. North Am., 319, 1846 (copied). Holbrook, Ichthyol. S. Carolina, ed. 1, 149, plate 21, fig. 2, 1853 (South Carolina).

Johnius ocellatus Girard, U. S. & Mex. Bound. Survey, 14, plate viii, fig. 1–4, 1859 (Indianola, Tex.).

Sciæna ocellata Günther, Cat. Fish. Brit. Mus., ii, 289, 1860 (America). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 280 (Pensacola, Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 571, 1883. Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 233 (Cedar Key, Florida). Goode, Hist. Aquat. Anim., 371, plate 125, 1884.

Sciænops ocellatus Gill, Proc. Acad. Nat. Sci. Phila., 1863, 30 (name only). Uhler & Lugger, Fishes of Maryland, 100, 1876 (southern part Chesapeake Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 378 (Beaufort). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 113 (St. John's River, Florida). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 132 (Pensacola). Bean, Proc. U. S. Nat. Mus., 1880, 93 (St. John's River, Florida; Beaufort, N. C.; Fort Macon, N. C.).

Lutjanus triangulum Lacépède, Hist. Nat. Poiss., iv, 181 and 217, plate 24, fig. 3, 1802.

Sciæna imberbis Mitchill, Trans. Lit. & Phil. Soc., New York, 411, 1815 (New York).

Habitat.—South Atlantic and Gulf coasts of the United States, New York to Texas.

This species is common along our coast, especially to the southward, where it one of the largest and most important of the food-fishes. On the Texas coast, where it is known as "Red-fish," or "Pescado Colorado," it exceeds in economic value all other fishes found there.

64. SCIÆNA HETEROLEPIS.

Johnius heterolepis Bleeker, Archives Néerlandaises, viii, 1873, with plate (Surinam).

Habitat.—Surinam.

We know this species solely from Dr. Bleeker's account of it. It much resembles the species of *Ophioscion*, but from these it is apparently separated by the entire preopercle, which, in the figure, is represented much as in *Sciæna* and *Johnius*.

65. SCIÆNA AQUILA.

(THE MAIGRE.)

? *Labrus hololepidotus* Lacépède, Hist. Nat. Poiss., iii, 517, plate 21, fig. 2, 1802 (Cape of Good Hope).

Cheilodipterus aquila Lacépède, loc. cit., v, 685, 1803.

Sciæna aquila Cuv. & Val., v, 28, pl. 100. Günther, ii, 291, and of writers generally.

Perca vanloo Risso, Ichthyol. Nice, ed. i, 298, plate 9, fig. 30, 1810.

Sciæna umbra Cuvier, Mém. Mus., i, 1 (not of Linnæus).

? *Sciæna capensis* Smith, "Ill. S. Afr. Fishes, plate 15."

Habitat.—Coasts of Southern Europe (said to range southward to the Cape of Good Hope).

Our description of this species is taken from specimens in the museum at Cambridge from Cadiz, Spain.

If the accepted synonymy be correct, and the species found at the Cape of Good Hope be identical with the Maigre of Europe, the species should stand as *Sciæna hololepidota.* But this identity seems rather assumed than proved. The Australian "Jew-fish," until lately also identified with *Sciæna aquila*, is now recognized as a distinct species (*Sciæna neglecta* Ramsay). It is, therefore, not improbable that the form found at the Cape is also different.

This species reaches a large size. It is in many respects analogous to *Sciæna ocellata*, which species is perhaps its nearest relative among the American forms.

66. SCIÆNA DELICIOSA.

Corvina deliciosa Tschudi, Faun. Peru. Ichthyol., 8, 1845 (Peru).
Sciæna deliciosa Günther, Cat. Fish. Brit. Mus., ii, 295, 1860 (copied).

Habitat.—Pacific coast of South America, north to Panama.

This species is said to be one of the most abundant food-fishes on the coast of Peru. A great number of specimens are in the museum at Cambridge. Most of them are from Callao, but a few from Panama.

This is a strongly marked species, having no very near relatives anywhere, and, if the other subgenera are to be noticed, this must form an additional one, for which we have suggested the name of *Callaus* (from Callao). It resembles *Genyonemus lineatus* as much as any of our species, but it reaches a much larger size and it has no barbels.

67. SCIÆNA UMBRA.

Sciæna No. 2 Artedi, Genera, 39; Syn., 65, 1734 (Venice; Rome).
Sciæna umbra Linnæus, Syst. Nat., ed. x, 289, 1758 (based on Artedi).
Sciæna nigra Bloch, Icthyologia, vi, 35, taf. 297, 1792.
Johnius niger Bloch & Schneider, Syst. Ichth., 76, 1801.
Corvina nigra Cuv. & Val., and of most recent authors.
Coracinus chalcis Pallas, Zoographia Rosso-Asiatica, iii, 256, 1811.
Corvina canariensis Cuv. & Val., Hist. Nat. Poiss., v, 93, 1830 (Canaries).

Habitat.—Coasts of Southern Europe.

This species is generally common in the Mediterranean. The speci mens examined by us are from Venice.

As there can be no possible doubt that this is the original *Sciæna umbra* of Linnæus, we have adopted the name *umbra* instead of the more frequently used name *nigra*.

68. SCIÆNA SATURNA.

(RED RONCADOR, BLACK RONCADOR.)

Amblodon saturnus Girard, U. S. Pac. R. R. Survey, 98, 1859 (San Diego, California).
Corvina saturna Günther, Cat. Fish. Brit. Mus., ii, 288, 1860 (San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 49 (Santa Barbara southward). Rosa Smith, West American Scientist, 1885, 47 (San Diego).

Rhinoscion saturnus Gill, Proc. Acad. Nat. Sci. Phil., 1862, 17 (California).
Sciæna saturna Jordan & Gilbert, Syn. Fish. North America, 572, 1883.
Johnius saturnus Jordan, Cat. Fish. North America, 93, 1885 (name only).
Corvina (Johnius) jacobi Steindachner, Ichthyol. Beitr., viii, 3, 1879 (San Diego), based on young specimens.
Sciæna jacobi Jordan & Gilbert, Syn. Fish. North America, 571, 1883 (copied). Rosa Smith, West American Scientist, 1885, 47 (San Diego).

Habitat.—Coast of Southern California, north to Santa Barbara.

This species is common on the coast of Southern California, where it is a food-fish of some importance, and is usually known as the Red Roncador or Black Roncador. It reaches a length of something more than a foot.

The nominal species, called *Corvina jacobi*, described from young specimens taken at San Diego, is doubtless identical with *Corvina saturna*. The only difference indicated by Steindachner which could have any serious importance is in the coloration. In the species of *Hæmulon*, *Anisotremus*, and other analogous groups the young often have exactly the coloration assigned to *C. jacobi*, while the adult may be very differently marked. We have not seen the very young of *saturna*, but have no doubt that it passes through the "*jacobi*" coloration in the course of its development.

69. SCIÆNA FASCIATA.

Cheilotrema fasciatum Tschudi, Faun. Peru. Ichthyol., 13, plate i, 1845 (Peru).
Corvina fasciata Günther, Cat. Fish. Brit. Mus., i, 305, 1860 (copied).
Corvina fasciata Steindachner, Ichthyol. Not., vii, 21, 1868 (Chili).

Habitat.—Pacific coast of South America.

Our account of this species is taken from a large specimen (10839, M. C. Z.) from Payta, Peru.

The species is closely related to *Sciæna saturna*, but it is a more robust fish with heavier head. The genus *Rhinoscion*, based on *S. saturna*, is perfectly identical with *Cheilotrema*. The name *fasciata* is not a fortunate one, as the dark bands are not conspicuous and not permanent.

Genus XIII.—RONCADOR.

Roncador Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 28 (*stearnsi*).

TYPE: *Corvina stearnsi* Steindachner.

This genus contains, so far as known, a single species, a large Sciænoid of the California coast, much resembling *Aplodinotus grunniens* and having similar teeth, except that the lower pharyngeals in *Roncador* are separate. The Spanish name, *Roncador* (grunter), is one of general application to these fishes, but on the California coast it is used most particularly for the present one.

ANALYSIS OF SPECIES OF RONCADOR.

a. Body oblong, heavy forward; the back elevated and compressed; depth 3 in length; head 3½ to 3¾; profile long, steep, and convex, abruptly rounded at the snout; snout very blunt, 3½ in head, about equal to the interorbital space; eye 5 in head; mouth moderate, low, subinferior, the lower jaw included; maxillary 2⅔ in head, reaching at least to below middle of eye; preorbital nearly as broad as eye; teeth in both jaws in broad villiform bands, none of them enlarged; lower pharyngeals large, with many rounded molars, the outer series and a patch at the outer corner, composed of villiform teeth; gill-rakers slender, rather short, 7+15; posterior margin of preopercle with short, stout teeth; dorsal spines strong, the longest 2 in head; caudal lunate, the upper lobe the longer; second anal spine stout, 3½ in head; pectorals much longer than ventrals, about as long as head; scales below lateral line in slightly oblique series. Color grayish silvery, with bluish luster, some streaks of dark points along the rows of scales; breast and belly with two dusky longitudinal streaks; a very conspicuous jet black spot as large as eye at base of pectoral; axil and lining of gill cavity black. D. X-I, 24; A. II, 8; scales 6-60-9..STEARNSI, 70.

70. RONCADOR STEARNSI.

(THE RONCADOR.)

[Plate V.]

Corvina stearnsi Steindachner, Ichthyol. Beitr., iii, 22, 1875 (San Diego).
Roncador stearnsi Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 28 (San Diego) (gen. nov.). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 49 (Santa Barbara, southward). Jordan & Gilbert, Syn. Fish. North Am., 572, 1883. Rosa Smith, Proc. U. S. Nat. Mus., 1883, 234 (Todos Santos Bay, Lower California). Goode, Hist. Aquat. Anim., 379, plate 129, 1884 (Santa Barbara, Cal.). Rosa Smith, West American Scientist, 1885, 47 (San Diego). Jordan, Cat. Fish. North America, 93, 1885 (name only).

Habitat.—Coast of Southern California, north to Santa Barbara.

This species is rather common on the coast of Southern California, where it is a food-fish of some importance. It reaches a weight of 5 or 6 pounds.

The black ocellus on the base of the pectoral fin in this species is as characteristic as that at the base of the caudal in *Sciæna ocellata.*

Genus XIV.—LEIOSTOMUS.

Leiostomus Lacépède, Hist. Nat. Poiss., iv, 439, 1802 (*xanthurus*).
Liostomus Gill, Proc. Ac. Nat. Sci., 1863, 63 (corrected orthography).

TYPE: *Leiostomus xanthurus* Lacépède.

This genus, as now understood, contains but a single species. It is distinguished from *Sciæna* chiefly by the obsolescence of the teeth in the lower jaw, and by the more paved teeth of the pharyngeals. The soft rays of the dorsal fin and especially of the anal are more numerous than in related groups.

ANALYSIS OF SPECIES OF LEIOSTOMUS.

a. Body short, deep, much compressed; back in front of dorsal compressed to a sharp edge; profile steep, convex, depressed over the eyes; dorsal outline convex, highest at front of dorsal; depth 3 in length; head 3¼ to 3½; snout very blunt, as long as eye, 3¼ to 3½ in head; mouth small, inferior, horizontal; maxillary 3 in head, extending to below pupil; no teeth in lower jaw, in the adult; upper jaw with a narrow series of minute teeth; gill-rakers short, slender, 8 + 22; lower pharyngeals small, with three series of molars posteriorly and many villiform teeth anteriorly; preopercle entire; preorbital broad, 1½ in eye; third dorsal spine highest, 1½ in head; soft dorsal with the sheath at its base, formed by a single series of scales; caudal long and forked, as long as head; anal long and slightly falcate; second anal spine, 2½ in the longest ray, 4 in head; ventrals ⅓ shorter than pectorals which are as long as the head; scales small, strongly ctenoid, extending on caudal and base of pectorals but not on other fins; lateral line little curved anteriorly; scales below lateral line in oblique series. Color bluish above, silvery below; about 15 narrow dark wavy bands extending from the dorsal downward and forward to below lateral line; a round black humeral spot rather smaller than eye; fins plain olivaceous, the caudal not yellow. D. X-I, 31; A. II, 12; scales 9-60 to 70-12 ....XANTHURUS, 71.

71. LEIOSTOMUS XANTHURUS.

(THE SPOT; GOODY; POST-CROAKER; OLDWIFE; LAFAYETTE.)

[Plate VI.]

Leiostomus xanthurus Lacépède, Hist. Nat. Poiss., iv, 439, plate 10, fig. 1, 1802 (Carolina). Cuv. & Val., Hist. Nat. Poiss., v, 142, 1830 (Martinique). DeKay, New York Fauna, Fishes, 70, 1842 (New York). Storer, Syn. Fish. North Am., 321, 1846 (copied). Gill, Proc. Acad. Nat. Sci. Phila., 1863, 63 (N. Y. to S. C.). Uhler & Lugger, Fishes of Maryland, 99, 1876 (Lower Potomac, Chesapeake Bay, Sinepuxent Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 281 (Pensacola, Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 574, 1883. Bean, Internat. Fishery Exhib. Berlin, 55, 1883 (Brazos Santiago, Tex.; Pensacola, Fla.). Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 233 (Cedar Key, Florida). Jordan & Meek, Proc. U. S. Nat. Mus., 1884, 237 (St. John's River, Florida). Goode, Hist. Aquat. Anim., 370, plate 124, 1884 (Newport, R. I., and southward). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Homoprion xanthurus Holbrook, Ichthyol. S. Carolina, ed. 1, 170, 1856 (South Carolina). Girard, U. S. and Mex. Bound. Survey, 11, 1859 (Brazos Santiago, St. Joseph's, Texas).

Sciæna xanthurus Günther, Cat. Fish. Brit. Mus., ii, 288, 1860 (New York).

Mugil obliquus Mitchill, Trans. Lit. and Phil. Soc., New York, 405, 1815 (New York).

Leiostomus obliquus DeKay, New York Fauna, Fishes, 69, plate 60, fig. 195, 1842 (New York). Storer, Syn. Fish. North Am., 321, 1846 (copied). Holbrook, Ichthyol. S. Carolina, ed. 1, 164, plate 24, fig. 2, 1856 (South Carolina). Girard, U. S. and Mex. Bound. Survey, 11, 1859 (Brazos Santiago, Tex.; Indianola). Gill, Proc. Acad. Nat. Sci. Phila., 1863, 32 (north to Mass.). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort). Bean, Proc. U. S. Nat. Mus., 1880, 93 (St. John's River, Florida; Wood's Holl).

Sciæna obliqua Günther, Cat. Fish. Brit. Mus., ii, 288, 1860 (North America).

Sciæna multifasciata Lesueur, Journ. Ac. Nat. Sci. Phila., ii, 225, 1821.

Leiostomus humeralis Cuv. & Val., Hist. Nat. Poiss., v, 141, plate 110, 1830 (New York).

Leiostomus philadelphicus Goode, Proc. U. S. Nat. Mus., 1879, 113 (St. John's R.). Goode & Bean, l. c., 1879, 131 (Pensacola) (not *Perca philadelphica* L.).

Habitat.—South Atlantic and Gulf coasts of United States; Cape Cod to Texas; Martinique (?).

This species is one of the most common food-fishes of our southern coast, being an excellent pan-fish. Notwithstanding the numerous nominal species which authors have recognized, there is no evidence whatever of the existence of more than one species of *Leiostomus* on our coasts.

The name *xanthurus* is an unfortunate one, as in this species the caudal fin is never yellow. This name came about through confusion with *Bairdiella chrysura*, in which species the caudal fin is bright yellow.

Genus XV.—PACHYURUS.

Pachyurus Agassiz, Spix Pisces Brasiliens., 1829, 123 (*squamipennis*).
Lepipterus Cuvier & Valenciennes, Histoire Naturelle des Poissons, v, 151, 1830 (*francisci*).

TYPE: *Pachyurus squamipennis* Agassiz.

This genus is composed of fresh-water Sciænoids inhabiting the rivers of Brazil. It is well separated from *Sciæna* (*Ophioscion*) by the weak dentition. Two groups or subgenera are readily distinguished by the form of the mouth, the group called *Lepipterus* agreeing in this respect very closely with the species called *Pachypops*, from which *Lepipterus* can only be separated by the absence of the small barbels at the chin, which are usually present in the species of *Pachypops*. As these barbels are quite small, and in individuals even occasionally absent, Dr. Steindachner has proposed to unite *Pachypops* with *Lepipterus* as a subgenus under *Pachyurus*. There is no doubt that *Pachypops*, *Lepipterus*, and *Pachyurus* together constitute a single natural group. The characters drawn from the form of the mouth and of the preorbital are subject to intergradation. Unless the presence of the barbel can here, as elsewhere, be used as a mark of generic distinction, all the species must be placed in *Pachyurus*. It seems to us, however, that convenience is but served by placing all the species in which barbels are habitually developed in one genus (*Pachypops*), and those which never have them in another (*Pachyurus*).

ANALYSIS OF SPECIES OF PACHYURUS.

a. Mouth terminal, oblique, small, but larger than in other species; the maxillary reaching front of pupil, its length about $2\frac{2}{3}$ in head; jaws subequal; caudal fin densely covered with scales, so that it is thick to the touch; preorbital scarcely turgid (*Pachyurus*).

b. Body compressed; the back elevated, the nape especially compressed; head low and narrow; profile depressed above the eyes, so that the sharp, projecting snout leaves a considerable concavity in the line of the profile; teeth in broad bands, all equally minute in both jaws; preorbital broad, broader than eye; skull not specially cavernous; pores and slits on snout obsolete; preopercle sharply but rather finely serrate on the bony border; eye large, $5\frac{1}{3}$ in head; snout $3\frac{2}{3}$; interorbital width $5\frac{1}{3}$; gill-rakers almost obsolete, 2 + 4 in number, not higher than wide; pseudobranchiæ small; caudal fin rhombic, much thickened; soft dorsal scaly, but not thickened; longest dorsal spine 2½ in head; anal scaleless, its second spine very strong, 1⅓ in head; pectoral 1⅔ in head; color silvery, with narrow dark streaks above the lateral line; both dorsals profusely covered with fine dark spots; head 3¼; depth 3½. D. X–I, 35; A. II, 7; scales 67 to 68; those in the lateral line scarcely larger .... SQUAMIPINNIS, 72.

aa. Mouth small, inferior, the maxillary barely reaching front of eye, about 3½ in head; lower jaw included; caudal fin less thickened; preorbital more or less cavernous and turgid (*Lepipterus* Cuv. & Val.).

c. [Dorsal rays X–I, 33; body elongate; head long and depressed over the eyes; depth 6 in length; head 4; maxillary concealed under preorbital; teeth in fine bands; mouth small, maxillary not reaching to front of eye; preopercle serrate; dorsal spines feeble, flexible, and little elevated; dorsal rays subequal; caudal rounded; dorsal and caudal completely scaled; second anal spine curved and compressed, larger and stronger than in related species; color entirely silvery, with numerous darker lines along the back; brown spots on second dorsal. D. X–I, 33; A. II, 7.] (*Cuv. & Val.*)..FRANCISCI, 73.

cc. Dorsal rays X–1, 26 to 29.

d. Second anal spine very long, 2 in head; anterior profile more or less concave, rather steep posteriorly; profile of snout convex; snout 3 in head; mouth small, with very small teeth overlapped by the turgid and translucent preorbital; eye large, 4½ in head; maxillary 3⅓; caudal fin rhombic, densely scaled, but less thickened than in *P. squamipinnis;* soft dorsal much scaly; anal naked; dorsal spines slender, the longest 2 in head, about as long as second anal spine; preopercle strongly serrate; gill-rakers very small; pectoral 1⅓ in head; color brownish, silvery below; traces of 2 or 3 faint dark streaks on posterior part of body above; spinous dorsal mostly black; soft dorsal with some dark spots; head 3½ to 3⅔ in length; depth 3⅓ to 3½. D. X–I, 26 to 29; A. II, 6 to 8; scales 65 (pores) to 70 (series)..BONARIENSIS, 74.

dd. [Second anal spine shorter, 3 in head; body slightly compressed and somewhat elongate; head conical, elongate; snout produced and somewhat pointed, 2⅔ in head; eye 4 in head; preorbital much swollen, concealing the maxillary; mouth inferior, small; maxillary not reaching to below eye; preopercle with moderate spinous teeth; longest dorsal spines ⅖ of depth of body; all the spines slender; soft dorsal scaly ⅘ of its height; caudal pointed; second anal spine 3 in head; anal rays naked, shorter than dorsal rays; scales small, finely ciliated; teeth minute, scarcely perceptible in upper jaw, in a fine villiform band below; body and second dorsal with blackish spots; head 4 in length; depth 4½. D. X–I, 26; A. II, 7; scales 9–85–20.] (*Günther.*) .... SCHOMBURGKI, 75.

72. PACHYURUS SQUAMIPINNIS.

Pachyurus squamipinnis (misprinted "*squamipennis*") Agassiz, Spix. Pisc. Bras., 123, plate 71, 1829 (Brazil). Günther, Cat. Fish. Brit. Mus., ii, 281, 1860 (Atlantic Ocean). Steindachner, Ichthyol. Beitr., viii, 13, 1879 (Rio São Francisco; Rio das Velhas).

Pachyurus lundii (Reinhardt, MS.). Lütken, Velhas-Flodens Fiske, xx, 1875 (Rio das Velhas).

Habitat.—Rivers of Brazil.

The numerous specimens of this species which we have examined are from the Rio das Velhas, in Brazil. The largest of these (8634, M. C. Z.) is about 15 inches long.

73. PACHYURUS FRANCISCI.

Lepipterus francisci Cuv. & Val., Hist. Nat., v, 152, plate 113, 1830 (Rio São Francisco).
Pachyurus francisci Günther, Cat. Fish. Brit. Mus., ii, 281, 1860 (copied).
Pachyurus corvina (Reinhardt MS.), Lütken, Velhas-Flodens Fiske, xx, 1875 (Rio das Velhas).

Habitat.—Rivers of Brazil.

We know this species from descriptions only.

74. PACHYURUS BONARIENSIS.

Pachyurus bonariensis Steindachner, Ichthyol. Beitr., viii, 8, 1879 (Rio de la Plata).

Habitat.—Basin of the Rio de la Plata.

We have examined three specimens of this species in the Museum of Comparative Zoology. Two of them, each about a foot in length, are from Buenos Ayres, the other from Rosario.

75. PACHYURUS SCHOMBURGKI.

Pachyurus schomburgki Günther, Cat. Fish. Brit. Mus., ii, 282, 1860 (Rio Capin; Carife; Pará). Steindachner, Ichthyol. Beiträge, viii, 11, 1879 (Pará; Cameta; Obidos; Lake Saraca; Rio Negro; Rio Branco).
Pachyurus nattereri Steindachner, Beitr. zur Kenntn. der Sciæn. Brasil., 10, plate iii, 1863 (Rio Branco; Rio Negro).

Habitat.—Rivers of Brazil.

This species is known to us from descriptions only. We have failed to recognize it in the collections at Cambridge. We follow Steindachner in regarding his *Pachyurus nattereri* as a synonym of *schomburgki*.

Genus XVI.—PACHYPOPS.

Pachypops Gill, Proc. Ac. Nat. Sci. Phila., 1861, 87 (*trifilis*).

TYPE: *Micropogon trifilis* Müller & Troschel.

This genus, like *Pachyurus*, is composed entirely of fresh-water species, inhabiting the Amazon region. It differs from *Pachyurus* only in the presence of small barbels at the chin, and in some individuals these appendages may be rudimentary or even wanting. For this reason Dr. Steindachner has proposed to regard this character as of no systematic importance, and to place these species in the subgenus *Lepipterus* under *Pachyurus*. But unless it can be shown that the *Pachyuri* sometimes possess barbels, it seems to us better to retain the two groups as distinct genera.

ANALYSIS OF SPECIES OF PACHYPOPS.

a. Dorsal rays X-I, 25 to 27; body without conspicuous dark brown spots; caudal rhombic; teeth all equally small.
b. Maxillary scarcely reaching front of eye, its length 4 to 4½ in head; barbels 3, minute (sometimes obsolete); snout prominent, blunt, 2¾ in head; eye very large, 3 in head; mouth very small, overlapped by the turgid preorbital; teeth small, equal; gill-rakers very small; soft dorsal and anal completely scaled; pectorals 1½ in head; caudal rhombic, 1¼ in head; second anal spine 2½ in head;

longest dorsal spine 1¼. Color uniform dusky, paler below; dorsals punctate with black. Head 3½; depth 4. D. X-I, 25 to 27; A. II, 6. Scales 58. FURCRÆUS, 76.

bb. [Maxillary reaching line of front of eye, its length 3½ in head; barbels 3, well developed; body oblong, compressed; eye not very large, 3½ to 3⅜ in head; snout prominent, rounded, 3½ in head; preorbital broad; teeth equal; preopercle rather finely serrate; soft dorsal closely scaled; anal scaly at base only; pectoral, 1⅞ in head; caudal rhombic, 1¼ in head; second anal spine, 2⅙; third dorsal spine, 1⅝. Color silvery, with 5 dusky longitudinal bands; dorsals edged with black, the membranes of the spinous part with longitudinal series of dark dots. Head 3⅛; depth 3½. D. X-I, 26; A. II, 6. Scales 50 to 55.] (*Steindachner.*)..TRIFILIS, 77.

aa. Dorsal rays X-I, 31 or 32; back and dorsal fins sprinkled with round dark spots; caudal fin not rhombic; outer teeth above slightly enlarged. Body rather elongate, the back elevated; head rather slender, depressed above the eye; snout rather long, bluntish at tip, 3 in head; eye large, 5 in head; mouth small, low, inferior, scarcely overtipped by the snout, the maxillary reaching front of eye, 3⅛ in head; teeth in broad bands, the outer teeth of upper jaw somewhat enlarged; barbels at chin 3, minute, not longer than nostril; preopercle sharply serrate. Gill-rakers slender, very short; preopercle and especially preorbital much swollen, cavernous, and translucent; mandible not cavernous; dorsal spines strong, the longest 2 in head, as long as the large anal spine; pectoral 1⅞ in head; caudal fin *f*-shaped, the upper lobe pointed. Color brown, with round dark-brown spots scattered over the back and sides, these forming streaks along the rows of scales, which are more or less irregular or interrupted, the spots not being confluent; both dorsals with rows of similar spots; ventrals dusky. Head 3½ in length; depth 3⅝. D. X-I, 31 or 32; A. II, 6 to 8. Scales 75 (8-67-13)..............ADSPERSUS, 78.

76. PACHYPOPS FURCRÆUS.

Perca furcræa Lacépède, Hist. Nat. Poiss., iv, 398, 424, 1802 (? Surinam).
Corvina furcræa Cuv. & Val., Hist. Nat. Poiss., v, 111, 1830 (same type).
Pachypops furcræus Steindachner, Beitr. zur Kenntniss Sciænoiden Brasiliens, 7, plate 1, 1863 (Rio Negro).
Pachyurus furcræus Steindachner, Ichthyol. Beitr., viii, 12, 1879 (Surinam; Rio Trombetas; Rio Negro; Amazon, near Cameta).
Corvina biloba Cuv. & Val., Hist. Nat. Poiss., v, 112, 1830 (habitat not known).
Pachypops biloba Steindachner, Ichth. Notiz., 206, 1864 (Surinam).

Habitat.—Rivers of Brazil and Guiana.

Specimens of this species are in the museum at Cambridge from Rio Trombetas, Rio Negro, Obidos, and Cameta. The specimen here described was obtained in Rio Negro by Rev. J. C. Fletcher.

This species was named in honor of a French chemist, Fourcroi.

77. PACHYPOPS TRIFILIS.

Micropogon trifilis Müller and Troschel, Schomburg Reise, iii, 622, 1848 (Guiana). Günther, Cat. Fish. Brit. Mus., ii, 273, 1860 (copied).
Pachypops trifilis Gill, Proc. Acad. Nat. Sci. Phila., 1861, 87 (copied). Steindachner, Beitr. zur Kenntniss Sciænoiden Brasiliens, 7, plate ii, figs. 1-3, 1863 (Rio Guaporé; Rio Negro).
Pachyurus trifilis Steindachner, Ichthyol. Beitr., viii, 12, 1879 (synonymy).

Habitat.—Rivers of Brazil and Surinam.

This species is known to us from Dr. Steindachner's descriptions and figure only.

78. PACHYPOPS ADSPERSUS.

? *Corvina grunniens* Schomburgk, Nat. Libr. Fish. Guiana, 1843, 136 (Rio Essequibo).
Pachyurus (*Lepipterus*) *adspersus* Steindachner, Ichthyol. Beitr., viii, 5, 1879 (Rio Parahyba, Rio Doce, Rio San Antonio, Mucuri).

Habitat.—Rivers of Brazil.

We have examined numerous specimens of this species in the museum at Cambridge from Rio Doce, Santa Clara, Rio San Antonio, and Menchez. The specimen described, 15 inches in length, is from the Rio Doce.

The scanty description of *Corvina grunniens* indicates some river Sciænoid, with distinctly spotted dorsal and anal fins, and with the fin rays D. IX, 32; A. II, 7. The account comes nearest among known species to *Pachypops adspersus*, and if this species occurs in the Essequibo it should probably stand as *Pachypops grunniens*. But without a better knowledge of the local fauna of Guiana, such an identification would be premature.

Genus XVII.—POLYCIRRHUS.

Polycirrhus Bocourt, Nouv. Arch. Mus. d'Hist. Nat., iv, 22, 1868 (*dumerili*).

TYPE: *Polycirrhus dumerili* Bocourt.

This genus is composed of three species of Sciænoid fishes, distinguished from *Micropogon* chiefly by the absence of serræ on the preopercle, and from *Genyonemus* by having the normal number of dorsal spines. All the known species are marked by well-defined dark cross-bands, and all belong to the fauna of South America.

ANALYSIS OF SPECIES OF POLYCIRRHUS.

a. Dorsal rays about IX–I, 22; caudal fin double truncate; body rather elongate, the back somewhat elevated, the head low and small; profile steep; ventral outline straightish; snout not very short, somewhat acute, 3½ in head; interorbital area broad, convex, 3 in head; eye 5½; mouth small, entirely inferior, maxillary extending past middle of eye, 2⅗ in head; teeth small, villiform, the outer scarcely larger; preopercle rounded, its edge with soft cilia; third dorsal spine 3 in head; soft dorsal with a scaly sheath, its membranes with small scales; ventrals filiform at tip, 1⅓ in head; anal inserted well forward, its second spine 2⅘ in head; caudal double truncate; lateral line much arched anteriorly. Color, bluish-gray, silvery below; 6 rather broad distinct cross-bars extending down to edge of belly; two inconspicuous dark cross-bars on head; lower fins pale. Head 3⅗ to 3⅘ in length; depth 3⅗ to 3¼. D. IX–I, 22 to 25; A. II, 7 or 8; scales 6–47 to 52–9 .... DUMERILI, 79.

aa. Dorsal rays X–I, 26 to 32.

b. Caudal fin obliquely truncate, or somewhat pointed. Dorsal rays X–I, 29 to 31; snout short, 3⅘ to 4½ in head; body more elongate than in *P. dumerili*, the snout lower, shorter, and more pointed; maxillary 3⅓ to 3½ in head; gill-rakers minute; fins scaly; soft dorsal rays 3 in head; eye 4½ to 6; longest dorsal spine 2⅓; caudal 1$\frac{1}{10}$ in head; second anal spine very small, 4⅓ in head; pectoral 1⅓; preopercle ciliated on its membranous border. Coloration less marked than in *P. dumerili*, the darker cross-bands narrower, more numerous (about 8), and less sharply defined; the anterior band sometimes reduced to a large round black blotch above base of pectoral; pectoral mostly dusky. Head 4; depth 3½. D. X–I, 29 to 31; A. II, 8; scales about 7–58–11 .. BRASILIENSIS, 80.

bb. Caudal fin slightly lunate or S-shaped; body compressed, rather robust; head low, little compressed, the snout extremely short and blunt, 4⅗ in head; gill-rakers small and slender; barbels well developed, about as in the other species; eye 4⅗ in head; mouth larger and more oblique than in the other species; the maxillary 3⅓ in head; pectoral 1⅓ in head; longest dorsal spine 2; second anal spine 3⅘. Color soiled, hardly silvery; about eight short, rather faint, dark cross-bands, as wide as the interspaces; fins all dusky. Head 3⅘ in length; depth 3⅘. D. X–I, 26; A. II, 9; scales 55.......PERUANUS, 81.

79. POLYCIRRHUS DUMERILI.

Polycirrhus dumerili Bocourt, Nouv. Arch. Mus. d'Hist. Natur., iv, 22, 1868 (La Union). Jordan, Proc. Acad. Nat. Sci. Phila., 1883, 288 (La Union) (note on Bocourt's type).

Genyonemus fasciatus Steindachner, Ichthyol. Beitr., ii, 31, 1875 (Panama). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 111 (Panama).

Habitat.—Pacific coast of Central America; Panama.

This small species is rather abundant about Panama. An examination of Bocourt's type of *Polycirrhus dumerili* has shown its identity with the *Genyonemus fasciatus* of Steindachner. The specimens in the museum at Cambridge are from Panama.

80. POLYCIRRHUS BRASILIENSIS.

Genyonemus brasiliensis Steindachner, Ichthyol. Beitr., ii, 34, 1875 (Pará, Santos).

Micropogon ornatus Günther, Shore Fishes Challenger, 13, plate vii, fig. A, 1880 (mouth of Rio de la Plata).

Habitat.—Coast of Brazil.

The specimens of this species in the Museum of Comparative Zoology are from Rio Janeiro and Santos. The identity of *ornatus* with *brasiliensis* has been claimed by Dr. Steindachner. Günther's description does not agree very well with the specimens examined by us, which are a part of the number of Dr. Steindachner's original types. It is not likely, however, that they belong to a different species.

81. POLYCIRRHUS PERUANUS.

Genyonemus peruanus Steindachner, Ichthyol. Beiträge, ii, 27, 1879 (Callao; Payta).

Habitat.—Coast of Peru.

The specimens of this species in the museum at Cambridge are from Callao and Payta. They are among the original types of Dr. Steindachner.

Genus XVIII.—GENYONEMUS.

Genyonemus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 87 (*lineatus*).

TYPE: *Leiostomus lineatus* Ayres.

This genus contains but a single species, abundant along the coast of California.

Although in a general way allied to *Polycirrhus* and *Micropogon*, it has some points of resemblance to *Corvula* and *Bairdiella*, and especially to *Sciæna deliciosa*.

ANALYSIS OF SPECIES OF GENYONEMUS.

a. Body oblong, somewhat compressed, the back little elevated; depth 3⅛ to 3⅜ in length; head 3⅛ to 3½; profile little convex, rather abruptly decurved at the snout; snout 4½ in head; mouth subinferior, somewhat oblique; maxillary 3 in head, reaching posterior margin of pupil, lower jaw included; teeth in villiform bands, the outer series above slightly enlarged; chin with five small pores and two series of minute barbels; preorbital two-thirds width of eye, which is 5½ in head; preopercle with a crenulate membranous border; opercle with radiating striæ; gill-rakers short and slender, 7+19; third dorsal spine highest, 1½ in head; first soft rays of dorsal highest, decreasing in height to the last; caudal lunate; first ventral ray produced as a filament, 1½ in head; pectoral slightly longer than ventrals; scales large, strongly ctenoid, those below lateral line in horizontal series; color silvery with brassy luster and black punctulations, these forming faint, oblique dark lines along the rows of scales; fins yellowish; axil black. D. XIII-I, 21 or 22; A. II, 11; scales 7-54-10 .... LINEATUS, 82.

82. GENYONEMUS LINEATUS.

Leiostomus lineatus Ayres, Proc. Cal. Acad. Nat. Sci., 1855, 25 (San Francisco). Girard, Proc. Acad. Nat. Sci. Phila., 1856, 135 (San Francisco). U. S. Pac. R. R. Survey, 99, plate 22 B, fig. 1-4, 1859 (San Francisco).

Sciæna lineata Günther, Cat. Fish. Brit. Mus., ii, 288, 1860 (copied).

Genyonemus lineatus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 89 (name only). Gill, Proc. Acad. Nat. Sci. Phila., 1862, 17 (name only). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (San Francisco, Monterey Bay, San Luis Obispo, Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 49 (San Francisco, southward). Jordan & Gilbert, Syn. Fish. North America, 574, 1883. Jordan, Cat. Fish. North America, 94, 1885 (name only).

Habitat.—Coast of Southern California, north to San Francisco.

This little fish is generally common along the coast of Southern California, where it is a food-fish of some importance and is usually known as the "Little Roncador."

Genus XIX.—MICROPOGON.

Micropogon Cuvier & Valenciennes, Hist. Nat. Poiss., v, 213, 1830 (*lineatus*=*furnieri.*)

TYPE: *Micropogon lineatus* Cuv. & Val.= *Umbrina furnieri* Desmarest.

The species of this well-marked genus are very closely related and are all American.

ANALYSIS OF SPECIES OF MICROPOGON.

a. Dorsal rays X-I, 28 to 30.

b. Scales comparatively small, about 9 in a vertical series between front of dorsal and lateral line, 12 in an oblique series; outer teeth of upper jaw evidently enlarged; dark spots on scales above lateral line not forming continuous stripes; 16 scales in an oblique series from vent upward and forward to lateral line. Body rather robust, the back elevated; profile regularly rounded, scarcely depressed above eyes; snout 3 in head; eye 5 in head; preorbital broader than eye; preopercle strongly serrate along its whole posterior margin; maxillary reaching front of pupil, 3 in head; gill-rakers slender, very short, numerous, about 7 + 16; third dorsal spine 2 in head; pectoral 1⅜ in head; caudal double truncate, 1⅘ in head; second anal spine 3 in head. Color brassy, paler below; middle part of body with short, irregular dusky vertical bars crossing the lateral line; many dark-brown spots on sides of back, irregularly placed, and not forming continuous streaks along the rows of scales; usually some of these coalesce to form two dark streaks concurrent with the back. Head 3 in length; depth 3¼. D. X–I, 28 or 29; A. II, 7; lat. l. 54 .... UNDULATUS, 83.

bb. Scales larger, 7 in a vertical series from front of dorsal to lateral line, 9 or 10 in an oblique series; teeth of outer series in upper jaw scarcely enlarged; dark spots on back forming continuous dark streaks nearly as wide as the pale interspaces; body a little more slender than in *M. undulatus*; profile almost straight, a little depressed above the eye; snout long, 3 in head; eye small, 6 in head, 1½ in interorbital area; preorbital wider than eye; maxillary 3 in head, reaching front of pupil; teeth in broad, villiform bands; preopercle less strongly serrate than in *M. undulatus;* third dorsal spine highest, 1⅘ in head; dorsals connected by a low membrane; dorsal with a sheath at its base formed by a single series of scales; soft dorsal naked; second anal spine 5 in head; scales of the breast and head cycloid; a dark spot on opercle; axil dusky; short vertical bars extending across lateral line; many oblique lines above these; markings more regular, though less sharply defined than in *M. undulatus*. Head 3⅘ in length; depth 3¼ to 3⅖. D. X–I, 30; A. II, 7; lateral line 54 .... FURNIERI, 84.

aa. Dorsal rays X–I, 24 to 26; outer teeth of upper jaw scarcely enlarged; scales rather large; snout little projecting; lateral line 48 (oblique series, 53 pores); scales between front of dorsal and lateral line, vertically 6 or 7; obliquely 8; 16 in an oblique series from vent; profile gibbous above the eyes, depressed at the nape; eye 1⅘ in snout, 6 in head; mouth broad, inferior, slightly oblique; maxillary entirely concealed by the broad preorbital, which is wider than the eye; maxillary extending to below anterior margin of the orbit; teeth in both jaws in villiform bands, those of the outer series of the upper jaw somewhat enlarged; preopercle with two strong spines at the angle and many smaller ones above these; gill-rakers little developed, not half the length of the pupil, 7 + 12; third dorsal spine highest, reaching to first soft ray, 1⅗ in head; soft rays of dorsal subequal; caudal double truncate; anal spine moderate, 1⅗ in the rays, 3⅓ in head; pectorals ⅙ longer than ventrals, slightly less than 1½ in head; scales on cheek, opercle, and breast cycloid, the rest ctenoid; soft dorsal with a weak scaly sheath anteriorly; soft dorsal and anal naked; lateral line arched anteriorly, becoming straight slightly in front of anal fin. Color, grayish silvery; dorsal region and sides above lower edge of pectorals marked with dark streaks extending obliquely upward and backward along the series of scales; about ten short oblique bars extending downward and forward across the arched portion of the laterial line; lining of gill cavity blackish; fins all yellowish; tip of spinous dorsal blackish; upper edge of pectoral and border of soft dorsal dusky. Head 3⅘ in length; depth 3⅘. D. X–I, 24 to 26; A. II, 7; scales 7–53–10 .... ECTENES, 85.

aaa. Dorsal rays X–I, 20 to 22; outer teeth of upper jaw scarcely enlarged; snout somewhat projecting; scales still larger; lateral line 42 (49 pores); scales above the lateral line, vertically, 5 or 6; obliquely, 8; 12 in an oblique series from vent; maxillary extending scarcely beyond the vertical from the anterior margin of the eye; body less elongate than in *Micropogon ectenes*; highest dorsal spines 1⅓ in head; anal spine about 4 in head; coloration essentially as in *Micropogon ectenes*. Head 3½ in length; depth 3⅗. D. X–I, 20 to 22; A. II, 7. Scales 7–48–15 .... ALTIPINNIS, 86.

83. MICROPOGON UNDULATUS.

(THE CROAKER.)

[Plate VII.]

Perca undulata Linnæus, Syst. Nat., ed. xii, 483, 1766 (South Carolina). Bloch & Schneider, Syst. Ichth., 87, 1801.

Micropogon undulatus Cuv. & Val., Hist. Nat. Poiss., v, 219, 1830 (New Orleans). Storer, Syn. Fish. North Am., 325, 1846 (copied). Holbrook, Ichth. S. Carolina, 145, plate 21, fig. 2, 1856 (South Carolina). Girard, U. S. & Mex. Bound. Survey, 13, plate xii, 1859 (mouth Rio Grande, Indianola, Galveston, Saint Joseph's Island, Texas). Günther, Cat. Fish. Brit. Mus., ii, 271, 1860 (in part) (New York). DeKay, New York Fauna, Fishes, 84, 1862 (New York). Uhler & Lugger, Fishes of Maryland, 102, 1876 (southern part Chesapeake Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 378 (Beaufort). Goode, Proc. U. S. Nat. Mus., 1879, 113 (Saint John's River, Florida). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 132 (Pensacola). Bean, Proc. U. S. Nat. Mus., 1880, 94 (Saint John's River, Florida). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 282 (Pensacola; Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Bean, Internat. Fishery Exhib. Berlin, 56, 1883 (Arlington, Florida). Jordan & Gilbert, Syn. Fish. North Am., 575, 1883. Jordan, Proc. U. S. Nat. Mus., 1884, 36 (Pensacola). Goode, Hist. Aquat. Anim., 378, plate 128, 1884 (Newport, R. I., and southward). Goode & Bean, Proc. U. S. Nat. Mus., 1885, 202, Linnæan types (South Carolina).

Sciæna croker Lacépède, Hist. Nat. Poiss., iv, 309, 314, 316, 1802 (Carolina).

Bodianus costatus Mitchill, Trans. Lit. and Phil. Soc. New York, 417, 1815 (New York).

Micropogon costatus DeKay, New York Fauna, Fishes, 83, plate 72, fig. 230, 1842 (New York). Storer, Syn. Fish. North Am., 325, 1846 (copied).

Habitat.—South Atlantic and Gulf coasts of the United States, Cape Cod to Texas.

This species is generally common along our Atlantic coast, becoming very abundant southward, but not extending into the West Indies. It is a food-fish of some importance.

84. MICROPOGON FURNIERI.

(VERRUGATO.)

*Umbrina furnieri** Desmarest, Première Décade Ichthyol., 22, plate ii, fig. 3, 1823 (Cuba).

Micropogon furnieri Jordan, Proc. U. S. Nat. Mus., 1884, 37 (Havana). Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 157 (Jamaica). Jordan, Proc. U. S. Nat. Mus., 1886, 44 (Havana).

Sciæna opercularis Quoy & Gaimard, Voy. Uran., Zool., 347, 1824 (Rio Janeiro).

Micropogon lineatus Cuv. & Val., Hist. Nat. Poiss., v, 215, plate 119 (Brazil; Porto Rico; Havana).

Micropogon argenteus Cuv. & Val., Hist. Nat. Poiss., v, 218 (Surinam).

Micropogon undulatus Günther, Cat. Fish. Brit. Mus., ii, 271, 1860 (in part; not *Perca undulata* L.) (Surinam; Bahia; Guatemala; Cuba; Jamaica). Günther, Fishes Central America, 387, 1869 (Atlantic coast of Central America). Poey, Synopsis, 325, 1868 (Cuba). Poey, Enumeratio, 48, 1875 (Cuba). Günther, An. & Mag. Nat. Hist., July, 1880 (Rio Plata). Poey, Fauna Puerto-Riqueña, 325, 1881 (Porto Rico).

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* This species, although named for its discoverer, Marcellin Fournier, is always written *furnieri* by Desmarest.

Habitat.—West Indies and coasts of South America.

This species is generally common in the West Indies and southward along the coast of Brazil. It is very close to the northern *Micropogon undulatus*, and for this reason its real distinction from the latter has been generally overlooked until quite lately. We have examined numerous specimens from Cuba and from Rio Janeiro.

85. MICROPOGON ECTENES.

Micropogon ectenes Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 355 (Mazatlan); Bull. U. S. Fish Com., 1882, 107 (Mazatlan).

Habitat.—Pacific coast of Mexico; Mazatlan.

This species was found by Professor Gilbert in moderate abundance at Mazatlan, where it seems to take the place of the closely allied *Micropogon altipinnis*.

86. MICROPOGON ALTIPINNIS.

Micropogon altipinnis Günther, Proc. Zool. Soc., 1864, 149 (San José; Panama; Chiapam). Günther, Fish. Central America, 387 and 425, 1869 (Chiapam; San José; Panama). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 111 (Panama).

Habitat.—Pacific coast of Central America.

This species is closely related to the others of the genus. It was found by Dr. Gilbert at Panama. Specimens from Panama are also in the museum at Cambridge.

Genus XX.—UMBRINA.

Sciæna (part) Artedi, 1738 (includes *Corvina*).

Sciæna (part) Linnæus, Systema Naturæ, ed. x, 289, 1758 (*umbra; cirrosa*).

Umbrina Cuvier, Règne Animal, ed. i, 297, 1817 (*cirrosa; Sciæna* L. being restricted to *Sciæna umbra*, a Linnæan, and *Sciæna aquila*, a non-Linnæan species).

Sciæna Bleeker,* Poissons de la Côte de Guinée, 1862, 66 (*cirrosa;* not the earliest restriction to a Linnæan type).

Umbrina Günther, Gill, Jordan & Gilbert, and of authors generally.

TYPE: *Sciæna cirrosa* Linnæus.

This genus contains a considerable number of species, most of them being American. It agrees with *Sciæna* in nearly all respects, excepting the presence at the chin of a short, thick barbel. A similar barbel is found in the genus *Menticirrhus*, but notwithstanding the fact that all European writers have confounded *Menticirrhus* with *Umbrina*, the two genera are not among the most closely related in this family.

* "Je note ici que l'espèce typique du genre *Sciæna* Art. étant l'*Umbrina cirrosa* CV., le nom de *Sciæna* devra être appliqué aux espèces dont Cuvier a fait des Umbrina, et ne pourra plus être employé dans le sens de Cuvier. Ni M. Günther ni M. Gill, dans leurs travaux sur les Sciénoïdes, paraissent avoir fait attention à ce que le nom générique d'Artedi est mal employé par les auteurs modernes, et M. Gill cite même le *Sciæna aquila* comme le type du genre." (*Bleeker, l. c.*)

In quoting *Umbrina cirrosa* as the type of Artedi's genus *Sciæna*, Bleeker means merely that it is the one placed first by Artedi in the list of species.

We find ourselves unable to follow Bleeker in using the name *Sciæna* for the group usually called *Umbrina*, for reasons which may be again briefly stated. *Sciæna* was originally (Artedi, 1738; Linnæus, 1758) founded on the typical species of the two modern genera *Umbrina* and *Corvina*. In 1817, *Umbrina* was set off from this group and *Sciæna* was made to apply to the group later called *Corvina*, a third species (*aquila*) being added to *Sciæna*. Later (1829) *Corvina* was separated by Cuvier. This gave *Umbrina*, *Corvina*, and *Sciæna*, the latter name then standing for *aquila*. In 1862, Bleeker proposed to use *Sciæna* for the type of *Umbrina*, because in enumerating his species of *Sciæna*, Artedi had made the *Umbrina* "No. 1" and the *Corvina* "No. 2." This is, however, a matter of no significance. In our view but one arrangement of these names is allowable. *Umbrina* must stand, *Sciæna* must take the place of *Corvina*, and the third species (*aquila*) must take a new name—*Pseudosciæna* Bleeker.

ANALYSIS OF SPECIES OF UMBRINA.

a. Dorsal rays X–I, 22 to 24.

b. Snout moderate, $3\frac{1}{8}$ in head; stripes on body yellowish, bordered with steel blue; preopercle with its bony margin distinctly serrate, the teeth at the angle broad and flattish. Body rather deep, the back elevated, the dorsal outline regularly rounded, highest at first dorsal spines; profile steep; snout low, bluntish, $3\frac{1}{8}$ in head; eye small, $1\frac{5}{8}$ in snout, $1\frac{1}{8}$ in interorbital area, about $5\frac{1}{2}$ in head; mouth moderate, inferior; maxillary reaching front of eye, $3\frac{1}{8}$ in head; preorbital one-third broader than eye; teeth villiform, in broad bands, the outer above little enlarged; lower pharyngeal teeth stout, conical, the inner posterior series slender. Spinous dorsal high the third spine $1\frac{1}{2}$ in head; soft dorsal scaleless; second anal spine small, $1\frac{2}{3}$ in soft rays, $2\frac{2}{3}$ in head; pectorals little shorter than ventrals, which are $1\frac{5}{8}$ in head; caudal slightly lunate, the upper lobe the longer. Color olivaceous, silvery below; upper parts with many wavy lines, yellowish in color, and each bordered on each side by a distinct streak of steel blue; the lines partly following the rows of scales, running nearly straight upward and backwards at the shoulders, more nearly horizontal, more irregular and more or less broken posteriorly; free membrane of opercle jet black within and without; gill cavity pale. Head $3\frac{4}{5}$ in length; depth $3\frac{1}{6}$ to $3\frac{1}{2}$. D. X–I, 22 to 24; A. II, 7; scales 9–51 (pores)–12; about 65 transverse series of scales .... CIRROSA, 87.

bb. [Snout very short, $4\frac{1}{2}$ in head; stripes on body dusky. Body somewhat elongate; the ventral outline straightish, dorsal outline elevated and much convex; profile steep and convex, slightly depressed over the eyes; snout bluntish, $4\frac{1}{2}$ in head; eye 6 in head, about equal to the broad preorbital; mouth subinferior, horizontal; maxillary reaching past middle of eye, $3\frac{1}{4}$ in head; barbel very short; dorsal spines rather strong, the longest $2\frac{1}{8}$ in head; anterior dorsal rays highest; base of membrane scaly; caudal slightly lunate; anal spine very strong, 3 in head; ventrals shorter than pectorals, which are $1\frac{1}{2}$ in head; scales very thin, covered with minute scales on their base; scales below the lateral line in horizontal series; lateral line regularly arched to above posterior margin of anal. Coloration much as in *Microopogon undulatus*; conspicuous undulating black lines follow the series of scales on whole of boby above the pectoral; pectoral, ventral, and anal blackish, with broad whitish margin. Head $3\frac{1}{4}$ in length; depth 3. D. IX–I, 24; A. II, 9; scales 6-60 (about)–10.] (*Günther.*) REEDI, 88.

aa. Dorsal rays X–I, 26 to 28; serræ of preopercle slender, not notably flattened.

c. Body with about nine dark vertical cross-bands, besides narrow undulating streaks along the rows of scales. Body rather stout, the back somewhat arched; eye 3½ in head; preopercle finely denticulate; mouth moderate, the maxillary reaching to below middle of eye; teeth subequal, villiform, in broad bands; gill-rakers minute, slender, 5 + 9; second dorsal spine highest, 1⅔ in head; second anal spine about 2⅓; pectorals short, 1⅔ in head; ventrals 1½; lateral line little arched. Head 3⅔; depth 3. D. X–I, 26 to 28; A., II, 6 or 7; scales 5–48–10............BROUSSONETI, 89.

cc. Body without dark cross-bands, the rows of scales above with distinct undulating streaks.

d. Snout bluntish, short, 4½ in head; serræ of preopercle comparatively numerous and strong, subterete. Body not very deep, the profile somewhat depressed over the eyes; eye 1⅓ in snout, 1⅓ in interorbital space, 5 in head; preorbital not quite so broad as eye; mouth inferior, the maxillary reaching to middle of eye, 2⅔ in head; teeth in broad bands, the outer series above little enlarged; gill-rakers shortish, rather stout, shorter than pupil, 6+9; pharyngeal teeth longer and more numerous than in *cirrosa;* highest dorsal spine 1⅔ in head; caudal slightly lunate; second anal spine strong, 2½ in head; color bluish above, silvery below; a dusky blotch on center of opercle; back and sides with distinct streaks of deep olive following the centers of the rows of scales, these lines regular and not interrupted; they run obliquely upward and backward below as well as above the lateral line, those below being more nearly horizontal; fins chiefly bright yellow; membrane of opercle pale; lining of gill cavity dusky. Head 3⅔ in length; depth 3⅓. D. X–I, 27; A. II, 6 or 7; lat. l. with about 50 pores; about 60 transverse rows of scales................RONCADOR, 90.

dd. Snout longer than eye, 3 to 3½ in head; preopercle distinctly serrate.

e. Second anal spine large, 2 in head; profile straight, moderately steep; snout rather acute; eye 4½ in head; mouth small, inferior, the maxillary nearly reaching middle of orbit, its length 2½ in head; teeth subequal; gill-rakers scarcely developed, 4 + 9; third dorsal spine highest, 1⅔ in head; anterior dorsal rays much longer than posterior ones; anal fin pointed, the second soft ray longest, the second spine very strong, 2 in head; ventrals slightly longer than pectorals, 1⅓ in head; lateral line moderately arched anteriorly; color bluish, silvery below; conspicuous dark lines following the rows of scales, those below lateral line oblique as well as those above; spinous dorsal dusky. Head 3⅜ in length; depth 3⅓. D. X–I, 26; A. II, 6; scales 5–48–8......................XANTI, 91.

ee. Second anal spine short and thickish, 3 in head. Back elevated, the anterior profile steep and rather convex; snout blunt, much protruding; mouth small, horizontal; the maxillary reaching just past pupil, 3 in head; eye 5 in head; preopercle finely and sharply serrate; gill-rakers very small; pectoral short, 1½ in head; longest dorsal spine 2; caudal fin slightly lunate, the upper lobe the longer; scales above lateral line in very oblique series, in oblique series below lateral line anteriorly; color, grayish, yellow below; faint dark lines along the scales on the upper half of the body, golden lines on scales below; dorsals finely punctulate; fins pale; gill cavity pale within. Head 3⅜ to 3⅔; depth 3⅓ to 3½. D. X–I, 28 or 29; A. II, 6; lat. l. 50 to 53...........GALAPAGORUM, 92.

aaa. Dorsal rays X–I, 31 to 33; preopercle with its edge weakly crenulate; snout very blunt, not longer than eye, 4 in head; back elevated; profile depressed posteriorly, anteriorly gibbous; mouth rather large, subterminal; maxillary reaching posterior border of pupil, 2½ in head; gill-rakers short and slender, 5+9; second dorsal spine highest, 2 in head; soft rays high; second anal spine 2½ in head; pectorals slightly shorter than ventrals, which are 1⅔ in head. Color bluish, silvery below, dark streaks along the rows of scales very faint, broader than the pale interspaces. Head 3½ in length; depth 3. D. X-I, 33; A. II, 7; scales 8-53-9.

DORSALIS. 93.

87. UMBRINA CIRROSA.

Sciœna No. 1. Artedi, Genera 38, 1734 (Mediterranean).
Sciœna cirrosa Linnæus, Syst. Nat., ed. x, 289, 1758 (Mediterranean; after Artedi).
Johnius cirrhosus Bloch & Schneider, Syst. Ichth., 72, 1801.
Umbrina cirrhosa of recent writers generally.
Perca umbra Lacépède, Hist. Nat. Poiss., iii, 16, 1802 (not *Sciœna umbra* Linnæus).
Chilodipterus cyanopterus Lacépède, Hist. Nat. Poiss., iii, 546, plate 6, fig. 3, 1802 (on a painting by Plumier).
Coracinus boops Pallas, Zoographia Rosso-Asiat., iii, 259, 1811.
Umbrina vulgaris Guichenot, Expl. de l'Algérie, 43, 1850 (coast of Algeria).
Sciœna cestreus Gronow, Cat. Fish., ed. Gray, 52, 1854 (Mediterranean).

Habitat.—Mediterranean Sea.

This handsome species is rather common in the waters of Southern Europe. Our specimens are from Venice and Palermo.

88. UMBRINA REEDI.

Umbrina reedi Günther, Shore Fishes, Challenger, 25, plate xiii, fig. B, 1880 (Juan Fernandez).

Habitat.—Coast of Chili.

We know this species from Günther's description only.

89. UMBRINA BROUSSONETI.

Umbrina broussoneti Cuv. & Val., Hist. Nat. Poiss., v, 187, 1830 (Jamaica). Storer, Syn. Fish. North Am., 324, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 277, 1860 (San Domingo, Jamaica). Cope, Ichthyol. Lesser Antilles, 471, 1870 (St. Martin). Jordan & Gilbert, Syn. Fish. N. Am., 576, 1883 (specimens described from Indian River, Florida).
Umbrina coroides Cuv. & Val., Hist. Nat. Poiss., v, 187, 1830 (Brazil). Storer, Syn. Fish. North Am., 323, 1846 (copied). Poey, Enumeratio, 48, 1875 (Cuba).

Habitat.—West Indian Fauna; Florida to Brazil.

This species is known to us from two specimens taken by Dr. J. A. Henshall in the Indian River, Florida. These agree on the whole better with *Umbrina coroides* C. & V., than with *Umbrina broussoneti*; but we think that Dr. Günther is probably right in regarding the two nominal species as identical.

We have also examined specimens from Jérémie, Hayti, and from Pernambuco in the museum at Cambridge.

90. UMBRINA RONCADOR.

(THE YELLOW-FINNED RONCADOR.)

Umbrina undulata Steindachner, Ichthyol. Beitr., iii, 21, 1875 (San Diego) (not of Girard).
Umbrina xanti Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 48 (Santa Barbara southward). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Santa Barbara, San Pedro, San Diego) (not of Gill).

Umbrina roncador Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 277 (west coast Lower California). Jordan & Gilbert, Syn. Fish. North Am., 576, 1883. Rosa Smith, West American Scientist, 1885, 47 (San Diego).

Habitat.—Coast of Southern California; north to Santa Barbara.

This species is rather common along the coast of Southern California from Santa Barbara as far south as Cerros Island. It is a handsome species, brightly colored in life, and of some value as food.

91. UMBRINA XANTI.

Umbrina xanti Gill, Proc. Acad. Nat. Sci. Phila., 1862, 256 (Cape San Lucas). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 363 (Cape San Lucas). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 (Mazatlan) and 111 (Panama). Gilbert, Bull. U. S. Nat. Mus., 1882, 112 (Punta Arenas).

Umbrina analis Günther, Fishes Central America, 387 and 426, 1869 (Panama).

Habitat.—Pacific coast of tropical America, Cape San Lucas to Panama.

This species is rather common along the west coast of Mexico, specimens having been taken by Dr. Gilbert, at Mazatlan, Punta Arenas, and Panama. These are identical with Gill's types of *U. xanti* and with Günther's *U. analis*, both of which have been examined by us.

92. UMBRINA GALAPAGORUM.

Umbrina galapagorum Steindachner, Ichthyol. Beitr., vii, 20, 1878 (James Island, Galapagos).

Habitat.—Galapagos Archipelago.

This species is known from Dr. Steindachner's original types, most of which are still in the Museum of Comparative Zoology.

93. UMBRINA DORSALIS.

Umbrina dorsalis Gill, Proc. Acad. Nat. Sci. Phila., 1862, 257 (Cape San Lucas). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 363 (Cape San Lucas). Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 (Mazatlan).

Habitat.—Pacific coast of Mexico.

This species seems to be rather rare. A large example was taken by Dr. Gilbert at Mazatlan, and this has been compared by us with the types of *U. dorsalis*, young examples taken at Cape San Lucas by Mr. Xantus.

Genus XXI.—MENTICIRRHUS.

Menticirrhus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 86 (*alburnus*).
Cirrimens Gill, Proc. Acad. Nat. Sci. Phila., 1862, 17 (*ophicephalus*).
Umbrula Jordan & Eigenmann, subgenus nov. (*littoralis*).

TYPE: *Perca alburnus* Linnæus = *Cyprinus americanus* Linnæus.

This genus is one of the most strongly marked in the family. It has been confounded by all European writers with *Umbrina*, with which it has not very much in common except the presence of the barbel at the chin. All the species are American, and most of them are closely related to each other. Two of them, however (*littoralis, elongatus*), while retaining the external form and appearance of the others, differ from them widely in the form of the lower pharyngeal teeth and in the presence of gill-rakers. These we have placed in a distinct subgenus, which we have called *Umbrula*. Another species (*ophicephalus*) is also somewhat aberrant and represents a third subgenus (*Cirrimens*).

The species of *Menticirrhus* are all bottom fishes. The low, elongate body, the large pectorals, and the obsolete air-bladder are all characters related to this peculiarity of habit.

ANALYSIS OF SPECIES OF MENTICIRRHUS.

a. Dorsal spines about 13; head very low, thick, sub-terete, the snout blunt and very prominent; lower pharyngeals with acute teeth; gill-rakers obsolete. (*Cirrimens* Gill.)

b. Body formed as usual in *Menticirrhus*; long and low, little compressed; head with very convex cross-outlines, high in front, gibbous above the nostrils; profile depressed above eye; snout 3½ in head; projecting for one-third its length; eye small, 5 or 6; mouth very small, inferior, the outer teeth in the upper jaw moderately enlarged; maxillary reaching to opposite middle of eye, 3⅗ in head; gill-rakers minute, reduced to little fleshy projections; gill openings contracted, the membranes more united below than in other species; preopercle with flexible cilia; lower pharyngeals small, the teeth mostly pointed; spinous dorsal high, the longest spines 1⅓ in head; pectorals short, 1⅙ in head, not reaching tips of ventrals; caudal S-shaped, the lower lobe the longer. Color, dark gray; pectorals dusky. Head 4; depth 4. D. XII-I, 23; A. I, 8; scales 74 (pores) .... OPHICEPHALUS, 94.

aa. Dorsal spines usually eleven; head not terete, more depressed, with lower snout.

c. Gill-rakers obsolete, reduced to tubercular prominences, covered with teeth similar to those on the other gill arches; lower pharyngeals narrow, the teeth villiform or cardiform, all of them acute or conical, none with rounded heads (molar); teeth in the outer series of upper jaw more or less enlarged; scales on breast large. (*Menticirrhus*.)

d. Soft dorsal rather short, its rays I, 18 to I, 22; snout prominent.

e. Snout very prominent, 3½ in head, its tip slightly turned upward, projecting beyond the premaxillaries for a distance about two-thirds diameter of the eye; spinous dorsal elevated, its longest spines 1⅓ in head, reaching beyond front of soft dorsal; eye large, but considerably smaller than in *M. nasus*, 5½ in head; mouth comparatively small, inferior, the maxillary reaching middle of eye, 3⅓ in head; posterior margin of spinous dorsal deeply concave; rays of soft dorsal low, subequal; caudal deeply *f*-shaped, the upper lobe much the longer, 1⅓ in head; ventrals short, 1⅘ in pectorals; pectorals 1⅓ in head; lateral line concurrent with the back. Color, bluish above, silvery below; spinous dorsal dusky; lining of gill cavity and inner side of pectorals dusky. Head 3½ in length; depth 4. D. X-I, 22; A. I, 8; scales 6-50-10 .... SIMUS, 95.

ee. Snout less prominent, about 4 in head, its tip not recurved; dorsal spines not elevated, the longest barely reaching soft dorsal, 1⅓ in head.

f. Dorsal rays X–I, 22; eye very large, 4½ in head; snout projecting beyond lower jaw for a distance about equal to half the diameter of the eye; mouth small, inferior, the maxillary reaching to below middle of eye, 3 in head; pectoral 1⅛ in head, caudal fin *f*-shaped, the upper lobe pointed, the lower rounded. Color, silvery; fins blackish. Head 3½ in length; depth 4. D. X–I, 22; A. I, 8; scales 6–54–14 ....NASUS, 96.

ff. Dorsal rays X–I, 19 or 20.

g. Snout low and pointed, 3⅜ in head, projecting much beyond the premaxillaries; eye rather large, 5½ in head; body long and low, with rather depressed profile, and low, sharp snout; maxillary extending beyond pupil, 3 in head; preopercular serræ somewhat bony, stiffer, and more distinct than in any other species, rather small and distant; gill-rakers minute, about half length of nostril; outer teeth of upper jaw much enlarged, as in *M. alburnus*; scales on breast large; dorsal spines high, the longest reaching beyond front of soft dorsal, 1⅛ in head; pectorals rather short, 1½. Color, plain, dark gray above, paler below; gill cavity dusky; lower fins all dark. Head 3½; depth 4. D. IX–I, 20; A. I, 9; scales 55 (pores). AGASSIZI, 97.

gg. Snout rather short and blunt, 4 in head, projecting beyond premaxillaries for about half a diameter of the eye; eye small, 7 in head; maxillary reaching nearly to posterior margin of eye, 3 in head; outer teeth of upper jaw much enlarged; pectoral long, 1⅛ in head; ventral 2 in head; longest dorsal spine as long as pectoral, anal spine half as long as the rays; upper lobe of caudal not produced. Color, plumbeous, bright silvery below; lower fins mostly black. Head 3 in length; depth 4. D. X–I, 18 to 20; A. I, 9; scales 6–50–14. PANAMENSIS, 98.

dd. Soft dorsal longer, its rays I, 23 to I, 25.

h. Mouth comparatively large, the maxillary reaching to below middle of eye, 2⅘ to 3½ in head; teeth on lower pharyngeals acute; back and sides usually with oblique dusky bars; lower lobe of caudal longest.

i. Outer teeth of upper jaw decidedly enlarged; dorsal spines not much elevated, the longest usually not reaching front of soft dorsal, 1½ to 1⅔ in head. Coloration, grayish silvery, the dark markings not pronounced and often obsolete.

j. Dorsal rays X–I, 22 or 23; snout rather shorter and less pointed than in *M. americanus*, 3½ in head; mouth smaller, the maxillary 3 in head. Coloration usually plain, sometimes very dark, otherwise as in *Menticirrhus americanus*. Head 3⅞; depth 4½. D. X–I, 22 or 23 (rarely 24); A. I, 7; scales 55 (6–52–10) ..............................MARTINICENSIS, 99.

jj. Dorsal rays X–I, 24 or 25; snout longer, 3⅛ in head; maxillary reaching nearly to middle of eye, 2⅘ to 3 in head; eye small, 2 in snout; teeth villiform, in broad bands, the outer series of the upper jaw very much enlarged, larger than in the other species; ventrals short, 1½ in pectorals; pectorals 1¼ in head; caudal *f*-shaped, the broad rounded lower lobe longer than the acute upper; scales all ctenoid, those of the breast larger and regularly placed. Color, grayish silvery, with obscure darker clouds along the back and sides; these marks forming dusky bars, running obliquely forward and downward to considerably below the lateral line, these often obsolete; the bar at the nape saddle-like; lining of gill cavity dusky; pectoral yellowish, dusky at tip; an obscure dusky streak along lower parts of sides running into lower lobe of caudal. Head 3½; depth 4 to 5. D. X–I, 24 or 25; A. I, 7; scales 6–55 (pores)–12..............AMERICANUS, 100.

ii. Outer teeth of upper jaw less enlarged; spinous dorsal elevated, the longest spine reaching past front of soft dorsal, its length 1½ in head; coloration strongly marked, body scarcely silvery. Profile slightly depressed above the eyes; eyes small, 2⅓ in snout, 2 in interorbital area, about 7 in head; snout long, bluntish, 3⅙ in head; mouth large; maxillary reaching middle of eye, 2⅙ in head; ventrals 1½ in pectorals, which are 1¼ in head; scales all ctenoid. Color dusky gray above, sometimes blackish, the back and sides with distinct dark oblique cross-bands running downwards and forwards, the anterior one at the nape extending downward, meeting the second and thus forming a V-shaped blotch on each side; a dark lateral streak bounding the pale color of the belly, most distinct posteriorly, and extending on lower lobe of caudal; inside of gill-cavity scarcely dusky; pectorals dark. Head 3¾ to 4 in length; depth 4½ to 4⅜. D. X–I, 26 or 27; A. I, 8; scales 7–53 (pores)–14.............................SAXATILIS, 101.

hh. Mouth smaller, the maxillary reaching scarcely to front of eye, 3⅛ in head; teeth on lower pharyngeals bluntish; coloration grayish, with dark streaks along the rows of scales. Snout long, little projecting, 3⅙ in head; eye small, 7 in head, 2¼ in snout, 1⅗ in interorbital area; outer teeth in upper jaw moderately enlarged, about as in *M. saxatilis;* lower pharyngeals a little broader than in *M. americanus,* the teeth coarser, and many of them bluntish, none of them really molar, those of the inner posterior corner of the bone much enlarged; ventrals 1½ in pectorals, which are 1⅓ in head; scales all ctenoid. Color sooty-grayish, with bright reflections; the back, all the fins, and under side of head dusky; undulating lines along sides running upward and backward, made of dark points in center of each scale; back often with very faint dark cross-bars; edge of opercle dusky; lining of gill-cavity slightly dusky. Head 4 in length; depth 4 to 5. D. X–I, 25 or 26; A. I, 8; scales 7–60–11.......UNDULATUS, 102.

cc. Gill-rakers present, very short and somewhat slender; lower pharyngeals rather broad; some or nearly all of the teeth molar, *i. e.,* enlarged, with thickened, rounded heads, the molar teeth covering at least the anterior portion of the bone; teeth in the outer series of upper jaw scarcely larger than the others; scales on breast small. (*Umbrula* Jordan & Eigenmann.)

k. Upper lobe of caudal longer than lower; scales rather small, about 25 in an oblique series from vent forward to lateral line; axillary scale one-third length of pectoral; snout very little projecting; gill-rakers very short, 3+5, the longest about one-third diameter of pupil; lower pharyngeal bones narrower than in *littoralis,* the molar teeth smaller, covering the whole anterior part of the bone; conical teeth on posterior part of the bone, the outermost row enlarged; body more elongate than in other species; profile low, little convex; eye small, 2½ in snout, 7 in head; snout long, 3 in head; mouth small, the maxillary scarcely reaching front of eye, 3 in head; second dorsal spine 1⅔ in head; anterior soft rays of dorsal almost twice as long as the posterior ones, caudal with an *f*-shaped margin; ventrals 1⅔ in pectorals; pectorals 1⅔ in head. Color bluish on sides and back, silvery below, without stripes or bands. Head 3½ in length; depth 4⅘. D. X-I, 22 to 24; A. I, 7; scales 5–53–13..ELONGATUS, 103.

kk. Upper lobe of caudal not longer than lower; scales rather large, 15 to 18 in an oblique series from vent upward and forward to lateral line; axillary scale not one-fourth length of pectoral; snout distinctly projecting beyond mouth, 3½ in head; gill-rakers larger than in other species, the longest about ½ length of pupil, the number X + 7; lower pharyngeal bones broad, most of the teeth developed as coarse molars, only those along the posterior margin conical; maxillary reaching past front of orbit, 3½ in head; outer teeth of upper jaw scarcely enlarged; longest dorsal spines reaching past front of soft dorsal, the free margin of the fin concave; caudal rather deeply lunate, the lower lobe rounded, the upper pointed; ventrals 1⅔ in pectorals, which are 1⅛ in head. Color silvery gray above, with bluish and bronze reflections, immaculate; a dark-bronze shade along sides on level of pectorals, extending to tail and along cheeks; belly below this abruptly white; dorsals light brown, spinous dorsal black at lip, the base narrowly white; caudal pale, its tip usually black; inner lining of pectoral and ventrals blackish; gill cavity pale. Head 3½ in length; depth 4⅔. D. X-I, 23 to 25; A. I, 7; scales 6–53 (pores)–12.......LITTORALIS, 104.

94. MENTICIRRHUS OPHICEPHALUS.

Umbrina ophiocephalus Jenyns, Zool. Beagle, Fish, 45, 1842 (Coquimbo, Chili). Günther, Cat. Fish. Brit. Mus., ii, 277, 1860 (copied).

Cirrimens ophicephalus Gill, Proc. Acad. Nat. Sci. Phila., 17, 1862.

Habitat.—Coast of Chili and Peru.

This singular species is represented by numerous specimens large and small in the Museum of Comparative Zoology. These are from Caldera, Chili (8603, M. C. Z.), and from Callao, Peru. It seems to us that the name *Cirrimens* proposed for this species can be used for a subgenus only.

95. MENTICIRRHUS SIMUS.

Menticirrhus nasus Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 and 111 (Mazatlan and Panama) (not *Umbrina nasus* Günther). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Menticirrhus simus Jordan & Eigenmann, sp. nov.

Habitat.—Pacific coast of tropical America; Mazatlan to Panama.

This species is known to us from the specimens collected by Dr. C. H. Gilbert at Mazatlan and Panama.

It was at first identified somewhat doubtfully with *Menticirrhus nasus* by Jordan and Gilbert. The examination of the original type of *Um-*

brina nasus has convinced Dr. Jordan that this is a different species. We here describe in detail the typical specimen under the name of *Menticirrhus simus*.

Menticirrhus simus sp. nov. Type No. 28292, U. S. Nat. Mus.

Depth 4 in length (5 in total); head $3\frac{1}{2}$ ($4\frac{1}{3}$). D. X-I, 22; A. I, 8; scales 6-52-10.

Body robust; back somewhat compressed and regularly arched; depth about uniform between the first dorsal spine and the first soft ray; caudal peduncle rather heavy; distance from last dorsal ray to beginning of middle caudal ray slightly more than 2 in head.

Head subconical; profile steep, slightly depressed over the posterior part of eyes; snout abruptly blunted, turned up anteriorly, suggesting the form of snout in the genus *Heterodon;* five large incisions in the upper lip, three large oval and three small round pores above them, as in other species of *Menticirrhus*; snout $3\frac{1}{2}$ in head; eye $5\frac{2}{3}$ in head; mouth horizontal, inferior, the snout extending $\frac{1}{4}$ of its length beyond the premaxillary; maxillary extending past middle of eye, slightly more than 3 in head.

Teeth in lower jaw villiform in rather broad bands; upper jaw with a band of small teeth and an outer series of enlarged ones; largest teeth of the outer series slightly longer than the anterior nostril; preopercle with fine widely placed teeth on its membranous border; gill-rakers obsolete; pseudobranchiæ very large; lower pharyngeal teeth villiform, those of the inner series much enlarged; first dorsal beginning behind base of pectoral; the first spine minute; the second spine highest, reaching to third dorsal ray, $1\frac{1}{5}$ in head; posterior margin of spinous dorsal deeply concave; dorsal soft rays low, subequal; caudal unequally lunate, the upper lobe much the longer, $1\frac{1}{5}$ in head; anal inserted under fifth dorsal ray; its spine weak, 5 in head; the anterior anal rays much the longer, but not extending to tip of last rays; ventrals $1\frac{3}{5}$ in pectorals; pectorals $1\frac{1}{6}$ in head.

Scales large; all strongly ctenoid; those in the lateral line and those above it more or less covered with smaller ones. Soft dorsal, with a very narrow scaly sheath. Bases of pectorals and caudal densely scaly, the rest of the fins naked. Color, grayish above, lighter below; lower parts of sides with numerous dark points; faint lines following the rows of scales above; spinous dorsal dusky, anal with dark specks; axil and inner margin of pectoral dusky; other fins plain; lining of gill cavity dusky.

This species differs from *Menticirrhus nasus* (Günther) in the size of the eye, the size of the teeth, and the size and shape of the snout. Dr. Jordan has examined the type of *M. nasus* and verified the description of Günther. The large size of the eye in *M. nasus* is not due to the immaturity of the typical example.

96. MENTICIRRHUS NASUS.

Umbrina nasus Günther, Fishes Central America, 387 and 426, 1869 (Panama). Jordan, Proc. Acad. Nat. Sci. Phila., 1883, 289 (Central America).

Habitat.—Pacific coast of tropical America, Mazatlan to Panama.

This species is known to us from Dr. Günther's original type. No others have since been taken, if, as we suppose, our *Menticirrhus simus* is really a distinct species.

97. MENTICIRRHUS AGASSIZI.

Menticirrhus agassizi Jordan, sp. nov. (Caldera).

Habitat.—Coast of Chili.

This species is known from a single specimen, 6½ inches long, in the Museum of Comparative Zoology, from Caldera, Chili. It was found mixed with specimens of *Menticirrhus ophicephalus*, in bottle 8603.

This species is named in honor of Professor Louis Agassiz.

98. MENTICIRRHUS PANAMENSIS.

Umbrina panamensis Steindachner, Ichthyol. Beitr., iv, 9, 1875 (Panama).

Menticirrhus panamensis Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 (Mazatlan); l. c., 111 (Panama). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Habitat.—Pacific coast of tropical America, Mazatlan to Panama.

This species is known to us from specimens taken by Dr. Gilbert at Panama and Mazatlan.

99. MENTICIRRHUS MARTINICENSIS.

Umbrina martinicensis Cuv. & Val., Hist. Nat. Poiss., v, 186, 1830 (Martinique). Storer, Syn. Fish. North Am., 323, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 277, 1860 (copied). Jordan, Proc. U. S. Nat. Mus., 1886, 539 (note on type of Cuvier & Valenciennes).

Umbrina gracilis Cuv. & Val., Hist. Nat. Poiss., v, 189, 1830 (Brazil). Günther, Cat. Fish. Brit. Mus., ii, 277, 1860 (copied). Jordan, Proc. U. S. Nat. Mus., 1886, 539 (note on type of Cuvier & Valenciennes).

Umbrina arenata Cuv. & Val., Hist. Nat. Poiss., v, 190 (Brazil). Jenyns, Zool. Beagle, Fishes, 44, 1842 (Bahia Blanca; Maldonado). Günther, Cat. Fish. Brit. Mus., ii, 276, 1860 (Jamaica).

Umbrina phalæna Steindachner, Ichth. Notizen, ix, 20, 1869 (Santos, Brazil).

Umbrina januaria Steindachner, Ichthyol. Beitr., v, 122, 1876 (Rio Janeiro).

Habitat.—West Indies to Patagonia.

We have examined the types of *Umbrina martinicensis* and *U. gracilis* in the museum at Paris. We have also examined numerous specimens in the museum at Cambridge, apparently identical with these, from Rio Janeiro, Rio Grande do Sul, Victoria, Bahia, and Montevideo. The species seems to be as common in South America as its analogue *M. americanus* is in North America. The two are exceedingly alike, and *martinicensis* is probably a geographical variety of the other, distinguished perhaps by a slightly smaller number of rays in the dorsal fin.

Were it not that the Sciænoid fauna of South America is chiefly different from that of North America, we should scarcely hesitate to place *martinicensis* in the synonymy of *americanus*. *Umbrina januaria* is apparently based on the specimens from Rio Janeiro examined by us. *Umbrina gracilis* was based on the dried skin of a young example, distorted and varnished.

Umbrina arenata, as described by Cuvier & Valenciennes, does not differ at all from *M. martinicensis*. As described by Dr. Günther, the scales are 72 to 78 in *arenata*. It is evident, however, that Günther has counted not the pores, but the number of vertical series of scales, and these range from 70 to 80 in nearly all of our species, the number exceeding the number of pores by about 20, and similarly exceeding the number of oblique series. We see no reason, therefore, for not placing *arenata* in the synonymy of *martinicensis*.

100. MENTICIRRHUS AMERICANUS.

(THE CAROLINA WHITING.)

[Plate VIII.]

Alburnus americanus (the Whiting) Catesby, Nat. Hist. Carolinas, etc., pl. 12, f. 2 (Jordan, Proc. U. S. Nat. Mus., 1884, 195).

Cyprinus americanus Linnæus, Syst. Nat., ed. x, 321, 1758 (based on the Whiting of Catesby) (not *Cyprinus americanus* of the twelfth edition, which is a Cyprinoid, *Notemigonus bosci* Cuv. & Val.).

Perca alburnus Linnæus, Syst. Nat., ed. xii, 482, 1886 (on specimens sent from Charleston by Dr. Garden). Schöpf, Schrift. Naturf. Freunde Berlin, viii, 162, 1788. Bloch & Schneider, Syst. Ichth., 87, 1801.

Centropomus alburnus Lacépède, Hist. Nat. Poiss., iv, 249, 257, 264, 1802.

Sciæna alburnus Gronow, Cat. Fish., ed. Gray, 51, 1854 (South Carolina).

Umbrina alburnus Cuvier & Valenciennes, v, 180, 1830 (in part). Holbrook, Ichthyol. S. Carolina, 136, plate 20, fig. 2, 1856 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 275, 1860.

Menticirrhus alburnus Uhler & Lugger, Fishes of Maryland, 101, 1876 (Chesapeake Bay). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 378 (Beaufort). Goode, Proc. U. S. Nat. Mus., 1879, 113 (Saint John's River, Florida). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 132 (Pensacola). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 282 (Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 577, 1883; Goode, Hist. Aquat. Anim., 376, plate 127 b, 1884. Goode & Bean, Proc. U. S. Nat. Mus., 1885, 202 (Linnæan types). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Umbrina phalæna Girard, Proc. Acad. Nat. Sci. Phila., 1858, 167 (Indianola, Brazos Santiago). Girard, U. S. and Mex. Bound. Survey, 13, 1859.

Habitat.—South Atlantic and Gulf coasts of the United States, Chesapeake Bay to Texas.

This species is very common on the sandy coasts of our Southern States, where it is a food-fish of some importance.

As elsewhere stated, this may be identical with the South American *Menticirrhus martinicensis*.

This species has generally received the specific name of *alburnus* given to it by Linnæus in the twelfth edition of the Systema Naturæ. In the tenth edition of the Systema, Linnæus had already given the specific name of *americanus* to the Whiting of Catesby. There is no doubt that Catesby had this common species in mind, although his rude figure resembles the Surf Whiting (*littoralis*) fully as much as it does the common Whiting.

101. MENTICIRRHUS SAXATILIS.

(THE KING-FISH; SEA MINK.)

[Plate IX.]

Johnius saxatilis Bloch & Schneider, Syst. Ichth., 75, 1801 (New York).

Menticirrhus saxatilis Jordan, Proc. Acad. Nat. Sci. Phila., 288, 1883 (note on type of Bloch & Schneider). Jordan, Proc. U. S. Nat. Mus., 1884, 129 (Key West). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Umbrina alburnus DeKay, New York Fauna, Fishes, 78, plate 7, fig. 20, 1842 (New York). Storer, Syn. Fish. North Am., 323, 1846 (Massachusetts) (not *Perca alburnus* L.).

Sciæna nebulosa Mitchill, Trans. Lit. & Phil. Soc. New York, 406, plate 3, fig. 5, 1815 (New York) (not of Gmelin).

Umbrina nebulosa Storer, Fishes Massachusetts, 35, 1839 (near Boston light house). Ayres, Fishes of Brookhaven, L. I., 259, 1842. Storer, Hist. Fish. Mass., 124, plate ix, fig. 4, 1867 (Boston light-house; Lynn; Provincetown). Günther, Cat. Fish. Brit. Mus., ii, 275, 1860 (New York).

Menticirrhus nebulosus Goode & Bean, Fish. Essex Co. and Mass. Bay, 17, 1879 (Danvers; Spite Bridge; Marblehead light-house). Bean, Proc. U. S. Nat. Mus., 1880, 93 (Wood's Holl, Mass; Noank, Conn.; Cohasset Narrows, Mass). Goode, Proc. U. S. Nat. Mus., 1881, 113 (St. John's River, Florida). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 282 (Pensacola). Jordan & Gilbert, Syn. Fish. North America, 577, 1883. Goode, Hist. Aquat. Anim., 375, plate 127a, 1884.

Habitat.—Atlantic and Gulf coasts of the United States, Boston to Key West and Pensacola, most common northward.

This species is generally common along the coasts of our Northern States, its greatest abundance being north of the limit of *M. americanus*, a species which it very closely resembles, the differences being of comparatively little importance. Southward its distribution seems to be peculiar. A large specimen was obtained by Dr. Jordan at Pensacola and several small ones at Key West. All these are very dark in color, but not otherwise evidently different from the common northern form. The name *saxatilis* should be used for this species. The original type of *Johnius saxatilis*, sent by Schöpf (?) to Bloch, is still in the museum at Berlin, where it has been examined by us. The name *saxatilis* for the Whiting, like that of *regalis* for the Weak-fish, came about through a confusion of the vernacular names, the supposed "King-fish" being named "*Johnius regalis*" by Bloch, and the supposed "Rock-fish," "*Johnius saxatilis*."

102. MENTICIRRHUS UNDULATUS.

(THE CALIFORNIA WHITING OR "SUCKER.")

Umbrina undulata Girard, Proc. Acad. Nat. Sci. Phila., 1854, 148 (San Diego, Cal.). Girard, U. S. Pacif. R. R. Survey, 121, 1859 (San Diego, Cal.).

Menticirrhus undulatus Gill, Proc. Acad. Nat. Sci. Phila., 1862, 17 (name only). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Santa Barbara, San Pedro, San Diego). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 48 (Santa Barbara, southward). Jordan & Gilbert, Syn. Fish. North Am., 578 and 933, 1883. Rosa Smith, West American Scientist, 1885, 47 (San Diego). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Habitat.—Coast of Southern California, north to Santa Barbara.

This species is rather common along the sandy coasts of Southern California, where it is a food-fish of moderate importance. Girard's type of *Umbrina undulata* has been examined by us. It is a young example of this species.

103. MENTICIRRHUS ELONGATUS.

Umbrina elongata Günther, Proc. Zool. Soc. Lond., 1864, 148 (Chiapam). Günther, Fishes Central America, 387 and 425, plate 64, fig. 2, 1869 (Chiapam). Steindachner, Ichthyol. Beitr., iv, 9, 1875 (Panama north to "San Diego," confounded with *M. undulatus*).

Menticirrhus elongatus Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 107 (Mazatlan). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Umbrula elongata Jordan & Eigenmann.

Habitat.—Pacific coast of tropical America, Mazatlan to Panama.

This species is rather common on the west coast of Mexico. Its relations are evidently with *M. littoralis*, but in several respects it represents a transition towards *Menticirrhus undulatus*, its nearest relative among the typical *Menticirrhi*.

104. MENTICIRRHUS LITTORALIS.

(THE SURF WHITING; SILVER WHITING.)

Umbrina littoralis Holbrook, Ichthyol. S. Carolina (first edition), 142, plate 20, fig 1, 1856 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 276, 1860 (copied).

Menticirrhus littoralis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 378 (Beaufort). Bean, Proc. U. S. Nat. Mus., 1880, 93 (Florida). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 283 (Pensacola, Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 606 (Charleston). Jordan & Gilbert, Synopsis Fish. North Am., 933, 1883. Bean, Internat. Fishery Exhib., 56, 1883 (Matanzas River Inlet, Florida). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Umbrula littoralis Jordan & Eigenmann.

Habitat.—South Atlantic and Gulf coasts of the United States, North Carolina to Texas.

This species is generally common in the surf along the sandy shores of the Southern States. It resembles *M. americanus* somewhat in external characters so that it has often been confounded with it by careless observers. Its technical distinctions are, however, numerous, and in the form of its pharyngeal teeth it differs in a marked degree from all the other species of *Menticirrhus* except *M. elongatus*. Were it not that *M. elongatus* and *M. undulatus* are both in several respects intermediate between *M. littoralis* and the typical forms of *Menticirrhus*, we should regard the subgenus *Umbrula*, based on *M. littoralis*, as certainly worthy of full generic rank.

Genus XXII.—PARALONCHURUS.

Paralonchurus Bocourt, Nouv. Arch. Mus., iv, 21, 1869 (*petersi*).

TYPE: *Paralonchurus petersi* Bocourt.

This genus seems to be most nearly related to *Lonchurus*, being in some respects intermediate between that and ordinary Sciænoids. But one species has been described.

ANALYSIS OF SPECIES OF PARALONCHURUS.

a. Body long and low; head slender, flattish, somewhat spongy above, with protuberant snout; eye 8½ in head; snout 3⅗; interorbital area 3¼; mouth horizontal; maxillary 2⅗ in head; teeth in villiform bands; upper jaw with a conspicuous outer row of larger ones; chin with 5 pores, a multifid barbel at the symphysis; rami with a row of slender barbels along inner edge; dorsal low, highest behind; soft dorsal scaled at base only; caudal pointed, as long as head; anal spines small; second spine as long as snout; pectorals very large, 2¾ in body; scales rather large, cycloid; color light olive with faint stripes on rows of scales; pectoral dusky; other fins plain. Head 3¼ in length; depth 4. D. X-I, 30; A. II, 9; scales 8-50-16 .... PETERSI, 105.

105. PARALONCHURUS PETERSI.

Paralonchurus petersi Bocourt, Nouv. Archives du Muséum, iv, 1869, 22 (San Salvador). Jordan, Proc. U. S. Nat. Mus., 1886 (Panama).

Habitat.—Pacific coast of tropical America, Panama.

This rare species is now known to us from the original account of Dr. Bocourt and from Dr. Jordan's notes on the original type in the museum at Paris. Specimens were later taken by Dr. Gilbert at Panama, but all of these have been destroyed by fire.

A second species of *Paralonchurus* was obtained by Dr. Gilbert, but the typical specimens were destroyed by fire and no description has been published.

The following is Bocourt's description:

"D. X-I, 30; A. II, 9. C. 17; P. 21; V. I, 5. L. lat. 50. L. trans. $\frac{8}{16}$.

"CARACTÈRES.—Corps allongé comprimé; la plus grande hauteur, prise à la naissance des pectorales, est contenue quatre fois dans la longueur (la caudale non comprise), la tête y entrant trois fois et demie. Museau déprimé, percé en avant d'un gros pore; deux lobes arrondis au-devant de la bouche, au-dessus de chacun desquels se trouve un autre pore. Diamètre horizontal de l'œil, compris trois fois et demie dans la largeur de l'espace interorbitaire, et près de dix fois dans la longueur de la tête. Bouche placée sous le museau, l'extrémité du maxillaire ne dépassant pas verticalement le bord postérieur de l'orbite. Quatre pores sous la mâchoire inférieure; entre les deux premiers on aperçoit un petit barbillon multifide touchant à la symphyse, et il y en a dix d'une grande ténuité placés sur chacune des branches de la mâchoire inférieure. Préopercule arrondi; une crénelure membraneuse existe sur son bord postérieur. Ligne latérale infléchie au-dessus de l'anale. Pectorales très développées. Dorsale profondément échancrée et à rayons épineux faibles; le premier, très court, prend naissance au-dessus de l'origine des pectorales; le quatrième, le plus long, égale la largeur de l'espace interorbitaire. Ventrales attachées au même niveau que les précédentes. Anale petite, et à épines médiocres. Caudale pointue, sa longueur égale celle de la tête. Anus plus éloigné, de l'extrémité de la queue que du bout du museau. Vessie aérienne épaisse, argentée et prolongée en une pointe très déliée. Écailles cycloïdes.

"Un seul exemplaire a été rapporté de La Union, République du Salvador.

"Longueur totale, 0^m 256."

Genus XXIII.—LONCHURUS.

Lonchurus Bloch, Syst. Ichth., plate 360, 1793 (*barbatus = lanceolatus*).

TYPE: *Lonchurus barbatus* Bloch.

This genus contains apparently but a single species, a rather rare inhabitant of the Caribbean waters. This species we have not been able to examine.

The genus seems to be one of the most remarkable of the family. Except its analogue, *Paralonchurus*, it seems to have no very near relatives.

ANALYSIS OF SPECIES OF LONCHURUS.

a. [Body long and low; the profile straightish, depressed over the eyes; interorbital area as broad as eye, which is as long as snout; snout small, 10 in head; snout soft, depressed, with conspicuous pore at tip; mouth oblique, subinferior; maxillary reaching a little beyond eye; teeth in fine bands; barbels 2, not longer than eye; preopercle with crenulate, membranaceous margin; upper ray of pectoral much elongate, 2½ in body; caudal elongate lanceolate, 4 in body; first ray of ventral reaching front of anal; anal short and high, its spines weak, inserted before middle of soft dorsal; scales mostly cycloid; lateral line becoming straight above anal; color brownish; pectoral and caudal fins black, other fins dusky. Depth 4 in length. D. X or XI-I, 38 to 40; A. II, 7 or 8; lateral line 60 to 70.] (*Cuvier & Valenciennes.*)..LANCEOLATUS, 106.

106. LONCHURUS LANCEOLATUS.

Perca lanceolata Bloch, Nov. Act. Sc. Copenh., iii, 383.

Lonchurus lanceolatus Günther, Cat. Fish. Brit. Mus., ii, 317, 1860 (copied).

Lonchurus barbatus Bloch, Ichthyol., plate 360, 1793. Bloch & Schneider, Syst. Ichthyol., 102, 1801 (Surinam). Cuv. & Val., Hist. Nat. Poiss., v, 193, 1830 (described from Bloch's type).

Lonchurus depressus Bloch & Schneider, Syst. Ichthyol., 102, 1801 (Surinam). Cuv. & Val., Hist. Nat. Poiss., v, 195, 1830 (copied). Günther, Cat. Fish. Brit. Mus., ii, 317, 1860 (West Indies).

Habitat.—Coast of Guiana.

This remarkable species we have had no opportunity to examine. We follow the suggestion of Dr. Günther, in regarding the nominal species, *Lonchurus depressus*, as a synonym of *L. lanceolatus*.

Genus XXIV.—POGONIAS.

Pogonias Lacépède, Hist. Nat. Poiss., iii, 138, 1802 (*fasciatus* = *cromis*).
Pogonathus Lacépède, Hist. Nat. Poiss., v, 121, 1803 (*courbina* = *cromis*).

TYPE: *Pogonias fasciatus* Lacépède.

This genus contains, so far as known, but a single species, a large coarse fish of our Atlantic coasts.

ANALYSIS OF SPECIES OF POGONIAS.

a. Body oblong, the back much elevated, ventral outline almost straight, the depth rapidly diminishing from the first dorsal spine backwards; depth 2½ to 3 in length; head 3⅓; profile rather steep and slightly convex; mouth moderate, inferior, the maxillary not reaching middle of eye, 3⅓ in head; teeth in broad bands, the outer series above scarcely enlarged; snout blunt, longer than eye, 3½ to 4 in head; lower pharyngeals large, completely united, covered with many blunt molars and a small patch of conical teeth at the outer posterior corner; gill-rakers 4 + 12, very short, slender; dorsal spines high but slender, the 4th highest, 2 in head; caudal subtruncate; second anal spine very large, about 2 in head; pectorals about as long as head; scales large, those on breast small; color grayish silvery, with 4 or 5 broad dark vertical bars, these disappearing with age; fins blackish. D. X-I, 19 to 21; A. II, 5 or 6; scales 5-47 to 50-9 .... CROMIS, 107.

x. Body deep, the depth about 2½ in length; snout blunt, 3⅘ in head. D. X-I, 21; scales 47; back usually without distinct oblique streaks . Var. *cromis*, 107 (*a*).

xx. Body more elongate, the depth about 3 in length; snout more acute, 3⅞ in head. D. X-I, 19; scales 50; color more silvery, with oblique faint dark streaks along the rows of scales above .... Var. *courbina*, 107 (*b*).

107. POGONIAS CROMIS.

(THE DRUM.)

[Plates X and XI.]

a. Var. *cromis.*

Labrus cromis Linnæus, Syst. Nat., ed. xii, 479, 1766 (Carolina). Gmelin, Syst. Nat., 1292, 1788 (Carolina).
Pogonias cromis Goode & Bean, Fishes of Essex County and Massachusetts Bay, 17, 1879 (Provincetown). Goode & Bean, Proc. U. S. Nat. Mus., 1879, 131 (Pensacola). Bean, Proc. U. S. Nat. Mus., 1880, 93 (St. John's River, Florida; near Charleston, S. C.). Jordan, Cat. Fish. North America, 93, 1885 (name only).
Labrus chromis Schöpf, Schrift. Naturforsch. Freunde Berlin, viii, 158, 1788 (New York).
Sciæna chromis Bloch & Schneider, Syst. Ichth., 82, 1801 (Carolina). Lacépède, Hist. Nat. Poiss., iv, 314, 1802.

Pogonias chromis Cuvier, Règne Animal, plate 29, fig. 1, 1829. Cuv. & Val., Hist. Nat. Poiss., v, 206, 1830 (New York; Montevideo). DeKay, New York Fauna, Fishes, 80, 1842 (New York). Storer, Syn. Fish. North Am., 324, 1846 (copied). Holbrook, Ichth. S. Carolina, ed. 1, 112, plate 16, fig. 2 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 270, 1860 (Lake Pontchartrain). Uhler & Lugger, Fishes of Maryland, 98, 1876 (Eastern Shore, Maryland). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 377 (Beaufort). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 280 (Pensacola; Galveston). Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 605 (Charleston). Jordan & Gilbert, Syn. Fish. North Am., 568, 1883. Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 233 (Cedar Key). Jordan & Meek, Proc. U. S. Nat. Mus., 1884, 237 (St. John's River, Florida). Goode, Hist. Aquat. Anim., 367, plates 121 and 122, 1884.

Pogonias fasciatus Lacépède, Hist. Nat. Poiss., iii, 137, 1802. Cuv. & Val., Hist. Nat. Poiss., v, 210, pl. 118, 1830 (New York). DeKay, New York Fauna, Fishes, 81, pl. 14, fig. 40, 1842 (New York). Storer, Syn. Fish. North Am., 324, 1846 (copied). Girard, U. S. & Mex. Bound. Survey, 11, 1859 (Brazos Santiago). Holbrook, Ichthyol. S. Carolina, 118, pl. 16, fig. 1, 1860 (South Carolina). Günther, Cat. Fish. Brit. Mus., ii, 270, 1860 (copied). Günther, Ann. and Mag. Nat. Hist., July, 1880 (Rio Plata).

Mugil grunniens Mitchill, Report in part Fishes New York, 16, 1814 (New York).

Labrus grunniens Mitchill, Trans. Lit. and Phil. Soc., 405, 1815 (New York).

Mugil gigas Mitchill, Report in part Fishes New York, 16, 1814 (New York).

Sciæna gigas Mitchill, Trans. Lit. and Phil. Soc., 413, 1815 (New York).

Pogonias gigas Ayres, Fishes of Brookhaven, L. I., 260, 1842 (Brookhaven, L. I.).

Sciæna fusca Mitchill, Trans. Lit. and Phil. Soc., 409, 1815 (New York).

b. Var. *courbina.*

Pogonathus courbina Lacépède, Hist. Nat. Poiss., v, 121, 1803 (Rio Plata).

Habitat.—Atlantic coasts of America; Long Island to Montevideo.

This species is common on the sandy coasts of the United States, where it reaches a very large size. It is probably the largest of all the *Sciænidæ*. It is a rather coarse fish, of no great value as food.

There is no doubt that all the North American names belong to a single species, the form called *fasciatus* being simply the young.

The South American form (*courbina*) is scarcely different from the Northern. We have examined specimens in the museum at Cambridge from Rio Grande do Sul and other localities in Brazil. We have found only the slight differences noticed in the analysis above.

Genus XXV.—APLODINOTUS.

Aplodinotus Rafinesque, Journ. de Phys., 1819, 418 (*grunniens*).

Amblodon Rafinesque, Journ. de Phys., 1819, 418 (based on the pharyngeal teeth of *A. grunniens*, supposed to belong to a species of Buffalo-fish).

Haploidonotus Gill, Proc. Acad. Nat. Sci. Phil., 1861, 102 (*grunniens*) (amended orthography).

Eutychelithus Jordan, Man. Vert., ed. i, 242, 1876 (*richardsoni*=*grunniens*).

TYPE: *Aplodinotus grunniens* Rafinesque.

This genus contains a single species, a large coarse fish, confined to the fresh waters of the United States. The genus differs from *Roncador* chiefly in the complete union of the very large lower pharyngeal bones.

ANALYSIS OF SPECIES OF APLODINOTUS.

a. Body oblong; back much elevated and compressed; depth 2⅘ in length; head 3⅓; profile long and steep, straightish; head slightly compressed; mouth moderate, subinferior, low; the maxillary reaching past middle of eye, 3 in head; teeth in villiform bands, the outer above scarcely enlarged; lower pharyngeals completely united; the teeth less blunt than in *Pogonias;* gill-rakers short, thickish, 6+14; preopercle obscurely serrated; snout bluntish, longer than eye, 4½ in head; dorsal spines strong and high; second spine highest, 2⅓ in head; a scaly sheath at the base of spines; the two dorsals connected; second anal spine very large, more than half the length of the head; caudal double truncate; scales rather thin and deep, the series somewhat oblique; scales on breast rather large; color grayish silvery, dusky above, sometimes very dark; back sometimes with oblique dusky streaks along the rows of scales. D. X, 30; A. II, 7; scales 9–55–13.
GRUNNIENS, 108.

108. APLODINOTUS GRUNNIENS.

(THE FRESH-WATER DRUM, GASPERGOU, THUNDER-PUMPER, SHEEPSHEAD, CROAKER, BUBBLER, WHITE PERCH.)

[Plate XII.]

Aplodinotus grunniens Rafinesque, Journ. de Phys., 1819, 88 (Ohio R.). Graham, Preliminary List Kansas Fishes, 77, 1884 (Kansas River). Jordan, Cat. Fish. North America, 93, 1885 (name only).

Amblodon grunniens Rafinesque, Ichth. Ohiensis, 24, 1820 (Ohio R.). Agassiz, Am. Journ. Sci. and Arts, 1854 (Tennessee R.). Girard, U. S. Pac. R. R. Survey, 96, plate 23, 1859 (St. Louis; Arkansas R.; Poteau R.; Milk R.).

Haploidonotus grunniens Gill, Proc. Acad. Nat. Sci. Phila., 1861, 104. Jordan, Fishes of Upper Georgia, 319, 1876 (French Broad R.; Cumberland R.). Jordan, Man. Vert., ed. i, 241, 1876. Nelson, Fishes Illinois, 44, 1876 (Lake Michigan). Jordan, Cat. Fish. Illinois, 50, 1878 (La Salle; Peoria). Bean, Proc. U. S. Nat. Mus., 1880, 94 (Sandusky, O.; Cincinnati, O.; Detroit, Mich.; Au Sable Riv., Mich.). Jordan & Gilbert, Syn. Fish. North America, 567, 1883. Jordan, Ohio Geol. Survey, iv, 983, 1883 (Ohio R.; Great Lakes). Forbes, Catalogue Fish. Illinois, 62, 1884 (Lake Michigan; Illinois R., Ohio R.). Goode, Hist. Aquat. Anim., 370, plate 123, 1884.

Sciæna oscula Lesueur, Journ. Acad. Nat. Sci. Phila., 1822, 252, plate 13. Kirtland, Rept. Zool. Ohio, 168, 192, 1838 (Ohio).

Corvina oscula Cuv. & Val., Hist. Nat. Poiss., v, 98, 1836 (copied). Richardson, Faun. Bor. Amer., iii, 68, 1836. Kirtland, Bost. Journ. Nat. Hist., iii, 350, plate 6, fig. 3, 1840. DeKay, New York Fauna, Fishes, 73, plate 21, fig. 63, 1842 (New York). Storer, Syn. Fish. North Am., 319, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 297, 1860 (Ohio Canal; Lake Pontchartrain).

Sciæna grisea Lesueur, Journ. Acad. Nat. Sci. Phila., 1822, 254.

Corvina grisea DeKay, New York Fauna, Fishes, 76, 1842 (New York).

Corvina richardsoni Cuv. & Val., Hist. Nat. Poiss., v, 100 (Lake Huron). Richardson, Faun. Bor. Amer., 64, 77, 1836. DeKay, New York Fauna, Fishes, 76, plate 20, fig. 55, 1842. Storer, Syn. Fish. North Am., 320, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 298, 1860 (copied).

Haploidonotus richardsoni Gill, Proc. Acad. Nat. Sci. Phila., 1861, 105 (name only).

Eutychelithus richardsoni Jordan, Man. Vert., ed. i, 242, 1876 (copied).

Amblodon concinnus Agassiz, Amer. Jour. Sci. Arts, 1854, 307 (Tennessee R.).

Haploidonotus concinnus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 104 (name only). Jordan, Man. Vert., ed. i, 242, 1876 (copied).

Amblodon lineatus Agassiz, Am. Jour. Sci. Arts, 1855, 307 (Osage River).
Haploidonotus lineatus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 105 (name only). Jordan, Man. Vert., ed. i, 242, 1876 (copied).
Amblodon neglectus Girard, Proc. Acad. Nat. Sci. Phila., 1858, 167 (Rio Grande). Girard, U. S. and Mex. Bound. Survey, 12, plate v, fig. 6–10, 1859 (Rio Grande, Matamoras).
Haploidonotus neglectus Gill, Proc. Acad. Nat. Sci. Phila., 1861, 105 (name only).
Corvina (Amblodon) neglecta Steindachner, Ichth. Notizen, vi, 1867, 38 ("southern part of the west coast of the United States").

Habitat.—Fresh waters of the Eastern United States, chiefly west of the Alleghanies; Great Lakes to Dakota, and Texas.

This species is one of the common inhabitants of our deep and sluggish rivers and of our lakes. Under favorable circumstances it reaches a large size, and a weight of 40 to 50 pounds. It is held in rather low esteem as a food-fish, its flesh being rather coarse and flavorless. In the lake region, as the "Sheepshead," it is altogether worthless, but farther south it holds a higher rank, the "White Perch" of the Ohio being regarded as a tolerable food-fish. In Texas the same species, as the "Gaspergou," is regarded as one of the best of the river fish.

There is no doubt that all of the nominal species above enumerated should be referred to a single one, *A. grunniens*.

Genus XXVI.—EQUES.

Eques Bloch, Ichthyologia, 1793 (*americanus*=*lanceolatus*).
Equietus Rafinesque, Analyse de la Nature, 1815, 86 (substitute for *Eques*, the latter name being considered too short).
Pareques (Gill Mss.) Goode, Bull. U. S. Nat. Mus., v, 50, 1875 (*acuminatus*).

TYPE: *Eques americanus* Bloch = *Chætodon lanceolatus* L.

This genus is one of the most remarkable in the family in respect to its osteology, as well as to the coloration of some of its species. One of the four known species, *Eques acuminatus*, resembles considerably *Sciæna* and other typical members of the family, while the bizarre form and coloration of *Eques lanceolatus* gives it some resemblance to the Chætodonts. The two other species are, however, intermediate, and we know of no sufficient character on which *Pareques* can be maintained as a distinct genus.

ANALYSIS OF SPECIES OF EQUES.

a. Dorsal rays X to XII–I, 36 to 46; first five or six of the interneurals* wedged in between the neurals of the second and third vertebræ, the rest between third and fourth. (*Pareques* Gill.)
b. Profile elongate, rather steep, but not nearly vertical; distance from snout to first dorsal spine about equal to depth of body (form approaching that of *Sciæna umbra*).
c. Dorsal spines little elevated, the longest about 5¼ in length of body; vertical fins unspotted; body oblong, compressed, the back somewhat elevated; eye about equal to snout, 4 in head; interorbital area not quite as broad as eye; preorbital 1⅛ in eye; mouth larger than in *Eques punctatus*, max-

* Not examined in *Eques pulcher*.

illary reaching past middle of orbit; teeth of upper jaw slightly enlarged; gill-rakers short, rather slender, 6 + 9; caudal peduncle and fin less deep than in *Eques punctatus*; second anal spine slightly shorter than soft rays, 2½ in head; soft dorsal scaly; scales large, the series below lateral line slightly oblique; longitudinal streaks on body not following the rows of scales ....ACUMINATUS, 109.

x. Color nearly black, with longitudinal whitish stripes on the body, not on the fins; one stripe from upper edge of eye straight to upper edge of caudal peduncle, one just above this to last rays of soft dorsal, two confluent behind from nape to middle of soft dorsal, two below the first from pectoral to base of caudal, the lowest to edge of caudal peduncle; fins dusky. Head 3; depth 2⅔. D. X–I, 38 to 40; A. II, 7; scales 50; eye 4 in head; snout 3⅘; maxillary 3; second anal spine 2⅛; longest dorsal spine 1⅞; pectoral 1⅐. (West Indian specimens.).........Var. *acuminatus*, 109 (*a*).

xx. Coloration dark smutty brown, with traces only of seven paler streaks; region at base of soft dorsal darker; spinous dorsal, tips of ventrals, and inside of gill cavity black; fins otherwise smutty. Head 3⅓ in length; depth 2⅘. D. X–I, 40; A. II, 7; scales 6–51–10; second anal spine 2⅓; eye 4; snout 4; maxillary 2⅓. (Specimens from Charleston.)
Var. *umbrosus*, 109 (*b*).

cc. Dorsal spines elongate, the longest 2⅘ in length of body; soft parts of vertical fins with white spots; body robust, the back much compressed, the general form much as in *Eques acuminatus*, but the caudal peduncle deeper and more compressed; profile rather steep, depressed over the eye; snout slightly longer than eye, 3⅓ in head; eye as wide as interorbital region; preorbital broad, as wide as eye; mouth small, sub-inferior; maxillary almost entirely concealed below the preorbital, 2½ in head, reaching to below middle of eye; teeth in both jaws in broad bands, the outer series of the upper jaw enlarged; preopercle entire, the membrane with slight cilia; gill-rakers small, slender, 6 + 11; lower pharyngeals small; the teeth all conical, those of the posterior angle and inner series somewhat enlarged; anterior dorsal spines as high as body; membranes of the soft portions of the vertical fins closely scaled to the tip; caudal broadly rounded; anal short and high; second spine about ⅔ of longest ray, 3 in head; anal spine placed midway between base of pectoral and base of caudal; pectorals and ventrals short and equal, 1⅐ in head. Color, dark brown, a light bar in front of eye extending around the chin, a second pale bar extending around the head immediately behind the eyes, a third extending from in front of dorsal over base of pectorals; a light bar along base of soft dorsal; a light bar extending from behind the elevated portion of the spinous dorsal downwards, dividing into two, the branches running straight back, the upper branch to beginning of last fourth of soft dorsal, the lower branch to base of caudal; 2 or 3 light, undulating longitudinal bars below these; fins all dark brown, the soft portions of the vertical fins with many whitish stellate spots. Head 3⅘ in length; depth 3. D. XI or XII–I, 46; A. II, 6 or 7; scales 8–55 to 59–11 or 12...PUNCTATUS, 110.

bb. [Profile very steep, "steeper than in *Eques lanceolatus*." Body deepest below first dorsal spine, thence rapidly tapering to the narrow caudal peduncle; eye 3 in head; snout 1⅓ in eye; mouth subinferior, the thick convex snout projecting beyond it; first ventral ray filiform, 3⅓ in body; longest dorsal spines 1⅔ to 2⅔ in length of body, their height nearly twice that of the body below them; color olivaceous, three dark-brown longitudinal bands along the sides, the middle one from eye backwards reaching tips of the middle caudal rays; the upper from occiput backward to end of soft dorsal; the lower from lower corner of eye to behind anal; two very faint broad cross-bars, the anterior from base of first dorsal to ventrals, the next from middle of soft dorsal to anal; tip of snout and chin black; an oblique bar below eye; spinous dorsal, pectoral, and ventral black, edged with white; edges of caudal yellowish; anal with brown points anteriorly. Head 3⅗ to 3⅓ in total length; depth the same. D. X-I, 37 or 38; A. II, 7; lat. l. 50.] (*Steindachner.*)..............PULCHER, 111.

aa. Dorsal rays XIV or XV-I, 53; about twelve of the anterior interneurals wedged in between the occiput and the neural spine of the third vertebra; profile almost vertical, the distance from tip of snout to first dorsal spine much less than depth of body. (*Eques.*)

d. Body deepest below first dorsal spine, rapidly tapering to the narrow caudal peduncle; profile very steep, little convex; eye little longer than snout, about 4 in head; preorbital broad, nearly as wide as eye; mouth small, slightly oblique; maxillary reaching to below anterior fourth of eye; teeth all villiform in broad bands, the outer scarcely enlarged; preopercle with a fringed membranous border; gill-rakers very short and slender, 6+9; anterior dorsal spines much elongate, 1⅖ in body; soft rays low, the membranes scaled to the tips; anal small; its second spine 3 in head; ventrals 1⅓ in head; pectorals scarcely shorter; color, light yellowish; a narrow brownish band from the corner of the mouth up across the middle of the eye, and meeting its fellow on top of head; another broader band edged with a narrow white line on each side from the nape down and back over opercle, meeting its fellow between the ventral fins and extending to the tips of their outer rays; a third and still broader band, also bordered by white, extending from the tips of the dorsal spines to their base, then downward and backward to the tips of the middle caudal rays; body below this band silvery white; above it somewhat darker. Head 4 in length; depth 2⅗. D. XIV to XVI-I, 53; A. II, 5; scales irregular, with smaller ones intermixed..............LANCEOLATUS, 112.

109. EQUES ACUMINATUS.

a. Var. *acuminatus.*

Grammistes acuminatus Bloch & Schneider, Syst. Ichth., 184, 1801.

Eques acuminatus Castelnau, Anim. Nouv. ou Rares de l'Amér. du Sud, 10, 1855. Günther, Cat. Fish. Brit. Mus., ii, 280, 1860 (Cuba). Poey, Memorias, ii, 370, 1861 (Cuba); Synopsis, 325, 1868 (Cuba). Cope, Ichthyol. Lesser Antilles, 471, 1870 (St. Croix). Poey, Enumeratio, 49, 1875 (Cuba). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Pareques acuminatus Goode, Bull. U. S. Nat. Mus., v, 50, 1876 (Bermudas). Bean, Internat. Fish. Exhib. Berlin, 54, 1883 (Key West).

Eques lineatus Cuv. & Val., Hist. Nat. Poiss., v, 1830, 169 (Brazil).

b. Var. *umbrosus.*

Sciæna acuminata Jordan & Gilbert, Syn. Fish. North Am., 573, 1883 (Pensacola).

Eques acuminatus umbrosus Jordan & Eigenmann, var. nov. (Charleston; Pensacola).

Habitat.—West Indian fauna, South Carolina to Brazil; var. *umbrosus* on the United States coast.

This species is not uncommon in the West Indies. In several respects it differs widely from the type of the genus *Eques*, in all these respects approaching the type of the genus *Sciæna*. It however seems impossible to regard *Pareques* as a genus distinct from *Eques*, as in several regards *Eques punctatus* is intermediate between *Eques acuminatus* and *Eques lanceolatus*.

A third species of the subgenus *Parequés* was obtained by Professor Gilbert at Panama, but the types were destroyed by fire before a description could be published.

Northern specimens of this species (Charleston, Pensacola, Key West) are much more plainly colored than the ordinary West Indian form. We propose for such the varietal name of *Eques acuminatus umbrosus*, taking as our type a specimen from Charleston sent us by Mr. Charles C. Leslie.

Of the ordinary striped form we have examined specimens in the museum at Cambridge from Rio Janeiro, Porto Rico, St. Thomas, and Sombrero. Our description of var. *acuminatus* is especially drawn from No. 563, M. C. Z., from the island of Sombrero.

110. EQUES PUNCTATUS.

(SERRANA.)

Serrana hispanis Parra, Piezas de Hist. Nat. de Cuba, 2, plate 2, lower figure, 1787 (Cuba).

Eques punctatus Bloch & Schneider, Syst. Ichth., 106, 1801 (based on Parra, 2, plate 2, fig. 2). Desmarest, Première Décade Ichthyol., 40, plate iii, fig. 2, 1823 (Cuba). Cuv. & Val., Hist. Nat. Poiss., v, 167, plate 116, 1830 (Cuba, Martinique). Storer, Syn. Fish. North Am., 322, 1846 (copied). Günther, Cat. Fish. Brit. Mus., ii, 281, 1860 (Jamaica). Poey, Proc. Acad. Nat. Sci. Phila., 1863, 176 (Parra, plate 2, lower figure). Poey, Synopsis, 325, 1868 (Cuba). Cope, Ichthyol. Lesser Antilles, 471, 1870 (St. Croix). Poey, Enumeratio, 49, 1875 (Cuba). Jordan, Proc. U. S. Nat. Mus., 1886, 43 (Cuba).

Habitat.—West Indian fauna.

This handsomely colored species is not uncommon in the West Indies, The specimen here described was obtained by Dr. Jordan at Havana. Others are in the museum at Cambridge, from Cuba and from Jérémie. Hayti.

111. EQUES PULCHER.

Eques pulcher Steindachner, Ichth. Notizen, vi, 43, 1867 (Barbadoes).

Habitat.—West Indian fauna; Barbadoes.

This species is known from Steindachner's description only.

112. EQUES LANCEOLATUS.

(SERRANA.)

Guapena, Edwards, "Gleanings, plate 210" ("Caraibes islands").

Chætodon lanceolatus Linnæus, Syst. Nat., ed. x, 277, 1758 (based on Edwards, plate 210). Linnæus, Syst. Nat., ed. xii, 466, 1766. Gmelin, Syst. Nat., 1254, 1788 (copied).

Sciæna lanceolata Castelnau, Anim. Nouv. ou Rares de l'Amér. du Sud, 10, 1855.

Eques lanceolatus Günther, Cat. Fish. Brit. Mus., ii, 279, 1860 (West Indies). Poey, Enumeratio, 49, 1875 (Cuba). Poey, Synopsis, 325, 1868 (Cuba). Poey, Proc. Acad. Nat. Sci. Phila., 1863, 177 (Parra, plate 2). Cope, Ichth. Lesser Antilles, 471, 1870 (St. Croix; St. Martin). Jordan & Gilbert, Syn. Fish. North Am., 932, 1883 (Pensacola). Jordan, Cat. Fish. North America, 94, 1885 (name only).

Serrana Parra, Piezas de Hist. Nat. de Cuba, plate 2, upper figure, 1787 (Cuba).

Eques americanus Bloch, Ichthyol., plate 347, 1793. Bloch & Schneider, Syst. Ichth., 105, 1801.

Eques punctatus var. Bloch & Schneider, Syst. Ichth., 106, 1801 (based on Parra, plate 2, fig. 1).

Eques balteatus Cuvier, Règne Animal, plate 29, fig. 2, 1829. Cuv. & Val., Hist. Nat. Poiss., v, 165, 1830 (Martinique). Storer, Syn. Fish. North Am., 322, 1846 (copied).

Sciæna edwardi Gronow, Cat. Fish., ed. Gray, 53, 1854.

Habitat.—West Indian fauna, ranging northward to Pensacola.

This interesting fish is widely distributed in the West Indian waters. The specimen described by us is in the National Museum, having been taken near Pensacola.

RECAPITULATION.

The following is a list of the species of *Sciænidæ* recognized by us as occurring in the waters of America and Europe. The distribution in general of each species is indicated by the use of the following letters:

E. Europe.
N. Atlantic coast, north of Cape Hatteras.
S. South Atlantic and Gulf coast.
W. West Indies.
C. California.
P. Pacific coast of Mexico and Central America.
F. Rivers of North America.
B. Coasts of Brazil.
A. Rivers of South America (Amazon).
V. Pacific coast of South America.

Subfamily I.—OTOLITHINÆ.

1. **Seriphus** Ayres.
   1. *Seriphus politus* Ayres. C.

2. **Archoscion** Gill.

§ *Isopisthus* Gill.

2. *Archoscion remifer* (Jordan & Gilbert). P.
3. *Archoscion parvipinnis* (Cuv. & Val.). W., B.

§ *Archoscion.*

4. *Archoscion analis* (Jenyns). V.

3. **Cestreus** Gronow. (To be called *Cynoscion*, if *Cestreus* be regarded as preoccupied by *Cestræus*.)

5. *Cestreus prædatorius* Jordan & Gilbert. P.
6. *Cestreus acoupa* (Lacépède). B.
7. *Cestreus squamipinnis* (Günther). P.
8. *Cestreus othonopterus* (Jordan & Gilbert). P.
9. *Cestreus striatus* (Cuvier). B.
10. *Cestreus obliquatus* (Valenciennes). W. (Doubtful species; unknown to us.)
11. *Cestreus nothus* (Holbrook). S.
12. *Cestreus regalis* (Bloch & Schneider). N., S.
12 (*b*). —— —— *thalassinus* (Holbrook). S.
13. *Cestreus reticulatus* (Günther). P.
14. *Cestreus nebulosus* (Cuv. & Val.). S.
15. *Cestreus parvipinnis* (Ayres). C.

16. *Cestreus xanthulum* (Jordan & Gilbert). P.
17. *Cestreus albus* (Günther). P.
18. *Cestreus stolzmanni* (Steindachner). P.
19. *Cestreus nobilis* (Ayres). C.
20. *Cestreus phoxocephalus* (Jordan & Gilbert). P.
21. *Cestreus leiarchus* (Cuv. & Val.). W., B.
22. *Cestreus virescens* (Cuv. & Val.). B.
23. *Cestreus microlepidotus* (Cuv. & Val.). B.
24. *Cestreus steindachneri* Jordan. B.
25. *Cestreus bairdi* (Steindachner). B.

4. **Ancylodon** Cuvier.
26. *Ancylodon ancylodon* (Bloch & Schneider). B., P.

Subfamily II.—SCIÆNINÆ.

5. **Nebris** Cuv. & Val.
27. *Nebris microps* Cuv. & Val. B., P.

6. **Larimus** Cuv. & Val.
28. *Larimus argenteus* (Gill). P.
29. *Larimus breviceps* (Cuv. & Val.). W., B., P. (Perhaps more than one species included in the synonymy.)
30. *Larimus stahli* (Poey). W.
31. *Larimus fasciatus* Holbrook. S.

7. **Odontoscion** Gill.
32. *Odontoscion dentex* (Cuv. & Val.). W.

8. **Corvula** Jordan & Eigenmann.
33. *Corvula macrops* (Steindachner). P.
34. *Corvula sialis* Jordan & Eigenmann. S.
35. *Corvula subæqualis* (Poey). W.
36. *Corvula batabana* (Poey). W.

9. **Plagioscion** Gill.
37. *Plagioscion squamosissimus* (Heckel). A.
38. *Plagioscion surinamensis* (Bleeker). A.
39. *Plagioscion auratus* (Castelnau). A.

10. **Bairdiella** Gill.
40. *Bairdiella archidium* (Jordan & Gilbert). P.
41. *Bairdiella chrysura* (Lacépède). S.
42. *Bairdiella ensifera* (Jordan & Gilbert). P.
43. *Bairdiella icistia* (Jordan & Gilbert). P.
44. *Bairdiella ronchus* (Cuv. & Val.). W., B.
45. *Bairdiella armata* Gill. P., W., B.
46. *Bairdiella aluta* (Jordan & Gilbert). P. (Doubtful species.)
47. *Bairdiella chrysoleuca* (Günther). P.

11. **Stelliferus** Stark.
48. *Stelliferus oscitans* (Jordan & Gilbert). P.
49. *Stelliferus rastrifer* Jordan. B.
50. *Stelliferus fürthi* (Steindachner). P.
51. *Stelliferus minor* (Tschudi). V.
52. *Stelliferus stellifer* (Bloch). B.
53. *Stelliferus lanceolatus* (Holbrook). S.
54. *Stelliferus ericymba* (Jordan & Gilbert). P.
55. *Stelliferus naso* Jordan. B.
56. *Stelliferus microps* (Steindachner). B.

12. Sciæna (Artedi) Linnæus.

§ *Ophioscion* Gill.

57. *Sciæna gilli* (Steindachner). B.
58. *Sciæna adusta* Agassiz. B., W.
59. *Sciæna typica* (Gill). P. (*Nomen ineptum;* perhaps to be called *Sciæna ophioscion.*)
60. *Sciæna imiceps* (Jordan & Gilbert). P.
61. *Sciæna sciera* Jordan & Gilbert. P.
62. *Sciæna vermicularis* Günther. P.

§ *Sciænops* Gill.

63. *Sciæna ocellata* Linnæus. S.

§ *Johnius* Bloch.

64. *Sciæna heterolepis* Bleeker. B. (Species unknown to us.)

§ *Pseudosciæna* Bleeker.

65. *Sciæna aquila* (Lacépède). E. (Perhaps to be called *Sciæna hololepidota.*)

§ *Callaus* Jordan.

66. *Sciæna deliciosa* Tschudi. V.

§ *Sciæna* (= *Corvina* Cuvier).

67. *Sciæna umbra* Linnæus. E.

§ *Cheilotrema* Tschudi.

68. *Sciæna saturna* (Girard). C.
69. *Sciæna fasciata* (Tschudi). V.

13. Roncador Jordan & Gilbert.

70. *Roncador stearnsi* (Steindachner). C.

14. Leiostomus Lacépède.

71. *Leiostomus xanthurus* Lacépède. S. (W. ?)

15. Pachyurus Agassiz.

§ *Pachyurus.*

72. *Pachyurus squamipinnis* Agassiz. A.

§ *Lepipterus* Cuv. & Val.

73. *Pachyurus francisci* (Cuv. & Val.). A.
74. *Pachyurus bonariensis* Steindachner. A.
75. *Pachyurus schomburgki* Günther. A.

16. Pachypops Gill. (Perhaps a subgenus under *Pachyurus.*)

76. *Pachypops furcræus* (Lacépède). A.
77. *Pachypops trifilis* (Müller & Troschel). A.
78. *Pachypops adspersus* (Steindachner). A. (Perhaps to be called *P. grunniens.*)

17. Polycirrhus Bocourt.

79. *Polycirrhus dumerili* Bocourt. P.
80. *Polycirrhus brasiliensis* (Steindachner). B.
81. *Polycirrhus peruanus* (Steindachner). V.

18. Genyonemus Gill.

82. *Genyonemus lineatus* (Ayres). C.

19. Micropogon Cuvier & Valenciennes.

83. *Micropogon undulatus* (Linnæus). S.
84. *Micropogon furnieri* (Desmarest). W., B.
85. *Micropogon ectenes* Jordan & Gilbert. P.
86. *Micropogon altipinnis* Günther. P.

20. Umbrina Cuvier.

87. *Umbrina cirrosa* (Linnæus). E.
88. *Umbrina reedi* Günther. V.
89. *Umbrina broussoneti* Cuv. & Val. S., W., B.
90. *Umbrina roncador* Jordan & Gilbert. C.
91. *Umbrina xanti* Gill. P.
92. *Umbrina galapagorum* Steindachner. V.
93. *Umbrina dorsalis* Gill. P.

21. Menticirrhus Gill.

§ *Cirrimens* Gill.

94. *Menticirrhus ophicephalus* (Jenyns). V.

§ *Menticirrhus.*

95. *Menticirrhus simus* Jordan & Eigenmann. P.
96. *Menticirrhus nasus* (Günther). P.
97. *Menticirrhus agassizi* Jordan. V.
98. *Menticirrhus panamensis* (Steindachner). P.
99. *Menticirrhus martinicensis* (Cuv. & Val.). W., B. (Doubtful species; probably a variety of the next.)
100. *Menticirrhus americanus* (Linnæus). S.
101. *Menticirrhus saxatilis* (Bloch & Schneider). N., S.
102. *Menticirrhus undulatus* (Girard). C.

§ *Umbrula* Jordan & Eigenmann.

103. *Menticirrhus elongatus* (Günther). P.
104. *Menticirrhus littoralis* (Holbrook). S.

22. Paralonchurus Bocourt.

105. *Paralonchurus petersi* Bocourt. P.

23. Lonchurus Bloch.

106. *Lonchurus lanceolatus* (Bloch). B.

24. Pogonias Lacépède.

107. *Pogonias cromis* (Linnæus). S.

107(*b*). —— —— *courbina* (Lacépède). B.

25. Aplodinotus Rafinesque.

108. *Aplodinotus grunniens* Rafinesque. F.

26. Eques Bloch.

§ *Pareques* Gill.

109. *Eques acuminatus* (Bloch & Schneider). W.

109(*b*). —— —— *umbrosus* Jordan & Eigenmann. S.

110. *Eques punctatus* (Bloch & Schneider). W.
111. *Eques pulcher* (Steindachner). W.

§ *Eques.*

112. *Eques lanceolatus* (Linnæus). W., S.

INDIANA UNIVERSITY,
Bloomington, Ind., July 25, 1887.

Note on Cestreus and Cynoscion.

The generic name *Cynoscion* Gill must be used instead of *Cestreus* for the Weak-fishes. Professor Gill calls my attention to the prior use of *Cestreus* by McClelland (Journ. Nat. Hist., v. 2, p. 151) in 1842, for a genus of gobies (= *Prionobutis* Bleeker). The type, *Cestreus minimus* McClelland = *Eleotris amboinensis* Day. For the Sciænoid genus, *Cestreus* (1854), must give place to *Cynoscion*.

LIST OF PLATES.

PLATE I.

PLATE II.

PLATE III.

PLATE IV.

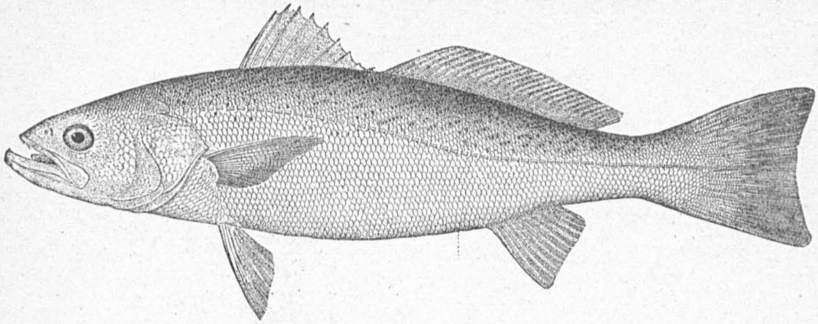


FIG. 1.—CYNOSCION REGALE (Bloch & Schneider). The Weak-fish, or Squeteague.
(No. 10421, U. S. N. M., from Wood's Holl, Massachusetts.)

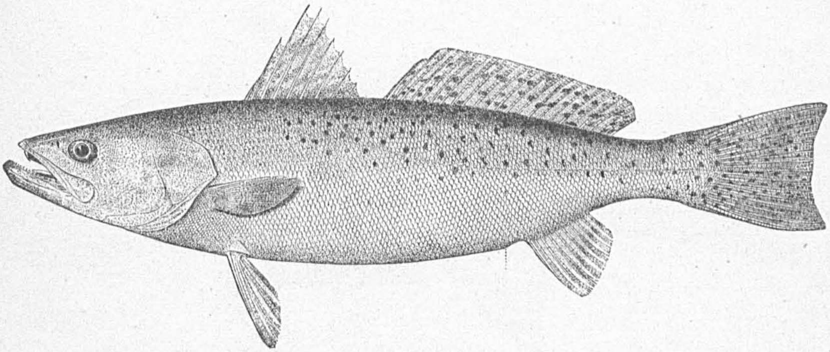


FIG. 2.—CYNOSCION NEBULOSUM (Cuvier & Valenciennes). The Spotted Weak-fish.
(No. 15000, U. S. N. M., from Norfolk, Virginia.)

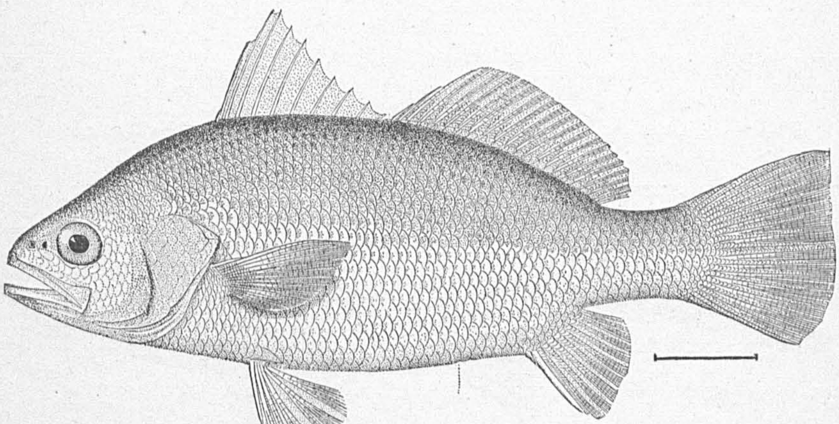


FIG. 3.—BAIRDIELLA CHRYSURA (Lacépède). The Mademoiselle, or Yellow-tail.
(No. 771, U S. N. M., from Beesley's Point, New Jersey.)

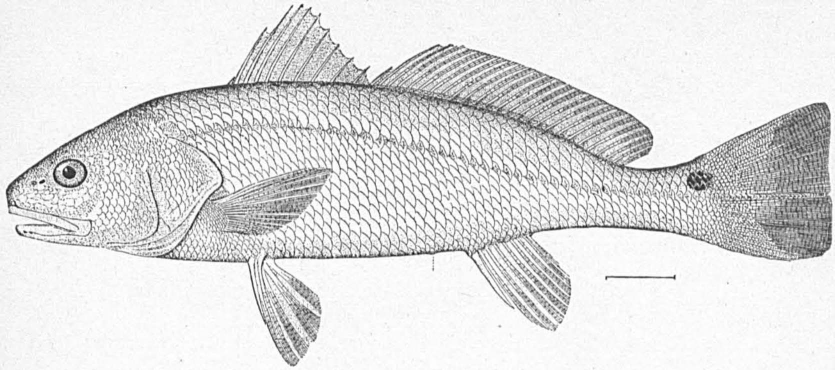


FIG. 4.—SCIÆNA OCELLATA Linnæus. The Red Drum, or Channel Bass.
(No. 622, U. S. N. M., from Indianola, Texas.)

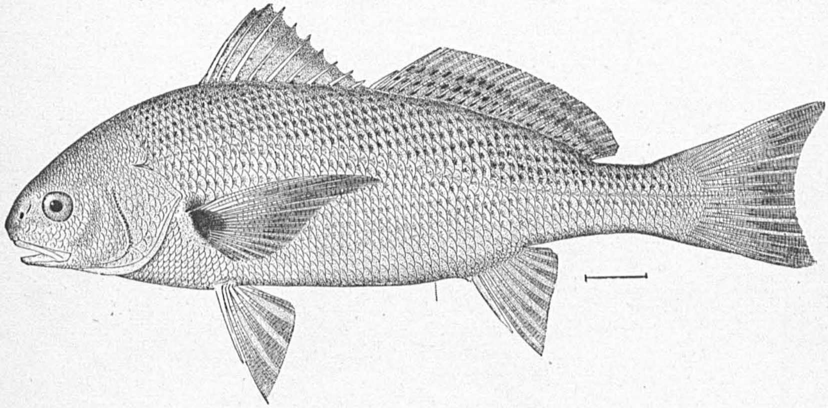


FIG. 5.—RONCADOR STEARNSI (Steindachner). The Roncador.
(No. 26864, U. S. N. M., from Santa Barbara, California.)

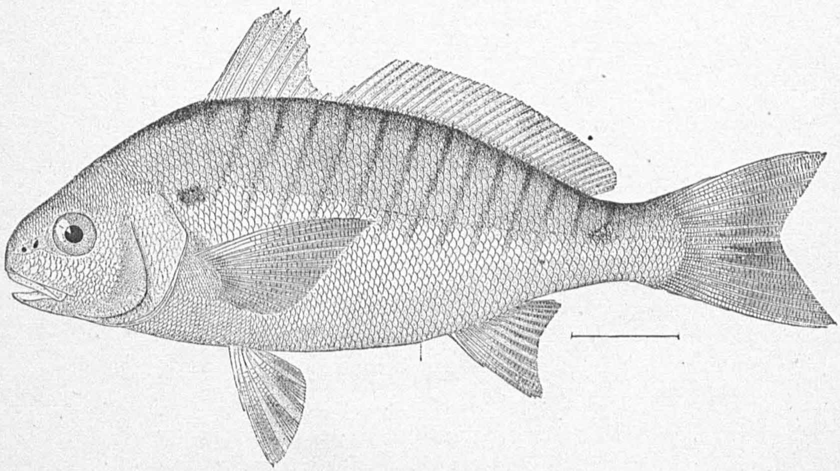


FIG. 6.—LEIOSTOMUS XANTHURUS Lacépède. The Spot.
(No. 20222, U. S. N. M., from Newport, Rhode Island.)

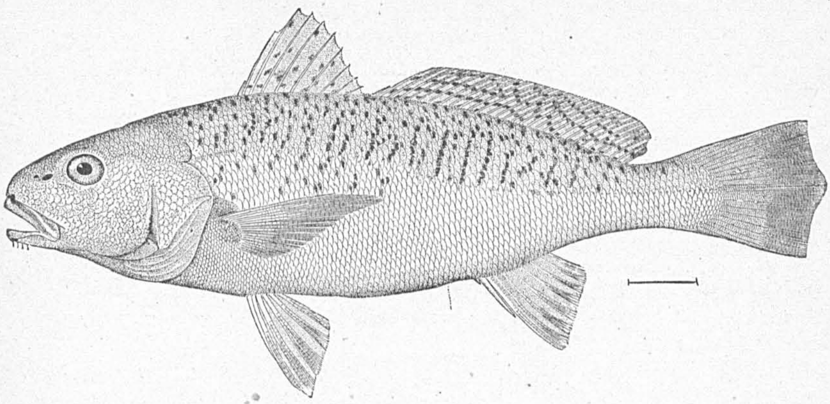


FIG. 7.—MICROPOGON UNDULATUS (Linnæus). The Croaker.
(No. 20742, U. S. N. M., from Newport, Rhode Island.)

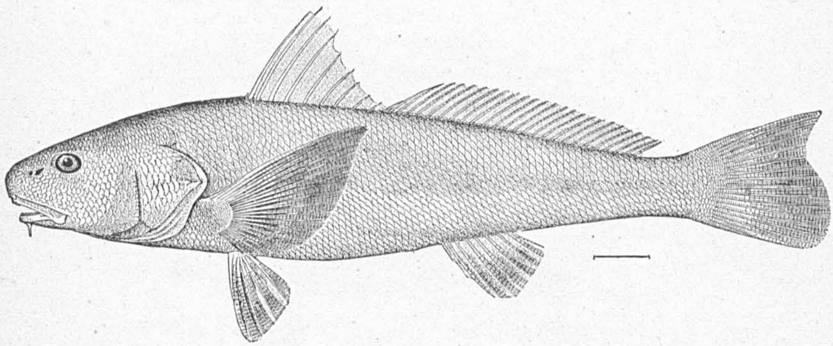


FIG. 8.—MENTICIRRHUS AMERICANUS (Linnæus). The Carolina Whiting.
(No. 22832, U. S. N. M., from Pensacola, Florida.)

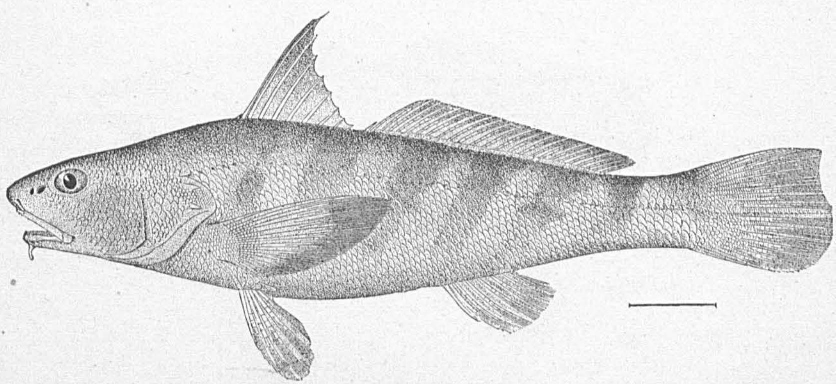


FIG. 9.—MENTICIRRHUS SAXATILIS (Bloch & Schneider). The King-fish.
(No. 25403, U. S. N. M., from Charleston, South Carolina.

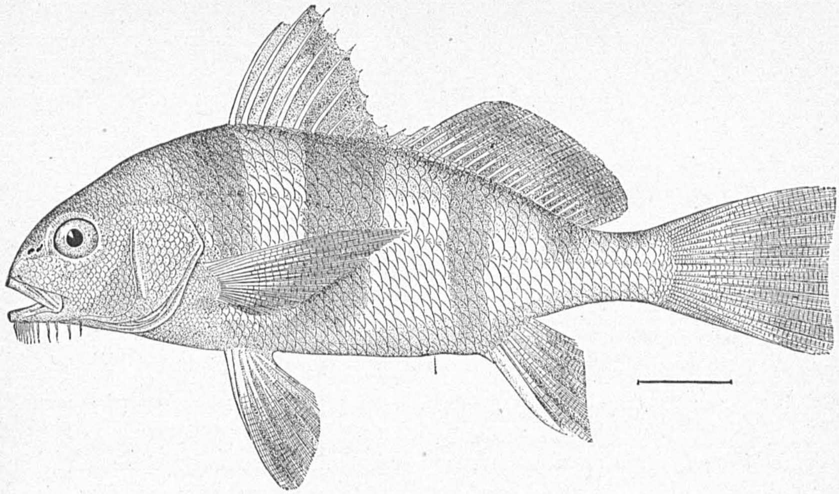


FIG. 10.—POGONIAS CROMIS Linnæus. The Drum (young).
(No. 18036, U. S. N. M., from Matanzas River Inlet, Florida.)

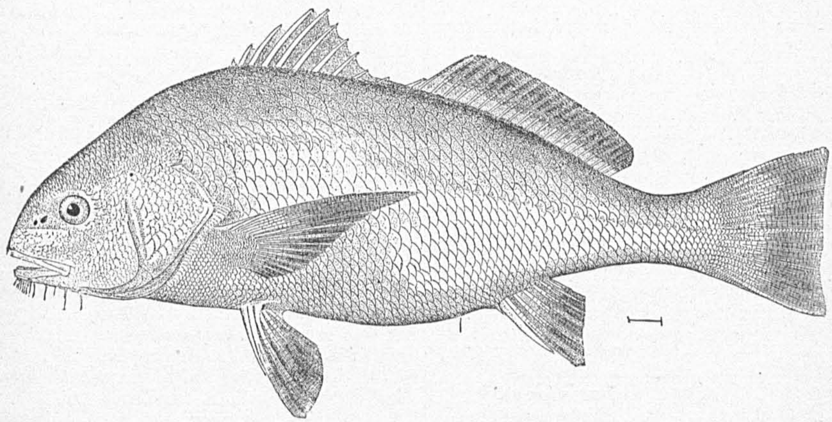


FIG. 11.—POGONIAS CROMIS Linnæus. The Drum (adult).
(No. 22936, U. S. N. M.)

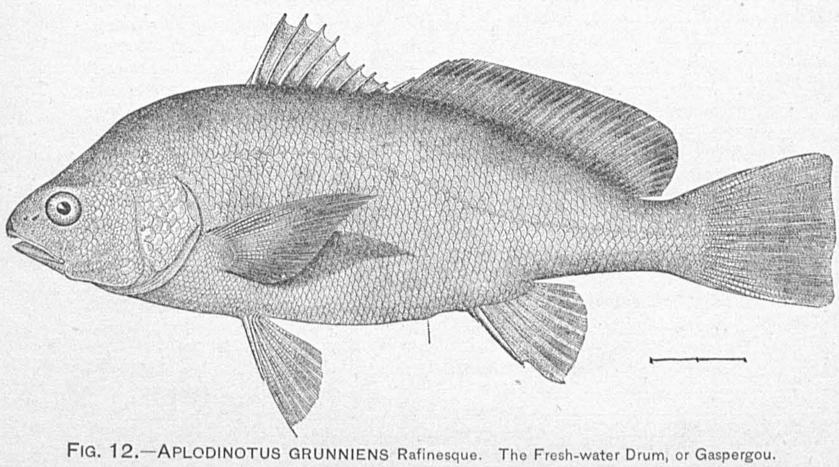


FIG. 12.—APLODINOTUS GRUNNIENS Rafinesque. The Fresh-water Drum, or Gaspergou.
(No. 10542, U. S. N. M., from Ecorse, Michigan.)

INDEX.

[NOTE.—The references are to page-figures in brackets.]

IV.—NOTES ON ENTOZOA OF MARINE FISHES OF NEW ENGLAND, WITH DESCRIPTIONS OF SEVERAL NEW SPECIES.

BY EDWIN LINTON.

In the summers of 1884–'85 I collected Entozoa from several of the commoner species of food-fishes and Selachians at the summer station of the U. S. Fish Commission, Wood's Holl, Mass.

Cestoid entozoa in the adult or strobile condition were found in great numbers in the alimentary tracts of all the Selachians examined. Encysted forms of the *Cestoidea* are for the most part confined to the *Teleostei* and are found in greatest abundance in the submucous coat of the stomach and intestine, although not infrequently met with in the peritoneum, liver, spleen, ovaries, &c. In every specimen of such fishes, as the Bluefish (*Pomatomus saltatrix*), Squeteague (*Cynoscion regale*), Striped Bass (*Roccus lineatus*), &c., examined, the walls of the alimentary tract were spotted thickly with minute cysts, which, when opened, were found to contain larvæ of some Cestods, most of them of the genus *Rhynchobothrium*. Some from the submucous coat of the Squeteague (*C. regale*) seem to be larvæ of the species which I have named *R. bisulcatum*.

In the gall-bladder of nearly every specimen of Squeteague (*Cynoscion regale*) that I have examined, I found hundreds of larval *Tetrabothria*. They are usually attached to the walls of the cystic duct in clusters of such size as to obstruct the passage. (Plate VI, Figs. 6 and 7.) They are easily dislodged and often may be seen in vast numbers in the amber-colored contents of the gall-bladder. These larvæ, when placed in sea-water, are quite active. Each moves by alternately thrusting forward a pair of bothria and by alternate contraction and extension of the body. While this is in progress the body is constantly changing its form. At times it is long and filiform, at others short and broad. At rest it is commonly thickened or obtuse in front, tapering posteriorly. The body of the larva consists of a thin limiting membrane about 0.05^{mm} thick, inside of which is a granular parenchyma, the latter a clear fluid filled with highly refractile globular masses averaging 0.01^{mm} in diameter. The bothria are four in number, without hooks, and in the majority of those examined, without costæ. In some specimens there seems to be the beginning of an auxiliary acetabulum at the apex of each bothrium.

The apex of the head, at times obtuse or even retuse, is frequently elevated into a terminal papilla, disclosing a conical proboscis and terminal os like that of *Echeneibothrium*. The entire head is sometimes invaginated. The length is difficult to determine, on account of the extreme variability of form, but the average length when at rest is not far from 2.5mm. When placed in fresh water they are apt to assume a filiform shape, with a length of from 4 to 6mm. When disturbed they contract to 1.5mm or less. Many of these larvæ have two small red blotches immediately behind the bothria. A water vascular system can be distinguished in most of them. This consists of a convoluted tube on each margin, becoming evidently double near the head and forming a loop in front of the bothria and giving off branches to the bothria. Larvæ resembling those from the gall-bladder, but smaller, were also found in the intestine of the Squeteague (*Cynoscion regale*) and of the Angler (*Lophius piscatorius*). These, wherever noticed, were in myriads, floating free in the chyle. (Plate VI, Figs. 8 and 9.)

Elongated cysts were found in the liver, or peritoneum, of most of the *Teleostei* that were examined. These when opened set free an endocyst which is contractile and has the power of locomotion to some extent. When subjected to the action of the compressor, lateral vessels can be discerned which are evidently parts of a water vascular system. When one of these endocysts (*blastocysts* Diesing), that is sufficiently developed, is opened, it will be found that an embryo has been developed within. In some, this embryo seems to be free in the parenchyma, and when the wall of the blastocyst is ruptured, it is at once freed from its living envelope. The development in this case seems to be analogous to the development of *Cercariæ* in a Sporocyst.

In other cases the neck of the embryo is protruded from the side of the blastocyst in the form of a loop. When further pressure is applied the head is released, while the blastocyst remains attached to the scolex much like the bladder of a *Cystocercus*. The embryo, however, it will be observed, is not released by evagination, as in *Tænia*.

Nematods were found in most of the fish that were examined, both free in the alimentary canal and encapsuled in the peritoneum, gastric cæca, liver, &c. They were found in the greatest numbers in the peritoneum of the Angler (*Lophius piscatorius*), from a single specimen of which hundreds of the Nematoid, *Agamonema capsularia* Dies., were obtained.

Several Trematods were met with, most of them free in the stomach of their host, but not so abundant as either the *Cestoidea*, *Nematoidea*, or *Acanthocephala*. These will be described in a subsequent paper.

The only fishes that were found comparatively free from intestinal parasites were the Sea-Robins (*Prionotus*), while a Sturgeon (*Acipenser sturio*) yielded but one specimen, a Nematod from the alimentary canal, and a few Trematods from the gills.

In the descriptive part of this paper I have confined my attention to the *Cestoidea* and the *Acanthocephala*, and with two exceptions, viz, *Dibothrium aluteræ* and *Echinorhynchus sagittifer*, to adult forms.

In the determination of genera I have been guided principally by Diesing's Revisions. Accepting the characters there enumerated, I have been compelled to create three new generic names, viz: *Spongiobothrium*, *Crossobothrium*, and *Phorciobothrium*.

For the determination of species I have made use of the publications of Rudolphi, Diesing, P. J. Van Beneden, Dujardin, Von Linstow, Wagener, Krabbe, Olsson, Eschricht, Leuckart, Küchenmeister, Zürn, Von Siebold, Leidy, Cobbold, and others.

Systematic work on the Entozoa is attended with much difficulty on account of the confusion in which the earlier literature is involved. In this connection I take the liberty of quoting a brief passage from Von Linstow's "Compendium der Helminthologie," Hannover, 1878:

"The number of well-founded species is indeed not quite so great as the list indicates, for a host of older names, especially originating with Rudolphi, figure in it, of which typical examples are no longer in existence, and which have been described imperfectly or not at all, so that they must remain forever an unsolved riddle. For example, many rudiments of *Tæniæ* discovered by this author, whose enumeration has been of not the least advantage to science, and many descriptions of older date have not since been recognized. One comes from their contemplation often in great perplexity of mind, and does not really know how they ought to be represented. Moreover, to make the entire literature effective was impossible, since too many species are described in such a way that it is not possible to recognize them again, and other specifications are so improbable that for this reason they must remain unconsidered; * * * when further the description of a new species is disposed of with an enumeration of the length and breadth, when, finally, for new species only the place where they are found is given, together with or without an accompanying description, as is to be found in many works, then I think I am not at fault in citing such publications only in limited amount."

It has been my endeavor to give as full a description of each species considered as the material at hand would justify. When only alcoholic specimens were accessible I have mentioned the fact in the proper place.

As the development of many of the *Cestoidea* seems to be quite different, even in closely related forms, it is very important that the systematic work which is done on them be so done as to leave no doubt in the mind of the investigator what species is being described, whether the name adopted for it holds or not. Appreciating the value of figures in establishing the identity of species, I have therefore not included in this paper descriptions of any forms unless accompanied with sufficient figures to make future identification reasonably certain.

In giving the specific names of fishes mentioned in this paper, I have used the nomenclature adopted by Prof. George Brown Goode in "The Fisheries and Fishery Industries of the United States, Section I." Washington, 1884.

The illustrations which accompany this paper are the work of my wife, Margaret B. Linton.

ORDER CESTOIDEA.

Family DIBOTHRIIDÆ *Diesing.*

DIBOTHRIUM Rudolphi.

Tæniæ spec. of Authors.
Rhytelminthus, *Rhytis*, *Alyselminthus*, and *Helsys* Zeder.
Bothriocephalus (*Dibothrius*) Rudolphi.
Diphyllobothrium Cobbold.
Dibothrium Diesing.

Dibothrium manubriforme, sp. nov.

[Plate I, Figs. 1-4.]

Head cuneate, tetrangular, truncate in front, tapering posteriorly, constricted into a cylindrical neck-like part near posterior, then expanding so that the posterior end of the head resembles one of the anterior segments of the body. The general appearance of the head when viewed laterally is therefore somewhat like a ball-bat, the constricted part representing the handle. Two longitudinal fossæ (bothria), laterally placed, extend from the anterior part of the head to the constricted part. Each of the marginal lobes thus formed is indented at the anterior extremity by a short but deep secondary fossa, which, together with the two lateral fossæ, give the head when viewed in front a four-lobed appearance. The edges of the lobes bordering the lateral fossæ are thin-lipped and flexible; anteriorly there is a transverse elevation forming both a lateral and a marginal rim and making an obtuse angle between the front and the side of the head. The marginal lobes, when at rest, have a rounded outline, fullest in the middle, tapering posteriorly, appressed slightly anteriorly, and raised into two small eminences on each side of the secondary fossæ. The head in a marginal view is somewhat flask-shaped. Seen from the front the head is squarish, with the angles rounded and the sides deeply cleft, the clefts rounded, the lateral clefts deeper than the marginal. Immediately back of the head the segments are very narrow, and for a greater or less distance, depending on the state of contraction, maintain about the same width as the base of the head. In some individuals the small anterior segments continue much farther back from the head than in the one figured (Plate I, Fig. 1). The segments are alternately short and long. This characteristic is quite plainly marked in those segments which immediately follow the head, is still noticeable on the median segments and also on the posterior ones, but is not so plainly marked on the latter as on the two former. In one specimen examined the first six segments did not show this alternation in size. In the next fourteen segments, however, the alternation was quite evident. The small anterior segments are terete, subtriangular in outline, narrow in front, wide behind, the length nearly equal to the greatest breadth. The succeeding segments are much broader than long.. At the widest part the ratio of the breadth to the length is as much as fourteen to one. As the segments increase in width they become much crowded together and thickened. In one specimen, measuring 140^{mm}, the segments increased in width uniformly for about 100^{mm} from the head; from that point they remained about the same size until near the posterior end, where they began to be elongated and at the same time became narrower and much thinner. The crowding together of the median segments is not due to contraction, but seems to be a permanent characteristic of the species. In some very young specimens the same character was observed. The general form of these worms, both young and adult, was persistent. Although kept for some time in water they were not observed to change their form in any essential particular from that given in the sketches.

In alcoholic specimens a dark median line will be noticed extending from the posterior end to the middle or anterior third of the strobile. This is due to the centrally situated ovaries, which are crowded with eggs. The genital apertures are lateral and may be traced in an irregular zigzag line on one side from about the anterior third of the body. In the mature segments they are rendered obscure, if not wholly obliterated, by the mass of eggs with which the center of the segment is filled. The eggs are white, opaque, oval; length, .045^{mm}; breadth, .03^{mm}. Associated with these perfect eggs are masses of others which become transparent when treated with oil of cloves or other strongly refracting media. These seem to be imperfect eggs which have not become invested with the thick hard shell which covers the perfect eggs.

An adult specimen gives the following measurements:

	Millimeters.
Length of strobile	133.00
Length of first series of segments	17.00
Length of head	3.50
Breadth of head in front, widest part	1.00
Average length of segments in first series	0.50
Breadth of widest segments, median	6.50
Length of widest segments, median	0.25
Length of posterior, mature segments	1.00
Breadth of posterior, mature segments	2.50

In another specimen the head and first segments give the following measurements:

	Millimeters.
Length of strobile	140.00
Length of head and first series of segments	30.00
Length of head	3.00

	Millimeters.
Breadth of head in front, widest part	0.90
Breadth of head just behind the front rim	0.80
Breadth of marginal lobe, about the middle	0.90
Breadth of head, narrowest part	0.21
Breadth of first segment, widest (posterior) part	0.80
Breadth of first segment, narrowest (anterior) part	0.42
Length of longer alternate segments, first series	0.40
Length of shorter alternate segments, first series	0.24

The segments of the first series are sometimes notched or crenulated on the postero-lateral margin, with a single median indentation; in others the edge is but slightly waving; in others it is nearly entire.

The following measurements are from a young specimen:

	Millimeters.
Length of strobile	20.00
Length of head	2.10
Breadth of head, anterior	0.80
Breadth of head just back of anterior rim	0.60
Breadth of head, narrowest (constricted) part	0.31
Breadth of first segments, widest (posterior) part	0.50
Breadth of first segments, narrowest (anterior) part	0.28
Average length of segments, longer alternates	0.35
Average length of segments, shorter alternates	0.24
Breadth of widest segments	0.90
Average length of widest segments	0.12
Width of posterior segments	0.35
Length of posterior segments	0.36

Habitat.—Both young and adult, one specimen of the former and six of the latter, were taken from the intestine of a spear-fish (*Tetrapturus albidus* Poey), August 8, 1885, at Wood's Holl, Mass.

Dibothrium aluteræ, sp. nov.

[Plate I, Figs. 5-8.]

Near *Dibothrium microcephalum* Rudolphi, Diesing, Systema Helminth., i, 592. *Ibid.*, Sitzungsb., xiii, 578, Revis. Ceph., Par. 241. Wagener, Nov. Act. Nat. Cur., XXIV, Suppl., 16, 69, tab. VII, 77. Van Beneden, in Bullet. Acad. Belgique, xxii, ii, 521.

Bothriocephalus microcephalus Bellingham, Ann. Nat. Hist., xiv, 253. (Habitat, *Orthagoriscus mola.*)

Head subsagittate with rounded apex; bothria oblong, lateral; neck, none; first joints distinct, about as long as wide, becoming much shorter and crowded together, much wider than long; genital apertures unknown.

Habitat.—File Fish (*Alutera Schœpfii*), Wood's Holl, Mass., August, 1884; 104 specimens from intestines of a single fish.

These specimens were all immature, none of them had the genital apertures developed. They ranged in length from 20^{mm} to 94^{mm}. The bothria in the smaller specimens are convex (Fig. 5), the central convex portions thin and transparent. A lateral view shows the bothria to be much narrower than the first joint, with curved regular outlines, except at the posterior edge, where there is a shallow notch. The front of the head is bluntly conical, expanding quickly, then moderately contracted, making a kind of knob or button at the apex; this knob is nearly circular. Measurements showed that the lateral diameter was but little greater than the marginal. In the larger specimens this convexity of the bothria had entirely disappeared, the thin membrane having collapsed and the typical fossæ of the *Dibothriæ* make their appearance. In the larger specimens, also, the bothria are much shorter in proportion to their width than in the smaller specimens (Fig. 7). The first segments are distinct, length as great or even greater than the width, triangular. The median and posterior segments are much crowded, width as much as or even more than ten times the length, alternately long and short, sometimes roughened by transverse wrinkles toward the posterior end. Posterior end bluntly rounded (Fig. 8).

The following measurements are from alcoholic specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of strobile	55.00	67.00	94.00	....
Length of head	0.60	....	0.64	0.64
Diameter of head, lateral apex	0.34	0.25	0.33	0.34
Diameter of head, marginal apex	0.30	0.25	0.33	0.34
Breadth of bothrium, widest part	0.42	0.40	0.52	0.54
Greatest marginal diameter of head	0.46	....	....	....
Lateral diameter of first segment	0.58	0.70	0.66	0.68
Marginal diameter of first segment	0.34	0.40	....	....
Length of first segment	0.34	....	0.40	....
Greatest width of strobile	2.50	1.60	1.80	....
Average length of segments near posterior	0.17	....	0.15	....
Length of posterior segment	0.20	....	....	....
Breadth of posterior segment	1.40	....	0.40	....

It will be seen upon comparing Figs. 6 and 7 that there is great variety of form to be found in the bothria of these worms. Other forms could be given, but it is believed that those chosen for illustration are sufficiently typical to prevent mistakes in identification. In many specimens the convex outline of the bothria is lost, while the other proportions of Figs. 5 and 6 are preserved. In cases where care is not taken the preserving fluid may distort the bothria.

I did not observe any indication of the hooks on the head, mentioned by Wagener for *D. microcephalum* (Entwickelung der Cestoden, p. 69, tab. vii, figs. 77 and 77*a*). The resemblance of this worm to Wagener's figure is sufficiently close to indicate a probable identity. The close relationship of the hosts, *Orthagoriscus mola* and *Alutera Schœpfii*, does not lessen this probability.

In the absence of positive proof of such identity, which can be obtained only by observing some other stages of development, I think it best to classify this worm as a new species with the provisional name *D. aluteræ*.

Family TETRABOTHRIIDÆ.

ECHENEIBOTHRIUM Van Beneden.

Echeneibothrium variabile Van Beneden.

[Plate I, Figs. 9–13.]

Echeneibothrium variabile Van Beneden, Mém. Acad. Belgique, xxv, 117, tab. iii, 1–4, 6–15. G. R. Wagener, Nov. Act. Nat. Cur., xxiv, Suppl., 85, tab. xxii, 280–282. Van Beneden, Mém. Vers Intest., 122 and 366, tab. xv, 6–8. Diesing, Revis. der Ceph. Ab. Par., 267. Olsson, Lunds Univers Arssk., tom. iii, 38, 40, tab. i, 15, 16.

Tetrabothrium (Echeneibothrium) variabile Diesing, in Sitzungsb., xiii, 1854, 581.

Larval state, Van Beneden, Mém. Acad. Belgique, xxv, tab. iii, 5. Diesing, Sitzungsb. der kais. Akad., xiii, 1854, 562. G. R. Wagener, *l. c.*, 85, tab. xxii, 279. Van Beneden, Mém. Vers Intest., 122, tab. xv, 5.

Bothriocephalus sphærocephalus? Deslongchamps, Encycl. Méth., ii, 150.

Echeneibothrium sphærocephalum Diesing, Revis. der Ceph. Par., 267.

The characters given for this species by Diesing, following Van Beneden, are:

Bothria four, pedicellate and highly versatile, at times linear or oval, at others cochleariform or calyciform, with a few transverse costæ, and divided into several loculi by a longitudinal partition. Muscular proboscis (myzorhynchus) large, subglobose, retractile, with a circular aperture (os) in the apex. Neck long. Anterior segments of body broader than long, median quadrate, ultimate oval. Genital apertures marginal, alternate. Penis armed with spines, scarcely bristly at base. Length as much as 100^{mm}.

In the latter part of August, 1884, I obtained several specimens of *Echeneibothria* from the spiral valve of the common Skate (*Raia erinacea*) which I have for the present referred to *E. variabile* Van Beneden. Some of the specimens possess characters which are given by Diesing as belonging to *E. sphærocephalum* Dies. (Revis. der. Ceph. Par., 267). It is probable, however, that these two species are identical, as indicated by Diesing: "Species hæc (*E. variabile*) cum præcedente (*E. sphærocephalum*) fortasse identica."

A few sketches and measurements were made of the specimens while they were still alive, but a pressure of other duties prevented a careful study of them then. When I found time to study them carefully they had lain for some time in alcohol and many of the segments had separated. There are two distinct types of head, one represented in Fig. 9, made from the living specimen; the other represented in Fig. 13, made from an alcoholic specimen. Other alcoholic specimens are identical in form with that shown in Fig. 9. In the first mentioned the bothria are somewhat oval; pedicels moderately extended; the border of the sucking disks thickened, marked with radiating lines, and gathered or puckered into a few large folds. The proboscis is globose, retractile. When the living specimen was viewed from the apex the aperture (os) could be seen surrounded by many radiating lines like the radiating muscles of the iris. In a side view of a mounted specimen a globular body about 0.2^{mm} in diameter can be seen lying in the center of the proboscis and about 0.1^{mm} from the apex. This globular mass has an aperture which lies opposite the aperture of the proboscis. It probably represents the true apex of the myzorhynchus retracted. The head behind the bothria is elongated into a neck-like part, which joins the true neck or jointless portion of the body by a definite articulation, which bears a faint resemblance to a ball-and-socket joint, in which the anterior part of the neck represents the "ball." There is also a difference in tissue, the neck having, besides longitudinal fibers, transverse fibers and many granular cells, while the neck-like portion of the head appears to be composed almost entirely of fibrous tissue arranged longitudinally.

In the other type the pedicels of the bothria are inflated and somewhat globose; the thickened border of the disk is not so much folded as in the first. The head behind the bothria is short and turgid. These differences, although striking when extreme cases are considered, are none of them so profound but that they may be accounted for by supposing them to represent different degrees of contraction. The bothria in the living worm are susceptible of great variety of form.

The segments begin from 1 to 2^{mm} back of the head. At first they are much broader than long, subsequently they become quadrate, then longer than broad. As the segments begin to mature they show a tendency to become narrowed anteriorly, with convex margins. A few of the extreme posterior segments are four times as long as broad, obtuse-pointed in front, posteriorly attenuate, with a truncate termination. The genital apertures are marginal, opening a little behind the middle. In some they are not exactly on the margin, but may be seen, in a lateral view, to be situated near the margin and running obliquely toward the center of the segment. The penis was retracted in all the specimens examined. It could be seen lying coiled up in the angle formed by the vagina where the latter turns abruptly from the middle of the segment towards the margin. The vagina could be traced from the ovaries in the posterior part of the segment along the median line until it reaches a point nearly opposite the marginal opening, where it turns abruptly towards the margin and opens immediately in front of the penis. The vas deferens is represented by a convoluted mass of tubes in the center of the segment. The anterior part of the segment is filled with large globular masses (ova). These are surrounded by a thick transparent membrane, and have a granular interior. A layer of oblong granular masses, smaller than the interior globular masses, surrounds the latter. This layer is adjacent to the marginal wall of the segment and the masses are at right angles to it.

In some specimens the median and posterior segments are very irregular in shape. This irregularity is sometimes produced by the apparent occurrence of an imperfect segment of triangular shape interjected between two others which are but slightly irregular; in other cases it has the appearance of two segments, one lying diagonally across the other and the two, as it were, welded together. Measurements of the head are not satisfactory on account of the extreme contractility of that part.

The following measurements were made from a mounted specimen corresponding in position and appearance with Fig. 9:

	Millimeters.
From tip to tip of extended bothria	1.48
From apex of proboscis (retracted) to neck	0.96
Breadth of neck	0.20
Breadth of first segment	0.20
Length of first segment	0.04
Distance from head to first segment	1.40
Length of a mature segment	2.60
Breadth of a mature segment	0.60
Length of segment near posterior	1.20
Breadth of segment near posterior	0.50
Length of longest living strobile	108.00

Habitat added: Common Skate (*Raia erinacea*), spiral intestine. Wood's Holl, Mass., August 25, 1884.

SPONGIOBOTHRIUM,* gen. nov.

Body articulate, tæniæform. Head separated from the body by a neck. Bothria four, opposite, pediceled, broken up into locinio-crispate folds, which are transversely costate. Unarmed; auxiliary acetabulum none; terminal papilla none. Genital apertures marginal.

This genus combines many of the characters of *Echeneibothrium* Van Beneden and *Phyllobothrium* Van Beneden. It differs from the former in the laciniæ of the bothria and in the absence of a terminal haustellum; from the latter in having pediceled instead of sessile bothria, and in the transverse costæ on the bothria.

Spongiobothrium variabile, gen. et sp. nov.

[Plate II, Figs. 13–19.]

Body articulate, tæniæform. Head separated from the body by a short neck, subquadrangular, tapering posteriorly, continuing at the anterior angles into four bothria. The bothria are pediceled and on their outer faces and borders are broken up into a number of delicate frill-like laciniæ, which are sometimes gathered into a more or less compact mass of crisp, puckered, or purse-like folds (Fig. 15) and sometimes expanded into long, curved, auriculate, or leaf-like flaps (Fig. 16). These are marked by transverse, parallel costæ which originate from a middle portion like the midrib of a leaf. There is no trace of either a

*Σπόγγος = a sponge or mop.

terminal papilla or auxiliary acetabulum. The neck, or unjointed part of the body, is short. In some the transverse striæ, which indicate the beginning of segments, were discernible almost immediately back of the head. The first segments are usually crowded, broader than long; subsequently they increase in length and become considerably longer than broad. In some of the ultimate segments the length is four or five times that of the breadth. The shape of the mature and nearly mature proglottides is very various.

This irregularity of shape is to be found in the living specimens as much as in those which have been preserved in alcohol. The most usual shape for the mature segments to assume is subquadrangular, somewhat contracted about the posterior third in the vicinity of the genital openings, expanding in front of this; the anterior end contracted into a short constricted neck where it joins the preceding segment. Sometimes this constriction occurs at the posterior instead of the anterior end of the segment. The ovaries are two sets of radiating tubes situated in the posterior end of the segment. The anterior half of the mature segments is crowded with globular masses (testes). These masses fill at least the anterior two-thirds of the adolescent segments. In the mature segments of all the specimens I have yet examined the center is filled with a convoluted mass, consisting of the retracted penis and the vas deferens, with perhaps the vagina and a portion of the oviduct. The extremely long and convoluted vas deferens is found protruding from the ruptured side of some of the segments which have been preserved in alcohol. This worm is remarkable for the slight change which it experiences when preserved in alcohol. Even the extremely delicate leaf-like folds of the bothria were not observed to curl up or shrivel when subjected to moderately strong alcohol. Fig. 15, Plate II, is a sketch made of a living specimen. I have since mounted the same individuals for permanent preservation. In the various processes of dehydrating with alcohol, staining with eosin, rendering transparent with oil of cloves, and afterwards mounting in Canada balsam, there has not been any shrinking or change of form, at least to any appreciable extent.

The water-vascular system is plainly indicated by two rather large tubes, which in the neck and anterior part of the body are sinuous, and each situated about as far from the other as it is from the nearest edge of the strobile. In subsequent segments they become widely separated from each other on account of the interposed ova and genital organs.

The substance of the head and pedicels of the bothria is for the most part fibrous tissue. The conical portion of the head is thus sharply marked off from the so-called neck. While the former is made up largely of fibrous tissue, the latter is granular, with but few longitudinal fibers. This feature can be easily brought out in preserved specimens by simple staining.

The following measurements were taken from mounted specimens:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of specimen	37.00	21.00	23.00	74.00
Length of bothria	0.96	0.90	....	....
Breadth of head—side	1.35	1.60	....	....
Breadth of head across the top	....	....	1.40	2.00
Length of one bothrium, expanded	....	....	3.00	....
Breadth of neck	0.20	0.16	0.20	0.24
Distance from head to first striæ	....	....	1.50	1.00
Distance from head to first distinct segment	1.80	1.40	2.00	2.60
Length of first segment	0.10	0.08	0.16	0.14
Breadth of first segment	0.20	0.26	0.24	0.32
Length of maturing segment	1.60	0.54	(*)	2.00
Breadth of maturing segment	0.32	0.24†	....	0.42
Length of posterior segment	0.74	0.80	....	1.56
Breadth of posterior segment	0.50	0.46	....	0.86

* Maturing segments very irregular, some long and narrow, others thick and short with rounded corners. † Variable.

Additional measurements of No. 4.

	Length.	Breadth.
	mm.	*mm.*
Segment 4mm from head	0.20	0.32
Segment 20mm from head	1.00	0.34
Segment 30mm from head	1.50	0.40
Segment 45mm from head	2.00	0.42
Segment near posterior end	2.40	0.70
Last segment but one	1.76	0.80
Last segment	1.56	0.86
Free segment	2.50	0.80
Free segment	3.00	0.80

Habitat.—Sting Ray (*Trygon centrura*), spiral intestine. Wood's Holl, Mass., August, 1884.

PHYLLOBOTHRIUM Van Beneden.

Phyllobothrium thysanocephalum,* sp. nov.

[Plate II, Figs. 1-12.]

In its sexually mature or strobile condition, this Cestode varies in length from 300mm to 1m. The head, as best seen in young specimens, has four bothria, which are quite early lobed and crisped and folded at the edges. In the adult these bothria are deeply lobed, so that even in a cross-section (Fig. 10) it is extremely difficult to make out the four primary lobes. The frilled, crisped, or ruffled structure of the bothria gives to the head, when at rest, a singularly striking resemblance to the short, imperfect branches which form the head in the cauliflower. The neck, or jointless part of the body, is very long. In one specimen, which measures 840mm in length, the first joints appear about 360mm back of the head. Immediately back of the bothria the head is slightly swollen and subcylindrical, and in alcoholic specimens nearly as wide as the bothria; in the living worm about three-fifths the width of the bothria.

* θύσανος = a tassel.

The neck is continuous with the head, slightly flattened, and tapers away from the head very gradually in fully grown specimens, so gradually, that its progress cannot be noted, except by comparing the width of the proglottides with that of the neck. The neck is marked with longitudinal rugæ, which continue well back on the forming proglottides (Figs. 1, 2). Where the transverse striæ, which mark the forming proglottides, begin, the surface of the body presents a rough, checkered appearance, due to these two systems of grooves, which is quite characteristic, and may serve to identify a fragment of one of these worms when neither head nor mature proglottis is present.

Proglottides, before they become free, are much broader than long, and each has a short, free posterior border, which becomes the rim or border mentioned in the description of the free proglottis. Penis very long, with a bulbous enlargement at the base. Near the posterior end the segments become rounded at the corners and somewhat elongated, until they graduate into the shape which is characteristic of the mature free joints.

Free proglottides (Figs. 4, 5) about twice as long as broad, very changeable in form, but in general rounded anteriorly; the extreme anterior end prolonged into a contractile papilla, which acts somewhat as a sucking-disk in aid of locomotion; posterior end truncate, with a narrow rim or border marked off from the basal edge by the transverse water-vessel. Sexual apertures marginal, opening a little back of the middle point. Penis very long; when erected, longer than the proglottis. Vagina opening immediately in front of the penis, flaring slightly at the mouth, quickly contracted into a short cylindrical tube, then expanding, finally reduced to a narrow tube, which runs anteriorly alongside a central clear space, enters the latter, and near its anterior end turns sharply, and runs back along the middle of the clear space until it unites with the ovaries in the posterior part of the proglottis.

Good preparations of the mature proglottides were obtained by subjecting them to slight pressure between two cover-glasses held in place by a spring wire-clip and hardened while in this position. When segments so prepared were afterwards stained, made transparent, and mounted, they were free from wrinkles or distortions, and showed the internal anatomy as well, indeed better, for topographical purposes, than could be shown with thin sections.

The chyle in the spiral intestine of the host, Tiger Shark (*Galeocerdo tigrinus*), swarmed with free proglottides, which were quite active. They had powers of independent movement and locomotion which gave them much the appearance of Trematods.

About twenty specimens in the strobile condition, but representing three stages of development, together with great numbers of free proglottides were found in the spiral intestine of a Tiger Shark (*G. tigrinus*). The larger adult specimens varied in length from one-half to one meter.

Measurements made on the largest specimen were as follows:

Total length of strobile	meter..	1
Breadth of head, lateral	millimeter..	15
Thickness of head, marginal	do...	6
Breadth of neck	do...	9
Breadth of posterior segment	do...	5
Length of posterior segment	do...	2

In this specimen all the mature proglottides had evidently become separated from the strobile. On another specimen, measuring 580^{mm} in length, the posterior proglottides were mature, and measured 5^{mm} in length and 2½^{mm} in breadth.

Measurements of free living segments give the following proportions: Length, 8^{mm}; breadth, 4 to 4.5^{mm}; length of penis, 4^{mm}+.

A second and younger stage was represented by specimens ranging in length from 190^{mm} to 230^{mm}. These differed from the next stage, described below, in size and in having a more or less evident beginning of a jointed condition. This, in the smaller forms of this second group, was indicated by tolerably distinct waving transverse lines. The largest specimen of this group, 230^{mm} in length, although tapering to a point at the posterior end like the others, had distinct segments for the last 30^{mm}.

Another group, consisting of quite young specimens, ranging in length from 31^{mm} to 57^{mm}, represented a third stage in the development of this worm (Figs. 7, 8). These are evidently the young of this species.

Measurements of one of them give the following dimensions:

	Millimeters.
Length of specimen	41.00
Length of head	1.50
Breadth of head	2.25
Length of rostellum	0.50
Breadth of neck just back of head	1.00
Breadth of posterior extremity	0.20

The neck increases slightly for a short distance back of the head. The body then tapers gradually and uniformly to the posterior end. In this group there is no sign of joints. Most of the specimens, particularly after they have been preserved in alcohol, have a much more compact arrangement of the folds of the bothria than appears in Fig. 7, which was sketched from a living specimen, one of the smallest of the lot. In larger specimens of this group the head is subglobose, with the edges of the bothria in crisp, closely lying folds, so that it is very difficult to make out the number of lobes of the bothria or to determine whether the latter are pediceled or sessile. The bothria are marginal, sessile, or on very short pedicels, each divided into at least two secondary lobes, which ultimately become a mass of crisp folds. In the center of the head, placed anteriorly, is a short chitinous rostellum on a pedicel of soft connection tissue (Figs. 7, 7*a*, 7*b*). Seen from the front this rostellum is quadrate, and presents to view four crescent-shaped bodies (Fig. 7*a*) with their convexities turned inward and inclosing a clear space, in the center of which is a granular elevation. The tips of the horns of these crescents are sharp-pointed, and form a circle of eight hooks, which surrounds the tip of the rostellum. When this rostellum is viewed from the side, each crescent is seen to be the recurved anterior border of an oblong or triangular trough-like plate. These four triangular plates occupy much the same relative position with respect to each other as the jaws in *Echinus*, and suggest the "lantern" of that animal. This proboscis was observed in all of the smaller specimens and in some of the half-grown ones, but had been lost by all of the larger specimens. It seems to have but a feeble attachment to the head, and became detached from several specimens while they were being examined. The length of this rostellum in the half-grown specimens was about the same as that found in the smaller specimens, viz, about 0.5^{mm}.

In a series of transverse sections made of a head of one of the larger specimens, it was noticed that there was a circular aperture in the sections of the anterior part of the head, which doubtless marks the place where the fleshy pedicel of the rostellum was inserted. The primary lobes of the bothria spring from a central muscular portion of the head (Figs. 9, 10), and consist of fascicles of muscular fibers which extend into the secondary and tertiary divisions. The crisped appearance of the head is due to minute crimped or frilled divisions of the lobes, and not to the crisping or curling of the free borders of the lobes, as in *P. láctuca* Van Beneden. The solid, central part of the head which serves as a support for the so-called bothria, is pointed anteriorly, where the lobes, in transverse section, appear to radiate from a common point. It is on this extremity of the head that the base of the rostellum is situated. This central portion or core of the head increases in size until at the base of the head it has the dimensions given in the measurements as the thickness and width of the neck. A transverse section of the basal part of the head or of the neck, in the smaller specimens, is rhomboidal (Fig. 12). In the larger specimens the breadth of the neck is greater in proportion to the thickness than is the case in the smaller specimens. In Fig. 10 a transverse section is shown of the head of an adult at about the anterior third. The central core of the head at this point is quadrate, and but two of the vessels of the water-vascular system appear. Sections made transversely through the middle of the head show the central core to be oblong (Fig. 9). The central part of such a section is a clear space with a few connective tissue fibers and granular masses in it. Both fibers and granules become more crowded in the vicinity of the longitudinal vessels which are sharply defined in cross-section. A transverse vessel was observed in a section through the head, which connected the two inner longitudinal vessels. The central clear space is limited by a dense layer of muscular and connective tissue fibers, which make a circular layer of tissue that can be traced back into the neck where it becomes much elongated and is surrounded by a layer of longitudinal fibers. In the head, outside of the ring of tissue which limits the central space, there may be seen in the sections both the cut ends of longitudinal fibers and also the beginning of transverse fibers, which extend out into the lobes of the head in dense fascicles.

The color of living specimens is translucent white, with sometimes a faint bluish tint. Alcoholic specimens are opaque, white, faintly yellowish, or cream-tinted.

This worm is near *P. lactuca* Van Beneden (Les Vers Cestoides, Pl. IV, Figs. 1–7), but differs from it in the following characters:

The neck and anterior unjointed part of the body are broader than the posterior mature segments. They are not so represented by Van Beneden for *P. lactuca*. The genital apertures instead of opening opposite the anterior third of the body of the proglottis, as in *P. lactuca*, open nearly opposite the posterior third. No mention is made of a rostellum in *P. lactuca*, but this difference alone would not justify the creation of a new specific name, since the rostellum could be easily overlooked, or if only mature strobiles were found, it is very probable that the rostella would have been lost.

Habitat.—Tiger Shark (*Galeocerdo tigrinus*), adult, half grown, and young specimens together in spiral intestine. July 23, 1885, Wood's Holl, Mass.

ORYGMATOBOTHRIUM Diesing.

Bothriocephali spec. Siebold.
Anthobothrii spec. Van Beneden.
Tetrabothrii (*Anthobothrii*) spec. Molin.

Orygmatobothrium angustum, sp. nov.

[Plate III, Figs. 1–3.]

Head round-pointed in front with four bothria, which are unarmed, hollowed out or boat-shaped when at rest, with anterior extremities, round-pointed, slightly appressed and projecting in front and surmounted at the apex by a supplemental disk (auxiliary acetabulum). A second, larger disk lies in the center of the hollow of each bothrium. The posterior end of each is rounded, broader than anterior end, usually flaring away from the neck. Border of bothria raised, somewhat thickened with entire outline. Pedicels short, neck long, narrow, marked with transverse, closely parallel, slightly notched or crenulate rings, which give a serrate outline to the edge. Segments long and narrow, mature segments five times as long as wide. Genital apertures marginal. This worm is near *O. versatile* Dies. (Revis. der Ceph. Ab. Par., 276.) *

* *Bothriocephalus auriculatus* Siebold, Zeitschrift f. Wissensch. Zool., ii, 218, tab. xv, 12.
Anthobothrium musteli Van Beneden, Mém. Acad. Belgique, xxv, 126 and 190, tab. vii, 1.
Tetrabothrium (*Orygmatobothrium*) *versatile* Diesing, Sitzungsb., xiii, 582.
Tetrabothrium musteli Van Beneden, Wagener, Nov. Act. Nat. Cur., xxiv, Suppl., 85, tab. xxii, 276–278.

It differs from *O. versatile*, however, in being much smaller, and in the proportions of the segments. In *O. versatile* the segments are square, while in *O. angustum* all the segments are long and narrow.

The following measurements were made from mounted specimens:

Dimensions.	No. 1.	No. 2.	No. 3.
	mm.	*mm.*	*mm.*
Length of strobile	17.00	18.00	20.00
Length of bothrium	0.64	....	....
Breadth of bothrium, widest part	0.32	....	....
Breadth of neck near head	0.14	....	....
Length of neck	5.00	....	....
Length of posterior segment	2.20	2.00	2.46
Breadth of posterior segment	0.44	0.28	0.54

The anterior supplemental disk (auxiliary acetabulum) is small and circular and is quite manifest. I must confess, however, that the identification of the other was not wholly satisfactory. An oval disk was distinguished in a few. In some heads stained with carmine, eosin, and hæmatoxylon, respectively, they cannot be distinguished. At about the anterior third the face of each bothrium, in the stained specimens, is crossed by a curved fibrous band which is concave in front. This band lies in the tissue of the bothrium and is not raised on the surface. It seems to be connected with another band lying farther back in the bothrium and deeper in its substance. If they are connected they probably make the oval border of the second disk. If one is to judge from the specimens in this lot—about fifteen in number—the secondary disk in the center of the bothria is an extreme doubtful character. It is plainly different in its nature from the anterior disk which was differentiated from the adjacent tissue clearly, both in unstained and stained specimens. The fine transverse striæ on the neck, which may be distinguished also on the mature proglottides, are a more characteristic feature of this worm than the second disk (auxiliary acetabulum).

The genital organs open nearly opposite the anterior fourth of the proglottis, on the margin.

The vagina can be traced from the posterior end of the segment, where it originates as a coiled tube, lying between the two marginally placed ovaries. It lies along the central line of the segment, until a short distance in front of a point opposite the vaginal opening, where it turns, forming a crook-shaped curve, and opens in front of the penis. The latter organ and the testis lie in the curve of the crook.

Habitat.—Dusky Shark (*Carcharias obscurus*), in spiral intestine. Wood's Holl, Mass., August, 1884.

CROSSOBOTHRIUM,* gen. nov.

Body articulated, slender, flattened, subquadrate; neck short or none; bothria four, opposite, pediceled, unarmed, each provided with

*Κροσσοί = a border, fringe.

one auxiliary acetabulum on the anterior border. Faces of bothria with a raised rim or border, which becomes more or less free, cut, or frilled as the worm grows weak, or when placed in fresh water or alcohol.

Genital apertures, both male and female, marginal. Development not known.

This genus is closely allied to *Phyllobothrium* Van Beneden, but differs from it in having the bothria pediceled instead of sessile, and in the absence of a distinct neck.

Crossobothrium laciniatum bears some resemblance to *Anthobothrium cornucopia* Van Ben., particularly in the shape of the segments, but differs from it in having distinct auxiliary acetabula, and in having the segments begin immediately behind the head. The bothria are not so long-pediceled as in *A. cornucopia.* The bothria, especially in living specimens in sea-water, bear a superficial resemblance to *Orygmatobothrium versatile* Dies. (*Anthobothrium musteli* Van Ben.), but there is no trace of a second auxiliary acetabulum on the face of the bothria. The habit of the strobile is, furthermore, quite different from *O. versatile* Dies.

Crossobothrium laciniatum, gen. et sp. nov.

[Plate III, Figs. 4-18.]

Body articulated, slightly flattened; cross-section of segments near head quadrangular; ratio of thickness to breadth about 1 to 2. The segments begin immediately behind the head, each is characterized by having four marginal flaps on the posterior border. The anterior segments in the larger specimens, for a distance of 20 or 30^{mm} back of the head, are about as broad as long, the posterior angles projecting into prominent triangular flaps, which, in a few cases, stand out almost at right angles to the face of the segments, but are usually appressed. The bodies of the segments are translucent, the posterior borders and projecting flaps opaque and ivory white in color. This feature is especially noticeable in specimens which have lain a few minutes in fresh water. Behind these slender anterior segments the remaining segments increase in breadth without increasing in length. Near the middle of the strobile the ratio of length to breadth is about 2 to 9. The median segments are flat and the triangular flaps develop into broad, rounded lobes. These lobes form a free border, which is sometimes reflexed and usually emarginate on the lateral edge.

The posterior segments are considerably lengthened; length about 1.5^{mm}; breadth about 2^{mm}, flattened; outline usually rounded or waving, narrower in front than behind, emarginate on lateral edge. (Plate III, Figs. 7, 8.) The shape of the free proglottides varies greatly while they are living, but at rest or in alcoholic specimens it is quite uniform.

The postero-lateral border is profoundly emarginate; the outline of the margin concave behind, then convex throughout the greater part of the length, concave again near the anterior end, which is extended into a rounded knob. (Plate III, Fig. 12.) In some free segments with a less rounded outline the shape is much like that of a steeple-crown hat with a drooping, flexible rim. Length of a mature free proglottis 2.8^{mm}; breadth of posterior edge, measured from tip to tip of the reflexed border, 2.1^{mm}; breadth of posterior, exclusive of reflexed border, 1.7^{mm}, tapering to an obtuse point in front. The bothria are four in number, marginal, short-pediceled, unarmed, each provided with a single supplemental disk (auxiliary acetabulum Diesing) on the anterior border.

The bothria of living, active specimens undergo such profound changes upon being transferred from sea-water to fresh water that it is necessary, in order to guard against mistakes, to give separate descriptions for each condition.

If allowed to lie in sea-water, these worms continue active for several hours. Some, after lying for twenty-four hours in sea-water, were still quite active, moving their bothria incessantly and alternately contracting and elongating the body and throwing it into irregular kinks and folds. The bothria are extremely mobile. They are usually hollowed out or boat-shaped on the face, bounded by a thickened rim or border which merges into the auxiliary acetabulum in front. In a resting position they are oval in shape, more or less narrowed in front and rounded posteriorly. Locomotion is effected by thrusting the bothria forward and attaching the face as a sucking disk to the surface over which the worm is moving, and thus dragging the body along. The bothria are usually thrust forward in pairs, the two which would stand diagonally opposite in a cross-section constituting a pair. They are thrust forward bodily and at the same time become greatly elongated in front. This attenuated part of each is frequently bent outward at right angles, so that the two stand apart like a pair of recurved horns. (Plate III, Fig. 11.) The remaining pair of bothria meanwhile is some distance back of the forward pair and much contracted longitudinally, the apex of each being a short distance behind the rounded papillary apex of the head. Each bothrium when thrust forward and attenuated is tipped by the auxiliary acetabulum, which forms a sort of sucker. Each individual bothrium, while active, resembles in its motions the movements of a common leech. The resemblance is heightened by the auxiliary acetabulum, which has much the appearance and is used in the same manner as the anterior sucker of some leeches. Often the posterior ends of the bothria bend outward and forward until they almost meet the recurved anterior ends. The under bothrium was noticed sometimes adhering to the bottom of the watch-glass in which the specimen was lying and spread out into a broad, thin, circular disk. In this case all appearance of a thickened border to the face of the bothrium was obliterated. Behind the bothria the head contracts suddenly into a short, neck-like part, which is about the same size and shape as the first segments, and, like them, is terminated by four triangular lappets at each of the four angles. This latter feature is unchanged either by fresh water or alcohol. When placed in fresh water the bothria become profoundly modified. Two distinct forms were observed; in one lot the specimens measuring from 112 to 124^{mm} in length, the breadth of the head is 3.5^{mm}, its length is 1.5^{mm}. The bothria are trumpet-shaped, very transparent and delicate, the outer face convex and surrounded by a delicate, narrow, raised border. It is circular except at the anterior edge, where it is broadly indented and interrupted by a circular, opaque disk (the auxiliary acetabulum). (Plate III, Fig. 6.)

In a second lot, the individuals of which measure from 95 to 250^{mm} in length, the breadth of the head is about 2^{mm}, its length 1.5^{mm}. (In an active specimen in sea-water the length of the head is about one-half of the breadth.) The rim or border of the bothria is irregular, broken, or ragged in outline, which gives to the head a crisped appearance, so as to suggest upon superficial examination the genus *Phyllobothrium* (Plate III, Fig. 5). The auxiliary acetabula are often concealed by the ragged edges of the bothria, but they can be plainly seen in a top view of the head (Plate III, Fig. 15).

Both the male and female apertures are marginal. It is often very difficult to make out the course of the vagina. By compressing a free proglottis, or better by flattening a proglottis between two glass slips and hardening it while in that position, and afterwards staining and transferring to glycerine or oil of cloves, the topography of the genital apparatus can be made out. At first I was wholly at fault with regard to the position of the vaginal opening, having been misled by the lateral aperture which is usually to be seen in the mature segments and from which the ova are discharged. This aperture resembles the vaginal opening in many of the *Dibothriæ*. It is found only in the posterior segments of the largest specimens and in the free proglottides. It is not always present even in these, as it is not unusual to find a free proglottis without the lateral aperture. When such a proglottis is examined its central part will be found to be filled with ova, often to such an extent that the lateral face of the proglottis is swollen in the middle so as to have a convex outline. In this case the lateral aperture may be seen already outlined but closed by a thin membrane, upon the rupture of which the eggs make their escape. The ovary is a lobed, glandular body lying near the posterior end of the proglottis. The vagina after leaving the ovary follows the median line but a short distance. It bends in a uniform curve towards the margin, and in its outer part lies immediately in front of the penis and very close to it. In the specimens which I have examined the course of the vagina as it approached the margin could not be made out until after it was differentiated by staining with carmine. The marginal aperture of the vagina is very small and is situated immediately in front of the penis. When the latter is retracted the two genital apertures seem to have the same marginal opening. The penis is long and slender. In some cases it was found protruding as much as 0.5^{mm}. It is covered with minute spines whose length is about one-eighth the breadth of the penis. The vas deferens is a long convoluted tube lying for the most part a little in front of the center of the proglottis. The central part of the proglottis around the ova is filled with the large glandular masses of the testes. The longitudinal vessels of the water-vascular system can usually be distinguished and between them and the margin, on each side, a series of granular masses, more opaque and smaller than the masses which make up the testes, extending to the ovary and widening in the vicinity of that organ. The lateral aperature for the discharge of eggs is situated a little way back of the middle and is surrounded by a low border or lip. It is oval in outline, the longer axis coinciding with the longitudinal axis of the segment and equal to about one-eighth the length of the segment. Its posterior edge is at about the posterior third of the segment and nearly opposite the marginal opening of the generative organs.

The following measurements were made upon living specimens which had lain for a few hours in fresh water:

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of strobile	100.00	142.00	195.00	212.00
Breadth of head	1.7	1.90	1.80	1.8
Length of head	1.4	1.50	1.45	1.5
Breadth of segments near head, excluding projecting flaps	0.6	0.56	0.70	0.7
Length of segments near head	0.7	0.35	0.50	0.7
Breadth of posterior segments	1.7	1.26	1.90	1.8
Length of posterior segments	1.2	1.26	1.60	1.4

The following measurements are from a segment which became detached from a strobile while still living and active in sea-water:

	Millimeters.
Length	3.10
Breadth in front	1.05
Breadth, middle	2.45
Breadth, posterior end	2.10
Length of penis	0.35
Breadth of penis	0.0875
Length of spines on penis	0.0100
Diameter of ova	0.0254

The breadth given above is approximate, as the segment was constantly changing its shape; the penis was only partly everted.

The following measurements are from a young specimen, in fresh water:

	Millimeters.
Entire length	20.00
Length of head	1.20
Breadth of head	1.80
Length of anterior segments	0.10
Breadth of anterior segments	0.30
Length of median segments	0.07
Breadth of median segments	0.90

Posterior segments but little larger than anterior.

Several young specimens were obtained, measuring from 5 to 20mm in length. In these the bothria were identical in shape and habit with those of the adult. In the younger specimens, however, the part of the head to which the bothria are attached was proportionally larger than it is in the adult. In the larger specimens of young the laciniate segments occurred throughout the entire length; in smaller specimens they occurred only near the head and at the posterior end, while the intermediate parts of the strobile were unsegmented or marked with faint transverse lines. In many of the smallest forms there were no laciniate segments, while the posterior end of the strobile carried a number of elongated segment-like bodies, totally unlike the segments of the adult. These pseudo-segments are evidently evanescent. (Plate III, Fig. 17.)

Habitat.—Sand Shark (*Odontaspis littoralis*), in spiral intestine, young and adult together, abundant, chyle swarming with free proglottides. July and August, Wood's Holl, Mass.

PHOREIOBOTHRIUM,* gen. nov.

Near *Cylindrophorus* Diesing.
Tetrabothrii Spec. Wagener.
Cylindrophorus typicus Diesing, Revis. d. Ceph. Ab. Par., p. 264.
Tetrabothrium Carchariæ Rondoletii Wagener, Nov. Act. Nat. Cur., xxiv, Suppl. 4 and 84, tab. xxii, 270–273; Statu larvæ Wagener, l. c. 4 and 84, tab. xxi, 266–268, tab. xxii, 269.
"Genus hoc insufficienter cognitum provisorio modo nomine Cylindrophori notavi" Diesing.

Body elongated, articulate. Head separated from the body by a neck. Bothria four, opposite, tubular, parallel, entire, each armed with compound hooks and provided with one supplemental disk (auxiliary acetabulum) in front. Minute spines on neck, or on neck and body. Genital apertures marginal.

Phoreiobothrium lasium,† gen. et spec. nov.

[Plate IV, Figs. 24–29.]

Head separated from the body by a neck. Bothria four, marginal, flat-tubular, subrectangular in outline, each with two compound hooks placed anteriorly, and one auxiliary acetabulum in front of hooks near the lateral edge of the bothrium. Face of the bothria hollowed out, with a thickened or raised border, so that each bothrium resembles a shallow tray. Inner edges of bothria united by a thin membrane, in which lie bands of fibrous tissue. Posterior end of the bothria elliptical, with a thickened ring or border, and marked with striæ parallel with the smaller diameter. These striæ, when highly magnified, prove to be low ridges, which give to the end of a bothrium the appearance of a coarse rasp. These striæ or ridges are not seen plainly unless the

* φορεῖον = a tray. † λάσιος = bristly.

bothria are reflexed. Neck flattened, rather slender, increasing uniformly backwards and merging imperceptibly into the jointed body, covered, sometimes sparsely, sometimes thickly, with very small, straight, sharp, bristle-like spines. The body has at first an unbroken outline, the square segments being indicated simply by fine, transverse lines. Farther back the segments become elongated, with the corners slightly rounded. Genital apertures marginal, opening about the middle line.

The compound hooks of the head have three recurved prongs each, the middle one slightly longer than the others, the inner one the shortest. These prongs rise from a common horizontal part, which is itself supported by a flattened or spatulate process, which lies immediately under the middle prong, is about the same length and parallel with it.

The following measurements were made from a mounted specimen:

	Millimeters.
Length of strobile	40.00
Length of head	0.52
Breadth of head	0.44
Breadth of neck	0.12
Length of first segments, 2mm from head	0.03
Breadth of first segments	0.01
Length of segments, 3mm from head	0.20
Breadth of segments, 3mm from head	0.42
Length of segment, 6mm from head	0.34
Breadth of segments, 6mm from head	0.42
Length of posterior segments	2.20
Breadth of posterior segments	0.84
Length of hooks	0.10
Length of bristly spines on neck or body	0.01

A few specimens in the lot differed from the prevailing type in being much more irregular in outline and having in general a more fragile structure. The neck is much distorted by contraction and much broader than in the prevailing type; the first segments, on the contrary, are longer and more slender. The posterior segments are elliptical, oblong, flatter, and more fragile in appearance.

In one specimen I found what seemed to be a transverse costa on the face of a bothrium. I looked in vain for a similar characteristic in the other specimens of the lot. If such costæ could be proved to be characteristic of this worm it would indicate a very close relationship with *Calliobothrium*.

In some the bristly spines were found on the neck and not on the body, in others sparsely on the body and not on the neck, in others thickly on both neck and body. They are, without doubt, the remnant of a bristly outer covering of the body, which is characteristic of the young and larval conditions of this genus.

The genus *Cylindrophorus* is a provisional one made by Diesing to include a single species which is not well known. He, however, includes it among those *Tetrabothriæ*, which are characterized by having no auxiliary acetabula on the bothria. The presence of a well-defined auxiliary acetabulum in this worm is therefore sufficient reason for not including it in the genus *Cylindrophorus*. The almost invariable occurrence of spines on the neck or body, or both, together with the shape of the bothria and hooks, present so many points of resemblance to Wagener's figures, from which Diesing created the generic name *Cylindrophorus*, that I do not feel justified in adding a new generic term to the already burdened nomenclature of Helminthology without at the same time admitting Diesing's *Cylindrophorus* in the probable synonymy of the genus.

The ovaries occupy nearly the posterior fourth of the proglottis. The vagina extends, from its origin in the ovaries, as a sinuous duct along the median line of the proglottis until it reaches the middle point, where it turns nearly at right angles and opens in front of and immediately adjoining the penis. The latter organ is retracted and lies coiled up in the angle of the vagina, but seems to be connected with a convoluted mass, which is situated centrally in the proglottis. A median tube can be traced from near the anterior end of the proglottis to the angle of the vagina and seems to lie parallel with that duct for some distance. Its union with the latter could not be made out. The greater part of the interior of the proglottis is filled with irregular granular masses, each of which is composed of several irregular or disk-shaped pieces, which are rather loosely joined together.

In a specimen which had been subjected to double staining in green and red analine colors, the ovaries in the base of the proglottis and what appeared to be their continuation into a double row of coarse granular masses lying along each margin, had a strong affinity for the blue staining. On the margins, outside of the coarse granular layer, a fine granular layer, and outside of that a transparent, structureless, epidermal layer, were differentiated. The vagina and anterio-median tube were also slightly stained with the green. The interior compound granular masses, the penis, and the convoluted mass of tubes (vas deferens) were unaffected by the green coloring matter. They were clearly differentiated, though not deeply stained, by the red analine, nearly all the red stain having disappeared when the specimen was washed in alcohol.

Habitat.—Dusky Shark (*Carcharias obscurus*), in spiral intestine. August, 1884, Wood's Holl, Mass.

CALLIOBOTHRIUM Van Beneden.

Calliobothrium verticillatum Rudolphi.

[Plate IV, Figs. 1–8.]

Onchobothrium verticillatum Rud., Diesing, Syst. Helm., i, 606.
Calliobothrium verticillatum Van Beneden, Dies., Revis. d. Ceph. Ab. Par., p. 280–281. Van Beneden, in Mem. Acad. Belgique, xxv, 138 and 192, tab. xii.
Bothriocephalus verticillatus Rud., Synops., 142 and 484. Leuckart, Zool. Bruchst., i, 56, tab. ii, 41, fragm. Nitzsch., Ersch., and Grub., Encycl., xii, 99. Dujardin, Hist. Nat. des Helminth., 621. Creplin, Troschel's Arch., 1849, i, 73.

Acanthobothrium verticillatum Van Beneden, Bullet. Acad. Belgique, xvi, ii, 79.
Onchobothrium (Calliobothrium) verticillatum Diesing, Sitzungsb. der Kais. Akad., xiii (1854), 585. Molin, l. c., xxx (1858), 135, xxxiii (1858), 292, and xxxviii (1859), 10; Idem, Denkschr., xix, 239, tab. v, 3.
Tetrabothrium verticillatum Wagener, Nov. Act. Nat. Cur., xxiv, Suppl. 85, tab. xxii, 274 and 275.

Head continuous, with the subquadrangular body. Bothria four, angular, subelliptical, unequally divided into three loculi by two transverse ribs; each bothrium armed with four simple hooks, and provided, in front of hooks, with a trilocular, auxiliary acetabulum, the loculi of the latter arranged in a triangle. Hooks equal and arranged in pairs. Body filiform anteriorly, increasing posteriorly; anterior segments provided with four triangular, laciniate processes on the postero-lateral margin, followed by other segments bearing one, and still others bearing two, additional flaps on each postero-lateral margin, subsequent segments with two rounded flaps near posterior, nearly circular in outline; ultimate segments considerably elongated. Genital apertures marginal. Length 75^{mm} to 100^{mm}.

Habitat.—Found at Wood's Holl, Mass., August, 1884, in spiral intestine of Smooth Dogfish (*Mustelus canis*).

In this species there is so much difference between segments occurring in different parts of the strobile, that some additional notes are necessary in order to make trustworthy identifications in cases where only fragments are found. The head is so small that it may be easily overlooked by the collector; moreover the anterior segments are so delicate that, as is often the case, they break and leave the head imbedded in the mucous membrane of the intestines of their host. The anterior portion of a living specimen, when isolated from its natural surroundings and placed in clear water, resembles a very delicate white hair. It may therefore easily escape any but the most careful search. The head itself is only about one-eighth as broad as the head of a common pin, while the breadth of the segments immediately behind the head is about the same as that of a human hair, and the thickness is only about one-third the breadth. The first segments are nearly twice as long as broad, flat and thin, somewhat distinctly four-angled, so that a cross-section is rectangular. The segments are continued at the postero-lateral corners into four triangular flaps, which are about one-fourth the length of the segment proper. The posterior margins of the segments, including the flaps, are thick, white, and opaque in life, while the bodies of the segments are translucent.

A few segments back from the head the middle of the postero-lateral margin of the segment begins to rise, and soon assumes the form of a third flap. In one specimen, which measured 68^{mm} in length, this third flap begins about the 38th segment. This character continues for several joints until about the 70th segment, when the median flap becomes bifid; at the 80th segment it has become decidedly two-notched, and at the 120th it is divided into two lobes, so that in this part of the body the postero-lateral edges of the segments are each distinctly four-lobed. The two original flaps, those near the margins, continue, however, to be a little longer and sharper-pointed than the two median ones. At the 150th segment the two middle flaps or lobes become indistinct, and are represented only by gentle flexures of the posterior margin; the notch between them is at this point broad and shallow. From the 160th or 164th to the 192d segment the median notch deepens gradually, and the secondary or median lobes disappear, leaving the postero-lateral margin two-lobed, the inner margin of each lobe with a slightly waving convex outline. The segments thus far are short and somewhat crowded, the length, in the specimen measured, after mounting in Canada balsam, uniformly about 0.14mm to 0.16mm. At the point where the segments become two-lobed the margins become rounded, convex, the segments lengthen to about 0.20mm. At the 200th segment the proglottides are nearly circular in outline, globose in living specimens. At this point the segments begin to lengthen abruptly. The average length of the last four segments, with circular outline, being 0.64mm, while the average length of the next four segments is 1.02mm. The last segment the 212th in the specimen from which the above measurements were taken, measured 1.90mm in length and 0.84mm in breadth.

The following measurements are intended to show the proportions at different points on the strobile. They were made from mounted specimens, and consequently may be a little less than they would be if taken from living specimens:

	Milimeters.
Length of specimen	60.00
Breadth of head, in front	0.23
Length of bothria	0.30
Breadth of bothria, front and middle	0.10
Breadth of bothria, posterior end	0.04
Spread of hooks, tip to tip	0.16
Length of hooks	0.14
Breadth of segments just back of head	0.076
Breadth of segments 1mm back of head	0.09
Length of segments without flaps	0.127
Length of segments including flaps	0.159
Breadth of segments 2mm back of head	0.16
Thickness	0.02
Length	0.14
Length, including flaps	0.16
Breadth of segments 11mm back of head	0.30
Thickness	0.08
Thickness, including flaps	0.16
Breadth of segments 18mm back of head, four lobes	0.46
Length	0.16
Thickness	0.10
Breadth of segments 22mm back of head	0.52
Breadth of segments 33mm back of head, two lobes	0.66
Length, including flaps	0.16
Breadth of segments 45mm back of head, round segments	0.78

	Millimeters.
Length	0.74
Length of posterior segments	1.90
Breadth of posterior segments	0.84
In another specimen:	
Length of posterior segments	2.20
Breadth of posterior segments	0.78

Number of joints in one specimen about 342, the last 11 of which were mature.

There was one prominent, transverse rib at about the posterior third of each bothrium; another, much less prominent, about the middle, at the extremities of the inner pair of recurved hooks, and two other faint, transverse lines, parallel with the ribs and apparently homologous with them, between this and the base of the hooks. The trilocular auxiliary acetabula showed but faintly in most of the specimens.

There is considerable difference between the anterior segments of the specimens examined and those figured by Van Beneden (Vers Cestoïdes, tab. xii). In Van Beneden's figures the anterior segments are represented as being several times as long as broad, and with the flaps rudimentary and rounded. The sketches of the head and anterior segments (Figs. 1, 2) were made from a mounted specimen. The proportions are identical with those of the living specimens, as is proved by comparing these sketches with some memorandum sketches made at the time of collecting. Among all the specimens, eight or ten in all, not one was noticed in which the segments differed materially from those represented in the figures. In Wagener's figures (Entwick. d. Cestoden, tab. xxii, fig. 274) the proportions of the anterior segments are about the same as I have found them. The transverse costæ of the bothria do not agree exactly with the figures of Van Beneden and Wagener, but the differences are so slight, that I have no hesitation in pronouncing the specimens which I have examined identical with those figured by Van Beneden and Wagener.

Family DIBOTHRIORHYNCHIDÆ *Diesing.*

RHYNCHOBOTHRIUM Rudolphi.

Tæniæ spec. Fabricius.
Bothriocephali (*Rhynchobothrii*) and *Tetrarhynchi* spec. Rudolphi.
Bothriorhynchus Van Lidth.

Rhynchobothrium bisulcatum, sp. nov.

[Plate IV, Figs. 9–23.]

Head subconical, bluntly rounded in front. Bothria two, lateral, separating slightly at posterior corners, coalescing in front, each divided into two distinct lobes by a median sulcus, which extends from the posterior border about one-fourth the length of the bothrium, where it divides into two less distinct but clearly marked sulci, which diverge and inclose two sides of a triangular space. At the extreme anterior end of each of these secondary sulci is situated one of the four proboscides. Each bothrium is broadly convex on the posterior border, with often a slight emargination on the posterior edge of each lobe. Each lobe is triangular, the posterior side being the posterior edge of the bothrium, the outer side being the marginal edge of the bothrium, and the inner side being bounded by the median sulcus and one of its branches. The central portion or face of each lobe is sometimes depressed, which gives rise to the appearance of a double furrow on each side of the median triangular piece. Posterior edges of bothria thick and fleshy, overlapping the neck. Neck tubular, conical, sometimes slightly swollen back of the head, a little shorter than the bothria, the posterior fourth prolonged into a collar, which incloses the anterior part of the body and its articulation with the neck. Proboscides (*trypanorynchi* Dies.) four, a little shorter than head, armed with numerous hooks arranged in spirals, about eight visible in each spiral; spirals about 0.02^{mm} apart. Hooks recurved, pointed, broad at base in an antero-posterior direction, very thin from side to side, those near the base of the proboscis shorter-curved and blunter than the others. Proboscis sheaths straight in front, but with a single short spiral curve at the posterior end where they join the contractile bulbs, with one of which each is connected. The four contractile bulbs, which lie side by side in the neck, are about twice as long as broad and about one-half the length of the neck. The distance between the point of articulation between the neck and the body and the posterior end of the contractile bulbs is normally about one-third the length of the latter.

So far as examined the heads presented the same general outline, with one exception. In the exceptional case noted there is a slight constriction of the bothria where they overlap the neck, at the point which marks the greatest diameter of the head in all the other specimens. This imparts to the head a more rounded outline in front than in the others, and a less diameter proportionally at the base of the bothria.

The body, usually very much attenuated anteriorly, is unjointed for a short distance back of the head. Fine transverse lines soon make their appearance, and shortly afterwards the first segments are formed. The latter are usually much broader than long, and rectangular in outline. Although they sometimes are lengthened with rounded corners, so as to give to the series of segments a beaded appearance.

The mature proglottides are always squarish, or rectangular, sometimes longer than broad, sometimes broader than long. The male genital openings are marginal, irregularly alternate, always near the anterior edge of the proglottis. Female genital openings lateral, median dehiscent, apparently not appearing until the proglottides are almost ready to separate.

Length of strobiles with mature proglottides from 40^{mm} to 230^{mm}.

The following measurements of head and neck give proportions which hold good for all:

Dimensions.	Marginal view.	Lateral view.
	mm.	*mm.*
Length of head	0.90	1.04
Breadth of head	1.10	1.04
Length of neck	0.76	0.70
Breadth of neck, anterior	0.72	0.76
Breadth of neck, posterior	0.40	0.44
Breadth of strobile back of neck	0.28	0.28

	Millimeters.
Length of proboscis	0.840
Breadth of proboscis, exclusive of projecting hooks	0.043
Breadth of proboscis, inclusive of projecting hooks	0.078
Length of anterior hooks	0.023
Breadth of base of anterior hooks	0.013
Length of hooks on base of proboscis	0.014
Breadth of base of hooks on base of proboscis	0.011

In the summer of 1884 I obtained two lots of these worms from the alimentary tract of the Dusky Shark (*Carcharias obscurus*).

The first lot, containing approximately 200 individuals, was lodged in the pyloric portion of the stomach, where the worms were so massed together as to make a swelling in the pylorus which was discernible before opening.

These specimens were not studied closely while they were alive. Upon examining them subsequently as alcoholic specimens, it was found that there was a very considerable variation in the length of the strobiles, and to some extent in the proportions of the segments. In the foregoing description I have enumerated those characters which belong to all; but inasmuch as there are some more or less clearly marked groups among them I shall add some further observations. I deem this of importance, for the reason that, if it were not for the great number of intermediate forms which these two lots furnish, one might be justified in making two, if not three, distinct species instead of one. The second lot came from the pylorus and spiral intestine of the same species of shark (*C. obscurus*).

Three groups were observed in the first lot. These differ from each other principally in the shape and proportions of the segments, the distance from the head at which mature proglottides occur, and in the total length of the strobile.

In the first group, which, for the sake of clearness, I shall name var. *α* (Plate IV, Figs. 9–12), the mature proglottides are flat and thin, square, or the posterior ones a little broader than long. When there are but few mature proglottides they increase in breadth rather abruptly, so that the strobile has a somewhat club-shaped or linear-obovate outline.

Generative organs: male not conspicuous, smooth, marginal, near anterior edge of proglottis as in all; female lateral, median, dehiscent, in mature proglottides easily recognized as a clear central spot; length of strobile as short as 36^{mm}; average, perhaps, about 45^{mm}, although it seems to graduate into var. *β*, which is much longer. In one specimen measuring 48^{mm}, the last twelve proglottides were mature and had an average length of 1^{mm}.

Measurements of a specimen, var. *α*, made from a mounted specimen, and hence probably a little distorted:

	Millimeters.
Length of strobile	36.00
Length of bothria	0.80
Breadth of head	0.90
Length of neck	0.70
Breadth of neck in front	0.60
Breadth of neck, posterior end	0.36
Length of proboscis	0.70
Length of proboscis sheath	0.76
Length of contractile bulb	0.32
Breadth of contractile bulb	0.14
Length of posterior proglottis	0.80
Breadth of posterior proglottis	1.30

The second group I shall also, for convenience, designate as a variety, calling it var. *β* (Plate IV, Figs. 17–20). The strobile, like that of var. *α*, is flat and thin, but is much longer. The mature proglottides do not make their appearance until 100^{mm}, or even 200^{mm}, back of the head. The first segments are short and broad; the succeeding segments increase in length until they become longer than broad. The median and postero-median segments are frequently rounded at the corners, giving to the strobile a beaded appearance. This character is usually present in those segments which immediately precede the mature proglottides. Usually about three longitudinal striæ can be traced on the median segments (Figs. 18–19). The posterior segments are rectangular, longer than broad. The following measurements were made on a mounted specimen, var. *β*.

	Millimeters.
Length of strobile	230.00
Length of head	0.76
Breadth of head	0.94
Length of neck	0.70
Breadth of neck in front	0.70
Breadth of neck, posterior end	0.40
Length of proboscis	0.60
Length of proboscis sheath	0.64
Length of contractile bulb	0.36
Breadth of contractile bulb	0.16
Breadth of strobile back of neck	0.26
Length of posterior proglottis	1.54
Breadth of posterior proglottis	1.20

A third group, which comprises individuals that have certain characteristics separating them from the two preceding groups, I have distinguished as var. γ (Plate IV, Figs. 13–16). These are all immature strobiles, but are much longer than var. α, and in some cases as long as var. β. The strobile is much thicker and rather wider than those of varieties α and β. The posterior segments, although not mature in any of the specimens, have a conspicuous male generative organ. The female generative opening is represented by a lateral, median, slightly raised papilliform eminence. Length about 100^{mm}; average length of last 30 segments 0.6^{mm}. The posterior segments are 2½ to 3 times as broad as long.

Measurements made from two mounted specimens.

Dimensions.	No. 1.	No. 2.
	mm.	*mm.*
Length of strobile	92.00	82.00
Length of head	1.10	0.70
Breadth of head	1.18	0.86
Length of neck*	1.00	0.60
Breadth of neck in front	0.80	0.54
Breadth of neck, posterior end	0.44	0.40
Length of proboscis	0.70	0.70
Length of proboscis sheath	0.90	0.70
Length of contractile bulb	0.46	0.36
Breadth of contractile bulb	0.16	0.10
Breadth of strobile back of neck	0.30	0.30
Length of posterior segment	0.50	0.40
Breadth of posterior segment	1.60	1.36

*In all measurements of the neck the distance from the postero-lateral or postero-marginal edge of the bothria to the posterior edge of the collar is the one given.

In the second lot containing about fifty specimens, the strobiles are not so mature as those of the first lot. The three varieties noted in the first lot are not so distinctly marked off. There are, however, two distinct kinds in this lot, which may possibly be due to the effect of the preservatives, but which are sufficiently noteworthy to be mentioned here. In the first the lobes of the bothria are smooth and bounded by regular curved lines as in the first lot, but with the centers of the faces of the lobes slightly hollowed out or depressed, so as to produce the effect of a raised border, and double furrows on the lateral face of the bothrium.

In the second the bothria are irregularly furrowed or wrinkled. The bothria are shorter than the neck. The neck is also wrinkled. These differences, although sufficiently marked to attract attention, do not occasion much perplexity where one remembers the wonderful powers of contractility possessed by the *Cestoidea*. They might, however, lead to confusion of species in cases where only a few specimens are at hand.

In describing new species of the *Cestoidea*, I am satisfied that, where it is possible, a great many specimens should be examined before final conclusions are reached. If this rule had been adopted by former workers in this field of Systematic Zoology the older literature of Helminthology would not be in its present state of confusion.

Attachment to the host.—Those found in the pylorus were not firmly attached, but would release their hold when the point of a scalpel was applied to their heads. This was characteristic of those of the first lot. With those found in the spiral valve, however, the case was quite different. In it these parasites were found to be firmly attached to the wall of the intestine. Many of them had tunneled holes in the mucous and submucous coats. In some cases these tunnels cut through the muscular coats of the intestine and opened into the interior body cavity. In some instances several heads were found occupying the same cavity. One of these pockets was 6.5^{mm} deep. In it were imbedded three heads belonging to three strobiles 20^{mm}, 32^{mm}, and 55^{mm} long, respectively. The heads were so tightly fastened in their fleshy cavern that they had to be cut out before they could be removed. A peculiarity of the individuals of this second lot is a tendency to contract the anterior segments, so that instead of being attenuated as in most of those of the first lot, the anterior segments are at first nearly as broad as the neck, and immediately widen until they are as broad or even broader than the head. This gives the worm the appearance of being constricted just back of the head. This habit of tunneling into the flesh of its host must make this parasite a very unpleasant guest. Usually in the case of those *Cestoidea* which infest the alimentary canal of their host, their presence cannot give rise to much pain, unless they are present in numbers sufficient to occasion obstruction. But with this worm it is quite otherwise. Wherever tunnels in the walls of the intestine caused by this worm were observed, it was noticed that there was much irritation of the mucous membrane. Not only was the mucous coat highly inflamed, but the inflammation often extended into the submucous and muscular coats. The whole interior of the spiral valve was blotched with angry-looking sores. If this is at all common, then we find in this worm an enemy of the Dusky Shark, small but not insignificant. It is certainly encouraging to find in nature, in the too small army of enemies which are arrayed in warfare against the Selachians, these humble sappers and miners lending their aid towards keeping down the numbers of these Ishmaelites of the sea.

Abnormal forms.—In the second lot a few monstrosities were observed, two of which are figured (Plate IV, Figs. 21 and 22). The first example, Fig. 22, is a strobile 13^{mm} in length, which, at about 2^{mm} from the posterior end, gives off from the postero-marginal edge a secondary strobile, in which there are about four joints faintly marked. The dimensions of the segment which sends off this budding part are: Length, 0.1^{mm}; breadth, 0.72^{mm}; of the succeeding segment, length, 0.1^{mm}; breadth, 0.62^{mm}; of the budding portion, length, 1.08^{mm}; breadth, 0.06^{mm}. The second example, Fig. 21, is a fragment; length of strobile not known. The segments have the beginnings of the male genital organs. A secondary strobile is given off from the margin of the primary strobile in a somewhat different manner from the one just described. A tendency towards a marginal thickening can be seen on the third segment in front of the one from which the secondary strobile becomes free. In the succeeding segments this marginal thickening, or rather widening, is more pronounced, and there is the beginning of an independent alar margin. On the next segment the alary margin is one-fourth the breadth of the segment itself, and from it springs the secondary series of segments. The breadth of the three segments mentioned is 0.82^{mm}, 0.86^{mm}, 0.90^{mm}, respectively, or of the latter, exclusive of the alary margin, 0.72^{mm}. The breadth of the succeeding segment is 0.72^{mm}. The length of each of these segments is 0.26^{mm}. Length of secondary strobile, 2.46^{mm}; number of segments, 21; breadth, 0.20^{mm} to 0.24^{mm}; average length, 0.12^{mm}.

Eversion and inversion of proboscis.—The proboscides do not play backwards and forwards in their sheaths like a piston-rod in its barrel, but each folds in upon itself from the outer extremity like the finger of a glove. When a proboscis is fully extended it has the appearance of a slender, solid cylinder, covered with recurved hooks. If, however, one which is not fully extended be examined, it will be found to be folded in upon itself from the outer end. As the hooks point backwards when the proboscis is extended, it can be easily seen that it is impossible to retract that organ by pulling it in bodily. When the proboscis is entirely retracted it forms a hollow tube, whose outer covering is the inside wall of the extended proboscis, and whose inner coat carries the hooks which now point forward. The whole tube lies in the proboscis sheath.

The manner of everting and inverting the proboscis seems to be identical in all the *Trypanorhynchi*, both in the mature and later larval stages. The contractile bulbs and proboscis sheaths contain a transparent liquid, in which float a few granules. The contractile bulbs act on the contained fluid exactly as the bulb of a syringe. The thick walls of the bulbs are composed of diagonal, interlacing fibers, whose contraction compresses the bulb and forces the fluid out into the proboscis sheath. The result of this action is to make the proboscis begin to unroll from the anterior end of the sheath. This will continue as long as the walls of the contractile bulbs continue to exert pressure on the fluid contents, or until the proboscis is entirely everted. When the proboscis is fully extended the granular liquid can be seen filling the interior of both proboscis sheath and proboscis. To the interior of the proboscis, at the anterior end, is attached a tubular cord of very contractile tissue, which lies in the hollow of the proboscis, extends back through the sheath, and is inserted at one side on the inner wall of the contractile bulb. The proboscis is inverted by the contraction of this cord. When the proboscis is inverted this cord lies in kinks and irregular coils in the contractile bulb and posterior end of the sheath. This movement is made rather quickly by the living worm. Upon removing some specimens from the pylorus of a Dusky Shark, it was noticed that when the heads were touched by the point of a scalpel or needle, even when the head was partly imbedded in the mucous membrane, the proboscides would be suddenly retracted and the worm detached.

Larval state.—Great numbers of encysted *Rhynchobothria* were found, mostly in capsules, between the mucous and submucous coats of the stomach of the Squeteague (*Cynoscion regale*) and the Bluefish (*Pomatomus saltatrix*), which appear to be the young form of this species. The proboscides and their hooks agree. The bothria and their lobes seem to be identical. The sequence from these fishes to the Dusky Shark is a natural one, and in the absence of any evidence to the contrary it may be fairly assumed that they are the encysted larvæ of *R. bisulcatum*. It is the purpose of the author to publish figures and a fuller description of these in a subsequent paper.

Habitat.—Strobile: Dusky Shark (*Carcharias obscurus*); pylorus and intestine; very abundant.

Scolex encysted: Squeteague (*Cynoscion regule*), Bluefish (*Pomatomus saltatrix*); submucous coat of stomach and peritoneum; very abundant. Wood's Holl, Mass., August.

This worm resembles *R. paleaceum* Rudolphi and Van Beneden. (Dies., Revis. d. Ceph. Ab. Par., p. 294.)

Tetrarhynchus lingualis Van Beneden (Les Vers Cestoides, p. 151, tab. xvii, 4, 6–9). It presents many differences from Van Beneden's figures and descriptions, however, among which may be mentioned here, as of most importance, the number and form of the hooks, the articulation of the neck with the body, and the position of the male genital openings. Van Beneden represents the latter in *R. paleaceum* as always opening at the posterior third of the segments. In all of the different forms of *R. bisulcatum* they open uniformly near or in front of the anterior third.

Rhynchobothrium tenuicolle Rudolphi.

[Plate V, Figs. 17, 18.]

Tetrarhynchus tenuicollis Rud., Synops., 130 and 451. Creplin, Ersch. and Grub. Encycl., xxxii, 295, note 34, and Erichson's Arch., 1846, 149. Dujardin, Hist. Nat. des Helminth., 551.

Rhynchobothrium tenuicolle Diesing, Sitzungsb., xiii, 1854, 595; and Revis. der Ceph. Ab. Par., 299.

Tetrarhynchus corollatus Siebold, Zeitsch. für Wissensch. Zoöl., ii, 241 (in part).

The characters given for this species by Diesing are the following: Head with suborbiculate lateral bothria, converging at the apex and with an elevated border; neck very long, subcylindrical, slender, rounded at the base; segments of the body bacilliform, ultimate ones contracted, easily falling off. Length of head and neck, 5.3^{mm} to 6.5^{mm}; length of body, 15^{mm} to 17^{mm}; breadth, 0.56^{mm}.

The proboscides for the larval condition are described as filiform, very slender, and armed with a long series of ternately verticillate and recurved hooks.

The published descriptions of this species are meager and unaccompanied with figures. It is with some hesitation, therefore, that I refer a few *Rhynchobothria* from the spiral valve of the Smooth Dogfish (*Mustelus canis*) to this species.

The head of the living worm is very variable in shape. The bothria are lateral and are united at the apex by their margins; usually broader than long, slightly emarginate on the posterior edge, with a raised and thickened border. The neck is long, cylindrical, the narrowest part about half way between the head and the contractile bulbs. There is a constriction immediately behind the contractile bulbs, back of which the neck swells into a nearly globular base. This rounded basal part of the neck is sharply marked off from the body by a short, narrow constriction. The body is without segments or transverse markings of any kind for a distance equal to as much as six times the length of the head and neck. Striæ then begin, which outline squarish segments. The first segments are a little longer than broad; subsequently they become much longer than broad, crowded with ova, and with the genital apertures marginal. The four proboscis sheaths are long and thrown into spirals, the coils of the spirals being dense or loose, as the neck is contracted or not. The proboscides when everted are seen to be very long and slender. They are closely beset with small hooks, which, when highly magnified, are seen to be of several distinct shapes. The prevailing shape of those near the end of the proboscis is slender, tapering, somewhat irregular in outline, with an abruptly recurved short point. Others have the same length, but differ in being broader, and in having a curved, convex outline on the posterior edge. Others have the same outline, but are very short. Others are slender, curved slightly and pointed, but are without the abruptly recurved point. Some are straight, others nearly straight, but bent slightly about the middle. The hooks on the proboscides, moreover, are arranged in distinct series of ternate groups. This arrangement could be plainly distinguished in some places, while in others it was but faintly indicated, and, owing to the extreme smallness of the hooks and their peculiar shape, it was impossible, from the specimens at my disposal, to determine the exact number of series, or whether, indeed, all the hooks were arranged in these ternate groups or not. Where most distinct there seem to be four series of ternate hooks. The longer hooks stand nearly at right angles to the axis of the proboscis, and are equal in length to about one-third of the diameter of the proboscis.

The following measurements are from an alcoholic specimen:

	Millimeters.
Length of strobile	31.00
Length of bothria	0.42
Breadth of bothria	0.34
Length of head and neck	2.00
Length of proboscis sheath	1.40
Length of contractile bulbs	0.29
Breadth of contractile bulbs	0.10
Breadth of neck near head (lateral)	0.24
Breadth of neck near middle (lateral)	0.20
Breadth of neck in front of basal bulb	0.34

	Millimeters.
Breadth of basal bulb of neck	0.39
Breadth of constriction between neck and body	0.20
Breadth of body just behind basal bulb of neck	0.28
Breadth of body 7.4mm from neck	0.28
Distance from neck to first striæ	11.20
Distance from neck to first segment	14.60
Length of first segments indicated by striæ	0.40
Breadth of first segments indicated by striæ	0.44
Length of first distinct segments	0.94
Breadth of first distinct segments	0.44
Length of last segments	3.00
Breadth of last segments	0.80
Breadth of proboscis	0.33
Length of hooks	0.0075
Length of longest hooks	0.009

These worms are actively locomotile while living. The two bothria act as sucking disks and change their shape continuously. As the head progresses the anterior ends of the proboscis sheaths separate slightly, when the soft tissue which forms the anterior end of the head is then drawn in so as to give to the front of the head the shape of a hollow cup; the anterior ends of the sheaths then approach each other and the hollow cup disappears, the tissue which forms it being thrust out into a short, blunt eminence (myzorhynchus).

Habitat.—Smooth Dogfish (*Mustelus canis*), in spiral intestine. Wood's Holl, Mass., August, 1884.

Family TETRACOTYLEÆ *Diesing.*

TÆNIA Linn.

Tænia dilatata, sp. nov.

[Plate V, Figs. 14-16.]

Head small, truncate, or, in living specimens, slightly prominent in front. Acetabula nearly circular, directed a little forwards. Neck rugose, very long, very contractile and dilatable, narrow in front, tapering toward the head; a short distance back of the head expanding into a number of irregular, transparent, dilated folds, which border both sides of an opaque central portion, in which two longitudinal canals are faintly outlined. First segments about three times as broad as long; median segments square, or broader than long; ultimate segments nearly square, sometimes broader than long, sometimes longer than broad. Genital apertures marginal, opening a very little in front of the middle.

A single specimen of this species of *Tænia* was obtained from the intestine of the Common Eel (*Anguilla vulgaris*) August 26, 1885. The length of the specimen, when stretched out by fastening one end with a needle to the bottom of the dissecting dish and removing all kinks and curves with a fine brush, was 170^{mm}. The length of the same specimen, after having been preserved in alcohol, is less than 90^{mm}. The specimen when first obtained and placed in sea-water was quite active. The body was constantly throwing itself into sinuous curves, while the head and neck were jerked from side to side with a moderately rapid motion. In addition to these movements the neck and anterior portions of the body constantly changed their shape by the inflation or dilatation of the investing membranes into wide transparent folds, constricted at irregular intervals by narrow transverse bands. The neck, meanwhile, was alternately stretched out and contracted like the body of a Nemertean. The anterior end of the head protruded into a proboscis-like papilla. The breadth of the head itself varied from 0.17^{mm} to 0.35^{mm}.

In the alcoholic specimen the dilatable folds of the neck are much contracted and broken. They lie in rough, ragged frills along each side of the dark central part of the strobile. The head is truncate or blunt in front. The neck immediately behind the sucking-disks is almost as wide as the head, flat, thin, and little, if at all, tapering.

The following measurements were made on the living specimen. The head and neck changed their position and shape so rapidly that it was with the greatest difficulty that trustworthy measurements could be made:

	Millimeters.
Breadth of head	0.28
Diameter of acetabula	0.12
Diameter of neck, narrowest part	0.20
Distance of first segments from head	17.00
Length of fourth segment from end of strobile	1.30
Breadth of same, posterior end	1.50
Breadth of same, anterior end	1.60
Length of posterior segment	0.90
Breadth of same, posterior end	0.60
Breadth of same, anterior end	1.25

Habitat.—Common Eel (*Anguilla vulgaris*); intestine; Wood's Holl, Mass., August 26, 1885; one specimen.

Von Linstow (Compend. der Helminth., 1878) records but two *Tæniæ* from the Common Eel, *T. macrocephala* Creplin and *T. hemispherica* Molin. *T. dilatata* is very different from the former. Diesing (Revis. der Ceph., Ab. Cycl., p. 378) mentions the latter, but gives no enumeration of characters. I do not have access to Molin's paper, and cannot, therefore, say whether *T. dilatata* is identical with his species or not. The peculiar inflated character of the neck suggests *T. ambigua* Dujardin, but the difference in size between the adult specimens is alone sufficient to render their union in the same species impossible.

ORDER ACANTHOCEPHALA Rudolphi.

ECHINORHYNCHUS Zoega.

Echinorhynchus agilis Rudolphi.

[Plate V, Figs. 1-6.]

E. agilis Rudolphi, Synopsis, 67 and 316. Westrumb, Acanthoceph., 17, tab. i, 1. Bremser, Icon. Helminth., tab. vi, 9-10. Dujardin, Hist. Nat. des Helminth., 535. Diesing, Syst. Helminth., ii, 35, and Revis. der Rhyngod., 746. Molin, in Sitzungsb. d. Kais. Akad. d. Wissensch., xxx, 142.

Color white. Proboscis clavate, very short, nearly globose, armed with three, sometimes apparently only two, series of hooks, about six in each series. Hooks in front row three or four times as long as those in second and third rows, each with a long, flat basal support. Front hooks sharply recurved, with recurved part long, pointed, and often slightly concave on the outer edge. Remaining hooks very small, slender, slightly bent, sometimes standing out nearly at right angles to the axis of the proboscis, when the latter is exserted. Anterior part of the body slightly contracted and capable of introversion along with the proboscis, thus forming a short, transversely plicate neck. Body arcuate, club-shaped, cylindrical, transversely rugose, widest a little in front of the anterior third, narrowing rapidly in front and diminishing uniformly but very gradually to the posterior end, which is truncate. Proboscis sheath rather short, manubriform; proboscis and sheath often found retracted by an invagination of the anterior body wall. Lemnisci usually long, slender, attenuate posteriorly, longer proportionally in male than in female. Testes three-lobed, followed by an oval opaque mass. Male genitalia posteriorly continued into a cup-shaped copulatory organ, which is capable of eversion and inversion.

Females 9^{mm} to 12^{mm} in length; males 4.6^{mm} to 6.44^{mm}.

When subjected to the action of the compressor a series of oval and circular cavities becomes visible in the inner coat of the body wall. These are evidently the channels of the vascular system seen in section. At intervals, however, there are large circular spaces in this vascular layer clearly defined by a circular thickened ring of connective tissue. These become so much enlarged in some as to be visible with a comparatively low magnifying power, and give rise to small mammillary elevations in the superficial layer of the body wall. These are evidently the "pores" or "orbicular disks" given as specific characters of *E. tuberosus* (Dujardin, Nat. Hist. Helminth., p. 538). They are described as usually numbering five or six on the convex side and a single one on the concave side. In the specimens which I have examined there does not appear to be either this regularity or proportion in their arrangement, *e. g.*, one specimen had four on the concave side and two on the convex. In others they could not all be made out definitely, but enough could be made out to show that they were irregularly placed.

Habitat.—Common Eel (*Anguilla vulgaris*); intestine; 12 specimens, ♂ and ♀; September 2, 1885. Dusky Shark (*Carcharias obscurus*); 1 specimen, ♂; August, 1884. Wood's Holl, Mass.

Of the following specimens of which measurements were made, No. 1 is a female, Nos. 2 and 3 are males. No. 3 is the specimen obtained from the spiral intestine of *C. obscurus*:

Dimensions.	No. 1, ♀	No. 2, ♂	No. 3, ♂
	mm.	*mm.*	*mm.*
Length of specimen	0.50	0.44	4.60
Length of proboscis	0.17	0.105	0.16
Breadth of proboscis, apex	0.17	0.14	0.162
Breadth of proboscis, base	0.15	0.12	0.132
Length of proboscis sheath	0.46	....	0.30
Breadth of proboscis sheath	....	....	0.12
Length of lemnisci	1.50	1.50	1.40
Breadth of body, anterior	....	....	0.19
Breadth of body, greatest	....	....	0.50
Breadth of body, posterior end	....	....	0.16

	Millimeters.
Length of hooks in front row	{ 0.084 0.090
Length of hooks in second row	0.023
Length of recurved part of front hooks	0.061
Length of ova	0.035
Breadth of ova	0.017

Length of ovarian masses much greater than ova, circular and oval, with diameters as much as 0.1^{mm}, others as low as 0.04^{mm}.

I confess no small degree of perplexity in identifying this species as *E. agilis*. The arrangement and character of the hooks of the proboscis ally it closely with this species and a little less closely with *E. claviceps* Zeder. The lemnisci are not so long in proportion to the length of the animal as in either of the above-named species. This is about the only character that hints at a probable specific difference which is sufficient to justify the separation of the specimens under consideration from either of the above species. The presence or absence of the so-called neck is rather a doubtful feature at best.

While there are no distinctive characters which seem to my mind to be important enough to justify the erection of a new species, there are certainly strong reasons afforded for uniting *E. claviceps* and *E. tuberosus*, which is, indeed, proposed by Dujardin (op. cit., p. 538) and accepted by Diesing, who does not mention *E. claviceps* in his revision, and including both under *E. agilis* Rudolphi.

In the absence of figures of these species I must content myself at present with referring these specimens to *E. agilis*.

With regard to the single specimen found in the spiral valve of *Carcharias obscurus*, it may be well to observe that its presence there may be accounted for by supposing it to have been introduced in the adult condition along with some more usual host which had been eaten by the shark a short time before the latter was examined. However interesting this supposition may be, it is hardly necessary, as there is no reason why *C. obscurus* should not be a proper host of *E. agilis.*

Echinorhynchus acus Rudolphi.

[Plate V, Figs. 7-13.]

Rudolphi, Wiedmann's Archiv., ii, 2, 51; Entoz. Hist., ii, 279; Synops., 71 and 324. Zeder, Naturg., 150. Westrumb, Acanthoceph., 24. Siebold, in Burdach's Physiol., 2, Aufl., ii, 196 (ovula). Drummond, Charlsworth's Mag. of Nat. Hist., ii, 516. Bellingham, in Annals of Nat. Hist., xiii, 256. Dujardin, Hist. Nat. des Helminth., 540. Creplin, Nov. Obs., 43, and in Ersch. and Grub. Encyclop., xxxii, 284. Leidy, in Proceed. Acad. Phila., viii, 48. Van Beneden, Mem. Vers. Intest., 279-287 (development).

For detailed synonymy and habitats, see Diesing, Syst. Helm., ii, 39-40, and Revis. d. Rhyngodeen, 747.

Proboscis linear with about twenty series of hooks; neck none; body long, greatest width a short distance back of proboscis, subattenuate posteriorly, bluntly rounded at posterior end. Length 27 to 81mm (Dujardin), breadth 2mm; males half as long as females; color usually white.

"The color is very various but generally white when distended, though frequently accompanied at the same time by a tinge of orange, pink, or cinereous. Sometimes the whole animal is reddish orange (especially the male), and sometimes the whole is ivory white with a solitary minute crimson dot here and there" (Drummond).

Some specimens flat, thin, with regular outline, others cylindrical with irregular transverse rugæ. All the specimens noted by me were white or faintly tinged with yellow.

The following measurements were made on alcoholic specimens:

Dimensions.	No. 1, ♀	No. 2, ♀	No. 3, ♂
	mm.	*mm.*	*mm.*
Length of specimen	46.00	45.00	20.00
Length of proboscis	1.04	1.06	0.96
Breadth of proboscis	0.28	0.32	0.28
Length of proboscis sheath	1.44	1.60	1.40
Breadth of proboscis sheath	0.36	0.36	0.36
Breadth of body, anterior	0.75	0.80	0.60
Breadth of body, antero-median	2.00	1.60	1.20
Breadth of body, near posterior end	0.60	1.10	0.60

Length of longest living specimen, 60mm.

Dimensions.	Millimeters.	Millimeters.	Millimeters.
Longest diameter of ovarian masses	0.11	0.07	0.08
Shortest diameter of ovarian masses	0.075	0.05	0.07
Length of ova	0.13	0.114	0.112
Breadth of ova	0.03	0.055	0.023
Length of embryo	0.098	0.08	0.076
Breadth of embryo	0.017	0.018	0.015

Length of hooks, 0.064^{mm}; breadth of same at base, 0.02^{mm}.

The proboscis, when fully extended, stands a little obliquely to the axis of the body. In all the specimens that I have seen the proboscis was either wholly extended or partly withdrawn bodily. In no case was the proboscis inverted. These worms are able not only to withdraw and to protrude the proboscis as a whole, but also to invert and evert it. When the proboscis is retracted in mass the walls of the body at the base of the proboscis are invaginated by the action of retractor muscles, which are attached to the base of the sheath and inserted on the median parietes of the body. When thus retracted the proboscis lies as a rigid cylindrical rod inclosed in a pouch made by the invaginated anterior end of the body (Fig. 12).

The protrusion of the proboscis seems to be effected by the propulsive force exerted by the fluid contents of the body cavity when forced forward by muscular contraction of the body-wall. A retractor muscle, or ligament, was traced from the interior of the proboscis sheath to the apex of the proboscis. Inversion of the proboscis itself is effected by this ligament, while eversion is produced by the action of the thick, muscular walls of the sheath upon a granular fluid which it contains. The hooks of the proboscis are arranged in quincunx order, thus giving rise to rows parallel with the long axis of the proboscis, and also to spiral rows. The body cavities of the females were crowded with myriads of eggs. These were long-oval and each contained a fusiform embryo. The outer covering of the ova is a delicate but rather thick, transparent membrane. Within this and immediately surrounding the embryo is a thin but dense coat, which is much compressed at one end so as to look like a loop, slightly compressed at the other. The embryo in most of the ova had not developed sufficiently to indicate more than a fusiform, granular mass lying within the dense hyaline inner coat of the ovum.

The spherical ovarian masses were in different stages of progress, some having simple granular contents, others having secondary masses within them, while in others oblong bodies, apparently young embryos or the beginnings of ova, could be distinctly seen.

Habitat.—Flat Fish (*Pseudopleuronectes americanus*), in intestine; eight specimens. Wood's Holl, Mass., September, 1884.

Echinorhynchus sagittifer, sp. nov.

[Plate VI, Figs. 1–2.]

This worm was found in the peritoneum of several species of fish. Although no adult specimens were found, the form of the immature specimens is so different from that of any adult *Acanthocephala* with which I am acquainted, and the structure and arrangement of the spines are so remarkable, that I propose the name *E. sagittifer* for it. Of course it is possible that it may subsequently be identified as the young of some form already described, as the spines of the body are probably shed in the course of its further development.

The proboscis is clavate, bluntly rounded in front, increasing slightly for a short distance back, and then narrowing gradually to the base, thickly beset with recurved hooks, of which there are about twenty series, counting from base to apex, and about fifteen visible in the longest spiral; proboscis eversible; neck short, unarmed; body always curved, anteriorly armed with sagittate spines, thus forming an armed collar back of the neck, the spines of which are arranged in about eight transverse rows, but placed a little irregularly. A short distance back of this spiny collar is a transverse row of sagittate spines, which are placed on the inner (ventral) part of the curve, and extend up each side nearly to the outer (dorsal) edge. Following this row are about twenty other rows of similar spines, similarly placed, except that none of them contains as many spines, and hence is not as long as the first row. The first eight or ten rows do not differ much in length nor in the number of spines; posteriorly the rows become shorter and shorter until the last, in which the spines are few and hard to distinguish. The body increases in size for some distance back of the neck, attains its greatest dimensions about the anterior third, and diminishes uniformly to the posterior end, which is in some slightly enlarged, ending ing with a bluntly rounded point.

These worms were all found in the body cavity of their host, coiled up and lodged in the serous coat of the intestine or stomach, or in the mesentery. When found they usually had the proboscis inverted, but everted it, in whole or in part, when immersed in alcohol or when placed under the compressor. They were surrounded by a thin investing membrane, which was of the nature of a cyst, while at the same time it appeared to belong to the worm. They were uniformly coiled in a curved or lunate shape, with the rows of spines on the concave side. The body is much roughened by transverse wrinkles or creases, especially towards the posterior end.

The branching vascular system characteristic of this order is clearly defined. If the plane in which the curved animal lies be called a dorsoventral one, then the principal vessels of the vascular system are lateral.

The sexual characters were already plainly distinguishable. In one specimen two oval masses suspended from the base of the proboscis sheath were identified as the beginning testes. These were oval, granular bodies, the first 1.16^{mm} back of the proboscis sheath, and the second 0.34^{mm} farther back; length of each 0.164^{mm}; breadth 0.127^{mm}. They lay in the ribbon-like band or tube which in all the specimens depended from the base of the sheath, and which doubtless represents the suspensory ligament. Behind the anterior oval body lay a cluster of spherical nucleated cells. The genitalia, in this specimen, ended in a campanulate expansion, at the base of which a small pointed body was recognized, which was probably the spiculum. This enlargement of the genital apparatus opened into a larger oval cavity in the extreme posterior end of the body. This was evidently the male bursa, but was still closed by the investing body-membrane.

In some specimens which had been stained and mounted in glycerine, bodies which looked like the lemnisci were discovered. These were paired organs, very long and slender, tapering gradually to near the posterior end, which was bluntly rounded. Their attachment was at the base of the proboscis sheath. In one specimen the attachment was by a short ligament. The general appearance of these organs was much like that of the lemnisci of *E. agilis*, but their attachment at the base of the sheath, instead of near the base of the proboscis, makes their indentification as lemnisci doubtful.

In a series of thin longitudinal sections made from one of these worms a cluster of spherical, granular masses was found lying just back of the base of the proboscis sheath and apparently supported by the suspensory ligament. These masses were each about 0.025^{mm} in diameter, and each contained a number of smaller cells. It is probable that these represent the early stages of the ovarian masses peculiar to this order.

The proboscis sheath is thick-walled and made up of two layers, the outer dense, about 0.03^{mm} thick; the inner loose in texture and 0.032^{mm} thick. From the base to about the middle of the sheath these layers are close together; from that point to the base of the proboscis they separate slightly, but unite again at the base of the proboscis. A retractile ligament extends from the proboscis back through the neck, where it divides into two branches, which continue to the base of the sheath, where they are attached. The sheath extends to the third or fourth row of ventral spines.

An oblong granular mass was noted about the middle of the proboscis, seen in a thin section, and on its inner wall. A round granular mass about 0.07^{mm} in diameter was seen near the base of the neck in one section. I could find no indication of a ganglion in the base of the proboscis sheath.

Measurements of mounted specimens.

Dimensions.	No. 1.	No. 2.	No. 3.	No. 4.
	mm.	*mm.*	*mm.*	*mm.*
Length of specimen	6.40	7.80	9.20	8.20
Length of proboscis	1.20	0.90	.....	1.20
Breadth of proboscis near apex	0.44	0.48	0.52	0.46
Breadth of proboscis at base	0.26	0.32	0.46	0.36
Breadth of body at anterior	......	0.50	......	......
Breadth of body at median	0.54	0.62	0.74	0.80
Breadth of body at posterior	0.30	0.46	0.40	0.40
Length of proboscis sheath	......	1.80	......	......
Length of neck	......	......	......	0.36
Number of rows of spines on body	21	......	......	18

Nos. 1 and 2 were from *Cynoscion regale*, No. 3 from *Pomatomus saltatrix*, and No. 4 from *Paralichthys dentatus*.

The length of the larger hooks on the proboscis is about 0.08mm; of the spines on the collar from 0.05mm to 0.06mm; of the spines in the ventral rows from 0.06mm to 0.07mm.

In specimen No. 1, of which measurements are given above, the number of spines visible on side in the first ventral row was 24; the number visible on one side in the second to the twenty-first rows, respectively: 16, 13, 13, 16, 17, 13, 13, 12, 12, 10, 11, 12, 11, 9, 9, 9, 8, 7, 10, 6.

Habitat.—Common Flounder (*Paralichthys dentatus*), Squeteague (*Cynoscion regale*), Bluefish (*Pomatomus saltatrix*). In peritoneum and mesentery. Wood's Holl, Mass., July and August, 1884–'85.

Echinorhynchus proteus Westrumb.

[Plate VI, Figs. 3-5.]

Dujardin, Hist. Nat. des Helminth., p. 529. Molin, in Sitzungsb. d. Kais. Akad. d. Wissensch., xxx, 143, and xxxiii, 295. Leidy, Proceed. Acad. Phila., v, 208, and viii, 48. Greef, Wiegmann's Archiv, i, 361–375, tab. vi. Pagenstecher, Z. f. w. Z., xiii, 413, tab. xxiii–xxiv. Leuckart, Mensch. Paras., ii, 785–817. Molin, Denksch. d. K. Akad., xix, 272–3, tab. ix, fig. 2–3.

For detailed synonymy and habitats see Diesing, Systema Helminth., ii, 51–53, and Revis. der Rhyngo., 754.

Proboscis cylindrical or often subclavate, with about 6 to 8 longitudinal series of recurved hooks visible on one side, 12 to 20 in each series. Median and anterior hooks flat and thin, postero-median and posterior, slender. A thin-walled, spherical bulla immediately back of the proboscis, followed by a long, slender, cylindrical neck. Body fusiform, slightly swollen and rounded anteriorly, obtusely rounded posteriorly; color varying from light lemon-yellow to orange. Length, 15mm to 23mm.

Measurements of a living specimen.

	Millimeters.
Length of specimen	23.00
Length of proboscis	0.75
Diameter of bulla	1.75
Length of neck	4.50
Length of body	16.00
Diameter of body, anterior	2.00
Diameter of body, posterior end	0.77
Diameter of neck, median	0.25
Diameter of proboscis, anterior	0.17
Diameter of proboscis, median	0.31

These parasites were found in great numbers attached to the inner wall of the large intestine of the Striped Bass (*Roccus lineatus*). They differ from most intestinal parasites in being highly colored. While the prevailing color is orange of different shades, many were observed which were a light lemon-yellow, and others intermediate between these colors.

The presence of these parasites in considerable numbers must be injurious to the host, since they are always firmly attached and usually cause much local inflammation. In many cases the proboscis was found to have penetrated the walls of the intestine and to be protruding into the body cavity. In most instances of this kind it was surrounded by an abnormal secretion from the tissues of its host. This secretion is of a dark-brown, cinnamon-brown, or amber color. In many cases the proboscides were found to have become nuclei, around which were formed, in concentric layers, calculi of this abnormal deposition. The whole is further inclosed in a thickened cyst composed of two or three layers of connective tissue over which is thrown a thin outer covering of peritoneum. A cluster of these encysted calculi, lying in the peritoneum of the large intestine of a specimen of Striped Bass (*Roccus lineatus*), is shown in Fig. 5; one of the cysts opened, in Fig. 5*a*; and a cross-section of a calculus removed from its cyst in Fig. 5*b*. The diameter of one of the largest cysts was 18^{mm}. In the calculus figured the diameter is 15^{mm}. The color on the surface is, when the calculus is placed in alcohol, a beautiful rich golden-brown with a silky luster. The surface is uneven, with little irregular rounded or mammillary eminences. The nucleus is irregularly linear, 1½ to 2^{mm} in length. The inner layers are thin, irregularly concentric and darker in color than the outer layers. Outside of this central, dark portion is a lighter ring about 2½^{mm} thick and made up of a great many thin, concentric layers. This lighter portion is sharply marked off from the remaining outer part of the calculus, separates from it easily, and can be removed from the half-calculus, as one cupel can be taken out of a nest made up of graded sizes. The outer ring is about 3^{mm} thick, is a little darker than the middle ring, but, like it, is made up of a number of thin, concentric layers. The layers of the two outer rings are more regularly concentric than those of the inner portion. The color of the cut part of the calculus is a little darker than that of the surface, and the luster is waxy. A piece of one of these secretions burned readily and left a small quantity of ash which was composed largely of calcium carbonate. In one, from which the alcohol had evaporated, crystals were noticed which had the general habit and appearance of those of oxalate of urea.

Alcoholic specimens are uniformly white in color.

Habitat.—Striped Bass (*Roccus lineatus*); large intestine; Wood's Holl, Mass., August and September, 1884–'85.

List of Entozoa described in this paper, with their hosts.

Entozoa.	Host.	Page.	Plate.	Figures.
1. *Dibothrium manubriforme* sp. nov	Spear Fish (*Tetrapturus albidus*).	4	I	1-4
2. *Dibothrium aluteræ* sp. nov	File Fish (*Alutera Schœpfii*)	6	I	5-8
3. *Echeneibothrium variabile* Van Beneden	Common Skate (*Raia erinacea*)	8	I	9-13
4. *Spongiobothrium variabile* gen. et sp. nov	Sting Ray (*Trygon centrura*)	10	II	13-19
5. *Phyllobothrium thysanocephalum* sp. nov	Tiger Shark (*Galeocerdo tigrinus*).	12	II	1-12
6. *Orygmatobothrium angustum* sp. nov	Dusky Shark (*Carcharias obscurus*).	16	III	1-3
7. *Crossobothrium laciniatum* gen. et sp. nov	Sand Shark (*Odontaspis littoralis*).	18	III	4-18
8. *Phorciobothrium lasium* gen. et sp. nov	Dusky Shark (*Carcharias obscurus*.)	22	IV	24-29
9. *Calliobothrium verticillatum* Rudolphi	Smooth Dogfish (*Mustelus canis*).	24	IV	1-8
10. *Rhynchobothrium bisulcatum* sp. nov	Dusky Shark (*Carcharias obscurus*.)	27	IV	9-23
11. *Rhynchobothrium tenuicolle* Rudolphi	Smooth Dogfish (*Mustelus canis*).	34	V	17-18
12. *Tænia dilatata* sp. nov	Common Eel (*Anguilla vulgaris*).	36	V	14-16
13. *Echinorhynchus agilis* Rudolphi	*Anguilla vulgaris* and *Carcharias obscurus*.	38	V	1-6
14. *Echinorhynchus acus* Rudolphi	Flat Fish (*Pseudopleuronectes americanus*).	40	V	7-13
15. *Echinorhynchus sagittifer* sp. nov	Common Flounder (*Paralichthys dentatus*), Squeteague (*Cynoscion regale*), and Bluefish (*Pomatomus saltatrix*).	41	VI	1-2
16. *Echinorhynchus proteus* Westrumb	Striped Bass (*Roccus lineatus*)	44	VI	3-5
17. Embryo *Tetrabothria*	Squeteague (*Cynoscion regale*)	1	VI	6-9

WASHINGTON AND JEFFERSON COLLEGE,
Washington, Pa., June 1, 1886.

EXPLANATION OF PLATE I.

FIG. 1. *Dibothrium manubriforme* sp. nov. Adult strobile, natural size.

FIG. 1*a*. Median segments of same, enlarged 3 diameters.

FIG. 1*b*. The same, opposite side, showing genital openings, enlarged 3 diameters.

FIG. 2. Head and anterior segments of young specimen, enlarged 12 diameters.

FIG. 3. Posterior segments of adult, enlarged 10 diameters.

FIG. 4. Ova. *a*, ova with white opaque shell; *b*, ova with thin transparent shell, enlarged 150 diameters.

FIG. 5. *Dibothrium aluteræ* sp. nov. Head and anterior segments, marginal view, enlarged 4 diameters.

FIG. 6. Lateral view of same specimen, enlarged 4 diameters; length of specimen 27^{mm}.

FIG. 7. Lateral view of head of another specimen, enlarged 4 diameters; bothria contracted and concave.

FIG. 8. Posterior end of same specimen, enlarged 4 diameters; length of specimen 76^{mm}.

FIG. 9. *Echeneibothrium variabile* Van Beneden. Front view of head as seen in living specimens, when the sucking disks are applied to the under surface of the cover-glass, enlarged 36 diameters.

FIG. 10. Outline of median, irregular segments, enlarged 10 diameters.

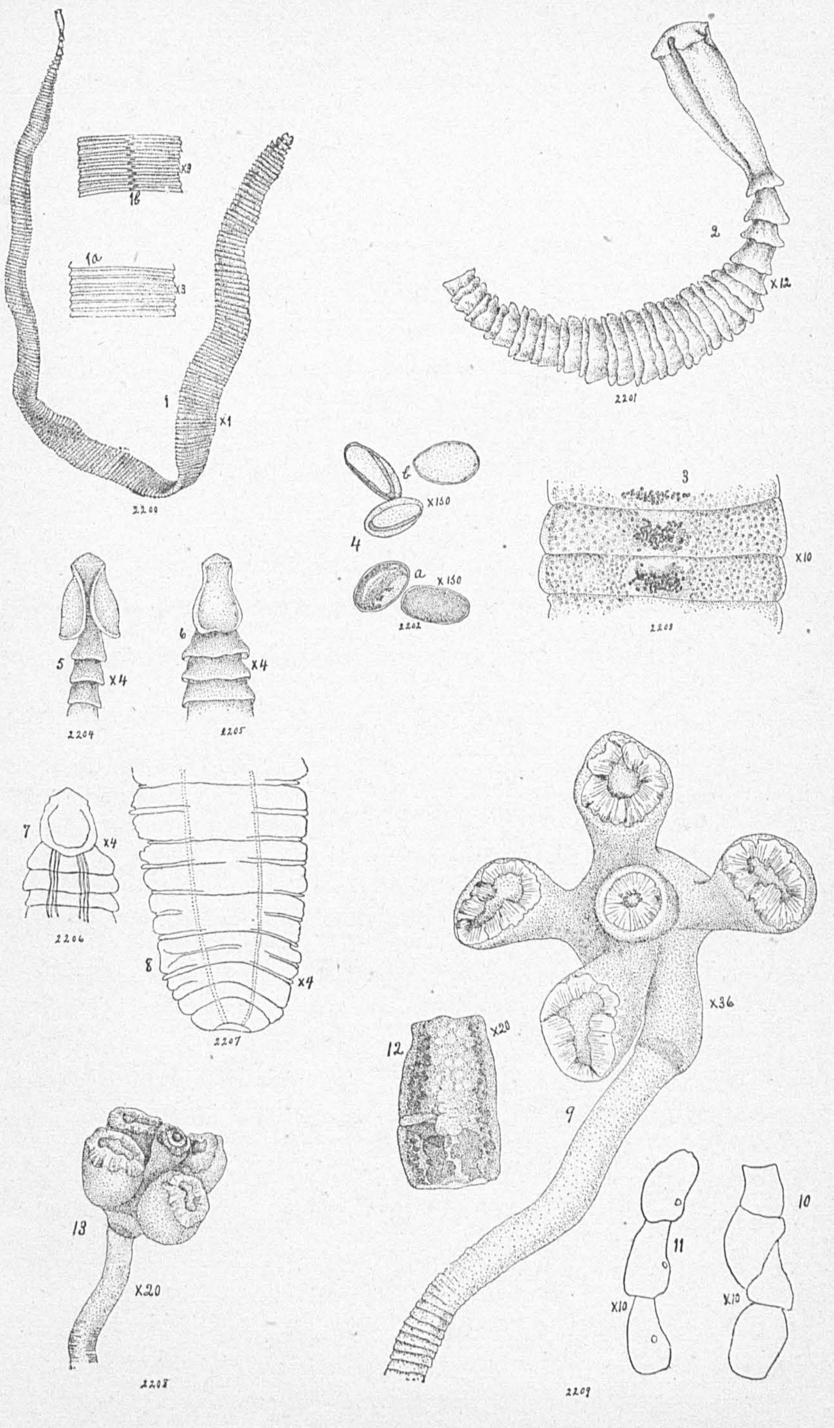
FIG. 11. Outline of other segments farther back, showing position of genital aperture, enlarged 10 diameters.

FIG. 12. One of the same, compressed, showing the genitalia, enlarged 20 diameters.

FIG. 13. Lateral view of head, alcoholic specimen, enlarged 20 diameters.

Figures 1, 2, and 9 from life; others from alcoholic and mounted specimens.

All figures made by Mrs. Edwin Linton.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2207
x36
12
x20
9
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x20
2208
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x10
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2209

EXPLANATION OF PLATE II.

FIG. 1. *Phyllobothrium thysanocephalum* sp. nov. Head and part of neck of adult, natural size, length of specimen 1 meter.

FIG. 2. Part of body of same, showing the beginning segments, enlarged 2 diameters.

FIG. 3. Segments near posterior end of adult, enlarged 2 diameters.

FIG. 4. Mature free proglottis, enlarged 2 diameters.

FIG. 5. Mature free proglottis, flattened under compressor, enlarged 4 diameters.

FIG. 6. Posterior segments of a specimen measuring 290^{mm} in length, enlarged 2 diameters.

FIG. 7. Head and neck of young specimen, enlarged 12 diameters.

FIG. 7*a*. Front view of rostellum, enlarged 18 diameters.

FIG. 7*b*. Side view of same, enlarged 18 diameters.

FIG. 8. Young specimen, natural size.

FIG. 9. Transverse section through middle of head of a young specimen, length 58^{mm}, enlarged 9 diameters.

FIG. 10. Transverse section through anterior third of head of adult, enlarged 9 diameters.

FIG. 11. Transverse section through neck a short distance back of head, adult, enlarged 6 diameters.

FIG. 12. Transverse section through neck of young, near the head, enlarged 9 diameters.

FIG. 13. *Spongiobothrium variabile* gen. et sp. nov., outline of strobile with regular slender segments, enlarged 5 diameters.

FIG. 14. Outline of another specimen with shorter and more irregular segments, enlarged 6 diameters.

FIG. 15. Side view of head, neck, and anterior segments, edges of bothria contracted, enlarged 10 diameters.

FIG. 16. Front view of head of another specimen, with two bothria expanded, enlarged 10 diameters.

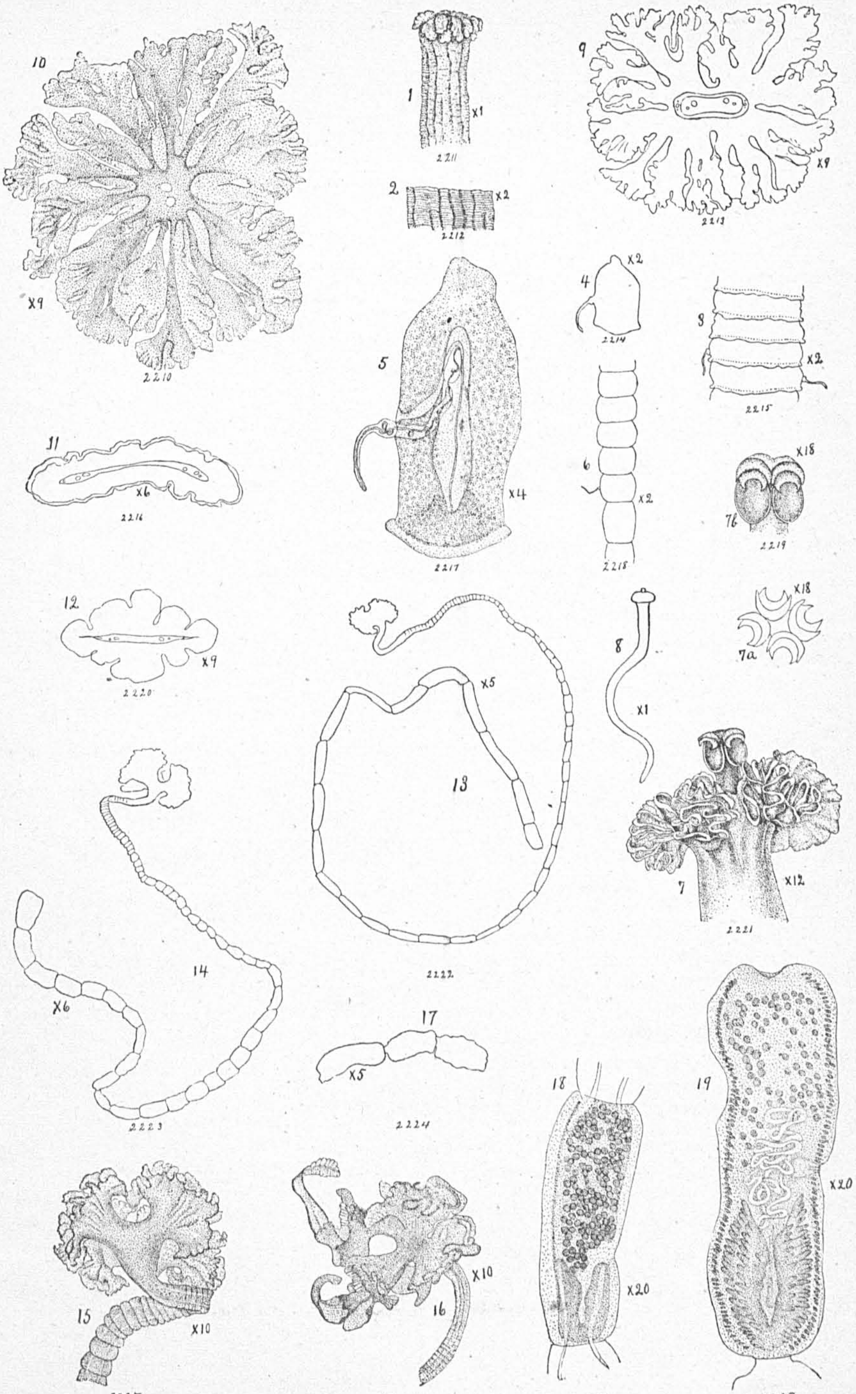
FIG. 17. Three mature segments, enlarged 5 diameters.

FIG. 18. Median segment, enlarged 20 diameters.

FIG. 19. Mature segment, enlarged 20 diameters.

Figures 3, 4, 6, 7, 8, and 15 from life; others from alcoholic and mounted specimens.

All figures made by Mrs. Edwin Linton.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7b
X18
2219
12
X9
2220
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X10
2226

EXPLANATION OF PLATE III.

FIG. 1. *Orygmatobothrium angustum* sp. nov., outline of strobile, enlarged 8 diameters.

FIG. 2. Head and part of neck of same, enlarged 20 diameters.

FIG. 3. Posterior segment of same, enlarged 20 diameters.

FIG. 4. *Crossobothrium laciniatum* gen. et sp. nov., adult strobile, in fresh water, natural size.

FIG. 5. Head and first segments of same specimen, enlarged 12 diameters.

FIG. 6. Head and first segments of a specimen after lying for a few minutes in fresh water, enlarged 8 diameters.

FIG. 7. Posterior segments of same, enlarged 6 diameters.

FIG. 8. Posterior segments of another specimen, showing lateral openings for the discharge of ova, enlarged 6 diameters.

FIG. 9. Head and first segments of adult, showing one position of bothria while in motion. The bothrium in front view and the one opposite (not shown in sketch) are thrust forward, enlarged 10 diameters.

FIG. 10. The same, with one bothrium flattened out and applied to the bottom of the watch-glass, enlarged 10 diameters.

FIG. 11. The same with two bothria pushed forward, the ends extended and curled outward, enlarged 10 diameters.

FIG. 12. Free proglottis showing lateral opening for discharge of ova, enlarged 6 diameters.

FIG. 13. Free proglottis before the ova are discharged, flattened under the compressor, enlarged 10 diameters.

FIG. 14. Another after most of the ova have been discharged from the lateral opening, also flattened under compressor, enlarged 10 diameters.

FIG. 15. Front view of head of specimen transferred from fresh water to alcohol, enlarged 10 diameters.

FIG. 16. Transverse section through another specimen, enlarged 10 diameters.

FIG. 17. Young strobile before segments have made their appearance near the head. The joints at the posterior end are pseudosegments; flattened under compressor, enlarged 12 diameters.

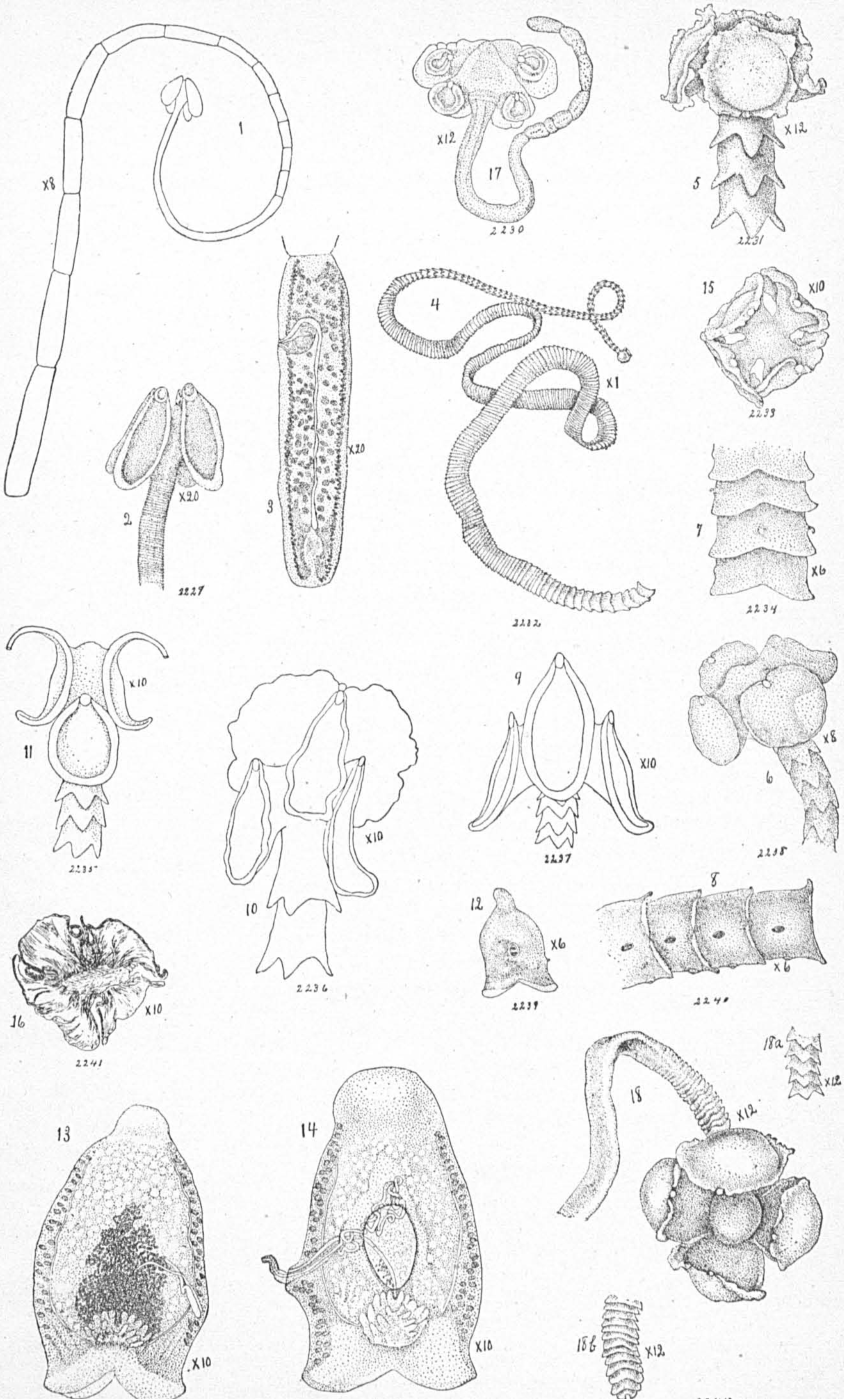
FIG. 18. Head and anterior part of a young specimen in fresh water, enlarged 12 diameters.

FIG. 18*a*. Anterior segments of same, enlarged 12 diameters.

FIG. 18*b*. Posterior segments of same, enlarged 12 diameters.

Figures 9, 10, 11, 13, 14, and 17, from living specimens in sea-water; figures 4, 5, 6, 7, 8, 18, 18*a*, and 18*b*, from living specimens in fresh water; others from alcoholic and mounted specimens.

All figures made by Mrs. Edwin Linton.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16
X10
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2242
14
X10
2243
18
X12
18a
X12
18b
X12
2244

EXPLANATION OF PLATE IV.

FIG. 1. *Calliobothrium verticillatum* Rudolphi. Head and first segments turned so that both a marginal and a lateral view may be obtained, enlarged 20 diameters.

FIG. 2. Transition segments near head, showing the formation of secondary lateral flaps, enlarged 20 diameters.

FIG. 3. Segments farther back, showing transition from three laciniæ to four, enlarged 20 diameters.

FIG. 4. Segments still farther back. The two median laciniæ have become of equal length and nearly as long as the primary flaps; enlarged 20 diameters.

FIG. 5. Segments still farther towards posterior end, showing incipient obliteration of the two median lateral laciniæ, enlarged 20 diameters.

FIG. 6. Segments approaching posterior end, showing further modification of posterior margin, enlarged 20 diameters.

FIG. 7. Segments near posterior end of strobile, enlarged 20 diameters.

FIG. 8. Posterior mature segment, enlarged 20 diameters.

FIG. 9. *Rhynchobothrium bisulcatum* sp. nov. Head and neck, lateral view, var. *a* (see description), enlarged 15 diameters.

FIG. 10. Anterior segments of same specimen, enlarged 9 diameters.

FIG. 11. Antero-median segments of same, enlarged 9 diameters.

FIG. 12. Posterior segments of same; length of strobile 48^{mm}; enlarged 9 diameters.

FIG. 13. Head and neck, marginal view, var. γ (see description); length of strobile 92^{mm}; enlarged 15 diameters.

FIG. 14. Antero-median segments of same, enlarged 9 diameters.

FIG. 15. Median segments of same, enlarged 9 diameters.

FIG. 16. Posterior segments of same, enlarged 9 diameters.

FIG. 17 Anterior segments of another specimen, var. β (see description); length of strobile 230^{mm}; enlarged 9 diameters.

FIG. 18. Median segments of same, enlarged 9 diameters.

FIG. 19. Postero-median segments of same, enlarged 9 diameters.

FIG. 20. Outline of posterior segments of same, enlarged 9 diameters.

FIG. 21. Abnormal form, secondary chain of segments, originating from the margins of two primary segments, enlarged 10 diameters.

FIG. 22. Another secondary chain from the postero-marginal border of a primary segment, enlarged 10 diameters.

FIG. 23. Apex of proboscis, enlarged 150 diameters.

FIG. 23*a*. Base of same, enlarged 150 diameters.

FIG. 24. *Phorciobothrium lasium* gen. et sp. nov. Outline of strobile, enlarged 6 diameters.

FIG. 25. Front view of head, enlarged 20 diameters.

FIG. 26. Lateral view of head of another specimen, enlarged 40 diameters.

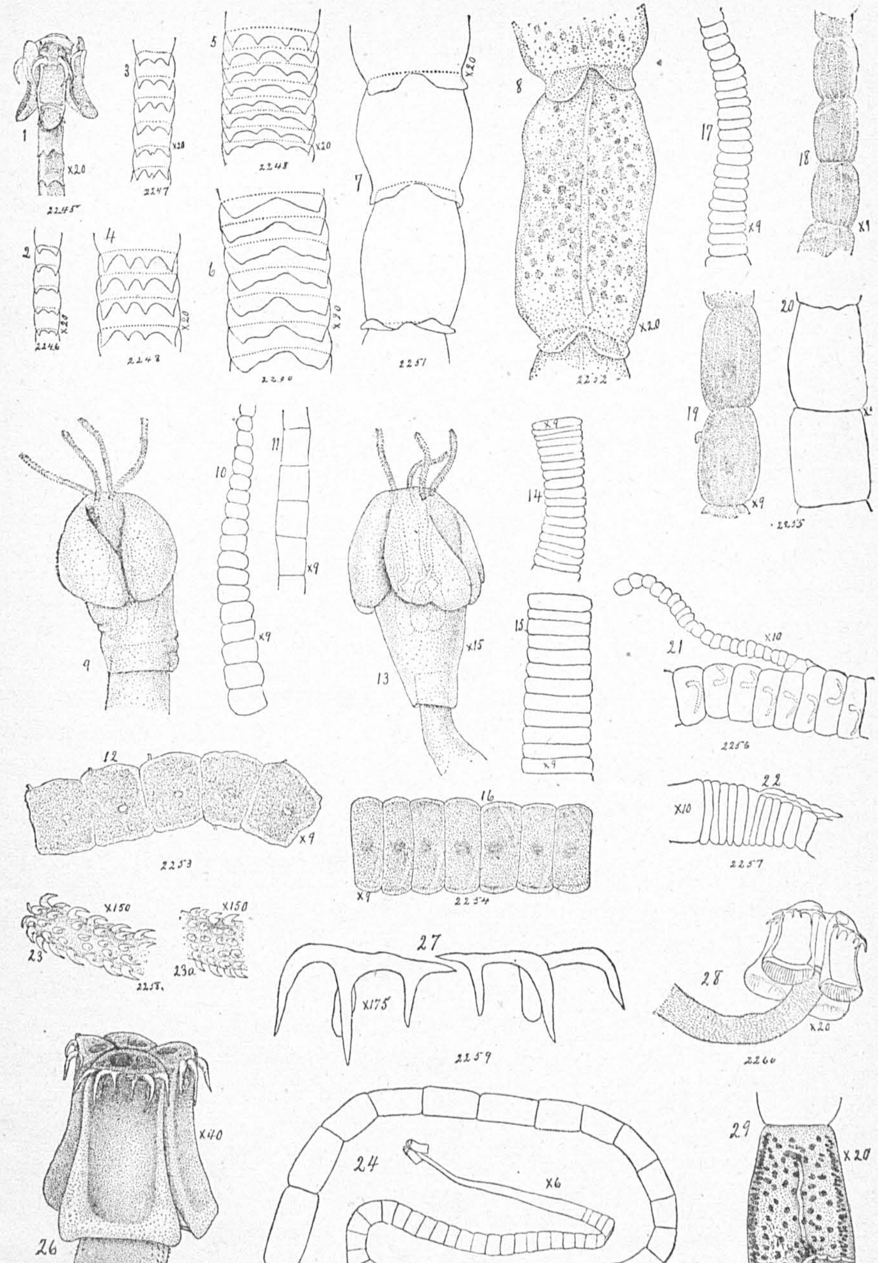
FIG. 26*a*. Spines from neck of same, enlarged 350 diameters.

FIG. 27. Compound hooks from one bothrium, enlarged 175 diameters.

FIG. 28. Another specimen with many spines on the neck, and showing striæ on bothria somewhat flattened under compressor; enlarged 20 diameters.

FIG. 29. Posterior mature segment, enlarged 20 diameters.

All the figures in this plate made from alcoholic or mounted specimens, by Mrs. Edwin Linton.



EXPLANATION OF PLATE V.

FIG. 1. *Echinorhynchus agilis* Rudolphi. Sketch of living specimen, male, flattened under compressor, enlarged 10 diameters.

FIG. 1*a*. Another specimen, male, natural size.

FIG. 2. Sketch of living specimen, female, flattened under compressor, enlarged 10 diameters.

FIG. 2*a*. Another specimen, female, natural size.

FIG. 2*b*. Ova, enlarged 200 diameters.

FIG. 3. Outline of specimen with proboscis retracted, enlarged 25 diameters.

FIG. 4. Outline of male, from *C. obscurus*, enlarged 15 diameters.

FIG. 5. Posterior extremity of another male, showing bursa everted, enlarged 15 diameters.

FIG. 6. Hooks of proboscis; *a*, from first row; *b*, from second row; *c*, from third row; enlarged 150 diameters.

FIG. 7. *Echinorhynchus acus* Rudolphi; outline of male, enlarged 20 diameters.

FIG. 8. Male and female alcoholic specimens, natural size.

FIGS. 9 & 10. Specimens in sea-water, enlarged 2 diameters.

FIG. 11. Specimen shown in Fig. 10, after lying some time in fresh water, enlarged 2 diameters.

FIG. 12. Outline showing proboscis partly retracted, retractor muscles and lemnisci, enlarged 15 diameters.

FIG. 13. Anterior end of female, showing protruded proboscis and ova, enlarged 15 diameters.

FIG. 14. *Tænia dilatata* sp. nov. Head and anterior part of neck, enlarged 18 diameters.

FIG. 15. Portion of neck, showing dilated folds, enlarged 18 diameters.

FIG. 16. Outline of posterior segments, enlarged 4 diameters.

FIG. 17. *Rhynchobothrium tenuicolle* Rudolphi. Outline of strobile, enlarged 2 diameters.

FIG. 18. Head and neck of same, enlarged 30 diameters.

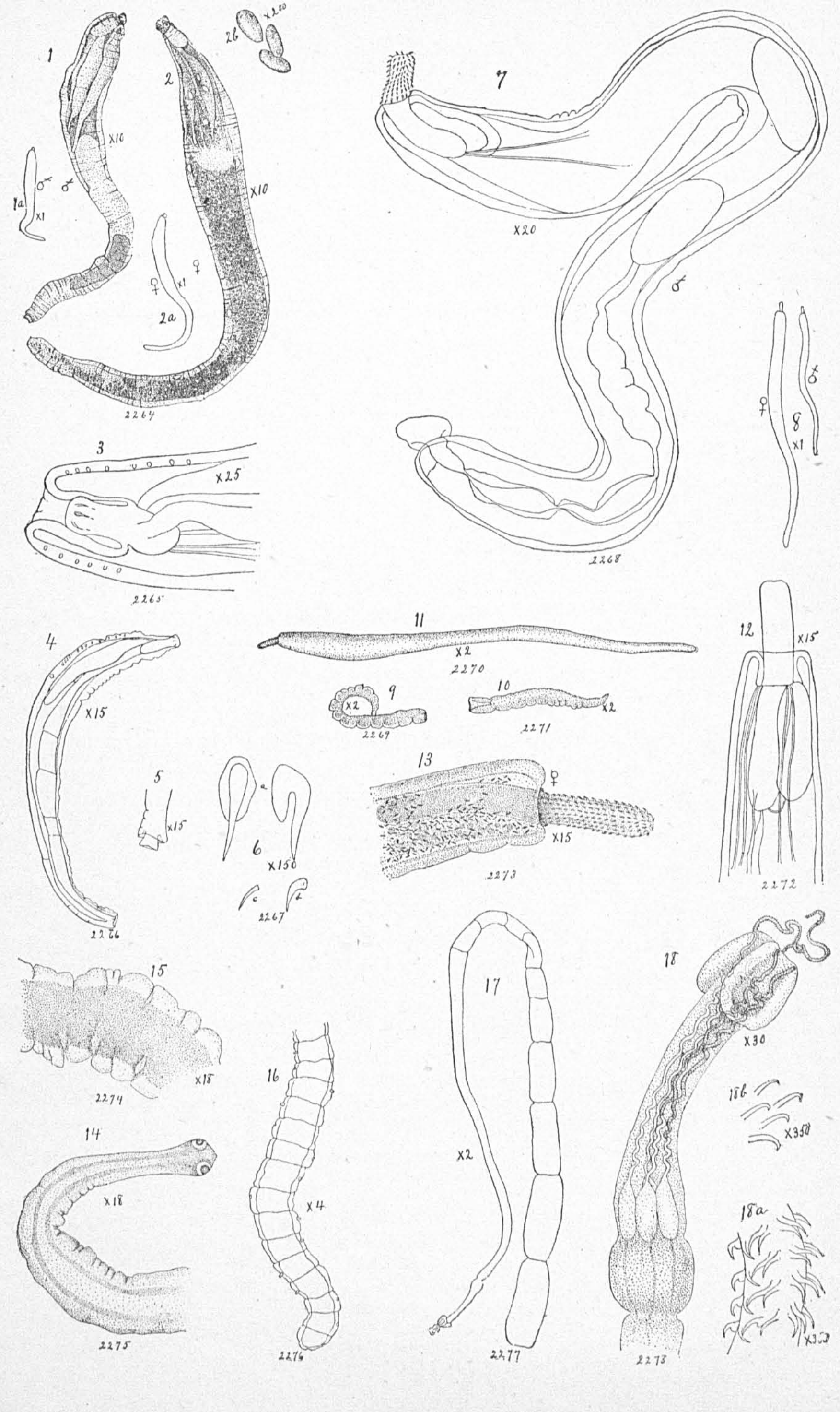
FIG. 18*a*. Portion of proboscis, enlarged 350 diameters.

FIG. 18*b*. Hooks near apex of proboscis, enlarged 350 diameters.

Figures 1, 1*a*, 2, 2*a*, 2*b*, 7, 9, 10, 11, 14, 15, 16 from life; others from alcoholic and mounted specimens.

All figures made by Mrs. Edwin Linton.

PLATE V.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x4
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2276
2277
2278
18b
18a

EXPLANATION OF PLATE VI.

FIG. 1. *Echinorhynchus sagittifer* sp. nov. Outline sketch of young, showing protruded proboscis, neck, collar armed with sagittate spines, transverse rows of sagittate spines on the body, and, interiorly, the proboscis sheath, retractor muscles of same, the genitalia depending from sheath of proboscis, enlarged 20 diameters.

FIG. 1*a*. Hooks of proboscis, ventral side, enlarged about 150 diameters.

FIG. 1*b*. Hooks of proboscis, dorsal side, enlarged about 150 diameters.

FIG. 1c. Sagittate spines from collar, enlarged about 150 diameters.

Fig. 1*d*. Sagittate spines from one of the transverse ventral rows on body, enlarged about 150 diameters.

FIG. 1*e*. Five contiguous hooks in one of the spiral series on the proboscis, enlarged about 150 diameters.

Fig. 2. Sketch of live specimen, somewhat flattened by the compressor, enlarged 12 diameters.

FIG. 3. *Echinorhynchus proteus* Westrumb. Portion of rectum of *Roccus lineatus* (Striped Bass) with parasites attached, natural size.

FIG. 4. Outline of an individual removed from its place of attachment, enlarged 2 diameters.

FIG. 5. Abnormal secretions in peritoneal covering of large intestine of *Roccus lineatus*, to the inner coat of which numbers of these parasites were attached, as shown in Fig. 3, natural size.

FIG. 5*a*. One of the cysts shown in Fig. 5, cut open, exposing the calculus within, natural size.

FIG. 5*b*. Transverse section through one of the abnormal secretions, showing its concentric structure, natural size.

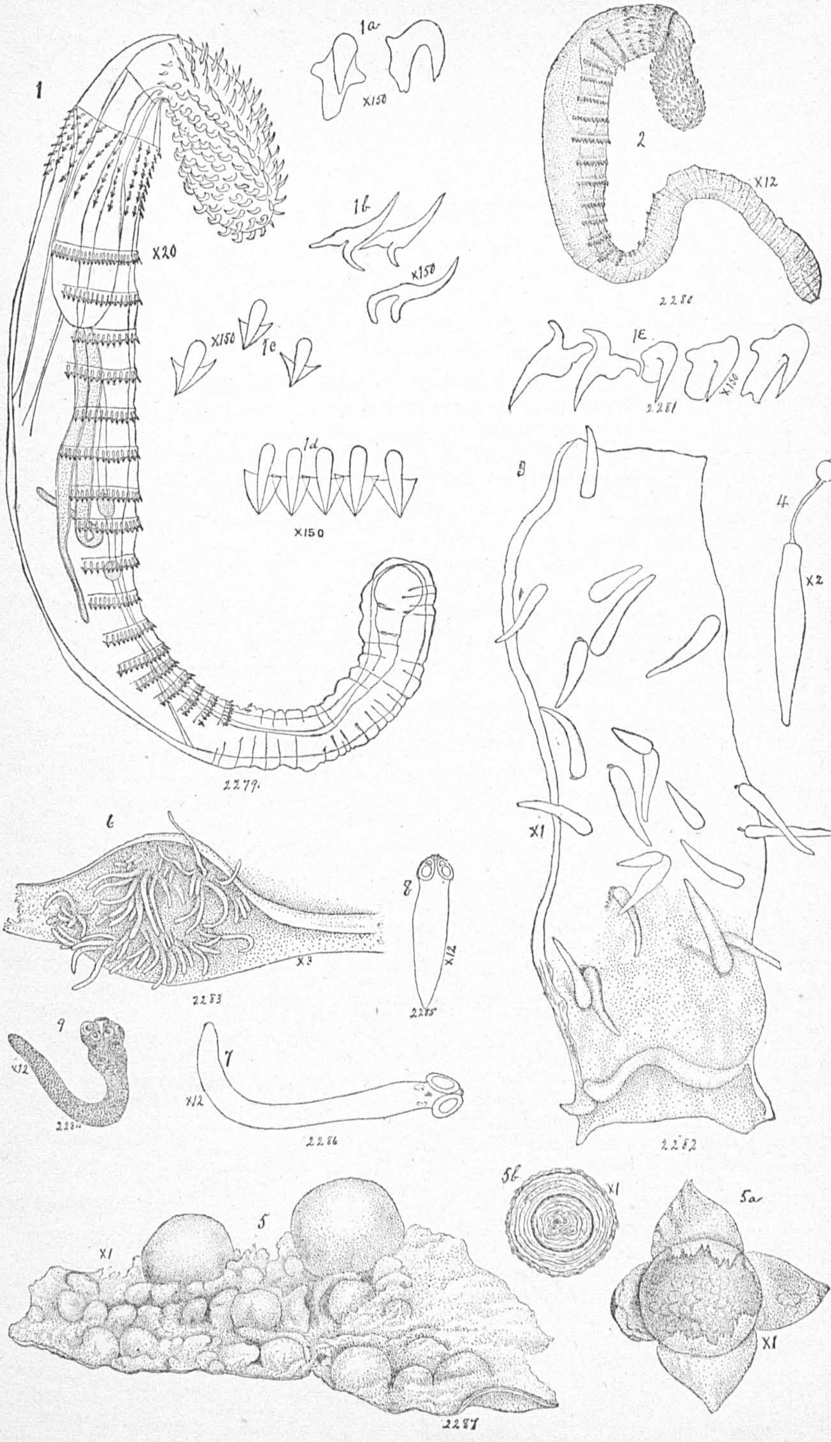
FIG. 6. Portion of cystic duct of *Cynoscion regale* with young *Tetrabothria* attached to mucous lining, enlarged 3 diameters.

FIG. 7. One of the specimens removed from its place of attachment, enlarged 12 diameters.

FIG. 8. A young *Tetrabothrium* from intestine of same host, enlarged 12 diameters.

FIG. 9. Another from same habitat, flattened under compressor, enlarged 12 diameters.

Figures 2, 3, 4, 6, 7, 8, and 9 from life; others from alcoholic or mounted specimens. All figures made by Mrs. Edwin Linton.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2280
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X150
2281
3
4
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X1
2282
6
X3
2283
8
X12
2285
9
X12
7
X12
2286
5
X1
2287
5b
X1
5a
X1

INDEX.

[NOTE.—The references are to page-figures in brackets.]

V.—REPORT ON THE MEDUSÆ COLLECTED BY THE U. S. FISH COMMISSION STEAMER ALBATROSS IN THE REGION OF THE GULF STREAM, IN 1885-'86.

By J. Walter Fewkes.

The following paper considers the Medusæ collected in the summers of the years 1885 and 1886 off the eastern coasts of the United States, in the region of the Gulf Stream. In this collection there are many genera which have already been described from this locality, and others which are believed to be new to science. Many belong to the so-called deep-sea fauna, and some, formerly supposed to be limited to great depths, are recorded by the collector from the surface waters.

Among Siphonophores, some of the most interesting are new specimens of the gigantic physophore, *Pterophysa*. One specimen in the collection of these animals reaches the great length of 23 feet in alcohol. Next to certain recorded specimens of the genus *Apolemia*, this is one of the largest Physophores yet described, and is the largest yet reported from the waters of the Gulf Stream contiguous to our coast. The new genus *Pleurophysa* is interesting in its relationship to the Rhizophysidæ, and the somewhat peculiar characters of the polypites. *Stomatoca periphylla* is recorded for the first time from the western waters of the Atlantic.

A new *Pegantha*, a genus which has never before been found in the Gulf Stream, is described. As more and more specimens of the interesting genus *Atolla*, ascribed by Hæckel to the deep-sea fauna, are collected, the number of specimens from the surface water is increased. In the present collection we have three more examples of this medusa from the surface. This fact would seem to indicate that the genus is not necessarily confined to the great depth at which it was collected by the Challenger.

Halicreas and *Solmaris incisa* are found in the collection, and new facts for the acceptance of the deductions made from previously known specimens recorded.

Ephyroides rotaformis is represented by several specimens.

A new Ctenophore, of the known genus *Callianira*, is recorded for the first time from the waters of the Gulf Stream.

As more and more is known of the medusan life of the Gulf Stream, we see how rich in new genera the waters of this current are, and what a good collecting locality it presents for a discovery of new genera, species, and even families of these pelagic organisms.

This paper, like those with a similar title which have preceded it, is preliminary to a final report on North American Hydrozoa, which the author has in preparation.

SIPHONOPHORA.

PNEUMATOPHORÆ.

Family RHIZOPHYSIDÆ.

PTEROPHYSA, Fewkes.

In the collection of 1883 a Siphonophore was recorded, to which, from the peculiar wings or ptera on the polypites, the name *Pterophysa* was given.

The stem of this specimen is very much twisted, and the float and other portions so contracted that it was impossible for me to make out the anatomy of any part except polypites. The wings of the polypites are, however, so exceptional, that it seemed justifiable to refer this specimen on this ground to a new genus.

Pterophysa differs from any Rhizophysid in this and certain other features of the anatomy, which are well marked in the new specimens recently collected. In the collection of 1883 a giant float was found, which, although at that time not recognized as belonging to *Pterophysa*, after study of new material is thought to belong to this genus.

Among the collections made by Mr. A. Agassiz, in the Blake, there is also a huge Siphonophore, which has ptera on the polypites, and seems to belong to the same genus. These are the physophores ("*Rhizophysa*") mentioned by A. Agassiz in a letter to the Superintendent of the Coast Survey.*

In the collections of the Albatross, in 1885, there are fresh specimens of *Pterophysa*, which throw light on some points in the anatomy of this curious Rhizophysid. The specimens are as follows:

	Catalogue number.	Station.
1	10435	2308
2	11685	2570

Of the new specimens, No. 1 is the best preserved and the largest. Both were found twisted on the dredge wire or rope. Neither of the

* Letter No. 3. *Bull. Mus. Comp. Zoöl.* Vol. V, No. 14, pp. 289–290.

specimens have the body complete, but from the fragments of both several common details can be made out. No. 1 is destitute of a float; No. 2 has the float well developed.

Pterophysa grandis, Fewkes.

[No. 1.]

The stem of this specimen is approximately 20 feet in length in alcohol. It is ribbon-shaped, about 3mm broad. Not twisted. Color in alcohol, white. No float present, but this structure is ruptured from its connection.

The terminal polypite is 40mm in length, elongated, finger-shaped, with dark color near its distal end. On the proximal third of its length it bears two well-marked lateral bands or ptera, which are placed opposite each other on the polypite. The terminal polypite arises from a point on the axis where the stem is somewhat thickened. The surface of the thickened stem is nodose, probably from contraction. A short fragment of a tentacle springs from its base of attachment to the stem. The stem narrows above the nodose enlargement, becomes again thickened as it recedes from the polypite, and then diminishes in size to the flat, ribbon-like shape of the stem.

The penultimate polypite is elongated, finger-like, 50mm in length, enlarged into a knob at the distal or oral end. In the proximal region, on each side, there are two marked ptera. The penultimate polypite is similar to the terminal, and arises from the stem by a long thread similar to but smaller than the peduncle. The filamentary union of the polypite to the stem arises from a tangled cluster of thread-like bodies on the stem. These bodies possibly correspond to the immature lateral branches of the tentacle.

Between the region of the stem from which the tangled lateral bodies arise and the other (opposite) end of the stem there are several polypites, all of which have similar filamentous attachments to the flat (in alcohol) axis, as the ultimate and penultimate. Many small clusters of sexual bodies, confined as a general thing to the flat axis, are noticed. These bodies have, like the sexual glands of *Rhizophysa*, the form of botryoidal clusters.

[No. 2.]

In this specimen a float and the proximal end of the axis are well preserved. The whole axis is 1.9m long.

The float is large, 15mm in length, and appears to be carried upright, as in *R. eysenhardtii*, Geg. It has an apical opening. This opening is surrounded by a zone of reddish pigment. From the pneumatophore hang digitiform appendages into the cavity of the pneumatocyst, as in the genus *Rhizophysa*. The walls of both pneumatocyst and pneumatophore are thin. At the base of the pneumatocyst the stem becomes thick and swollen, while lower down, more distally from the float, it tapers gradually and becomes flat, as in the first specimen. On the one side of the thickened region of the stem there arises a small cluster of flask-shaped bodies, in the form of elongated, digitiform structures, which may be undeveloped polypites. Below (more distally from the float) the latter structures we find a number of polypites, more or less thickened by contraction, which are arranged in clusters. No tentacles observed attached to them. Nine polypites (one broken in examination) were counted in the largest cluster.

The distal end of the stem now (distally from the float) diminishes in diameter, and a second cluster of flask-shaped bodies is seen. When this second cluster is closely examined it is found to be composed of four polypites, brought together by a contraction of the stem. These polypites have ptera, but no tentacles. The last of the second cluster of polypites, the most distant from the float of any yet considered, is 60^{mm} from the apex of the float. The stem, between the first and second clusters of polypites, is muscular, more or less folded and nodose by contraction. It sometimes shows an infolded groove on one side.

The diameter of the stem distally from the second cluster of polypites diminishes very considerably, and after the addition to the number of existing polypites of two more, we find a long bare interval of the axis.

In addition to the long fragment of *Pterophysa* in No. 2, there are two other fragments of large size, which seem to belong to the same animal. Both of these fragments have a nodose stem, which appears much twisted and contorted. The first fragment is about 250^{mm} long, and at one end is flat, and seems to be broken from the axis of the larger specimen in the same bottle. It is enlarged about midway in its length, and at one end bears a swollen nodose body, from which arises a polypite. This polypite has a tentacle, which arises from one side.*

If we compare this fragment and its polypite with the terminal polypite of the specimen already described (No. 2), we find a close resemblance in many particulars. A swollen nodose body is present in both. Tentacles exist in both. The fragment is therefore regarded a terminal polypite.

In another fragment of No. 2 we have a long undivided part, which bifurcates and becomes nodose at the free ends, while a botryoidal body, homologous with a sexual gland, arises from one of the bifurcations.

PTEROPHYSA, sp. incog.

In the collection made by Mr. Agassiz in the Caribbean Sea there are a few mutilated specimens of a *Pterophysa*, the polypites of which have

* It is possible that in my account of the polypites of *Pterophysa* collected by the Albatross in 1883, I have exaggerated the grasping power of the ptera of these organs. As I then stated, "It is difficult to determine definitely the function of the ptera and the peculiar structure of the polypites of *Pterophysa*, unless we study the animal alive."

a close likeness to the above, although I have not been able to satisfactorily study the other organs. These specimens, in one or two instances, are destitute of a float, but when that organ is present it has the same cluster of flask-shaped immature polypites below it as in *Pterophysa*. The polypites themselves have the lateral wings.

Specimens of Pterophysa collected by the Blake.

Station.	Locality.
205	Off Martinique.
110	Kingston, St. Vincent. (Lat., 20° 10′ 30″ N.; long., 74° 19′ 20″.)
108	Off Nuevitas.

gen. incog.

Among the Siphonophores collected by the Blake is one from St. Kitt's, which I have not been able to identify on account of its fragmentary nature. The fragments consist of large numbers of polypites. The stem, float, and other organs are wanting. One or both ends of the polypite has a very dark red or purple (red) color. There are no lateral ptera. The polypites are about 40^{mm} in length.

PLEUROPHYSA, gen. nov.

P. INSIGNIS, sp. nov.

Among the new Rhizophysidæ are many specimens of a genus which is different from any yet described, and which probably is a new genus as well as species. The specimens are very numerous and come from the following localities:

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
12100	2543	39 58 15	70 42 30
	2585		
	2584		

Pleurophysa is destitute of nectocalices and hydrophyllia. The axis is thick (in alcohol), and all the appendages arise from one side of the stem.

Float small, pyriform, pigmented at the apex, with thin walls. Just below the float there is a small cluster of stylated spherical bodies, which occupy the same position as the undeveloped nectocalices in other physophores.

The region of the stem below the cluster of stylated bodies is thickened, and bears on one side a row of knobs. These were at first thought to be the line of attachment of nectocalices. In a large number of specimens, however, no sign of a nectocalyx was discovered.

The distal end of the anterior stem (portion from which the knobs arise) is marked by a cluster of spherical or club-shaped bodies, which in some of the specimens have a reddish color even in alcohol. These botryoidal clusters resemble sexual bodies. The distal region of the stem from the cluster of bodies last mentioned is much longer than the anterior, and bears on one side a double row of flask-shaped bodies closely crowded together. These bodies are fimbriated on one side by small lateral appendages, and are thought to be polypites. No tentacles were observed, and no clusters of sexual bodies or immature tentacular knobs at the bases of the polypites. No clusters of sexual bodies on the axis between the union of the supposed polypites and the axis.

The polyp stem is spirally coiled in many of the specimens. No hydrophyllia. Tasters, unknown.

It must be said that the interpretation given to the different organs which has been given above is somewhat conjectural. Of the float, stem, and polypites there can be little doubt. It seems probable that the cluster of bodies which separate the anterior stem from the polyp stem are sexual bodies.

The nectocalices and hydrophyllia are easily ruptured from the stem, and their absence may simply be due to this fact. It seems strange that among so many specimens not even a fragment of these bodies is found, while in specimens of *Agalma*, collected by the same collectors, these gelatinous structures are well preserved. We shall, therefore, look with interest to a new collection of *Pleurophysa* and a study of better-preserved specimens for anatomical details, which this account necessarily leaves in great imperfection.

Family PHYSALIADÆ.

PHYSALIA ARETHUSA, Tilesius.

This physophore is one of the most commonly collected of all the siphonophores of the Gulf Stream. In the collections of 1885–'86 it is recorded from the following localities:

Catalogue number.	Station.	North latitude.			West longitude.		
		°	′	″	°	′	″
11637	2566	37	23	00	68	08	00
11639	2567	37	45	00	66	56	00
15233	2711	38	59	00	70	07	00
15255	2712	38	20	00	70	05	30
15754	2723	36	47	00	73	09	30
15755	2725	36	34	00	73	48	00
15762	2727	36	35	00	74	03	30

PHYSOPHORÆ.

Family AGALMIDÆ.

{ AGALMA OKENII, Esch.
{ CRYSTALLODES RIGIDUM, Hæck.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11838	Hyd. 743	41 15 30	64 23 00
11684	2569	39 26 00	68 03 30
11647	2570		
11676	2566	37 23 00	68 08 00
15264	2712	38 20 00	70 05 30

HIPPOPODIÆ.

Family HIPPOPODIDÆ.

GLEBA HIPPOPUS, Forskal.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11676	2566	37 23 00	68 08 00
11684	2569	39 26 00	68 03 30
12111	2566	37 23 00	68 08 00
11683	2566	37 23 00	68 08 00

DIPHYÆ (CALYCOPHORÆ).

Family ABYLAIDÆ.

ABYLA TRIGONA, Quoy & Gaimard.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11670	2566	37 23 00	68 08 00

This is the first mention of *A. trigona* from the Gulf Stream, although I have seen specimens from the Caribbean Sea.

A fragment of the posterior Nectocalyx.

Family DIPHYIDÆ.

EPIBULIA AURANTIACA, Vogt.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11836	Hyd. 753	40 18 30	53 39 30
12109	2543	39 58 15	70 42 30

DIPHYES, sp.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11836	Hyd. 753	40 18 30	53 39 30

MUGGIÆA, sp. ?

Among the Diphyid-like Medusæ are many specimens which have the anterior nectocalyx only. All of these I have placed in the genus *Muggiæa*, following Chun* in his limitation of the generic name *Muggiæa* to Diphyids with one nectocalyx, which resembles the anterior nectocalyx of the genus *Diphyes*. Our Atlantic species somewhat resembles *M. kochii*, but differs from it in several particulars. In the absence of more knowledge of the live animal, I will provisionally refer this to an unknown species of *Muggiæa*.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
15227	2711	38 59 00	70 07 00
15254	2715	38 29 30	70 54 30
15755	2725	36 34 00	73 48 00

*Ueber die cyclische Entwickelung und Verwandtschafts-Verhältnisse der Siphonophoren. *Sitzungsber. Akad. Wiss.*, LII, pp. 1155–1172. Berlin, 1882.

DISCOIDEA.

Family VELELLIDÆ.

VELELLA MUTICA, Bosc.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11644	Hyd. 753	40 18 30	53 39 30
15748	2727	36 35 00	74 03 30
15749	2723	36 47 00	73 09 30
15751	2727	36 35 00	74 03 30
15755	2725	36 34 00	73 48 00

Family PORPITIDÆ.

PORPITA LINNÆANA.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11640	2536	39 56 15	70 47 30
11641	2537	39 56 45	70 50 30
11642	2538	39 57 30	70 51 15
11643	2566	37 23 00	18 08 00

CRASPEDOTA.

Family ÆQUORIDÆ, Eschscholtz.

POLYCANNA, Hæckel.

It is very difficult to distinguish the genera and species of the above family, especially the American representatives.

A. Agassiz describes three species of *Zygodactyla* from our coast: *Z. grœnlandica* Ag., *Z. crassa* A. Ag., and *Z. cyanea*, A. Ag. Hæckel places *Z. grœnlandica*, *Z. crassa*, and *Cremastoma flava*, A. Ag., in the genus *Polycanna*, Hæckel, while *Z. cyanea* A. Ag. is referred to his genus *Mesonema* as *M. cyaneum*. According to A. Agassiz, the tentacles in *Z. grœnlandica*, *Z. crassa*, and *C. flava* are more numerous than the chymiferous tubes. This is true also, according to Hæckel, of *P. vitrina*, Hæck. In *P. germanica* and *P. italica*, Hæck., the tubes and tentacles correspond in number, while in *P. fungina*, Hæck., the radial tubes are more numerous than the tentacles. These characters form the three subgenera:

1. *Rhacostoma*. Radial tubes more numerous than tentacles.
2. *Cremastoma*. Radial tubes equal in number to the tentacles.

3. *Zygodactyla*. Tentacles more numerous than the radial tubes.

It is evident from what we know of the development of the Medusa (gonophore) of *Z. grœnlandica* (?) that the relative number of tentacles and radial tubes varies with age, and consequently the three subgenera are difficult to separate on this feature alone. There are specimens of *Polycanna* in the collection with characters of the first subgenus *Rhacostoma*, to which I have already given the name *P. americana*. It is believed that we have at least two species of *Polycanna* on our New England coast, and provisionally these may be known as *P. grœnlandica* and *P. americana*. The basis of the separation of the two is the existence in the former of rows of subumbral knobs between the chymiferous tubes and the absence of these knobs in the latter. It happens that in the latter the number of tentacles is less than the number of chymiferous tubes, while in the former, according to A. Agassiz, the number of tentacles is greater than that of the radial tubes.*

It seems to me that the presence or absence of the subumbral knobs is a much safer character to rely upon in the separation of our species of *Polycanna* than any which has yet been suggested. If new investigation shall show that true specimens of *grœnlandica* do not have subumbral knobs, our New England species is possibly new. From the fact that a supposed type specimen of *Polycanna*, labeled *Z. grœnlandica*, in the collection of the Museum of Comparative Zoology, has these tubercles, the name *grœnlandica* is retained for this species.

There is another *Zygodactyla*-like Medusa in which I have not been able to find these gelatinous knobs, either in a live animal or in alcoholic representatives. As this species also differs from the species *crassa* and *cyanea* in the relative number of tentacles and chymiferous tubes, it is supposed to be the new species, *americana*.

Unlike all other American *Zygodactylæ*, as described by A. Agassiz, this species has a smaller number of tentacles than of radial tubes, and at the same time none of the alcoholic specimens have subumbral tubercles. It is possible that the former feature indicates an immature Medusa, but not so the latter; for, as has been already shown, the subumbral tubercles are present in the Medusa when very small.

Specimens referred to *P. americana* were collected in the following localities:

Catalogue number.	Station.	North latitude.			West longitude.		
		°	′	″	°	′	″
11650	2563	39	18	30	71	23	30
11665	2567	37	45	00	66	56	00
11673	2566	37	23	00	68	08	00
11674	2563 ?	39	18	30	71	23	30
11677	2566	37	23	00	68	08	00
? 11649	2539	39	50	45	70	53	00

* The existence of radial subumbral knobs and a larger number of tentacles than radial tubes is supposed to characterize *grœnlandica*, although the knobs are not mentioned in A. Agassiz's description.

Polycanna americana,* Fewkes.

Of all the specimens of the species examined in the collection of 1885, No. 11674, station 2563, is the best preserved. A diagnosis of the species is made from this specimen.

Disk flat, with a slight apical protuberance. Roof of the stomach convex, thicker than the margin. Diameter of the roof of the stomach, 28mm. Diameter of the disk, 70mm. Stomach wide, lips open. The stomach wall is formed by papillate folds, the number of which is equal to the tubes. These tubes fall down below the velum. Numerous (107) chymiferous tubes, each of which bears a folded sexual gland, reaching from the vicinity of the stomach to the marginal vessel.

Tentacles, 29–32? in number, long, base inflated. Between each pair of tentacles there are five or more small protuberances on the bell margin. These are either otocysts or immature tentacles. No subumbral tubercles on the umbrella, between the chymiferous tubes.

Of the other recorded *Polycannæ*, *P. grœnlandica*, *P. flava*, and *P. crassa* have more tentacles than chymiferous tubes. No tubercles are recorded in *P. flava*. In an alcoholic specimen of *Zygodactyla*, with tubercles, now in the collection of the Museum of Comparative Zoology, the tentacles are missing. I cannot, therefore, say at present whether the specimens with tubercles have the same number of tentacles as tubes or not. If the *Zygodactyla*, with tubercles, last mentioned, has more tentacles than tubes it may be *grœnlandica;* if less, it is doubtful whether it is the same as the species (*grœnlandica*) which is recorded by A. Agassiz as possessed of more tentacles than tubes.

Family AMPHINEMIDÆ, Hæckel.

Stomatoca† periphylla, Hæckel.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
15220	2711	38 59 00	70 07 00
15253	2713	38 20 00	70 08 30

Two well-preserved specimens of this species were found by the Albatross in the summer of 1886.

We have in our waters two very beautiful genera of the family of Tiaridæ, with two opposite tentacles. One of these is the well known

*This species is supposed to be the same, or closely allied to the genus once called *Rhegmatodes*, now *Polycanna*. It is given the former name in the plates, the latter in the text of Hæckel's System der Medusen. The species falls in Hæckel's subgenus *Rhacostoma* (L. Agassiz, *sensu mutato*) and may be the same as *P. fungina*, Hæck.

† The spelling, *Stomatoca*, is adopted instead of *Stomotoca*, from the derivation στόμα (gen. στόματος) root στοματ.

S. apicata (*Amphinema apicatum*, Hæckel); the other, the *Dinematella*, Fewkes. Both of these have in the adult condition an apical prominence on the bell, which in the former is without internal cavity, and in the latter with a cavity. *Stomatoca periphylla*, Hæckel, is destitute of this prominence, is much larger, and the stomach is situated on an especial "Magenstiel." In this species the mouth lappets, stomach with sexual bodies, lie outside the bell cavity. The specimens agree substantially with Hæckel's description, except that the tentacular bulbs at the base of the tentacles are more swollen than he represents in his figure (Pl. iv, fig. 10, Das System der Medusen). It is probable from the studies of Hincks, Allman, and Hæckel that the young of this species has for its hydroid a genus related to or identical with *Perigonimus*. This notice is the first record of *S. periphylla*, from the Western Atlantic.

Family GERYONIDÆ, Eschscholtz.

LIRIOPE SCUTIGERA, McCr.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
15229	2711	38 59 00	70 07 00
15253	2713	38 20 00	70 08 30

Family CUNANTHIDÆ, Hæckel.

CUNINA ?

Among the Narcomedusæ there are a few specimens of a *Cunina*-like medusa which is temporarily referred to this genus. The specimen was so mutilated that it was impossible to tell whether it was a *Cunina* or a *Solmaris*, although from the character of the festoon canal and the existence of gastral pouches, it seems more closely allied to the former genus. It was not possible to see the gastral pouches, one of the main characters of the Cuninidæ, in several of the specimens, although they are well seen in one of the same.

Specimens examined.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
....	2585 *	....	....
11087	2569	39 26 00	68 03 30

The collar lobes of these specimens are girt by a horseshoe-shaped festoon canal, as in the Peganthidæ, but the bell is more flexible and not crossed by the radial elevations and depressions upon the exumbrella.*

Umbrella flat, discoid, with a ring of sexual bodies divided into as many lobes as tentacles and alternating with them. In each marginal lobe there is a genital sac, which is free from the wall of the lobes on the floor of the gastral pouches.

Tentacles numerous, 20 to 22 or more in number, springing from the sides of the body or the peripheral border of the umbrella. Tentacles longer than the diameter of the bell. The marginal collar is composed of as many lobes as there are tentacles, and each has a festoon canal. Peroniæ wanting. ?

The following notes were made from a specimen with 22 tentacles: Umbrella flat, lens-shaped or discoidal. Color, transparent, white in alcohol, flabby, gelatinous. Outer surface (exumbrella) smooth. The body divided into a central region and a peripheral collar.

Central region plano-convex or double convex. The greater convexity is below. Diameter in alcohol, 20^{mm}.

Upper surface flat. No coronal fossa or annular indentation at the rim near the origin of the tentacles.

The marginal collar is composed of twenty-two marginal lappets joined laterally by a thin membrane. The festoon canal broad, extending from tentacle to tentacle in well-marked horseshoe shaped-loops. No sense bodies were seen, on account of the poor preservation of the specimen.

The festoon canal seems to open on each side of the tentacle into the central stomach cavity. The edge of the marginal lappets is girt by a thin velum. The tentacles are long (longer than the diameter of the bell) and are inserted into the gelatinous substance of the bell by a conical root extending radially. No peronia and no marked marginal canal besides the festoon canal. Twenty-two gastral pouches. The stomach is a dish-shaped cavity bounded above by the under surface of the central region of the disk and below by the wall of the stomach. Well-marked gastral pouches. The mouth has a broad opening without protruding lips.

The sexual bodies lie in a ring on the peripheral region of the lower stomach walls in the gastral pouches. In the specimen with twenty-two tentacles these organs were not seen.

In other and larger specimens in which, however, in one instance at least, there are not as many tentacles, the sexual bodies take the form of sacs hanging in the lower wall of the stomach between the radii of the tentacles. In one case these glands are very much inflated; in another they have the form of a simple band. Of the species of *Cunina*

* The species of *Cunina*, *C. discoides*, may eventually turn out to be one of the Atlantic species of *Solmaris*. It may be the young of *S. coronantha*, Hæckel.

from the Atlantic,* *C. campanulata*, Esch. has ten gastral pouches, *C. oligotis*, Hæckel, has sixteen. Of Mediterranean *Cuninæ*, *C. vitrea*, Gegenbaur, has ten to twelve gastral pouches; *C. lativentris*, Gegenbaur, the same number; and *C. prolifera*, Gegenbaur, sixteen. *C. rhododactyla*, Hæckel, has ten to fifteen gastral pouches, and *C. rubiginosa* ten to twelve. A species from the Pacific Ocean, *C. mucilaginosa*, Blain., and one from the Indian Ocean, *C. multifida*, Hæckel, have respectively twenty to twenty-four and thirty-two stomach pouches. These latter, however, appear to differ from my *Cunina* in the length of the tentacles and other structural details. Our specimens therefore may be looked upon either as of a new species or more mature adults of species already described.

These specimens were at first referred to *Solmissus* in a provisional examination of them. The structures which I have interpreted as the festoon canals would throw them out of the genus *Solmissus*. *S. faberi* Hæckel, has twenty-four gastral pouches, and *S. bleekii* thirty-two.

Subfamily TAMOYIDÆ, Hæckel.

CARYBDEA (TAMOYA) HAPLONEMA, F. Müller.

Specimens of this medusa were taken at the following localities:

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11679	2566	37 23 00	68 08 00
11686	2566	37 23 00	68 08 00

Claus † considers *Tamoya* the old genus, *Carybdea*, Peron et Leseuer. Hæckel ‡ describes a medusa, which the above specimens closely resemble as *Carybdea pyramis*, Hæckel. The latter author separates *Carybdea* from *Tamoya*. My specimens resemble more closely his *Carybdea* than *Tamoya*. They are larger than *C. pyramis* and smaller than *T. haplonema*. If the two genera are separated our medusæ more closely resembles *Carybdea*, but I have followed Claus in regarding them as the same. This medusa appears to be the same as that which is mentioned as *Tamoya* in the collection of 1883-'84. §

* *Cunina discoides*, Fewkes, was probably described from an immature specimen. No gastral pouches were observed, and it is therefore probable that it belongs to the Solmaridæ. It is possibly the young of *Solmaris coronantha*, Hæckel.

† Ueber *Carybdea marsupialis*. *Arbeit. Zool. Inst. Wien.*, I Heft., 1878.

‡ Das System der Medusen, pp. 440, 443.

§ *Cf.* Report on Albatross Medusæ for 1883-'84. *Ann. Rept. Com. Fish and Fisheries*, 1884, p. 951.

Family HALICREASIDÆ, Fewkes.

HALICREAS MINIMUM, Fewkes.

Specimens of *Halicreas* were taken from the following locality:

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
15244	2719	38 29 30	71 58 00
15750	2728	36 30 00	74 03 30

This genus is recognized by the eight tuberculated projections on the exumbral margin of the bell. From these projections there extend to the vicinity of the center of the bell eight ribs or radial depressions, which appear on the subumbral surface as radial depressions between which the octants of the subumbrella are somewhat swollen. Near the center of the subumbrella is a ring of eight knobs which lie one in each octant between the above-mentioned depressions.

There is a well marked vellum below the marginal projections. The radial projections appear as elevations on the exumbral side of the bell in alcoholic specimens.

In my former paper* I referred this genus to the Narcomedusæ of Hæckel. There is no reason from a study of new material to change that opinion of the affinities of the family of Halicreasidæ.

Family PEGANTHIDÆ, Hæckel.

Among the families of Narcomedusæ described by Hæckel is the Peganthidæ, a family without radial canals and gastric pouches in the subumbrella but with a festoon canal. The sexual bodies are either lobed or form a non-continuous band on the under floor of the stomach.

Among the medusæ collected by the Albatross is one which has a close likeness to the genus *Pegantha* of the Peganthidæ but which differs from the known species of this genus so widely that it may be necessary later to call it a new species.

This *Pegantha* somewhat resembles *P. quadriloba*, although the genital sacs are not as markedly four-lobed as Hæckel's description of this species would seem to indicate. It has marked lobes in the sexual glands, but the poor condition of preservation and the rupture in one or two instances of the gland from its attachment rendered it impossible for me to tell to what species this *Pegantha* belongs.

* *Bull. Mus. Comp. Zool.*, ix, 8, p. 306. In one of the two specimens of *Halicreas* there described, sausage-shaped sexual bodies were observed hanging from the underside of the bell. In one of the above specimens (15750) glandular bodies were observed in the subumbral radial furrows.

PEGANTHA, sp.

[Plate 1.]

The sexual bodies divided into a number of separate sacs pendant from the abaxial lower wall of the stomach. The sexual glands do not enter the umbrella lobes but alternate with the attachments of the tentacles, which they equal in number. No coronal fossa.*

Specimen examined.

Catalogue number.	Station.	North latitude.	West longitude.
11654	2559	° ′ ″ 39 48 00	° ′ ″ 71 48 30

Bell, crown-shaped, twice as broad as high, with stiff gelatinous walls. The bell is thick, biconvex, firm. The marginal lobes folded inward on the oral side so that they are with difficulty bent back to normal position without rupture. Exumbrella crossed by strongly-marked, prominent radial ridges, separated by radial furrows. These ridges and furrows arise from the center of the exumbrella in the radii of the marginal lappets and divide, sending off lateral branches which pass into the marginal lappets.

The collar of the umbrella, or the peripheral portion of the bell, is made up of thirteen horseshoe-shaped marginal lobes with festoon canals. These lobes are connected by a thin membrane which unites contiguous lobes and skirts their borders. The specimen was not well enough preserved to observe the sense-bodies.

The subumbrella is divided into two regions, one corresponding with the central disk and marked by the lower stomach wall; the other with the collar region formed by the horseshoe lappets. The mouth opening is simple. The lower stomach wall thick, well marked. The sexual sacs form a number of pouches upon the outer rim of the lower stomach wall. They appear as folds or separated sacs, the exact number of which could not be determined in the single specimen studied. There are thirteen sexual glands, each of which lies in an internemal radius. An open niche is formed in each marginal lappet, as described by Hæckel, in which the sexual organs are forced when the medusa bends inward the lobes of the collar. There are thirteen tentacles, each of which arises in the incisions formed by the horse-shoe-shaped festoon canal. They are long and slender, apparently hollow, and have the same color as the bell.

* The surface of the exumbrella is continuous and without division between the disk part of the umbrella and the marginal lobes. *P. pantheon*, which this species in some respects closely resembles, has a "deep horizontal coronal fossa."

Family SOLMARIDÆ, Hæckel.

SOLMARIS INCISA, Fewkes.

Catalogue number.	Station.	North latitude.	West longitude.
11667	2429	° ′ ″ 42 55 30	° ′ ″ 50 51 00

Several large specimens of this giant Narcomedusa occur in the collections; in one of these the form of the bell is unmutilated and the subumbral elevations and depressions well shown. The velarium is undivided into marginal lappets, showing that my conjecture of the non-existence of separate lappets in the jelly-fish is borne out by a study of fresh material. There are in the largest specimen (entire) thirty subumbral depressions. There are thirty tentacles and the same number of peroniæ. No festoon canal.

Many of the "marginal lappets" in other specimens are united, indicating, as already suggested, the existence of connections along the peroniæ, which are split in most of the specimens studied. The velarium is formed by a union of all the marginal lappets, and recalls that of other Solmaridæ.

The feature upon which the species is built is the radial grooves on the under side of the umbrella, as already elsewhere described. These "radial-furchen" resemble structures in *Cunina campanulata*, where, according to Hæckel, they are on the "untere magenwand." In *S. incisa* these furrows are on the upper wall of the stomach or the under wall of the disk.

A new examination of *S. incisa* to determine, if possible, whether I might not be mistaken in my identification, and whether my specimen does not belong to *C. campanulata* has convinced me that my specimens have no festoon canals, and differ in many other ways from *Cunina*. *S. incisa* is more disk-like than campanulate, is larger than *Campanulata* and has more tentacles. Instead of gastral pouches in the pernemal radii there are prominent umbral elevations. The furrows are internemal. In one specimen the edges of the gastral furrows were lined with a white structure which may be the remnants of the attachment of the ovaries. The species differs so greatly from other *Solmares* that it may probably be found to be a new genus.

This animal is a giant among the Narcomedusæ. The only genus of the group which approaches it in size is *Polyxenia*, of which *P. cyanostylis*, Esch., according to Eschscholtz is 80^{mm} in diameter. According to Hæckel a species found by him was one-third smaller than that of

Eschscholtz. The largest of the other genera of Narcomedusæ are 50mm in diameter, one-half the size of large specimens of *S. incisa.*

In all specimens of *S. incisa* found, the under wall of a stomach is supposed to be ruptured and absent. The liability of this to occur in Solmaridæ has led me to suppose the same thing possible in my new species.

ACRASPEDA.

Family COLLASPIDÆ, Hæckel.

ATOLLA BAIRDII, Fewkes.

No.	Catalogue number.	Station.	North latitude.	West longitude.	Depth.
			° ′ ″	° ′ ″	*Fathoms.*
3	11663	2428	42 46 00	50 55 30	826
4	15756	2732	37 27 00	73 33 00	1152

No.	Tentacles.	Marginal lappets.	Sense bodies.	Diameter of central disk.	Breadth of corona.
				mm.	*mm.*
3	23	46	23	40	18
4	22	44	22	40	18

ATOLLA VERRILLII, Fewkes.

No.	Catalogue number.	Station.	North latitude.	West longitude.	Depth.	Number of specimens.
			° ′ ″	° ′ ″		
9	11672	2569	39 26 00	68 3 30	1872	1
10, 11, 12	15236	2717	38 24 00	71 13 00	Surface.	3

No.	Tentacles.	Marginal lappets.	Sense bodies.
9	26	52	26
10	28	56	28
11	28	56	28
12	22	44	22

The two species of American *Atollæ*, *A. bairdii* and *A. verrillii*, can be readily distinguished by the size of the marginal sense bodies, which in the latter are larger, longer, and narrower than in the former. The number of tentacles in *bairdii* is generally twenty-two, while in *verrillii* we find several specimens with twenty-eight. Why Hæckel has assigned from sixteen to thirty-two tentacles to the Collaspidæ does not appear from what we already know of the genera (*Collaspis* and *Atolla*) which compose the family. The least number of tentacles observed in any of my *Atollæ* is twenty-two. Hæckel records an *Atolla* with nineteen tentacles. The greatest number of tentacles observed in any *Atolla* is twenty-eight in my species *verrillii*. It is not denied that it is possible that *Atollæ* with less than nineteen or more than twenty-eight tentacles may be later observed, but until these are found it is well to include the limits in the number observed (nineteen, *teste* Hæckel), twenty-two to twenty-eight.

The deepest limit in the ocean at which *Atolla* has been recorded is 2,369 fathoms. Many specimens are recorded from the surface. *Atolla* has been found by the Albatross within the following geographical limits: Lat. 38° 19′ 26″ to 42° 46′, long. 50° 55′ 30″ to 71° 58′. The Albatross has collected thirteen specimens of the genus.

The genus *Collaspis*, Hæck., of which several drawings are published by Hæckel (System der Medusen, Pl. xxviii), was collected "by Smith" between Kerguelen and Crozet Islands in "about 1,000 fathoms," according to Hæckel. The expedition upon which this specimen was collected is not mentioned, but the great depth from which it is said to have been taken excites more than usual interest in it. Very few, if any, other hauls besides those of the Challenger have been made at this depth in this remote locality, and this seems to be the only medusa ascribed to "Smith" from this locality. Hæckel's description of *Collaspis* was made from a very much mutilated specimen, which he reconstructed from his knowledge of *Atolla*, and allowed a drawing of the medusa thus reconstructed to be published. On account of what might be regarded as suspicious circumstances, under which Hæckel's description of *Collaspis* was made, the genus is not recognized.

According to Filhol (La Vie au Fond des Mers, p. 244) *Atolla* is found "dans l'Atlantique sud et dans l'Atlantique nord au niveau du canal des Faröer." The species of the *Atolla*, from the latter locality, is not mentioned by Filhol, and it is probably the same as one of mine, *A. bairdii* or *A. verrillii*.

The increase in number of specimens from the surface would indicate that *Atolla* is found on the surface of the ocean as well as at great depths. The data for this statement are those of the collector. I have already discussed the limitations which necessarily exist to a rigid acceptance of the recorded depths ascribed to this and other so-called deep-sea medusæ.

Family PERIPHYLLIDÆ, Hæckel.

PERIPHYLLA HYACINTHINA,* Steen.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11651	2427	42 46 00	51 00 00
11655	2565	38 10 20	69 02 30
11662	2429	42 55 30	50 51 00
15750	2728	36 30 00	74 33 00
15756	2732	37 27 00	73 33 00

Family EPHYRIDÆ, Hæckel.

EPHYROIDES ROTAFORMIS, Fewkes.

Several more specimens of this remarkable genus and species were collected by the Albatross in 1886. Although all were in good condition as far as the bell and subumbral radial elevations are concerned, the finer anatomy could not be made out.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
15236	2717	38 24 00	71 13 00
15249	2719	38 29 30	71 58 00
15256	2717	38 24 00	71 13 00
15266	2712	38 20 00	70 05 30

Ephyroides is characterized as follows: On the subumbral surface of a thick umbrella there are radial elevations (in one specimen 32 in number) which alternate with the marginal lappets. These elevations are half cylindrical, sausage-shaped, radially situated, extending from the margin of the umbrella at its junction with the marginal lappets towards the center of the bell. They resemble on the subumbral side of the umbrella the socles of the exumbral side, and lie in the radii be-

* This species is common as far north as Greenland. The allied genus *Nauphanta* somewhat resembles the young *Periphylla*, but has eight sense bodies and eight tentacles. It remains yet to be seen whether the young *Periphylla* has the same number of tentacles and sense bodies as the adult. If it has eight tentacles instead of twelve it may be readily conjectured that *Nauphanta* is a young *Periphylla*, and that immature tentacles have been mistaken for sense bodies.

I have elsewhere recorded a *Nauphanta*, *N. polaris*, Fewk., from Lady Franklin Bay, North Greenland.

There seems to be a relationship between the cold waters of great depths of the sea and those of the cold waters of the Arctic Ocean. Temperature would seem to play an important part in the relationship of medusæ from these two localities.

tween those which pass through the middle line of each marginal lappet. The best preserved of all the specimens is from Station 2717. In this specimen the stumps of certain of the tentacles are present. They lie, as stated above, on the notches between the marginal lappets. The form of the abaxial rim of the marginal lappets in this specimen is bifid, recalling the appearance in the marginal lappets of *Atolla*. The exumbral surface of the marginal lappet is rough, with slight projections. Its rim is thin, the attachment and body of the lappet thick and gelatinous. The whole marginal lappet recalls those of the species *verrillii* of the genus *Atolla*. No sense bodies were seen in the alcoholic material at my control.

It is desirable that the live medusa of *Ephyroides* be studied, as the features presented by the alcoholic material are of great morphological interest. It has not seemed to me best to say anything about these questions until more is known of the anatomy of the extraordinary genus.

Family CYANEIDÆ, L. Agassiz.

CYANEA, sp.

A specimen of *Cyanea* from the Gulf Stream differs in certain respects from the *Cyanea arctica*, Per. et L., of the New England coast. It also differs from other species of this genus which have been described. With the imperfect knowledge derived from a single specimen, I hesitate to introduce a new name into the nomenclature of this genus, although there is little doubt that the specimen referred to is not the common *C. arctica*.*

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11668	2542	40 00 15	70 42 20
11669	2542	40 00 15	70 42 20

A much larger specimen than either of those mentioned above was collected in 1879, Station 378, No. 5124, off Cape Cod. This specimen resembles more closely than the others the common *C. arctica*, Per. et Les., but the mouth appendage and tentacles are missing. The forms of the marginal lappets are like those of *C. arctica*.

* One of the main differences between this *Cyanea* and *C. arctica* is found in the incisions in the marginal lappets. There are in the unknown *Cyanea* eight deep ocular incisions, eight shallower tentacular incisions, and the margin of the bell between each occular and tentacular incision is again incised. There are therefore 32 marginal lappets.

Family PELAGIDÆ, Gegenbaur.

PELAGIA CYANELLA, P. and Les.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11678	2566	37 23 00	68 08 00
11656	....		
11688	2569	39 26 00	68 03 30
....	2566	37 23 00	68 08 00
11680	2566	37 23 00	68 08 00
(6) 15225	2711	38 59 00	70 07 00
15226	2711	38 59 00	70 07 00
15236	2717	38 24 00	71 13 00
15237	2715	38 29 30	70 54 13
15239	2716	38 29 30	70 57 00
(2) 15240	2716	38 29 30	70 57 00
15245	2711–22	38° 20′–39° 13′	70° 5′ 30″–72° 12′
15765	2724	36 47 00	73 25 00
15760	2724	36 47 00	73 25 00
15757	2724	36 47 00	73 25 00
15763	2724	36 47 00	73 25 00
15762	2727	36 35 00	74 03 30
15752	2730	36 42 00	74 30 00
15758	2735	37 23 00	73 53 00
15759	2731	36 45 00	74 28 30
15761	2731	36 45 00	74 28 30
15764	2731	36 45 00	74 28 30.
15747	2731	36 45 00	74 28 30

CTENOPHORA.

BEROË OVATA? Br.

Catalogue number.	Station.	North latitude.	West longitude.
		° ′ ″	° ′ ″
11658	2563	39 18 30	71 23 30
11659	2542	40 00 15	70 42 20
11842	2563	39 18 30	71 23 30
....	2575	41 07 00	65 26 30

CALLIANIRA, sp.?

Station 2585.

This is the first record of this genus from the Gulf Stream.

CAMBRIDGE, MASS., *May* 27, 1887.

EXPLANATION OF THE PLATE.

PEGANTHA, *sp. incog.*

FIG. 1. View of Pegantha from the side.
FIG. 2. View of Pegantha from aboral region.

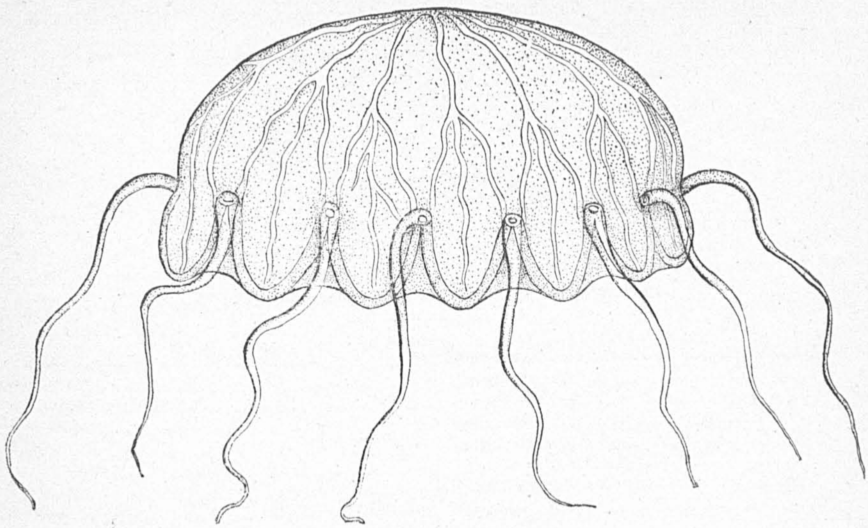

Fig. 1.

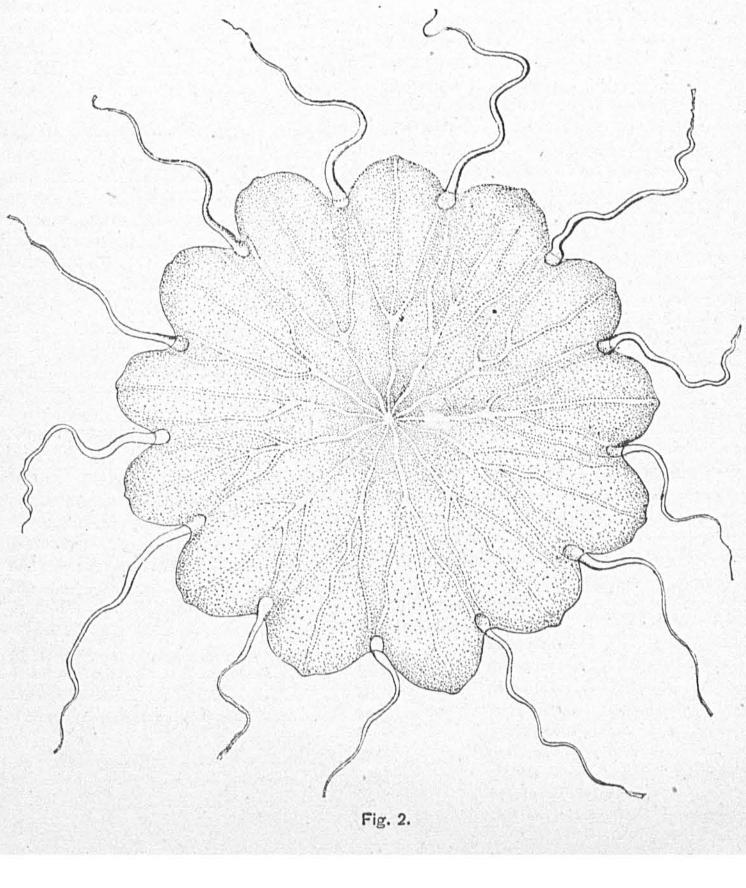

Fig. 2.

INDEX.

[NOTE.—The references are to page-figures in brackets.]

APPENDIX C.

FISH CULTURE.

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VI.—ON THE FISH-CULTURAL ESTABLISHMENTS OF CENTRAL EUROPE.*

By Dr. Eugenio Bettoni and Dr. Decio Vinciguerra.

A.—NOTES ON FISH-CULTURAL ESTABLISHMENTS VISITED BY DR. BETTONI.

List of the establishments visited.

Location of establishment.	Character of establishment.	Name of director.	When founded.
Switzerland:			
Zurich, Canton of Zurich	Cantonal	Dr. Asper	1882
Dachsen, Canton of Zurich	do	Maendli and Dr. Asper.	1875
Neuhausen, Canton of Schaffhausen.	do	Moser-Ott	1877
Germany:			
Hüningen, Alsace	Governmental	H. Haack	1854
Selzenhof, Baden	Owner, Mr. Schuster	C. Schuster	1872
Radolfszell, Baden	do	Dietrich	1877
Seewiese, Bavaria	Owner, Mr. Zenk	M. Hartmann	1881
Cosmandorf, Bavaria	Owner, Mr. Mittag	Mittag	1880
Wilthen, Saxony	The Catholic Church at Bautzen.	Teubner	1880
Lübbinchen, Prussia	Owner, Mr. Eckardt	R. Eckardt	1808
Berneuchen, Prussia	Owner, M. v. d. Borne	Max von dem Borne	1877
Michaelstein, Brunswick	Governmental	Wegener	1881
Netherlands:			
Velp	Joint stock company	Bontjes	1871
Apeldoorn	Owner, Mr. Nordoek-Hegt.	Nordoek-Hegt	1880

I.—Salmon and Trout Culture.

The water in general.—In consulting various treatises on the subject I have found that, in founding a fish-cultural establishment, it is necessary to take into account the origin of the water to be employed, so that it may be used for that branch of fish-culture to which it is best adapted. In fact the water of springs, brooks, and rivers may all be employed in the incubation and raising of salmonoids, provided, of

* *Sugli Stabilimenti di Piscicoltura visitati all'estero dal Novembro, 1884, all'Aprile, 1885.*" From *Annali di Agricoltura*, Rome, 1885. Translated from the Italian by Herman Jacobson.

course, that it meets all the necessary requirements of purity, nutritive substances, sufficient aeration, and suitable temperature.

Spring water, which does not contain mineral substances, is to be specially recommended for hatching, provided it is not so warm as to exceed 10° C. [50° Fahr.]; as owing to its even temperature it appears cool in summer and warm in winter.

On the other hand, brook water commends itself, because generally it is easy to obtain, and contains a good deal of air, in which latter respect it is excelled by river water, which is well adapted to the purpose, if it does not carry too much mud. In northern countries, however, this water is apt to freeze.

In view of the above it will not seem strange that the first request which I made of the directors of the establishments visited by me was to inform me in relation to the quality of the water employed by them. I have below tabulated their statements regarding the quality and temperature of the water employed in their hatcheries.

Establishments in which only spring water is used, which rises in close proximity to the hatching chambers.

Establishments.	Number of springs and their course.	Temperature. In winter. °C.	Temperature. In winter. °F.	Temperature. In summer. °C.	Temperature. In summer. °F.
Dachsen	Two springs, close to the hatching chamber	8	46	10	50
Neuhausen	One spring, at a distance of about 500 feet from the hatching chamber, and led to it by underground pipes.	9	48	10	50

Establishments in which spring water, brook water, or river water, either each by itself or mixed, is used.

Establishments.	Number of springs and their course.	In winter. °C.	In winter. °F.	In summer. °C.	In summer. °F.
Hüningen	Several springs which rise in the extreme southwest of the territory occupied by the establishment; a portion of their water being led to the hatcheries through pipes, 2,050 feet long.	10	50	*10	50
	Rhine water from a canal connecting the Rhone and the Rhine, led into the inclosure, and brought into the hatching houses by means of turbines.	Varying.		Varying.	
Selzenhof	A spring at a short distance	8	46	12.5	55
	Water from a brook which rises at the distance of half an hour.	2.5–8	37–46	12–15	54–59
Seewiese	Several springs rising within the inclosure of the establishment.	8	48	8?	46?
	Water from the brook called "Fischbach," a tributary of the river Saale.	.....	.....	.....	.....
	A mixture of the two waters	11	52	11	52

*In the official report, "*Notice historique sur l'Etablissement de Huningue*," Strasburg, 1862, it is stated that the temperature of the springs is even, but during the winter 1884–'85 very noticeable variations of temperature were observed. The only mention made of such variations in said report is that of 1856, during the winter of which year the temperature fell to zero.

Establishments supplied from springs led to the hatching house through long open courses, or through ponds and canals.

		°C.	°F.	°C.	°F.
Wilthen	A spring rising at the distance of one kilometer [about 1094 yards], led into a basin, and thence to the hatching chamber.	0-2	32-36	High.	
Lübbinchen	Three springs, one of which rises close to the village, and the others at a distance of one kilometer, whose waters, after being united, are, through a canal of 650 feet, led into a pond, whence through another canal of half a kilometer they are led into the hatching chambers.	0-10	32-50	20-25	68-77
Michaelstein	Distant springs furnish water to some ponds, from one of which the water is led to the hatching chamber.	0-0.5	32-33	High.	
Velp	A spring at a distance of three-quarters of an hour; the water is led through open canals to a small pond in view of the establishment.	0-1	32-34	20	68
Apeldoorn	It is doubtful whether the water comes from a spring, as its quantity is truly exceptional (10,000 cubic meters [about 350,000 cu. feet] per day); it comes a distance of three kilometers [nearly 2 miles] in open canals.	2-3	36-37	11	52

Establishments which use other water.

		°C.	°F.	°C.	°F.
Radolfszell	Drinking water of the country	1	34	10	50
Zurich	Drinking water of the city, drawn from the lake.	4	39	21.5?	71?
Cosmandorf	Mill canals coming from the river Rothe	1.5-8	35-46	19	66
Berneuchen	Mill canals coming from the river Mietzel	0-3	32-37	25	77

Temperature of the water favorable to hatching.—It is at present almost impossible to say which of the various temperatures under the influence of which the hatching process is accomplished is absolutely preferable; but in general it may be stated that, in the cold of winter, a temperature which does not rise much above 10° C. [50° F.] is favorable for salmonoids; nevertheless there are facts to show that salmonoids have been successfully hatched both at a much lower and at a much higher temperature (at Torbole in water of 11° C. [51.8° F.], and at Garda in water of 14° C. [57.2° F.]). But it is certain that the development of the embryo succeeds better if the hatching water has an even temperature than if it exceeds certain limits of heat or cold; and this condition is more generally found in spring water than in other water. It should be understood, however, that favorable conditions of temperature may also be found in other than spring water; and if these conditions do not exist, we have seen fish-culturists endeavor to obtain them by mixing waters of different origin, as is done or can be done at Hüningen, Selzenhof, and Seewiese; or by having recourse to a stove, which in several places I have seen in the hatching rooms, as an indispensable article of furniture. The objection might be raised that the mixing of spring water with other water, or the substitution of other water, the placing of the hatching chambers in the ground, as is done in some northern countries, and the stoves, have no other object than to ward off the dangers of freezing; but we may be allowed to suspect that practice employs all these means in order to obtain or to approximate that evenness of temperature which otherwise could not be obtained.

As it is necessary, therefore, to know whether sudden changes of temperature during the hatching period can be averted and whether they are hurtful, and to find out what are the final consequences of accelerated and of retarded hatching* on the life of the young fish which have been hatched from eggs treated in different ways, it follows that fish-culture is, strictly speaking, experimental. The answers of theoretical fish-culture on these points cannot be entirely evasive and categorical. Meanwhile, however, by carefully interpreting all that practice teaches, and by applying physiological analogies, we find that the changes from a relatively high to a relatively low temperature are to be feared, while there is not so much danger in changes from a low to a high temperature, because if there is a certain given degree of warmth care can be taken to maintain it.

Fish-culturists distrust hatching at a relatively high temperature, not because they think that it may unfavorably affect the development of the embryo, but because, as Max von dem Borne states, the young fish which have been hatched before their proper time are in need of food earlier than they would have been otherwise, and nature, still wrapped in its winter sleep, may not yet be able to furnish the food.

Hermann Haack also verbally stated the same, relative to hatching accelerated by comparatively too hot water, as, in his opinion, the young fish hatched too soon and placed in a lake immediately after the absorption of the umbilical sac, would miss the food furnished by the eggs of insects which can not be obtained until mild weather sets in. In view of this circumstance, he is inclined to prefer slow hatching in river water, which is generally colder in spring than spring water, or in brook water coming from springs, which, however, during a long course has had time to lose some of its original warmth. It appears to me, however, that Mr. Haack's suggestion does not yet furnish a complete remedy. He proposes to plant the young fish later, which may become possible by feeding them for some time artificially in the same water in which they have been hatched.

But is it really true that young fish placed in a lake too early must necessarily die? Fish, like most other animals having blood of a variable temperature, can, as is well known, remain without food for a long time; but we desire to know, as regards salmonoids, and for purposes of fish-culture, which are the extreme limits of the period of fasting which the young fish can reach, and whether this will not more or less exercise an influence on their bodily development, on their health, and on the condition of their offspring. And this is a question which can only be solved by experimenting.

Filtration of the water.—It is well known that water conducted in open canals through a country covered with vegetation carries with it leaves and other vegetable matter, which has either fallen into it or

* According to Ainsworth's observations the duration of hatching varies with the salmon from 1 to ½, at a temperature varying from 2.5° to 12.5° C. [36.5° to 54.5° F.].

which has been brought there by winds and showers; it is therefore a common practice to keep these objects out of the water by means of gratings and chains, or similar contrivances, even in cases where the water is not to be used for such delicate objects as the hatching of fish. But water invariably contains other particles, principally belonging to the mineral kingdom, which remain floating, as their weight is very light, and which are sometimes so diminutive that they can not be discerned with the naked eye, the water being to all appearances perfectly clear; and it is these particles which, if allowed to remain in the water for any length of time, cover any objects submerged in it with a sediment.

The best authors on the subject of fish-culture state that this sediment is injurious to the eggs of fish. Max von dem Borne does not hesitate to say that, next to mold, this sediment is the most dangerous enemy of fish; and Benecke, not satisfied to call attention to the dangers of this sediment, accurately describes the means by which it can be removed, and states that even the clearest water will always contain some of it.* Hence filters are used, which I do not deem it necessary to describe here, as they are well known, and have been described in many treatises on the subject, the object of which filters being to remove by mechanical means many of the small impurities, sediment, and diminutive animals. Prof. P. Pavesi also attributes the mortality which several times made sad ravages in the hatching-houses of the fish-cultural establishment of Torbole to the lack of filtration.†

The theoretical knowledge which I possessed, and the practical knowledge derived from experiments made at Torbole and Garda, caused me to start on my trip to foreign countries with the firm expectation that I would find filters universally adopted. But my surprise was great to find their use not near so general as I had supposed, and that they were entirely wanting even in establishments where the quantity of sediment had for a long time formed the cause of serious complaints, as, for instance, at Hüningen. In consulting the historical notice of this establishment I found that the turbid character of the water of the Rhine was deplored, and the wish expressed (in 1862) that filtering apparatus might be introduced, which was entirely wanting; and that then, as now, the water from some neighboring ponds was used for the hatcheries, because the Rhine water contained so much sediment.

In only five of the fourteen fish-cultural establishments which I visited did I see filtration properly practiced, namely, at Seewiese, Berneuchen, Wilthen, Michaelstein, and Velp, and a rudimentary filtration at Dachsen and Selzenhof. At Zurich the water of the lake is led into reservoirs for public use, and is sufficiently filtered for that pur-

* B. Benecke: *Fische, Fischerei und Fischzucht in Ost- und West-Preussen*, Königsberg, 1881, p. 459.

† P. Pavesi: *Esposizione Internazionale di pesca a Berlino*, Roma, 1882, p. 105.

pose; but the process of filtering should be repeated near the fish-cultural establishment.

Mr. Haack justifies the absence of filtering apparatus by saying that practice has shown the sediment to be harmless, and I can state from personal observation that fish eggs have been successfully hatched at Hüningen even in hatching-boxes and in California apparatus, supplied with water directly from ditches without any grating at the entrance.

At Max von dem Borne's establishment I saw in operation the filter with several chambers, terminating with the so-called American filter (of flannel), but in answer to my inquiries he stated that for filtration there might be substituted the washing of the eggs by letting water fall on them from a certain height from the pierced spout of a simple watering-can. This proves at any rate that this eminent fish-culturist has not abandoned the idea above referred to, that the sediment is hurtful, as long as he tries to remove it in some way or other.

Those who maintain that filtration is useless can not say that they follow the example of nature, because if it is true that the trout cover the eggs which they lay in brooks, they do it with small stones and not with mud; and the sediment cannot adhere to the eggs, because they are continually kept floating by little currents passing through the crevices between these stones.

I am not able to explain the difference of opinion in this respect among such competent persons; but I have no doubt that in every case the opinion is based on experience drawn from the peculiar practice prevailing in the different localities. It is generally agreed that if the quantity of the sediment exceeds certain limits it becomes hurtful to the eggs, preventing free respiration. But as regards allowing a small quantity of sediment, people should be guided by its quality, which in one place may be such as to render its removal necessary, while in others it may be left without running any risk.

Of whatever description the filtering apparatus may be, the filtering should be done through thick or relatively indestructible matter, sand, or fine gravel, alternating with layers of charcoal, sponges, &c. Even then it may not be entirely efficacious in directly preventing the development of the minute spores, which are among the most dangerous enemies of pisciculture. But if sediments of a mineral nature are combined with organic matter, which may sometimes happen (although the combination may greatly vary in its character), I think a mechanical process of filtration may indirectly be successful by keeping the parasites away, or at least diminish their spreading, since only organic matter contains the conditions favorable to their growth. There is no doubt, however, that the antiseptic property of coal, which is largely employed as a means of filtration, is lost after a short time, so that after a certain time the filters will only act in a mechanical way. For this reason I would like to know whether any experiments have been made in pisciculture with filtration by "carferal" (carferal, or iron sponge, is a compound of aluminium, iron, and carbon, the preparation of which is kept a secret: it is used largely in the British navy), which, even after having served for a long time, will not leave in the water which passes through it any traces of ammonia or any spores, which does not happen when charcoal is employed. In my opinion the use of carferal for filtering the water to be employed in hatching fish eggs would at least keep away the mold; and perhaps it would be possible to use water containing a large quantity of organic substance of another nature.

To reach a conclusion in this matter I should say that under certain circumstances filtration may be unnecessary, especially if the sediment is so light that it remains floating in the water; but it will be necessary, if the sediment forms deposits on any bodies submerged in the water, or if, owing to its peculiar nature, it possesses injurious qualities. But filtration may be recommended under all circumstances, if for no other reason, because one would rather see the eggs clean, and also because inspection would become easier.

Aeration of the water.—A defect which is sometimes found in spring water, especially if it flows into the hatching-box after having for some time passed through closed canals, is the scarcity of air, which is not the case in brook or river water which has for a long distance passed through the open air, and which through its constant contact with it has retained a large supply of this vivifying agent.

Some fish-culturists, as, for instance, Mr. Schuster, consider the aeration of the water of such importance as to favor it and to increase it artificially, when there does not seem to be a sufficient quantity of air in the water. I cannot but think that artificial aeration of the water is absolutely necessary in cases where the air is lacking, and is a laudable precaution when such lack of air is suspected, though there may be no means of proving it, and superfluous when water is used which contains a superabundance of air; but under no circumstances will aeration prove hurtful. Moreover, the different kinds of apparatus used for artificially aerating water are so simple and so little expensive that economical reasons should never prevent people from using them.

I am sorry that I have lost the design of the air-injector of Mr. Schuster which I saw in position at the mouth of the outflow of the water into the hatching troughs, but I will give a description of the principle on which it is based. It simply consists of two concentric metal vessels, into the lower one of which the water flows from the other through holes in the bottom. The water in forcing itself through these holes produces air, which enters at the upper part of the central tube and mingles with the water.

At Neuhausen the water destined for hatching is aerated by means of pipes which carry it underneath the hatching-house. These pipes are placed near the surface of the water in distributing canals, and are of such a diameter that the water rising above the outer edge does not completely fill them.

The water descends like a long veil along the inside of the pipe, producing a strong current of air, which rushes down with the water. I do not think that these pipes are constructed for the express purpose of acting as air-injectors; but, howsoever this may be, it is none the less true that they serve this purpose in a very efficacious manner.

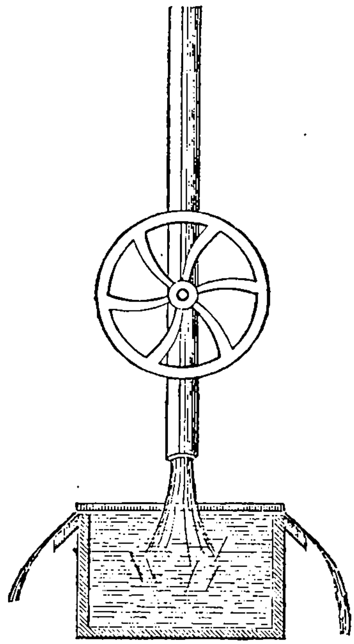


Fig. 1.

The manner in which the water enters the individual hatching-boxes may also be a means of introducing air into the water. I refer particularly to the practice which I observed in the establishment of Neuhausen and also in that of Dachsen. In the Neuhausen establishment the water, which from the general distributing reservoir is made to gush through a pipe at same height above two troughs, first enters a square box, whence it descends along the short sides like a waterfall, as shown in Fig. 1.

At Dachsen the water flows through stop-cocks into common terra-cotta flower-pots, the bottom hole of which is purposely somewhat enlarged. The pot rests on a piece of metal sheet, on which are placed a number of small pebbles. As the distance between the mouth of the stop-cock and the pebbles in the flower-pot is sufficient to allow the stream of water to spread out somewhat, and to break itself on the pebbles with a certain force, the water comes in constant contact with the air, as shown in Fig, 2, I must also state that the water may receive some air in the open canals through which it is led into the hatching-houses at Hüningen, Selzenhof, Neuhausen, Dachsen, Zurich, Berneuchen, Michaelstein, Velp, and Apeldoorn. This small quantity of air is, however, entirely lacking at Cosmandorf, Wilthen, and Seewiese, where the distributing canals are entirely closed. This remark should not be misunderstood, since the object in view may be fully attained, as the water contains a sufficient quantity of air, either owing to the fact that it is either river or spring water, or by flowing open for a considerable distance after it has left the spring.

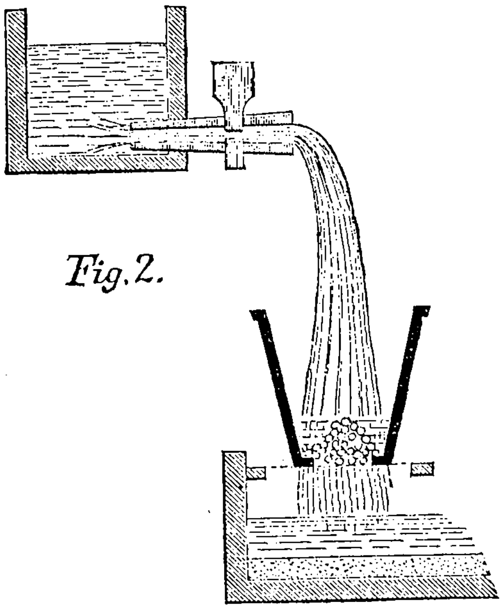


Fig. 2.

Hatching apparatus.—The character of the hatching apparatus which I saw in operation to some extent partakes of the nature of the period in which the establishments to which they belong were founded; but they also reflect the special views and the degree of technical education of their directors.

It is certain that among the very large number of models of hatching apparatus which I have seen there is not one which could be said to answer the purpose better than the others; but if we take into consideration the requisites which they must possess, it will easily be understood that these requisites may be obtained in many different ways, and by different means. For the sake of clearness I will enumerate the principal requisites which the hatching apparatus must possess, as follows:

1. They must furnish a suitable, continuous, regular, and uniform supply of aerated water.

2. They should economize space as much as is compatible with the proper performance of the hatching operation and with the least possible hinderance to the renewal of the water.

3. They should be constructed of impervious, durable, and clean materials.

4. They should be placed in such a manner as to facilitate the operations which should be carried on during the hatching process, especially the separation of the spoiled eggs from the healthy ones.

According to their typical character I may classify the hatching apparatus which I have seen in operation as follows:

1. *Coste's system:* (1) Stairs of troughs; (2) hatching tables; (3) subterranean canals.

2. *Simple troughs:* (1) Troughs of carbonized wood; (2) troughs of cement or zinc.

3. *Hatching tables:* (1) Williamson tables; (2) Zenk tables.

4. *Holton's system:* Holton hatching apparatus.

5. *California troughs:* (1) Eckardt troughs; (2) California boxes; (3) funnel-shaped troughs; (4) automatic selectors.

6. *Ice boxes:* The Haack box.

The defects of the Coste troughs are well known, and have been clearly shown as fish-culture has further advanced. It is, therefore, not astonishing that they have been everywhere abandoned, even at Hüningen, where the present director of the establishment does not use them at all. I saw a Coste stairway in white enameled clay at Neuhausen, but it was not in use. Hatching tables (Coste's system) I saw, however, at Hüningen, where they are still used, and form part of the material which the imperial German Government acquired with the establishment. These tables are about a meter long, with a somewhat deep edge, and are placed on an incline; the first receives the water direct from a spout in the short side of the table. A perforated partition of zinc plate, running parallel with the lower edge, lets the water pass, which then flows from this edge through small leaden pipes upon the table placed below. Some of these pipes are kept closed with a stopper, while others are left entirely open, so as to maintain the desired level. The large compartment (lined on the inside with zinc) is placed between the edge and the partition running parallel with the lower edge, and is destined for the eggs, which are placed on a soft bed supported by the well-known network of glass stems, for which, in some cases, a more economical construction of metal wire is substituted.

Similar to the Coste tables are the large troughs in cement, placed on an incline, which fill the large hatching-hall of the Velp establishment. They are placed in a row of five double compartments having a common edge, and leading to a compartment which is double the size of the others, and which is the last of the row. Some troughs intended for hatching are 86 centimeters [about 34 inches] broad and 2 meters [about 79 inches] long. Here likewise the eggs are placed on Coste frames, many of which are set in terra-cotta, and have, in place of the glass beams, beams of chalk. In these tables the water flows over the eggs more easily, and does not flow among them; the aeration, however, is not and can not be so defective as in the Coste stairway, since the water flowing through pipes from the front edge on to the table below rushes down upon it, and rises again a little, and in every compartment spreads advantageously over a large surface. But it is certain that the renewal of the water must form the proper test, whether apparatus can, in the establishment which possesses it, be used to advantage or not. The Coste tables at Hüningen show, by their state of preservation and by their dimensions, that they are not so expensive as those found at Velp.

The spring water at Hüningen is in part made to flow through canals of cemented brick-work which are laid in the ground under the hatching hall. They may be compared to veritable brooks, while by their bottom, arranged in long steps ending in perforated cross partitions, they resemble the Coste tables.

This system of subterranean canals has one great inconvenience, as it compels the person who places the frames for the eggs in position, or who has anything to do about them, to work kneeling on the pavement. This inconvenience is not found in the hatching tables at Hüningen and at Velp, as they are placed at a convenient height. The simplest apparatus, however, is the large wooden troughs which I saw at Neuhausen and Dachsen. The first of these were constructed according to two identical models, but differing in size. Two and two are placed lengthwise by the side of each other; their edges are about 20 centimeters [8 inches] high; their shape is that of a parallelopiped; they have a partition 25 centimeters from the short edge, opposite to which the water enters if their length is 2.68 meters and their breadth 43 centimeters [106 by 17 inches]; and at a distance of 8 centimeters, if their total length is 68 centimeters and their breadth only 22 centimeters [27 by 9 inches.] The eggs are spread on frames of iron and wire, the water, which is kept at a height of 8 centimeters, flows into the space between the partition and the outer edge through closed pipes, at the end of which there is a metal grating.

The Dachsen troughs resemble those which I have just described, but here the eggs are placed on a layer of very fine gravel 2 centimeters [¾ inch] high, above which there are 3 centimeters of water. This system of hatching in wooden troughs, the eggs being placed on very fine gravel, is practiced a good deal in America; and I have also seen it employed at Zurich, but the same result is said to be obtained by placing the eggs on the carbonized bottom of the trough, or on frames of metal wire, of switches, or glass reeds. I would, however, observe in this connection that, the general conditions of hatching being the same, which it seems to me is hard to prove, the frames represent an expensive but durable material, and the gravel a comparatively small expense, all the work required being to get it all of a suitable size, and to wash it in a dilution of mineral acids before using it. If, therefore, it was not more to the purpose to keep the eggs on frames, it would be the most economical way to place them directly on the bottom of the boxes.

At Radolfszell, likewise, there are some wooden troughs constructed in this simple and primitive plan. I saw at Mr. Schuster's establishment, at Selzenhof, similar troughs, but constructed in cement, and therefore of more solid material, more durable, and neater in their appearance. Their length varies from 4.8 to 3 meters [16 to 10 feet]. As they have a partition of wire in the usual place, with the well-known canal which carries the water to the pavement, they do not need any special description. I will only state that those which are placed in the room to the right of the entrance have an excavation immediately underneath the place where the water rushes out for the purpose of regulating its movement and preventing it from springing up with too great force.

A portion of the very large hatching-room at Apeldoorn contains troughs in cement, placed in pairs. Each trough is supplied with water from a separate spout, and therefore there is not the least trouble to keep the water aerated. Some of the troughs are of wood, but it is intended to substitute for them, at no distant time, troughs made of the material referred to above.

The hatching-tables according to the Williamson system are well known and have often been described. They have the advantage of causing the current of water to pass below the frames containing the eggs, these frames being, in order to economize space, placed in this hatching apparatus one above the other. I have seen these tables at Radolfszell and Michaelstein. In the last-mentioned establishment they are placed over cemented tanks, which serve for fish, and are used only in case of necessity.

The Zenk tables, which are an invention of the owner of the Seewiese establishment, Mr. Frederick Zenk, although not in every respect like the Williamson hatching apparatus, still resemble it somewhat. They are troughs 2 meters long and 60^{cm} broad [6½ by 2 feet], made of pine wood, tarred on the outside and carbonized on the inside,* and their edges are 20^{cm} [nearly 8 inches] high. The water flows from two stop-cocks at the head of the trough against a partition of wood, which touches the bottom of the trough, but which is 4 centimeters lower than the edge; thence it passes into another compartment, whose partition rises to the same height as the edge, but does not touch the bottom. The water, therefore, flows over the first partition, as in the Williamson system, and passes underneath the second. A zinc pipe, starting from the distributing-pipe, is laid diagonally on the bottom nearly the entire length of the trough. This pipe passes over the first and below the second partition, and has all along its sides holes, from which small currents of water flow, which is said to exercise a very beneficial influence on the hatching process. At the distance of 9 centimeters from the end wall

* Carbonization is obtained by a piece of red-hot iron, or by applying smoking sulphuric acid.

of the trough there is a partition which has nine holes, in three perpendicular rows, which can be closed by means of small cork stoppers, with the view to regulate the depth of water in the trough. If all the nine holes are open the water in the hatching apparatus keeps at a height of 5 centimeters; if the lower holes are closed the water rises to the height of 10 centimeters; if those in the middle are closed the water rises to a level of 15 centimeters; while if the upper holes are closed the water may rise to 20^{cm}. (See Figs. 3 and 4.)

Into the troughs placed underneath the first the water flows in the following manner: The water, which reaches these troughs from those above, has already served, but fresh water is led into them through the diagonal pipe at the bottom, which receives it direct from the distributing-pipe.

The eggs are placed on rectangular frames measuring 56 x 25^{cm} [22 by 10 inches.] They are made of galvanized-iron wire and have perforated edges. If these frames, as is sometimes done, are not placed parallel with the edges of the trough, this is done to avoid too uniform a current. On every one of these frames there can be placed 10,000 trout eggs, and as six frames can be placed on the bottom of the trough and over each one of these three, these troughs have each a total capacity of 60,000 eggs.

The hydraulic movement of this trough is in most respects like that of the Williamson trough, only with this difference in favor of the latter, that the movement is repeated at each row of frames, partitions being interposed, which are wanting in the Zenk trough and which, in my opinion, do not present the same advantage as the pipe in the bottom of the Seewiese trough. Both models, however, have the inconvenience that it is difficult to pick out the good from the spoiled eggs, for which purpose it is always necessary to change the place of the frames so that the one which is to be operated on is always at the top.

I saw the Holton apparatus at Radolfszell and Cosmandorf, but they were not in operation.

As a matter of course, Mr. Eckardt, at Lübbinchen, employs the troughs of his own invention, which, according to the movement of the water, must be classed among the California apparatus. It is not necessary to describe them here, as Professor Pavesi has already given a full description of them in his report above referred to.

The California trough is used very much, but not so extensively as might be supposed from the favor which it has found with many fish-culturists. Still, I have found establishments in which it is the only hatching apparatus in use; and many in which it is used in addition to other hatching apparatus, for the reason that owing to lack of space the number of these apparatus could not easily be increased.

The location of Hüningen is not favorable to the use of this apparatus on a large scale, but owing to the favor which it has found with the distinguished director of the Hüningen establishment (who himself had introduced some modifications in it), it forms part of the apparatus which has been acquired during his directorship. At Hüningen I have also seen California troughs in use in the open air.

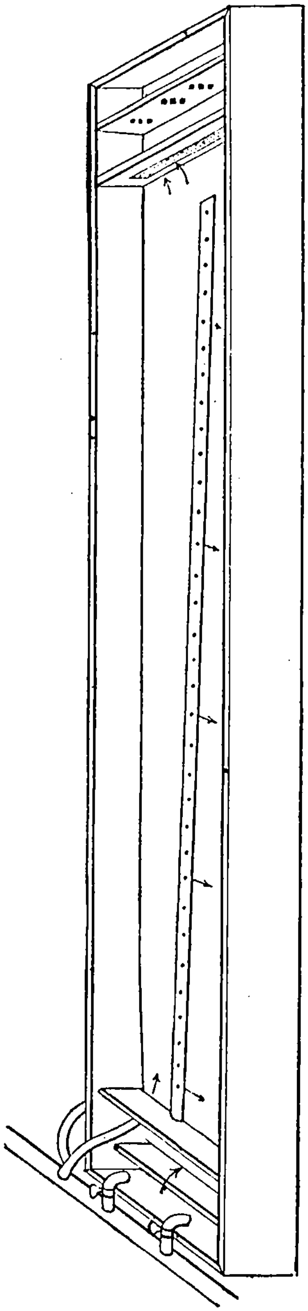


Fig. 3.

ZENK TROUGH.

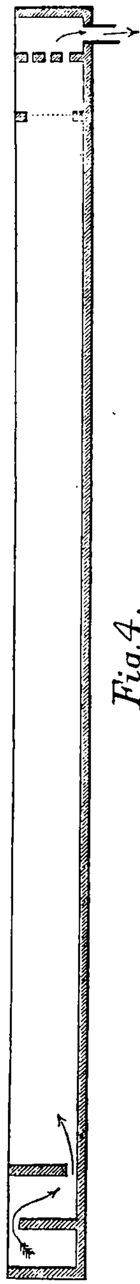
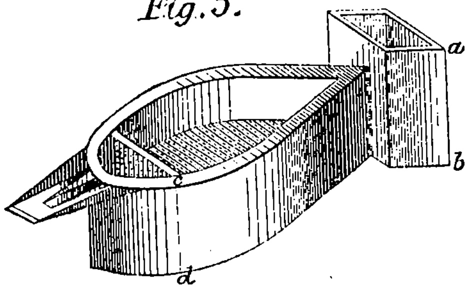


Fig. 4.

SECTION OF TROUGH.

As reserve or supernumerary apparatus I have seen these troughs employed at Selzenhof, Zurich, and Seewiese.

Fig. 5.



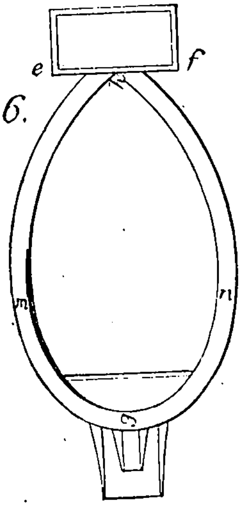


Fig. 6.

In the last-mentioned establishment I have seen it with such singular modifications that I deem it proper to give an idea of the same.

One of these models represents a small box with a rectangular base (see Figs. 5 and 6) which serves to receive the water directly from the distributing cock. Along a line in the middle of the longer side of this box there is joined to it a receptacle of oval shape, in which the box with the eggs is placed. A small pipe placed below the upper edge of the box pours the water into a second pipe which is lower, broader, and longer, which takes the water which cannot all come out through the smaller pipe and which also flows between the two partitions, the inside and lower of which supports the frame for the eggs, while the upper limits the external surface of the apparatus. The capacity of this box is 6,000 trout eggs, the exact quantity which a California trough of the normal type and dimensions can hold.

I do not consider it necessary to describe another modified type of the California box, capable of holding 7,000 trout eggs, lower than the regular California box, but with cross-sections and rectangular sides, which I saw at Seewiese, and which, like the first mentioned, is made by Ignaz Walther, of Marktreit. At Cosmandorf, however, the California trough only is used (Max von dem Borne type) without a third box, and with the addition of the "catch-box," as also with von dem Borne at Berneuchen, and to a great extent at Michaelstein.

In the last-mentioned place some of the California troughs are of the Schuster model—that is to say, with a fixed perforated partition; but some have a movable partition. The boxes are arranged on an incline in such a manner that each incline has seven steps, so that the water flowing from one spout passes from one box to the other, from the first to the seventh in the row.

At first sight this arrangement shows the same defects which have been noted in the Coste stairway; but the better distribution of the water, the large pipe which serves for its outflow (which causes it to fall below in the shape of a thin veil), and the quicker renewal of the same, makes up in the California troughs for the scarcity of air, which in the Coste troughs is remedied by the presence of small faucets, which distribute the water in the shape of small springs.

The best way of utilizing the California boxes, economizing space as much as is compatible with the proper dispatch of the hatching process, I have seen employed at Berneuchen. Here each spring supplies only two troughs in succession, a box being placed between each couple. Three models of California troughs are employed here, namely, Max von dem Borne, normal type; funnel-shaped troughs (Bell); and automatic selectors.

The troughs are placed in cemented tanks, which successively are used for various operations connected with fish-culture; for keeping the spawners and milters which are to furnish eggs for artificial fecundation, for hatching, and finally for the young fish. These tanks are 2 meters long, 50 centimeters broad, and 30 centimeters deep [about 79 by 20 by 12 inches].

By keeping the California boxes in tanks the water is prevented from flowing on the pavement, and another useful object is reached by an arrangement for regulating the depth of water in these tanks by means of a pipe with an elbow, attached on the inside to the mouth of the discharge pipe and terminating in a box of tin or perforated zinc. This pipe may be more or less inclined by the operator, and allows him to obtain the needed depth of water, as by increasing or decreasing the contact of the water and the box he can raise or lower the level of the water in the tank.

The addition of a wooden box into which the discharge pipe passes from the tanks will not in any noticeable way influence the result of fish-cultural operations; but it will serve as an illustration of the exemplary order and cleanliness which reign in Max von dem Borne's establishment. I can not imagine anything more convenient and cleanly, as well as healthy, than his establishment, where you can approach the tanks containing the apparatus through which the water runs on any side without wetting your feet.

I may pass in silence the Lavallette troughs (which I saw at Seewiese), and the Zug apparatus (which I saw at Zurich); the first, because made of porcelain, has a surface perforated by only a few and large holes; and for the second automatic selectors have been substituted to advantage.

To some extent ice boxes may be considered as belonging to the hatching apparatus. They consist of prismatic or cubic boxes with thick walls of wood, sometimes lined on the outside with zinc. In these boxes, which may have a double lid, are placed, at a suitable distance, one above the other, several frames with a perforated wooden or wire bottom. On these the eggs are placed on moist cloths. On the top frame ice is placed which lets its cold drippings pass through the perforated bottom. In this manner eggs have been shipped a long distance, and the embryonal development has been delayed.

In reviewing the character of the hatching apparatus which I saw in operation, I would say:

1. That on account of their convenience (suitable height of the apparatus) troughs of any kind of material, and hatching tables of the height of an ordinary table, are equally to be recommended.

2. Troughs of cement and metal are preferable on account of the durability of the material, and because they can easily be kept clean.

3. On account of the proper hydraulic movement all those apparatus are to be preferred in which the water runs among the eggs placed at its bottom.

4. An arrangement by which the eggs are more scattered is not to be recommended, unless the abundant and rapid renewal of the water fulfills the third condition.

5. Owing to the greater facility with which the spoiled eggs can be picked out from among the sound ones, those methods are to be preferred, by which the eggs are placed in a single layer.

6. I consider it better to place the eggs on frames of netting in preference to placing them on fine gravel, or directly at the bottom of the trough; the best kind of frame is that which allows the water to pass through easily (wire netting), and which has perforated edges.

7. All the hatching apparatus which I have seen answers the purpose more or less, but the ordinary California trough excels them all, because it meets all the desired requirements.

8. Automatic selectors are particularly suited for the hatching of eggs of *Coregoni;* while the ordinary California trough is specially adapted to the hatching of the eggs of salmonoids.

At Hüningen I saw in operation the Haack apparatus. It was there employed for *Coregonus* eggs from the Lake of Constance, which were hatched at the expense of the Italian Government. The eggs remained in the box containing fine ice until it was time to separate the fecundated eggs from those which had not been fecundated, and which were opaque, and from those which through contact with moss and alga had assumed a bright blue color, so as to make them resemble colored crystals.* The eggs were gradually hatched on Coste tables.†

Hatching-houses.—It is my opinion that he who travels for the purpose of obtaining a practical knowledge of the various aids employed in an industry like fish-culture should pay more attention to a critical examination of the apparatus seen in operation in the various establishments than to the extent to which this apparatus is employed, because this will necessarily vary according to the funds at the disposal of the establishment and the importance of the operations to be performed. I shall therefore not speak of the size of the various hatching-houses, but pass in quick review the characteristic features which they must possess.

The object of these houses is to protect both the hatching apparatus and the persons who work them against the inclemencies of the weather. If in case of necessity any kind of house or shed with windows suitably placed may be converted into a hatching-house, it is none the less true that buildings erected for the purpose, in a suitable position and furnished with all the necessary requisites, will answer the purpose better. Any one constructing such buildings should have due regard to the severity of the weather, and provide them with sufficiently thick walls. Thus at Cosmandorf the hatching-house has double walls of wood with compressed straw between them.

At Cosmandorf, Dachsen, and Apeldoorn the hatching-chambers are also of wood. The large hatching-room at Berneuchen has three walls of wood, the fourth being of brick, formed by the same canal which carries the water into the establishment. The roof is formed of wooden slats, covered both on the inside and outside with tarred pasteboard. The placing of the hatching-chamber in the ground made necessary by the hydraulic movement also serves the economical purpose of affording protection to the water and the apparatus against the excessive cold of the winter.

I have already referred to the hatching-canals at Hüningen, which run in the pavement, as being made necessary by the circumstance that the water has to be brought from a spring which rises at too low a level; but they may also serve to keep the water from freezing. Whenever

* It seems to me that the vegetation which endangers packed eggs is perhaps favored by the finish of the cloth in which they are wrapped and on which they rest. I would therefore recommend the use of cloth without any finish, or from which it has been removed by a solution of lye.

† I saw at Seewiese an ice box for transporting *Thymallus* eggs to the establishment from the place where the eggs had been fecundated. This apparatus had the dimensions of an ordinary Dillen vessel used by herbalists, and is made of tin by Joseph Schwarz-Spengler, in St. Pölten, and like this can be carried slung over the shoulder. It contains six frames for eggs, and a seventh (the top one) for ice. It has two panels, one for lowering what constitutes the long side of the parallelopiped box, the other to raise the upper side.

the climate makes it necessary (as at Berneuchen, Lübbinchen, Seewiese, &c.), stoves are employed.*

The hatching-chambers at Hüningen, Selzenhof, Radolfszell, Wilthen, Lübbinchen, Michaelstein, Velp, Zurich, and Neuhausen are of masonry.

The rooms where the hatching apparatus is kept should be sufficiently lighted by windows placed in suitable position, so as to facilitate the inspection of the eggs and the separation of the spoiled eggs from the good, &c. It is also asserted that a violet or blue light is most favorable to the embryonal development of the eggs and fish. I accordingly expected to see colored glass employed in some establishments, but my expectations were disappointed.

I confess that, with Professor Verson, among others, I am somewhat skeptical as regards the influence of monochromatic (violet) light to the exclusion of the white (composed of various rays of the luminous spectrum) on animal organisms, since, as Verson thinks, the same number of rays of a given color on which it is intended to experiment, to the exclusion of others, pass through a colorless glass.

But, to return to the subject to which I referred, it is easy to guess the reason for the absence of colored glass from the hatching-houses, because according to the advanced opinion of our time the eggs will develop better in complete darkness.† Moreover, it is of little importance in industrial establishments whether some think favorably of violet and blue rays, while others have their doubts on the subject, as experiments in this matter would seem more appropriate in a zoological laboratory. Complete darkness has also its dangers, as it favors the development of mold, while light favors the generation of green algæ.

Even a simple pavement of beaten clay (at Dachsen) may suffice for a hatching room, and it is certainly preferable to some other pavement made of or covered with cement (Selzenhof, Hüningen, Berneuchen, &c.); and in this connection I cannot speak too highly of the Berneuchen establishment for the ingenious way of preventing a light and continuous movement which, if not hurtful to fish-culture, may injure the building and interfere with the work of the operator.

As regards the filtration of the water it may be stated that the filter may either be placed in a room immediately adjoining the hatching room or in that room. The selection of a place for the filter will depend on topographical circumstances and on the desire to avoid any unnecessary enlargement of the building. It is certain, however, that if the filter is placed in the hatching room itself or in one immediately adjoining it, this will be found more convenient, as it affords a better chance to watch this useful apparatus without having regard to the state of the weather.

* Although there are large stoves at Hüningen, they were not used this year, not even during a period of intense cold, when the temperature of the spring water became considerably lower.

† For this reason, as well as to protect the young fish against their enemies, the hatching apparatus is kept covered.

It is also useful to have in the hatching-rooms a place for tanks where, during the proper season, and separated by sexes, the spawning fish destined for artificial fecundation may be kept. This is done on a large scale at Hüningen, where there are great tanks in the ground constructed of concrete. It has already been said that at Berneuchen every provision in this respect has been carefully made by Max von dem Borne. It is not necessary to speak of the size of these tanks, as they will have to be in proportion to the number of spawning fish kept on hand in each establishment.

Artificial fecundation of salmonoids.—After it has been ascertained that the spawning fish have reached sexual maturity artificial fecundation may commence. This may be done either by one person alone or with the aid of an assistant.*

In the first case the female fish is taken from the water and held with the right hand over the basin destined to receive the eggs. If the fish is large it is held inclined at a sharp angle. The belly of the fish is then pressed with the thumb of the left hand, the movement being in a downward direction.

If another person assists in the operation he must hold the fish by the tail by means of a cloth. The two operators hold the fish almost vertically over the basin, the first one holding it by the head with the hand and in the manner indicated, and the second by the tail. The first has to go through the manipulation described above to cause the eggs to come forth. The male fish is subjected to exactly the same operation.

The amount of pressure should correspond with the greater or less degree of maturity of the female, without, however, passing certain limits, as excessive pressure would injure the fish without reaching the object in view. In some cases the eggs have reached such a state of maturity that they will come out of themselves when the fish is examined to ascertain whether the genital gland has swelled enough to be operated on.

In natural spawning the salmonoids will deposit their eggs at different, more or less short, intervals; while where the process is artificial they all come out at one and the same time with a certain violent movement, which, however, does not interfere with their successful embryonation. The milt of one male fish is used for the eggs of two or three female fish.

In primitive fish-culture the eggs were kept under the water to be fecundated, as people believed that in doing so they followed the teachings of nature. But it frequently happened that many eggs were not

* The male fish may be recognized by having a more slender body, and its sexual maturity by the brown color of the skin of the belly. When the male fish is large its jaws are more hooked than those of the female. The female is recognized by having a stouter body; it has reached maturity when the belly is swelled out and elastic, and particularly puffed up above the anal fin, and when the reddish genital gland begins to swell.

fecundated, and were thus lost. In nature the male fish closely follows the female, and it may be said that the laying of the eggs and their fecundation are simultaneous. But in spite of the action of the water which kills the enemies of the eggs, and the alkaline sliminess of the eggs which favors their movements, it is a fact that many eggs do not undergo the process of fecundation which necessarily takes place under the water. At the present time, therefore, nature is no longer imitated in a servile manner, and it is the general practice to employ dry fecundation, which assures better and more general success. When as many eggs have been obtained as are deemed sufficient, and artificial fecundation has been reached by mixing at proper and regular intervals the milt with the spawn, the eggs are washed and then placed in the troughs.

The possibility of fecundating eggs on the shore of the waters from which the fish have been taken is proved by the circumstance that the eggs immediately after fecundation are so elastic as to allow of their being packed and shipped to the places where they are to be hatched. As soon as incubation has commenced this is no longer possible, even if managed in the most delicate manner, as the eggs when exposed to any pressure will inevitably be lost. But transportation again becomes possible when the eggs are near being hatched; that is to say, when the eyes of the embryo can easily be distinguished through the shell. From a practical point of view it is, therefore, important to know whether fresh eggs contained in a dead female fish can be fecundated.

If it is desired to know how many eggs have been obtained, the object can be reached by measuring them in small cylinders of a known capacity, having perforated sides and bottom, and, the kind of fish from which the eggs have come of course being known, to count the eggs in one cylinder* and multiply by the number of cylinders.

Packing and shipping embryonated eggs.—I have witnessed the packing of embryonated eggs, to be sent a considerable distance, at Hüningen and at Selzenhof. The eggs were placed on a bed of moistened wadding, gathering them in a piece of cloth folded in such a manner as to prevent the eggs from touching the sides, and keeping them covered. The layer of eggs was placed on the perforated bottom of a small wooden box. The next box is exactly like the first, and the last box of the pile contains the small pieces of ice, the cool dripping of which keeps the eggs below alive. The pile of boxes has on the top a stick of the same length as the boxes, and rests on a similar stick at the bottom. The whole is kept in position by a cord placed crosswise, and is then put in a larger box, the spaces between its inner sides and the pile of boxes containing the eggs being filled with sawdust, hay, or compressed moss.

From Pavesi's report the labels are known which are attached to the outside of the package, and which contain the address of the persons

*A liter measure [a little more than a quart] of eggs contains 15,625 *Thymallus* eggs, 8,000 trout eggs, 7,000 of salmon, and 36,926 of the *Coregonus*.

to whom they are sent, and generally some directions for their treatment by the railroad employés.

In Germany packages of eggs are received in the mails as postal parcels, and the administration of posts is directed to treat the package with the greatest care, in compliance with the request "urgent" written on a piece of red card-board attached to the usual label.

Tanks and ponds for salmonoids.—My report would not be complete as regards salmon culture if I did not mention the open tanks and ponds which in many establishments are used for keeping the stock of salmonoids.

The tanks are laid in cement, and covered with an iron grating, and the salmonoids are kept in them, separated according to age. They are so arranged that the fish in them can easily be fed artificially. As regards the matter of artificial feeding, tanks are perhaps better than ponds, as a possible excess of food* can more easily be removed in the former, and as it is also easier to prevent any injurious pollution of the water.

Special mention should be made of a simple contrivance adopted at Hüningen to protect the fish kept in certain provisional tanks, with wooden sides, especially against rats, which, if they have once got into them, find no way to get out. For this purpose boards are placed at right angles with the vertical sides of the tank, and projecting a little over the water. How this contrivance may serve as a trap will be understood without any further explanation by a glance at Fig. 7.

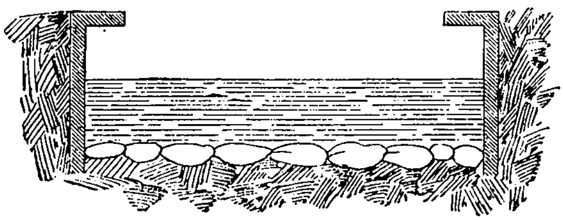


Fig. 7

Trout which have reached a certain age are generally placed in ponds, in company with other non-carnivorous fish, which rid the water from any superfluous vegetation (especially algæ), and thus enable the sal-

* Daily visits are made to the hatching-box to remove the spoiled eggs. Among the substances employed to feed salmonoids I have observed meat ground fine, meat flour, dissolved brain, heart chopped fine, cut-up entrails, and larvæ of flies bred in decaying flesh. There are many more or less complicated machines for grinding the food, but as they have been described in various treatises, I need not give any further description of any of them, not even of the ingenious hydraulic grater for meat which I saw at Seewiese, because its construction can easily be imagined.

monoids to have more ready access to small crustaceans and mollusks, which form an important part of their food.

Mr. Haack considers it also necessary to place in ponds those trout which have been deprived of their eggs by an artificial process, because here they will find more favorable conditions for gaining flesh and for recovering from the sudden exertion incidental to forced spawning.

Although on general principles it is preferable that the water in ponds destined for salmonoids should during summer be kept cool, and that its temperature should in no case exceed 31° C. [88° F.] (according to my observations the temperature did not exceed this limit in any of the establishments which I visited), it will be well to note that aeration, an abundance of water, frequent agitation of the same, and a just proportion between the capacity of the water and the number of fish to be kept in it, will allow the fish to do well even if the summer temperature of the ponds should not altogether come up to the conditions as mentioned above.

It would be useless to describe the arrangements for obtaining the best hydraulic movement in the ponds and to provide for their draining without losing the fish. This is done by putting partitions in suitable places; perforated zinc plates being at present preferred for that purpose. More or less ingenious apparatus is employed in this connection, as well as sewers and pipes; but as they are known from models, it will not be necessary for me to describe them.

In constructing the bottom of the conduits, cement or stone is at present preferred to wood, which is only seemingly more economical.

Planting young salmonoids.—When should the young salmonoids be planted? The answers to this question differ somewhat, and reflect the individual opinions of various fish-culturists.

Mr. Haack prefers to plant them when the umbilical bag has begun to disappear, stating that as soon as they are placed in the water they will hide under stones as long as they do not feel the desire to seek food, and during this time they become acclimatized in the new element.

In the Netherlands the young salmon are not planted until they have lost the umbilical bag, and after they have been kept and fed artificially for an entire year.

At Wilthen the young trout are not placed in brooks until they have been kept for a certain time in the apparatus where they were born, where they have lost the umbilical bag, and where they have been fed. After they have passed the fine season of the year in the brook they are in autumn placed in ponds, where they remain about a year; and after that they are sold, if they have reached the weight of at least half a pound.

It is not customary to place in open waters embryonated eggs of salmonoids which are near being hatched, for fear of some voracious fish, especially the *Chondrostoma nasus* and the *Barbus fluviatilis*. Although

Mr. Haack declares that it not advisable to plant eggs in large lakes and rivers, he states that he has made some experiments in small streams and lakes.

In Italy (at least in many parts of it) the *Squalius cavedanus* would have to be feared particularly; but I take the liberty to state that, when some years ago I planted eggs during spring in some large lakes of upper Italy, I invariably found the water in which I planted the eggs free from fish. Moreover, if it is logical to presume that young fish freed from the umbilical bag, lively and well able to swim, will be better prepared to escape their voracious enemies than the sluggish eggs, it will not be entirely unreasonable to suppose that young fish which are still impeded in swimming by the umbilical bag will not be particularly active, and able to escape from their enemies even if they should hide in the maze of the gravelly bottom.

Species of salmonoids which are cultivated in the fish-cultural establishments visited by me.—The post of honor among the salmonoids which form the object of artificial fish-culture in Switzerland, Germany, and the Netherlands is held by the salmon, *Salmo salar*, a veritable gastronomic delicacy, which gives rise to a considerable trade.

The variety which enters during the spawning season the large rivers of Central Europe from the North Sea and the Baltic is in German called "Lachs," while the barren variety which lives in fresh water and does not go into the sea is called "Winter Salm."

All public administrations prohibit salmon fishing during the period when these fish go up the rivers to spawn; and no fish of this kind are allowed to be sold until it has been officially ascertained that the eggs destined for artificial fecundation have been laid.

Artificial fecundation is practiced, for instance, at Basel by Mr. Glaser, at Lauffenburg by the agents of the Fishery Company, which for this privilege pays a considerable sum to the Governments of Baden and Aargau. It is also practiced at Neuhausen, in the cantonal establishments of Zurich, and at Dachsen. Mr. Glaser also furnished salmon eggs to the Hüningen establishment before Mr. Haack taught fecundation according to the most approved modern method. I have also witnessed the incubation of salmon eggs in the establishments of Neuhausen, Selzenhof, Seewiese, Cosmandorf, Velp, and Apeldoorn.

The young fish are mostly intended for open rivers, and are therefore sold to the various governments. Salmon eggs fecundated at Selzenhof have been bought by the Government of Saxony, and have been hatched at Cosmandorf, to be placed eventually in the river Wesenitz, a tributary of the Elbe. The establishment at Cosmandorf has also rendered this service to the Academy of Forestry at Tharand, in Saxony, where Professor Nitsche does his share in aiding the diffusion of fish-culture. The Saxon Government pays the Cosmandorf establishment 1 mark 30 pfennige [about 31] cents for every thousand young salmon hatched.

The Velp establishment hatches salmon for the river Yssel, and receives from the Netherlands Government 2 cents (Dutch) [about 1 cent American money] for each young salmon, and receives in all a sum amounting to 25,000 lire [$4,825], which the Netherlands Government pays to the various fish-cultural establishments in the Netherlands, which are charged with restocking the rivers.

At Velp about 500,000 salmon eggs can be hatched, 300,000 of which are obtained from fish in the Netherlands waters, while 200,000 are received from the Upper Rhine. Besides young fry, salmon one year old are also placed in the rivers; and the Government pays at the rate of 50 centesimi [about 10 cents] per fish. Another half million salmon eggs can be hatched at Apeldoorn.

At Apeldoorn the California salmon is also hatched, which develops quicker than the Rhine salmon. It is this salmon which the eminent fish-culturist, Mr. von Baer, president of the German Fishery Association, considers (as he informed me) as peculiarly adapted to the rivers flowing into the Mediterranean, owing to the fact that there is much greater analogy between that sea and the Pacific than between the North Sea and the Pacific. Mr. von Baer has, during the years 1877 to 1880, planted in the Danube, which flows into the Black Sea, 670,000 eggs of the California salmon.

The eggs of the *Salmo sebago*, another fish of American origin, also develop very rapidly; and large numbers of these fish are now found at Seewiese, where during the time of my visit 2,000 eggs were hatched, and where some tolerably large specimens were found in ponds.

Trout culture is carried on still more extensively, and I have seen it in operation in all the establishments which I visited. Fecundation of *Salmo fario* (the common European river or brook trout) is everywhere practiced with spawning fish taken in the immediate neighborhood. It is not so common to find establishments which devote themselves to the *Salmo* or *Trutta lacustris*, and the only ones where I have seen this done are Hüningen and Selzenhof.

In some cases the indigenous species do not satisfy the fish-culturists, and they have commenced to introduce some foreign varieties of the trout; among the rest the *Salmo irideus*, or the *Trutta iridea*, from California. The oldest specimens of *Trutta iridea* are found at Hüningen, where they were obtained from eggs which came direct from America in 1882, and which have already propagated their species in their new home. The value of this trout, according to Mr. Haack, is in the fact that it is an unusually hardy fish, and is therefore sure to thrive in Germany.

I have also seen some *Trutta iridea* (one year old) at Lübbinchen, and some (two years old) at Michaelstein. Mr. Schuster also has some *Salmo carpio* from the Garda lake, which he keeps in cemented tanks at Radolfszell, and which he obtained from eggs furnished to him from Torbole Trentino.

At the present time two varieties of the *Salvelinus* are cultivated, namely, the *Salmo* (or *Salvelinus*) *umbla*, and the *Salmo* (or *Salvelinus*) *fontinalis*. The second variety may now be considered acclimatized at Hüningen, Apeldoorn, Berneuchen, and in many other establishments. The *Salmo fontinalis* is a great favorite, not only on account of its rapid development, but also on account of the extraordinary beauty of its coloring.

The spawning season of the *Thymallus vexillifer* had not yet begun, and I could not, therefore, witness the hatching of the eggs of this fish; which, however, is raised in many establishments. Mr. Eckardt, for instance, keeps them in a special paved pond.

The alimentary value of the *Coregoni* is sufficiently known; and I therefore deem it proper to devote a few lines to this fish, all the more as experiments are being made to introduce it in Italy, where it is not found. But also in countries where this fish is found attempts are made to introduce new varieties, such as the American *Coregonus albus*, which is cultivated at Zurich, Lübbinchen, and Berneuchen.

The Radolfszell establishment, situated on the shores of the Lake of Constance, gives special attention to the *Blaufelchen* or *Coregonus wartmanni*. There are several varieties of this fish; and the Radolfszell establishment knows of at least three, differing from each other not only by bodily characteristics, but also by their geographical distribution. These are the *Blaufelchen*, found in the Lake of Constance proper; the *Silberfelchen*, in the Untersee (connected with the Lake of Constance), and the *Ganfisch*, found only in a certain limited portion of the lake. The *Coregoni* at Selzenhof come, as may be supposed, from the Lake of Constance. From this same lake came the *Coregoni*, hatched at Hüningen, which have been sent to the Italian Government for the Lake of Como, where they find the required food, as that lake contains the pelagic crustaceans, which, as Dr. Asper, of Zurich, has already declared, are an indispensable article of food for this fish.

Mr. Eckardt does not think that there is any specific difference between the *Coregonus marœna* and the *Coregonus wartmanni*, and bases this opinion on the reciprocal fecundation of the sexual products of these two varieties. Notwithstanding the fact that such fecundation has actually been observed—proving that even cross-breeds may possess the faculty of fecundation—this would not form a very strong proof in favor of Mr. Eckardt's opinion.

Two conditions are essential to the existence of *Coregoni*, namely, great depth of water and suitable food (insects). Nevertheless it is possible, according to Mr. Schuster's statement, to introduce the *Coregonus fera* also in shallow water, provided it contains suitable food.

The production of hybrids of salmonoids also forms part of the work of fish-culture, and has been done on a sufficiently large scale. The salmon, the *Salvelinus umbla*, and the American trout will interbreed with the trout.

I think that the attempt to fecundate, for instance, salmon eggs with milt of the trout, should not remain the only one, and that, besides endeavoring to find out whether the mixing of the sexual products of these two kinds of fish will result in successful fecundation, fish-culturists should also endeavor to utilize in some way eggs, which through the possible failure of the male fish, would run the risk of being lost.

It is said that the hybrid of the salmon and the trout does not migrate to the sea; and in this respect it resembles the "Winter Salm," with which it also shares the physiological characteristics of being barren. Haack, however, asserts that the barrenness of the hybrid of the *Salvelinus umbla* (male) and the trout (female) can not be proved. At Berneuchen hybrids were obtained from the *Salmo fontinalis* and the trout. Dr. Asper, of Zurich, has no very high opinion of these hybrids, which generally have a small head, an irregular dorsal profile and ovary. At Dachsen a great mortality has been observed among the young bastards of the salmon and trout, whose umbilical bag has the bluish color of algæ.

In the following table are given the kinds of salmon cultivated in the various establishments:

Name.	Locality of establishment.
Salmo salar	Zurich, Dachsen, Neuhausen, Hüningen, Selzenhof, Cosmandorf, Velp, and Apeldoorn.
Salmo quinnat	Apeldoorn.
Salmo sebago	Seewiese.
Salmo fario	Zurich, Dachsen, Neuhausen, Hüningen, Selzenhof, Seewiese, Cosmandorf, Berneuchen, Michaelstein, Velp, and Apeldoorn.
Salmo lacustris	Selzenhof and Apeldoorn.
Salmo carpio	Radolfszell.
Salmo irideus	Hüningen, Lübbinchen, and Michaelstein.
Salmo umbla	Hüningen, Selzenhof, Radolsfzell, Wilthen, Lübbinchen, Berneuchen, and Michaelstein.
Salmo fontinalis	Hüningen, Seewiese, Berneuchen, Velp, and Apeldoorn.
Thymallus vexillifer	Zurich, Dachsen, Neuhausen, Hüningen, Selzenhof, Radolfszell, and Seewiese.
Coregonus fera	Berneuchen.
Coregonus wartmanni	Zurich, Hüningen, Selzenhof, Radolfszell, Lübbinchen, and Berneuchen.
Coregonus maræna	Lübbinchen and Berneuchen.
Coregonus albus	Lübbinchen and Berneuchen.
Osmerus eperlanus	Zurich and Lübbinchen.
Trout ♂ Salmon ♀	Dachsen, Neuhausen, Seewiese, and Cosmandorf.
Salvelinus ♂ Trout ♀	Hüningen and Seewiese.
Trout ♂ Salmo fontinalis ♀	Berneuchen.

II.—CYPRINUS CULTURE.

Carp.—The principal object of cyprinus culture is the carp, *Cyprinus carpio*, which in Central Europe has from time immemorial given rise to a very lucrative trade. The great ease with which it is multiplied, raised, and protected against its enemies, its prolific nature, the preference which it shows for vegetable food, and its rapid growth, explain the great favor which this fish has found with fish-culturists, and may even justify the expectation that its cultivation may also be extended to Italy, although we are not inclined to consider the carp a remarkable delicacy.

Carp are raised in ponds, where they are kept either by themselves or in company with other fish. Different kinds of ponds are used in carp culture, namely, spawning ponds, raising ponds, growing ponds, and winter ponds.

The water of the spawning ponds should be somewhat warm. This condition is obtained by having these ponds exposed to the sun, by changing the water slowly, and by selecting such as are not very deep, the average depth of water not being more than one meter [3¼ feet]. Vegetation should be abundant, but not excessive. Reeds and grasses which soon cover a pond, should be checked in their growth. If possible, Mr. Haack would remove all the phragmites from the numerous ponds at Hüningen. Among aquatic plants the *Glyceria fluitans* is useful, and much sought after by the carp, which deposits its eggs on it.

To regulate the spawning of carp, Mr. Haack advises to place the fish intended for that purpose in comparatively cold water, and thence take them at the proper time to the spawning ponds, where, stimulated by the higher temperature of the water, they will soon deposit their eggs. Benecke, on the other hand, advises to place the carp in the spawning ponds when their water still has the winter temperature.

The number of spawning fish to be placed in a spawning pond covering an area of from one-tenth to half an acre should, according to Max von dem Borne, not exceed two females and one male, each weighing 8 pounds, from which in a few days two to three thousand young fish will be obtained. A single carp weighing 8 pounds is, therefore, capable of producing enough young to stock 500 hectares [about 1,235 acres] of ponds. Mr. von dem Borne has had seventeen successive spawnings in water having a temperature of 31° C. [about 88° Fahr.]. It is therefore not at all surprising, if Mr. Haack states that he has realized from the above-mentioned number of carp in one pond, which costs hardly $10 to keep up, the sum of $300.

Mr. Haack informed me that, in order to preserve all the good qualities of the carp which he cultivates, he is very careful in selecting his spawning fish from among those which from time to time are furnished him for the purpose, selecting those which are not only sufficiently robust, but which also possess all the other requisites of form and color which make them desirable spawners. He therefore applies the true principles of rational selection also to these animals.

The artificial fecundation of the carp is possible, but it is very little practiced. The fish-culturist is contented in most cases to leave to the carp the care of laying its eggs. Some people inclose the spawning fish in non-floating and perforated boxes containing branches and awl-shaped leaves (juniper branches in Mr. Eckardt's establishment), which, as soon as they are covered with eggs, are placed in more suitable water. Professor Nitsche advises experiments with the artificial fecundation of carp, using frames covered with some silk stuff, like those used by Möbius for herring. Fecundation should of course be accomplished under the water, as with other kinds of fish that lay adhesive eggs, in recognition of the fact that the spawn of fish which spawn in summer matures less rapidly when brought in contact with water than the spawn of fish whose fecundation takes place in cold water.

I regret very much that the season was not favorable for seeing in full operation the Lübbinchen ponds described by Max von dem Borne, and arranged in such a manner as to insure the greatest possible result from the spawning of carp, and the keeping of many other kinds of fish. As it is not my intention to give a detailed description, I shall merely give the general plan on which they are constructed. The ponds are deep in the center, have flat shores, and are connected by numerous openings with canals which are much lower.. On the bottom near the shores the collectors (bushes or branches) are placed, and are soon covered with the eggs of the spawning carp. After the eggs have been laid, these collectors are placed in other ponds, or in the canals surrounding the ponds, care being taken to prevent the spawning fish from entering these canals. It is necessary to remove the eggs from the spawning fish, as the grown carp will injure them and devour the young fry. The spawning ponds should be allowed to lie dry during winter, so as to kill the small animals which are enemies of the carp, and especially the pike which may have got into the ponds. The young fish would soon suffer from want of food if this contingency was not provided for by distributing them in suitable quantities in the growing ponds.

Mr. Max von dem Borne has even the smallest carp taken out of the pond by a man who stands in the water and uses for this purpose a muslin dipper. All the fish which he catches in this way he throws into floating barrels with a bottom of very fine wire. After he has gathered a sufficient quantity, he transfers them, by means of a zinc basin with a spout, to the tin cans in which they are conveyed to the ponds for which they are intended.

The growing ponds should be proportioned to the number of fish which it is intended to raise in them, due regard being taken to the amount of food which they contain. The fish are distributed according to age; for which reason rational carp-culture requires many of these ponds.

In the growing ponds other fish may be kept with the carp; for instance, pike and bass. These fish should, however, be very small, so as not to prey upon the carp. The principal object of having these fish in the ponds is to prevent the carp from spawning, as spawning would make them lean. In these ponds artificial food is also used, consisting of flour-balls, vegetables, potatoes, bran, dung (from cattle), larvæ of flies, &c.

If the conditions are favorable, the carp can winter in the ponds; but in some establishments, as, for instance, at Hüningen, there are special winter ponds, in which the carp are kept during the cold season. For these ponds spring water is used if it is somewhat warm. To prevent the carp from being frozen, special excavations are made in the bottom of these ponds, where the carp crowd together in a semi-lethargic state. The water of these winter ponds should be deep. But if the water should freeze, it becomes necessary to make holes in the ice, so as to introduce air into the water below. These holes are covered with sheaves of reeds, having a broad base and forming a kind of roof over the holes, thus preventing further freezing. It is necessary, however, that these holes be frequently examined, so as to keep them always open.

Tillage of carp ponds.—Mr. Haack recommends the custom which has been introduced, of using the carp ponds also for agricultural purposes. After they have served as ponds for two or three years, they are drained, and then plowed for the cultivation of grain and potatoes. According to the director of the Hüningen establishment, a pond which has undergone dry cultivation is richer in small crustaceans which form a favorite food of fish. For instance, the eggs of the *Phyllopoda* will develop better during a dry season.

It will easily be understood why it is useful and profitable to use the bottom of the ponds after a certain period for agricultural purposes, thus utilizing the large quantity of fertilizing matter, consisting of leaves, aquatic plants, animal matter, and excrements of fish, which has accumulated in the pond; while on the other hand it is difficult to explain why ponds used in this manner should be richer in fish. Mr. Haack believes that this is owing to the greater development of small crustaceans; but the greater abundance of these crustaceans has not been sufficiently explained by science. We are, however, allowed to suppose that the greater number of fish is caused not only by the increase of small crustaceans, but also by the more luxuriant aquatic vegetation which will develop in soil, which after lying dry, has been plowed and cultivated, and before being again submerged has changed chemically by the influence of the air and sun. Whether this explanation is correct or not the fact remains and deserves to be taken into account.*

Other kinds of cyprinoids which are cultivated.—As secondary objects of cyprinus culture we may mention the crucian carp (*Carassius vulgaris*), the Chinese goldfish, the *Idus melanotus*, and the tench.

As regards the crucian carp (*Carassius vulgaris* Nilsson), I would state that, compared with the common carp, it presents a great variety of forms, and will interbreed with the *Idus melanotus*, but its flesh has not so delicate a flavor as that of the carp; nor is its culture so profitable, as its growth is much slower.

The goldfish (*Carassius auratus*), owing to its beautiful color, is much sought after as an ornament for ponds, artificial lakes, aquariums, &c., and it is therefore cultivated to advantage.

The *Idus melanotus*, especially its small variety, rivals and perhaps excels the goldfish in brilliancy of color, which changes with its different ages.

The tench (*Tinca vulgaris*) is another cyprinoid which is cultivated to advantage, especially its golden variety, which is kept in aquariums. The manner of raising this fish differs but little from that of the carp, as it is quite customary to stock ponds both with tench and carp.

III.—OTHER KINDS OF FISH.

Pike.—At Radolfszell, Mr. Dietrich, the manager of Mr. Schuster's establishment, has been successful with the artificial fecundation of pike (*Esox lucius*). The eggs of the pike are very small, the embryo develops very rapidly, and the young are hatched in about twelve days. They were placed in a small lake, where they did well but did not prove an advantage to the other fish. Mr. Max von dem Borne has also been successful in fecundating pike eggs. As far as I know, fecundation of pike eggs has not been attempted at Lübbinchen, where these voracious fish are kept only in the growing ponds, to keep the carp from spawning. Here they are kept in company with the *Lucioperca sandra* and the perch (*Perca vulgaris*), which last-mentioned fish is considered to diminish any excess of small fish, as they take away the food from fish which are the proper object of fish-culture.

Black bass.—Successful experiments in acclimatizing this American fish (*Huro nigricans* Cuv. & Val., *Micropterus salmoides* Lacép.) have been made at Berneuchen. The number of individuals of the first importation which survived the long journey was very small; but from the 3 which survived, Mr. Max von dem Borne obtained about 1,300 young fish. I have mentioned this new branch of fish-culture, because Mr. v. d. Borne thinks that it is adapted to the rivers of southern Italy; and I must confess that I have great faith in the opinion of this distinguished fish-culturist. But before introducing this fish, the question should be thoroughly considered, whether it would be expedient to increase the number of voracious fish. The black bass likes to spawn on a bed of large stones. I have seen some very large specimens of this fish which are considered the oldest now in Germany.

Eels.—All the eels found in the waters of Continental Europe came from the sea as young eels, forming what is called the "mounting" of the eels. The attempt to convey these young eels to places where they will break their journey, or to guide them to such places if they do not go there of their own accord, to some extent resembles the method pursued at Comacchio and Polesine, where from time immemorial the eels have been guided into the basins destined for them. The most enthusiastic advocate of the introduction of these young eels into German waters is Mr. Haack, who once procured them from France, but now obtains them direct from Pisa, Italy, where they are brought into the market in enormous quantities.

The following is the method employed by Mr. Haack for packing them and transporting them from Pisa to Hüningen. He employs large, square baskets lined with coarse cloth (jute), the inside being divided into several horizontal compartments, which are produced by pieces of cloth being sewed to one side of the cloth which forms the lining. In each compartment are placed branches of *Potamogeton pectinatum* or *Potamogeton crispum*, which afford hiding-places to the young eels, and which, owing to their peculiar elasticity, protect them from the danger of being crushed. Layers of *Potamogeton* and eels alternate, until the compartment is comfortably filled, when another cloth is drawn out, which receives other alternate layers of *Potamogeton* and young eels. If the plants are sprinkled a little they will supply enough moisture to keep the young eels alive. These packages are sent from Pisa to Basel by way of the St. Gothard tunnel, special directions being given the employés of the railroad to forward them promptly. From Basel they are conveyed to the imperial fish-cultural establishment of Hüningen on wagons.

As soon as the eels arrive at their destination they are, together with the plants which have protected them during their journey, placed in water on the hatching-tables or in open tanks, where they move about very nimbly, trying to avoid the light. The dead ones are picked out when the plants are taken away, and afterwards during the daily visits.

Fish-cultural establishments or private individuals in Germany who wish to obtain young eels get them from Hüningen. This has already been done by the Radolfszell establishment, which has placed them in the Lake of Constance, in the hope that after some time they will again make their appearance when they have reached a greater size. Although in Italy we are more favorably situated in this respect than Mr. Haack, as we have plenty of young eels, we should nevertheless follow his example and increase this useful species of fish in our waters.

At Neuhausen I saw an apparatus (eel-way) intended to favor the

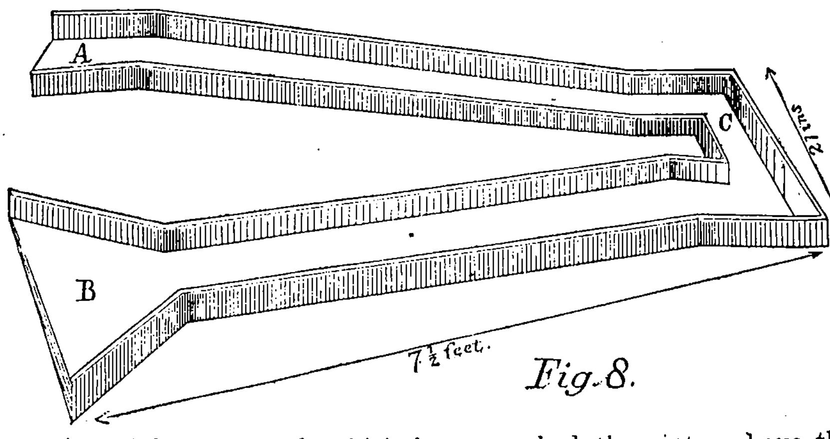


Fig. 8.

retention of the young eels which have reached the water above the famous falls of the Rhine. (See Fig. 8.)

It is a wooden canal with a smooth bottom, with wooden partitions (not shown in the figure) placed at regular intervals; the entire length is 5.07 meters [$16\frac{2}{3}$ feet]; it is divided in two arms (A, B) of nearly equal length, and connected by a horizontal arm (C); the first in the beginning runs horizontal, and afterwards slopes towards the arm C; and from this again slopes the arm B, which widens at its end. It is clear that this canal will conduct a current of water from a higher to a lower level.

I am not able, however, to understand what benefit can be derived from the use of this apparatus, which will not increase the "mounting" of the eels (which in my opinion cannot be accomplished by any contrivance whatever); but which will draw some of them away into water-courses, which, owing to the lack of communication with the streams by which the young eels usually ascend, would under ordinary circumstances not have them.

The following table will show what fish, not belonging to the salmonoids, are cultivated in the establishments which I visited:

Name.	Locality of establishment.
Acipenser ruthenus	Lübbinchen.
Huro nigricans	Lübbinchen and Bernouchen.
Lucioperca sandra	Seewiese, Lübbinchen, and Bernouchen.
Silurus glanis	Lübbinchen.
Cyprinus carpio	Hüningen, Seewiese, Lübbinchen, Bernouchen, Michaelstein, and Apeldoorn.
Carassius vulgaris	Hüningen, Lübbinchen, and Apeldoorn.
Carassius auratus	Hüningen, Seewiese, Lübbinchen, Velp, and Apeldoorn.
Idus melanotus	Hüningen, Seewiese, and Lübbinchen.
Tinca vulgaris	Hüningen, Seewiese, Lübbinchen, Bernouchen, and Michaelstein.
Esox lucius	Lübbinchen and Bernouchen.

Apparatus, arrangement, and products

Place.	Kind of water used.	Hatching rooms.	Hatching apparatus.
Zurich	Lake	1 chamber of masonry	8 wooden troughs; zinc troughs; 2 Zenk apparatus; California boxes.
Dachsen	Spring	1 chamber of wood	24 wooden troughs
Neuhausen	....do.	1 chamber of masonry	26 wooden troughs; Coste troughs.
Hüningen	Rhine water and several springs.	2 halls of masonry, with area of 165 sq. m. each. 1 hall with area of 540 sq. m. Total area of 870 sq. m. [about 1,040 sq. yds.].	Coste tables; hatching boxes; California troughs; Coste troughs; wooden troughs.
Selzenhof	Spring and brook.	3 chambers of masonry	Cement troughs; California boxes.
Radolfszell	Drinking water	1 chamber of masonry	4 wooden troughs; 3 Williamson troughs; 1 Holten incubator.
Seewiese	Spring and brook.	1 wooden house and 1 of masonry.	40 Zenk troughs; California boxes; 10 Lavalette apparatus.
Cosmandorf	River	1 small house of wood	12 California boxes; 1 Holton's apparatus.
Wilthen	Spring	....do	4 California boxes; 3 wooden troughs.
Lübbinchen	....do	1 small room of masonry, with area of 4 sq. m. [about 43 sq. ft.].	Eckardt troughs
Bernenchen	River	Several large houses; some of masonry, some of wood.	California boxes; funnel-shaped troughs; automatic selectors.
Michaelstein	Pond	1 large chamber of masonry, with area of 81.7 sq. m. [about 879 sq. ft.].	112 California boxes; 8 Williamson tables.
Velp	Spring	1 large house of masonry, with area of 150 sq. m. [about 1,614 sq. ft.].	40 Coste tables
Apeldoorn	....do	1 large house with area of 185 sq. m. [about 1,990 sq. ft.].	41 cement troughs; 31 wooden troughs.

of fourteen European hatcheries.

Capacity of apparatus.	Ponds, tanks, etc.	Kind of water in ponds and tanks.	Kinds of fish cultivated.
500,000 salmon eggs.	....	....	Salmon, trout, grayling, several Coregoni.
....do	2 ponds for male trout......	Spring............	Salmon, trout, grayling, salmon-trout.*
.... do..............	....do	....do	Salmon, trout, grayling, salmon-trout.*
12,000 eggs of Salmonidæ per year.	Large tanks in a great hall; several open tanks in cement; 50 ponds for salmon, trout, etc.; 1 large pond for summer fish, and 1 pond for carp; numerous ponds for goldfish, spawning carp, etc.	Rhine water, springs, waste from the hatching hall, a ditch, etc.; filtered water for several ponds.	Salmon, trout, Salmo irideus, S. fontinalis, Salvelinus, Thymallus vexillifer, several Coregoni, carp, crucian, goldfish, golden orf, tench, Salvelinus-trout.*
8,000,000 eggs of Salmonidæ.	9 ponds for Salmonidæ......	Brook	Salmon, trout, Salvelinus, grayling, several Coregoni.
....	Tanks in cement indoors ...	Drinking water...	Salvelinus, carp, grayling, several Coregoni.
7,000,000 trout eggs.	12 ponds for Salmonidæ ; 11 ponds for either Salmonidæ or Cyprinidæ; several tanks.	Spring and brook.	Salmo sebago, S. fontinalis, trout, Thymallus vexillifer, bass, carp, crucian, golden orf, tench, trout-salmon,* Salvelinus-trout.*
120,000 eggs of Salmonidæ.	Wooden tanks for spawners.	River..............	Salmon, trout, trout-salmon.*
60,000 eggs........	18 ponds, covering 10½ acres.	....	Trout, Salvelinus.
....	Over 100 ponds; 1 special pond for Thymallus; 24 concrete basins, each of 50 sq. m. [538 sq. ft.]; wooden tanks.	Spring............	Salmo irideus, Salvelinus, several Coregoni, Osmerus eperlanus, sterlet, bass, Silurus, carp, crucian, goldfish, golden orf, tench, pike.
Very large number	22 ponds; basins with filters for young carp.	River	Trout, Salvelinus, Salmo fontinalis, Coregoni, perch, bass, carp, tench, pike, trout-S. fontinalis.*
1,120,000 trout eggs.	4 tanks in cement; 27 ponds, 4 of them for Salmonidæ.	Spring and brook.	Trout, Salmo irideus, Salvelinus, carp, tench.
600,000 salmon eggs.	7 ponds for trout; 6 for salmon; 2 for goldfish.	Spring............	Salmon, trout, Salmo fontinalis, goldfish.
....do	88 round ponds or tanks; 54 small brooks for young trout.	....do.	Salmon, Salmo quinnat, S. fontinalis, trout, lake trout, carp, crucian, goldfish.

* Cross-breeds of the 2 fish named.

IV.—SOME OF THE CAUSES OF THE GENERAL DIFFUSION OF FISH-CULTURE IN THE COUNTRIES VISITED, ESPECIALLY IN GERMANY.

The process of artificial fecundation of fish is said to have been a secret possessed by some French monks towards the end of the fifteenth century. It was also discovered by the Hanoverian Jacobi (1758), and again fell into oblivion, but when it was again discovered in 1849 by two fishermen, Remy and Gehin, due publicity was given to it by Professor Coste. No practical application, however, was made of it until, at Professor Coste's suggestion, the Hüningen establishment was founded, to which Europe is certainly indebted for the modern impulse given to fish-culture, because its influence made itself felt not only in France, to which it formerly belonged, but also to foreign countries, including Germany. The new industry soon spread rapidly and made constant progress, numerous societies and journals promptly diffusing its knowledge.

But Hüningen, during the last years of the French régime, did not keep up with the progress made in fish-culture, both in Europe and America, and lost its importance, until it passed into the hands of the German Government, and Mr. Haack became its director, when it again began to improve.*

The interest taken in fish-culture by the Governments of Germany, Switzerland, and the Netherlands, which in a large measure have contributed to the restocking of public waters, and which have also furnished the necessary material for private establishments, has greatly aided the diffusion of artificial fish-culture; its further progress is assured, as the results of its operations are no longer uncertain, and as the pecuniary benefit derived therefrom becomes greater.

This industry has been made popular to no small degree by the public exhibition of fish-cultural apparatus in full operation in zoological gardens (as at Dresden, Amsterdam, Frankfort-on-the-Main), and in aquariums (Berlin), which, as is well known, are visited by large numbers of people.

In Saxony fish-culture is popularized by courses of lectures given by Professor Nitsche, of the Academy of Forestry, at Tharand. As this is the only course of instruction on fish-culture of which I have any precise knowledge, it will not be out of place to give a more detailed description of the same. At certain convenient seasons Professor Nitsche gives free lectures on fish-culture at the Academy of Forestry. He has published a large wall diagram, giving illustrations of the fish in question (trout); the distinctive characteristics of sex; the eggs, both sound and spoiled by mold; the phases of their embryonal development; the young fish with and without the umbilical sac; a figure showing artificial spawning; the gravel-filter of Mr. Ryfsell, pincers, glass pipes,

*Mr. Haack has introduced at Hüningen new apparatus; has had cement tanks constructed; has improved the distribution of the water, and the arrangement of the ponds.

vessels for measuring the eggs; California boxes, whole and in sections, cans for transporting eggs, etc.

In these short courses apparatus, fish, and eggs are shown, while in a small room of the academy, which has been transformed into a hatching chamber, the California apparatus is shown in full operation with trout eggs.

Analysis of lectures on the artificial raising of trout

A.

I.—INTRODUCTION. PROPAGATION OF TROUT IN OPEN WATERS.

1. Waters in which trout and their kind live.
2. The spawning of trout in open waters:
   a. The spawning season (winter), and the spawning places.
   b. Fecundation of the eggs laid by the female by means of milt ejected by the male.
   c. Dangers to which the eggs are exposed during their development and during the hatching.
3. Showing that in open waters only a small percentage of the eggs is hatched. Can this be remedied by artificial raising?

II.—THE ARTIFICIAL RAISING OF TROUT.

1. Idea of artificial trout raising, *i. e.*, an artificial way of depositing, keeping, and hatching the eggs and protecting them against dangerous influences.
2. Method of artificial fecundation:
   a. The procuring of spawning fish.
   b. Separation and distinction of the sexes.
   c. Indications of sexual maturity.
   d. The spawning of the ripe female.
   e. Dry fecundation of the eggs by means of the milt.
   f. Counting the eggs by means of a measuring glass, and their introduction into the hatching troughs.
3. Necessary conditions for the development of fecundated eggs. Precautions to prevent any animals from destroying the eggs. Pure water needed incessantly:
   a. By chemical processes the water should be kept free from injurious matter.
   b. And by mechanical processes from mud.
   c. Its temperature should not be too high (0.5° to 8.6° C.) [33° to 47.5° F.].
   d. The largest possible quantity of air should pass through the water.
   e. During the hatching time it should neither cease to run nor freeze.
4. The California box, the apparatus best adapted to raising a small quantity of trout:
   a. Description and demonstration of the California box and its accessory apparatus.
   b. Instructions for placing it in position.
   c. Demonstration of the advantage of the California boxes, as compared with other apparatus, where the eggs are placed on a bed of sand. The advantages consist in a saving of space, and in the greater ease with which the eggs and young fish are kept clean.
5. Care of the eggs during the hatching time:
   a. They should be left entirely undisturbed during the first week.
   b. Dead eggs should be removed every day to prevent the formation of fungus.
   c. All sediment should be removed.
6. Young fish, and their care:
   a. The approach of the hatching is indicated by the visibility of the eyes of the embryos.
   b. The young trout is hatched with an umbilical sac.
   c. Change of the young fry to a small fish.
   d. Keeping the young fish clean, and regularly removing the dead.
7. Placing of the young fish in water adapted to their raising:
   a. The proper time for placing the fish in water.
   b. Hatching brooks and hatching ponds.
   c. Transportation of the young fish to the water; cans employed for transporting them.

III.—CONCLUSION.

Facility with which brooks can be stocked with trout; given the possibility of receiving from a distance, by mail, embryonated eggs:
- *a.* Selection of a good spring, even if it should be small.
- *b.* Treatment of the fish after their arrival.

Exhortation to make experiments on a small scale.

B.

I.—INTRODUCTION.

1. The growing depopulation of our waters, and the causes of this phenomenon:
   - *a.* Voracious fish.
   - *b.* Many streams have become unable to maintain fish alive, owing to industrial and mercantile establishments, and to the lack of spawning places, and of suitable places where the fish can live.
2. Desirability of using for the raising of fish any waters which may still be adapted to the purpose.
3. Trout are best adapted to this purpose.
4. Artificial raising is the best means.
5. The artificial raising of fish is a German invention (invented by the Hanoverian Jacobi in 1758; first published, 1763-'64). After it had fallen into oblivion it was invented anew by a fisherman of the Vosges, Remy, in 1849, and practiced on a large scale at the establishment of Hüningen, in Alsace, which passed into the hands of Germany in 1871.

II.—LIFE AND PROPAGATION OF TROUT IN OPEN WATERS.

1. Waters in which trout and their kind live; the idea that trout confine themselves to mountain streams is erroneous.
2. Spawning place and season of the trout.
3. The ovaries of the female empty their contents into the abdominal cavity.
4. Structure of the egg:
   - *a.* The yelk.
   - *b.* The germ.
   - *c.* The shell of the egg and the micropyle.
5. The testicles of the male have ducts carrying:
6. The sperm:
   - *a.* The liquid of the sperm.
   - *b.* Spermatic filaments.
7. Depositing the eggs; their fecundation by means of the male semen.
8. Fecundation is accomplished by the entrance into the micropyle of at least one spermatic filament.
9. The development of the young fish:
   - *a.* Point from which the formation of the body of the young fish starts.
   - *b.* Extension of the same and formation of the back of the young fish.
   - *c.* Growth of the yelk round the germinal spot.
   - *d.* Formation of the shape of the body of the young fish.
   - *e.* Visibility of the eyes by the formation of pigment in the eyes.
   - *f.* The little fish with its umbilical sac, and its hatching from the egg.
   - *g.* The change of the embryo, which does not need any food, to a perfect little fish.
10. Conditions favorable to the normal development of the embryo:
    - *a.* The eggs should be fecundated.
    - *b.* The eggs should be daily moistened with water not chemically pure.
    - *c.* The water should be furnished with a constant supply of fresh air.
    - *d.* Mud, which hinders the access of air, should be removed.
    - *e.* The temperature of the water should not be too high (0.5° to 8° C.) [33°-46.5° F.]. Too high temperature accelerates development, while too low temperature delays it.
    - *f.* Safety from mechanical dangers. If the eggs are bruised, malformation is caused. Safety of the fish against enemies belonging to the animal kingdom.
11. Which conditions of success are not all found in open spawning places; and how a large part of the eggs run a great risk.

III.—THE RAISING OF TROUT.

1. The nature of trout raising.
2. Procuring fish for artificial fecundation:
   - *a.* Obtaining spawning fish.
   - *b.* Distinguishing the male from the female fish.
   - *c.* Indications of the maturity of the spawn.
   - *d.* The spawning of the mature female.
   - *e.* The spawning of the mature male.

III.—THE RAISING OF TROUT—Continued.

2. Procuring fish for artificial fecundation—Continued.
   f. Different methods of fecundation (dry and moist).
   g. Counting the eggs by means of measuring glasses; and placing them in the hatching troughs.
3. Necessary conditions for placing a hatching trough:
   a. A hatching trough may be placed anywhere where there is a current of not too warm water, which may be conducted to a place secure against freezing.
   b. Water of ponds, rivers, and springs may be used, each having its peculiar advantage.
   c. Chemical purification of the water, and freeing it from injurious matter, is indispensable.
   d. Cleaning the water from mud may be effected by means of clearing basins or by filtration. Arrangement of a small sand-filter.
   e. It is desirable that the water should fall into the hatching troughs from a certain height, thus producing air.
   f. A space protected against frost may be arranged by means of a very simple apparatus, as a small wooden shed covered with substances which are non-conductors of heat, such as reeds, straw, sawdust, etc.
   g. The pipes through which the water is conveyed should be so arranged that they can easily be cleaned.
4. A good hatching trough should be:
   a. Of durable material.
   b. Easy to handle.
   c. Easy to clean.
   d. Well protected against the enemies of fish.
   e. Should have room for a suitable quantity of eggs on a small bottom.
   f. Should be so arranged as to render easy the care and management of the eggs.
5. All these requisites are possessed by Max von dem Borne's California trough:
   a. A description and demonstration of the trough and its accessory apparatus.
   b. Showing the disadvantage of placing the eggs on a bed of sand.
6. Care of the eggs and the young fry:
   a. Necessity of daily visits to the apparatus; special attention during rain-storms and snow-fall.
   b. Treatment of the eggs during the first stage.
   c. Removing every day the dead fish, to prevent the formation of fungus.
   d. Removing all sediment.
   e. How to recognize the approach of the hatching by means of the points of the eyes which become visible.
   f. Keeping the hatched embryos clean.
7. Placing the young fry in the waters where they are to be raised:
   a. Proper time for transporting the fry.
   b. The brook for the young fry, and its character.
   c. Transporting the young fry to the places where they are to be raised.
   d. Cans for transporting them.
8. Some brief hints as to the management of trout ponds.
9. Stocking with trout such waters as are adapted to the purpose, but where no trout are found:
   a. Various methods of stocking with grown fish, young fry, and with eggs; hatching of the same near the waters which are to be stocked.
   b. The last-mentioned method to be preferred; accustoming the fish to the water in which they are to live.
   c. Choice of a good spring for embryonated eggs; a spring which has been tried and found to answer the purpose, even if far away, is to be preferred to one which has not been tried.
   d. Facility of sending eggs by mail.
   e. Treatment of the eggs, when they have arrived at destination, in the hatching troughs.
10. Management of trout ponds; their character:
   a. If there is only one pond, it can be used only as a growing pond.
   b. If there are at least three ponds, young fish may be raised in them.
   c. Hatching ponds, raising ponds, growing ponds.
   d. The food of trout in ponds.
11. Growth of the trout:
   a. The growth of trout is possible wherever there is suitable food.
   b. Growing basins for trout; conditions of soil, abundant supply of suitable water; the proper control of this supply.
   c. The growth of the trout depends on ample food, and a limited space for moving about.

III.—THE RAISING OF TROUT—Continued.

12. More extensive arrangements for raising trout:
  a. Circumstances under which they are made; if the object is to stock a large area of water, or if a large sale of eggs is looked for.
  b. Principal ideas which should guide persons in arranging a large establishment.
  c. The hatching house; conditions of soil and abundant supply of water, with a good fall. Essential characteristics of the hatching house: Protection against frost, sufficient light, so the eggs can be properly taken care of, close proximity to the dwelling of the inspector.
  d. Samples of hatching troughs adapted to large establishments; Williamson troughs.
  e. Apparatus for filtration and aeration.
  f. Packing and shipping of embryonated trout eggs.

13. Hints on the raising of other species of salmonoids; where are such fish raised?
  a. Raising of *Thymallus vexillifer*.
  b. Raising of *Salvelinus*.
  c. Raising of salmon.

IV.—CONCLUSION.
  a. Brief review of legislation relative to the fish in question.
  b. Advantages of large fishery associations.
  c. Exhortation to found small fishery associations.
  d. The German Fishery Association, and its influence.

V.—FINANCIAL STATEMENT OF THE HÜNINGEN ESTABLISHMENT FROM APRIL 1, 1884, TO MARCH 31, 1885.

INCOME.

From the German ministry of agriculture for placing young salmon (one million) in the Rhine	$5,497.80
Sale of embryonated eggs of salmonoids:	
(a) To Germans	1,904.00
(b) To foreigners	357.00
Sale of embryonated eggs of Coregoni	71.40
Sale of carp	714.00
Sale of ice and reeds	238.00
Reimbursements for packing	238.00
	9,020.20

EXPENSES.

Salary of director, besides lodging	856.80
Two keepers, besides lodging	456.96
Secretary and treasurer	471.24
Wages of workmen	714.00
Traveling expenses of director	380.80
Rent (ground rent)	499.80
Purchase of eggs of salmonoids and fish	2,380.00
Food of fish	476.00
Packing eggs	238.00
Library and experiments	142.80
Maintaining and improving ponds, &c	952.00
Maintaining and improving buildings	357.00
Unforeseen expenses	142.80
For new constructions	952.00
	9,020.20

BRESCIA, *June* 21, 1885.

B.—NOTES ON FISH-CULTURE IN GERMANY, SWITZERLAND, AND THE NETHERLANDS, BY DR. VINCIGUERRA.

I.—GERMANY.

1. *Hüningen.*—The imperial establishment of fish-culture at Hüningen is situated in Alsace, at a short distance from the Swiss boundary, and only 8 kilometers from Basel. Founded in 1854 by Professor Coste and two engineers, Berthot and Detzem, it passed through different phases and finally into the possession of the German Government; and since that time Mr. Hermann Haack has been its director.

The establishment has no fixed allowance from the Government, because it should, if possible, be self-supporting, but the expenses have, so far, always considerably exceeded the income; and the deficiency has been made up by the German Government, in the shape of a compensation paid for young salmon placed in the Rhine every year.

The ground on which the establishment stands belongs to the village of Blotsheim, covers an area of 39.56 hectares [97¾ acres], and is rented for an annual sum of $465.22.

The water of the establishment is supplied by copious springs, of which there is a sufficient number in the neighborhood, from a small brook called the Augraben, and from the canal connecting the Rhone and the Rhine. For the hatching of the eggs Director Haack prefers this water to brook and spring water, because it seems that the latter contains larger quantities of the germs of the much-dreaded mold; moreover, it is too warm, having a constant temperature of 10° R. [54.5° F.], while the temperature of the brook and canal water falls even to the freezing-point. The water is no longer filtered in the true sense of the term; but before being distributed through the establishment, it passes through grates and fascines, in order to keep out any large foreign bodies.

The ground floor of the principal building and that of the left wing are devoted to the hatching of the eggs of salmonoids. The eggs of the common trout are gathered and fecundated in the establishment from fish raised there; the eggs of lake trout, salmon, *Salvelinus*, *Thymallus*, *Coregonus*, &c., are received from abroad. Of the five kinds of American salmonoids introduced into Europe a few years ago through the efforts of the German Fishery Association, two are raised in the establishment. These are the American trout, or "Bachsaibling" (*Salvelinus fontinalis*), and the California trout, or rainbow trout (*Salmo irideus*), both distinguished by their beautiful color and their fine shape. The former has already been sufficiently spread by fish-culturists; while the latter is not yet found so generally; although Mr. Haack thinks, if specially cultivated, it will yield very fine results.

The Hüningen establishment carries on an active trade in the eggs of salmonoids, $2,332.40 worth of these eggs having been sold during the season of 1884–'85; live fish are also sold, especially carp, and also trout, after they have for two or three years furnished sexual products for reproduction. Every year young salmon are placed in the Rhine to the number of from 500,000 to 1,000,000, and in return the establishment receives from the German Government a sum sufficient to cover the annual deficiency, provided it does not exceed $5,950.

The hatching apparatus used in the large halls of the Hüningen establishment are still substantially those invented by Coste, having frames with a bottom of glass stems, although for these there have been substituted, to a large extent, other frames with a bottom of metal staves, or a network of metal wire, used particularly when eggs of the finer kinds of fish, such as *Coregoni*, are to be hatched. Generally the eggs which are to be hatched in the establishment are, when near being hatched, placed in troughs made of pine-wood, about 3 meters long, 40 to 50 centimeters broad, and 15 to 20 centimeters deep [about 10 × 1½ × ½ feet], at the lower end of which there is a metal grating to prevent the escape of the young fish. They are covered with a strong wooden lid to prevent mice and rats from getting in, and to have the development of the eggs carried on in darkness, which greatly favors such development. These troughs are then placed in the open air, and after the eggs have been hatched the young fish are fed until they are near losing their umbilical sacs, when they are immediately placed in some river or lake, it being considered better to place them in open waters a few days before they have entirely lost the umbilical sac. When the number of eggs to be hatched is very large, Mr. Haack also uses California apparatus, more or less modified; especially those recently constructed by Professor Benecke on the principle of the La Vallette apparatus.

The young fish destined to be raised in the establishment are placed in small basins laid in cement, into which water runs continually. Here they are raised and fed artificially, and are not taken out, except in very cold winters, when for some days they are placed in basins in the small wing on the right. There are also ponds for carp and for some other cyprinoids (*Tinca*, *Idus*, &c.), some small for winter, and others large for summer; these ponds are used for reproduction and the development of the young fish. The largest of these ponds covers an area of 1 hectare [about 2½ acres]. The ground where it was excavated was rented for the sum of $9.65 per annum, and the annual income from carp raising amounts to $289.50.

After several experiments Mr. Haack has succeeded in transporting from Pisa to Hüningen live young eels, known by the name of "blind eels." He keeps them for a certain time in cemented basins, and then ships them to other parts, some as far as the most remote portion of the province of Pomerania.

The imperial establishment of Hüningen is the one which has given the greatest impetus to the spread of the industry of fish-culture; but at the present time this industry has made such rapid strides in Germany, that Mr. Haack deems it proper and advisable that the Government should cease to carry it on exclusively, but let private enterprise take hold of it.

2. *Selzenhof.*—The fish-cultural establishment of Selzenhof is situated about an hour and a half's journey from the city of Freiburg in the Grand Duchy of Baden. It belongs to Mr. Schuster, the mayor of Freiburg, who founded it in 1865, and enlarged it in 1872. It does not receive any fixed subsidy; but the Baden Government pays it for the young salmon placed in the Rhine and for the *Coregoni* placed in the Lake of Constance, on the shores of which Mr. Schuster has another establishment, Radolfszell.

It furnishes embryonated eggs to the German Fishery Association, and to many public and private fish-cultural establishments.

The eggs are hatched in a small one-story building, divided into three rooms, two large and one small. The water comes from a brook running at a short distance from the house, but as in winter this water is too cold, it is then mixed with spring water, which is warmer, so that in the hatching-room its temperature is not lower than 2° R. [36.5° F.]. The water passes through a sand-filter, which need not always be employed, as the water is very pure. The hatching-rooms are somewhat lower than the filter, and the water which enters through two pipes, one for each of the large rooms, circulates in an open canal, constructed of masonry, placed at a certain height along the walls, whence it falls into the troughs below. To each of the openings perforated metal tubes are attached, for the purpose of aerating the water, which process Mr. Schuster considers very important, and endeavors to further it by every possible means.

The kinds of fish on which Mr. Schuster operates all belong to the family of the salmonoids, and are especially the Rhine salmon, river trout, lake trout, *Salvelinus*, *Thymallus*, and *Coregonus*. A trade is also carried on in trout eggs fecundated by salmon milt, which are much sought after by fish-culturists, because the hybrids obtained by this process develop very rapidly and do not go into the sea. He has also undertaken the culture of *Salmo fontinalis* and *Salmo irideus* from North America.

The troughs which serve for hatching the eggs are cemented and 22 in number. Their length varies from 360 to 480 centimeters, and their breadth is 45, and their depth 18 centimeters. [Each trough is therefore about 14 feet long, 18 inches wide, and 7 inches deep.] They are covered with wooden lids, having some openings provided with grating. The eggs are placed on wire frames, which can be placed one above the other. There are also employed some California boxes, according to a model prepared by Mr. Schuster.

There are 9 ponds, which are used for raising young fish and for keeping the spawning fish. Two of these ponds are for carp. The ponds are arranged one above the other, so that the water passing from one pond to the next forms a little waterfall, and is therefore always properly aerated. The Selzenhof establishment can hatch about 3,000,000 eggs at the same time.

3. *Radolfszell.*—This establishment is situated in the little town of Radolfszell on the "Untersee," a branch of the Lake of Constance, and like the preceding one it is the property of Mr. Schuster. It was founded in 1877, principally for the purpose of reproducing *Coregoni*. It consists of one large hall, which formerly served as a public bath. The water used in it is the common drinking water of the place, and is not filtered. In summer its temperature is about 8° R. [50° F.], and in winter it sometimes falls to 1° R [34° F.] The water is contained in a reservoir placed in the highest part of the hall, and thence it is by wooden conduits led into the troughs, of which there are 7, some without divisions, and with several compartments, on the Williamson system. The troughs are at some height above the ground, resting on wooden supports. For the hatching of *Coregoni* a Holton apparatus is principally employed. It consists of a kind of wooden box into which the water enters through a hole in the bottom, and gradually passes through 15 frames made of iron wire, placed one above the other. Each of these frames can hold about 20,000 eggs. The water finally flows over the upper edge of the apparatus.

Although the principal fish raised in this establishment are *Coregoni*, some other fish are also cultivated, as the lake trout (among them the famous trout from Lake Garda, some young specimens of which I saw, which had been raised in the establishment), *Salvelinus*, and *Thymallus*. They are placed in the upper course of the Rhine, and some in the lake, where formerly they were not found. After the river and lake had been stocked, people soon began to catch these fish. The German Fishery Association pays a reward of $1.19 to every fisherman who can prove that he has caught one.

4. *Seewiese.*—The establishment of Seewiese near Gemünden in Franconia (Bavaria) belongs to Mr. Frederick Zenk, of Würzburg, who founded it in 1881 on ground belonging to him, and entirely at his own expense. The establishment does not receive subsidies of any kind, and has no other income except from the sale of eggs and fish.

The hatching room is 20 meters long, 9 broad, and 3½ high [about 65½ × 29½ × 11½ feet]. The water rises to a height of 2 meters [about 6½ feet] above the floor, and runs along the northern wall in a pipe having a diameter of 8 centimeters [about 3⅛ inches.] It generally comes from a brook in the neighborhood, which contains a great many fish, and is therefore called the "Fischbach." The temperature varies from a maximum of 10° R. [54.5° F.] in summer, to a minimum of 1° R. [34° F.] in winter.

If the water flows too warm or too cold, it can be mixed by a small hydraulic pump; or there may be substituted for it spring water, having a constant temperature of about 5° R. [43° F.] The water of the brook is filtered through an apparatus containing sponges and sand.

The hatching-troughs are of wood carbonized on the inside; their number is 20, and they are arranged in groups of 4 each. The frames used are those of Coste, and others having a network of metal wire. Some California boxes of various systems are also used.

The fish raised in this establishment are river trout, lake trout, *Thymallus*, *Salvelinus*, and cross-breeds of *Salvelinus* (♂) and trout (♀); also some American species, as *Salmo sebago* and *Salvelinus fontinalis*.

Besides the above-mentioned hatching-house, there is another smaller one, fed exclusively by spring water, where, besides ordinary troughs, circular porcelain apparatus (according to the La Vallette system) are used.

There are also 20 ponds of different size for young *Salmo sebago* and American *Salvelinus*, from which, though only two years old and not more than 15 centimeters [6 inches] long, Mr. Zenk has already obtained eggs. In these ponds there are also carp, bass, tench, and golden orf (*Idus melanotus* var. *aureus*).

In the large hatching-room there can be kept and developed about 6,000,000 trout eggs.

5. *Cosmandorf.*—Near the village of Cosmandorf, between Dresden and Tharand, in Saxony, a short distance from the confluence of the "red" Weisseritz and the "wild" Weisseritz, there is a small fish-cultural establishment belonging to Mr. Mittag, one of the proprietors of the fisheries in the Weisseritz and the Wesenitz, who, among other economical enterprises has undertaken to restock these waters by means of artificial fish-culture. He does not receive any direct subsidy from the Government, but it furnishes him gratuitously the embryonated salmon eggs, which are to be placed in the Weisseritz; and also pays him 31 cents for every thousand young salmon which have been hatched in his establishment. Mr. Mittag is, however, obliged to furnish the necessary material for Prof. Nitsche's fish-cultural course at the Tharand Academy of Forestry. The establishment has been in existence about six years. Some time before this another much larger establishment was founded, but proved an entire failure.

The water is supplied by a mill canal which comes from the "red" Weisseritz, and also furnishes the water-power for a manufactory of wood material (pasteboard). The water is not filtered, although this would be beneficial on account of the sediment from the manufacture referred to above. The temperature, during the hatching season, varies from 1° to 6° C. [34° to 43° F.].

The hatching-house is small; it has double wooden walls with a layer of hay between them. The water runs along one of the walls in a wooden canal. It should be noted that the faucets of the pipes through which the water flows into the hatching apparatus are not, as is generally the case, on the sides of the pipes, but at the very end of the pipe, in order to make it more difficult for the sediment to gather. The hatching apparatus which I saw consisted of twelve California boxes, on the von dem Borne plan, but without the third inside box. I also saw a Holton apparatus, but it was not in use. Outside the hatching-house there is a wooden tank containing trout of both sexes destined to serve as propagators.

The establishment does not have a commercial object, and only serves to stock the neighboring waters. Only trout and salmon are raised. An attempt was made some time ago to introduce *Salvelinus* in some of the ponds, but they were soon devoured by the trout.

6. *Tharand (Academy of Forestry).*—There is not a genuine fish-cultural establishment, with a practical object, near the Tharand Academy of Forestry; but it possesses only a small room for the various hatching apparatus used by Professor Nitsche in his fish-cultural course. He showed me all the material used by him in this course, which never lasts longer than a week, and which has already been followed by good results.

7. *Wilthen.*—This establishment is located near Schirgiswalde, in Saxony. Its foundation is due to the above-mentioned course of fish-culture by Professor Nitsche at Tharand. The ground belongs to the Catholic church at Bautzen, and the establishment is managed by Mr. Waurick, superintendent of forestry, who deserves credit for having founded it. But here, as in other places, the monks had in olden times already constructed some carp ponds. At present only trout are raised for the market. The establishment does not receive any subsidy.

The water comes from a spring at a distance of about one kilometer [nearly two-thirds of a mile] and is led through a conduit into a receiving reservoir, whence it passes into the hatching-house. The temperature of the water, at the time of my visit, was 2° R. [36.5° F.]; but it may fall to the freezing-point, and rise a great deal in summer. The water is filtered through two flannel filters, which are in the hatching-room. It flows through a wooden conduit, which can be opened in order to be cleaned. This conduit, outside the house, and the tank, are covered with straw to prevent the water from freezing.

For hatching, California boxes are used (Nitsche system), and wooden troughs, about 1½ meters [5 feet] long. In each of these there are two wooden frames with a wire bottom, on which the eggs are placed. After the eggs are hatched, the frames are removed, and the young fish are left free in the troughs until they have lost the umbilical sac, or even some time longer, feeding them artificially with meat chopped fine. They are then taken to the brook, fed from the receiving reservoir with spring water, where they remain till autumn, when they are caught and conveyed to the ponds, where they stay at least a year, until they have reached a weight of at least 250 grams [8¾ oz.]. Above the place where the fish are the brook is closed by a sluice, and below by a metal grating, so that the fish cannot escape.

There are a great many ponds, some of them very large; they are connected with the brook which passes through them in the shape of small waterfalls, which serve to aerate the water and prevent the escape of the fish. In summer the temperature of the water may rise to 25° or 30° C. [77° or 86° F.] without injuring the trout contained in it.

The fish in the ponds are fed artificially with meat—ground meat (which generally serves as a fertilizer)—and with the larvæ of flies. To obtain these, poles are rammed into the bottom of the ponds, and the carcass of some animal is placed on them. The flies deposit their eggs on the carcass, and the larvæ which develop from them gradually fall into the water and serve as food for the young trout.

8. *Lübbinchen.*—This model establishment is located near the city of Guben, in the Prussian province of Brandenburg, and belongs to Mr. Eckardt, one of the men to whom the industry of fish-culture is deeply indebted. Although it may be said that there is hardly any kind of fish, to which fish-culture is applied, which he has not cultivated, there are two to which he has specially devoted his efforts, namely, *Coregoni* and carp.

The Lübbinchen property covers an area of 10 hectares [nearly 25 acres], 9 of which are occupied by ponds, but at some distance Mr. Eckardt owns 400 hectares [988½ acres], with some lakes containing a great many fish.

The water comes from two springs, distant about 1 kilometer [nearly ⅝ mile] from Mr. Eckardt's house. It passes underneath an open vault, in order to get some air, and is then conveyed about 200 meters [219 yards]. It feeds the ponds and the basins, and is again collected in a small lake. It also forms a small brook destined for young trout, and from this brook comes the little stream which enters the hatching-house. The water is not filtered.

The hatching-house covers an area of hardly 4 square meters [43 square feet]. The water runs in an open conduit of wood, bitumınated. The apparatus used for hatching are the boxes invented by Mr. Eckardt, each of which can hold as many as 20,000 *Coregonus* eggs, and have the advantage that they can be placed one above the other. There are raised artificially *Coregonus*, trout, European and American *Salvelinus*, &c.

The ponds and basins are more than 100 in number, and, as has already been stated, occupying an area of 9 hectares [22¼ acres]. The largest pond covers more than 1 hectare [about 2½ acres]. The first ponds, in the immediate neighborhood of the house, are about 1½ meters [5 feet] deep, and have some small canals through which the water runs all the year round, so as to keep them clear. The oxygenation of the water is kept up by reeds and water lentils, which grow in the ponds in great abundance. Beyond these ponds there is a large pond, about 4 meters [13 feet] deep, and some smaller ponds.

There are also some wooden and cemented tanks, containing pike, *Silurus*, tench, crucians, golden orf, &c. There are carp weighing as much as 14 pounds. There are 24 cemented basins, covering each an area of about 50 square meters [538 square feet]. In these there are sterlets from the Volga, *Coregoni* from the Madue lake and from the Lake of Constance, American *Coregoni*, *Salvelinus*, *Salmo irideus*, &c.

The temperature of the water in the ponds does not differ much from that of the air; in summer it may get as high as 20° to 25° R. [77° to 88° F.], and in winter the ponds are apt to freeze. Mr. Eckardt deserves special credit for having succeeded in hatching the eggs of the delicious *Coregoni* of the Madue lake, and artificially raising these fish, which are greatly esteemed by Germans; but still more for the impetus he has given to the industry of carp cultivation. He succeeded in transporting the eggs a considerable distance by causing the carp to spawn on juniper branches placed in the ponds, these eggs being glutinous and therefore adhering to the branches. After these branches have been in the water some time they are taken out covered with eggs, which, even when transported some distance, will, under favorable conditions, develop normally. In special and very simple apparatus he ships live carp to a great distance, even as far as North America.

9. *Berneuchen.*—The most important fish-cultural establishment visited by me is without doubt the one belonging to the distinguished fish-culturist, Max von dem Borne, located on his estate of Berneuchen, at a short distance from the city of Küstrin, in that part of the province of Brandenburg called the "Neumark." Mr. von dem Borne founded this establishment in 1876, entirely at his own expense, and he does not receive any subsidy whatever. As a general rule he does not carry on the business of selling eggs or fish, and merely labors in the public interest for the German Fishery Association.

The water of the Berneuchen establishment is brought from a stream called the "Mietzel," by means of a canal, which also furnishes the water-power for some mills. Its temperature varies very considerably; in winter it falls as low as zero (when I visited Berneuchen its temperature was 2° R. [36.5° F.]), and in summer it may get as high as 20° R. [77 F.]. The roof of the hatching-house is covered with tarred pasteboard, under which there are two thicknesses of boards, to which recently one of pasteboard has been added; one of the walls runs along the canal and is of masonry, while the others are of wood. Inside, the house is divided into 2 rooms; in the first there are 4 basins, 1 large and 3 small ones, intended for young carp; and the filtering apparatus. The water is made to pass through four compartments filled with sand, and through a flannel filter. From these filters the water passes into the second room, in the middle of which it runs in an open conduit of cement, from which by means of common faucets it is distributed to the right and the left. On both sides, and a little lower than the central conduit, there are cement basins, 7 on each side, about 2 meters long [6½ feet]. Each of these basins contain 4 California boxes, the 2 upper ones large, and the lower ones somewhat smaller, which serve for hatching salmon and trout eggs. For hatching *Coregonus* eggs a special apparatus is used, invented by von dem Borne, and called the "automatic selector." To each of these hatching apparatus there is attached a small box, intended to gather the young fry after they have slipped out of the egg. When this has taken place, the young *Coregoni* fall into the basins below, which have about 3 centimeters [1⅕ inches] of water, while the young salmon and trout are left in the hatching-boxes. The hatching apparatus have covers, because otherwise one rat could in one night destroy the entire contents. The room can be heated artificially. Besides eggs of various German salmonoids, I saw in process of hatching eggs of American *Coregoni* and *Salvelinus*.

Mr. von dem Borne also has 22 ponds, the largest covering an area of 11½ hectares [about 28¾ acres]. In these there live and are raised fish of many different kinds—salmonoids, cyprinoids, &c. In the majority of the ponds, however, there are carp, the ponds being arranged according to the Dubitsch system, already described by me in another report. Among the foreign kinds the black bass (*Huro nigricans*) from Florida deserves special mention, as Mr. von dem Borne has succeeded in propagating this fish in his ponds. This kind, like the bass and some other fish, deposits its eggs among stones; and it is therefore necessary to prepare a bed of small stones in the place where it is intended they shall spawn.

10. *Michaelstein*.—In 1880, by an agreement between the Governments of Prussia, Brunswick, and Anhalt, for the purpose of stocking the public waters of the Harz Mountains, a fish-cultural establishment was founded in Michaelstein, near Blankenburg, with Mr. Dreckmann, superintendent of forests, as director. After his death Mr. Wegener became its director. As far back as the Middle Ages there were in this neighborhood carp ponds, constructed by the monks.

The water comes from one of the ponds close to the establishment and passes through a small grating; thence it passes into a filter composed of six boxes, the first containing pieces of sponge, the second sand, the third again sponges, and so on, alternating. In winter the temperature of the water falls to the freezing-point. After the water has reached the hatching-room it is, by means of faucets, to which small flannel bags are sometimes attached with the view to better filtration, distributed through the apparatus, which are California boxes modified according to the Schuster system. These boxes are arranged on 9 wooden staircases, each of the 14 steps containing two boxes; therefore in all 252 boxes. Each box may contain about 10,000 trout eggs. There are also 4 large cemented tanks for grown trout, and some wooden troughs, which are only used in case of absolute necessity. Besides river trout, *Salvelinus* and American trout are raised in this establishment. Some of these, two years old and weighing about 3 pounds, have already propagated the species under artificial cultivation.

There are a great many ponds, some of which might possibly be used for trout, and others for salmonoids, while in others carp alone can be raised, because the bottom is too muddy for others. In these ponds are kept the fish which are to serve as propagators, and they are caught when the time for fecundation has come.

II.—SWITZERLAND.

11. *Neuhausen.*—This establishment is located about 300 meters [328 yards] from the celebrated falls of the Rhine. It belongs to the canton of Schaffhausen, which founded it in 1877. It is under the superintendence of Mr. Moser-Ott.

The water comes from a spring about 200 paces from the establishment, and is carried through a conduit about a meter and a half [5 feet] below the level of the floor. The temperature is not very high, nearly always 7° R. [about 48° F.]. It is not filtered. It rises to the ceiling of the hatching-house, whence it falls into a long, rectangular wooden basin, from which through vertical pipes it descends into the hatching-room below. To each pipe there are two troughs. These are of wood, about $2\frac{1}{2}$ meters long, 40 centimeters broad, and 20 centimeters deep [about $98 \times 16 \times 8$ inches]. They are arranged in couples, each couple having one pipe through which the water flows into the troughs, and one common outlet pipe. The number of troughs is 16. The water inside the troughs reaches a height of about 6 centimeters [$2\frac{1}{3}$ inches] during the hatching of the eggs, which are placed on frames of varnished iron wire, but after the eggs have been hatched the height of the water is reduced to 3 centimeters [$1\frac{1}{6}$ inches]. There are also in use small wooden troughs 80 centimeters long [$31\frac{1}{2}$ inches]. In the hatching-room, 10 meters long and $7\frac{1}{2}$ meters broad [about 33×25 feet], there is also a large tank for live fish.

The only kinds of fish raised at Neuhausen are trout, salmon, and *Thymallus*, with the view to placing them in the Rhine, on the account of the canton; but a small trade is also carried on, principally in fecundated salmon eggs which have not yet become embryonated.

There are two small ponds for keeping trout, especially males, which are to furnish the material for reproduction.

In the Neuhausen establishment about 500,000 eggs can be hatched at one time.

12. *Dachsen.*—On the opposite bank of the Rhine, a little farther distant from the falls, there is the establishment of Dachsen, on territory belonging to the canton of Zurich, which founded it in 1875, but reduced it to its present condition in 1881.

It is under the management of Director Asper, of Zurich. The water comes from springs close to the establishment and is collected in a reservoir, whence through a pipe it flows into the hatching-house. It is not filtered, but the end of this pipe has a grating to prevent any mud, leaves, &c., from entering. In winter its temperature is 5° to 6° R. [$43\frac{1}{4}$° to $45\frac{1}{2}$° F.], and is somewhat higher in summer. Inside the room the pipe conveying the water rises vertically from the floor and flows into a canal in the center, constructed of masonry, and raised about 2 meters [6½ feet] above the pavement. From this central canal the water flows into troughs, arranged perpendicularly on either side of the same, through pipes about 20 centimeters [8 inches] long, which empty into a flower-pot without bottom filled one-third with sand, resting on the network of metal wire, which covers the upper part of the trough. Thus the stream of water is broken in its fall, and is aerated. The troughs are of wood, 24 in number, and of the same dimensions as those used at Neuhausen. No frames are used, but the eggs, as well as the young fry, rest on a bed of sand and very fine gravel, at least 4 centimeters [1½ inches] high. Each trough may contain about 20,000 eggs.

As at Neuhausen, there are two ponds for trout, especially for males, selected as reproducers. The kinds of fish raised are salmon, trout, and *Thymallus*, for stocking the Rhine. No trade, properly so-called, is carried on; but exchanges are made with other establishments, for instance, with Hüningen.

13. *Zurich.*—The Zurich establishment is located at the place where the river Limmat flows out of the lake, and is under the immediate supervision of Dr. Asper. Like the Neuhausen establishment it belongs to the canton of Zurich.

The water comes from the Lake of Zurich. It is brought into the city by pumps, and is used by the people of Zurich as drinking water. Before being used it undergoes a thorough process of filtration. In winter its temperature is generally 3° to 4° C. [37.4° to 39.2° F.], while in summer it can reach and exceed 20° C. [68° F.]. It circulates inside the hatching-room by means of a pipe suspended from the ceiling.

The establishment is provided with hatching apparatus of different kinds: Wooden and zinc troughs, California boxes of various systems, small troughs of cement, &c. In the troughs the eggs are at first laid on frames of metal wire, but when they are near to being hatched they are placed directly on the bottom covered with gravel or sand. Salmon and trout eggs are hatched for the Limmat and the Rhine, and *Coregonus* eggs for the Lake of Zurich.

For the latter kind of fish the American method answers well; it consists in keeping the eggs in a kind of large cylindrical bottle of glass, with a large mouth, closed by a perforated tin lid, pierced in the center by a pipe through which the water passes, and again flows out through the holes in the lid. In this manner the development of the much-dreaded parasitical fungi is prevented, especially during the first period of the development of the eggs. When the eyes become visible the eggs are placed in an ordinary California box.

At Geneva, Zug, and in some other places another apparatus was used with considerable success, consisting of a large glass funnel, 30 to 40 centimeters [about 14 inches] high, which is filled with eggs till within a short distance from the top, and into which the water enters through the lower aperture, keeping the eggs in motion and carrying away the dead and spoiled ones, which are lighter than the others.

Dr. Asper has also been successful in hatching eggs of the American *Coregonus*, and has placed some young ones in the lake.

14. *Geneva.*—In the quarter of Geneva known as "Sous Saint Jean," is located the fish-cultural establishment belonging to the canton of Geneva, which at present is under the direction of Mr. Covelle.

The water comes from the Lake of Geneva, and is the same which is used as drinking water in the city. In winter its temperature is 6° C. [42.8° F.] and sometimes it falls to 4° C. [39.2° F.]; in summer it is very warm, but during that season no operations are carried on in the establishment. Generally it is not filtered, but when a north wind (the so-called "*bise*") prevails, it becomes turbid, and at that time it is, when coming out of the faucets, made to pass through a zinc box divided into two compartments, half filled with gravel. Mr. Covelle, however, proposes to substitute for these apparatus a large filter, to be placed outside the building.

The water runs along the walls of the hatching-room, which is 13 meters long and 12 broad [nearly 43 × 40 feet], in iron pipes, which are preferable to wooden ones, because parasitical fungi are not so apt to form in them.

In the hatching-room there are 28 troughs, placed in two double rows, each containing 7; they are cemented, 2½ meters long and 70 centimeters broad [about 98 × 28 inches] on the inside. The one standing against the wall is 20 centimeters [nearly 8 inches] higher than the outer one. For each trough there is a faucet, to which is attached a winding appendage of brass, with a small hole at the end; so the water does not flow out more than at the rate of 6 liters [about 6¼ quarts] per minute. Inside this tube is placed a small grating, which prevents all matter from stopping up the hole. The water flows from the upper trough into the lower one through a zinc pipe, to which is attached a distributing apparatus, which may also be attached to the upper faucet. The lower troughs have as an outflow a straight iron pipe, terminating at the top in a small grate.

These pipes, joined two and two, lead to a conduit under the pavement, which ends in a large basin placed at the end of the room, which serves for keeping, separately, the male and female propagating fish.

For hatching *Coregonus* eggs the funnel-shaped apparatus already referred to is used. It is provided with a metal edge with a vertical grate, which runs along a peripheric canal, whose opening communicates with the conduit of the edge, from which the young fish and the spoiled eggs fall, while the good ones remain at the bottom.

The hatching frames which Mr. Covelle places in the large troughs have a bottom of metal wire with very narrow interstices. I think, however, that a network with larger openings is preferable, which would allow the young fish to pass through soon after they are hatched. The bottom of the troughs is generally covered with very fine gravel.

The Geneva establishment hatches eggs of the Swiss and American *Coregonus*, *Thymallus*, and *Salvelinus*, but principally eggs of lake trout, of which about 500,000 are raised per annum. The attempt has been made to introduce salmon in the lake, but it has not proved successful.

III.—NETHERLANDS.

15. *Velp.*—The Velp establishment is near Arnhem, at a short distance from the castle of Billiom, on the river Yssel. Its director is Mr. H. E. Bontjes. It was founded in 1871, with a view to placing young salmon in the Yssel; but now it distributes them in nearly all the rivers of the Netherlands. The Dutch Government pays about 1 cent for every young salmon, and about 10 cents for every one-year-old salmon placed in public waters, expending for this purpose a total sum of nearly $5,000. The establishment consists of a large and very high hall, 15 meters long and 10 meters broad [about 49 × 33 feet].

The water used is spring water. It comes in an open canal, a distance of 4 to 5 kilometers [about 3 miles]. In winter its temperature sometimes falls to 1° C. [34° F.], and even lower, while in summer it rises to 20° [77° F.]. Near the establishment it is collected in galvanized-iron pipes, through which it flows into a basin placed in front of the house, whence it passes into another basin inside. The water first goes into a little room, and is gathered in a cask, through a metal grating intended to keep out all impurities; thence it passes, through a funnel filled with small sponges, into a large vat, half filled with gravel, and from this it goes into the hatching-room. In this room there are four rows of double troughs, in cement, arranged on six steps. The lower trough, however, is not divided, and each row therefore consists of ten vessels, each 2 meters long and 86 centimeters broad [about 79 × 34 inches], and of a last one twice as broad. In these troughs the salmon eggs are placed on Coste frames, which often have a network of clay pipe-stems. Above the cement troughs others, made of wood, can be placed. The water flows under the pavement of the hall, whence it rises vertically in pipes, through which it flows into the troughs.

Besides the two basins referred to for trout and one-year-old salmon, there are five basins for salmon, six for trout, and two for Chinese goldfish. During the first state the young fish are fed with brains chopped fine, then with heart, &c.

The establishment makes a specialty of hatching salmon eggs, of which it can hold 500,000. The eggs are mostly obtained from fish caught in the Netherlands, and in that case from dead females and from fish from the Upper Rhine. Besides salmon I have seen the eggs of trout and the American *Salvelinus* hatched in this establishment.

16. *Apeldoorn.*—The establishment of Apeldoorn, founded in 1880 by Mr. J. Noordhoek Hegt, is 4 Dutch miles from Apeldoorn. It receives its water from a spring at a distance of about 3 kilometers [nearly 2 miles],

which yields 10,000 cubic meters [about 350,000 cubic feet] of water per day. Close to the hatching house it falls about 4 meters [13 feet], and is partly gathered in an open wooden canal, which serves to bring it into the hatching house. It is not filtered. Its temperature, even in very cold winters, is 2° to 3° C. [35.6° to 37.4° F.].

There are in all seventy-two troughs, generally double, arranged in three rows. Some of them are still of wood, but they will soon be replaced by others of cement.

There are many ponds and basins for fish of different kinds, intended for raising fish and for selling them. The principal object of this establishment is to raise young salmon for the Rhine, but it also hatches eggs of common trout, lake trout, American trout, American *Salvelinus*, and California salmon; likewise crucians, carp, gold tench, and other cyprinoids.

IV.—Fish-Cultural Methods.

There are two methods in use for increasing the number of different kinds of fish: The first, in which human influence is reduced to its minimum, consists in placing the fish under the most favorable conditions for spawning. This may be called protective fish-culture, and is known by the name of "pond-culture;" it is particularly adapted to the cyprinoids, and among these specially to the carp.

By the second method the eggs are taken from the fish, mixed with the milt, and hatched, and the young fish are cared for and fed, until the suitable time has arrived for placing them in the water; natural processes are followed as closely as possible, and all hurtful influences kept away. This last is genuine artificial fish-culture, and is especially applicable to fish which, like the salmonoids, spawn in winter, and consequently do not develop too rapidly.

Protective fish-culture does not demand so much care as artificial fish-culture, and can easily be carried on even on a large scale. In following the protective method the fish-culturist should confine himself to providing favorable conditions for the fish which he intends to raise, leaving all the rest of the work to nature. If carp are to be raised, there are placed (in the spawning-season) in a small pond, covering an area of 1,000 square meters [10,764 square feet], which has been kept perfectly dry until a few days beforehand, two male and one female fish, which have been carefully selected. These fish will spawn in a few days, and the young fry will develop very rapidly. After they have lost the umbilical sac they should be placed in a larger pond, covering an area of at least 1 hectare [2½ acres], or in the waters for which they are intended. The bottom of the pond used for reproducing carp and other cyprinoids should be muddy; while for bass, American perch, and other fish it should be gravelly. By allowing the carp to spawn on juniper branches Mr. Eckardt has succeeded in conveying the eggs from one pond to the other, and he ships them by railroad in the same manner in which the eggs of salmonoids are usually shipped. An important condition for raising carp is that the ponds can be laid entirely dry.

The rules to be observed in artificial fish-culture are, however, much more numerous. According to Benecke they may be classed under the following categories: Obtaining and fecundating the eggs in an artificial manner, hatching them, raising the young fish until they have lost their umbilical sac, shipping them, and placing them in suitable waters.

The artificial fecundation of fish eggs is, at present, generally practiced according to the dry method, the Russian method of Wraskij. By a gentle pressure on the abdomen the mature eggs are extracted from the body of the female, and allowed to drop into a dry vessel; over the eggs is poured the seminal liquid obtained in the same manner from the male; the mixture is gently stirred with the hand, gradually adding a little water. Eggs have even been successfully fecundated which had been taken from female fish which had been dead several hours.

The best fish for propagators are those which are not too old; this applies particularly to the male fish. It is advisable not to use the same fish as propagators for several years in succession, with the view to avoid the evil consequences of the fatty degeneration of the genital organs, advanced age, and consanguinity. If the fish selected for the purpose of reproduction are healthy and fine, their products will be so likewise. It is possible to produce hybrids; but these, besides being barren, show a very high rate of mortality, and in my opinion their raising can not be recommended.

The eggs, after having become fecundated, are subjected to the hatching process. In a temperate climate this process may be effected in the open air and in open waters, in apparatus either floating or placed on the bottom of a brook or some other water-course; but it is always safer, and in most cases absolutely necessary, that the hatching should be done in covered and inclosed places, which are called hatching-houses. These should be constructed in such a manner that the water inside is not liable to freeze; they should have sufficient light, so that there is no difficulty in selecting the eggs; but the light should not be too strong, because this favors the development of algæ and parasitical fungi.

The principal question which should engage the attention of fish-culturists, is the selection of the water destined for the hatching-house. It should be clear, free from impurities, have a low and even temperature (possibly from 2° to 5° C. [35.6° to 41° F.]), and, what is still more important, should be abundantly aerated. These conditions are found particularly in brook water, which has only one fault, namely, that it is frequently muddy. Spring water is generally too warm and too little aerated, but both these defects may be remedied by letting it, before entering the hatching-house, run for some distance through a covered canal over a bed of gravel, and forming some little falls. Wherever these two kinds of water are found in the same neighborhood, it will be best either to use only one or to mix the two. Whenever brook water, and even when spring water is used, one should not fail to let it pass, before being used, through a filtering apparatus, which usually consists of one or more vats or basins half filled with gravel, through which the water is made to flow. Small pieces of sponge may also be used, and the American filters of flannel have also been found to answer the purpose very well. The modern hatching apparatus, in which the eggs can be stirred and washed without difficulty, render it less necessary to filter the water.

In cold countries all possible precautions should be taken to prevent the freezing of the water, by placing the pipes through which it flows before entering the hatching-house at a certain depth below the ground, and by enveloping them in straw or other non-conductors of heat.

Inside the hatching-house the water should be gathered in a reservoir, or should run in a canal (an open one to be preferred) at a height of at least 2 meters [6½ feet] above the pavement; the canals may be of wood, cement, or metal, according to circumstances, and from them the water should fall vertically into the hatching apparatus placed below. The object of letting the water fall from a certain height is to add to its aeration; special contrivances attached to the pipes may also serve this purpose.

The hatching apparatus generally used in large fish-cultural establishments are cement troughs, as being the most durable and less apt to favor the development of parasites on the eggs. The eggs may be placed in these troughs, on frames with a wire bottom, the bottom being covered with very fine gravel. Wherever water is abundant it is advisable that each trough should have a separate faucet, because if parasites should develop in any one of them the infectious germs can easily be removed. Even wooden troughs may be used, provided they are carbonized on the inside, or at least tarred. In small, especially private, establishments the most useful hatching apparatus is the California box, of whatever model it may be. Those, however, are preferable in which the water flows through a very large opening.

After the eggs have been placed in the apparatus strict watch should be kept over them to remove immediately all those which have not been properly fecundated, which show traces of disease, or have become opaque. The eggs should be kept in the dark, because light favors the development of fungi and parasitical algæ. All hatching apparatus, no matter of what kind, should be provided with strong covers to prevent mice, rats, &c., from entering.

When the eggs are near being hatched they can, if they are on frames in large troughs, be taken off the frames and placed on the bottom, or placed in special apparatus. If, on the other hand, they are in California boxes, it is not necessary to do this. Great care should be taken to remove at once spoiled eggs or dead young fish, as the presence in the apparatus for any length of time of one dead body may cause the death of thousands of healthy eggs or young fry. To obviate this difficulty, the water should never cease to run into the apparatus freely. Whenever the fish begin to be less lively than usual and there is reason to suspect the development of the much-dreaded fungus (*Saprolegnia*), endeavors should be made to prevent its spread by throwing a large quantity of salt into the water. In some cases excellent results have been obtained by raising fresh-water fish in sea water. When the young fish are intended for public waters it is best to place them there some days before they have lost their umbilical sac, so they may become somewhat accustomed to their new element before they are compelled to seek their food. They should not all be put into the water at the same time and at one and the same place, but be scattered over a larger surface of water, selecting localities which contain the conditions favorable to their existence. Instead of quite young fish it would be preferable to put into open water fish about one year old, which are stronger and are not exposed to so many dangers. If the young fish are to be fed artificially the first food should consist of brains chopped very fine; afterwards they may be given meat chopped fine, fish eggs which have not been fecundated, ground meat (meat flour), and larvæ of flies. When they are two to three years old fish begin to be capable of propagation.

Fecundated eggs may be transported without any danger at two periods, immediately after fecundation and after the points of the eyes begin to show in the embryo, while during the first stage of the development even the least shock may cause the death of the embryo. The eggs are wrapped in a small piece of moist muslin and placed on a bed of moistened wadding, which in its turn rests on a bed of moss. They are covered with a similar layer of wadding and moss, on which another layer of eggs may be placed. In this way they can be shipped a considerable distance, placing on the top of the whole pile a small piece of ice, which serves to keep the temperature low, and which should be renewed from time to time. The box containing the eggs is placed inside another larger one, and the space between the two boxes is filled with sawdust, hay, &c.

The American fish-culturist, Fred Mather, has invented an apparatus, a sort of chest with different bottoms, which is used for transporting the eggs which the German Fishery Association receives every year from the U. S. Fish Commission. The first attempts to convey eggs such a distance were not successful, but at present they are shipped with perfect safety.

It is much more difficult to transport young fish, owing to the necessity of having the water aerated. For this purpose Schuster and others have constructed vessels to which air-pumps are attached, but according to Haack and others, these are not absolutely necessary; if great precaution is taken, and the water is changed as often as possible, using also ice, so that the water does not get too warm, the young fish may be shipped a considerable distance without great loss. The consignment of fish should in every case be in charge of a practical, intelligent, and reliable person.

There is of course much less difficulty in transporting grown fish. Director Haack has succeeded in transporting alive from Pisa to Hüningen young eels, known under the name of "blind eels."

In Italy the first attempts to stock the public waters with fish were made by Professor De Filippi, and continued during the last few years, by the aid of the ministry of agriculture, industry, and commerce, by Professor Pavesi. But in order to make these experiments with the certainty of favorable results, they should be preceded by investigations relative to the physical and biological conditions of our fresh waters, such as Professor Pavesi has made in some of the lakes of northern Italy, Lake Trasimeno and Lake Albano.

All the kinds of salmonoids found in Central Europe, with the exception of the Rhine salmon, the Danube salmon, and the different kinds of *Coregonus*, are also found in the fresh waters of Northern Italy; and it is therefore certain that these efforts to increase the fish in our waters will be crowned with success. The trout, the *Salvelinus*, and *Thymallus* could easily be cultivated, and there is also reason to hope that the *Coregoni* introduced at first in Lake Maggiore by Professor De Filippi, and recently in Lake Como by Professor Pavesi, will become acclimatized and will propagate.

In Central and Southern Italy only trout are found; but it would not be difficult to increase their number in the upper tributaries of the Arno, the Tiber, and in all the streams of fresh waters coming from the Apennines. I have not yet been informed of the results of the attempts made during the past year to introduce Rhine salmon in the Po and the Pescara. During my stay in Germany, I was advised more than once, especially by the illustrious president of the German Fishery Association, von Behr, to attempt the acclimatization of the California salmon (*Oncorhynchus chouicha*), which lives in localities whose natural conditions greatly resemble those of Italy. The non-migratory salmon of the Schoodic Lakes (*Salmo sebago*) might be raised to advantage in the deep lakes of Northern Italy, and the volcanic lakes (craters) of Central Italy.

Throughout the whole of Italy, but especially in Central and Southern Italy, the industry of carp culture is, as I think, destined to be developed veloped on a large scale; so far it has been introduced in some lakes and ponds. Mr. Max von dem Borne also advised the cultivation in Italy of the American black bass (*Huro nigricans*). It is true that it is a very voracious fish, but the same may be said of the pike; and yet they do not destroy all the other fish in the waters in which they are found; suitable precautions and careful watching may prevent much of this evil; and there is no reason to exaggerate the dangers to which one kind of fish is exposed by another.

Fish-culture in Italy, especially in its southern portion, presents doubtless fewer difficulties than in Central and Northern Europe, by reason of the milder climate, which does not expose the water in the hatching-house to the danger of freezing, and renders unnecessary many of the precautions which have to be taken in a more northern climate.

There are two methods of stocking with fish the fresh waters of a country: The founding of large central establishments of fish-culture, or of small fish-cultural stations scattered throughout the country. It has now been demonstrated that the second method is the better and more practical of the two. Large fish-cultural establishments are in nearly all cases more subject to diseases which destroy the eggs and the young fish than small ones. "Splendid results may be expected from fish-culture only when every one has become his own fish-culturist," says von Behr, and with good reason. But in order to obtain these results it is necessary that this industry should become more general and should be prized as highly as it deserves, and this can only take place after long and patient labor, and if the proper impetus is given by the Government. This is the grand service which the Hüningen establishment has rendered to the whole of Europe. But when fish-culture has entered the field of private enterprise the Government should cease to carry it on. This is also the opinion of the eminent director of the Hüningen establishment, Mr. Haack. The large fish-cultural establishments should be the centers from which this industry is spread, and they should make efforts to start as large a number as possible of small establishments throughout the country.

This result has been reached perhaps in the most satisfactory manner in Saxony, since in that kingdom there were, at the end of 1882, not less than 73 fish-cultural establishments, both large and small, or one to every 40,000 inhabitants and to about 200 square kilometers [77 square miles]. This result is due particularly to the efforts of Doctor Nitsche, professor of zoology in the Academy of Forestry at Tharand. Since 1878 he has given a special course of lectures on fish-culture, lasting not longer than a week. These lectures have been attended by the students of the academy and by many other persons, among the rest several fish-culturists. In most cases the inspectors of forests, both Government and private, have founded the different fish-cultural establishments, and have done their share in diffusing the practice of fish-culture. The same could be done in Italy. The Institute of Forestry at Vallombrosa possesses, as I think, all the necessary material for a course of fish-culture. This course should be made free to all, so that it could be attended not only by the students of the institute, but also by persons employed in the superintendence and care of forests. The course should not merely comprise theoretical instruction relative to the physiology and reproduction of fish, the histological development of the embryo, &c., but it should be essentially practical and brief, occupying in all not more than three or four weeks, divided into different periods, and thus it will be possible for the employés of the forest service, the only service which at present can be counted on in this respect, to become practically acquainted with fish-culture.

In conclusion it cannot be denied that in Italy the sea fisheries are of greater importance than the fresh-water fisheries; but at the same time it should be stated that even in the sea man may exercise a beneficial influence on the propagation of fish. We have an example of this by what is done in this direction in America as regards the cod, and in the Baltic as regards the herring. Some of our efforts should, therefore, be directed to salt-water fish-culture, which is destined in time to produce still greater results than fresh-water fish-culture.

GENOA, *August* 6, 1885.

[*After visiting and studying the principal fish-cultural stations of Germany, Switzerland, and the Netherlands in 1884–'85, under orders from the Italian Government, Dr. Bettoni and Dr. Vinciguerra advised the establishment of two somewhat similar stations in Italy. The principal fish which they pointed out as suitable for cultivation were salmon, trout, and carp. Bolsena was mentioned as the most favorable place in Central Italy for one such establishment. The plan for the station contemplated a hatching-house, with all the necessary apparatus, an artificial canal from a small stream to the Lake of Bolsena, and the construction of two large ponds, each with an area of 1,000 square meters [nearly ¼ acre] and a depth of one meter [3¼ feet]; these ponds being intended for the cultivation of carp on the Dubitsch system. Besides these ponds, two rectangular basins were to be laid in cement, each with an area of 12.5 square meters [134.5 square feet], and two other basins, one round and the other elliptical, to be used as stock and winter ponds for carp and other fish. The total estimated cost for starting this station was about $2,350. Brescia was proposed for the location of the establishment in Upper Italy, on a somewhat larger scale than the one at Bolsena. The plan contemplated making a large canal and two small ones, emptying into a pond of irregular shape, having an area of 246 square meters [2,648 square feet]. From this pond another canal is to start, feeding a large hatching-house and supplying water for three circular ponds with an area of 495, 128, and 110 square meters, respectively [5,328, 1,378, and 1,184 square feet]. There are to be also four rectangular ponds, in pairs, each covering 414 square meters [4,457 square feet], and two large rectangular ponds, each with an area of 506 square meters [5,447 square feet]. The building is to contain, besides hatching-rooms furnished with the latest improved apparatus, a room for the director, one for a laboratory, and one for a small museum. The total estimated cost for the Brescia station was about $4,650.]

*This paragraph is not a part of Dr. Bettoni's report, but is from an article by Prof. P. Pavesi relative to the establishment of fish-cultural stations in Italy. It is inserted here as showing one of the results of Dr. Bettoni's work.—EDITOR.

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[NOTE.—The references are to page-figures in brackets.]

APPENDIX D.

REPORTS OF VESSELS AND STATIONS.

VII.—REPORT ON THE WORK OF THE UNITED STATES FISH COMMISSION STEAMER ALBATROSS FOR THE YEAR ENDING DECEMBER 31, 1886.

BY LIEUT.-COMMANDER Z. L. TANNER, U. S. N., COMMANDING.

The vessel was at the navy-yard, Washington, D. C., on the first of January, practically ready for sea, although the mechanics were still at work on one of the boilers. Cold weather coming on at this time, the Potomac was frozen over and all navigation ceased.

Lieut. Seaton Schroeder, executive officer and navigator, was detached on January 2, and Lieut. H. S. Waring assumed his duties. Ensign W. S. Benson reported for duty on the 13th, and Ensign W. S. Hogg on the 16th.

We were detained by ice until 7 a. m., February 17, when we cast off from the wharf and steamed down the Potomac river. Several buoys were out of place, and after passing Glymont considerable floating ice was encountered. A heavy gorge was found between Upper and Lower Cedar Points, but we passed it without difficulty or delay. We anchored in Hampton Roads at 1.30 a. m., February 18, and at daylight got underway for the navy-yard, Norfolk, Va., where we arrived and moored to the coal wharf at 8.30 a. m. Having telegraphed our departure to the commandant, we found 100 tons of coal on the wharf awaiting our arrival, thus saving us a day in coaling.

At meridian February 20 we left Norfolk, and proceeded to sea under the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., February 1, 1886.

SIR: For the purpose of extending researches commenced by the Albatross into the distribution and habits of the more important food-fishes of the United States, especially of the mackerel, menhaden, bluefish, etc., you will proceed, as soon as the steamer is ready, to Norfolk, Va., there, if convenient, to go into dock, and then take on board coal for the trip. After that you will continue the voyage, at the earliest possible moment, to the waters of the Bahama Islands, as there is reason to believe that the yet undetected winter abode of the fish mentioned may be found to be in that vicinity.

If encountered, you will note the comparative number of the fish, their character and peculiarities; and also determine whether they carry on the operations of spawning, and, if so, under what circumstances. You will also note any facts that may present themselves to you as to other species of fish, such as sheepshead, Spanish mackerel, drum, and other useful food-fishes known on the coast of the United States or peculiar to those waters; and will secure specimens of the various kinds for the purpose of more critical examination on the return of the vessel to Washington.

As in previous cruises, you will make collections by trawl, dredge, or otherwise, of the marine animals inhabiting the waters, whether vertebrate or invertebrate, and will gather as many data as you can respecting their relationship to each other and to their physical surroundings.

The Navy Department having expressed a desire to have a series of soundings made in the Bahama seas for the purpose of extending our hydrographical knowledge, you are authorized to do what you can in this connection without endangering the safety of the men or the vessel under your command. It is understood that the extra expense of any work done in behalf of the Navy Department is to be defrayed by a supply of coal not to exceed 200 tons for the trip; and for this the Department has authorized you to call upon the coal depots at Key West or Pensacola.

You will give the scientific corps accompanying the vessel all possible facilities in carrying out their investigations, allowing them such opportunities for visiting the shores and bringing them on board again as may best aid in their work. Mr. James E. Benedict, as heretofore, will act as chief of the scientific party, aided by Thomas Lee and Willard Nye, jr.

Respectfully,

SPENCER F. BAIRD,
Commissioner.

Lieut.-Commander Z. L. TANNER,
Commanding Steamer Albatross, Navy-Yard, City.

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., February 2, 1886.

DEAR SIR: In continuation of my original detail of Messrs. Lee and Nye as assistants to Mr. Benedict in the natural history work of the Albatross during her coming cruise, I have taken advantage of the return from California and the Arctic Ocean of Mr. Charles H. Townsend, of the Fish Commission, and arranged to have him accompany the vessel on the Bahama trip. He is a gentleman of most excellent qualifications, and I have no doubt you will find him a pleasant addition to the scientific corps.

You will please arrange to have him mess in the ward-room, and give him comfortable accommodations in any stateroom that may be vacant.

Mr. Townsend is an accomplished collector and naturalist, and has been in the service about three years.

Yours truly,

S. F. BAIRD.

Capt. Z. L. TANNER,
Commanding Steamer Albatross, Navy-Yard, City.

BUREAU OF NAVIGATION, NAVY DEPARTMENT,
Washington, D. C., January 18, 1886.

DEAR SIR: I learn from Lieutenant-Commander Tanner, commanding the U. S. Fish Commission steamer Albatross, that it is your intention that the vessel shall cruise in the vicinity of the Bahama Islands and the Gulf Stream, engaging in work connected with the Commission, and that it will not interfere with this work for Lieutenant-Commander Tanner to fill several important gaps in the lines of deep-sea soundings in that vicinity, provided that the additional coal required for this purpose can be transferred from the Navy Department.

I have therefore to request that, if practicable, the necessary soundings indicated in the accompanying chart by red lines may be taken, and to state that the actual amount of coal consumed by the Albatross for steaming purposes, while so employed, will be issued to that vessel at Key West, not exceeding in amount 200 tons.

Very respectfully, your obedient servant,

J. G. WALKER,
Chief of Bureau.

Prof. SPENCER F. BAIRD,
Commissioner of Fish and Fisheries, Washington, D. C.

We passed Cape Henry at 2.40 p. m. with clear weather and moderate NW. gale. Cautionary off-shore signals were flying at Norfolk, Fortress Monroe, and Cape Henry. The wind continued during the night, and at meridian the following day backed to SW., blowing a fresh gale until noon of the 22d, gradually decreasing in force to a moderate breeze from west in the evening.

We commenced sounding to the northward of Great Abaco on the morning of the 23d, in 557 fathoms, latitude 28° 41′ N., longitude 78° 03′ W., and ran a line to the eastward, reaching a depth of 2,845 fathoms, in latitude 28° 43′ N., longitude 76° 26′ W.

From 5 to 5.30 p. m. we swung ship under steam, observing azimuths of the sun on every other point of the compass in order to ascertain errors due to local attraction.

We then steamed to the southward, and at 12.51 a. m. on the 24th sounded in 3,196 fathoms, latitude 28° 34′ 42″ N., longitude 76° 10′ 25″ W. This depth was a surprise to us, as the soundings on the chart to the northward and southward did not lead us to expect more than 2,800 fathoms. A line was then run to the southward, terminating in 677 fathoms, latitude 27° 38′ N., longitude 76° 23′ 24″ W., thence to the northward and eastward to latitude 27° 51′ N., longitude 75° 53′ 30″ W., where a depth of 2,599 fathoms was found. The wire parted while reeling in, and we lost the specimen cup and thermometer. The break was attributed to an imperfect splice, but we subsequently learned that it was caused by a partial collapse of the drum.

The weather was boisterous during the day, and although the work was carried on successfully, it was at considerable expense of labor and fuel and no little personal discomfort.

The wind continued from east to south during the 25th, with a heavy head sea. One sounding only was taken during the day, in 2,761 fathoms, latitude 27° 30′ N., longitude 75° 35′ W. The wire parted again while heaving in, and the thermometer and specimen cup were lost. The line was continued to San Salvador, or Watling's Island, the greatest depth found being 2,709 fathoms. We reached the island and anchored off Cockburn Town at 9 p. m. on the 26th. The settlement as seen from seaward consists of a small group of white houses, a tall flagstaff, and two or three boat-houses on the beach. In approaching from the northward, Riding Rock Point will be recognized by three isolated palm trees just back of it, overtopping all other foliage. The coast from the point to the settlement is a series of low rocky cliffs, a white sand beach commencing at the latter point. To reach the anchorage, bring the flagstaff to bear east and stand in slowly, keeping the lead going, and anchor in from 14 to 7 fathoms, white sand bottom. Boats land on the sand beach in front of the settlement.

There is a light-house in process of construction on Dixon's Hill, about two miles from NE. point, and one mile from the eastern shore. The tower is of limestone and is being built in the most substantial manner. Its base is 100 feet above the sea, and the center of focus 65 feet above the base, making a total height of 165 feet above the sea. It is to have a first-order lens, and will be completed in about a year.

Water is procured from wells, and is very hard. Good mutton, fowls, eggs, sweet potatoes, and the fruits of the season can be procured at fair prices.

The magistrate, Maxwell Nairn, esq., the only white man living on the island, is a naturalized American citizen, and was formerly a ship-master sailing from Philadelphia. Lieut.-Commander James M. Forsyth, U. S. N., a relative of Mr. Nairn, had written him of our coming, and he had been looking for us for several weeks. He received us very kindly and made prompt and very satisfactory arrangements for the accommodation of a couple of naturalists we wished to leave on the island while the vessel went to Rum Cay. He gave his office for a laboratory and sleeping quarters, and took them to his own table for meals.

Messrs. Lee and Nye were detailed to remain behind, and they were landed on the morning of the 27th with everything necessary for the prosecution of their work. After seeing them established in their new quarters we got under way about noon and ran a line of soundings to Rum Cay, the greatest depth of water being 1,264 fathoms, white coral ooze.

We arrived and anchored in Port Nelson, Rum Cay, at 5.30 p. m., hauled fires, and made preparations for work on and about the island.

We were met here by still other friends and relatives of Lieut.-Commander Forsyth, whom he had informed of our expected arrival. They exerted themselves to make our stay pleasant and rendered material assistance in the prosecution of our work.

The following day being Sunday no work was done. The collectors were away at early daylight on Monday, and their explorations were prosecuted vigorously during the remainder of our stay. On board ship we overhauled the sounding apparatus, and while transferring the wire from the working reel for the purpose of overhauling splices, &c., we found the drum partially collapsed, thus accounting for our loss of wire on the outward trip. We then mounted a new and heavier reel. Should it show signs of weakness, it would be advisable to adopt some other and stronger type, which can, I think, be readily procured.

A plan of Port Nelson and St. George's Bay, or Man-of-War anchorage was made by Lieutenant Scott, assisted by Ensign Hogg.

We made a fair collection of the fishes of the island, but our attempts to gain information regarding their spawning habits resulted in absolute failure, the natives having little or no knowledge of the subject. When questioned about migratory fishes, such as mackerel, shad, and menhaden, they said they were unknown among the islands, but blue-fish were taken at any season of the year. I was unable to identify the blue-fish of the islands with our northern fish of that name, those I saw being "parrot fish," of a deep blue color and called blue-fish by the natives.

We continued our practice of rendering medical aid to the people of the islands where they had no resident physician, the ship furnishing necessary medicines if they could be spared from the stores. Dr. Flint gave a portion of each day to the care of the sick, and his name will be long remembered by the people of Rum Cay for his kindness and attention.

The harbor and settlement of Port Nelson lie on the south side of Rum Cay, about 6 miles east of Sandy Point, the western extremity of the island. The harbor is formed by a reef running westward from Sumner's Point. The channel is narrow and intricate for vessels of more than 10 feet draught, and should not be attempted without a pilot; 18 feet can be carried through the channel.

St. George's Bay, or Man-of-War anchorage, lies to the westward of Port Nelson, and is in fact a part of the same bay, separate names being given to designate different localities in the same harbor. It is easy of access, the channel being straight and clear, with a depth of 24 feet. A vessel intending to enter St. George's Bay should keep in blue water, outside of the reef, until the conspicuous white house on Cottonfield Point bears N. by E.; then stand in for it until inside the reef, when she may anchor in any desired depth, white sand bottom. This anchorage is safe in all ordinary weather.

The settlement of Port Nelson will be recognized at a distance by a grove of tall cedar trees near the center of the village which overtop all other foliage. The Government flagstaff marks the head of a small wharf having 4 feet of water at its outer end. The white house referred to on Cottonfield Point is about 1¼ miles to the westward of the flagstaff.

A poor quality of beef, good mutton, fowls, eggs, sweet potatoes, and fruits of the season were obtained at fair prices. The water is procured from wells in which the tides rise and fall, and is decidedly hard.

The following brief historical sketch by Lieut.-Commander James M. Forsyth, U. S. N., a native of the island, is replete with interesting facts and reminiscences:

"Rum Cay, one of the Bahama group, is probably identical with Santa Maria, the second island touched at by Columbus. Little is known of its history until the latter part of the eighteenth century, when, with the adjacent islands, it became the refuge of a number of loyalists from the Carolinas and other parts of the United States. Most of these refugees had been engaged in cotton growing in their former homes, owned slaves whom they brought with them, and continued the cultivation of cotton. The island at this time was well wooded, and in clearing for fields the *lignum-vitæ* and the dye woods not only paid all expenses, but gave a fair profit. The cotton, hard wood, and dye woods were annually shipped to England through agents in Nassau, and supplies were received at the island through the same channel. Later on, probably about 1818, the salt industry began to be developed. The island has one of the best salt ponds in the Bahamas, lying convenient to a safe and commodious anchorage. The salt was manufactured by solar evaporation, and exported direct to the United States and British provinces. For a period of about fifty years the island was fairly prosperous. Then the abolition of slavery began to be pressed on the colonists by the British government, causing an unsettled state of affairs until, finally, emancipation was proclaimed. Naturally this worked great changes in the control of labor. The wants of the newly liberated slaves were few and simple, and in a country where the climate was mild and sea and soil readily yielded the mere necessaries of life, the laborer with his new found liberty was quite independent. Some of the proprietors of land became disheartened and left the island. Those who remained found that cotton could not be profitably cultivated with the uncertain labor of their former slaves, and as the supply of valuable woods was about exhausted, salt became the leading product. From 1840 to 1852 there was exported from Rum Cay between 100,000 and 250,000 bushels of salt yearly, reaching the highest production in 1852. The prices, paid on delivery on board generally cash down, ranged from 10 to 15 cents a bushel; 10 cents was considered fair profit, 12 cents very good, and 15 cents extra. In November, 1853, a severe hurricane struck the island and caused great damage. The sea broke into the reservoir of the salt pond, injured the canals and wharves, and gave the salt business a set-back from which it never fully recovered. During the Crimean war, 1854–'56, prices went up to 25 cents a bushel. The demand exceeded the supply, for the damage inflicted by the 1853 hurricane limited the production. Since that time the output of salt has gradually decreased, and is now small, the shipment of a cargo being an event. This decline of production was due to various causes, foremost among which were competition, sharply pressed, and the protective tariff placed on salt by the United States. Early in the fifties the salt ponds at Inagua and Fortune Islands were taken hold of by enterprising men who commanded capital. Superior facilities for loading and quicker dispatch were promised to vessels and great pains taken to secure charters in the United States and at St. Thomas (at that time a noted port of call for West India traders who were in search of homeward bound cargoes). This turned the trade into a new channel. Then the United States tariff on salt cut the price down so low that profit on the industry was impossible. With the loss of this trade the population decreased, people leaving the island to search for employment. In 1850 the population was about 800, of whom 35 were whites. At present it is about 350, of whom 3 are whites. The inhabitants are as a whole an industrious, law-abiding people. Their deliberate methods of labor are at times aggravating to foreigners, yet they are capable of long-continued and severe effort and will work faithfully when sure of fair wages and certain pay. At plodding, steady labor they do not excel, a trait more the effect of climate than anything else. In the season of salt raking and the loading of vessels their quick, cheerful mode of work cannot be surpassed. The strong hold the salt industry had on the laboring class was due to the fact that the main work was done in large companies with song and excitement, the returns were prompt and distributed almost at once, whilst there were long periods when the laborer was at liberty to enjoy his ease in a fine climate and work as he pleased on his own little holding. Emancipation was disastrous to the proprietors, but shows a strong balance in its favor in the comparative happiness and comfort it has given to the colored people. Even those who mourn most over the decadence of the Bahamas must admit that it has proved to be the greatest good to the greatest number. At Rum Cay all business is in the hands of the blacks, several of whom show marked ability, integrity, and intelligence. There are several churches and a public school, where the rudiments of an English education are taught. The inhabitants of this island as a community were never wreckers. They are skillful and fearless boatmen, good fishermen, and make capital sailors on the small craft of the Bahamas. They still cling to the hope that the removal of the United States tariff on salt will restore some of the old-time prosperity, but there is doubt if such would be the case. The trade has sought new channels and is hard to turn back; and new deposits of salt have been found in the United States. The use of canned provisions for sea life, and the supply of armies and navies, has lessened the demand for salt provisions, so that the future of the island must depend on agriculture and stock raising.

"Pineapple culture has been started of late years, the first cargo being shipped to the United States about 1878. At present four or five cargoes are shipped every year, and the prospect for success is good. Fiber plants of several varieties grow readily and efforts are being made to cultivate them. Some attempt is also being made to establish cocoanut groves. The agricultural products of the island were never sufficient to support the population, mainly because more attention was given to salt raking as more remunerative. Supplies were obtained from Watling's and Long Islands. At present, with a reduced population, the products are still insufficient to supply the people, though Indian corn, Guinea corn, sweet potatoes, yams, peas, tomatoes, beans, okra, melons, bananas, plantains, and oranges are produced. Cattle, sheep, and hogs are reared to some extent and shipped to Nassau. Under a careful system of agriculture these products might be largely increased, but unfortunately a method of working land on shares, established just after emancipation, has educated the laborer into carelessness as to the life of the soil. No manuring is attempted, and land is worked until it is exhausted; then new tracts are cleared. A liberal use of fire in clearing often does harm. The soil is light and mainly composed of vegetable mold and is injured as to producing qualities by the passing over it of the flames. This working on shares, with its inherent defects, is not the fault of the colored people, but is rather a legacy from the old slavery times, when, after emancipation, the freedman had no capital but his daily labor, whilst the proprietors held the land. The only way to bring land and labor together was to start this share culture, one-third of the product going to the land owner. This system is, however, steadily being displaced by that of the small freeholder. The colored man's first ambition is to own his house and plot of ground. The descendants of the slaves are therefore buying land from the government and the descendants of the slave-owners, often becoming owners of the land where their forefathers were held in slavery, so that at the present time a large portion of the island is owned by the colored race. The soil will give rich returns when carefully cultivated, and as a quiet home for the small freeholder of the colored people it can hardly be equaled. A bad year may come, caused either by drought or hurricane, but a little forethought in the good years will render the owner of five or ten acres of land more independent and comfortable than a laboring man can possibly be anywhere else in the world. Land is cheap, government lands selling at five shillings sterling per acre. There is no tax on land, so with ordinary industry a home may easily be kept. If there was a sure market and quick transportation for fruit and vegetables production would be stimulated, for each owner would strive to keep his holding at its best. The day may come when, with the waters of the Bahamas used as a winter cruising-ground by American yachtsmen, and Nassau the headquarters and winter resort it should be, there will be the desired increased demand for out-island produce and an incentive given to more careful and thorough work."

At 5.50 a. m., March 8, we got under way and ran a line of soundings to Conception Island, the greatest depth being 1,017 fathoms. Arriving off the western side of the island about 11 a. m. the naturalists went on shore for a few hours. We, in the mean time, steamed several miles off shore and lowered the trawl in 1,169 fathoms, white coral ooze bottom. After dragging a few minutes it fouled on one of the projecting coral rocks which crop up at intervals throughout the Bahamas, even in the deepest water. We succeeded in getting the trawl on board, with the net somewhat torn, after several hours' effort, only to find a few shrimp, a small octopus, and a few minute forms in the bag. Our experience has been the same on all coral sand or ooze bottoms, which seem to be almost barren of life.

The naturalists returned at 2.45 p. m. with a large number of birds and, the trawl being up, a few minutes later we started ahead, running a line of soundings to Columbus Point, Cat Island, the greatest depth being 845 fathoms, developing a connecting ridge between the islands.

We sounded in 22 fathoms on the reef off Columbus Point about dusk, and a few minutes later slowed down and put over the large surface tow-net. Very little life was found. During the night a line of soundings was carried to Watling's Island, developing a depth of 2,482 fathoms. At daylight on the morning of the 9th we anchored off Cockburn Town, took Messrs. Lee and Nye on board, and returned to Rum Cay, anchoring in St. George's Bay at 4.40 p. m. We were under way at 6.15 a. m. on the 10th, and ran a line of soundings to Cape Sta. Maria, north end of Long Island; thence to the SW. end of Cat Island, where we arrived at 5.27 p. m. and anchored for the night at Hawk's Nest anchorage. The greatest depth found during the day was 1,398 fathoms, between Rum Cay and Long Island, and 1,056 fathoms between the latter and Cat Island.

Hawk's Nest anchorage is safe and convenient, with northerly or easterly winds. We anchored in 7 fathoms, white sand bottom, the buildings on Hawk's Nest hill bearing ENE., with the western extremity of the reef about 300 yards distant.

The naturalists landed at daylight the following morning and returned at 10.30 a. m., when we got under way and ran a line of soundings across Exuma Sound to the NW. end of Exuma Island, thence to the south end of Eleuthera Island, arriving and anchoring at Miller's anchorage at 6.43 a. m. on the 12th. The naturalists landed an hour later and made a successful hunt for birds, reptiles, &c.

At 1.50 p. m. we got under way and made two hauls with the tangles on the edge of the reef in 36 and 369 fathoms. The bottom was exceedingly rough, the tangles fouling soon after they landed on the reef. We secured very few specimens beside fragments of coral rock which were detached by dragging the apparatus over the uneven surfaces. Finding the work difficult and almost wholly unproductive, we returned to our anchorage at 4.55 p. m.

We were under way again at 1.16 a. m., March 13, and ran a line of soundings to Wide Opening, thence to the head of the Sound. At 2.05 p. m. we lowered the trawl in 791 fathoms, white coral ooze, landing it on deck at 4.53 p. m., with a few shrimp, a fragment of a holothurian, a quantity of dead coral, &c., the mud-bag being filled with the white, pasty ooze of the bottom.

The results of this haul confirm our former experience of the barrenness of waters where the bottom is composed of coral sand or ooze. The haul finished, we started for the channel between Eleuthera and Little San Salvador Islands, sounding 1½ miles inside the reef in 476 fathoms, and one-half mile outside in 926 fathoms. The depth increased to 2,664 fathoms 30 miles to seaward in a northerly direction, latitude 25° 2′ 45″ N., longitude 75° 43′ W. Having completed the line, we steamed for N.E. banks off Northern Eleuthera, running a line of soundings from 11 fathoms on the banks, to 2,663 fathoms, latitude 25° 44′ 45″ N., longitude 76° 23′ 15″ W. The last sounding was taken at 5.10 p. m., March 14. We then stood for Nassau, New Providence, under low speed, arriving and mooring in the harbor at 7.15 a. m., March 15. We were visited by the harbor-master and health officer, and promptly granted pratique. A boat was sent for the United States Consul, T. J. McLain, who visited the ship. At 3 p. m., accompanied by the United States consul, I made an official call on his excellency the governor, Henry A. Blake. It being the closed season, a license for our naturalists to shoot birds for specimens was requested, and granted as follows:

GOVERNMENT HOUSE,
Bahamas, March 17, 1886.

In virtue of the authority vested in me by the terms of the 48th Victoria, chapter 10, I hereby grant permission to the undernamed persons to take, during the year 1886, whatever birds or eggs of birds, protected by the provisions of the said act, they may require for the purposes of the scientific expedition of which they are members.

HENRY A. BLAKE,
Governor.

Jas. E. Benedict, C. H. Townsend, F. L. Washburn, Thomas Lee, W. Nye, jr.

HENRY A. BLAKE,
Governor.

The birds mentioned in the act are: Wild pigeons, partridges, doves, flamingoes, boobies, man-of-war birds, pimlies, noddies.

The governor very kindly sent us the following letter also, which is evidence of his friendly interest in our work, and desire to assist in its prosecution:

GOVERNMENT HOUSE,
Nassau, March 17, 1886.

To whom it may concern:

The governor requests that public officers and other inhabitants of the islands of this colony will afford every assistance in their power to the naturalists on board the U. S. S. Albatross, who are engaged in scientific investigations.

HENRY A. BLAKE,
Governor.

The work of collecting and investigation was carried on vigorously during our stay in port, and large numbers of rare and interesting specimens were obtained.

His excellency the governor visited the ship on the 17th, and spent several hours in inspecting the apparatus, examining the specimens, and familiarizing himself with our methods. He has a good knowledge of natural history, and is doing useful work in that branch of science himself; hence his study of our apparatus and methods was with unusual interest and intelligence.

At 6.10 a. m., March 24, we left the harbor of Nassau, and ran a line of soundings to the south end of Great Abaco, the maximum depth being 1,490 fathoms. At 5.25 p. m. we anchored off Soldiers' Road Settlement and landed Messrs. W. Nye, jr., and C. H. Townsend, with necessary supplies and apparatus for the prosecution of their work while the vessel was absent. This anchorage is safe with winds from NW. and N. to E. The Albatross anchored in 7 fathoms, white sand bottom, Hole-in-the-Wall light-house bearing ENE. three-fourths E. in sight over the land. We left the anchorage at 8.10 p. m., and ran a line of soundings through NW. Providence Channel to Great Isaac's, thence proceeding direct to Key West, Fla., where we arrived and anchored at 2.05 p. m., March 26. The flagship Tennessee, flying the flag of Acting Rear-Admiral James E. Jouett, the Powhatan, Galena, Swatara, and Yantic were at anchor in the harbor, and the U. S. Coast and Geodetic Survey steamer Blake arrived during the evening. The fleet left at 11.45 a. m., March 28, and the U. S. S. Brooklyn came in and went to the coal wharf.

At 1.40 a. m., on the 30th, fire broke out in a building adjoining the San Carlos theater, and quickly spreading among the dry wooden structures in the vicinity, soon became totally unmanageable in the absence of suitable fire apparatus. A working party of thirty men, under command of the executive officer, Lieutenant Waring, was sent on shore from this vessel at 2 a. m., and fought the fire until 3 p. m., when it was under control. Ensigns Benson and Hogg and Mr. Thomas Lee volunteered their services, and rendered valuable assistance. The party went armed with axes and a coil of rope for pulling down and demolishing buildings, as that was about the only method of fighting the fire in the absence of water and fire-engines. Large parties well officered were sent from the Powhatan and Brooklyn, and the crew of the revenue-cutter Dix were early at the scene of fire. Captain Matthews, of the Brooklyn, with his torpedo corps, leveled many buildings, which tended to narrow the track of the flames as they swept through the city toward the water.

Steam was raised as soon as it was seen that the conflagration was becoming serious, and every preparation made to get under way should assistance be required in moving vessels from the wharves. Several men were detailed to carry hot coffee and hard-bread from the ship to the parties on shore, and about fifty gallons were dispensed in this way, much to the comfort of both officers and men. All the business portion of the city, including the wharves, was burned, beside several large cigar factories and many dwellings. The government property was saved.

We commenced coaling at 6.45 a. m., on April 2, and finished at meridian on the 3d, having taken on board 127 tons.

The fire disarranged all business matters on shore so much that we were unable to procure money for the use of the vessel, fresh water for the boilers, or stores for officers and crew, hence it was determined to go to Havana for the articles required. As there was a wide break in the soundings between American Shoal, on the Florida coast, and Matanzas, we took the opportunity to run a line between the points mentioned. Leaving port at 5.10 p.m. we commenced the line off American Shoal in 145 fathoms, and completed it at 12.45 p.m., April 4, when we started for Havana under steam and sail, arriving and mooring at one of the government buoys at 6.30 p.m. The health officer visited the ship and granted pratique; and officers from Spanish and German men-of-war in port called, tendering the usual civilities. These calls were returned on the following day, when I also visited the commodore (acting admiral) and captain of the port.

The services of the government water-boat were secured and the boilers filled on the 6th, preparations for sea being completed in the mean time. At 7.30 a. m., April 7, we left port and spent the forenoon hauling the tangles near the reef to the eastward of Morro Castle, taking 126 *Pentacrinus*, a variety of coral, crustacea, shells, &c. The trawl was lowered at 2.09 p. m. in 1,025 fathoms, and landed on deck at 4.45; a water haul. The current was so strong that the trawl failed to reach the bottom. We then started for Key West, arriving and anchoring off the government wharf at 6.17 a.m. the following morning.

At 7 a. m. we went alongside the Freeda A. Willey and took from her 50 tons of coal which filled the bunkers and bags, about 30 tons being carried on deck. We cast off and went to sea at 5 p.m., and at 6 a.m.

the following day put the dredge over in 56 fathoms off Carysfort Reef. Thirteen hauls of dredge, tangles, and trawl were made during the day between Carysfort and Fowey's Rocks, in from 56 to 369 fathoms. Large numbers of minute shells, numerous crustacea, small fish, cephalopods, &c., were taken. We continued dredging till dark, then steamed across the straits to Great Isaac's and ran a line of soundings thence to SW. Point, Great Bahama Island; after which the northern part of NW. Providence Channel was sounded, the greatest depth, 869 fathoms, being found 18 miles west of Burrows Cay. The last sounding was taken at 10.16 p. m., and we then steamed direct for Soldiers' Road anchorage, Great Abaco, arriving at 5.40 a. m., April 11.

While engaged in sounding the NW. Providence Channel, we encountered a strong NW. current, exceeding 2 knots per hour, setting into the bight, and a counter-current of some force to the southward and eastward along the line of reefs from Burrows to Gordo Cays. Brisk to fresh easterly winds prevailed.

Boats were sent for Messrs. Nye and Townsend, who had been on the island since March 24. They appeared in good condition, and reported fair success in collecting. Everything being on board, we left at 8.30 a. m. for Tongue of Ocean, anchoring in 4½ fathoms on the eastern bank at 10.40 p. m. We were under way again at 5.20 the following morning, and at 7 a. m. anchored off Green Cay and landed the naturalists. The anchorage is on the west side of the cay, the northwest and southwest points projecting slightly, forming an open bay protected from easterly winds. The bottom is white sand and there is sufficient room for vessels to anchor and swing.

The island is uninhabited at present, but gives evidence of having supported quite a large population in earlier times. The collectors returned at 10.45, much pleased with their success and anxious for another opportunity of landing on the cay. We were under way at 11 a. m., and steaming to the southward passed Booby Rocks, then hauled up to the southward and eastward for the extremity of Tongue of Ocean, sounding and putting the tangles over in 36 fathoms at 5.30 p. m., latitude 23° 34′ N., longitude 76° 33′ W. It was an exceedingly rough coral bottom, and we anticipated a variety of specimens usually found on such ground, but our catch was confined to a few sprays of gorgonian coral, sponges, mollusca, and crustacea. Steaming W. by S. one mile the tangles were again lowered in 369 fathoms, the same rough and barren bottom being encountered.

The large surface tow-net was put over a little after dark with equally poor success, very few specimens being taken. A line of soundings was run to High Point, Andros Island, during the night, and thence to Booby Rocks, where we anchored at 7.10 a. m., April 13. The depth of the southern portion of Tongue of Ocean developed by our soundings averaged about 750 fathoms, ranging from 711 to 805 fathoms, with the bottom of white coral ooze as found throughout the Bahamas.

The naturalists landed as soon as we came to anchor, hoping to get a few specimens of sea birds, numbers of which were seen on the wing hovering over the rocks. They returned in about an hour with two specimens of boobies, the only species of bird they saw. We then got under way, and at 9.46 lowered the tangles in 97 fathoms off the west side of Green Cay. It was an exceedingly rough bottom, and we expected a rich haul, but found nothing but a few gorgonian corals, barnacles, and sponges. The dredge was then lowered in 140 fathoms, coral sand bottom, but it soon caught on a coral lump and parted the rope at the hoisting engine. The end caught under the guard on the dredge-block, which for the second time held the rope till we could clamp and secure it. The bottom was found to be exceedingly barren, a few small shells being the only specimens brought up by the dredge. We anchored off Green Cay at 11.30 a. m., and landed the naturalists. They returned at 1.30 p. m., when we got under way and resumed our work of sounding, finally anchoring for the night on the bank in latitude 24° 29′ N., longitude 77° 15′ W.

We were under way the following morning at daylight and continued the soundings. The weather was clear and pleasant with light airs and calms during the forenoon, but later in the day the wind increased to a moderate gale from north with thick rainy weather and heavy sea. We continued work until dark, then hove to under the lee of Thompson's Cay until daylight the following morning, when a line of soundings was run to the west end of New Providence Island, completing the work in Tongue of Ocean.

The gale continued with a heavy and exceedingly uncomfortable sea. The bar at the entrance of Nassau Harbor was breaking so heavily that we were unable to enter, and were forced to make an anchorage in Southwest Bay to leeward of the island.

The weather appearing to have moderated somewhat on the 17th, we got under way and steamed to the vicinity of the bar which we found still impassable, and were obliged to return to our anchorage in Southwest Bay. Another attempt was made to enter on the 19th, but the bar was still breaking heavily and it was not until the 21st that we succeeded in passing it. We reached the harbor at 11.30 a. m. on that day, received the usual visits, and, during the afternoon, accompanied by the United States consul, I made an official call on the governor.

The naturalists continued their work while we were detained at Southwest Bay, and, after our arrival in Nassau, the fishing and sponging industries of the Bahamas were investigated as thoroughly as our limited time would permit. The results of their inquiries will be found in the naturalist's report.

During the prosecution of our work among the islands we have encountered brisk to strong winds from various points of the compass, easterly winds prevailing, and much squally weather. These conditions are normal for the months of January and February, but rather exceptional for March and particularly for April. We left Nassau April 30, and ran a line of soundings from Egg Island reef to a point of the shoal off Hole-in-the-Wall, to develop a shoal said to exist in mid-channel. An old shipmaster who traded for many years among the islands said he had fished on it and knew that it existed. We found a depth of 2,222 fathoms on the spot indicated, and saw no signs of shoal water. It is more than probable that the captain fished on the extremity of the reef, making off 10 miles or more from Hole-in-the-Wall, and it is not at all strange that he should think himself half way across the channel, particularly if he was in a small vessel.

From Hole-in-the-Wall we steamed to Little Guana Cay, and sounded in 940 fathoms, latitude 26° 40′ N.; longitude 76° 49′ 30″ W.; then ran a line to the northward and eastward, perpendicular to the coast, to latitude 26° 50′ N., longitude 76° 04′ 45″ W., reaching a depth of 2,670 fathoms. The course was then changed to the northward and westward and a sounding taken in 2,715 fathoms, latitude 27° 11′ N., longitude 76° 19′ W. The next cast gave 943 fathoms, latitude 27° 41′ N., longitude 76° 41′ W. From this point a line was run to the westward to latitude 27° 57′ 30″ N., longitude 77° 27′ 30″ W., in 660 fathoms. The trawl was lowered at this station at 8.29 a. m., May 2, and a large number of pteropod shells, a few fish, a single specimen of *Argonauta*, dead shells of various species, and a quantity of foraminifera were obtained.

A line of soundings was then run to the southward and westward, striking the banks off Grand Cay. At 5.45 p. m. we lowered the trawl in 338 fathoms, coral sand, latitude 27° 22′ N., longitude 78° 07′ 30″ W., and made a successful haul. Among the specimens were four species of sea-urchins, dogfish with young, munidas, two species of gorgonian coral, shrimp, crabs, glass sponges, brachiopod shells, fish, &c. At 7.20 we steamed to the northward and at 8.20 stopped for forty minutes to use the submarine light. A few good specimens were procured, but the waters were exceedingly barren. The course was resumed at 9 p. m., and at 5.24 a. m. the following day the trawl was lowered in 572 fathoms, latitude 27° 58′ 30″ N., longitude 78° 24′ W. Five hauls were made during the day between the above position and latitude 28° 40′ N., longitude 78° 46′ W., in 504 fathoms. The character of the specimens taken in all the hauls was much the same; among them were shrimp, starfish, many fine specimens of flabellum, hermit-crabs, barnacles, sea-urchins, a variety of corals, pennatulas, holothurians, hydroids, several species of fish, &c., beside a large quantity of foraminifera washed from the contents of the mud-bag.

The large tow-net was put over after dark and the submarine lights used, but the surface was barren of life. At 11 p. m. we steamed to the northward and westward, and at 5 30 a. m. the following morning lowered the trawl in 438 fathoms, gray sand, latitude 29° 16′ 30″ N., longitude 79° 36′ 30″ W. Five hauls were made during the day between the above position and latitude 29° 47′ N., longitude 80° 05′ 45″ W., in 263 fathoms, fine gray sand. The first three hauls brought up large masses of branching coral of various species, besides a few fish, sea-urchins, shrimp, &c. The last two had very little coral, but a variety of other specimens, among which were several species of crabs, mollusca, worm-tubes, shrimp, sea-urchins, and numerous species of fish. The surface net and submarine light were used successfully during the evening.

The working ground of the day was under the bed of the Gulf Stream and extended diagonally across its course. At 9 p. m. we started ahead to the northward and eastward, and at 5.20 a. m., May 5, lowered the trawl in 270 fathoms, gray sand, latitude 30° 47′ 30″ N., longitude 79° 49′ W. Seven hauls were made during the day between the above position and latitude 31° 31′ N., longitude 79° 05′ W., in 277 fathoms, coarse brown sand. The results of the day's work were remarkable for the enormous loads of coral brought up by the trawl and tangles. Other specimens were taken in considerable numbers also, among which may be mentioned hydroids, siliceous sponges, sea-urchins, sea-anemones, and several varieties of fish. A large porpoise was caught during the day, and its skeleton preserved for the National Museum.

The bottom was so thickly covered with coral that the trawl was soon wrecked, and the tangles were used in subsequent hauls. A remarkable feature of the day's work was the capture of nine sharks, of a species unfamiliar to us. One of them was preserved in salt for future examination at the laboratory of the National Museum. The stomach of one was found to contain about a gallon of oil of a reddish tint, which smelled like ordinary fish-oil. Unfortunately most of it was lost, but we saved about half a pint for examination. The presence of this large quantity of oil in a shark's stomach shows that it had fed bountifully on it a short time before, but it would be difficult to conjecture where it could have found it. The stomach contained nothing else.

We steamed to the northward and eastward during the night, and at 5.17 a. m. on the 6th lowered the trawl in 240 fathoms, gray sand and coral, latitude 32° 26′ N., longitude 77° 43′ 30″ W., and made seven hauls during the day between that position and latitude 32° 40′ N., longitude 76° 40′ 30″ W., in 782 fathoms, light gray ooze.

The results of the day's work were very satisfactory. The earlier hauls were on coral bottom and the nets were badly cut, but later in the day, after reaching deeper waters, we found smooth bottom, from which we brought up a great number and variety of specimens. The various forms of deep-sea fish were unusually abundant, besides sea-anemones, corals, hydroids, hermit-crabs, shrimp, cephalopods, pennatulæ, squid, shells, glass sponges, ophiurans, holothurians, &c. The working ground of the 5th and 6th was, like that of the 4th, under the bed of the Gulf Stream.

The winds, which had been light to moderate from the 2d, increased during the afternoon of the 6th, and at midnight, when the last haul was finished, was blowing a brisk breeze from SW., with indications of approaching bad weather.

The submarine light was used until about 2 a. m. on the 7th, when we started ahead under steam and sail for the capes of the Chesapeake. The weather became overcast during the afternoon and the wind increased, with falling barometer. At 8 p. m. there was a moderate gale from south, with thick threatening weather and incessant thunder and lightning, followed by a furious squall half an hour later. We were near the northern verge of the Gulf Stream off Cape Hatteras, where the sea rises with the wind and assumes a magnitude entirely disproportionate to the apparent cause.

We passed Cape Henry at 7.30 a. m. on the 8th, and the weather still being thick and unsettled, anchored in Hampton Roads until the following morning, when, the storm having passed, we steamed up the bay, anchoring for the night off Upper Cedar Point. We were under way at daylight on the 10th, and arrived at the navy-yard, Washington, D. C., at 10.50 a. m.

We remained at the navy-yard overhauling and refitting for the summer's cruise until June 30, when we left for Norfolk, Va., arriving the following morning.

At 7.30 a. m., July 2, we went into dry-dock, and the work of scraping and painting the bottom commenced. Considerable rust was discovered, but very few barnacles or other marine life. The vessel was last docked at Baltimore May 27, 1885, and has therefore been a little more than thirteen months in the water; five months at sea, three months in the Potomac river, followed by another three months at sea in West Indian waters, and finally about two months in the Potomac. These intervals in fresh water killed the marine growths, thus accounting for the comparatively smooth bottom. The rust was readily accounted for, and was excessive wherever the dredge-rope or sounding-wire had been in contact with the bottom. There was much rust near and below the water-line, where the paint was rubbed off by ice when we were steaming down the Potomac *en route* to the West Indies in February last.

We found another small piece gone from a broken blade on the port propeller, and to compensate for the loss of weight and surface, an equal area was cut off the opposite blade. The outboard bearings are wearing somewhat, and it will be necessary to reline both shafts when the vessel is docked again.

The painting having been finished, the ship was hauled out of dock at 1 p. m., July 7, and at 2 p. m. we commenced coaling, finishing at 2.30 p. m. on the 8th, having received $120\frac{200}{2240}$ tons. At 5.10 p. m. we cast off from the wharf and proceeded down the Elizabeth River. The weather was clear and very warm. We passed Cape Henry at 7.45 p. m. and at 9.45 set our course for Wood's Holl, Mass. The weather became overcast, with rain-squalls and fogs during the night, continuing until our arrival, at 2.30 p. m., July 10.

At 5.10 p. m., July 15, we left for a dredging trip, and passing Gay Head at 7.35 p. m. we set our course to the southward during the night. The weather was clear and pleasant, with fresh breeze from southwest.

At 9.03 a. m. the following day we sounded in 555 fathoms, latitude 39° 50′ N., longitude 70° 26′ W., and while reeling in the stray line parted, losing one specimen cup and one N. Z. thermometer with Tanner improved case. The beam-trawl was lowered at 9.27 and landed on deck at 11.16, with one octopus, two large crabs, six species of fish, archasters, maldana, and foraminifera. Two other hauls were made during the day in latitude 39° 43′ N., longitude 70° 29′ W., and latitude 39° 38′ N., longitude 70° 22′ W., respectively, resulting about the same as the previous haul, with the addition of several benthodytes and sea-spiders. The surface net was towed in the early morning and evening with meager results.

At 4.30 a. m., July 17, we sounded in 887 fathoms, brown ooze, latitude 39° 33′ N., longitude 70° 50′ W., and at 5.04 put over the beam-trawl. It was landed at 7.42 with one specimen of *Cyclothone lusca*, but no bottom specimens. Two other hauls, in 1,106 and 1,137 fathoms, latitude 39° 35′ N., longitude 70° 54′ W., and latitude 39° 35′ N., longitude 71° 02′ 30″ W., respectively, were made during the day, securing a large quantity of Ophiomusium, 5 species of fish, benthodytes, 1 octopus, and numerous archasters. Serial temperatures were taken to 1,000 fathoms. The surface net was used in the evening as before, but the results were uninteresting.

The following day six stations were occupied, in depths from 326 to 835 fathoms, between latitude 39° 52′ N., longitude 71° 20′ 45″ W., and latitude 39° 37′ N., longitude 71° 08′ W. The results were the same as on the previous days, with the exception of a specimen of *Onus rufus*, taken in the last haul. Serial temperatures were taken to 500 fathoms, and the surface net towed without success. At 9.05 p. m. we started for Wood's Holl. Soon after entering Vineyard Sound the following morning we discovered the steamer Gate City aground on the beach east of Robinson's Hole, Naushon Island, and, communicating with her, learned that she had gone ashore the previous evening during a dense fog. We offered assistance, but there was nothing to be done pending the arrival of divers, who had been sent for. We then resumed our course, and in a few minutes saw the steamer Panther aground near Job's Neck, Naushon Island, and in response to our offers of assistance, they requested us to aid them in getting afloat. We took a hawser from her stern and towed her off the rocks, when she proceeded to New Bedford.

We arrived and moored to the Fish Commission wharf at 10.30 a. m. The captain and agent of the Gate City called about 11.30 and requested us to tow Davis's wrecking scow to the stranded vessel, as it was very important that the divers should be on the spot as soon as possible, and there was no other means of getting them there for several hours. We left soon after with the scow in tow, delivered her at the steamer about 1 p. m., and returned to port.

We remained at the wharf, coaling ship, overhauling apparatus, and making necessary repairs to boilers, until 1.40 p. m., August 2, when we proceeded to sea under the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Wood's Holl, Mass., July 29, 1886.

SIR: As soon as the Albatross is ready you will make a cruise to the eastward, for the purpose of determining the existence and, if possible, the character of certain banks which are believed by some to exist, but which, so far, have not been properly sounded and examined.

In connection with this inquiry you will follow, as far as convenient, the suggestions of the Hydrographic Office of the U. S. Navy as embodied in a letter from Commander Bartlett.

A particular point to be examined is the so-called Hope Bank; another is in the vicinity of the Flemish Cap, and also an alleged marine ridge connecting Flemish Cap with the Azores.

In the course of this voyage you will of course take occasion, by sounding, trawling, and dredging, to ascertain any physical or biological characters of the region.

In consequence of Mr. Benedict's resignation, Mr. Thomas Lee, the assistant naturalist, will have charge of the natural history work, and of the various operations of making collections and preserving them for transfer to Wood's Holl.

The length of time during which the voyage is to last is left to your discretion. The principal object of finding and defining the banks in question is to furnish new grounds to the American fishermen, and you will therefore take such steps as are in your power to determine their economical value, by securing full collections of the fishes themselves and the animals that serve them for food.

You are authorized to stop at any port in the British Provinces for the purpose of taking in coal and supplies.

As opportunity presents you will communicate by telegraph your whereabouts and the general condition of the vessel and those on board.

Very respectfully,

SPENCER F. BAIRD,
Commissioner.

Lieut.-Commander Z. L. TANNER,
Commanding Steamer Albatross.

We steamed to the eastward through Vineyard Sound and over Nantucket Shoals. The weather was pleasant, but the barometer was falling rapidly and a heavy thunder-shower approaching from the northward and westward. It followed along the land, gradually gaining on us, until, off the east end of Nantucket, the storm finally passed ahead and across the bow.

The officer of the deck reported seeing on two occasions, between 8 and 10 p. m., several pieces of floating ice from 8 to 10 feet square and 5 feet thick. Ice in this locality in August is unusual, if not unprecedented.

We had light southerly winds and moderate swell during the night, with pleasant weather and passing clouds. A strong NW. wind was blowing at noon on the 3d, and increased to a moderate gale later in the day.

The following is a copy of the Hydrographer's letter, referred to in the preceding orders of the Commissioner:

BUREAU OF NAVIGATION, NAVY DEPARTMENT,
Washington, D. C., July 16, 1886.

DEAR SIR: The receipt of your letter of July 13 is acknowledged. I send to-day copies of Hydrographic Office charts 21*a* and 22*a*, on which I have marked in red pencil the position of possible dangers. The records of these are very meager, and would be of no assistance to you. I have also indicated by blue pencil crosses where it is desirable to have soundings. Of course any others that you can get will be useful.

I am inclined to think there is a submarine ridge extending from the Azores to the Flemish Cap, hence I have marked a line to develop it. This may be the mackerel grounds you have been looking for.

The line across the old position of Hope Bank will develop it in a north and south direction, if it exists. Your line (referring to your work of last year) runs east and west.

Beaufort and Milne Banks ought to be developed, and the vicinity of Zaragosa Rock ought to be closely examined. If you are going to the eastward of the Azores I should like to know it, as there is a host of reported dangers all around these islands.

Very respectfully,

J. R. BARTLETT,
Commander, U. S. Navy, Hydrographer.

Lieut.-Commander Z. L. TANNER, U. S. N.,
Commanding U. S. F. C. Steamer Albatross.

The first line of soundings indicated by blue pencil crosses on Hydrographic Office chart 21*a*, referred to in the above letter, began at latitude 40° 14′ N., longitude 65° 56′ W., where, notwithstanding the prevalence of a gale, we sounded, at 2.10 p. m., August 3, in 2,224 fathoms. We carried the line to the eastward to latitude 40° 20′ N., longitude 64° 54′

W., in 2,575 fathoms, thence to the position assigned to Hope Bank, where eleven soundings were taken at intervals of about 5 miles, the depths ranging from 1,930 to 2,069 fathoms. On the position assigned the bank, latitude 41° 29′ 28″ N., longitude 63° 17′ W., we found a depth of 1,969 fathoms. Five soundings taken by the Albatross last year form another line from 5 to 10 miles farther south.

Leaving the reported position of Hope Bank on the morning of the 5th, we ran a line in a northeasterly direction to Sable Island Bank. The depths decreased gradually, showing no evidence of outlying banks or shoals. This line was recommended by the Hydrographer.

On the morning of the 6th we discovered an unexpected error of the compass, which had carried us about 20 miles out of our course during the night, thus throwing discredit on our steering-card. As we were entering the region of fogs it was necessary to ascertain our compass errors as accurately as possible; accordingly, at as early an hour in the afternoon as practicable, we swung ship under steam, observing azimuths of the sun, from which a table of errors was constructed. A comparison of the card thus obtained, with that we had been using, not only accounted for the deviation from our course, but demonstrated the fact that something was wrong. A search occupying the remainder of the day and night resulted in the discovery of a piece of iron pipe, 1¾ inches outside diameter and 8 feet in length, deposited in the seine-boat on the starboard side of the deck. The forward end of the pipe was about 8 feet from the compass and 1 foot 6 inches below the card. The cause of disturbance being found and removed, a new card was made by swinging the ship on the 7th, the results corresponding nearly with observations in Narragansett Bay.

A line of soundings was then run between Banquereau and Grand Bank, about 60 miles to the southward of our line last year, in from 1,780 to 1,172 fathoms.

At meridian, August 8, we sounded in 34 fathoms on Grand Bank, latitude 44° 52′ N., longitude 50° 25′ W., and put over the hand-lines baited with menhaden. Two cod and two haddock were taken, thus confirming our former experience that menhaden are worthless as bait for cod on the Grand Bank. Another trial was made at 6.12 p. m., in 35 fathoms, without taking a fish.

The significance of hydrographic soundings 1,042 to 1,047, inclusive, in 35, 35, 35, 38, 41, and 115 fathoms, will be made apparent by reference to H. O. chart 21*a*, where the contour of the eastern edge of the Grand Bank is distorted, apparently, on the evidence of a single negative sounding.

The line was continued east on the same parallel to develop a bank referred to in the following extract from a letter of Capt. J. W. Collins of the U. S. Fish Commission schooner Grampus, dated Wood's Holl, Mass., July 10, 1886:

"Referring to our conversation of this date, relative to the possible future movements of the Albatross, I beg to submit to your consideration the following:

"On the general charts of the North Atlantic a small bank is laid down to the eastward of the Grand Bank, perhaps about 200 miles distant from the latter, and about on the 45th parallel of north latitude. This bank, on which are marked depths approximating 75 to 100 fathoms, has long been an object of much interest to the Gloucester fishermen, and much speculation has been indulged in as to whether the bank really exists or not. If so, it is universally believed that cod and halibut may be found there in great abundance, and its authentication would, no doubt, prove a bonanza to the fishermen.

"If it does not exist, the settlement of the question would prove not only interesting, but extremely valuable to the fishermen, since they may be prevented from spending their time in fruitless search for the bank.

"The Albatross is so eminently well adapted to making this research that I trust I may be pardoned for hoping she will look for the place in question if her other work takes her in the vicinity of the Grand Bank during the summer.

"The value of such work may be fairly illustrated by the fact that, a short time ago, while the Grampus lay in Gloucester Harbor, one of the captains came on board who was about to sail on a halibut trip. Incidentally he told me it was his intention to try to find Hope Bank when he got to sea. I told him that it had no existence except in the imagination of the person who reported it, and that the Albatross had found 2,000 fathoms where the bank is laid down.

"This information not only surprised him, but pleased him very much, for he said it would practically save him (and another vessel which was going to make the attempt in company) a broken trip, since he had determined to spend a week or ten days in the search."

The depth found 100 miles east of the Grand Bank was 1,916 fathoms, increasing to 2,658 fathoms 200 miles farther east. The soundings show no rise in the sea-bottom along this line, which extends far enough to the eastward to intersect a marine ridge extending from the Azores to Flemish Cap. On the contrary the depths increased with great regularity until the maximum, 2,658 fathoms, was reached at the extremity of the line in latitude 45° 14′ N., longitude 42° 03′ W. From this point a line was run to Flemish Cap, as indicated by the hydrographer, with still no signs of marine elevations until reaching the abrupt rise of the Cap.

A few words as to the accuracy of our various positions may not be out of place here. We had generally clear weather to 6 p. m. on the 8th, enabling us to locate the soundings as accurately as ordinary sea observations permit. On the 9th, latitude by ex-meridian altitudes of the sun was obtained, but no longitude. Foggy weather and moderate

SW. winds prevailed. The sun was visible at intervals during the 10th, giving us an excellent opportunity of locating the ship. Strong winds to moderate NW. gale prevailed. On the 11th the sun was visible at intervals until late in the afternoon, affording us ample opportunity of locating our stations.

Our first sounding on the 11th was taken at 3 a. m. in 2,135 fathoms, and the next at 10.38 a. m. in 73 fathoms, gray sand, black specks, and stones, on Flemish Cap, latitude 46° 50′ N., longitude 44° 35′ W. The beam-trawl was put over at this station, resulting in the capture of several specimens of Cottidæ, ophiurans, starfish, sea-anemones, sea-urchins, corals, &c. It may be said that stones were a marked feature in all the hauls during the day, the bottom seeming to be pretty thickly strewn with them, dropped there by ice.

Four other hauls were made at stations 2,693 in 78 fathoms, 2,694 in 86 fathoms, 2,695 in 105 fathoms, and 2,696 in 98 fathoms, the character of the bottom and catch comparing closely with those of the first haul.

A serious leak was discovered in the bottom of the port boiler, water and steam escaping to such an extent that it was impossible to get near enough to determine the nature of the damage. Fires were hauled and the boiler blown down, when the leak was traced to a defective gasket on a mud-hole plate.

After the trawl was on board we steamed to the westward toward the Grand Bank, carrying a line of soundings across to further develop the connection between the two banks. The greatest depth was 477 fathoms. Reference to H. O. chart 21*a* will show Flemish Cap to be an extension of the Grand Bank, to which it is connected by a narrow submarine ridge having a depth of 500 fathoms or less, increasing rapidly on either side to 1,000 fathoms.

We were enveloped in a dense fog during the night of the 11th and all of the 12th, which made it impossible to locate ourselves by observation, but, assuming the eastern extremity of the Grand Bank to be correctly laid down on the chart, we were able to plot our soundings with some degree of accuracy.

The normal direction of the current between the banks is about ESE., but we experienced a strong set to the northward and eastward. A fresh SW. breeze which prevailed at the time may account for the change of direction.

The trawl was lowered at 12.09 p. m. on the 12th in 206 fathoms, green mud, black specks, lat. 47° 40′ N., long. 47° 35′ 30″ W., and came up at 1.15 p. m. with specimens of ray, halibut, a large number of macrurus, flounders, sea-anemones, starfish, mollusks, &c. A rock was brought up also, weighing about 2,000 pounds, and much time and patience was expended in getting it on board without sacrificing the net.

Necessary repairs being completed, fires were started under the port boiler.

Soundings were continued toward the coast for navigational purposes, we being enveloped in a dense fog, which continued until 2 p. m. on the 13th. These soundings have been carefully located, and may have some value hydrographically.

We arrived at St. John's, Newfoundland, at 7.10 p. m., August 13, and found H. M. S. Emerald, Lily, and Mallard at anchor in the harbor. An officer came on board, and, in the name of the senior officer present, tendered the usual civilities of the port. The United States consul visited the ship at 10 a. m., August 14. His call was returned later in the day, and official visits were made to the governor, and Capt. A. H. Hamond, of H. M. S. Emerald, senior British naval officer present.

Fires were hauled and the usual work of stopping leaks in the boilers commenced. We coaled ship on the 19th, taking on board 100 tons of anthracite.

Preparations were made for extending the cruise to the eastward, including Beaufort Bank, Milne Bank, and Laura Ethel Shoal, but that part of the expedition being abandoned, we took on board only the quantity of coal required for the trip to Wood's Holl, including a few days' dredging and sounding.

We coaled from Shea's Wharf, where we also filled the boilers with fresh water, which was taken from a hydrant in the street, at a cost of $12 for 10,000 gallons. The necessary hose for conducting the water on board was borrowed of the fire department.

At 9.30 a. m., August 21, we got under way and proceeded to sea *en route* to Wood's Holl. The weather was clear until 5 p. m., when we were enveloped in a dense fog. Cape Race bore WNW. about 4 miles distant. As our course was seaward, we stood on and soon ran out of the fog bank into clear, pleasant weather. Our course during the night was to the southward and westward, and at 8 a. m. the following morning we cast the trawl in 90 fathoms, latitude 45° 07′ N., longitude 55° 09′ W., off the southern extremity of Green and St. Pierre Banks. Five hauls were made during the day on a westerly course, in from 50 to 205 fathoms, the results being numerous ascidians, ophiurans, starfish, mollusca, and several species of fish. The positions and depths indicate an extension of the 100-fathom line to the southward of Green and St. Pierre Banks. Fog shut in about sundown and continued during the night.

We finished trawling for the day at 6.18 p. m. and started ahead, running a line of soundings across the channel between St. Pierre and Banquereau, developing a depth of from 226 fathoms in mid-channel to 32 fathoms on the latter bank.

The fog continued until 6 a. m., August 23. At 7.33 we sounded in 32 fathoms, latitude 44° 25′ N., longitude 57° 35′ W., on Banquereau, and put over several hand-lines, taking 136 cod in 45 minutes. The vessel was not anchored, but allowed to drift. The fish were examined for parasites, contents of stomach, &c. Two hauls of the trawl were made during the day in 140 and 110 fathoms, on the southeast extremity of Sable Island Bank, resulting in the capture of a few fish, ophiurans, starfish, shrimp, sea-anemones, and mollusca.

At 9.11 a. m., the 24th, we cast the trawl in 1,255 fathoms, latitude 42° 47′ N., longitude 61° 04″ W. The frame was landed at 1.07 p. m., minus the net, which had been torn away by an overload of stones or mud. We expended much time and patience in the vain endeavor to clear it from the bottom without sacrificing the apparatus. We started ahead on our course as soon as the haul was completed, the general appearance of the weather making it inadvisable to cast the trawl again. The wind, which was light during the early part of the day, increased to a moderate gale from WNW. in the afternoon. The barometer was unsteady and there was a heavy southerly swell; in fact, all indications pointed to heavy weather.

The 25th commenced with fresh winds from WNW., and overcast misty weather. We had heavy rains and light to moderate breezes in the middle part, and fresh SSE. winds in the latter part of the day. The barometer was unsteady, and although the sea was comparatively smooth, the general indications were of approaching bad weather. Ten soundings were taken during the day near the position assigned to Hope Bank, in depths ranging from 1,644 to 1,943 fathoms. The soundings are inshore, or to the northward of those taken on the outward trip, and demonstrate beyond doubt that no shoal or bank exists on the ground covered by them.

We were unable to locate our position by observation during the day except by ex-meridian observations of the sun for latitude, and, although we had covered the ground satisfactorily, we determined to remain on the spot until the weather permitted us to verify our work. With this object in view the vessel was hove to from midnight until 1.10 p. m., August 26, when, having ascertained our position by good observations, we proceeded to run a line of soundings at right angles to those of the previous day in from 1,587 to 1,910 fathoms; the results confirming the general accuracy of our former work.

The unsettled weather of preceding days culminated in a cyclone of moderate force on the 26th, as will be shown by the following extract from the meteorological columns of the ship's log.

The force of the wind should be increased about .2 — otherwise the record may be considered correct.

Date.	Time.	Wind, true.	Force.	Barometer.	Sea.
August 25	8 p. m.	E	4–6	29.98	Smooth.
August 26	1 a. m.	E. by S	4–6	29.92	Do.
Do	Noon	ENE	4–7	29.70	Rough.
Do	3 p. m.	NE. by E	4–6	29.64	Heavy.
Do	6 p. m.	NNE	5–6	29.68	Do.
Do	11 p. m.	N	6–8	29.86	Do.
Do	Midnight	NNW	5–6	29.90	Moderate.
August 27	2 a. m.	NW	3	29.92	Do.
Do	8 a. m.	WNW	3	29.98	Smooth.

Having completed our search for Hope Bank, we ran a line of soundings to the westward to George's Bank without finding any indications of shoal water to the eastward of it.

Having definitely proven that Hope Bank does not exist in the locality assigned it on H. O. chart 21*a*, it may not be out of place here to inquire into the probable reasons for its having been frequently reported. Reference to the chart will show its assigned position to be near the northern edge of the Gulf Stream, where its deep blue waters, with temperatures above the normal and high specific gravity, impinges upon the colder green water of the Arctic current. The first sight of this green water on emerging from the Gulf Stream gives one the impression that he has suddenly struck soundings. The bank once placed on the chart, the navigator who found himself in green water anywhere in that region during foggy weather, or when from any cause he was uncertain of his position, would conclude at once that he was in shoal water, and locate himself on the position assigned to Hope Bank. The difference in color and specific gravity between the waters of the Gulf Stream and the region adjacent varies with the seasons, and is more marked during summer and autumn, when the fresh water from melting ice finds its way from the Arctic.

On August 3, at meridian, in latitude 40° 26′ 30″ N., longitude 66° 19′ W., surface temperature 78° F., the specific gravity reduced to 60° F. was 1.027808, and at noon of the 5th, latitude 41° 48′ N., longitude 62° 51′ 30″ W., surface temperature 67° F., the reduced specific gravity was 1.025008, a difference of .0028, quite sufficient to account for the change of color. Thus it will be seen that the various indications of shoal water are accounted for from natural causes wholly independent of the existence of banks or shoals, and the depths developed by our soundings show positively that none exist in that locality. The navigator in passing over the region had neither time nor the means at hand for satisfactory investigation; therefore he was forced to judge from appearances, which, we have shown, are deceptive.

It may not be out of place here to call attention to a report concerning Hope Bank, which to a casual observer would be considered definite and final as to its existence in the locality mentioned.

We have what purports to be a complete copy of the log of the fishing schooner Marguerite on a voyage from Gloucester, Mass., to Iceland, extending from April 27 to September 24, 1885. On September 21, on the return trip, the following remarks are found relating to the bank above mentioned:

"*From 4 to 8 a. m.*—Wind steady in force and direction. At 7 a. m., water being discolored, sounded; depth 63 fathoms, with coarse sand. At 7.30 a. m., water looking whiter, sounded again, found 45 fathoms, with small black pebbles. At first thought the vessel had overrun the log and was on soundings on George's Bank. At 8 a. m. sounded; depth 38 fathoms.

"*From 8 a. m. to noon.*—Wind steady in force and direction. At 8.30 a. m. took observation, which almost corresponded with the distance run by the log. At 9 sounded; depth 90 fathoms; hauled the vessel close to the wind SW. by W. At 9.30 sounded; depth 100 fathoms; hard bottom. Tacked ship, run off to the NE. 6 miles, sounded; depth 40 fathoms, with small black pebbles; run to the north 4 miles, sounded; found 75 fathoms; hauled up ESE. 4 miles, sounded; got 62 fathoms; tacked ship and kept off course. At noon found the latitude to be 41° 38′ and longitude 63° 30.′"

The above extract from the schooner's log would seem to be conclusive, at least, as to the soundings having been made as stated, even if her position was not correctly given. A vessel's log is usually taken as evidence in court, and entries in it are generally the results of personal observation of its writer or of other officers in charge of the deck for the time being. Facts only are looked for, and fictitious entries are so foreign to the habit of seamen generally that it would be considered correct until proved otherwise. Yet this copy fails to inspire confidence; in fact, the evidences of its having been cooked to suit the occasion are so palpable that its reliability becomes questionable at every point. It is a well-known fact that a fishing vessel's log is brief, that her navigational and scientific instruments are few, and equal to her absolute necessities only, yet this copy purports to give for every hour of the cruise, day and night, a complete record, including the filling out of 18 columns in the United States Navy log-book, which was used for making the copy, nine of them being meteorological observations, besides remarks more or less full.

On September 20, the day before the discovery of Hope Bank, this remarkable vessel made 77 miles in 12 hours on a SW. by W. course, wind WSW., sailing within one point of the wind! With a wind force of 4 to 5 she made 7 to 8 knots, heeling 3° to 4°, with leeway of one-half a point, the same leeway being maintained later in the day with a speed of 2 knots, heel of 1° to 2°, and wind force from 1 to 2.

The following entry is found on May 13, at noon:

"Latitude, D. R., 48° 35′ 00″ N.

"Longitude, D. R., 42° 38′ 00″ W.

"Latitude by observations of ⊙ 48° 38′ 00″ N.

"Longitude by chronometer ⊙ 42° 36′ 00″ W.

"Current during the time 1.7 knots per hour, setting to the eastward."

We find recorded here a current of 40.8 miles for 24 hours, whereas, assuming the calculations for position to be correct, there was actually a current of 4 miles N., 40° E. during the day.

Similar examples might be quoted throughout the whole log-book, but the above extracts are sufficient to illustrate its value as an accurate record of results. The meteorological record is hardly worthy of comment.

Referring to the log of September 21, we find the schooner making 3 knots an hour until 7 a. m., the time the sounding commenced, and, as the wind is logged "steady in force and direction" from this time till noon, the vessel should have made 15 knots had she continued on her course; but instead of this uninterrupted progress she takes eight soundings in average depths of 64 fathoms, which must have consumed three-quarters of an hour at least, and sails 21 knots, about 5 knots an hour, or 2 miles an hour more than she would have logged had she taken no soundings and continued on her course with the wind two points abaft the beam.

Further comment is unnecessary; enough has been written to show that reports of shoals and banks at sea are not always reliable, even when soundings, character of bottom, and other seemingly reliable data are given. A reference to the plan (Plate I) will show that the schooner Marguerite did not find bottom in the region indicated, and the presumption is strong that the lead was not put over the side at all.

At 9.33 a. m., August 27, we cast the trawl in 1,188 fathoms, latitude 41° 28′ 30″ N., longitude 65° 35′ 30″ W., landing it on deck at 12.44 p. m. Among the forms taken were a quantity of ophiurans, starfish, shrimp, mollusks, blue hake, *coryphænoides*, *Macrurus asper*, and skate. The trawl was lowered again at 2.21 p. m., but it soon buried and was lost.

At 7.09 a. m., August 28, the trawl was lowered in 980 fathoms, latitude 40° 07′ N., longitude 67° 49′ W., and landed on deck at 9.22 a. m.; a water haul, the current having prevented its reaching bottom. Another haul in 866 fathoms, six miles to the westward, brought up an enormous load of mud and numerous ophiurans, holothurians, mollusks, crustaceans, and several varieties of fish, among them being *coryphænoides*, *Macrurus Bairdii*, blue hake, lycodes, &c. A third haul was made in 984 fathoms a few miles farther westward with much the same results.

At 5.35 p. m. we started for Wood's Höll. Fog shut in as soon as we touched the banks and continued until we passed the South Shoal lightship, when it partially cleared. It shut down again off No Man's Land and continued until our arrival in port at 11.58 a. m., August 29.

We saw but few birds during the trip except "Mother Carey" chickens, which were always with us. An occasional gull and a few terns were seen. Whales were seen in the region between Sable Island and Grand Bank, and porpoises were frequentley observed playing about the ship. A large school of curved-fin orcas were seen on Flemish Cap during the morning of August 10.

We were detained in port overhauling our dredging and sounding gear, cleaning and repairing boilers and other mechanical appliances until 5.58 a. m., September 14, when we left for Newport, R. I., for coal, preparatory to a dredging trip.

Arriving at the latter port at 10.30 a. m., we commenced coaling from a schooner alongside at 1.15 p. m., and finished at 6 p. m. the following day, having taken on board $91\frac{154}{2240}$ tons.

We got under way at 6.40 and proceeded to sea *en route* to our working grounds, which were included in the region between latitude 38° and 39° N., and longitude 70° and 72° W. Light to moderate SE. winds, smooth sea, and partially cloudy, pleasant weather was experienced during the night and following day.

At 3.38 p. m., September 16, we lowered the trawl in 1,544 fathoms, brown ooze, latitude 38° 39′ N., longitude 70° 07′ W., and landed it on deck at 7.43 p. m., with numerous specimens of shrimp, starfish, ophiurans, mollusks, *Macrurus asper*, lithodes, benthodytes, benthysaurus, &c. The surface net and submarine electric light were used with fair success until 10 p. m., when we steamed slowly to the southward to change our position.

The trawl was lowered at 5.49 a. m., the 17th, in 1,867 fathoms, latitude 38° 20′ N., longitude 70° 05′ 30″ W., and landed on deck at 10.24, a water haul. There were, however, a few valuable specimens of crustacea, &c., taken while the net was coming up. It was again lowered at 11.20 a. m. in 1,859 fathoms, latitude 38° 20′ N., longitude 70° 08′ 30″ W., and landed at 4.05 p. m., with specimens of hermit-crabs, ophiurans, mollusks, sea-anemones, and eight species of fish. A third haul was made at 4.58 p. m. in 1,825 fathoms, latitude 38° 22′ N., longitude 70° 17′ 30″ W., and landed at 9.46 p. m., with mollusks, ophiurans, starfish, shrimp, ascidians, macrurus, &c. The surface net was used successfully during the evening. Six dolphins and one shark were taken with hook and line during the day, and a large squid of an unknown species was found dead on the surface.

Light airs and calms prevailed, with clear, warm weather, the thermometer reaching 80° Fahr. We had quite a strong current (17′) to the southward and westward, sometimes called the Gulf Stream countercurrent. It was this current which caused the failure of the first haul in the morning.

At 5.33 a. m., September 18, the trawl was lowered in 1,753 fathoms, latitude 38° 29′ 30″ N., longitude 70° 54′ 30″ W., and landed at 10.17 a. m., with several species of fish, shrimp, starfish, sea-anemones, &c. At 11.04 it was put over the second time, in 1,631 fathoms, latitude 38° 29′ 30″ N., longitude 70° 57′ W., and came up at 3.15 p. m., with several macrurus, shrimp, mollusca, gold-band coral, &c. The trawl was cast a third time in 1,615 fathoms, at 3.54 p. m., latitude 38° 24′ N., longitude 71° 13′ W., and was landed at 8.32 p. m., a water haul. There were several interesting specimens, however, taken on the way up.

The engines were stopped and the ship allowed to drift until 3 a. m., September 19, when we ran 10 miles to the westward, and at 5.38 put over the trawl in 1,569 fathoms, latitude 38° 24′ N., longitude 71° 52′ W., landing it on deck at 10.08 a. m., with numerous archasters, shrimp, *Cyclothone lusca*, and fish. Two other hauls were made during the day in 1,536 fathoms and 1,509 fathoms, in both cases the trawl failing to reach bottom owing to the strong current. The last haul, latitude 38° 36′ 30″ N., longitude 72° 12′ W., was notable, however, for the capture of a new species of fish, 5 feet in length, allied to *Gastrotomus*. While occupying this station Mr. Lee succeeded in shooting a large blue heron —adult female—which was flying about the ship. The bird was quite fat, and did not appear to be at all distressed, though so far at sea. The surface net and submarine electric light were used to good advantage, large numbers of squid being taken by aid of the latter.

Monday, September 20, moderate breeze from SW., hauling to the northward and increasing to a strong wind at meridian. The trawl was lowered at 6.02 a. m., in 813 fathoms, latitude 38° 56′ N., longitude 72° 11′ 30″ W., and landed on deck at 8.50, with two specimens of *Geryon quinquedens*, flabellum, annelids, holothurians, large numbers of fish, &c. It was cast again at 9.33 in 594 fathoms, latitude 39° 13′ N., longitude 72° 01′ W., and landed at 12.32 p. m., with 190 *Macrurus Bairdii*, 20 blue hake, 3 pole flounders, 4 dogfish, 3 *Geryon*, shrimp, mollusca, annelids, holothurians, &c. A school of whales was seen during the forenoon.

The weather becoming too boisterous to continue dredging, we started for Wood's Holl at 12.40 p. m., arriving and mooring at the wharf at 10.30 a. m., September 21.

We remained at Wood's Holl overhauling the sounding and dredging apparatus, repairing boilers, and making general preparations to leave the station for the season, until October 21, when at 2.40 p. m. we cast off from the wharf and proceeded to sea. The weather was clear, with fresh westerly winds and heavy swell which moderated during the night. We had Mr. Tabor, an artist from the *Century* Company, on board, who made the trip for the purpose of picturing the operations of the Albatross.

An accident occurred on the morning of the 22d which might have been serious. While verifying the scale on the accumulator, the dredge rope broke under a strain of about 5,000 pounds, and the tension-rod flying back with great force, struck the band supporting the accumulator and boom topping-lift at the foremast head, broke the bolts, and allowed the band, accumulator, and boom to come on deck with a crash. No one was hurt, though several men had narrow escapes. The heel of the dredging-boom was broken and the accumulator guide-rods badly bent, besides other minor damages, all of which were repaired during the day and following night.

At 5.42 a. m., October 23, we put the trawl over in 1,685 fathoms, latitude 36° 47′ N., longitude 73° 09′ 30″ W., landing it on deck at 10.19 with many macrurus, starfish, marguerites, crustaceans, and one large lithodes. It was put over again in 1,641 fathoms, at 12.02 p. m., latitude 36° 47′ N., longitude 73° 25′ W., and landed on deck at 4.46 with several species of fish, two (probably new) mollusca, holothurians, &c. The large surface net was towed at intervals with fair success, and the submarine electric light was used during the evening. Among the specimens taken were about forty squid.

At 5.54 a. m., October 24, the trawl was lowered in 1,374 fathoms, latitude 36° 34′ N., longitude 73° 48′ W., and landed on deck at 10 a. m. with many macrurus, hake, holothurians, starfish, and a large quantity of brisinga. It was cast a second time at 11.10 a. m. in 1,253 fathoms, latitude 36° 34′ N., longitude 73° 54′ 30″ W., but while heaving in the rope parted, losing 1,210 fathoms and the trawl. Another cast was made at 4.09 p. m. in 1,239 fathoms, latitude 36° 39′ N., longitude 74° 03′ 30″ W., and, when landed on deck, at 7.26 p. m., the net was found to contain a large number of macrurus, hake, one large *Synaphobranchus*, many holothurians, benthodytes, a quantity of brisinga, mollusca, &c. The large surface net and submarine electric light were used during the evening with fair success.

At 5.45 a. m., October 25, the trawl was cast in 859 fathoms, latitude 36° 30′ N., longitude 74° 33′ W., and landed on deck at 8.14 a. m. with single specimens of black dogfish and *Gastrostomus*, numerous hake, lycodes, ophiurans, sea-urchins and mollusca, several species of crustaceans, and a quantity of flabellum. A second cast was made at 9.10 a. m. in 679 fathoms, latitude 36° 36′ N., longitude 74° 32′ W., and the trawl landed on deck at 11.30 a. m., containing the same species as were found in the previous haul. A third cast was made at 12.28 p. m. in 727 fathoms, latitude 36° 42′ N., longitude 74° 30′ W., and finished at 2.39 p. m.; contained the usual number of macrurus and hake found in similar depths along the Atlantic coast. Single specimens of pole flounder and *Geryon quinquedens* were found, besides a quantity of skates' eggs containing live embryos. There were also varieties of mollusca and starfish and a quantity of flabellum. The fourth and last cast of the day was made at 4.12 p. m. in 781 fathoms, latitude 36° 45′ N., longitude 74° 28′ W., and finished at 6.44 p. m., the net containing skates' eggs, lycodes, holothurians, pennatulas, macrurus, and hake. There was a single specimen of red brick; also fourteen soles of shoes, the uppers having been rotted away. The surface net was towed at intervals with fair success. Our working ground being in the route of coastwise traffic, one or more steamers were in sight at all times during the day.

At 6.09 a. m., October 26, the trawl was cast in 1,152 fathoms, latitude 37° 27′ N., longitude 73° 33′ W., and landed on deck at 9.20 a. m., with numbers of hake, benthodytes, starfish, holothurians, sea-urchins, pennatulas, and other forms of Alcyonaria. It was cast again at 10.19 a. m. in 944 fathoms, latitude 37° 26′ N., longitude 73° 43′ W., and was up at 1.05 p. m., with many macrurus, starfish, sea-urchins, three cephalopods, *Alloposus mollis*, one specimen of *Onus rufus*, holothurians, Alcyonaria, &c. A third cast was made at 1.52 p. m. in 841 fathoms, latitude 37° 23′ N., longitude 73° 53′ W., the trawl being landed on deck at 4.35 p. m., with many specimens of macrurus, crustaceans, benthodytes, starfish, sea-urchins, pennatulas, &c. The fourth and last haul was made at 4.55 p. m. in 811 fathoms, latitude 37° 23′ N., longitude 74° 02′ W. It was completed at 7.32 p. m., and, besides an enormous load of mud, the net contained one specimen of a large red spiny crab, lithodes, pennatulas, starfish, flabellum, shells, and a large squid, *Stenoteuthis megaptera*, 5 feet 6½ inches in length, weighing 30 pounds. There were also the usual variety of deep-sea fish. The large surface net was towed at intervals with fair success. The use of this net in winter and spring has shown the surface waters of the North Atlantic to be comparatively barren of life, but during the latter part of summer and autumn many forms of crustacea are found, either mature or in the larval form. Fish are a marked feature of the catch, among them being the surface fishes, of various kinds, that have their homes in floating Gulf-weed, or hover about the *medusæ*. The young of various species, notably the bluefish and flying-fish, are taken in large numbers, besides many other forms too numerous to mention. It may be truly said that the introduction of the large surface net has opened a new field of investigation.

At 7.35 p. m. we started for port. The weather, which had been mild and pleasant, threatened a change for the worse, and, after a night of menacing indications, we encountered, about 5 a. m., a furious squall of wind and rain. Passing Cape Henry at 6.28 a. m., we steamed up Chesapeake Bay and the Potomac River, anchoring for the night at 5.37 p. m., near Lower Cedar Point. We got under way again at daylight, October 28, and reached the navy-yard, Washington, D. C., at 1 p. m. Specimens and other articles received on board for transportation were sent to the Smithsonian Institution, and the work of cleaning and refitting was commenced. Spars and rigging were overhauled and a new fore-top-gallant yard made to replace the old one, which was rotten. The chain cables were overhauled and restowed, store-rooms and holds broken out, cleaned, and painted, or whitewashed, and the inner side of the iron hull scraped and painted where accessible.

The engines were overhauled and repaired by our own people.

An appropriation was made during the first session of the Forty-ninth Congress for new boilers. Passed Assistant Engineer George W. Baird, U. S. N., prepared designs for them, and for a rearrangement of coal-bunkers, &c., which were approved, and, after duly advertising in the public press, the contract was awarded to the Columbian Iron Works and Dry Dock Company, of Baltimore, Md., for the sum of $13,439.

MECHANICAL APPLIANCES.

The mechanical appliances and apparatus generally have worked very well during the year, but experience has suggested improvements here and there, most of which have been adopted.

ACCUMULATOR.

The necessity is still felt for an improved accumulator having greater elasticity under extreme tension. We have consulted the best spring manufacturers in the country and about exhausted the inventive talent on board without thus far attaining the desired result.

COUNTER-BALANCES.

[Plate V.]

When dredging very low speed is required, from one-half to $1\frac{1}{2}$ knots per hour, and to attain it one propeller only is turned as slowly as possible, but even then we cannot always bring the vessel down to the desired limit, except by stopping the engine until her headway is checked, when it is started again. The revolutions could be brought down to 24 per minute in smooth water, but after the introduction of carefully adjusted counter-balances a further reduction to 18 revolutions per minute was effected.

These counter-balances were designed by Passed Assistant Engineer George W. Baird, U. S. N., to reduce the vibration of the engines when running at high speed, and it is gratifying to say that they have served the purpose as well as the more important one mentioned above.

SOUNDING FROM BOATS.

[Plate II.]

The necessity for greater facilities for sounding from boats has been apparent to us on several occasions when developing banks or shoals. It is frequently desirable to extend lines of soundings from 2 or 3 fathoms to several hundred fathoms with the same boat, and we have accomplished the object in a simple and inexpensive manner by fitting our Tanner sounding machine to work on the stern of the steam cutter, thus giving the boat a compact and reliable apparatus for sounding in depths from 1 to 1,000 fathoms.

BAIRD'S ANNUNCIATORS.

[Plate VI.]

Among the most important improvements in mechanical appliances during the year are the pneumatic annunciators designed by Mr. Baird, showing by dial and index pointer, on the bridge and in the pilot-house, what the engines are doing. It is desirable to know whether engine-room signals are promptly and correctly answered on any steamer, but doubly so on this vessel, where the safety of the apparatus depends upon it.

THE SIGSBEE DEEP-SEA SOUNDING MACHINE.

This machine has performed its work admirably during the year. We have crushed one reel, which caused the loss of some wire and two or three sounding cups and thermometers before it was discovered, but a heavier one being mounted we had no further trouble in that direction, although we had to contend with greater inertia incident to the increased weight. This is of no great importance in moderate depths, but when the weight of wire and its attachments approximate to that of the sinker, every pound of extra weight in the reel detracts from the simplicity and reliability of the apparatus.

Passed Assistant Engineer George W. Baird, U. S. N., of this vessel, proposed an improved reel, which would not only be stronger and lighter, but would avoid the necessity of throwing off and putting on the belt when a sounding is taken. (Plate III.) Mr. Baird describes this important addition to the sounding machine as follows:

"It is made of aluminum bronze, cast by the Cowles Electric Smelting and Aluminum Company, of Cleveland, Ohio, and finished by D. Ballauf, of Washington, D. C. This metal is reported, after tests by responsible engineers, as standing a tensile strain of over 100,000 pounds per square inch, and is represented as being as strong as the best steel as regards compression and torsion.

"The reel is cast in one piece and the rims are strengthened by numerous ribs which do not materially increase its weight.

"The objections to the old reel are its great weight and consequent inertia when revolving at high speed, as in sounding; the delay incident to putting on the belt, and working the water of condensation out of the steam cylinder when starting to reel in; also the necessity of shipping the cranks and heaving in the first few fathoms by hand.

"These objections were kept in mind while making the present design. The bronze reel A and cast-iron pulley D are mounted on the shaft B. The pulley is grooved (*d*) to carry the belt. The original frames CC are used. The pulley D is driven from the same engine and belt which drove the old reel; with the new reel in use the engine is kept running all the time, revolving the pulley D in a direction to reel in the wire.

"The pulley D has its rim beveled and fitted to a corresponding surface on the reel A, and when pressed together will, by its friction, carry the reel with it. The pulley D may be pressed against A, or withdrawn from it through the intervention of the clutch lever E and crank F. The open end of the lever E, which permits the pulley and reel being lifted out of the frame without the lever E being disturbed, is the design of Lieut.-Commander Z. L. Tanner. To retard the velocity of the reel when paying out wire the lever G and its attached brake (shown in dotted lines) are provided. The operation of the machine is as follows: Turn the crank F to the left, which withdraws the friction wheel D from its contact with the reel A, when the latter being freed will revolve and pay out the wire by gravity. The engine is then started and the pulley D revolved in the opposite direction, *i. e.*, the direction to reel in the wire. When the sinker reaches the bottom the crank F is quickly revolved to the right, which throws the friction in gear and starts the reel A to winding in the wire.

"The throttle valve of the engine, the friction crank F, and the friction lever G are close together, and under the control of one man, who can readily regulate and manage them. The counter or register, which measures the quantity of wire paid out or reeled in, is on the opposite side of the machine, convenient for the inspection of the officer in charge of the sounding."

The vessel has not been at sea since the completion of the new reel, but we have tested it at the wharf with a few fathoms of wire and a 35-pound lead, which demonstrated the advantage of the new arrangement over the old as far as rapidity of working is concerned. The strength of the reel can be demonstrated only by practical operations in deep water.

DREDGE ROPE.

The dredge rope furnished by the Hazard Manufacturing Company has not been uniform in tensile strength or length of lay, and the result has been that we have lost several thousand fathoms, with trawls and appurtenances. One lot of 4,000 fathoms was so imperfect that we had to reject it. Crucible steel has been used in the manufacture of our rope heretofore, but the requirements are so great that it has been difficult to fulfill them, and we are now getting estimates for the best mild extra plow steel, which should give much better results. With a superior quality of rope and an improved accumulator we hope to be more economical in the expenditure of dredging apparatus.

DEEP-SEA TEMPERATURES AND THERMOMETERS.

Deep-sea temperatures have been observed with great care during the year, and much thought has been given to the improvement of deep-sea thermometers with a view of attaining still greater accuracy. The following remarks on this subject are by Dr. J. H. Kidder, who has charge of the Fish Commission and Smithsonian Institution instruments, and to whom we are indebted for the suggestion of the special thermometer referred to:

"The Negretti-Zambra deep-sea thermometers now in general use by the Fish Commission, while doubtless the best instruments yet devised, cannot probably be depended upon for differences of temperature less than one-half degree Fahrenheit. Being pointed only to full degrees, upon short stems, the degree spaces are so small that estimation of small fractions is almost as much a matter of opinion as a fact of observation. As heretofore furnished, the individual thermometers have furthermore shown a wide difference in range, some reading from $-30°$ to $+100°$, others from $+34°$ to $+92°$; the results being that scarcely any two instruments showed degree spaces of the same width, and that the observer gained nothing by his experience with one thermometer in estimating fractions of a degree with another. The slight departures from uniformity in breaking column shown by some of the instruments, although seldom equaling half a degree, tend to cast a doubt upon readings to small fractions; and it may be that the quantity of mercury contained in the small safety bulb at the top of the tube is sufficient to cause a fractional error when the temperature of the water differs from that of the air at the time of reading.

"For these reasons, and considering the fact that at depths greater than 1 mile the general ocean temperature falls very gradually if at all, and that observations at far greater depths do not agree in reporting corresponding differences in temperature, I requested authority from the Commissioner to order an experimental half-dozen of longer tubes of uniform range, and pointed to one-fifth degree Fahrenheit (Plate IV). The specification was as follows: 'The special thermometers are required to be of sufficient length to be legibly pointed in fifths of a Fahrenheit degree, and it is particularly desired that all of the instruments now or hereafter ordered shall conform as nearly as possible to the range from 20° to 90° Fahrenheit, as specified in my letter of August 6, 1886.' (Order dated September 6, 1886.)

"As far as can be determined by laboratory experiments the new thermometers fulfill all of the desired conditions, and are besides unusually free from index error. It is possible that before the Albatross sails I shall be able to furnish a correction for the small error arising from the expansion of the mercury contained in the small safety bulb at the top of the tube after oversetting."

THE TANNER IMPROVED THERMOMETER-CASE WITH THE SIGSBEE CLAMP AND THE NEGRETTI-ZAMBRA SPECIAL DEEP-SEA THERMOMETER.

[Plate IV.]

Fig. 1 shows the apparatus complete, and Fig. 2 a vertical sectional elevation of the case containing the thermometer.

NOMENCLATURE.

a. Neck of the bulb.
b. Catch reservoir.
c. Small receptacle.
d. Partition confining mercury in shield surrounding bulb.
e. Glass shield inclosing thermometer.
f. Thermometer-case.
g. Thimble with rubber lining.
h. Spiral springs.
i. Cap.
j. Pivot.
k. Slot for reading scale.
l. Frame of cast brass.
m. Guard.
n. Propeller.
o. Spindle.
p. Stud.
q. Sigsbee clamp.
r. Latch.
s. Slot.

The thermometer-case is made of brass except the Sigsbee clamp, *q*, and spiral springs, *h*, which are phosphor bronze. The frame is cast and the case in which the thermometer is inclosed is an ordinary tube of commercial pattern.

The Negretti-Zambra deep-sea thermometer was described as follows in the Report on the Construction and Outfit of the U. S. Fish Commission Steamer Albatross, 1883:

"The thermometrical fluid is mercury; the bulb containing it is cylindrical, contracted in a peculiar manner at the neck *a;* and upon the shape and fairness of this contraction the success of the insrtument mainly depends. Beyond *a* the tube is bent and a small catch reservoir at *b* is formed for a purpose to be presently explained. At the end of the tube a small receptacle, *c*, is provided. When the bulb is downward the glass contains sufficient mercury to fill the bulb, tube, and a part of the receptacle *c*, having, if the temperature is high, sufficient space in *c*. When the thermometer is held bulb upward the mercury breaks at *a*, but of its own weight flows down the tube, filling *c* and a portion of the tube above *c*, depending upon the existing temperature. The scale is accordingly made to read upward from *c*.

"To set the instrument for observation it is only necessary to place it bulb downward, when the mercury takes the temperature just as in an ordinary thermometer. If at any time or place the temperature is required, all that has to be done is to turn the thermometer bulb upward and keep it in this position until the reading is taken. This may be done at any time afterward, for the quantity of mercury in the lower part of the tube which gives the reading is too small to be sensibly affected by a change of temperature, unless it is very great; while that in the bulb will continue to contract with greater cold and to expand with greater heat. In the latter case some mercury will pass the contraction *a* and fall down and lodge at *b*, but it cannot go farther so long as the bulb is upward, and thus the temperature to be read will not be affected.

"The thermometer is inclosed in a glass shield which eliminates all errors that might arise from pressure at great depths.

"To mount the thermometer, unscrew the cap *i* (Plate IV), drop a spring, *h*, into the case, slip a thimble, *g*, over the glass shield at *d*, put the thermometer in the case, drop in another thimble, which will rest on the upper end of the shield; then place another spring on the thimble and screw the cap in place. The thermometer will then be suspended between delicate spiral springs at the ends, and soft rubber rings which surround the shield. This arrangement has proved effectual in guarding the thermometer against jars incident to the service required of it on board the Albatross.

"To take a temperature set the spindle, *o*, into the hole in the cap, *i*, by screwing it down until the propeller blades are against the stud *p*, then by means of the Sigsbee clamp, *q*, secure it to the temperature rope. The bulb will then be down and the mercury in the tube connected with it, the position required to take the temperature. The water acting on the propeller during the descent will keep it in position, resting against the stud, *p*, but as soon as the reeling in begins the propeller is set in motion, bringing the screw on the upper end of the spindle into action, gradually raising the propeller until the lower end of the spindle is withdrawn from the hole in the cap, *i*, when the thermometer promptly turns over and registers the temperature by breaking the column of mercury at the point *a*, the column then falling to the bottom of the tube. It can be read at any time afterward, as changes of temperature do not affect the reading after the column is once broken."

The latch, *r*, and slot, *s*, in which it works, has been added to prevent lateral motion after the thermometer has been turned over.

THERMOMETERS FOR AIR AND SURFACE TEMPERATURES.

The instruments for this purpose were made by J. and H. J. Green, New York, and are all that can be desired.

STEAM TRAP.

[Plate VIII.]

The exhaust steam from the radiators, fore and aft the vessel, is trapped to the hot-well and again fed into the boilers, thus effecting a considerable saving in fuel.

We first used the Hawes trap, which did not prove satisfactory. The Chapman trap was then tried with better results, but it frequently failed to carry off the water, thus flooding the radiators and causing more or less annoyance. Mr. Baird, coming to our assistance again, devised a simple and inexpensive trap which has performed its work admirably, relieving us from the annoyances above mentioned.

BOILERS.

[Plate IX.]

Mention has been made of an appropriation for new boilers, made necessary by a contemplated cruise in the Pacific. The old ones are much worn and require extensive repairs after each trip, making them totally unfit for a long cruise.

With the introduction of new boilers we will increase the size of the coal-bunkers between 60 and 70 tons, thus augmenting the steaming distance over 1,000 miles. A "donkey" boiler is included in the new arrangement, for distilling water, heating and lighting ship, and for fire purposes. Heretofore this service has been performed by one of the main boilers, at comparatively large expense.

MAIN STAY-SAIL.

We formerly carried a fore try-sail gaff, but owing to the position of the standard compass, pilot-house rail, &c., were unable to use the sail. We have recently dispensed with the gaff and substituted a stay-sail, containing 900 square feet of canvas, hoisting on the main-spring stay, which extends from the main to the foremast head. This sail can be carried in ordinary weather.

PERSONNEL.

The health of officers and crew has been excellent during the year, and no deaths have occurred. There have been several changes among the officers. Lieut. Seaton Schroeder, executive officer and navigator, was detached January 2, 1886, Lieut. H. S. Waring assuming his duties.

In the detachment of Lieutenant Schroeder the Commission lost one of the most accomplished and indefatigable workers it has ever drawn from the Navy.

Ensign W. S. Benson reported for duty January 13, and Ensign W. S. Hogg on the 16th.

Mr. James E. Benedict, resident naturalist, resigned September 1, and was succeeded by Thomas Lee, assistant.

The following officers are attached to the vessel at the close of this report, December 31, 1886:

Lieut.-Commander Z. L. Tanner, U. S. N., commanding.
Lieut. H. S. Waring, U. S. N., executive officer and navigator.
Lieut. (J. G.) B. O. Scott, U. S. N.
Lieut. (J. G.) W. S. Hogg, U. S. N.
Ensign W. S. Benson, U. S. N.
Surgeon J. M. Flint, U. S. N.
Paymaster C. D. Mansfield, U. S. N.
Passed Assistant Engineer G. W. Baird, U. S. N.

CIVIL APPOINTMENTS.

Thomas Lee, resident naturalist.
E. H. Shuster, clerk to commanding officer.

PETTY OFFICERS, FIRST CLASS.

Seaman class.

J. W. Astrom, chief boatswain's mate.

Special class

Charles Wright, master-at-arms.
S. L. Pritchard, equipment yeoman.
N. B. Miller, apothecary.
G. A. Miller, paymaster's yeoman.
F. L. Stailey, engineer's yeoman.

Artificer class.

John Hawkins, machinist.
Walter Blundell, machinist.
F. M. Stromberger, machinist,
W. L. Watson, machinist.

Attention is called to the appended reports of the chiefs of the various departments:

Navigator's report, giving a summary of the distances steamed, objects of the cruise, number of soundings, dredgings, &c.

Engineer's report; medical department, sanitary report and record of specific gravities; naturalist's report, including lists of birds and fishes taken in the Bahamas; list of hydrographic soundings; and dredging and trawling record.

Navigator's report—Summary of the movements of the Albatross for the year 1886.

Date.	Movements.	Distance.	Object.
		Miles.	
February 17 to 18	Washington, D. C., to Norfolk, Va	174	
February 20 to 27	Norfolk, Va., to San Salvador	1,053.4	Sounding.
February 27 to 28	San Salvador to Rum Cay	34	Do.
March 8 to 15	Rum Cay to Nassau, New Providence	560.3	Sounding and dredging.
March 24 to 26	Nassau, New Providence, to Key West, Fla.	389.8	Sounding.
April 3 to 4	Key West to Havana, Cuba	156.3	Do.
April 7 to 8	Havana to Key West	90	Sounding and dredging.
April 8 to 21	Key West to Nassau	793.4	Do.
April 30 to May 8	Nassau to Hampton Roads	1,001.8	Do.
May 9 to 10	Hampton Roads to Washington	162	
June 30 to July 1	Washington to Norfolk	174	
July 8 to 10	Norfolk to Wood's Holl	405.8	
July 15 to 19	Wood's Holl and return	390.2	Sounding and dredging.
August 2 to 13	Wood's Holl to St. John's, Newfoundland	1,883.2	Do.
August 21 to 29	St. John's to Wood's Holl	1,060.8	Do.
September 14	Wood's Holl to Newport	40	
September 15 to 21	Newport to Wood's Holl	499.2	Sounding and dredging.
October 21 to 28	Wood's Holl to Washington	724.1	D
Total (95 days)		9,592.3	

The above table gives the number of days the vessel was at sea during the year; also the distance run and the object of each trip. The number of days at sea, 95. Number of dredging stations, 107. Number of hydrographic soundings, 221.

ENGINEER'S DEPARTMENT.

Report of G. W. BAIRD, *Passed Assistant Engineer, U. S. N.*, 1886.

THE MAIN ENGINES.

The engines have been in operation 1,160½ hours, while the ship was on her course, in free route, besides the time occupied in sounding and dredging at sea, while the engines were worked to signal.

The ship has steamed on her course 9,495 geographical miles—a mean of 8.182 knots per hour. During this time the starboard engine made 4,652,279 revolutions and the port engine 4,632,994, being a mean of 66.81 per minute for the starboard, and 66.53 for the port.

The cruising has been made under easy steam, usually on a limited allowance of coal. We are carrying the same boiler pressure (50 pounds per square inch above the atmosphere) that we carried last year, but have seldom run the engines up to the highest power obtainable with even that limited pressure. The highest speed recorded for one hour during the year is 10.4 knots, and highest average for 7 hours, uninfluenced by wind or sea, is 9.93 knots.

The shaking of the ship (which has never been violent) has been somewhat reduced by the counter-balance wheels (Plate V) which we had built by the Steam Engineering Department at the Washington navy-yard, in January. The writer designed them in two parts, in order to get the wheels on without disturbing the shafts, and by filling certain pockets with lead we contributed counter-balance to the engines. It has always been difficult to move the engines by hand, owing to the preponderance of the moving parts over the original counter-balances; this has been modified by making teeth on the periphery of the wheel (Plate V) which afford additional points for "pinching" the engines. These new counter-balance wheels fit over the forward webs of the low-pressure cranks. The cost of the two wheels complete was $314.04, or about 7¾ cents per pound.

The new feed-pump valves, referred to in my last report, have fulfilled my most sanguine expectation; the pumps have not failed for an instant, during the year, and their noise has been very much diminished.

During the year we have fitted a new key to the starboard rock-shaft, and have put new anti-attrition metal in the port low-pressure crank-pin brasses; we have raised the main valves on their stems to restore the lead.

The following synopsis for the year's run covers the time the ship was running, in free route, on her course; it includes the time the vessel was slowed down, in fogs, going into and coming out of port, running between dredging stations, &c., but not the time soundings or dredgings were being taken. We have considerable trouble to keep the valve-stems of the high-pressure valves and those of the high-pressure cut-offs tight for any extended period; this is owing to the shallowness of the stuffing-boxes and also to the uneven wear of cut-off rods. I will make a requisition for the Katzenstine metallic packing for these rods at the beginning of the year. We have replaced the main air-pump valves with hard-rubber valves, purchased of the Davidson Steam Pump Company at a cost of $29.10.

Synopsis of the steam log of the Albatross for the year 1886.

Engines:	
Mean point of cutting-off, in the high-pressure cylinders, from commencement of stroke ....inches..	16.3
Mean point of cutting-off, in the low-pressure cylinders, from commencement of stroke ....inches..	16.8
Mean number of holes of throttle-valve open	4.19
Mean vacuum in the condenser ....inches..	22.7
Mean pressure in the boilers, per square inch ....pounds..	47.9
Mean pressure in starboard receiver, per square inch, above zero ....pounds..	19.3
Mean pressure in port receiver, per square inch, above zero...do....	20

Temperatures:	
Of engine-room	107.9
On deck	67.5
Of injection water	69.8
Of discharge water	95.9
Of feed water	75.4
Total time fires were lighted ... hours	6,232$\frac{1}{12}$
Total time engines were in operation, the ship being on her course ... do	1,160$\frac{1}{3}$
Revolutions:	
Total of starboard engine	4,652,279
Total of port engine	4,632,994
Mean of starboard engine per minute	66.81
Mean of port engine per minute	66.56
Total number of geographical miles	9,495.2
Mean number of geographical miles per hour	8.182
Total tons of coal consumed while engines were in operation	562$\frac{218}{2240}$
Mean number of pounds of coal consumed per hour while the engines were in operation	1,087
Total tons of coal consumed for all purposes	953$\frac{419}{2240}$
Total tons of refuse (ashes) from the coal	211$\frac{440}{2240}$
Draught of water:	
Greatest:	
Forward ... feet and inches	11 5
Aft ... do	13 10
Least:	
Forward ... do	10
Aft ... do	12 5
Mean, for the whole of the steaming:	
Forward ... do	10 6.81
Aft ... do	13 0.31

The greatest continuous speed during the year 1886.

Date, July 19, 1885:	
Speed ... knots	9.93
Number of hours	7
Direction of wind	NNE.
Force of wind	$\frac{6}{7}$
State of sea	Smooth.
Number of furnaces used	4
Steam pressure in boiler, per square inch ... pounds	50
Steam pressure in receiver, per square inch ... do	25.5
Revolutions per minute	81.5
Vacuum ... inches	23.7
Holes in throttle-valve open	5
Cut-off in non-condensing cylinder ... inches	22
Cut-off in condensing cylinder ... do	12$\frac{1}{8}$
Temperature:	
In engine-room	115
On deck	68.6
Of injection water	69.8
Of discharge water	98
Of feed water	78.7
Draught:	
Forward	10′. 8″
Aft	12′. 7″

Anthracite coal per hour ....pounds..	1,226
Indicated horse-power {	529.2
	5
	534.2
Coal, per indicated horse-power, per hour ....pounds..	2.29

The ship was docked in July at the Norfolk navy-yard. We found the outboard valves in good order. A quantity of barnacles (*Balanidæ*) was found inside the cast-iron chamber of the injection-valve. We found the zinc ferrules in the nozzle of the outboard blow-valve had corroded but little, while the iron chamber appeared preserved. We found the line-shafts, under the insulation tape, to be free from corrosion. This tape has been on the shafts two years.

The annunciator, referred to in my last annual report, was duly completed, and has worked well during the year.

A current of air blown into the bottom of the case (Plate VI) will cause the little wind-mill at the top to revolve. This is mounted on the vertical spindle, which has a screw-thread near its lower end which gears into a toothed wheel; this wheel, which is on a horizontal shaft, carries an arrow on each end; the back of the indicator is secured to one side of the pilot-house, with a circular hole in the wood large enough to move in; the front arrow is visible from the deck and the back arrow from the interior of the pilot-house. If a current of air, blown into the bottom of the indicator, revolves the arrow ahead, it is manifest that the direction of the arrow will be reversed if the current be reversed.

To secure these positive blasts, a small blower (as in Plate VII) is placed in the engine-room, parallel with the line-shaft, to which shaft it is belted. If the engine goes ahead the blower delivers a blast, and if the engine backs the blower induces an air current, and if the engine stops the blower and current of air cease simultaneously.

There is one of these machines for each of the main engines; their action is positive and automatic, and they can make no mistake.

On board the United States ships Boston and Atlanta there are three of these indicators in each circuit, which consequently announces the motion of the engine at as many different parts of the ship. To connect the blower and indicators we use lead pipes.

The inertia of a ship in motion is considerable, and it takes some little time for the ship to change her direction even after the engines are reversed; it often occurs, in sounding and in dredging, that opposing wind and currents carry the ship from the desired position in reference to the wire; hence it becomes imperative for the commander to know, promptly, if either engine has moved in the desired direction. Damage due to mistakes either in striking or in interpreting the signals, which hitherto occurred, have not occurred since the pneumatic indicators have been used. The tax on the commander's mind in reconciling the wind, waves, current, strains on and direction of the dredging wire, while dredging in the great depths of the Gulf Stream is considerable, and when he had, in addition to this, to remember the direction both engines were moving in, it was a surprise that successful work was done at all.

GOVERNORS.

The Svedberg governors have performed well during the year. They have required no repairs nor alteration, and but little attention.

On completing the repairs to the boilers at the Washington navy-yard, in January, we put a cold-water pressure of 65 pounds in the port boiler and 64 pounds in the starboard boiler; at which pressure they appeared tight, but the soft patches on the front inboard corners began to leak soon afterwards.

The 1½-inch screw (pipe) plugs we put in the boilers were tight. One of the plugs began to leak on the 1st of March and the legs began to leak soon afterwards. On the 1st of April we discovered one of the steel socket rivets broken off; we replaced it with an iron one.

On our return to Washington (from the Bahama cruise) we replaced five rivets in a patch on the back leg of port boiler; and a soft patch on a seam on the shell of starboard boiler; replaced a soft patch in the forward inboard corner of No. 4 furnace; replaced two soft patches in the port inboard corners of both boilers; put a new stem in the starboard main check-valve; calked seams and rivets in No. 4 furnace; a new rivet in a brace in the starboard boiler; replaced two soft patches on the waist of port boiler and one on starboard boiler; replaced a soft patch on the bridge end, inboard corner of No. 1 furnace; to accomplish this last job it was necessary to dig a portion of the cement out of that boiler, which we replaced. We put several new rivets in the front sheet of this furnace.

On completing the repairs at Washington the vessel made her summer cruise, during which time leaks occurred as before, but we were able to obtain fresh water at Wood's Holl and at St. John's—the only ports visited—and we only accumulated scale while at sea after our supply of fresh water was exhausted. Our stay at Wood's Holl was longer and our voyages were of shorter duration than during previous cruises, which enabled us to take better care of the boilers.

During the year we have paid for repairs to the boilers:

For labor, $516.21; for material, $494.15. Total, $1,010.36.

NEW BOILERS.

In obedience to the Commissioner's order the writer designed boilers to replace those now in the ship, which were bid on by a number of large engineering establishments; these bids were opened on the 23d of this month and the Columbian Iron Works and Dry Dock Company, of Baltimore, was found to be the lowest bidder.

The new boilers are to be two in number, cylindrical in form, and are specified to be of "the best American charcoal-hammered iron."

They are to be placed in the main hold fore and aft, one forward of the other, with the fire-room athwart-ships between them.

A steam chimney is placed over the fire-room—between the boilers—and is supported on wrought-iron built-up girders, supported by the boilers, essentially as recommended in my quarterly report dated 31st of March, 1884.

The external diameter of the boilers is 12 feet, and the length on line of axis is 10 feet 3 inches. Each boiler has three furnaces, 36 inches internal diameter, and exposes a length of grate of 6 feet 6 inches, making an aggregate of 117 square feet of grate surface.

The tubes are to be wrought-iron lap-welded, 3 inches external diameter, 7 feet 9 inches long, No. 10 wire gauge in thickness; there are in all 394 tubes, including 48 stay-tubes, which are No. 8 W. G. thick.

The shells of the boilers are to be $\frac{3}{4}$ of an inch thick; the longitudinal seams are double strapped; the circumferential seams are to have single straps; all the seams are butted.

The heads are to be $\frac{9}{16}$ inch thick, butted and strapped. The heads are braced by $1\frac{5}{8}$-inch rods, spaced 12 inches centers, and the other flat surfaces are stayed by $1\frac{1}{4}$-inch screw-stays, spaced $7\frac{1}{2}$-inch centers.

The steam-chimney is 7 feet 4 inches in diameter (the same as the old one) and is 10 feet high.

The flue is 4 feet 4 inches in diameter, is in four sections, stiffened by the Adamson rings, and is $\frac{5}{8}$ inch thick.

The boilers are to sit in and be secured to wrought-iron saddles, which are to be riveted to the floor frames. The holding-down bolts are $1\frac{1}{2}$ inches in diameter, and six in number for each boiler.

The old stop-valves, checks, blows, salinometers, gauges, etc., are to be utilized as far as possible.

A new $8\frac{1}{2}$-inch stop-valve, a section of $8\frac{1}{2}$-inch copper steam pipe, a 3-inch safety-valve, one new escape-pipe, two safety feed-valves, and two sections of feed and blow pipe are to be made new.

The covering of the boilers will consist of half an inch of kaolin, half an inch of hair felt, and half an inch of wood pulp.

The center of the smoke-pipe will come about 5 feet 3 inches forward of the present one. We will put four ventilators (instead of two) into the fire-room, and, by bringing them close to the smoke-pipe, we will leave more "floor room" on deck than at present, and will bring the ventilator hoods clear of the main-stays, that we may run them up about 8 feet into the air. As there will be a boiler on both sides of the fire-room, we will need all the air we can get into the fire-room.

The iron in the old coal-bunkers is to be utilized in the new ones. We will get the new boilers and bunkers between the same bulk heads that inclose the old ones, but the new arrangement affords a space of 12 inches in the clear (at the smallest place) around the boilers, and an increase of more than 30 tons of coal in the bunkers.

DONKEY-BOILER.

This boiler is to be of the same material as the main boilers, is to be cylindrical in form, 4 feet 6 inches in diameter, and 4 feet 8 inches in length. It is to have a single furnace-flue 30 inches in diameter, exposing a grate 3 feet 3 inches long. It is to have a steam drum 24 inches in diameter and 15 inches high; the tubes are to be eight in number, 4½ inches in diameter, and 3 feet 9 inches long, arranged in nests over the spandrels of the furnace; they are to be lap-welded drawn tubes. This little boiler is to be placed on the main deck in the deck-house amidships, between the main steam drum and the galley. The object of using this boiler is to warm the ship, run the dynamo, run the pumps (for washing decks, pumping bilge, supplying the aquaria, etc.), and distilling water when the main boilers are not in use. It is believed that considerable labor and coal will thus be saved, as well as saving the main boilers.

DREDGING-ENGINE.

The follower-bolts in the starboard cylinder of this engine, which were broken a year ago by water freezing in the piston, were at the time temporarily replaced by bolts belonging to another engine, have been replaced by new and proper bolts. The guide-roll of this engine was badly worn and scored by the dredge wire, and was replaced by a new one made at the Washington navy-yard in June last. Two new wrist-pins have been made for this engine. The cost for labor on the above was $13.80; material, 35 cents; total, $14.15.

REELING-ENGINE.

This engine has been overhauled and adjusted; the wrist-pins, which were wearing "out of round," have been turned around one-fourth of a turn, that the future wear may come on the high places.

SOUNDING-ENGINE.

The steam hose on the sounding-engine burst at sea, on the 1st day of May, and as there was no way of repairing it the writer substituted the exhaust-hose for it and erected a temporary exhaust-pipe of iron, which temporary plan answered very well until the ship reached port. We provided new and larger steam hose and attached them. We had the steam cylinder rebored, increasing its diameter nearly one-quarter of an inch, had new piston-rings made, and provided a proper oil-cup to lubricate the valve and piston of this engine. The cylinder was not true and the original piston-rings leaked, which diminished the power of the engine, which is really too small for the work. The changes made it a little better. The writer believes, when the increased pressure from the new boilers is applied to this little engine, that it will reel the wire in about 15 per cent. faster than it did originally. A new bronze sounding-reel has been built by contract, and has been fitted to its place by the men in this department. Its pulley is slightly less in diameter than that of the original reel, and with increased pressure on the steam piston it is believed that the speed of reeling in will be from this cause augmented. The cost of the labor and material consumed on the engine of the sounding-machine—which come in the writer's department—were as follows:

38 feet of steam hose	$18.00
1 oil-cup	.60
1 hose-coupling	2.00
Labor	20.70
Total	41.30

STEERING-ENGINE.

The steam steering-gear has not been used much during the year, but has, when used, done its work with promptness and precision. The plates over the exhaust chambers and passages are very light and are not bolted close enough; this makes bad air-leaks which reduces the vacuum from 2 to 3 inches in the condenser.

STEAM-WINDLASS.

This machine continues to give satisfaction. Besides hoisting, catting, and fishing the anchors, it is used to reel off wire rope, warp the ship, and hoist boats. No repairs have been needed to this engine during the year, except sweating thin pieces of brass on the sides of the crank-pin brasses, at a cost of $1.38.

STEAM ASH-HOISTER.

This machine continues to work admirably. The (cast-iron) gland to one of the piston-rods was discovered to be broken; there was sufficient metal in it and the fracture showed a clear break, an indication that it was broken by accident or stupidity. The broken gland was replaced by a brass one at the Washington navy-yard, at a cost of $2.76.

STEAM-PUMPS.

We have had to renew the leather cup-packings on the water-piston of the circulating pump during the year, at an expense of $8. The piston, which is of cast iron, is badly corroded and will not last much longer. It should be replaced by a light brass piston fitted for hemp packing. We have had the steam-chest of the hydrant pump rebored, and a new steam-valve put in during the month of June, at an expense of $27.05.

A No. 1 Davidson steam-pump has been purchased and erected in the engine-room to circulate sea-water through the aquaria. The piping is entirely of brass, and is provided with proper valves, tap-cocks, and safety-valve, which may be regulated in the laboratory. The pump and piping were erected by the men in this department.

Cost of the aquarium pump	$90.56
Cost of piping	48.23
Cost of valves, cocks, and fittings	11.89
Total	150.68

STEAM CUTTERS.

These two boats continue to do good service, and are always ready for use when required. The nature of the service of this ship, which gives us semi-annual opportunities to overhaul these two boats, and the hearty co-operation of the commanding officer in all matters pertaining to their efficiency, are two important elements in the great success of these Herreshoff boats. During the year the following repairs were made to the larger boat, at the Washington yard: A sheet-brass cover was put on the separator, new wrist-pins were put in the cross-heads, and the cross-head gibs were rebabbitted; the lower half of the casing of the boiler has been renewed; new pins were made for the eccentric-rods; new pins were made for the link blocks; the plunger and valve of the hand bilge-pump were refitted; a new steering-wheel and drum were made. In November a set of grate-bars were made. Repairs, such as straightening the screw-blades, which had been bent, remaking joints, &c., have been made by our own men. The cost of repairs to this boat at the Washington navy-yard amounted to $54.66. During the year we have bought from the builders of the boat a new slide-valve for the high-pressure cylinder, at a cost of $5.50. The wear of these slide-valves, which are made of brass, is all on one side.

The smaller boat (the gig) broke her high-pressure piston ring and spring and bent the rod and follower on the 7th of March. The brass follower was screwed to the cast-iron piston by a fine thread; this became loose and unscrewed. We repaired it temporarily by casting a solid Babbitt-metal ring, in place, and straightening the rod and follower; we replaced the piston, later in the year, by one of wrought iron. Later in the year we lost the low-pressure piston in the same way, and replaced it in like manner. The slide-valve of the high-pressure engine, which was worn to a knife-edge on one side, has been replaced with a new one.

The smoke-pipe was rolled out of the gig on the night of the 5th of March, in 3½ fathoms of water; it was recovered by a native diver. The top of the boiler was so badly torn by the accident, and the lower casing so badly corroded and burned out by the end of the summer cruise, that we were obliged to put on an entirely new casing. As the fine boiler-shop at the Washington navy-yard had been discontinued, as such, we were obliged to employ a journeyman boiler-maker and build the casing ourselves. By the courtesy of the chief engineer of the navy-yard we were permitted to use the shop. We purchased the material from L. H. Schneider, of Washington.

The cost of repairs to the gig during the year was as follows:

1 safety-valve spring	$0.75
1 high-pressure slide-valve	4.50
1 high-pressure piston	13.50
1 low-pressure piston	17.00
Material for new boiler casing	35.57
Labor for new boiler casing	49.68
1 set of fire-bricks	2.50
Total	123.50

FRESH-WATER DISTILLING APPARATUS.

During the year we have distilled 53,425 gallons of water, which has been uniformly of good quality. A leak was discovered in the joint at one end of the coils during the month of June. This leak was stopped by a plumber's joint of soft solder, by a navy-yard workman, at a cost of $9.

The practice of cleaning and whitewashing the interior of the tanks each time they are emptied is continued with good results.

ELECTRIC LIGHT.

The uniformly white, steady, and agreeable light from our Edison incandescent lamps has continued throughout the year.

The commutator of our Z-dynamo, though much worn, is still efficient. The engine is as efficient as when new, and gives us but little trouble. The engine and dynamo are run by a coal-heaver.

The usual amount of breakage of wires and burning out of cut-out plugs has occurred, which has generally been traced to short circuiting through sea-water, which leaks through the decks, &c., and gets at the wires.

We find, in repairing these wires (which are of copper) that they are now quite soft and ductile, though they were quite brittle two years ago. There can now be no doubt that a molecular change is going on in these wires all the time. The three-light pendants, with their flexible cables, have been used the entire year, to the exclusion of the arc lights. The attachment at the end of the cable is troublesome in that the men break them by sometimes screwing up too hard; sometimes they burn out by arcing, from failure to screw them up to good contact, and again by dirt separating the contacts just enough for the purpose.

One of the small tension-screws of the dynamo brushes has been renewed during the year, and drip-pans have been fitted to the pillow-blocks of the dynamo, the blocks being cut out to receive the pans.

The dynamo has been in operation 1,574 hours and 26 minutes during the year, during which time a mean of about 47 lamps has been in circuit, aggregating the following cost:

14¾	tons of coal, at $5.17	$76.25
43½	gallons of oil, at 55 cents	23.925
149	lamps, at 85 cents	126.65
34	3-light safety-plugs, at 8 cents	2.72
18	6-light safety-plugs, at 8 cents	1.44
1	30-light safety-plug, at 8 cents	.08
2	key-sockets, at 70 cents	1.40
4	plain sockets, at 60 cents	2.40
3	wire shade-holders, at 30 cents	.90
3	pounds copper wire, at 40 cents	1.20
2	pounds insulation tape, at 50 cents	1.00
1½	gross assorted screws, at $1.25	1.875
46	feet flexible cord, at 15 cents	6.90
4	attachment plugs, at 40 cents	1.60
3	dynamo-brushes, at 60 cents	1.80
1	standard receptacle, at 44 cents	.44
	Total	250.58

Taking the 16 candle-power lamps as requiring double the current of one 8 candle-power, the mean number of lamps will be (as nearly as can be estimated) 47; the candle-power hours will then be ($47\times1574\times8=$) 591824, and this quantity, divided into the total cost, gives the cost of $\frac{250.58}{47\times1574\times8}=0.042$ cents per candle-power per hour, or almost exactly what an equal gas-light costs the consumers in Washington city.

The submarine lamps have worked very well during the year. The naturalists employed them extensively on the Bahama Banks, where the white bottom of the sea afforded a beautiful reflector in the darkness of the night. By the aid of the marine glass (improvised in this department) the position of the light and adjacent objects were readily observed even when the surface of the water was disturbed.

Though no hitch or delay has occurred during the year, and the plant has worked fully as well as when first installed, I feel obliged to say that the B circuit of only 51 volts pressure is rather behind the age, so far as economy is concerned, and therefore recommend the exchange of the dynamo for one of higher potential.

The Albatross was, I believe, the first Government vessel (of any nation) that employed the incandescent electric lighting for internal illumination.

The experiments made and the results obtained here were carefully considered in the Navy Department before any venture was made to light their ships in a similar manner. We have produced our light, I believe, at least as economically as any people using so weak a current as we employ, but since we installed our plant great improvements have been made in dynamos. The change in the dynamo will not be very expensive.

LIFE-TIME OF LAMPS.

For the past two years we have kept the lamps in the engine-room alone in circuit all the time, that we might obtain a correct estimate of the average duration of the lamps.

The total lamp hours was 27,987 hours and 31 minutes, and the total number of lamps expended was 30, so that the mean life-time of the lamps in the engine-room appears to be $\left(\frac{27987-31}{30}=\right)$ 932 hours and 54 minutes. Lamp No. 92 is included in the above average, though it was broken after 701 hours of incandescence.

In recording the great life-time of these lamps, it is proper to state that they were in circuit all the time, and were lighted and extinguished daily with the starting and stopping of the dynamo, and were, consequently, never suddenly heated nor cooled.

VENTILATION.

The ventilating fan has been in use, during the warm weather, for several hours each night when at sea. The wastefulness of the Wise motor, which drives the fan, is so great, that the writer does not feel justified in using it a great deal. The new arrangement of boilers will displace the present fan and motor, and I recommend that a pair of Sturtevant's No. 5 monogram exhaust fans and an orthodox steam-engine be put in place thereof. They can be placed in the donkey-boiler room conveniently. To exhaust some of the heated air from the space over the working platform of the engine-room I recommend that two wrought-iron chimneys be run from this point to the open deck above.

The four proposed ventilators to the new fire-room, which will extend 8 feet above the deck, will doubtless be much more efficient than the present two, having the same (18 inches) diameter, and which are only 3 feet above the deck. The movable cowls of the new ventilators will be of copper, to prevent affecting the standard compass.

WARMING.

The usual trouble from breaking of heater valves has continued. It is impossible to say when or by whom these valve-stems are twisted off or threads stripped; it is a contest between small brass valves and muscle, in which the latter appears to triumph. The large heater, which was removed from the berth-deck last year, has been replaced.

The steam traps (Chapman's) have never been satisfactory; water accumulates in the heaters if we trust to the automatic action of the traps, and if we attempt to regulate the drain by adjusting the by-pass, we find steam blowing through at times.

The writer designed a valve (Fig. 2, Plate VIII) and improvised a trap by screwing the valve into a cast-iron cylinder we had been using for an oil-filter; the steam and water enters at the top and the condensed water escapes through the valve; the steam does not escape.

We substituted this for the Chapman trap for draining the after heaters, and find it works admirably.

COAL.

Excepting 30 tons of semi-bituminous coal purchased at Nassau in April, and about two tons for the cutters, we have used anthracite coal exclusively.

The total consumption, for all purposes, has been 953 tons 419 pounds, and the average cost has been $5.17 per ton.

The quality has been generally good, except that obtained from the Norfolk navy-yard, which we found dirty and air-slaked.

We check the weight of coal received by the increase in the ship's displacement, which latter quantity is obtained from a calculation of the ship's increase in draught of water. We either witness the weighing of every pound of coal we buy, or weigh it ourselves as it is delivered alongside the ship. The following amounts of coal have been used for the purposes specified:

	Tons.
Coal consumed to propel the ship while on her course, to warm the ship, pump bilges, wash decks, and hoist ashes while the main engines were in operation	$562\frac{2213}{2240}$
Coal consumed to light the ship by electricity	$14\frac{1934}{2240}$
Coal consumed to ventilate the ship	$10\frac{1867}{2240}$
Coal consumed to distill water	$23\frac{1978}{2240}$
Coal consumed by the steam cutters	$9\frac{2238}{2240}$
Coal consumed for driving the hoisting engine, steam windlass, washing decks, warming ship, and keeping fires banked when the main engines were not in operation	$277\frac{7}{2240}$
Total coal consumed by the engineer's department	$899\frac{968}{2240}$
Coal consumed by the equipment department (cooking)	$53\frac{1637}{2240}$

MEDICAL DEPARTMENT.

Report of Surgeon J. M. FLINT, *U. S. Navy*.

The general health of the ship's company during the year has been very good. No cases of serious illness have occurred, and only those trifling accidents incident to all the ruder occupations of men. The provisions for ventilation are the same as heretofore, and are reasonably effective when in use. The between-decks, in this as in all other ships with which I have been acquainted, are more or less malodorous at sea. No precautions can prevent the evolution of foul gases in the bilges of a ship, where the presence of organic matter and the conditions of heat and moisture favorable to decomposition are unavoidable. How to remove these gases before they have contaminated the air of the apartments of men and officers, is a problem not yet solved; it is evident, however, that any system of ventilation in order to be perfect must be in continuous action.

The first part of the year, from early in February to May, was passed principally among the Bahama Islands, where the temperature was mild, the winds fresh but soft, and the climate generally conducive to health and comfort. The islands themselves in their present condition furnish wonderfully little of general interest to the visitor, and fail utterly to justify the glowing accounts given of them by their discoverers. The inhabitants of the islands, with the exception of New Providence, are poor and thriftless but not wretched or degraded, mostly colored, evidently diminishing in numbers, extracting a very plain subsistence from a thin soil impervious to modern implements of husbandry, and from the more open-handed generosity of the sea. There are no educated medical men on the islands except at Nassau, and the announcement of the presence of a "doctor" among them was sufficient to surround him speedily with a numerous *clientèle*, consisting of the sick, those who had been sick, and those who thought that they might at some future time get sick, all anxious to avail themselves of the rare opportunity for professional treatment. Every effort was made to minister to their necessities as well as their fancies, and their expressions of gratitude for what they received were evidently sincere. So far as was observed the physical condition of the people seemed to be good. There were few maimed or deformed, and only occasional evidence of the prevalence of specific diseases among them, either at present or in the past. These remarks, however, apply only to the outlying islands and not to New Providence, upon which is situated Nassau, the largest town and the principal commercial port of the Bahamas.

Among the interesting cases observed was one of Hysterical Paralysis of several months' continuance, the patient having been utterly unable to move a muscle of the lower extremities during that time. The subject was a well-conditioned young girl, one among numerous victims of a remarkable epidemic of hysteria attending great religious excitement on Cat Island. Several hundred persons, a very large percentage of the whole population, were said to have been affected, mostly young people, boys and men as well as girls and women, and their wild vagaries were related by witnesses with a solemnity that assured the hearer how firmly rooted was the belief in the supernatural character of the manifestations. Treatment of this case by nerve tonics and electricity for a few days was attended by such marked improvement that a complete and speedy recovery was certain.

The summer and autumn cruise of the ship was made on the North Atlantic coast, with Wood's Holl as headquarters, northward as far as St. John's, Newfoundland. The Grand Banks in August developed the same foggy, rainy, disagreeable, and depressing climate for which it is noted, and a week in the quiet and snug harbor of St. John's was a welcome and refreshing interlude. Nothing for record in this department occurred during the summer, except the development of a case of Melancholia in one of the seamen, who was in consequence transferred to the naval hospital at Chelsea, Mass., and subsequently to the Government Insane Asylum in the District of Columbia. No satisfactory cause for the disease could be assigned.

The determinations and record of the densities of sea-water have been continued by this department during the year. The observations have been chiefly confined to surface densities, and the collection of water for the purpose has usually been made at 12 o'clock each day that the ship was at sea. The specimen is kept until it has taken about the temperature of the room and of the instruments employed, and the same care as heretofore exercised in the reading and reduction. The record in itself presents no remarkable features calling for extended remarks. The high gravities of the Southern waters, where evaporation is rapid, is observable, and especially in those inclosed basins like Exuma Sound and Tongue of the Ocean, where there are no active currents to restore the equilibrium with the ocean water in general. In contrast are the low gravities of the Northern waters, where evaporation is slight and the water is freshened by the Arctic currents.

The record of temperatures and densities observed during the year is appended:

Record of temperatures and specific gravities.

Date.	Time of day.	Latitude N.	Longitude W.	Depth.	Temperature. By attached thermometer.	Temperature. Of the air.	Temperature. Of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° F.
1886.		° ′ ″	° ′ ″		°	°	°		
Feb. 21	12 m.	33 31 00	75 58 00	Surface	69	45	86	1.0243	1.028616
22	12 m.	31 15 24	76 44 00	...do	68	66	86	1.0242	1.028516
23	12 m.	28 24 24	78 10 00	...do	72	71	86	1.0242	1.028516
24	12 m.	27 44 30	77 16 00	...do	71	74	85	1.0244	1.028500
25	12 m.	26 31 00	75 06 30	...do	70	70	78	1.0256	1.028408
26	12 m.	24 47 36	74 36 15	...do	74	73	77	1.0258	1.028418
27	12 m.	Off San Salvador		...do	75	75	77	1.0257	1.028318
Mar. 5	12 m.	Port Nelson, Rum Cay		...do	73	75	81	1.0254	1.028739
6	3 p. m.	Well near beach, Port Nelson		...do	......	76	81	1.0010	1.004339
6	3 p. m.	Well in center of town, Port Nelson.		...do	......	76	80	1.000	1.003160
6	3 p. m.	Salt ponds, Port Nelson		...do	......	76	80	1.0850	1.088160
12	12 m.	Exuma Sound		...do	71	72	85	1.0248	1.028900
17	12 m.	Harbor of Nassau, New Providence.		...do	74	82	76	1.0264	1.028832
April 9	12 m.	25 26 00	79 59 30	...do	74	71	84	1.0242	1.028112
10	12 m.	26 33 00	78 21 20	...do	73	71	85	1.0240	1.028100
11	12 m.	25 23 00	77 26 00	...do	73	72	84	1.0246	1.028500
12	12 m.	Tongue of Ocean, south end		...do	73	74	78	1.0264	1.029208
13	12 m.	Green Cay, Tongue of Ocean		...do	74	77	77	1.0266	1.029218
14	12 m.	24 50 00	77 39 00	...do	74	73	76	1.0260	1.028482
15	12 m.	South Bay, New Providence		...do	73	73	76	1.0264	1.028832
30	12 m.	Off Eleuthera Island		...do	76	70	85	1.0246	1.028700
May 1	12 m.	Off Abaco Island		...do	74	76	86	1.0242	1.028516
2	12 m.	27 48 00	77 37 45	...do	73	72	84	1.0246	1.028512
3	12 m.	28 18 00	78 32 30	...do	73	72	84	1.0246	1.028512
4	12 m.	29 35 00	79 53 00	...do	77	72	85	1.0244	1.028500
5	12 m.	31 09 00	79 33 30	...do	77	73	83	1.0250	1.028720

Record of temperatures and specific gravities—Continued.

Date.	Time of day.	Latitude N.	Longitude W.	Depth.	Temperature. By attached thermometer.	Temperature. Of the air.	Temperature. Of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° F.
1886.		° ′ ″	° ′ ″		°	°	°		
May 6	12 m.	32 38 00	77 05 30	....do..........	77	73	84	1.0245	1.028412
7	12 m.	34 10 00	75 22 00	... do..........	74	75	83	1.0246	1.028326
Aug. 3	12 m.	40 26 30	60 19 00	.,..do..........	75	68	78	1.0250	1.027808
4	12 m.	41 41 00	63 38 00	....do..........	66	70	79	1.0232	1.026183
5	12 m.	41 48 00	62 51 30	....do..........	67	67	78	1.0222	1.025008
6	12 m.	43 23 00	59 32 30	....do..........	61	64	81	1.0212	1.024539
7	12 m.	43 53 30	55 36 00	....do..........	62	63	81	1.0220	1.025339
8	12 m.	44 45 00	50 34 00	....do..........	62	62	81	1.0215	1.024839
9	12 m.	45 03 00	46 15 00	....do..........	62	64	69	1.0245	1.025787
10	12 m.	45 16 00	42 24 00	....do..........	71	69	69	1.0252	1.026487
11	12 m.	46 40 31	44 54 30	....do..........	56	55	69	1.0246	1.025887
12	12 m.	47 41 00	47 28 30	....do..........	48	53	62	1.0248	1.025070
13	12 m.	47 12 00	50 56 30	....do..........	54	57	62	1.0242	1.024470
17	12 m.	St. John's, Newfoundland...		....do..........	54	64	81	1.0215	1.024839
21	12 m.	45 19 00 (Off coast of Newfoundland.)	52 48 00	....do..........	55	64	70	1.0220	1.024983
22	12 m.	45 14 00	55 04 00	....do..........	56	50	70	1.0220	1.024983
23	12 m.	43 52 00	58 51 00	....do..........	62	66	87	1.0202	1.034700
24	12 m.	42 49 00	60 59 00	....do..........	67	70	85	1.0214	1.025500
25	12 m.	41 38 00	63 15 00	....do..........	65	64	85	1.0230	1 027100
26	12 m.	41 55 00	63 49 00	....do..........	73	73	85	1,0234	1.027500
27	12 m.	41 20 00	65 19 00	....do..........	70	68	83	1.0240	1.027726
28	12 m.	40 14 00	67 56 00	....do..........	72	73	84	1.0236	1.027512
Sept. 16	12 m.	39 15 00	70 23 15	....do..........	74	75	79	1.0244	1.027383
17	12 m.	38 20 00	70 12 00	....do..........	77	70	80	1.0242	1.027360
18	12 m.	38 30 30	70 57 30	....do..........	75	76	77	1.0246	1.027218
10	12 m.	38 32 00	72 03 00	....do..........	74	75	78	1.0244	1.027208
20	12 m.	39 10 00	72 06 00	....do..........	72	66	78	1.0245	1.027308
Oct. 22	12 m.	38 39 00	72 38 00	....do..........	66	57	83	1.0244	1.028126
23	12 m.	36 47 00	73 20 00	....do..........	69	67	82	1,0240	1.027520
24	12 m.	36 35 00	73 58 00	....do..........	68	66	81	1,0237	1.027039
25	12 m.	36 42 25	74 30 00	....do..........	69	70	78	1.0242	1,027008
26	12 m.	37 25 00	73 50 00	....do..........	68	71	78	1.0241	1.026908

REPORT OF THE NATURALIST, MR. THOMAS LEE.

The work of the Albatross for 1886 began with a cruise among the Bahama Islands. Mr. James E. Benedict was in charge of the scientific department, and was assisted by Messrs. Willard Nye, jr., C. H. Townsend, F. L. Washburn, and myself.

We left Norfolk February 20, and met with little of interest before reaching our anchorage at Watling's Island. Before speaking of our work, it is my pleasant duty to acknowledge our great indebtedness to Lieut.-Commander James M. Forsyth, of the United States Navy, for furnishing us with much valuable information with regard to the character of the islands, and for letters to Mr. R. C. Nairn, of Watling's Island, and the Misses Forsyth, of Rum Cay, who showed us every courtesy and attention, besides very materially aiding us in our work.

February 27 Mr. Nye and I landed on Watling's Island, and remained there till March 9. The Albatross ran over and anchored at Rum Cay. We were cordially welcomed by Mr. Nairn, who furnished us with comfortable quarters, thus enabling us to get to work at once.

Watling's, like all the islands of the Bahama group, is made up of coral limestone, much weathered upon the surface, and below it of a very cavernous nature. A great part of the interior of the island is occupied by a series of connecting lakes, which are surrounded by hills rising quite abruptly from the water to a height of 50 to 140 feet, and thence sloping more gradually to the ocean. Between the hills and the ocean are a number of large swamps, hardly above tide-level.

The coast-line is partly rough coral rock rising abruptly from the water, partly stretches of coral sand, and the island is pretty well surrounded by outlying coral reefs. Though there is little soil, the greater part of the island is clothed with a dense, low, scrub growth, with here and there a large tree to indicate what the timber was in old times. The surface has been quite extensively under cultivation, but since the abolition of slavery nearly all the white people have left the island, and the negroes cultivate fields only here and there, and scarcely do more than get a living off the ground.

The swamp water is pretty much all brackish, but fresh water can be had at any point by digging down to near the ocean level. It collects slowly and is subject to a rise and fall with the tide.

We found the rough, coral bottom near the shore ill adapted to seining, and the inhabitants brought in but few species of fish caught with hook and line.

A trip across the island to a creek on the eastern coast resulted in the capture of a number of species of fish. There was little opportunity to haul the seine, but we made a number of sets across the mouths of small creeks, and then drove the fish down into the net.

From the lakes we seined a large number of minnows, *Atherina stipes*—a species most plentiful in these waters and apparently the only fish occupying them.

The lake water is very saline and subject to a slight rise and fall with the tide, though there is no apparent connection between the lakes and the ocean.

We made a trip through the lakes to a cave near the new light-house at the northern end of the island, and from which several human skulls are said to have been taken. The cave is near the lake, in the face of a low semicircular ledge of limestone. The mouth of this cave, about 8 feet long by 2 feet in height, was originally walled up. It now stands open, the wall having been pulled down. Within, the cave extends about 50 feet along the face of the ledge on each side of the entrance, and the low roof meets the floor about 20 feet back. It is divided into several chambers by natural columns rising from the floor to the roof. The largest of these chambers extends back to a pool of brackish water on the lake level, and it was from this chamber that we made our collections. A careful search through the other parts of the cave revealed no human remains, and only a few small bits of broken pottery. The outer wall of the cave is a mass of stones, piled up to the roof, through which the earth from without has washed into the cave, and down across the floor. Whether this wall is artificial or natural would be an exceedingly difficult task to determine.

From among the loose stones and earth, near this outer wall, we picked out several pieces of coarse pottery, and several pieces of bone belonging to the human skull, among them two jaw-bones with teeth intact. About half way across the floor we found a number of human long bones strewn about with no apparent arrangement.

Miss Nairn, who was one of the first to visit this cave, told us that she saw five or six skulls lying upon the floor when she was there, and that one of them had been taken to the library at Nassau.

Both going and coming through the lakes we saw great numbers of cormorants floating lazily about on the water or sitting on the mangrove bushes along the shore. They remain throughout the year and breed on these lakes. We saw, too, a number of herons, of which we shot several, and flocks of Bahama ducks and blue-bills, but could not get near these latter.

Coming home, we landed on Iguana Key and captured six iguanas of the genus *Cyclura*. We saw there a large brown rat, but did not succeed in capturing it.

During our stay on Watling's Island we visited several other caves, but found no human remains. In all the caves visited we found but one bat, though there was every indication that they had been there in great numbers quite recently. The negroes say that they always disappear during the winter months.

We procured a number of stone implements during our stay. These the negroes call thunderbolts, believing that they fall with the lightning. They preserve them very carefully, as a charm to ward off the lightning, and are very loth to part with them.

We made collections of the shore fauna as well as of lizards, crabs, insects, and mollusks from all parts of the island, and of birds we took a number of species as well as several nests with eggs.

Miss Nairn, who seemed quite conversant with the habits of most of the birds, told us that in December, during high winds, swallows sometimes made their appearance, very tired. They stay but a few days, and then disappear. The "gale bird," undoubtedly our bobolink, comes too, during the high autumn winds, in large flocks, but stays only a few days.

On March 8 the Albatross left Rum Cay, and on the same day touched at Conception Island and gave the naturalists a chance to make shore collections. One haul with the beam trawl, near Conception Island, at station 2629 (1,169 fathoms), brought up only a few crustaceans, one glass sponge, one piece of coral, and one fish. The mud-bag was filled with coral sand, with pteropod shells and foraminifera in it.

March 9 the Albatross picked up Mr. Nye and myself and then ran back to Rum Cay, to give us a chance to take some photographs at Port Nelson.

The character of the surface and the growth at Rum Cay are about the same as at Watling's Island, and the collections made at each island were made up largely of the same things.

The land snails, *Helix*, however, on Rum Cay were found clinging to the bushes, in low, wet places, in vast numbers, much greater than observed on any other island, and a very large collection was made.

The inhabitants of Rum Cay fish almost entirely with hand-lines, though occasionally using basket traps. They never attempt to do more than catch fish enough for immediate use.

We left Rum Cay March 10, and anchored off Cat Island for the night. Next morning we landed and made quite extensive collections. Near the shore, and running parallel with it, were several low ridges covered with thick scrub growth and separated by partly open glades. Further inland were fields of millet bordered by quite heavy timber. Had it not been for a high wind our collection of birds here would undoubtedly have been much larger and comprised many more species, as this was one of the best collecting grounds visited during our cruise.

March 12 we landed in the morning on Eleuthera Island, and worked over a low country which stretches from the shore to high land about a mile inland. The day was perfect and our collections comprised a number of birds and a good representation of the shore fauna.

In the afternoon two hauls with the tangle, at stations 2630 (244 fathoms) and 2631 (280 fathoms), brought up only a few glass sponges and a few small pieces of coral.

March 13 a haul with beam trawl, near the head of Exuma Sound, at station 2632 (791 fathoms) showed a bottom of white coral ooze with no apparent animal life.

We anchored in Nassau Harbor, New Providence, on the morning of March 15, and remained till March 24.

To Governor and Mrs. Blake we are indebted for much assistance in our work of making collections, as their knowledge of the character of the country, and of the localities in which certain things could be found, was a great help to us.

Mrs. Blake had a very fine collection of stone implements, from various islands, and a lignum-vitæ stool from a cave on Rum Cay, of which we got very fair negatives.

The fish-market at Nassau afforded an opportunity for making a large collection of fish, as the fishermen are compelled to sell all their fish through the market. The fishing industry is a large one, and I give a few details from data collected upon the subject by Mr. Benedict.

There is no record of the number of vessels employed in fishing, but it is estimated at 120 sail. The vessels are principally of two classes—schooners, measuring 28 to 30 feet on the keel, and sloops of about 18 feet keel.

The schooners carry a crew of 7 men and do most of their fishing with seine of 1-inch mesh, 30 fathoms long, and 80 meshes deep. The sloops carry 3 or 4 men and do all of their fishing with hand-lines. The hand-line fishing is done with the aid of a water-glass. The water-glasses are simply a box, painted some dull color, with a pane of plain window-glass set in the bottom. The fisherman holds this box on the surface of the water, and, by looking through the glass, can see the bottom through this clear water perfectly plainly to a depth of 50 or 60 feet. When fishing, the men hunt about till they find a spot where the fish are plenty, then, by watching their lines through the glass, they can tell exactly when to strike the fish. Most of the fishing is done at Abaco and the Berry Islands, the vessels staying out about a week and bringing the catch in alive in their wells. The larger specimens of skip-jack, bone, hound, and amber fish are split and dried in the fore rigging, but the bulk of the catch is peddled out fresh at the market—the demand for fish determining the stay of each vessel in port. A fare will run from $12 to $60, and anything over $40 the fisherman considers good work. After paying the expenses of a cruise, two shares of the profits go to the vessel, one to the seine, one to the captain, and one to each member of the crew.

Many species of fish from these waters are excellent eating, and few seem to be poisonous. While barracuda, hog, and amber fish are more likely to be poisonous than other species, this property is by no means confined to them. Cases of poisoning, however, are of such rare occurrence that the natives pay little attention to the matter, and have no rule as to what can be eaten and what cannot.

The sponge fishing is another very important industry, the details of which I give from data collected by Mr. Nye.

The sponging fleet consists of about 475 vessels and employs not less than 4,000 men, the majority of them negroes. The vessels used are sloops of 15 to 20 feet over all, and schooners running up to 20 tons, though commonly about 36 feet over all. The largest schooners carry 12 to 18 men and 6 to 10 boats—one of 12 feet and the others 10 feet in length.

The sloops carry 4 to 7 men and 3 or 4 boats. The small boats are of the smooth, round-bottom class, like the northern smack-boat, but with less sheer.

The sponging trips last about six weeks, and are made at all seasons except the "hurricane month," October, when the vessels are generally hauled up for repairs.

When on the sponge ground the vessel anchors in 3, or heaves to in 5, fathoms of water, and the crew put off, two in a boat, at sunrise, and remain till sunset, unless a boat-load is secured before that time. One man handles the boat, generally sculling, while the other gathers the sponges, using a water-glass in one hand and a long pole, rigged with a two or three tined hook, with the other. The men become very expert with this hook, and work to a depth of 5 fathoms, but seldom if ever over that depth. Ten pounds, dry weight, is a first-class catch for one boat in a day. The fresh sponges are left on deck until the vessel has a deck-load, when they are taken to the "crawl," a crib built of sticks in the shallow water near the shore, where they are left to rot for six or eight days. The rotten flesh and dirt is then beaten and washed out, the sponge being held in one hand and struck repeatedly with the "clipper," held in the other hand, and frequently rinsed. They are then thrown upon the beach to dry.

One man can wash 50 pounds, dry weight, of large sponges, or 15 pounds of mixed sponges, in a day. Though sponge beds get fished out and destroyed by hurricanes, the fishermen consider the supply inexhaustible, for they say the young sponge grows so rapidly, reaching a marketable size in about three months after its attachment, and new beds are so plenty that they have little trouble in finding either a new set or a new bed. The sponges broken off by storms collect in soft, muddy spots, and are known as "rolling sponges."

The fishermen recognize six kinds of sponges, though both they themselves and the dealers have many names for the different varieties of each. In point of abundance they run: (1) Reef (including glove), *Spongia tubifera.* (2) Grass, *Spongia cerebraformis.* (3) Boat (including velvet), *Spongia barbara.* (4) Wool, *Spongia gossypina.* (5) Yellow, *Spongia corlosia.* (6) Key West (no specimen obtained).

The wool ranks first in value followed by reef, boat, grass, yellow, and Key West. Six hundred pounds, dry weight, is considered a good fare for a single cruise. The sponges are all brought to Nassau and sold through the market. No fixed value can be given, but a first-class wool sponge of 8 inches diameter brings 15 to 20 cents, and the small glove sponges 1 to 2 cents each. The vessel bears one-third of the expense of the outfit and takes one-third of profits. The balance goes two shares to captain, and one share to each member of the crew.

While in Nassau we made large collections of the shore fauna, including fine specimens of the red and of the yellow fan corals, *Gorgonia flabellum*, which grow in great numbers on the reefs.

To Mr. Nye's indefatigable zeal and amphibious habits are due the credit for the bulk of these collections, as well as for the fish not brought into the market for food.

Trips inland added several species to our collection of birds, and one trip to the caves on Captain Lightborn's plantation, on his invitation and under his kindly guidance, resulted in the capture of a number of bats, *Phyllonycteris seyckorni*, which proved very wide-awake and flew swiftly about when disturbed by the lights. The bats, *Vesperugo serotinus*, taken from the vaulted chambers under Fort Charlotte, on the contrary, seemed quite torpid, and would do nothing but chatter, even after having several of their number shot from the bunches hanging to the ceiling.

Among our collections at Nassau were two unlaid but perfectly developed eggs of the Bahama cuckoo, taken from specimens of that bird shot there.

March 24 we started for Key West, stopping on our way to land Messrs. Nye and Townsend on Abaco Island. At Key West we collected several species of birds, among them several specimens of the vireo, *Vireo noveboracensis maynardi*, recently described by Maynard.

This bird seems to be very abundant here, but extremely shy and hard to see among the dense foliage.

On March 30 the greater part of Key West's business section burned down, creating quite an excitement. The next day Mr. Washburn left us to return North. April 3 we sailed for Havana, and on the 7th, on our way back to Key West, five hauls with the tangle at Stations 2633 to 2637, in 100 to 200 fathoms, brought up about one hundred and twenty-five specimens of the sea-lily, *Pentacrinus decorus* and *Pentacrinus mülleri*, with a few sea-urchins and brittle-stars.

We left Key West on April 4, and on the 5th began a line of dredgings, off Carysfort light, at Station 2639 (56 fathoms). We took six hauls with a ship's dredge and four with the beam-trawl, the depth ranging from 56 to 217 fathoms. The bottom proved barren, and we took only a few small crustaceans, fish, and hydroids, the latter attached to the dead scallop shells, which were abundant.

April 11 we picked up Messrs. Nye and Townsend, with their extensive collections.

We had hoped that they would get a few flamingoes on Abaco, but, though they saw about sixty birds, they were too shy to approach, and a fire, which broke out in the woods, soon drove them all from their feeding-grounds.

The flamingoes live on a large tract of land, about 6,000 acres in extent, on the west side of the island. The surface is little above tide-level, and is composed of soft ooze, washed in from the coral reefs. Scattered through this tract are lakes, of all sizes, from 6 inches to 3 feet deep, and islands, of higher ground, covered with trees. The flamingoes keep to the larger lakes, or "swashes," as the inhabitants call them, and are very shy. In the breeding-season they are much less shy, and are frequently killed while feeding in the smaller swashes by negroes, who consider them excellent eating. Parrots are said to have been common on the island, but of late years few are seen on the southern end of the island. One flock was reported as coming daily to feed on an old field, near the light-house at Hole-in-the-Wall, but no specimens were procured.

From Abaco we ran past New Providence into the Tongue of Ocean, and on the morning of April 12 landed on Green Cay. The island is small and heavily wooded, rising to high ground near the center. Near our landing-place was a pond with the remains of old salt-works. In spite of a steady rain we got a number of birds, among them two specimens of Kirtland's warbler.

In the afternoon a haul with tangle at station 2649 (36 fathoms) brought up a few small corals, sponges, mollusks, and crustaceans. A haul at station 2650 (369 fathoms) brought up nothing.

April 13, a haul with tangle at station 2651 (97 fathoms), and with ship's dredge at station 2652 (140 fathoms), brought up a few gorgonian corals, barnacles, and mollusks.

On the 14th two boobies were shot, just after daylight, on Booby Rocks, and later we landed on Green Cay. The white-headed pigeons, *Columba leucocephala*, were very abundant, but extremely shy, always flying out of thick foliage, and taking great care to put the tree between you and themselves. We shot a number of small birds and found a lizard, *Liocephalus carinatus*, extremely abundant.

In the pores of the limestone, near the salt-pond, were quartered immense soldier-crabs, and under the bushes in the grassy swales in the interior, were hundreds of land-hermits crawling about. On the salt pond we started three Bahama ducks and saw several winter yellowlegs.

In the afternoon we took a haul with beam trawl at station 2653 (1,000 fathoms), and found a bottom of coral ooze with no apparent animal life.

On the 15th we anchored in Southwest Bay, New Providence, and had to wait till the 21st for the bar at Nassau to become passable.

During this time the country was well hunted over and a number of birds taken.

From the ship fish could be plainly seen moving about on the bottom, and several species were captured on hand-lines.

On the 17th Mr. Townsend and I walked to Nassau and shot several birds on our way through the pine woods.

Our second stay at Nassau, April 21 to 30, was pretty much a repetition of our former work, though we added a few species to our collection of birds, and nearly doubled our collection of fish.

We left Nassau April 30 and reached Washington on May 10.

On the way north we took twenty-three hauls with the beam trawl and three with the tangle—stations 2654 to 2679 (263 to 731 fathoms). We added many valuable specimens to our collection of deep-sea fish and invertebrates, several large hauls of coral being of special interest.

At station 2655 one porpoise, *Tursiops tursio*, was taken, of interest from his nearly uniform dark color. At station 2656 eight sharks, *Carcharhinus lamia*, were taken with hook and line. Porpoise blood had been draining from the scuppers all day, and when we put over the electric light in the evening the water was literally alive with these sharks.

Throughout the entire cruise the electric light was used for surface collecting whenever there was an opportunity, and, while among the Bahamas, many interesting forms of fish and invertebrates were taken, as well as at several stations during our run north.

The Albatross lay in Washington till June 30, when we started for Wood's Holl.

July 15 we left Wood's Holl. Mr. Benedict was in charge of the scientific department, assisted by Mr. Sanderson Smith and myself.

We ran to the southward and eastward about 100 miles and took twelve hauls with the large beam trawl at stations 2680 to 2691 (226 to 1,106 fathoms). The bottom there is extremely rich in animal life, and we made very extensive and valuable collections of fish and invertebrates.

August 1 Mr. Benedict left the Albatross. Since that time I have had charge of the scientific department, and Mr. Sanderson Smith has been with the ship, detailed from the shore laboratory.

August 2 we left Wood's Holl for a cruise to the eastward. On the 3d we sighted a large school of porpoises traveling to the southward. On the 5th a barn swallow flew on board ship. On the 6th sighted six finback and one humpback whale, and on the 7th a large school of killers traveling northwest. On the 11th we took several hauls with the beam trawl, beginning at station 2692 (78 fathoms), just to the southward of the Flemish Cap, running up on to the Cap at station 2694 (56 fathoms). Here we found a bottom quite like that of the Grand Bank, while stations 2695 and 2696 (105 and 98 fathoms), just to the west of the Cap, showed a hard, barren bottom.

At station 2697 (199 fathoms), we landed a bowlder of about 2,000 pounds on deck, with a number of sponges, mollusks, crustaceans, and fish.

After this haul we ran to St. John's for coal, and while there I made a collection of young salmon, *Salmo salar*, and brook trout, *Salmo fontinalis*, at Harbor Grace Junction, together with a few birds.

August 24 we left St. John's, and while running to the south passed a number of finback whales moving to the northward.

Eight hauls with beam trawl, beginning at station 2698, near the edge of the bank, and running to the westward to station 2705, brought up many interesting specimens. From the deeper hauls between the two banks we took a great number of sea-pens, *Pennatula aculeata*, and a few specimens of *Pennatula borealis;* also a number of species of fish, among them *Macrurus bairdii* and *Sebastes marinus* in great numbers.

August 23, at hydrographic station 1070 (32 fathoms), we took, on hand-lines, one hundred and thirty-six cod, *Gadus callarias*, in about half an hour's fishing. We used squid for bait, and the cod took it voraciously. An examination of the cods' stomachs revealed a great number of Bank clams, *Cystodaria siliqua*, with a few fish, crabs, squid, and other small mollusks.

One dolphin, *Delphinus delphis*, was here captured from a school. On the 25th there was a winter yellow-leg about the ship, and a swallow flew on board during the high wind next day. On the 26th, too, we saw a number of porpoises, *Delphinus delphis*, moving to windward.

Five hauls with the beam trawl, to the southward and eastward of George's Bank, at stations 2706 to 2710, 866 to 1,188 fathoms, brought up many interesting specimens.

We reached Wood's Holl August 27.

Leaving Wood's Holl September 14, we made a cruise about 200 miles to the southward to deep water on the inner edge of the Gulf Stream, and found a very rich bottom at stations 2711–2722, 594 to 1,867 fathoms. We succeeded in bringing in the large soft holothurians *Benthodytes gigantea* and *Euphronides cornuta*, in an excellent state for study, by injecting them, through the natural orifice, with alcohol and setting the tanks of full strength alcohol in which they were placed directly upon the ice.

One of the deep-sea fishes from station 2720, 1,509 fathoms, *Ophiognathus* sp., was of special interest, as it was the first taken by the Albatross.

During this cruise we observed a pigeon-hawk, a cedar-bird, and a woodpecker about the rigging.

At station 2719 we took a big blue heron—*Ardea herodias*—which was very fat and seemed quite at home out there.

We had excellent opportunities for surface work, and made large collections, both with the scoop-nets about the electric lights and with the large tow-net. As usual the large tow-net brought the best results just about dark in the evening.

While at Wood's Holl, during the latter part of September, I made several trips, in company with Messrs. Edwards and Nye, over to Gay Head and Menemsha Bight, in the steam-launch Cygnet, to secure specimens of the haglets (*Puffinus borealis*) and jægers (*Stercorarius pomarinus* and *parasiticus*), which were following the mackerel and herring. We shot a number of specimens, and were able to make a fine series of skins, besides sending a number of fresh birds to Washington.

On October 21 the Albatross started south. We made thirteen hauls with the beam trawl, stations 2623 to 2635, 629 to 1,672 fathoms, just to the southward of our last work.

The fauna was much the same, but we added one new species of fish to our collections.

A large specimen of the squid, *Sthenoteuthis megaptera*, was taken at our last station.

The amount of phosphorescence about most of the deep-sea life is a very striking feature of all the hauls landed after dark.

It is impossible to speak of our deep-sea work except in this very general way, on account of the vast amount of material collected. For particulars we shall have to wait for the reports of the specialists to whom the material has been turned over for study.

Thanks to the kindness of Dr. Bean and Mr. Ridgway, in allowing me access to their books, I have been able to copy off the following lists of the fish and of the birds collected by us while among the Bahama Islands.

It has seemed advisable to mention in these lists those species taken by other collectors which we did not succeed in finding, and this I have done as far as I have found any record of their work.

Our work for the season closed with the arrival of the Albatross at Washington on October 27.

List of fish taken by steamer Albatross among Bahama Islands and at Nassau fish-market during March and April, 1886.

No.	U. S. Mus. No.	Name, &c.	Common name.	Locality.
		Family *Tetrodontidæ*.		
1	38380	Chilomycterus geometricus Mitchill	Hedge-hog	Market, Nassau.
2	*38507	Tetrodon spengleri Bloch		Electric light, Abaco.
3	*38505	Tetrodon sp		Electric light, Nassau.
4	*38506	Tetrodon sp.†		Electric light, Nassau.
		Tetrodon testudineus *Linnæus*		Green Turtle Cay.
		Family *Ostraciontidæ*.		
5	38378	Ostracion trigonum Linnæus	Shell-fish	Rum Cay.
6	38376	Ostracion quadricornis Linnæus	Cow-fish	Market, Nassau.
	38377	Ostracion quadricornis		Abaco.
		Family *Balistidæ*.		
7	38374	Balistes vetula Linnæus	Turbot	Rum Cay.
8	38373	Balistes vetula	Turbot	Market, Nassau.
9	38372	Balistes buniva Lacépède	Durgan-fish	Rum Cay.
10	38375	Monacanthus pullus Ranzani		Market, Nassau.
	*38500	Monacanthus sp		Electric light, New Providence.
		Family *Syngnathidæ*.		
11	*38512	Siphostoma sp		Electric light, Abaco.
	*38513	Siphostoma sp		Electric light, Watling's.
	*38514	Siphostoma sp		Electric light, New Providence.
		Family *Pleuronectidæ*.		
(†)	....	Citharichthys macrops Dresel		Green Turtle Cay.
		Family *Fierasferidæ*.		
12	38498	Fierasfer dubius Putnam		Nassau.
		Family *Ophidiidæ*.		
13	*38499	Ophidium sp		Abaco.
		Family *Blenniidæ*.		
14	*38379	Labrosomus nuchipinnis Quoy & Gaimard.		Abaco.
	*38517	Labrosomus nuchipinnis		Watling's.
	*38515	Labrosomus nuchipinnis		Nassau.
15	38381	Myxodes lugubris Poey		Nassau.
16	38382	Myxodes varius Poey		Nassau.
(†)	....	*Cremnobates sp*		
17	*38520	Blenny (probably close to Clinus gobio).		Abaco.
		Family *Gobiesocidæ*.		
(†)	....	Gobiesox cephalus Lacépède		Green Turtle Cay.
18	*38386	Gobiesox sp		Abaco.
		Family *Gobiidæ*.		
19	38384	Gobius soporator Cuv. & Val	Rockfish	Nassau.
	38383	Gobius soporator		Abaco.
	38385	Gobius soporator		Green Cay.
		Family *Scorpænidæ*.		
20	38387	Scorpæna plumieri Bloch	Toadfish	Market, Nassau.
21	38388	Scorpæna *grandicornis Cuv. & Val*		Abaco.
		Family *Scaridæ*.		
22	38389	Scarus cœruleus Bloch	Bluefish	Market, Nassau.
	*38393	Scarus sp		Nassau.
		Family *Labridæ*.		
23	38390	Sparisoma catesbyi Lacépède	Parrot-fish	Market, Nassau.
24	38392	Sparisoma distinctus Poey	Pug	Nassau.

* Young.

† All fish so marked were taken during the winter of 1886 by students of Johns Hopkins University.

List of fish taken by steamer Albatross among Bahama Islands, &c.—Continued.

No.	U.S. Mus. No.	Name, &c.	Common name.	Locality.
		Family *Labridæ*—continued.		
25	38391	Sparisoma flavescens Bloch & Schneider.	Pug	Market, Nassau
26	38394	Thalassoma bifasciatum Bloch	Slippery Dick	Nassau.
27	38395	Xyrichthys lineatus Linnæus	Yellow pudding-wife	Nassau.
28	38396	Xyrichthys infirmis Bean	Blue pudding-wife	Nassau.
29	38400	Platyglossus radiatus Linnæus	Pudding-wife, Slippery Jenny.	Market, Nassau.
30	38401	Platyglossus maculipinna Müller & Troschel.	Slippery Jenny	Nassau.
31	38397	Platyglossus bivittatus Bloch	Slippery Jenny	Nassau.
	38398	Platyglossus bivittatus	Sucker	Rum Cay.
	38399	Platyglossus bivittatus (1,169 f. near Conception Island).		Station 2629.
(†)		Platyglossus nov. sp		Green Turtle Cay.
32	38402	Lachnolæmus maximus Walbaum	Hogfish	Market, Nassau.
33	38403	Bodianus rufus Linnæus	Spanish hogfish	Market, Nassau.
		Family *Pomacentridæ*.		
34	38404	Pomacentrus leucostictus Müller & Troschel.	Blackfish	Nassau.
35	38405	Pomacentrus obscuratus Poey	Blackfish	Nassau.
	*38504	Pomacentrus sp		Nassau.
36	38408	Glyphidodon saxatilis Linnæus	Scotch porgy	Nassau.
	*38407	Glyphidodon saxatilis		Green Cay.
		Family *Gerridæ*.		
37	38410	Gerres aprion Cuv. & Val	Shad	Watling's.
38	38409	Gerres lefroyi Goode	Narrow shad	Market, Nassau.
(†)		Gerres zebra Cuv. & Val		Green Turtle Cay.
		Family *Acanthuridæ*.		
39	38412	Teuthis hepatus Linnæus	Tang	Market, Nassau.
40	38411	Teuthis tractus Poey	Tang	Market, Nassau.
		Family *Chætodontidæ*.		
(†)		Chætodon striatus Linnæus		Green Turtle Cay.
41	38413	Holacanthus ciliaris Linnæus	Yellow angel-fish	Market, Nassau.
42	38414	Pomacanthus aureus Bloch	Black angel-fish	Market, Nassau.
		Family *Carangidæ*.		
43	38419	Trachurops crumenopthalmus Bloch.	Goggle-eye	Market, Nassau.
44	38421	Caranx latus Agassiz	Horse-eye jack	Market, Nassau.
45	38418	Caranx chrysus Mitchill	Running-jack	Market, Nassau.
46	38422	Caranx bartholomæi Cuv. & Val	Yellow-jack	Market, Nassau.
47	38420	Caranx ruber Bloch	Skip-jack	Market, Nassau.
48	38423	Seriola rivoliana Cuv. & Val	Jack	Watling's.
49	38425	Trachynotus glaucus Bloch	Old-wife	Market, Nassau.
50	38424	Trachynotus rhomboides Bloch	Permit	Market, Nassau.
		Family *Latilidæ*.		
51	38427	Malacanthus plumieri Cuv. & Val	Sand-fish	Nassau.
	38426	Malacanthus plumieri	Sand-fish	Rum Cay.
		Family *Mullidæ*.		
52	38428	Mulloides martinicus Cuv. & Val	Goat-fish	Market, Nassau.
53	38429	Upeneus maculatus Bloch	Goat-fish	Market, Nassau.
		Family *Berycidæ*.		
54	38431	Holocentrum ascensione Osbeck	Squirrel-fish	Market, Nassau.
	38430	Holocentrum ascensione	Red snapper	Rum Cay.
55	38432	Holocentrum riparium Poey		Abaco.
		Family *Sparidæ*.		
56	38433	Kyphosus sectatrix Linnæus	Chub	Market, Nassau.
57	38452	Calamus milneri Goode & Bean	Shad porgy	Market, Nassau.
58	38454	Calamus calamus Cuv. & Val	Saucer-eye porgy	Market, Nassau.
59	38455	Calamus leucosteus? Jordan & Gilbert.	Little-head or sheep-head porgy.	Market, Nassau.

* Young.

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List of fish taken by steamer Albatross among Bahama Islands, &c.—Continued.

No.	U. S. Mus. No.	Name, &c.	Common name.	Locality.
		Family *Sparidæ*—continued.		
60	38453	Calamus bajanado Poey	Jolt-head porgy	Market, Nassau.
(†)	....	Lagodon rhomboides Linnæus		Green Turtle Cay.
		Family *Pristipomatidæ*.		
61	38440	Lutjanus mahogoni Cuv. & Val	Rock snapper	Market, Nassau.
62	38435	Lutjanus griseus Linnæus	Gray snapper	Market, Nassau.
63	38439	Lutjanus analis Cuv. & *Val*	*Mutton-fish*	Market, Nassau.
64	38436	Lutjanus caxis? Bloch & Schneider	Schoolmaster	Market, Nassau.
65	38437	*Lutjanus synagris Linnæus*	Lane snapper	Market, Nassau.
	38438	Lutjanus synagris		Abaco.
66	38434	Lutjanus buccanella Cuv. & Val	Black-finned snapper	Nassau.
67	38441	Ocyurus chrysurus Blohe	Yellow tail	Market, Nassau.
	38442	Ocyurus chrysurus		Abaco.
68	38443	Anisotremus virginicus *Linnæus*	*Pork-fish*	Market, Nassau.
69	38477	Hæmulon sciurus Shaw	Boar grunt	Market, Nassau.
	38478	*Hæmulon sciurus*	*French margate*	Market, Nassau.
	38476	Hæmulon sciurus		Abaco.
70	38470	*Hæmulon melanurum* Linnæus	White grunt	Market, Nassau.
71	38475	Hæmulon arcuatum Cuv. & Val	Sow grunt	Market, Nassau.
72	38484	Hæmulon tæniatum Poey	Hardhead	Nassau.
73	38482	Hæmulon aurolineatum Cuv. & Val.	Hardhead	Nassau.
74	38480	Hæmulon flavolineatum Desmarest.	Yellow grunt	Nassau.
	38481	*Hæmulon flavolineatum*		Abaco.
75	38483	Hæmulon rimator Jordan & Swain		Abaco.
76	38487	*Hæmulon carbonarium Poey*	Bastard grunt	Market, Nassau.
77	38486	Hæmulon acutum Poey	Sailor's choice	Market, Nassau.
78	38485	*Hæmulon* gibbosum Walbaum	Margate	Market, Nassau.
		Family *Serranidæ*.		
79	38488	Epinephelus striatus Bloch	Hamlet	Market, Nassau.
80	38489	*Epinephelus* apua *Bloch*	*Spotted hind*	Market, Nassau.
81	38490	Enneacentrus guttatus Linnæus	Rock hind	Nassau.
	38491	*Enneacentrus guttatus*	Rock hind	Rum Cay.
82	38492	Enneacentrus fulvus Linnæus	Yellow coney	Rum Cay.
	38494	Enneacentrus fulvus punctatus Linnæus.	Nigger-fish	Rum Cay.
	38493	Enneacentrus fulvus punctatus Linnæus.	Coney	Nassau.
	38495	Enneacentrus fulvus rubra Bloch & Schneider.	Nigger-fish	Nassau.
	38496	Enneacentrus fulvus rubra	Nigger-fish	Watling's.
		Family *Percidæ*.		
83	38471	Apogon nov. sp		Nassau.
		Family *Priacanthidæ*.		
84	38449	Priacanthus arenatus Cuv. & Val	Glass-eye snapper	Market, Nassau.
85	38450	Priacanthus cruentatus Lacépède	Gold-fish	Rum Cay.
		Family *Sphyrænidæ*.		
86	38446	Sphyræna picuda Bloch & Schneider	Barracouta	Watling's.
		Family *Echeneididæ*.		
87	38416	Echeneis naucrates Linnæus	Sucking-fish	Market, Nassau.
		Family *Atherinidæ*.		
88	{38456 {38458	Atherina stipes Müller & Troschel	Minnow	Watling's.
	38457	Atherina stipes var		Lake, Watling's.
	38459	Atherina stipes		Rum Cay.
	38460	Atherina stipes		Cat Island.
89	38463	Atherina araea Jordan & Gilbert		Cat Island.
	38461	*Atherina araea*		Watling's.
	38462	Atherina araea		Rum Cay.
	*38464	Atherina araea		Abaco.
		Family *Mugilidæ*.		
90	38447	Mugil trichodon Poey	Mullet	Watling's.
	*38448	*Mugil trichodon*		Abaco.
(†)	....	Querimana gyrans Jordan & Gilbert		Green Turtle Cay.

* Young.
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List of fish taken by steamer Albatross among Bahama Islands, &c.—Continued.

No.	U. S. Mus. No.	Name, &c.	Common name.	Locality.
		Family *Cyprinodontidæ*.		
91	38501	Cyprinodon rivirendi Poey	Mud-gut	Salt Pond, Green Cay.
(†)	38939	Gambusia puncticulata		Green Turtle Cay.
		Family *Synodontidæ*.		
92	*38502	Synodus sp		Watling's.
	*38503	Synodus sp		Abaco.
		Family *Albulidæ*.		
93	38445	Albula vulpes Linnæus	Bone-fish	Watling's.
	38444	Albula vulpes	Bone-fish	Market, Nassau.
		Family *Elopidæ*.		
94	38519	Elops (probably)		Rum Cay.
	38518	Elops (probably)		Abaco.
		Family *Clupeidæ*.		
95	38469	Clupea sp	Pincers	Nassau.
		Family *Dussumieridæ*.		
96	38465	Dussumieria stolifera Jordan & Gilbert.		Nassau.
	38466	Dussumieria stolifera		Watling's.
	38468	Dussumieria stolifera		Electric light, Rum Cay.
	38467	Dussumieria stolifera		Electric light, Cat Island.
		Family *Murænidæ*.		
97	38470	Moringua nov. sp		Abaco.
98	38472	Sidera moringa Cuvier	Morray	Nassau.
99	38473	Sidera funebris Ranzani	Morray	Abaco.
100	38474	Echidna catenata Bloch		Abaco.
		Family *Galeorhinidæ*.		
101	38497	Hypoprion brevirostris Poey	Puppy shark	Watling's.

* Young.
† All fish so marked were taken during the winter of 1886 by students of Johns Hopkins University.

A list of birds taken by steamer Albatross on the Bahama Islands during March and April, 1886.

[+=Species included on authority of Dr. Bryant.
O=Species included on authority of W. B. Moore.
B=Species included on authority of J. K. Brace.
×=Species included on authority of Charles B. Cory.]

Number.	Name.	Bahamas.	Inagua.	Long Island.	Rum Cay.	Fortune Island.	Watling's Island.	Acklin Island.	Conception Island.	Green Cay.	Cat Island.	Andros Island.	Eleuthera.	New Providence.	Great Stirrup Cay.	Abaco.	Grand Bahama.	Bimini.	St. Domingo Cay.	Booby Rocks.	Ship Channel.
	Family *Podicipidæ.*																				
1	Colymbus dominicus (Ditoppur)				2		1					×									
	Family *Laridæ.*																				
	Larus atricilla	+																			
	Gelochelidon nilotica	×																			
	Sterna maxima	+																			
	Sterna sandvicensis acuflavida	+						×													
	Sterna hirundo							×													
	Sterna dougalli	+		×				×													
	Sterna antillarum		×																		
	Sterna anæthetus			×																	
	Sterna *fuliginosa*	+																			
	Sterna philadelphia			O																	
	Anous stolidus	+																			
	Family *Procellariidæ.*																				
	Puffinus auduboni																				+
	Family *Phaëthontidæ.*																				
2	Phaëton flavirostris	×														1					
	Family *Sulidæ.*																				
3	Sula cyanops																		+		
	Sula sula																		+	1	
	Family *Phalacrocoracidæ.*																				
4	Phalacrocorax dilophus floridanus	×					1					×									
5	Phalacrocorax mexicanus						1														
	Family *Pelecanidæ.*																				
	Pelecanus fuscus															([1])		+			
	Family *Fregatidæ.*																				
6	Fregata aquila	+					1														
	Family *Anatidæ.*																				
	Anas boschas	+																			
	Anas carolinensis	+																			
7	Anas discors (Steel)	+																			
	Dafila bahamensis		×				([1])			([1])						1					
8	Aythya americana	+																			
	Aythya marila nearctica	+			3		1														
	Aythya collaris	+																			
	Erismatura rubida	+																			
	Chen hyperborea		+																		
	Dendrocygna arborea	+	+									×									
	Family *Phœnicopteridæ.*																				
	Phœnicopterus ruber		+													([1])					
	Family *Plataleidæ.*																				
	Ajaja ajaja		×															+			
	Family *Ardeidæ.*																				
	Botaurus exilis													×							
	Ardea herodias	×					([1])							+							

[1] Seen.

A list of birds taken by steamer Albatross on the Bahama Islands, &c.—Continued.

Number.	Name.	Bahamas.	Inagua.	Long Island.	Rum Cay.	Fortune Island.	Watling's Island.	Acklin Island.	Conception Island.	Green Cay.	Cat Island.	Andros Island.	Eleuthera.	New Providence.	Great Stirrup Cay.	Abaco.	Grand Bahama.	Bimini.	St. Domingo Cay.	Booby Rocks.	Ship Channel.
	Family *Ardeidæ*—Continued.																				
	Ardea egretta	+																			
	Ardea candidissima	+																			
[1]9	Ardea rufa	×														1					
10	Ardea prælei															2					
11	Ardea tricolor ruficollis		×			O	3														
	Ardea cœrulea	+																			
12	Ardea virescens (Poor Joe)	+			3		3									1					
	Nycticorax nycticorax nævius																				
13	Nycticorax violaceus (Gaulden)								1	1											
	Family *Rallidæ*.																				
	Rallus longirostris crepitans	+																			
14	Porzana carolina									1		×									
	Inornis martinica	+																			
	Gallinula galeata	+																			
15	Fulica americana	+														1					
	Family *Recurvirostridæ*.																				
	Himantopus nigricollis	×																			
	Family *Scolopacidæ*.																				
	Gallinago delicata	+										×									
	Macrorhamphus griseus		×																		
	Tringa maculata		+																		
	Tringa fuscicollis		×																		
	Tringa minutilla	×																			
	Ereunetes pusillus	×																			
	Calidris arenaria											×									
	Totanus melanoleucus	×	+																		
16	Totanus flavipes		+		3		2														
	Symphemia semipalmata	+														×					
	Bartramia longicauda													O							
	Actitis macularia							×				×									
	Family *Charadriidæ*.																				
	Charadrius squatorola	×										×									
	Charadrius dominicus			×																	
	Ægialitis vocifera	+										×									
	Ægialitis semipalmata	+																			
	Ægialitis meloda	+																			
17	Ægialitis wilsonii	+	×						1			×									
18	Arenaria interpres	×					1														
	Family *Hæmatopodidæ*.																				
19	Hæmatopus palliatus	+	×									×				2					
	Family *Tetraonidæ*.																				
	Colinus virginianus floridanus													[1]+							
	Family *Columbidæ*.																				
20	Columba leucocephala	+	×							2		+									
21	Zenaida amabilis	+			1		6				1										
[2]22	Columbigallina passerina	+			19		3		1	2	1		1			3					
	Geotrygon martinica												×								
	Family *Cathartidæ*.																				
	Cathartes aura											+				[1]×	+				
	Family *Falconidæ*.																				
	Circus hudsonius		+																		
	Accipiter fuscus	+												×							
	Buteo borealis		+											+							

[1] Seen. [2] Nest and eggs.

A list of birds taken by steamer Albatross on the Bahama Islands, &c.—Continued.

Number.	Name.	Bahamas.	Inagua.	Long Island.	Rum Cay.	Fortune Island.	Watling's Island.	Acklin Island.	Conception Island.	Green Cay.	Cat Island.	Andros Island.	Eleuthera.	New Providence.	Great Stirrup Cay.	Abaco.	Grand Bahama.	Bimini.	St. Domingo Cay.	Booby Rocks.	Ship Channel.
	Family *Falconidæ*—Continued.																				
	Falco peregrinus anatum		+									[1]+		+							
23	Falco columbarius						1			2				O		2					
	Falco sparverius													+	+						
	Pandion haliaëtus carolinensis	+																			
	Family *Strigidæ*.																				
	Strix pratincola		+											+							
	Family *Bubonidæ*.																				
	Speotyto cunicularia floridana													O							
	Family *Psittacidæ*.																				
	Psittacus leucocephala		+													([2])					
	Family *Cuculidæ*.																				
24	Crotophaga ani (Black Witch)				5									1							
25	Coccyzus maynardi (Billy Kon-Kon; nov. sp. Ridgway)				4		2						1	+							
[3]26	Saurothera bahamensis		O											4							
	Family *Alcedinidæ*.																				
27	Ceryle alcyon	+					([4])			1											
	Family *Picidæ*.																				
28	Dryobates villosus maynardi (nov. sp. Ridgway)													1		6					
29	Sphyrapicus varius		+		1									+							
30	Centurus nyeanus (nov. sp. Ridgway)						1														
31	Centurus blakei (nov. sp. Ridgway)															17					
	Family *Caprimulgidæ*.																				
	Chordeiles virginianus minor											×	+								
	Antrostomus carolinensis											×	O								
	Family *Trochilidæ*.																				
[5]32	Doricha evelynæ (God Bird)	+	+		21		12		2	6	1		2	7		10					
	Doricha lyrura		×																		
33	Sporadinus ricordi											×				42					
	Sporadinus bracei													B							
	Family *Tyrannidæ*.																				
34	Tyrannus dominicensis	[6]×	O							2											
	Tyrannus magnirostris		+																		
	Pitangus caudifasciatus													+							
35	Pitangus bahamensis													4		3					
36	Myiarchus leucaysiensis		+							2				7		7					
37	Contopus bahamensis												1	1		1					
	Family *Icteridæ*.																				
	Dolichonyx oryzivorus (Gale Bird)						([3])							+							
38	Agelaius phœniceus bryanti (nov. sp. Ridgw.)													+		2					
	Family *Fringillidæ*.																				
39	Ammodramus sandvicensis savanna				1					1		[7]×				1					
	Passer domesticus													B							
40	Passerina cyanea										2			[7]O							
	Passerina ciris													O							

[1] Eggs.
[2] Reported.
[3] Eggs from ovary.
[4] Seen.
[5] Nest and eggs.
[6] South of New Providence.
[7] Seen only.

A list of birds taken by steamer Albatross on the Bahama Islands, &c.—Continued.

Number.	Name.	Bahamas.	Inagua.	Long Island.	Rum Cay.	Fortune Island.	Watling's Island.	Acklin Island.	Conception Island.	Green Cay.	Cat Island.	Andros Island.	Eleuthera.	New Providence.	Great Stirrup Cay.	Abaco.	Grand Bahama.	Bimini.	St. Domingo Cay.	Booby Rocks.	Ship Channel.
	Family *Fringillidæ*—Continued.																				
[1]41	Euetheia bicolor	+			12		15		7	4	18		5	4		3					
42	Phyrrulagra violacea	+	×								15	×	10	7		8					
	Phyrrulagra noctis		×																		
43	Spindalis zena		×	×							5		9	20							
44	Spindalis zena townsendi (nov. sp. R.)									1						11					
	Family *Hirundinidæ*.																				
45	Callichelidon cyanoviridis											×		+		1					
	Hirundo horreorum	[2]+																			
	Tachycinita bicolor													[2]O							
	Family *Vireonidæ*.																				
46	Vireo altiloquus barbatulus													3							
47	Vireo crassirostris									8				13		13					
48	Vireo crassirostris flavescens (nov. sp. Ridgw.)				14				4		8		17								
	Vireo flavifrons													O							
	Family *Cœrebridæ*.																				
[1]49	Certhiola bahamensis	+	+	×	38		12		18	6	4	×	6	4		9					
50	Mniotilta varia				2		2			2			1	6							
51	Helmintherus vermivorus													3		1					
52	Helminthophila pinus													+		1					
53	Compsothlypis americana		+		1					1				8							
54	Dendroica tigrina	×			5					3				7		2					
	Dendroica æstiva													+							
55	Dendroica coronata				2									+		2					
56	Dendroica cœrulescens						1		1					2							
57	Dendroica petechia gundlachi	[3]×	+		38		9		8				1	1							
	Dendroica maculosa	+												+							
	Dendroica pensylvanica													[2]+							
58	Dendroica striata	+												3							
	Dendroica blackburniæ													[2]+							
59	Dendroica dominica													1							
60	Dendroica kirtlandi						4			2		×									
61	Dendroica vigorsii													2		1					
62	Dendroica palmarum				17		6		3	8	8		3	8		1					
63	Dendroica discolor	×			25		16		1	4	11		7	12		6					
64	Sciurus aurocapillus	×			1		3			8	1		1	7		3					
65	Sciurus noveboracensis	+												+		1					
66	Geothlypis trichas	×			11		4		1	6	1		5	4		6					
67	Geothlypis rostrata													1							
68	Geothlypis tanneri (nov. sp. Ridgw.)															4					
69	Geothlypis coryi (nov. sp. Ridgw.)												3								
70	Setophaga ruticilla	+								2		+		10							
	Family *Troglodytidæ*.																				
[1]71	Mimus bahamensis		+		23		12		9	1	4		6	1							
72	Mimus polyglottus													O		1					
73	Galeoscoptes carolinensis		+		1					3				1		5					
74	Margarops fuscatus		×		10		7														
	Family *Sylviidæ*.																				
75	Polioptila cœrulea		+											6		11					
76	Polioptila cœrulea cæsiogaster (nov. sp. Ridgw.)													6		11					
	Family *Turdidæ*.																				
77	Mimocichla plumbea								1					2		10					
78	Mimocichla rubripes													+							
79	Turdus mustelinus													1							

[1] Nest and eggs.
[2] Seen only.
[3] South of Long Island.

In the following tables the abbreviations for the characters of the bottom and the instrument used are from the following code:

Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.
C	Clay.	fne	fine.	stf	stiff.
Co	Coral.	lge	large.	bk	black.
St	Stones.	rky	rocky.	bu	blue.
G	Gravel.	rtn	rotten.	dk	dark.
S	Sand.	stk	sticky.	gy	gray.
For	Foraminifera.	br	brown.	rd	red.
Pter	Pteropods.	choc	chocolate color.	wh	white.
M	Mud.	gn	green.	dd	dead.
P	Pebbles.	lt	light.	L. B. T.	Large beam-trawl.
Oz	Ooze.	slat	slate color.	S. B. T.	Small beam-trawl.
R	Rock.	yl	yellow.	Bl. Dr	Blake dredge (deep-sea dredge).
Sh	Shells.	crs	coarse.		
Glob	Globigerina.	hrd	hard.	Sh. Dr	Ship's dredge (mud-bag).
Sp	Specks.	sml	small.		
brk	broken.	sft	soft.	Tgls	Tangles.

For the record of hydrographic soundings preceding those herewith reported, reference should be made as follows: Nos. 46–557, pages 111–112, Fish Commission Report for 1884; Nos. 591–868, pages 74–77, Fish Commission Report for 1885.

Record of hydrographic soundings of the U. S. Fish Commission steamer Albatross for the year 1886.

Serial number.	Date.	Hour.	Position.						Depth.	Character of bottom.	Temperatures.			Current.
			Lat. N.			Long. W.					Air.	Surface.	Bottom.	
	1886.		°	′	″	°	′	″	*Fathoms.*		°	°	°	
869	Feb. 23	10.36 a. m	28	41	00	78	03	00	557	gy. S. bk. Sp	69	70	39.7	Nominal.
870	Feb. 23	12 m	28	40	00	77	52	00	570	gy. S. bk. Sp	71	68	39.7	Do.
871	Feb. 23	1.30 p. m	28	40	30	77	37	00	572	gy. S. bk. Sp	73	73	39.7	Do.
872	Feb. 23	2.58 p. m	28	41	30	77	28	00	581	gy. S. bk. Sp	86	74	39.7	Do.
873	Feb. 23	4.44 p. m	28	42	00	77	09	00	600	wh. S	86	74	39.2	Do.
874	Feb. 23	6.45 p. m	28	42	30	76	53	30	623	gy. S. bk. Sp	71	70	39.2	Do.
875	Feb. 23	8.20 p. m	28	42	45	76	39	00	762	Oz	67	70	39.7	Do.
876	Feb. 23	9.58 p. m	28	43	00	76	26	55	2,845	Oz	70	70	36.8	Northwest by north, 1 knot.
877	Feb. 24	12.51 a. m	28	34	42	76	10	25	3,196	Oz	68	69	36.8	Northwest, 1½ knots.
878	Feb. 24	4.20 a. m	28	24	06	76	15	55	1,407	No specimen	69	71	37.8	Nominal.
879	Feb. 24	6.02 a. m	28	12	30	76	15	00	691	gy. S	69	71	39.2	Do.
880	Feb. 24	7.41 a. m	28	01	00	76	13	00	622	yl. Oz. gy. S	69	71	39.2	Do.
881	Feb. 24	9.10 a. m	27	49	00	76	12	00	633	gy. and br. S	70	71	39.5	Do.
882	Feb. 24	10.41 a. m	27	38	00	76	23	24	677	br. S	72	71	39.0	No current.
883	Feb. 24	12.08 p. m	27	37	00	76	12	00	705	gy. and br. S	74	71	39.1	Do.
884	Feb. 24	2.08 p. m	27	42	00	76	02	00	762	For	70	72	39.2	Do.
885	Feb. 24	5.25 p. m	27	51	00	75	53	30	2,599	No specimen	71	73	....	Do.
886	Feb. 25	6.45 a. m	27	30	00	75	35	00	2,761	No specimen	70	71	....	North by west, 2 knots.
887	Feb. 26	4.14 a. m	25	29	00	74	50	00	2,589	For. Oz	73	72	....	North by west, ½ knot.
888	Feb. 26	10.40 a. m	24	50	00	74	36	45	2,709	br. Oz	74	73	36.7	
889	Feb. 26	2.59 p. m	24	25	00	74	36	00	2,639	br. Oz	76	75	37.6	
890	Feb. 26	6.52 p. m	24	08	00	74	35	00	1,135	hrd	74	73	38.6	
891	Feb. 27	12.54 p. m	23	57	00	74	36	30	535	Co	77	75	43.8	
892	Feb. 27	1.56 p. m	23	50	00	74	38	00	1,264	wh. S. Co	77	76	38.2	
893	Feb. 27	3.17 p. m	23	43	00	74	39	30	1,263	lt. br. Oz	79	77	38.2	
894	Mar. 8	7.07 a. m	23	37	20	74	57	40	850	Co. S	78	75	39.1	
895	Mar. 8	8.16 a. m	23	42	20	74	59	30	657	Co. S	78	75	40.1	
896	Mar. 8	8.49 a. m	23	44	35	75	01	35	1,017	Co. S	78	75	38.7	
897	Mar. 8	9.40 a. m	23	46	30	75	03	50	578	Co. S	78	75	42.3	
898	Mar. 8	10.38 a. m	23	49	30	75	08	30	115	wh. Co. S	75	73	67.8	
899	Mar. 8	3.44 p. m	23	55	20	75	11	20	845	Co. S. bk. Sp	74	75	39.2	
900	Mar. 8	4.49 p. m	24	01	20	75	13	30	741	wh. S. rd. and bk. Sp. For	73	75	39.5	
901	Mar. 8	5.54 p. m	24	08	30	75	15	00	22	wh. S. Sp. and brk. Sh	73	74	74.3	
902	Mar. 8	7.36 p. m	24	09	00	75	06	00	2,194	br. M. Co. S	72	74	37.2	
903	Mar. 8	10.18 p. m	24	08	00	74	56	30	2,482	br. Oz	72	74	26.7	
904	Mar. 9	12.56 a. m	24	08	00	74	45	00	2,255	br. Oz	72	74	36.5	
905	Mar. 9	3.20 a. m	24	07	00	74	38	00	2,061	br. Oz	72	74	36.7	
906	Mar. 9	3.44 p. m	23	35	00	74	47	30	149	Co. S. Sh	78	75	65.1	

907	Mar. 10	8.14 a. m	23	37	00	75	06	30	1,398	Co. S	71	74	38.4	
908	Mar. 10	10.17 a. m	23	46	30	75	13	45	1,338	Co. S	72	74	38.2	
909	Mar. 10	12.08 p. m	23	43	45	75	20	45	448	Co. S	72	74	48.3	
910	Mar. 10	1.23 p. m	23	50	30	75	23	30	1,047	Co. S	69	73	38.5	
911	Mar. 10	2.48 p. m	23	56	30	75	26	30	1,211	Co. S	68	73	38.3	
912	Mar. 10	4.18 p. m	24	02	45	75	29	00	361	Co. S	69	73	54.3	
913	Mar. 10	5.05 p. m	24	06	30	75	30	45	273	hrd. Co. S	70	73	n. t.	
914	Mar. 11	10.46 a. m	24	07	00	75	32	30	515	Co. S	68	72	n. t.	
915	Mar. 11	12.13 p. m	24	01	15	75	38	45	1,051	Co. S. bk. Sp	67	72	38.6	
916	Mar. 11	1.42 p. m	23	55	20	75	45	10	1,056	Co. S	68	73	38.6	
917	Mar. 11	3.03 p. m	23	49	30	75	51	40	974	Co. S. bk. Sp	68	73	39.1	
918	Mar. 11	4.20 p. m	23	43	30	75	58	00	124	Co. S	69	73	68.3	
919	Mar. 11	5.44 p. m	23	52	00	76	00	15	863	gy. Oz	67	73	39.1	
920	Mar. 11	7.42 p. m	24	00	40	76	02	45	967	wh. Co. S	66	73	38.6	
921	Mar. 11	9.43 p. m	24	09	00	76	05	00	990	wh. Co. S	66	72	38.6	
922	Mar. 11	11.35 p. m	24	17	20	76	07	30	1,002	wh. Co. S	66	72	38.6	
923	Mar. 12	1.37 a. m	24	25	40	76	09	50	971	gy. Oz	64	69	38.6	
924	Mar. 12	3.43 a. m	24	33	40	76	11	20	937	gy. Oz	65	71	38.6	
925	Mar. 12	5.47 a. m	24	39	40	76	13	50	781	Co. S	66	68	39.0	
926	Mar. 13	2.31 a. m	24	36	30	76	12	00	899	Co. S	72	71	39.0	
927	Mar. 13	4.11 a. m	24	33	00	76	24	30	923	Co. S	73	71	38.6	
928	Mar. 13	5.50 a. m	24	29	00	76	31	15	801	wh. Oz	73	72	39.1	
929	Mar. 13	7.18 a. m	24	25	00	76	37	00	143	wh. Oz	73	72	70.2	
930	Mar. 13	8.21 a. m	24	33	00	76	35	30	842	Co. S	76	73	38.8	No current.
931	Mar. 13	9.41 a. m	24	41	30	76	33	45	864	Co. S	80	74	38.8	Do.
932	Mar. 13	11.02 a. m	24	49	20	76	32	15	764	Co. S	80	74	39.1	Do.
933	Mar. 13	11.58 a. m	24	52	30	76	31	30	325	gy. Oz	78	74	56.2	Do.
934	Mar. 13	8.43 p. m	24	35	20	76	02	45	476	wh. Oz	75	74	46.5	Do.
935	Mar. 13	9.37 p. m	24	38	20	76	01	45	926	wh. Oz	75	74	n. t.	Strong northeast.
936	Mar. 13	11.28 p. m	24	46	50	75	55	45	1,965	gy. Oz	74	73	36.7	
937	Mar. 14	1.45 a. m	24	54	30	75	49	20	2,432	br. Oz	75	73	36.7	No current.
938	Mar. 14	4.22 a. m	25	02	45	75	43	00	2,664	br. Oz	75	73	36.7	Do.
939	Mar. 14	1.23 p. m	25	35	00	76	35	15	11	Co. S	71	72	n. t.	Do.
940	Mar. 14	1.36 p. m	25	35	30	76	34	30	14	Co. S	71	72	n. t.	Do.
941	Mar. 14	1.55 p. m	25	36	30	76	34	45	29	Co. S. rd. Sp	71	72	n. t.	Do.
942	Mar. 14	2.08 p. m	25	37	15	76	34	00	139	hrd. Co	71	72	n. t.	
943	Mar. 14	3.05 p. m	25	40	15	76	29	15	1,927	Co. S	73	72	38.1	North-northwest, ¾ knot
944	Mar. 14	5.10 p. m	25	44	45	76	23	15	2,663	br. Oz	72	72	36.7	North-northwest, ½ knot.
945	Mar. 24	6.30 a. m	25	07	00	77	21	30	375	Co. S	69	72	n. t.	No current.
946	Mar. 24	8.02 a. m	25	15	30	77	24	45	1,409	br. Oz. Co	71	73	38.4	West by north, 2 knots.
947	Mar. 24	10.05 a. m	25	25	30	77	27	50	1,490	br. Oz	70	74	39.1	No current.
948	Mar. 24	1.03 p. m	25	35	30	77	27	45	1,079	hrd. Co. S	69	74	39.1	South, 1½ knots.
949	Mar. 24	3.51 p. m	25	47	00	77	20	30	1,164	hrd. Co. S	68	74	38.6	South, ¾ knot.
950	Mar. 24	10.34 p. m	25	53	15	77	33	00	1,312	gy. Oz	65	71	38.4	Do.
951	Mar. 25	4.03 a. m	25	59	00	78	12	00	411	gy. Oz	66	71	49.8	
952	Mar. 25	6.49 a. m	26	04	00	78	29	00	383	br. and gy. Oz	69	74	51.8	No current.
953	Mar. 25	8.55 a. m	26	07	00	78	45	30	281	wh. Oz	69	75	58.3	Do.
954	Apr. 3	9.33 p. m	24	14	00	81	30	00	145	brk. Sh	72	73	46.3	
955	Apr. 3	11.02 p. m	24	05	45	81	30	30	445	wh. Oz	72	75	41.6	East-northeast.
956	Apr. 4	12.56 a. m	23	58	30	81	31	00	589	gy. S. yl. Sp	72	75	40.5	East-northeast, 1 knot.
957	Apr. 4	2.42 a. m	23	51	00	81	31	45	980	gy. S. bk. Sp	73	76	39.9	North-northeast, 2 knots.
958	Apr. 4	5.00 a. m	23	43	00	81	32	15	777	br. Oz	73	76	39.6	Do.

Record of hydrographic soundings, &c.—Continued.

Serial number.	Date.	Hour.	Position. Lat. N. °	′	″	Long. W. °	′	″	Depth.	Character of bottom.	Temperatures. Air.	Surface.	Bottom.	Current.
	1886.								*Fathoms.*		°	°	°	
959	Apr. 4	6.43 a. m	23	35	30	81	32	45	815	lt. br. Oz	74	76	39.6	No current.
960	Apr. 4	8.25 a. m	23	28	00	81	33	15	792	lt. br. Oz	74	77	39.6	Do.
961	Apr. 4	10.03 a. m	23	20	30	81	33	45	707	br. Oz	73	77	40.6	Do.
962	Apr. 4	11.51 a. m	23	13	00	81	34	30	398	br. Oz. Sh	76	77	50.0	
963	Apr. 4	12.36 p. m	23	08	00	81	35	30	261	br. S. Sh	76	77	56.7	
964	Apr. 10	4.50 a. m	26	21	00	78	50	45	443	wh. Oz	68	76	48.4	
965	Apr. 10	7.02 a. m	26	27	00	78	38	00	290	br. S. brk. Sh	70	74	60.6	
966	Apr. 10	9.16 a. m	26	25	30	78	27	50	528	br. S	70	73	40.7	West-northwest, 1 knot.
967	Apr. 10	11.33 a. m	26	31	30	78	21	00	367	yl. M	70	73	53.0	Do.
968	Apr. 10	12.18 p. m	26	33	00	78	24	20	18	Co. S	71	73	73.2	
969	Apr. 10	12.26 p. m	26	32	30	78	24	00	148	Co. S	71	73	n. t.	
970	Apr. 10	1.20 p. m	26	36	30	78	18	30	18	Co	71	73	74.7	
971	Apr. 10	2.24 p. m	26	38	30	78	14	00	274	Co. lt. br. Oz	71	74	62.3	
972	Apr. 10	4.23 p. m	26	39	00	78	09	00	157	gy. Oz	72	74	67.2	
973	Apr. 10	5.04 p. m	26	38	45	78	00	00	10	gy. S. fne. Sh	71	73	n. t.	
974	Apr. 10	5.52 p. m	26	34	00	77	58	45	234	gy. Oz	71	73	63.8	
975	Apr. 10	7.35 p. m	26	22	00	78	08	00	867	wh. Oz	70	73	39.6	
976	Apr. 10	10.10 p. m	26	16	00	77	55	00	711	br. Oz	69	73	39.6	
977	Apr. 12	9.17 p. m	23	39	15	76	47	00	740	wh. Oz	74	74	39.6	North, slight.
978	Apr. 12	11.08 p. m	23	44	00	77	00	00	756	wh. Oz	73	74	40.2	
979	Apr. 13	12.55 a. m	23	49	00	77	13	00	763	wh. Oz	73	74	39.4	
980	Apr. 13	3.12 a. m	23	50	00	77	25	30	740	lt. br. Oz	73	73	39.6	
981	Apr. 13	4.43 a. m	23	58	00	77	20	00	805	lt. br. Oz	73	73	39.4	
982	Apr. 13	6.18 a. m	23	57	00	77	12	15	514	lt. br. Oz	73	73	40.4	
983	Apr. 13	2.22 p. m	24	07	00	77	21	00	809	wh. Oz	82	74	57.3	
984	Apr. 13	3.54 p. m	24	13	00	77	30	30	822	lt. br. Oz	78	74	39.4	
985	Apr. 13	5.20 p. m	24	19	30	77	24	30	852	lt. br. Oz	70	74	47.6	
986	Apr. 13	6.46 p. m	24	25	00	77	18	15	639	wh. M	74	74	59.8	
987	Apr. 14	5.35 a. m	24	29	30	77	19	00	441	wh. M	72	73	45.7	
988	Apr. 14	7.28 a. m	24	37	00	77	30	00	939	Co. M	80	73	39.1	
989	Apr. 14	9.28 a. m	24	43	00	77	42	00	734	lt. br. Oz	76	74	39.6	
990	Apr. 14	7.01 p. m	25	19	30	77	57	30	959	lt. br. Oz	71	73	38.6	
991	Apr. 15	7.23 a. m	25	11	00	77	47	30	1,195	lt. br. Glob. Oz	69	73	40.7	
992	Apr. 15	9.23 a. m	25	02	30	77	40	00	1,084	yl. M	74	73	39.8	
993	Apr. 17	7.42 a. m	25	06	00	77	32	00	794	Co. S	72	73	39.4	South, ½ knot.
994	Apr. 30	12.12 p. m	25	35	45	76	57	00	1,527	lt. br. Oz	79	76	44.2	
995	Apr. 30	1.39 p. m	25	39	30	76	53	45	1,922	wh. Co. Oz	79	76	36.9	
996	Apr. 30	3.10 p. m	25	43	00	76	58	00	2,222	br. Oz	79	76	39.1	
997	Apr. 30	4.55 p. m	25	47	00	77	03	00	1,773	gy. S. bk. Sp	77	76	37.0	

998	Apr. 30	6.25 p.m	25	50	45	77	09	00	11½	No specimen	77	76	n.t.	
999	May 1	1.51 a.m	26	40	00	76	49	30	942	brk. Sh	75	77	39.1	
1000	May 1	3.47 a.m	26	43	00	76	38	30	2,800	br. Oz	75	77	36.8	East by south, ½ knot.
1001	May 1	6.55 a.m	26	45	00	76	26	00	2,764	gy. Co. S	77	76	38.1	Do.
1002	May 1	9.42 a.m	26	47	00	76	15	00	2,693	br. Co. S	76	74	38.4	
1003	May 1	12 m	26	50	00	76	04	45	2,670	br. Oz	76	74	38.1	
1004	May 1	4.36 p.m	27	11	00	76	19	00	2,715	Co. S. For	76	73	38.1	
1005	May 2	12.06 a.m	27	41	00	76	41	00	943	gy. Oz. bk. Sp	69	72	38.6	
1006	May 2	2.18 a.m	27	45	00	76	52	30	671	yl. Oz. bk. Sp	69	72	41.1	North, ½ knot.
1007	May 2	4.18 a.m	27	49	00	77	04	00	690	yl. Oz. bk. Sp	69	72	41.1	
1008	May 2	6.15 a.m	27	53	00	77	16	00	669	yl. Oz. bk. Sp	71	73	39.9	
1009	May 2	11.13 a.m	27	49	30	77	35	00	661	Co. S. For	72	73	.....	
1010	May 2	12.57 p.m	27	42	30	77	45	00	663	lt. br. Oz	74	74	40.5	
1011	May 2	2.30 p.m	27	35	45	77	51	00	682	Wire parted, lost 400 turns, ther., and lead	74	74	.....	
1012	May 2	3.59 p.m	27	27	00	77	59	00	610	wh. S	74	74	40.8	
1013	May 5	4.35 p.m	31	27	00	79	12	00	280	crs. gy. S	76	77	50.2	
1014	July 18	3.05 a.m	39	57	00	71	24	45	58	br. S. Sh	72	71	53.1	
1015	July 18	3.43 a.m	39	54	00	71	24	00	119	gn. M	72	71	51.0	
1016	July 18	5.26 a.m	39	50	00	71	20	30	226	gn. M	72	71	43.1	
1017	Aug. 3	2.10 p.m	40	14	00	65	56	00	2,224	br. Oz. C	68	75	36.7	
1018	Aug. 3	6.22 p.m	40	15	00	65	35	00	2,951	br. Oz	68	74	36.2	
1019	Aug. 4	1 a.m	40	20	00	64	54	00	2,575	gy. and br. Oz	68	73	37.3	Northwest, 1 knot.
1020	Aug. 4	6.40 a.m	40	52	24	63	53	00	2,337	lt. br. Oz	67	73	.....	
1021	Aug. 4	12.27 p.m	41	29	28	63	27	30	1,919	lt. br. Oz	70	66	37.5	Northwest, 1 knot.
1022	Aug. 4	1.50 p.m	41	29	28	63	21	00	1,932	lt. br. Oz	69	64	37.7	Do.
1023	Aug. 4	3.04 p.m	41	29	28	63	17	00	1,969	lt. br. Oz	68	64	37.3	Do.
1024	Aug. 4	4.35 p.m	41	29	28	63	10	15	1,980	lt. br. Oz	69	64	37.3	East-northeast, 1 knot.
1025	Aug. 4	6.02 p.m	41	29	28	63	05	15	1,996	lt. br. Oz	65	66	.....	East, 1 knot.
1026	Aug. 4	7.37 p.m	41	25	30	63	08	00	2,025	lt. br. Oz	65	66	36.2	
1027	Aug. 4	10.44 p.m	41	24	00	63	19	00	2,033	lt. br. Oz	66	65	36.3	
1028	Aug. 5	1.03 a.m	41	22	20	63	29	30	2,054	lt. br. Oz	65	66	36.2	
1029	Aug. 5	3.11 a.m	41	31	00	63	27	30	1,930	lt. br. Oz	65	66	36.2	
1030	Aug. 5	4.45 a.m	41	30	30	63	15	00	1,978	lt. br. Oz	64	63	35.2	
1031	Aug. 5	6.22 a.m	41	32	30	63	00	30	2,033	lt. br. Oz	62	64	36.3	
1032	Aug. 5	8.19 a.m	41	29	30	62	47	30	2,069	lt. br. Oz	62	64	36.2	
1033	Aug. 5	12.31 p.m	41	53	00	62	35	15	1,768	No specimen	67	67	.....	
1034	Aug. 5	4.47 p.m	42	21	00	62	18	00	1,138	br. Oz	69	66	38.2	Northeast by east, 2 knots.
1035	Aug. 5	8.48 p.m	42	43	00	62	03	00	231	gy. S. bk. Sp	67	64	40.8	
1036	Aug. 6	8.44 p.m	43	30	00	57	40	00	1,731	lt. br. Oz	64	62	37.2	East-northeast, 1 knot.
1037	Aug. 7	4.37 a.m	43	45	00	56	09	00	1,758	stk. br. M	62	62	37.2	
1038	Aug. 7	12.38 p.m	44	02	00	54	39	00	1,780	lt. gy. M	66	64	36.9	East, ½ knot.
1039	Aug. 7	6.43 p.m	44	13	00	53	47	00	1,172	br. Oz	63	63	37.7	East, 1 knot.
1040	Aug. 8	12.03 a.m	44	23	00	52	42	00	81	For. bk. Sp	61	62	31.9	
1041	Aug. 8	12 m	44	52	00	50	25	24	34	rd. S. bk. Sp	62	62	39.7	
1042	Aug. 8	6.12 p.m	45	00	00	49	15	00	35	wh. S. brk. Sh	60	62	31.1	
1043	Aug. 8	6.54 p.m	45	00	00	49	09	00	35	hrd	60	62	31.0	
1044	Aug. 8	7.27 p.m	45	00	00	49	03	00	35	wh. S	57	59	30.9	
1045	Aug. 8	8.03 p.m	45	00	00	48	57	00	38	P	57	58	31.4	
1046	Aug. 8	8.39 p.m	45	00	00	48	51	00	41	P. wh. S. brk. Sh	57	58	30.4	
1047	Aug. 8	9.13 p.m	45	00	00	48	45	00	115	crs. wh. S. brk. Sh	57	56	31.9	
1048	Aug. 8	11 43 p.m	45	02	00	48	20	00	1,169	lt. br. Oz	57	56	37.8	
1049	Aug. 9	6.47 a.m	45	02	00	47	08	00	1,916	lt. br. Oz	62	59	38.2	East, 1 knot.

Record of hydrographic soundings, &c.—Continued.

Serial number.	Date.	Hour.	Position. Lat. N.			Long. W.			Depth.	Character of bottom.	Temperatures. Air.	Surface.	Bottom.	Current.
	1886.		°	'	"	°	'	"	*Fathoms.*		°	°	°	
1050	Aug. 9	1.32 p. m	45	02	00	45	58	00	1,981	br. Oz	65	62	36.3	
1051	Aug. 9	7.56 p. m	45	04	00	44	38	00	2,549	br. Oz	65	63	36.2	
1052	Aug. 10	2.40 a. m	45	06	00	43	23	30	2,621	lt. br. Oz	67	68	36.8	North, 1 knot.
1053	Aug. 10	9.36 a. m	45	14	00	42	03	00	2,658	br. Oz. For	69	70	37.8	North-northwest, 1½ knots.
1054	Aug. 10	6 47 p. m	45	43	00	43	00	00	2,577	lt. br. Oz	69	68	36.8	Do.
1055	Aug. 11	3.03 a. m	46	21	00	43	47	00	2,135	S. G	57	60	37.3	Northeast, 1½ knots.
1056	Aug. 11	7.43 p. m	47	02	30	45	06	30	103	hrd	59	58	38.2	
1057	Aug. 11	9.20 p. m	47	14	00	45	31	30	155	wh. S. bk. Sp	58	57	39.7	
1058	Aug. 12	1.51 a. m	47	27	00	46	11	30	423	br. Oz	56	57	38.7	
1059	Aug. 12	6.58 a. m	47	32	12	46	53	30	477	No specimen	53	49	......	
1060	Aug. 12	4.37 p. m	47	44	00	48	12	30	170	gy. S. P	55	50	37.1	Southerly, ½ knot.
1061	Aug. 12	5 21 p. m	47	46	00	48	19	30	168	gy. S. bk. Sp	55	51	36.5	Do.
1062	Aug. 12	7.17 p. m	47	49	00	48	41	30	147	gy. S. bk. Sp. brk. Sh	54	51	35.2	
1063	Aug. 13	12.14 a. m	47	57	00	49	24	30	106	gy. S. bk. Sp	54	52	32.4	
1064	Aug. 13	3.48 a. m	48	02	00	50	10	30	100	gy. M	55	53	30.4	
1065	Aug. 13	7.58 a. m	47	31	00	50	17	00	62	gy. S. bk. Sp. P	56	54	30.1	
1066	Aug. 13	11.31 a. m	47	26	00	51	00	30	74	fne. gy. S. bk. Sp	57	54	......	
1067	Aug. 13	2.57 p. m	47	30	00	51	45	00	98	gn. M	55	55	......	
1068	Aug. 22	8.55 p. m	44	40	00	56	43	30	226	gy. M	60	58	40.4	
1069	Aug. 22	11.43 p. m	44	31	00	57	09	00	38	gy. S. P	60	58	33.7	
1070	Aug. 23	7.23 a. m	44	25	00	57	35	00	32	wh. S. bk. Sp	63	59	......	
1071	Aug. 23	3.44 p. m	43	38	00	59	18	30	63	gy. S. bk. Sp	67	62	35.6	
1072	Aug. 25	8.02 a. m	41	37	00	62	58	00	1,943	dk. br. Oz	63	65	36.9	Southeast, 2 knots.
1073	Aug. 25	9.33 a. m	41	37	00	63	05	00	1,854	dk. br. Oz	63	68	36.7	Do.
1074	Aug. 25	10.58 a. m	41	37	00	63	11	30	1,798	dk. br. Oz	63	65	37.2	Southeast, 1½ knots,
1075	Aug. 25	12.21 p. m	41	37	00	63	18	00	1,779	dk. br. Oz	64	65	37.1	East, 2 knots.
1076	Aug. 25	1.53 p. m	41	37	00	63	26	00	1,762	dk. br. Oz	70	73	36.9	Do.
1077	Aug. 25	3.15 p. m	41	37	00	63	34	00	1,741	dk. br. Oz	70	73	36.9	
1078	Aug. 25	4.35 p. m	41	42	00	63	34	00	1,644	dk. br. Oz	70	72	37.2	
1079	Aug. 25	6.01 p. m	41	42	00	63	27	00	1,693	dk. br. Oz	70	72	36.9	
1080	Aug. 25	7.28 p. m	41	42	00	63	21	00	1,697	dk. br. Oz	70	72	36.9	
1081	Aug. 25	9.05 p. m	41	42	00	63	14	30	1,713	lt. br. Oz. For	70	71	37.5	Easterly, 2 knots.
1082	Aug. 26	12.29 p. m	41	49	00	63	50	00	1,587	br. Oz. gy. M	73	73	37.5	
1083	Aug. 26	2.09 p. m	41	42	00	63	47	30	1,620	br. Oz. For	74	73	37.2	East by north, 2 knots.
1084	Aug. 26	3.34 p. m	41	37	00	63	45	00	1,699	br. Oz. For	74	74	37.2	
1085	Aug. 26	4.59 p. m	41	32	00	63	43	00	1,805	br. Oz. For	74	74	36.7	
1086	Aug. 26	6.26 p. m	41	26	00	63	40	45	1,910	br. Oz. For	74	73	36.7	
1087	Aug. 26	8.29 p. m	41	27	00	63	54	30	1,880	lt. br. Oz	70	73	36.7	
1088	Aug. 27	12.26 a. m	41	27	00	64	22	30	1,879	lt. br. Oz. For	67	72	36.7	Northwest, 2 knots.
1089	Aug. 27	4.10 a. m	41	28	00	64	51	30	1,696	No specimen	68	72	......	

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross for the year 1886.

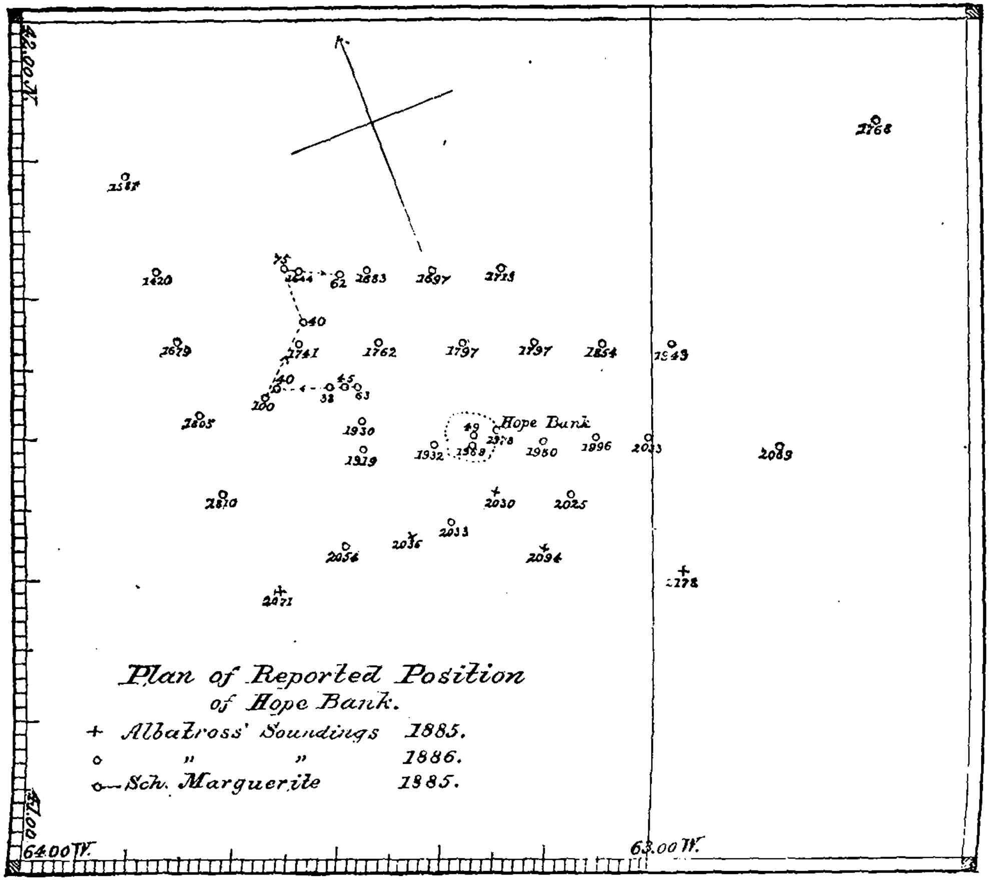
[For the record of Albatross dredging stations preceding that herewith presented, reference should be made as follows: Nos. 2001-2116, pages 219-221, Fish Commission Report for 1883; Nos. 2117-2310, pages 106-110, Fish Commission Report for 1884; Nos. 2311-2628, pages 66-73, Fish Commission Report for 1885.]

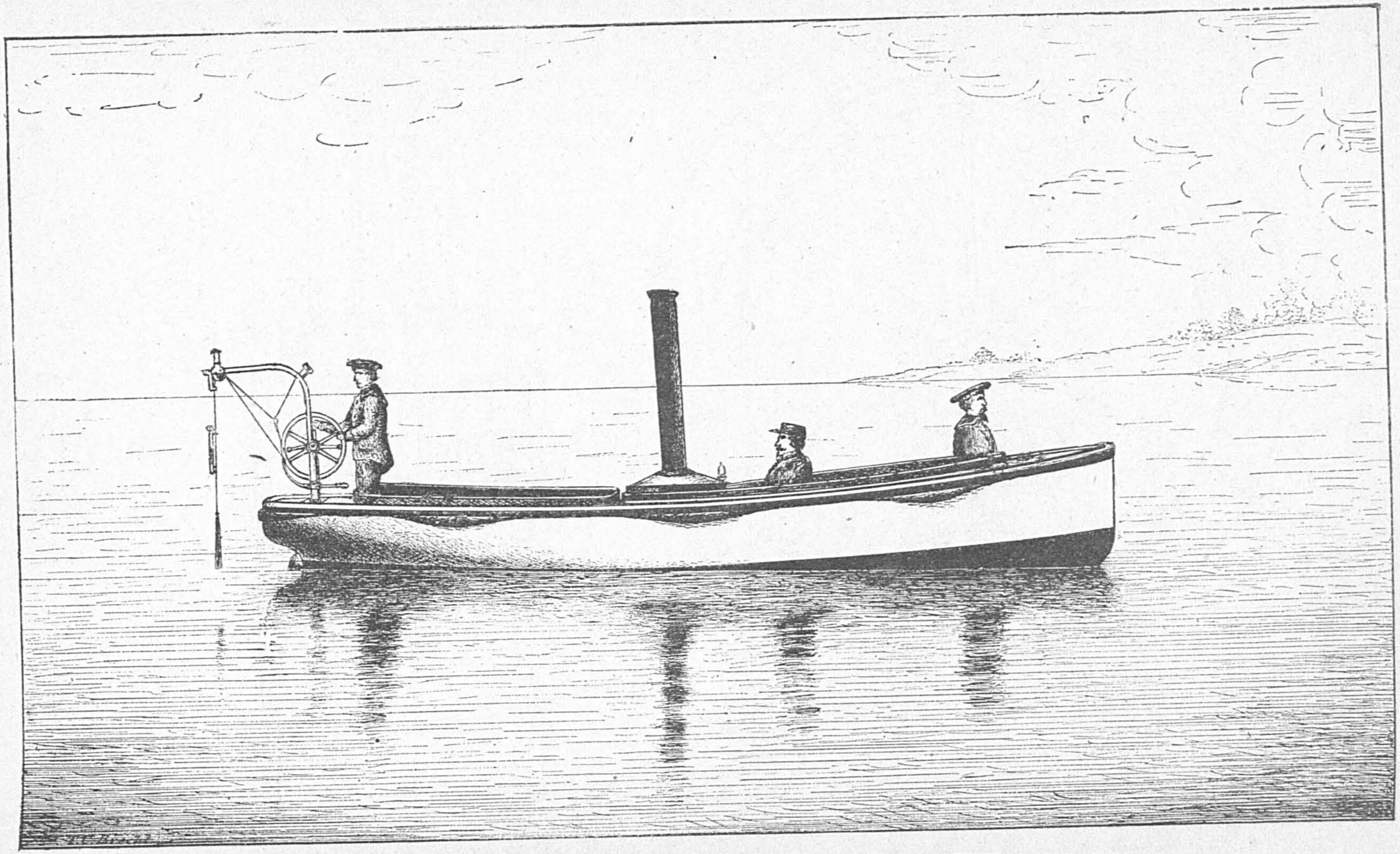
Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1886.		° ′ ″	° ′ ″	°	°	°	*Fath.*					*Miles.*	
2629	Mar. 8	12.07 p. m	23 48 40	75 10 40	73	73	38.4	1,169	Co. S	N.	1	S. by W. ¾ W.	2¼	L. B. T.
2630	Mar. 12	2.10 p. m	24 39 45	76 11 30	72	72	61.8	244	Co. S	SE.	4	ESE.	¼	Tgls.
2631	Mar. 12	3.03 p. m	24 39 30	76 11 00	73	72	59.8	280	Co. S	SE.	4	NNW.	⅛	Tgls.
2632	Mar. 13	2.29 p. m	24 30 43	76 23 45	75	73	39.4	791	Co. S. gy. Oz	SSE.	4	E. by N.	2	L. B. T.
2633	Apr. 7	8.05 a. m	23 11 00	82 19 30	74	76	60.8	208	Co. S	NE.	3	......	......	Tgls.
2634	Apr. 7	8.48 a. m	23 10 45	82 18 45	74	76	......	162	br. S. brk. Sh	NE.	3	......	......	Tgls.
2635	Apr. 7	10.05 a. m	23 10 55	82 18 55	71	73	62.8	208	dead Co. Sh	N. by E.	3	......	......	Tgls.
2636	Apr. 7	10.52 a. m	23 10 45	82 18 45	71	73	62.6	191	dead Co. Sh	N. by E.	3	......	......	Tgls.
2637	Apr. 7	11.32 a. m	23 10 45	82 19 00	70	75	65.8	143	dead Co. Sh	N. by E.	3	......	......	Tgls.
2638	Apr. 7	2.09 p. m	23 17 45	82 18 00	69	76	39.6	1,025	yl. S	N.	3	......	......	L. B. T.
2639	Apr. 9	6.05 a. m	25 04 50	80 15 10	70	73	......	56	Co. S	NE.	4	NE. by N.	¼	Bl. Dr.
2640	Apr. 9	6.33 a. m	25 05 00	80 15 00	70	73	......	56	Co. S	NE.	4	NE. by N.	¼	L. B. T.
2641	Apr. 9	8.14 a. m	25 11 30	80 10 00	70	74	69.2	60	Co. S	NE.	4	NE. by N.	¼	L. B. T.
2642	Apr. 9	10.41 a. m	25 20 30	79 58 00	71	74	42.6	217	gy. S	NE. by E.	4	NE. by N.	1	L. B. T.
2643	Apr. 9	11.54 a. m	25 25 00	79 55 15	71	74	43.1	211	gy. S	NE. by E.	4	NE. by N.	1½	L. B. T.
2644	Apr. 9	2.01 p. m	25 40 00	80 00 00	73	73	43.4	193	gy. S	NNE.	3	N. ¾ W.	¾	Bl. Dr.
2645	Apr. 9	3.15 p. m	25 46 30	80 02 00	70	75	43.4	157	gn. S	NNE.	3	......	......	Bl. Dr.
2646	Apr. 9	4.14 p. m	25 47 00	80 05 00	71	75	......	85	gy. S. For	NNE.	3	N.	½	Bl. Dr.
2647	Apr. 9	4.49 p. m	25 48 00	80 04 00	71	75	......	85	gy. S. For	NNE.	3	N.	½	Bl. Dr.
2648	Apr. 9	5.17 p. m	25 53 00	80 03 30	71	73	......	84	gn. M	NNE.	3	N.	½	Bl. Dr.
2649	Apr. 12	5.25 p. m	23 34 00	76 33 00	73	74	74.2	36	Co. S	SE.	6	......	......	Tgls.
2650	Apr. 12	6.01 p. m	23 34 30	76 34 00	73	74	57.8	369	Co. S. wh. Oz	SE.	6	SE. by E.	2	Tgls.
2651	Apr. 13	9.46 a. m	24 02 00	77 12 45	75	74	73.4	97	wh. Oz	E.	4	......	......	Tgls.
2652	Apr. 13	10.06 a. m	24 12 30	77 13 00	75	74	67.1	140	wh. M	E.	4	......	......	Bl. Dr.
2653	Apr. 14	11.35 a. m	24 52 30	77 39 00	78	74	39.1	1,000	lt. br. Oz	N.	3	NW. by W.	3	L. B. T.
2654	May 2	8.29 a. m	27 57 30	77 27 30	76	73	39.3	660	yl. Oz. bk. Sp	WNW.	2	NW. by W.	1	L. B. T.
2655	May 2	5.49 p. m	27 22 00	78 07 30	72	76	47.5	338	gy. S	NW.	3	NW. by W.	¾	L. B. T.
2656	May 3	5.24 a. m	27 58 30	78 24 00	69	71	41.2	572	For	N.	3	WNW.	1½	L. B. T.
2657	May 3	8.35 a. m	28 08 00	78 28 00	71	73	44.7	540	For	N.	3	WNW.	1¾	L. B. T.
2658	May 3	12.20 p. m	28 21 00	78 33 00	72	73	41.7	514	For. brk. Sh	N. by E.	3	NNW. ½ W.	1¼	L. B. T.
2659	May 3	3.35 p. m	28 32 00	78 42 00	73	74	45.2	509	br. For	N.	3	NW.	1	L. B. T.
2660	May 3	6.47 p. m	28 40 00	78 46 00	72	74	45.7	504	yl. For	NNE.	3	NW.	¼	L. B. T.
2661	May 4	5.20 a. m	29 16 30	79 36 30	70	75	45.5	438	gy. S. bk. Sp	ENE.	4	NNW.	1	L. B. T.
2662	May 4	8.19 a. m	29 24 30	79 43 00	72	75	43.7	434	gy. S. brk. Sh	ENE.	4	NNW.	¾	L. B. T.

Record of dredgings and trawlings, &c.—Continued.

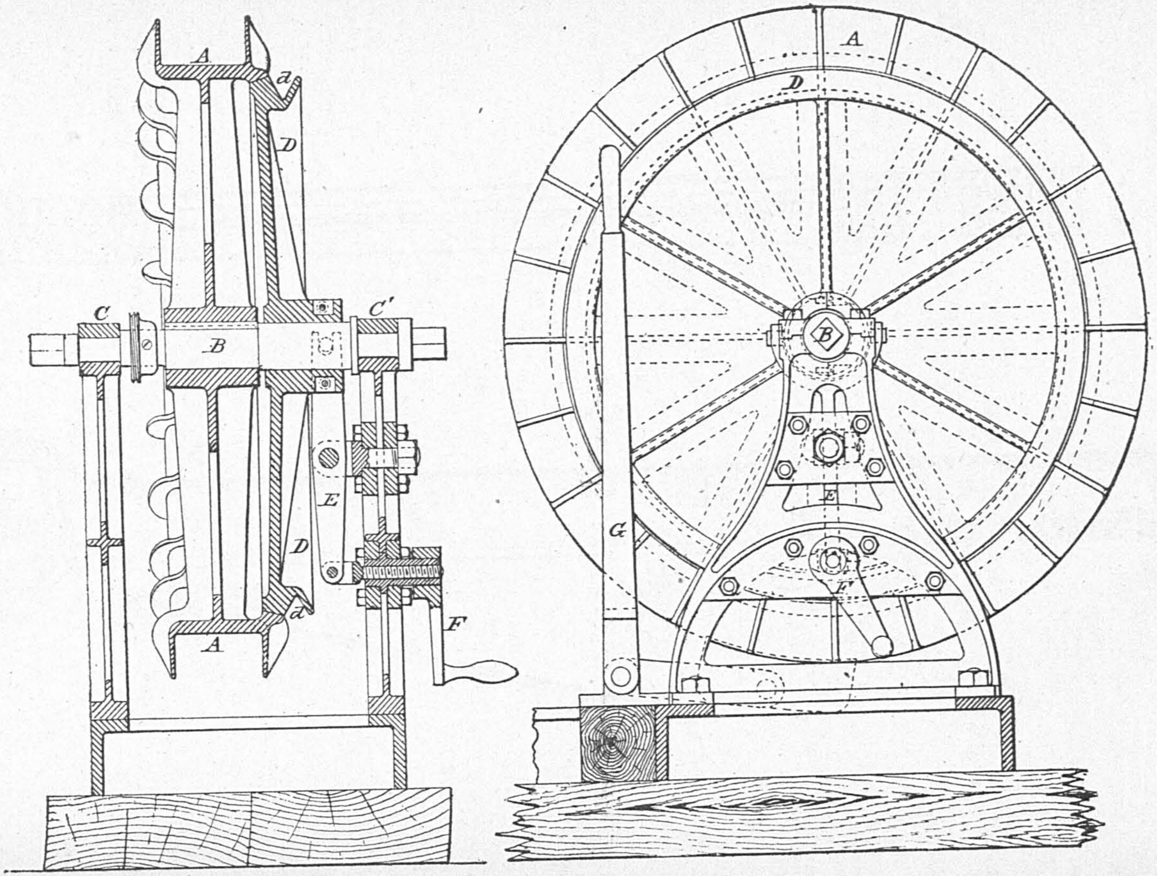
Serial number.	Date.	Hour.	Position.		Temperatures.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1886.		° ′ ″	° ′ ″	°	°	°	*Fath.*					*Miles.*	
2663	May 4	10.46 a. m	29 39 00	79 49 00	72	77	42.7	421	br. S	E.	4	NNW.	¾	L. B. T.
2664	May 4	2.26 p. m	29 41 00	79 55 00	74	75	42.7	373	Co. S	E.	2	N.	1	L. B. T.
2665	May 4	5.16 p. m	29 47 00	80 05 45	75	76	45.2	263	fne. gy. S	ESE.	3	SSE.	¾	L. B. T.
2666	May 5	5.26 a. m	30 47 30	79 49 00	70	74	48.3	270	gy. S	E.	1	NNE.	1¼	L. B. T.
2667	May 5	7.22 a. m	30 53 00	79 42 30	75	75	48.7	273	gy. S. bk. Sp	E.	2	NNE.	¾	L. B. T.
2668	May 5	9.37 a. m	30 58 30	79 38 30	73	76	46.3	294	gy. S. dd. Co	E.	2	NNE.	¼	L. B. T.
2669	May 5	11.23 a. m	31 09 00	79 33 30	73	77	43.7	352	gy. S. dd. Co	E.	2	NNE.	¼	L. B. T.
2670	May 5	1.52 p. m	31 20 00	79 22 00	73	74	44.5	280	gy. S. dd. Co	E.	1	......	......	L. B. T.
2671	May 5	2.45 p. m	31 20 00	79 22 00	76	77	......	280	gy. S. dd. Co	E. by S.	1	......	......	L. B. T.
2672	May 5	5.55 p. m	31 31 00	79 05 00	73	77	54.3	277	crs. br. S	SE.	1	NE. by E.	¼	Tgls.
2673	May 6	5.17 a. m	32 26 00	77 43 30	72	77	51.6	240	Co. gy. S. bk. Sp	SW.	1	NE. by E.	½	Tgls.
2674	May 6	8.45 a. m	32 32 00	77 17 00	72	76	46.0	316	gy. S. bk. Sp. Sh	SW.	2	E.	1½	L. B. T.
2675	May 6	10 a. m	32 32 30	77 15 00	73	75	45.8	327	gy. S. bk. Sp. Sh	SW.	2	E.	1	L. B. T.
2676	May 6	12.19 p. m	32 39 00	77 01 00	73	77	45.8	407	gn. Oz. gy. S.	SW.	2	E.	1	L. B. T.
2677	May 6	2.49 p. m	32 39 00	76 50 30	75	78	39.3	478	gn. M	SW.	2	E.	1¼	L. B. T.
2678	May 6	5.42 p. m	32 40 00	76 40 30	74	77	38.7	731	lt. gy. Oz	SSW.	3	SSW.	1	L. B. T.
2679	May 6	8.14 p. m	32 40 00	76 40 30	72	75	38.6	782	lt. gy. Oz	SSW.	3	SW.	1½	L. B. T.
2680	July 16	9.27 a. m	39 50 00	70 26 00	...	...	......	555	No specimen	S. by E.	5	SSE. ½ E.	½	L. B. T.
2681	July 16	12.55 p. m	39 43 00	70 29 00	...	...	......	990	gn. M	S.	4	SE.	1	L. B. T.
2682	July 16	5.28 p. m	39 38 00	70 22 00	...	...	......	1,004	gn. M. S.	WSW.	3	SE. by E.	1½	L. B. T.
2683	July 17	5.04 a. m	39 33 00	70 50 00	...	...	......	887	br. Oz	SSW.	2	SE. by S.	1	L. B. T.
2684	July 17	8.18 a. m	39 35 00	70 54 00	...	...	......	1,106	br. C. bk. Sp	SSW.	1	SSE.	1½	L. B. T.
2685	July 17	1.59 p. m	39 35 00	71 02 30	...	...	......	1,137	gn. M. wh. Sp	Calm.	0	S.	1½	L. B. T.
2686	July 18	4.31 a. m	39 52 00	71 20 45	...	...	......	226	gn. M	SW.	2	W.	¾	L. B. T.
2687	July 18	6.12 a. m	39 46 00	71 19 00	...	...	......	326	gn. M	SW.	1	W.	¾	L. B. T.
2688	July 18	8.17 a. m	39 42 00	71 12 00	...	...	......	644	gn. M	SW.	1	SW. by W.	1	L. B. T.
2689	July 18	10.18 a. m	39 42 00	71 15 30	...	...	......	525	gn. M	SSW.	1	NW.	2	L. B. T.
2690	July 18	1.12 p. m	39 39 00	71 11 00	...	...	......	643	gn. M	Calm.	0	SW.	1	L. B. T.
2691	July 18	5.18 p. m	39 37 00	71 03 00	...	...	......	835	lt. gn. M	SSW.	2	NW.	1½	L. B. T.
2692	Aug. 11	10.49 a. m	46 50 00	44 35 00	...	...	......	73	gy. S. sml. bk. St	NW.	3	W. by S.	½	L. B. T.
2693	Aug. 11	12.09 p. m	46 53 00	44 39 30	...	...	......	78	rd. and gn. S. bk. and gy. P	NW.	2	W. by S.	1¼	L. B. T.
2694	Aug. 11	1.55 p. m	46 52 30	44 54 30	...	...	......	86	gy. S. bk. Sp	WSW.	3	WNW.	¾	L. B. T.
2695	Aug. 11	3.44 p. m	46 51 30	45 06 30	...	...	......	105	gy. S. bk. Sp. P	W.	3	NE.	½	L. B. T.
2696	Aug. 11	4.33 p. m	46 53 30	45 05 30	...	...	......	98	gy. S. bk. Sp	W.	3	NE.	½	L. B. T.
2697	Aug. 12	12.09 p. m	47 40 00	47 35 30	...	...	......	206	gn. M. bk. Sp	SSW.	2	SW. by S.	½	L. B. T.
2698	Aug. 22	8.10 a. m	45 07 00	55 09 00	...	...	......	90	gy. S. bk. Sp. P	SSW.	2	S. by W.	¼	L. B. T.
2699	Aug. 22	10.53 a. m	45 01 00	55 23 00	...	...	......	72	Co	WSW.	2	E. ¼ S.	⅛	L. B. T.

2700	Aug. 22	1.29 p. m	44 56 30	55 48 00				59	gy. S. bk. Sp	SW.	2	E. ¾ S.	½	L. B. T.
2701	Aug. 22	2.02 p. m	44 56 00	55 49 30				75	gy. S. bk. Sp	S.	2	E. ¼ S.	½	L. B. T.
2702	Aug. 22	5.25 p. m	44 50 00	56 19 30				215	gn. M	S.	3	W.	¾	L. B. T.
2703	Aug. 23	11.30 a. m	44 01 00	59 02 30				140	gy. S. bk. Sp	S. by W.	4	WSW.	½	L. B. T.
2704	Aug. 23	4.52 p. m	43 32 00	59 22 00				110	gy. S. bk. Sp	SW. by S.	6	WNW. ½ W.	¾	L. B. T.
2705	Aug. 24	9.11 a. m	42 47 00	61 04 00				1,255	lt. br. Oz	N.	1	N. by E. ½ E.	2½	L. B. T.
2706	Aug. 27	9.33 a. m	41 28 30	65 35 30				1,188	gy. Oz. For	SE.	2	SW.	1½	L. B. T.
2707	Aug. 27	2.21 p. m	41 24 00	65 48 00				1,099	br. Oz. For	WSW.	3	SW. by W.	1½	L. B. T.
2708	Aug. 28	7.09 a. m	40 07 00	67 49 00				980	br. Oz	SW. by W.	4	W.	1	L. B. T.
2709	Aug. 28	9.55 a. m	40 07 00	67 54 00				866	br. M	WSW.	2	WNW.	¾	L. B. T.
2710	Aug. 28	2.45 p. m	40 06 00	68 01 30				984	gn. M	SSW.	3			L. B. T.
2711	Sept. 16	3.40 p. m	38 59 00	70 07 00				1,544	Glob. Oz	SE.	4	W.	1½	L. B. T.
2712	Sept. 17	5.49 a. m	38 20 00	70 05 30				1,867	br. Oz	Calm.	0	W.	1½	L. B. T.
2713	Sept. 17	11.20 a. m	38 20 00	70 08 30				1,859	br. Oz	Calm.	0	W.	1½	L. B. T.
2714	Sept. 17	4.58 p. m	38 22 00	70 17 30				1,825	br. Oz	WSW.	1	SW.	1½	L. B. T.
2715	Sept. 18	5.33 a. m	38 29 30	70 54 30				1,753	br. Oz	WSW.	2	WNW.	1½	L. B. T.
2716	Sept. 18	11.04 a. m	38 29 30	70 57 00				1,631	br. Oz. For	NW.	2	NW.	1½	L. B. T.
2717	Sept. 18	3.54 p. m	38 24 00	71 13 00				1,615	br. Oz	NE.	3	NW.	1	L. B. T.
2718	Sept. 19	5.38 a. m	38 24 00	71 52 00				1,569	br. Oz	E.	4	NNW.	2	L. B. T.
2719	Sept. 19	11.13 a. m	38 29 00	71 58 00				1,536	gy. Oz	ESE.	3	NW.	1½	L. B. T.
2720	Sept. 19	3.54 p. m	38 36 30	72 12 00				1,509	gy. Oz	S.	2	NE. by N.	2	L. B. T.
2721	Sept. 20	6.02 a. m	38 56 00	72 11 30				813	gy. Oz	W. by N.	4	NW.	1	L. B. T.
2722	Sept. 20	9.33 a. m	39 13 00	72 01 00				594	gn. M	N. by W.	6	WSW.	3	L. B. T.
2723	Oct. 23	5.42 a. m	36 47 00	73 09 30				1,685	gy. Oz. For	N. by W.	2	WSW. ¾ W.	1	L. B. T.
2724	Oct. 23	12.02 p. m	36 47 00	73 25 00				1,641	gy. Oz. For	NNW.	2	SW.	2	L. B. T.
2725	Oct. 24	5.54 a. m	36 34 00	73 48 00				1,374	gy. Oz. For	NE.	5	W.	1½	L. B. T.
2726	Oct. 24	11.10 a. m	36 34 00	73 54 30				1,253	gy. Oz	NE.	4	W. by S.	1	L. B. T.
2727	Oct. 24	4.09 p. m	36 35 00	74 03 30				1,239	gy. Oz	ENE.	4	W.	1	L. B. T.
2728	Oct. 25	5.45 a. m	36 30 00	74 33 00				859	gy. Oz	NE. by E.	3	NW. ½ N.	1	L. B. T.
2729	Oct. 25	9.10 a. m	36 36 00	74 32 00				679	dk. gn. M	ENE.	2	NNE.	1	L. B. T.
2730	Oct. 25	12.28 p. m	36 42 00	74 30 00				727	gn. M. For	E.	2	N.	¾	L. B. T.
2731	Oct. 25	4.12 p. m	36 45 00	74 28 00				781	gy. Oz	Calm.	0	N. by E.	1	L. B. T.
2732	Oct. 26	6.09 a. m	37 27 00	73 33 00				1,152	dk. gn. M	SE.	1	WSW.	1½	L. B. T.
2733	Oct. 26	10.19 a. m	37 26 00	73 43 00				941	gn. M	SE.	2	SW. by W.	2	L. B. T.
2734	Oct. 26	1.52 p. m	37 23 00	73 53 00				841	sft. gn. M	SE.	2	WSW.	1½	L. B. T.
2735	Oct. 26	4.55 p. m	37 23 00	74 02 00				811	sft. gn. M	SE.	2	SW.	1½	L. B. T.

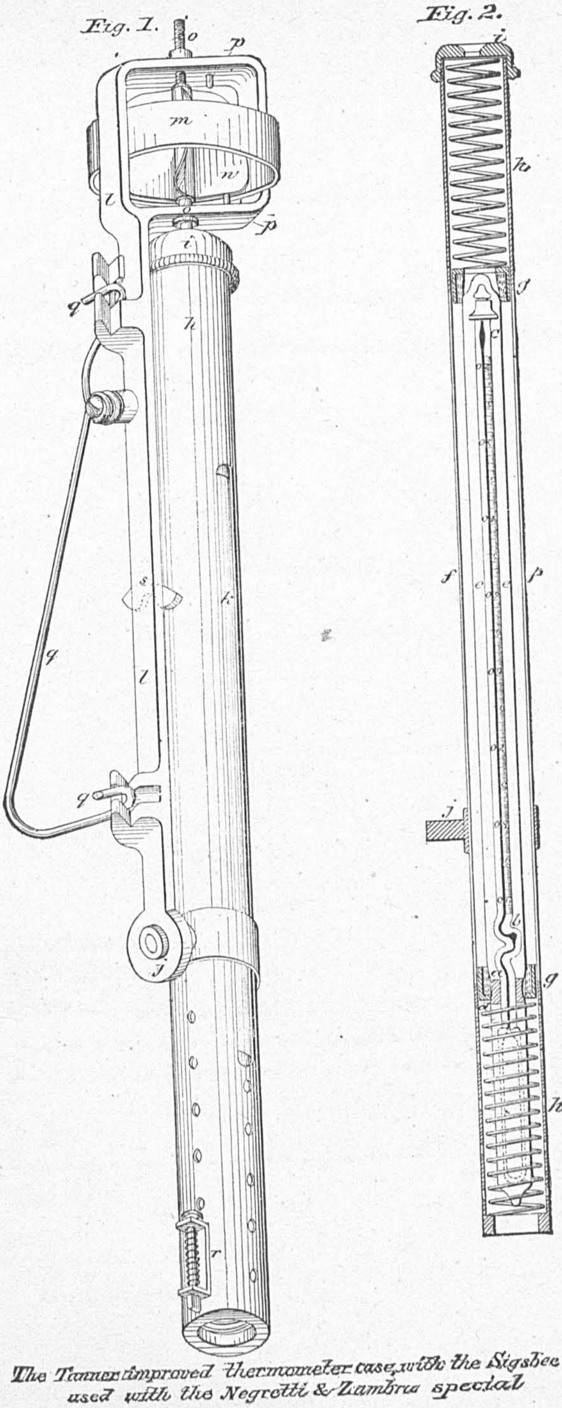

Plan of Reported Position
of Hope Bank.
+ Albatross' Soundings 1885.
○ " " 1886.
○— Sch. Marguerite 1885.
Hope Bank
42.00 N.
41.00
64.00 W.
63.00 W.



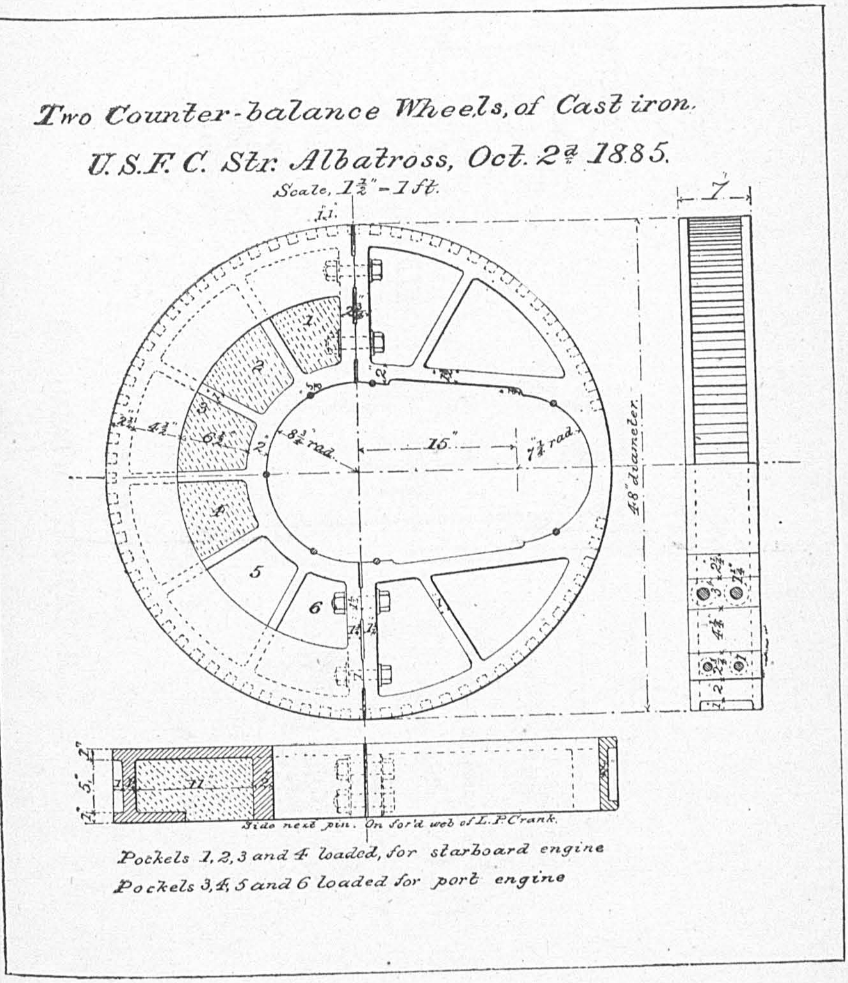
THE TANNER SOUNDING MACHINE MOUNTED IN THE STEAM CUTTER.



IMPROVEMENT IN DEEP-SEA SOUNDING MACHINE.



The Tanner improved thermometer case, with the Sigsbee clamp, used with the Negretti & Zambra special deep-sea thermometer.



COUNTER-BALANCE WHEELS.

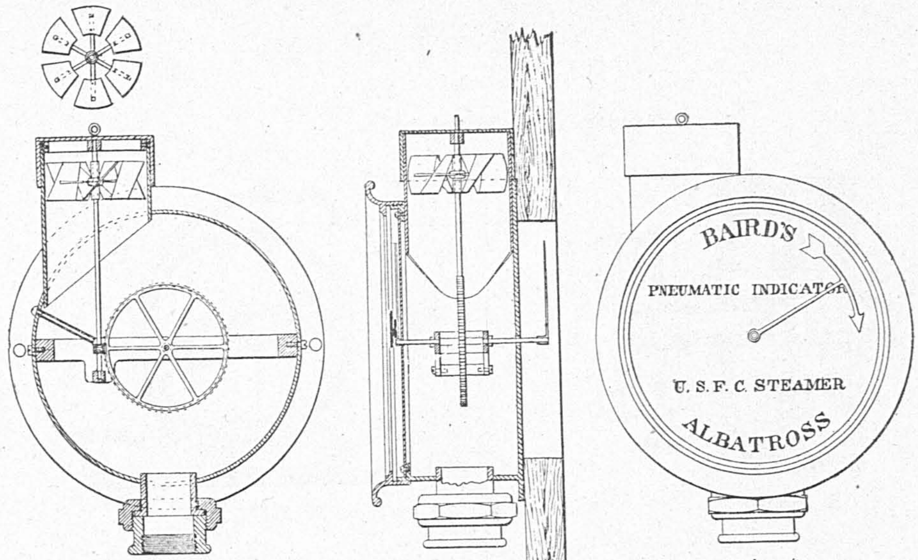


Fig. 1. *Fig. 2.* *Fig. 3.*

BAIRD'S

PNEUMATIC INDICATOR.

The Blower for the Pneumatic Indicator.

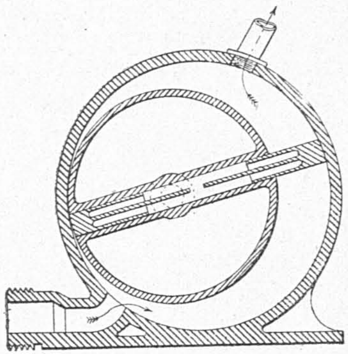


Fig. 4.

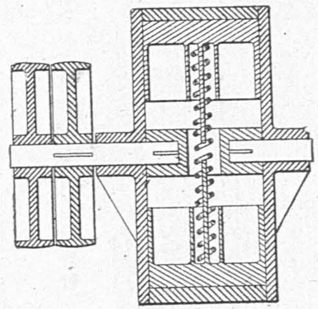


Fig. 5.

Fig. 1.

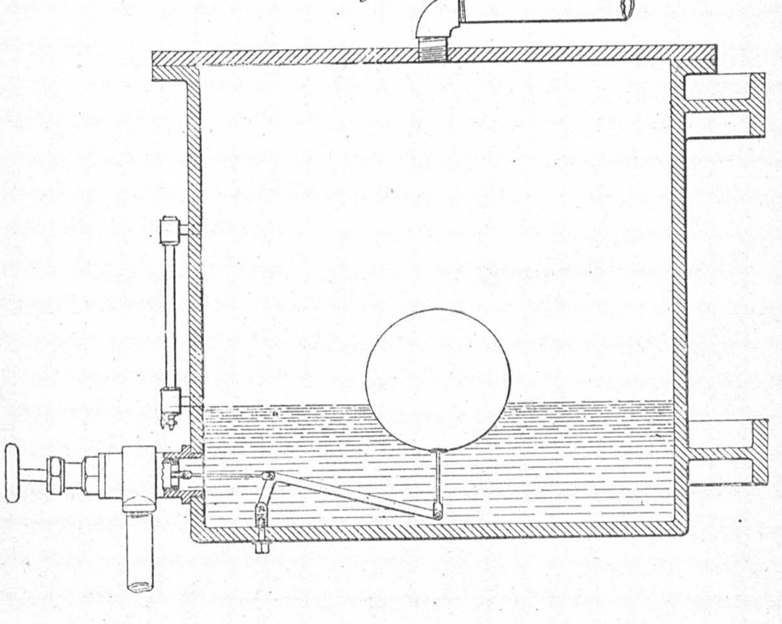
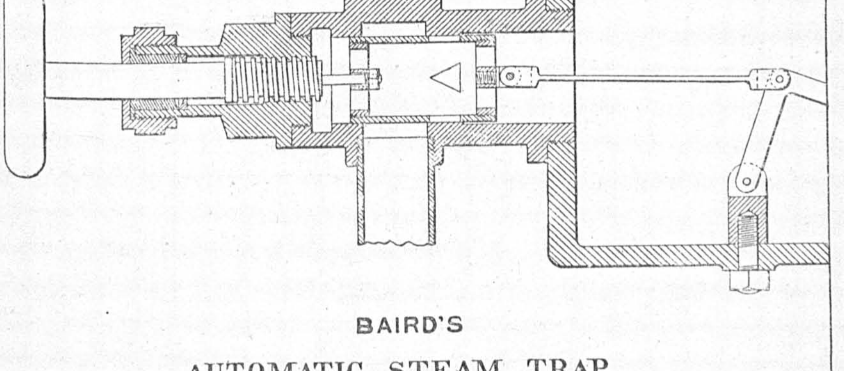
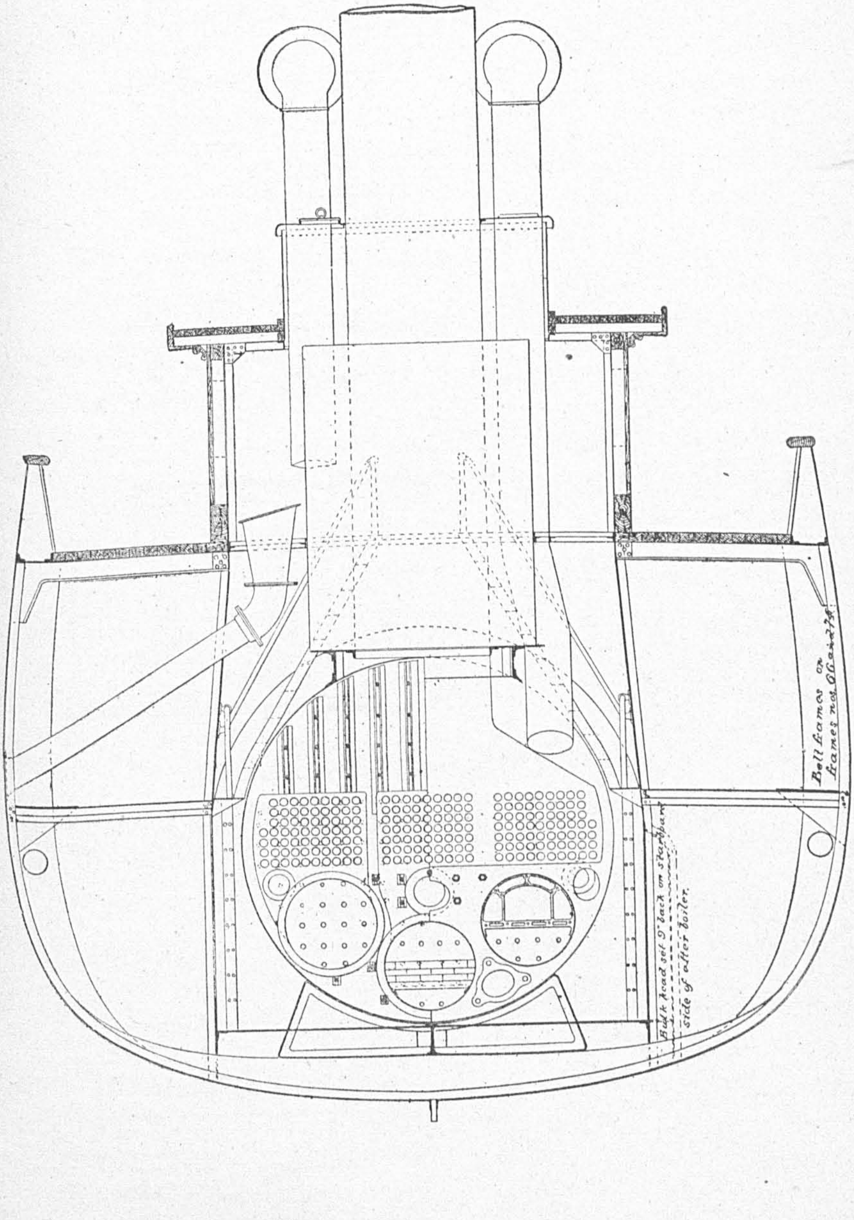


Fig. 2.

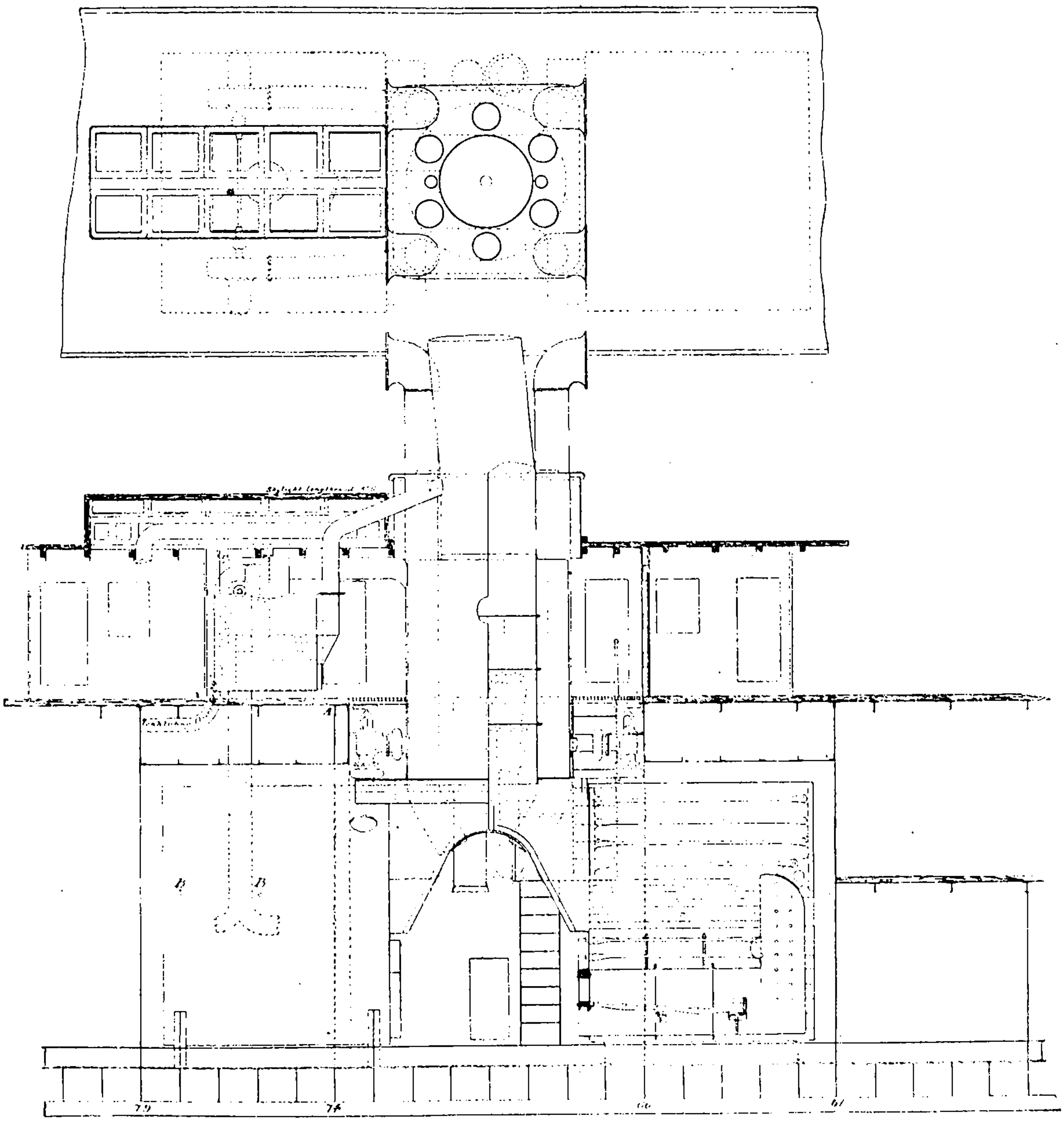


BAIRD'S

AUTOMATIC STEAM TRAP.



BOILERS FOR THE STEAMER ALBATROSS.



BOILERS FOR THE STEAMER ALBATROSS.

INDEX.

[NOTE.—The references are to page-figures in brackets.]

VIII.—REPORT OF OPERATIONS OF THE U. S. FISH COMMISSION STEAMER FISH HAWK FOR THE YEAR ENDING DECEMBER 31, 1886.

BY MATE JAMES A. SMITH, U. S. N., COMMANDING.

The following is a general report of the operations of this vessel for the year 1886:

On January 1 the vessel was moored to the wharf at the U. S. Fish Commission Station at Wood's Holl, Mass. The crew and some of the hatching equipment of the vessel were utilized in the codfish hatching work then being conducted at that station. This continued until February 14, when the vessel proceeded to New Bedford, Mass., to procure coal and stores, returning to the station at Wood's Holl on February 16. The next few days were spent in building a live-fish car, and otherwise preparing for a trip to the cod fishing-grounds in Ipswich Bay, for the purpose of procuring spawn for propagating purposes. On February 21 left station at Wood's Holl and proceeded down Vineyard Sound, bound for Gloucester, Mass., arriving there at 8 a. m. the next day.

On February 24 got under way from Gloucester Harbor, steamed to Ipswich Bay, and in that vicinity boarded several fishing vessels in search of codfish spawn, but did not succeed in procuring any, and proceeded to harbor of Portsmouth, N. H. Came to anchor in the roadstead at 4 p. m.

On February 25 got under way at 5 a. m., steamed out towards the Isles of Shoals, boarded several fishing vessels, and succeeded in procuring about 8,000,000 of codfish eggs. Then proceeded to Portsmouth Harbor and came to anchor off New Castle. Shipped 4,000,000 cod eggs from Portsmouth, N. H., to Wood's Holl Station. A severe gale of wind from SSE. shifted to NW., in which some slight damage was done to vessel by two schooners fouling while at anchor. Steam-launch of the vessel was also sunk, and at times there was great danger of the vessel dragging on the rocks, which was happily averted. Weather moderating on the 27th, at 3 p. m. slipped starboard and port chains, steamed up the river, and arrived at Kittery navy-yard, where the vessel was made fast to the wharf and remained until the gale was over.

On March 3, at 3 p. m., steamed down the river and picked up the buoy; unshipped anchors and chains, which were both secured. Swept for steam-launch and made a rigid search for her all next day, but without success.

From March 4 to 23 the vessel was engaged in making trips to the fishing-grounds whenever the weather would permit. Boarded all fishing vessels for the purpose of procuring codfish spawn, and shipped it to station at Wood's Holl, Mass.

On March 24 got under way from navy-yard at Portsmouth, N. H., and proceeded to Boston, Mass.; arrived and made fast to wharf at navy-yard at 4 p. m. Vessel remained there until April 10 awaiting orders, during which time repairs were made to the upper work that had been damaged by the collision with the schooners during the gale of February 27.

On April 12, at 4 p. m., unmoored ship from wharf and steamed down the harbor, bound to Wood's Holl, Mass., arriving at Fish Commission wharf on the 14th.

On April 16, at 10 a. m., cast off from wharf and proceeded down the Vineyard Sound, bound to New York. At 5.30 p. m. put into Newport, R. I., on account of fog. Got under way next day and proceeded to Brooklyn; made fast to wharf at navy-yard, Brooklyn, at 6.45 April 18. The vessel remained there awaiting orders until the 21st.

On April 22 proceeded down East River to sea, bound to Havre de Grace, Md. Arrived at Battery Station at 4 p. m. on April 24, and began to fit up hatching apparatus for the season's shad work.

On April 26, at 4 p. m., left Battery Station, steamed over to North East River and anchored at a point midway between Red Bank and Carpenter's Point, adjacent to the fishing-shores and gillers. Sent out spawn-takers daily to the fishing-shores and gillers, which duty was carried on until May 1, when orders were received to discontinue work at this point and proceed to the Delaware River. At 6 p. m. went to Battery Station and transferred all shad spawn and eggs in process of hatching to superintendent of station.

On May 3 steamed up to Havre de Grace; coaled ship at Hiller's coal wharf. At 1 p. m. cast off from wharf, steamed down the river, landed Assistant Commissioner Ferguson at Battery Station, then proceeded down Chesapeake Bay, bound to the Delaware River; arrived and came to anchor off Gloucester City, N. J., at 12.30 p. m., May 5.

From May 6 to June 19 vessel was stationed in the vicinity of Gloucester City, N. J.; crew were employed in gathering shad spawn from the different fishing-grounds on the river. The depositing and transferring of shad fry was continued until the close of the season; a detailed report of which has been printed in Fish Commission Bulletin, 1886, page 289.

On June 10, at 3.30 p. m., proceeded to Cooper's Point, Camden, N. J. Arrangements were made to haul the vessel out on Tilton's marine railway, repairs being needed to the sheathing and the ship's rudder. On June 15 the vessel was hauled out, repairs were made, and vessel was launched on the 17th. On June 19 took on board 50 tons of coal from coal wharf at Port Richmond. Returned to Gloucester City, N. J.

On June 21, at 5.30 a. m., proceeded down the Delaware River, bound to Washington, D. C.; arrived at and made fast to wharf at navy-yard at 1 p. m., June 24.

From June 25 to July 9 the vessel was at navy-yard, Washington, D. C., awaiting instructions, in the mean time making some necessary repairs to main boiler and repairing dredging-machine and scows to be towed to Saint Jerome Station, Maryland.

On July 10, at 5.15 a. m., got under way from navy-yard, Washington, D. C., with dredging-machine and two dump-scows in tow, and proceeded down the Potomac River, bound to Saint Jerome Station, arriving there next day at 6.30 p. m., and delivered them to superintendent of station.

On July 12, at 1.10 p. m., proceeded up the bay, bound to Battery Station, arriving there at 10 a. m. next day; took on board a lot of machinery for transportation to Saint Jerome Station.

On July 14, at 10.40 a. m., left Battery Station with two steam-launches in tow and proceeded down the bay, bound to Saint Jerome Station, arriving there on the 16th at 2 p. m. Delivered machinery and launches to superintendent of station; vessel remained at station until August 3. Crew were employed while there in working on dredging-machines and scows and rendering assistance to the superintendent of the station in dredging the channel. During the stay of the vessel at this place the command of the vessel was turned over to Mate James A. Smith, U. S. Navy. W. J. Maxwell, U. S. Navy, was detached and ordered to duty on the U. S. Fish Commission steamer Albatross.

On August 3 received orders from Assistant Commissioner T. B. Ferguson to tow dredging-machine, two dumping-scows, and one steam-launch to Battery Station, Havre de Grace, Md.

On August 4, at 2 p. m., got under way and proceeded up the bay with tow and arrived at Battery Station at 6 p. m. next day, and delivered the dredging-machine and scows and steam-launch to superintendent of Battery Station, and vessel remained at station until August 20. Crew were employed in dredging-machine and scows in digging out the channel leading into the station. On that date received orders to proceed to Saint Jerome Station and drive a well for the use of the station.

On August 21, at 10 a. m., got under way with well-driving equipment on board, bound to Saint Jerome Station. Arrived there next day and made fast to the Fish Commission wharf. Crew were employed until August 27 in driving well pipes, when orders were received to discontinue work at this place and proceed to Wood's Holl, Mass.

On August 28 took on board well-driving apparatus and seven men for transportation to Wood's Holl Station. At noon steamed out of creek and proceeded down Chesapeake Bay and came to anchor in Hampton Roads at 10.30 p. m.

On August 29, at 9 a. m., got under way and proceeded out to sea. Visited Winter-Quarter Shoal, Five-Fathom Bank, and Sandy Hook Light-Ship and consulted with the keepers in regard to the temperature observations for the United States Fish Commission. Arrived at Newport, R. I., and came to anchor at 10 p. m., having been instructed to stop there and convey the Commissioner to Wood's Holl, Mass. On September 2, Commissioner Spencer F. Baird came on board. At noon steamed out of the harbor, bound to Wood's Holl; arriving at station at 5.45 p. m., where vessel remained awaiting instructions until September 12.

On September 13 took on board steam windlass left at the station by the schooner Grampus. Received orders to proceed to Providence, R. I., to have it fitted in vessel by American Ship Windlass Company; also to tow steamer Halcyon to Bristol, R. I., for repairs.

On September 14, at 7 a. m., cast off from wharf at station, steamed out of the harbor with steamer Halcyon in tow. At 3.30 p. m. dropped steamer at Herreshoff's Works at Bristol, R. I.; then continued to Providence, R. I., arriving there at 5.30 p. m. The vessel remained here until September 26, having steam windlass fitted.

On September 27, at 3.30 p. m., proceeded to Wood's Holl, Mass., having put into Newport over night on account of fog. Vessel remained at Wood's Holl awaiting instructions until October 23, during which time the crew were variously employed about the station, discharging coal from schooner, etc.

On October 23 received orders to sail for Battery Station, touching at New York and Saint Jerome Station en route. Took on board some articles for transportation to both stations; also took launch Cygnet in tow as far as New York.

On October 24, at 6.30 a. m., cast off and steamed out of harbor with launch Cynget in tow, bound to New York. Arrived there and made fast to wharf at navy-yard, Brooklyn, at 8 a. m. next day. While there, received paymaster's stores from navy-yard.

On October 26, at 7 a. m., steamed down East River and proceeded outside of entrance to New York Bay; made several hauls of the trawl in the vicinity of Sandy Hook Light-Ship for the purpose of ascertaining if any of the English sole could be found which were deposited in that locality some years ago. Did not succeed in finding any. Weather looking threatening, came to anchor in the Horse Shoe, and were detained by bad weather until November 1. Got under way at 7 a. m. that morning and proceeded to sea, bound to Battery Station, touching at Saint Jerome Station en route, arriving there at 9 p. m. on November 2, where well-driving apparatus was landed.

On November 3, at 9 a. m., got under way with launch 55 in tow and proceeded up Chesapeake Bay, came to anchor off Spesutie Island at

9.30 p. m., and arrived at Battery Station next morning; anchored in the channel opposite the station, where vessel remained until November 20. The majority of the crew of the vessel were employed every day on work about the station, such work as the superintendent of the station required.

On November 22 received instructions from the Assistant Commissioner, T. B. Ferguson, to proceed with vessel to Saint Jerome Station; got under way and proceeded down Chesapeake Bay, arriving next day. Took on board several wheelbarrows, three flumes and gates to be transferred to Battery Station.

On November 25, at 4 a. m., got under way and proceeded up the bay to Battery Station, arriving there at 8.30 a. m. November 26. Got lighter alongside; put on board all articles received at Saint Jerome Station, which were transferred to superintendent of Battery Station. From then to December 3 the vessel remained at the station. The majority of the crew were employed in discharging coal for station, tending dredging-machine and scows, wheeling mud, and assisting carpenter's gang to build extension of hatching-house.

On December 3 weather very cold (temperature 18); drifting ice began to come down the channel. Not being able to get alongside of wharf at station, and to prevent vessel from being frozen in, at 4 p. m. got under way and steamed down off Spesutie Island and came to anchor. About 10 p. m. found ice making about the vessel. Got under way and steamed down the bay and anchored above Poole Island. Next morning proceeded to Baltimore, Md., and awaited instructions.

On December 24, at 9 a. m., went to Locust Point and took on board two small boilers and other machinery for transportation to Battery Station; then steamed up to Skinner's ship-yard and made fast to wharf.

On December 25 steamer Halcyon hauled alongside, and there were placed on board this vessel her cylinders, crank-shaft, and bed-plates, etc., to be taken to Battery Station as soon as the channel was open. From this time to December 31 ship remained at Skinner's ship-yard awaiting instructions.

WOOD'S HOLL, MASS., *September* 12, 1887.

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IX.—REPORT ON THE OPERATIONS OF THE STEAMER HALCYON FOR THE YEAR ENDING DECEMBER 31, 1886.

[Abstract.]

At the beginning of the year this steamer (formerly known as the Lookout) was at Battery Station in winter-quarters, where she remained undergoing repairs until March 28. The services of the crew were utilized for various items of shore duty when not required for painting, cleaning, and overhauling the steamer and its apparatus.

On March 28, with Assistant Commissioner Ferguson and William Hamlen on board, she proceeded to Baltimore, to take on articles for use in shad-hatching, and 12 men for spawn-takers. After returning, the vessel remained at the station until April 15, when she proceeded to Baltimore, and on the 17th to Saint Jerome Station, with the assistant commissioner on board. On April 18 and 19 pound-nets were visited between Smith's Point and the mouth of Wicomico River. Proceeding up the Rappahannock River as far as Layton, 100 stake shad gill-nets and 58 pound-nets were counted. The vessel, needing repairs, proceeded to Baltimore, and was hauled out on the railway April 22, from which time until the 26th the shaft was undergoing repair.

From April 27 to May 23 the Halcyon was engaged in gathering and hatching shad spawn and in depositing the fry. A detailed report of this work has been published in the Fish Commission Bulletin for 1886, page 295. The total number of eggs procured was 4,561,000, a number far in excess of any previous year.

From the close of the shad season to May 27 the vessel was used for making freight trips between Battery Station and Havre de Grace. On that date she went to Wilmington, Del., with William P. Sauerhoff on board, to investigate the shad fisheries of the Delaware. After some slight repairs had been made to the vessel the assistant commissioner came on board and inspected her, after which she proceeded to Baltimore, arriving on the 28th. From this point Major Ferguson accompanied the vessel to Battery Station.

In May the equipment was increased by the addition of a light naphtha-engine launch. On June 4 the steamer was loaded with lumber and stores for Saint Jerome. After discharging the cargo she steamed to Washington navy-yard, and arrived June 6. Two days later, accompanied by the assistant commissioner, she proceeded to Saint Jerome, and afterwards to Battery Station. On June 10 the vessel proceeded to Havre de Grace, where the assistant commissioner left the ship.

From June 11 to the end of the month the vessel was used for several freight trips.

On June 30 the steamer proceeded to Hawkins Hole, behind Hampton Roads, and fitted up apparatus for the artificial hatching of crabs. On July 3 several female crabs were secured, the spawn of which was placed in hatching-jars. On July 8 deposited crab spawn in Elizabeth River. On July 10 secured the spawn of five female crabs and placed it in hatching-jars. On July 12 overhauled pound-nets in the vicinity of Back River Light. The catch of mackerel was very small, one net securing 130 mackerel and 25 pompanos, none of which were found to be ripe.

On July 28 the command of the vessel was turned over to William Hamlen, James A. Smith having been transferred to the command of the steamer Fish Hawk.

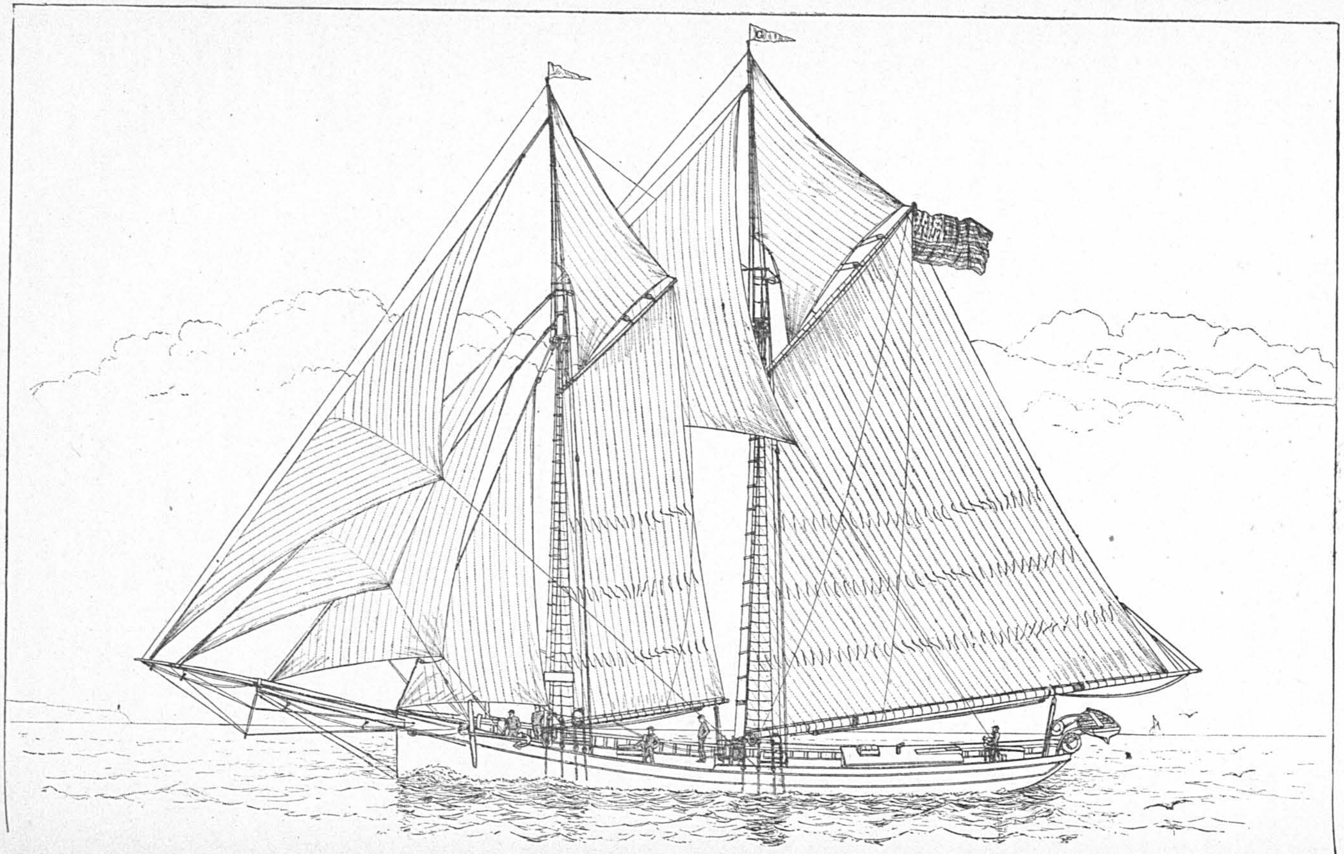
On July 30 the vessel left Baltimore, bound for Wood's Holl, reaching New York City on August 4 and Wood's Holl on August 9. On the 26th of August search was made in the neighborhood of Cox's Ledge for swordfish, without success. On August 26 proceeded, with the assistant commissioner on board, to Mattapoisett, Mass., to meet Gen. W. F. Smith. On the return trip to Wood's Holl, without any known cause, the shaft snapped and the propeller was lost. The vessel was then examined by a submarine diver, and the broken shaft removed. On September 7, with the assistance of a diver, the wheel was recovered from the channel. On September 14 the vessel was towed by the Fish Hawk to Bristol, R. I., and hauled up to Herreshoff Manufacturing Company's wharf. While waiting to be hauled out on the railway the crew was engaged in painting and cleaning. On October 1 the vessel was towed to Providence, R. I., and hauled out on the dry-dock for repairs.

On October 4 conveyed the assistant commissioner to Fall River. Later in the month trips were made to Newport, R. I.; New Bedford, Mass.; Noank, Conn.; and New London, Conn. At the latter place the assistant commissioner rejoined the vessel, and the compasses were tested by Lieutenants Waring and Scott, of the Albatross.

On October 25 the Halcyon, with the assistant commissioner on board, left Wood's Holl for Battery Station, where she arrived October 29 and remained until November 1. After this various trips were made to Baltimore, Saint Jerome, and Annapolis, at which latter point the assistant commissioner joined the ship.

In the early part of December the vessel got aground from dragging of anchor, and it was impossible to get afloat until the 9th, when the tugs Pacific and Champlin towed her to Havre de Grace. In endeavoring to get off, the condensing-pipe was broken. This necessitated going to Baltimore for repairs, where she remained alongside of Skinner & Son's railway wharf until the close of the year.

BALTIMORE, MD., *January* 4, 1887.



THE GRAMPUS.

X.—REPORT UPON THE OPERATIONS OF THE U. S. FISH COMMISSION SCHOONER GRAMPUS FROM JUNE 5, 1886, TO MARCH 15, 1887.

BY J. W. COLLINS.

The Grampus was completed by the contractor, and went into commission on the morning of June 5, 1886, previous to which time the officers (first mate, D. E. Collins; second mate, J. M. Coombs; machinist, G. W. Williams), three seamen, and the cook had joined her and were assisting in making preparations for sea. At 10.40 a. m. on the 5th of June, we left Noank, Conn., and arrived at Wood's Holl on the afternoon of June 6. On June 8 we sailed from Wood's Holl for Gloucester, where we arrived at 6.30 p. m. on the following day. Boats and fishing gear which had been made at Gloucester were taken on board at that place, and some necessary changes were made in the sails. On June 14, left Gloucester for Boston, arriving at the latter place the same afternoon. The chronometer and other instruments and apparatus were taken on board at Boston. Returned to Gloucester June 16; on June 22 sailed from Gloucester for Wood's Holl, reaching the latter place at 7 p. m. on the following day. The vessel remained at Wood's Holl until August 12, the time in the interim being spent in making the necessary preparations for a cruise.

On the morning of August 12 we left Wood's Holl on a cruise to the so-called "tilefish grounds," which lie along the northern edge of the Gulf Stream, in depths varying from 75 to 175 fathoms, between the meridians 70° and 73° west longitude.

After leaving Wood's Holl we went to Newport for bait, arriving at that place the same evening. A supply of menhaden bait was obtained on the 13th from fishing steamers off Wickford, and the next day a quantity of clam bait was purchased at Newport.

At 5.40 p. m., August 14, got under way at Newport and proceeded to sea. On the afternoon of August 15 three trawls were set in 96 fathoms, latitude 39° 59′ N., longitude 70° 15′ W.

From this time until and including August 21, trials were made every day, with the exception of August 17 (when it was too rough to fish), with hand-lines and trawl-lines in depths varying from 60 to 160 fathoms, at intervals of from 5 to 20 miles apart, until a position was reached, latitude 39° 20′, longitude 72° 04′ 15″, where the trawls were set for the last time during the cruise. The results of these trials for fish were very meager. A few common hake (*Phycis chuss*) and silver hake or whiting constituted the chief part of the catch.

On the morning of the 18th, at 5.30 o'clock, I noticed a large number of small horse-mackerel (*Orcynus thynnus*) alongside, running with the vessel. We immediately put out two bluefish troll-lines and caught 10 of the fish. Such of them as were not severely wounded we put into the well, but some of them soon died. We had one of them cooked and found it very palatable, the flavor resembling somewhat that of the common mackerel. These fish were of uniform size, and, approximately, about 18 to 22 inches in length. Although they seemed to bite readily at troll-hooks when first put out, it was not long before they refused to take them, and all subsequent attempts at capturing others on hooks proved unavailing. These fish exhibited a remarkable peculiarity, and one which I have not previously noticed in similar species. While the vessel would be lying to, drifting, they would remain around her, their presence being detected by an occasional flash of white, as they turned in the water several fathoms below the surface. But as soon as the vessel was under way and sailing through the water, they would rise near the surface and follow along on both sides, seemingly taking great delight in chasing her, their movements resembling those of the common porpoise or dolphin (*Delphinus delphis*); the chief difference being that the tunny exhibited no disposition to "play" under the bow as the dolphin does, but contented itself with keeping near each quarter of the vessel. It may be remarked here (though somewhat anticipating the rest of the report) that this school of fish remained alongside of the vessel for two or three days and nights, following her with unflagging vigilance, and with seemingly increasing numbers. For most of the time when the vessel was sailing, many hundreds of these fish could be seen on each side and astern, sometimes as far off as 200 fathoms, running down the slope of a wave. Several were struck with the harpoon, but our latest efforts to catch them on a trolling-line proved abortive. Mr. Newcomb saved the gills from some of the dead specimens, parasites having been observed on them.

The object of this cruise was mainly to ascertain if any tilefish (*Lopholatilus chamæleonticeps*) could be found on the grounds where this species had existed in such abundance prior to the great mortality which occurred to the same in the spring of 1882. No tilefish were taken on the grounds visited, and, so far as could be ascertained, by examination of the stomachs of the fishes caught, there was a decided scarcity of food suitable for the *Lopholatilus*.

The attempts to catch the tilefish having now continued for six days, and our researches having extended over a stretch of ground nearly 120 miles in length, where the *Lopholatilus* was formerly known to occur in large numbers, it seemed to me undesirable to pursue the investigation to greater length, more particularly as our bait at this time was quite unfit to use. I think it is now safe to say that the large number of sets made with the trawl-line on this occasion, together with the trials made with hand-lines, clearly demonstrate the fact, that, if the tilefish has not become absolutely extinct in this region, it is certainly so rare that the chances of obtaining it are limited. It is possible that in other regions it may be found, or it may be taken, at some later period, in the locality visited by us, but at the present time it seems very doubtful if it exists along the northern borders of the Gulf Stream to the eastward of 73° west longitude.

It is a somewhat remarkable fact, and one seemingly worthy of notice in this place, that, with comparatively few exceptions, the fish caught had no food in their stomachs. Hake are notably voracious, and it is reasonable to infer that if food is abundant in this region there would be as good evidence of it as when, in former years, the tilefish were found gorged with crustacea, etc.

We left the tilefish ground on the evening of August 21. It was calm and foggy during the a. m. of the 23d. At this time we were off to the southward of Block Island, about 15 or 16 miles distant. Here we saw several schools of porpoises running in various directions. In the afternoon the wind increased from a light air to a moderate breeze from the southward. We headed in for Martha's Vineyard. The fog cleared for awhile, and Block Island was seen. A number of hagdons (*Puffinus major*) were seen on the previous day off Long Island, and others were noticed to-day. At 12.40 p. m. I succeeded in wounding one, which we secured alive, and brought it on board.

We arrived at Wood's Holl on the afternoon of August 24. As soon as the collections which had been obtained on the cruise were landed, together with such portion of the vessel's equipment as was not required for work in the immediate future, preparations were made for a trip to the eastern fishing banks in quest of halibut, which, it was hoped, might be brought into port alive in the vessel's well, thus affording an opportunity for experimentation in the artificial propagation of this important and valuable species.

The large iron steam windlass and the engine and boiler used on the Grampus having been found too heavy for her, the accumulation of weight forward making it difficult to keep the vessel in trim, and causing her to pitch and send heavily in a seaway, the Commissioner determined to have them removed and to substitute instead a wooden windlass, such as is ordinarily used on fishing schooners.

The boiler and steam pump were landed at Wood's Holl, and, arrangements having been made with Gloucester parties to make the necessary changes in the windlass, we left Wood's Holl on September 1, and on the following day reached Gloucester.

On the afternoon of the 2d the vessel was hauled out on the railway to have the condensing pipes taken off her bottom, and at high water the next day she was launched again and moored to the railway pier, where she lay nearly all the time while the new windlass was being made and put on.

The construction of the vessel's deck-frame forward of the foremast, though well adapted to the requirements of a steam windlass such as had first been put on her, was not so well suited for the support of a wooden windlass. It was necessary to put in a new deck-beam for the windlass bitts to rest on and fasten to, and also a new pawl-bitt. To do this the deck had to be taken up forward of the foremast, running back of the forecastle in places to break joints. New decking had also to be put in where the hole for the smoke-stack of the steam boiler had previously been cut.

The change in the windlass rendered necessary a change in the stowage of the chain cables. These had been stowed under the forecastle floor, forward of the foremast, but under the new arrangement they were placed in boxes built on the after side of the forecastle bulkhead. This carried the weight of the chains—some 6,500 pounds—about 10 feet farther aft, nearer the center of the vessel; a desirable change, since she would thus be less liable to pitch and send heavily in a seaway.

September 6 the iron windlass was landed, and the next day it was shipped to Wood's Holl. Some delay was experienced in getting the new windlass completed, owing to the fact that several days' work were expended on the stick of timber first selected before it was found to be unfit for the purpose. The work of the carpenters, calkers, painters, and plumbers was finally completed at noon of September 22.

Previous to this, at 9.40 a. m., September 15, Mr. James Carswell, expert fish-culturist, reported on board, he having been ordered on from Washington by the Commissioner to join the vessel for this cruise to the banks. Mr. R. L. Newcomb joined the vessel on the 21st to make the cruise in the capacity of naturalist.

It was thought that there was at least a probability of finding halibut with ripe eggs, which might be taken from the fish and impregnated on the ground. In this event it would be necessary to have some device to keep the eggs in, so that they would retain their vitality and go on in their development until the vessel reached Wood's Holl. Mr. Carswell devised and had made two wooden frames, each capable of holding two of Chester's glass hatching-jars. These frames were so arranged that they would float in the well, thus supporting the nearly immersed jars, their motion being regulated by upright wooden guides nailed to the side of the well, though they were not prevented from oscillating with the movement of the vessel in a seaway. Ten of the Chester jars were sent on from Wood's Holl and taken on board; also pans, dippers, etc., that were required for fish-cultural purposes were purchased.

The season was at hand when heavy weather might be expected on the banks. The foretopmast was therefore sent down and the rigging set up taut before sailing. September 21 we took on board six tons of ice, and the next day, just before sailing, the water tanks were refilled.

As previously mentioned, the repairs on the vessel were completed at noon of September 22, and at 4.20 p. m. of the same day we sailed on a cruise to the banks under the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Wood's Holl, Mass., September 19, 1886.

SIR: As soon as the repairs and alterations incident upon the completion of the new windlass are completed, you will proceed with the Grampus to some one of the eastern banks for the purpose of determining the possibility of bringing in cod and halibut living, in connection with the artificial propagation of these species. If you can add some living haddock or pollock or others of the gadoid fish, you will do so. Should you find any of these fish spawning, it may be well to try the experiment of stripping them on the spot, and bringing the eggs in under such conditions as you and Mr. Carswell may decide upon. The locality to be visited, and the period of your stay, are left to your discretion. The vessel will return to Wood's Holl with its cargo.

You will also obtain as good a series of the sea-fowl of the coast as you can secure, procuring as many duplicates as possible. A few specimens of each species should be brought in the flesh, to be forwarded to the National Museum.

Very respectfully,

SPENCER F. BAIRD,
Commissioner.

Capt. J. W. COLLINS,
Commanding Schooner Grampus, Gloucester.

We passed Eastern Point at 5.25 p. m., and at 11 a. m., September 23, we spoke the schooner Carrie E. Payson, of Portland, one of the gill-net herring fishing fleet, off Wood Island, Maine. From her we obtained 8 barrels of fresh herring, which we immediately iced for bait.

As soon as the bait was on board (at 11.50 a. m.) we filled away on port tack, close hauled by the wind, heading SE. ½ S., with a moderate breeze E. The latter part of the day was rainy, with light to moderate wind from E. to SE., varied by calms; weather threatening in appearance.

We went into Portland Harbor for the night, in company with a large fleet of fishing and coasting vessels, and at 8 p. m. anchored off Fort Preble.

At 6 a. m., September 24, we got under way, and ran out of Portland with a light breeze, which varied from W. to WNW. The wind gradually increased during the p. m., and at midnight blew a moderate gale from NNE.

The wind blew stiff during the first part of the 25th, decreasing to moderate breeze at meridian.

At 12.15 p. m. sounded in 49 fathoms, hard bottom; latitude 43° 05′ N., longitude 65° 15′ W.; put out 5 hand-lines and caught 17 cod, mostly of small size, and one haddock. These were all put into the well, but 9 of the cod soon died. Their ovaries and spermaries were very small, apparently not at all advanced in development. Nothing was found in the stomachs of the fish except a few pieces of partially digested squid. Squid were seen in the water following up the fishing gear, but none could be caught on a squid-jig that was put out.

We lay to fishing one and three-quarters hours, and got under way at 2 p. m. Just previous to this a school of porpoises came alongside the vessel for a brief time, but did not "play" under the bow when we kept off.

At 2.45 p. m. spoke schooner Garibaldi,* at anchor in 82 fathoms (approximately), trawling for cod. Her captain came on board. He reported having good fishing, and said he caught a halibut that day, which was then on deck among the recently caught codfish.

Mr. Carswell and I went on board the Garibaldi to ascertain what stage of development the reproductive organs of the halibut were in. It was a male, of about 25 pounds' weight. Its spermaries, though not ripe, were in an advanced condition of development.

In the evening, as we lay becalmed, about 200 squid were caught, the majority of which were put into the well alive. They seemed to live without any difficulty, but in a few days they nearly all made their escape through the holes in the bottom of the well, which are large enough to allow a somewhat bulkier animal to pass through if he chance to hit directly in a hole.

There was a moderate breeze from SSW. on the morning of the 26th, but the wind rapidly augmented in force, blowing a stiff breeze at 3 p. m. and somewhat stronger after that, veering westerly. We ran to the eastward, along the southern border of La Have Bank, making occasional soundings and trials for fish with hand-lines, but without success. Only one of the cod put into the well yesterday remained alive to-day.

At 11 a. m., while we were lying to trying for fish, the schooner Mabel Leighton, of Gloucester, spoke us, and her captain, Charles H. Greenwood, told me that he had a large squid on board which he would give to the Fish Commission. I immediately went on board the Leighton and got the squid. It proved to be the "broad-finned squid" (*Sthenoteuthis megaptera* Verrill), of which no perfect specimen had heretofore been obtained in the United States. The only perfect specimen previously known was picked up on Cape Sable, Nova Scotia, and it is now in the Provincial Museum at Halifax.

Captain Greenwood said the squid had been caught on the previous evening by John F. McDonald, one of his crew, who was fishing with an ordinary squid-jig. The locality where it was taken was off the southern part of La Have Bank, near the meridian of 64° W., and in 82 fathoms of water.

* This vessel was destroyed by fire October 2, near Murder Island, off the west coast of Nova Scotia.

I made the following measurements of the specimen before putting it into alcohol:

	Ft.	In.
Total length (tip of tail to end of longest tentacles)	4	4
Length of longest tentacle, each	2	7
Length of body, exclusive of head	1	7½
Length of upper pair of arms, each	0	8¾
Length of pair of arms next the upper ones, each	0	11
Circumference of body, 2 inches behind the junction with the head	1	3

At noon we filled away and ran to the eastward, and at 1.45 p. m. spoke the schooner M. A. Baston, of Gloucester, a halibut catcher, at anchor in 220 fathoms. Her position, as given by Captain Thompson, was latitude 42° 47′ N., longitude 63° 12′ W.

After lowering and furling the mainsail and laying the vessel to under foresail and jib, I went on board the Baston, accompanied by Mr. Carswell.

On her deck were 12 to 15 halibut that had just been caught. The fish were opened and examined to ascertain the condition of the reproductive organs. These were found in various stages of development; some well advanced, but none fully ripe.

Captain Thompson reported halibut fairly plentiful, and thought we might get enough for our purposes if the weather proved favorable. I therefore concluded to lay to by his vessel and wait for an opportunity to fish.

The next day, September 27, was very unfavorable for our purpose, since we had to set under sail, or make a "flying set," as it is often called. It was raining in the early morning, with a fresh WSW. wind. At 7 a. m. the wind hauled to WNW.; the rain ceased, and was immediately followed by a thick fog, which continued till 11 a. m. Between meridian and 4 p. m. the wind hauled from NW. to NE., increasing in force, with a rough choppy sea and current setting southwesterly with considerable strength.

The crew of the Baston went out about noon to haul their lines, which had been previously set. Two of her dories, each having two men, were brought so far to leeward by the change of wind that they could not reach their vessel. Indeed, the men could make little or no headway against the wind, sea, and current. Anticipating a difficulty of this kind, I had run down to leeward of the Baston, and a lookout was kept for any of her boats that might be in that direction. The men in the first dory we picked up were considerably exhausted. They had been unable to find their gear, and had been rowing continuously for several hours; they could then scarcely hold their position against the sea and wind. After getting the boats on board we beat up to windward of the Baston, hove to, hoisted out her dories at 5.30 p. m., and her men returned to their vessel.

On the 28th the wind was moderate from ENE. in the morning, veering southeasterly in the evening. We set two codfish trawls, each having 1,000 hooks, in from 90 to 110 fathoms, pebbly bottom; position (5013), lat. 42° 50′ N.; long. 63° 20′ W. This set was made chiefly to procure cod, hake, etc., to use as bait for catching halibut. There was also some probability of catching a few of the latter species. The total catch was as follows: 60 cod; 81 hake (*P. chuss*); 37 cusk (*Brosmius americanus*); 5 pollock (*Pollachius carbonarius*); 2 small skates; a few shells, chiefly whelks (*Buccinum*), and some sea anemones. The following birds were collected during the day: 6 common hagdons (*Puffinus major*), 1 black or sooty hagdon (*P. fuliginosus*), 7 jægers, and 1 young herring gull.

It was rainy during the first part of the 29th, and too rough and blowy to fish. In the afternoon the weather improved slightly, but the wind blew fresh all day, with occasional squalls and a choppy sea. Shortly before noon the M. A. Baston's dories went out to haul the trawls which had been set the previous evening. Soon after, we passed close to the Baston's stern, and Captain Thompson hailed, saying he had ordered his men to give us any small halibut they should get which appeared to be strong enough to live in our well. Being very desirous of ascertaining whether or not halibut that were caught in deep water (200 to 350 fathoms) could be kept alive in a vessel's well, I deemed it best to accept this generous offer. Accordingly, during the afternoon we got 4 halibut from the Baston's dories, the fish varying in size from 18 to about 50 pounds weight each. They appeared tolerably lively when put into the well, but they soon died, the last of them being dead on the following morning. The birds collected on the 29th were as follows: 3 hagdons, 1 noddy (*Fulmarus glacialis*), and 4 jægers.

September 30 was moderate, with fog in the latter part of the day. We set two halibut trawls to the westward of the M. A. Baston, beginning to set about 2 miles from her in 321 fathoms. The strong current carried the gear nearly 2 miles to the westward before it fetched up. The depth at the northwestern end of the trawls, where they brought up, was 266 fathoms. After the gear was set, and while we were waiting for the time to arrive when it should be hauled (between 10 and 11.30 a. m.), several birds were shot, as follows: 8 hags (*P. major*), 4 kittiwake gulls, and 6 jægers.

Much difficulty was experienced in hauling the trawls, owing to the great tenacity of the sticky clay bottom, into which the anchors were buried. The difficulty was increased by one of the trawls of the schooner Gertie May, of Portland, going across one of ours, the result being that our gear parted and we lost nearly half of one trawl.*

We caught 19 halibut, 14 of which were put into the well alive. Eleven of the live halibut were caught on a portion of trawl that we

* The Gertie May had just arrived at this place, from the eastward, and had set under sail some time after our gear was out. The current swept one of her trawls afoul of one of ours—a result that could not be anticipated, since no indications of the strong westerly tide were apparent to one on a vessel under sail, more particularly as there was little surface current.

hauled on board the vessel. These fish were lifted over the rail with the greatest care. They were immediately unhooked and put into the well. Every possible effort was made to guard against the fish receiving any injury. The conditions under which they were captured were certainly as favorable as they well could be, in deep water, to insure their living in the well; and it was felt that this would be an unusually good test of the feasibility of keeping alive halibut that had been caught in such a depth. The result, however, was contrary to our hopes; for, although we did not complete hauling the lines until 8.25 p. m., six of the fish were dead next morning, and all died in less than 36 hours after they were put into the well. This, though somewhat discouraging, was not entirely unexpected. It is self-evident that a fish taken from a depth of 200 to 300 or more fathoms must undergo a very great change in pressure and temperature in reaching the surface. Such changes are generally fatal to many species of fish, and might be particularly so to a halibut caught on a trawl-line, and which must necessarily be half drowned and so much exhausted that it would not have sufficient vitality left to endure what otherwise it could successfully withstand. It will, therefore, in my opinion, be difficult, if not absolutely impracticable, to get halibut from deep water which will have sufficient vitality to live until they can be carried into port alive.

This being the case, the attempt to obtain a supply of gravid halibut will be attended with many difficulties, and it is probable that success will be attained only after considerable experimentation. The fact that the breeding grounds of the halibut are usually, so far as known, in depths ranging from 150 to 400 fathoms, and that the species is now seldom found in any considerable abundance in shallow water, complicates somewhat the solution of the problem.

It is, however, a fact that halibut may yet be caught in a few localities on the west coast of Newfoundland, and along the shores of southern Labrador, in very shallow water—5 to 15 fathoms—during midsummer. There is a strong probability that fish caught there would live for a considerable period in a vessel's well. The conditions of the water in the well would be the same as those in which they were living, and their capture on such shallow grounds would not seriously affect their vitality. It is, of course, not yet certain what effect the change of temperature might have on them before they arrived at Wood's Holl, for undoubtedly there would be a considerable difference in this respect between the littoral waters of Newfoundland and Labrador and those of southern Massachusetts.

We had hoped that some fish might be found with ripe eggs and milt, so that the eggs could be impregnated and some experiments made with them on board. But, although the majority of the halibut we caught, as well as those seen on board of the M. A. Baston, were apparently well advanced, none of them were ripe. This fact, together with our total lack of success in keeping any halibut alive, made me determine to fish in shallower water the remainder of the trip, since it was possible halibut might be caught there, and if we got any they would have a much better chance to live.

The halibut we dressed had almost nothing in their stomachs. In eight that were carefully examined we found only a few bones, and pieces of fish that were wholly or partially digested. Among these I recognized the head of a "hand-saw" fish (*Alepidosaurus ferox*).

The wind blew a gale on the 1st and 2d of October, backing from SSE. on the morning of the 1st to WNW. and W. on the evening of the same day, blowing a smart gale, with a heavy cross-sea. On the 2d the wind veered from W. to NW. and blew a moderate gale, with a sharp choppy sea and heavy tide rips. This being the first gale of any magnitude to which the Grampus had been exposed, her movements were noted with care and interest. During the heaviest of the gale she lay to very steadily under a double-reefed foresail. She lay close to the wind, varied little more than one-half point in the direction of her head, and made comparatively little leeway. Later, the forestaysail, with the bonnet out, was set with the reefed foresail. Under this sail she lay steady and was very weatherly. In all cases she was remarkably dry on deck, apparently had less pitching and sending motion than the average vessel of her size, but her sideways motion was rather quick, as it generally is in small craft, though she lurched far less heavily than the ordinary fishing schooner.

The weather was fine on October 3, with a moderate breeze, varying from NW. to WSW. Between 7 and 8 a. m. two halibut trawls were set in 80 fathoms, latitude 42° 52′ N., longitude 63° 04′ W. No halibut were caught. The total catch was as follows: 18 cusk, 8 hake, 9 cod, 7 spiny-backed dogfish (*Squalus*), 1 blue shark, and 2 small skates.

This result, with our previous experience, led me to think it nearly useless to remain longer on La Have Bank. I therefore determined to work to the westward and be governed by circumstances as to whether we tried on Brown's Bank or Seal Island Ground, or both. Scattering halibut are sometimes found on these fishing grounds, and to visit them offered the greatest probability of success in seeking fish in moderate depths.

Fine weather prevailed on October 4, with moderate to fresh breeze, varying from SSW. to W. ½ S. At 11.40 a. m. sounded on Roseway Bank, in 39 fathoms, sand and pinkish colored bryozoa; latitude 43° 19′ N., longitude 64° 40′ W. Hove to under mainsail and foresail and put out hand-lines. Cod were abundant. In about one and one-half hours we caught 50 or 60 cod and 4 haddock, all of which were immediately put into the well. Those fish which had swallowed the hook in biting generally had their gills wounded in getting the hook out. They died in a short time, and about one-third of the whole number had to be removed from the well. These were dressed and iced for halibut bait. Almost nothing was found in the stomachs of the fish that were dressed, and their generative organs were very little developed.

Shortly after meridian the supply of drinking water was reported nearly exhausted, and I determined to go into Shelburne to fill water. Accordingly, at 1.30 p. m., we got under way, and at 5.30 p. m. anchored in Shelburne, above Sand Point. Upon going on shore I learned that it would be necessary to go to the village of Shelburne, 5 miles further up the harbor, to fill water or to get other necessary supplies.

It was calm and foggy on the morning of the 5th, but at 9.30 a. m. the fog cleared off and a light northerly breeze sprang up. We immediately got under way to beat up to Shelburne village, but the wind was exceeding light, with occasional periods of calm, so that it was 1.30 p. m. when we anchored near the wharves.

At 10.50 a. m., on October 6, we got under way to go down the harbor to Sand Point. While beating down the harbor we met the schooner Laura Sayward, of Gloucester, whose captain spoke us and reported his vessel in distress, she being short of water, provisions, and light. In compliance with his request, I gave him 2 gallons of kerosene to supply his immediate need of a light, and also gave him a letter of introduction to F. O. Blanchard, esq., a citizen of Shelburne, who is a law partner of Mr. White, the American consul, asking him to use his good offices to assist Captain Rose in obtaining a supply of provisions, enough at least to enable him to reach home.* I have since learned that the officials at Shelburne refused to permit the captain of the Laura Sayward to buy provisions.

At 1.30 a. m., October 7, we got under way and left Shelburne. After getting out of the harbor a course was steered for Cape Sable, and it was my intention to set halibut trawls near the cape if the weather proved favorable, since reports had reached Shelburne that a considerable number of halibut had been taken in that locality a few days previously. But when we had reached the locality where it was proposed to fish, the wind blew fresh, and there was a sharp choppy sea running. It was too rough and windy to set trawls, therefore we ran into Pubnico for a harbor.

On the morning of October 8 we left Pubnico, but the wind was light, and we did not reach any fishing ground until the forenoon was well advanced. At 10.20 a. m. halibut trawls were set in 22 fathoms between Bon Portage and Seal Island, latitude 43° 25′ N., longitude 65° 51′ W. Nothing was caught except 9 spiny-backed dogfish and 17 skates, also a few sea lemons. Hand-lines were also put out, both before and after the trawls were hauled, but only dogfish were caught.

At 1.35 p. m. put out boat dredge, the vessel at this time drifting in a calm with the flood tide setting toward the Mud Islands. A small

* The letter was as follows: "This will introduce to you Capt. Medeo Rose, of the schooner Laura Sayward, of Gloucester. He has just arrived here in a distressed condition, being short of provisions and water, owing to heavy adverse winds on his passage home from the banks.

"I know, of course, that he has the right to fill water, and I trust you will have no difficulty in securing for him sufficient supplies to obviate any risk of actual distress on his passage home from here."

quantity of marine life, chiefly shells and crustacea, was obtained from the dredge, but when it was put out again, at 2.10 p. m., the net bag was torn open by the rocky bottom and nothing was taken.

On October 9 two sets were made with halibut trawls on the Seal Island Ground, the localities being as follows: First position, latitude 43° 04′ N., longitude 65° 54′ 15″ W.; depth, 50 fathoms; pebbly bottom. Second position, latitude 43° 06′ N., longitude 66° 07′ W.; depth, 40 fathoms; bottom, sand and gravel.

Catch: First set, 39 dogfish, 10 skates, 15 cusk, and a few sea lemons. Second set, 21 dogfish, 9 skates, and 5 cusk; also 2 small sponges attached to stones and gravel.

At 4.40 p. m. the dories came alongside from hauling the trawls for the second time and were hoisted on deck. At the same time the boat dredge was put out, with 125 fathoms of towing line payed out on it. Nothing was got in the dredge.

The absolute failure which we had met with in the various attempts made to catch halibut in moderate depths convinced me that there was small probability of catching any fish of this species in shallow water, unless we were prepared to continue our cruise several weeks longer, for a new supply of bait would have to be obtained to start with, the small quantity of herring we had left on board being then unfit for use. Our ice was also exhausted. Besides this, little success could be expected so long as dogfish remained so abundant as we had found them on Seal Island Ground, and we certainly could not expect to find them less plentiful on Brown's Bank. For, not only will these pests of the fisherman gather round a trawl when it is being set, to eat the bait off or get caught, but their presence on a fishing ground is usually sufficient cause for other species to leave, at least to such an extent that other fish are seldom plentiful.

Not considering it desirable to refit, I determined to return to Wood's Holl. Therefore, as soon as the dredge was hauled, shortly after 5 p. m., October 9, we filled away, and after a pleasant passage—most of the time with unfavorable winds—we arrived at Wood's Holl at 9.45 a. m. on the 12th of October.

No noteworthy incident occurred on the passage home, with the single exception of falling in with three fishing schooners while beating down the eastern side of Cape Cod, on the afternoon of the 11th. As they were going in the same direction that we were bound, and all of them some distance to the windward of us (from 4 to 10 miles), it was a fair opportunity, at least a better one than had previously been afforded, of making a comparative test of the sailing qualities of the Grampus when beating dead to windward. Two of the vessels, a large two-masted clipper schooner of about 150 tons register, and the other a craft of perhaps 70 tons, we outsailed very much, beating them, at the most moderate estimate, two knots an hour, dead to windward. The third vessel is reputed to be one of the best sailers in the fishing fleet. At 2 p. m., when we were 4 or 5 miles to windward of Cape Cod

Highland Light, she was just fairly in sight to windward, the upper part of her sails showing above water, and with glasses I made her out to be a fishing vessel, beating to the southward. We gained on her rapidly, and at 9.30 p. m. we weathered her, when just off the bell buoy north of the Pollock Rip. The distance made to windward by our vessel did not exceed 28 miles, and though the other vessel towed a seine boat, the rate at which we outsailed her proved that the Grampus can at least make a fair rate of speed in windward work.

Since the latter was designed for an improved type of fishing vessel (more particularly, however, to obtain greater safety), it is gratifying to find that she is more than commonly swift, since speed is an important and necessary qualification in a schooner which must be employed in most branches of our fisheries.

The collections and fish obtained on the trip were landed on the 12th and 13th. Reference is made to the following notes, prepared by Mr. R. L. Newcomb, for a statement of ornithological collections:

List of ornithological specimens obtained by the U. S. Fish Commission schooner Grampus, from September 26 to October 9, 1886, inclusive.

[By Raymond L. Newcomb.]

Date.	Where obtained.	Remarks.
	S. pomatorhinus.	
1886. Sept. 28	La Have Ridges	Fourteen specimens were obtained. One of them was in the dark plumage.
29	La Have	Two specimens secured.
Oct. 9	Southeast of Nova Scotia, lat. 43.03 N., long. 65.55 W.	Twenty-one specimens were obtained. Four of these were in the dark plumage.
	Stercorarius buffonii.	
9	Southeast of Nova Scotia, lat. 43.03 N., long. 65.55 W.	Two specimens were obtained.
	Puffinus major.	
Sept. 28	La Have Ridges	Six specimens procured.
29	La Have Bank	Two specimens procured.
30	do	Six specimens procured.
	P. fuliginosus.	
28	La Have Ridges	One specimen was obtained.
	L. argentatus, var. *Smithsonianus.*	
28	La Have Ridges	One immature gray specimen was taken.
	Rissa tridactyla.	
30	La Have Bank	One adult and three immature specimens were obtained.
Oct. 3	La Have Ridges	One adult specimen procured.
9	Southeast of Nova Scotia, lat. 43.03 N., long. 65.55 W.	Three specimens were obtained.
	Sterna macroura.	
Sept. 26	La Have Bank	One specimen obtained.
	O. leucorrhoa.	
28	La Have Ridges	Seven specimens obtained.
	Sula bassana.	
Oct. 9	Southeast of Nova Scotia, lat. 43.03 N., long. 65.55 W.	Two immature specimens were obtained.
	M. velvetina.	
4	Passage from La Have to Roseway Bank	One immature specimen was obtained.

Mr. James Carswell, who had been on board during the trip to the banks as an expert fish-culturist, left the vessel October 13, after her arrival at Wood's Holl.

On October 14 we got under way and made a short run to Gay Head to observe the movements of the fishing vessels, which were then engaged in hook-and-line mackerel fishing about the western end of Vineyard Sound. Mr. Thomas Lee, naturalist of the steamer Albatross, accompanied us, and he and Mr. Newcomb interested themselves in collecting and making observations on the sea birds that were seen near Gay Head. We returned to Wood's Holl in the latter part of the afternoon.

Having made preparations for a new cruise, we left Wood's Holl on October 17, for Gloucester, where we arrived on the following day. A supply of hand-line gear for catching pollock was obtained.

It was necessary for me to remain on shore to attend to business matters connected with the vessel and to do other necessary work for the Commission. Therefore, on October 20, I ordered the first mate, Mr. D. E. Collins, to take command of the vessel, and when the weather permitted to proceed to the fishing grounds in Massachusetts Bay and to the eastward of Cape Ann and procure as many live cod, pollock, etc., as practicable.

On October 24 the anchor of the vessel fouled a telegraph cable on Jeffrey's Ledge, when a kedge anchor, a 30-pound Chester anchor, and 5 fathoms of manila-hawser were lost. The Grampus not being provided with a suitable anchor and hawser for riding on the fishing grounds, I hired an anchor and 100 fathoms of 7-inch manila-cable from Daniel Allen and Son, of Gloucester, which served for the remainder of the trip.

The weather was very rough and fish difficult to obtain on the inshore grounds during the latter part of October and the beginning of November. A good deal of difficulty was experienced also in endeavoring to keep the fish alive in the well. Cod caught in moderate depths appeared to live fairly well, but a very large percentage of the pollock died.

On November 13, having determined to take the fish that had been caught to Wood's Holl, I resumed command of the vessel. On November 15 we sailed from Gloucester and reached Wood's Holl on the following day. The total of live fish landed was as follows: 195 cod, 25 pollock, 17 haddock, 7 hake, 6 squirrel hake, and 2 cusk. After our arrival at Wood's Holl, Mr. Newcomb, whose term of service had expired, left the vessel.

At 7 a. m., November 20, we sailed from Wood's Holl, and at 2.10 a. m. on the following day arrived at Gloucester, when I immediately transferred the command of the vessel to the first mate, who remained in charge until December 8. During this period (from November 21 to December 8) he exerted himself, as opportunity offered, to procure all live fish which it was possible to obtain. Through all this time the weather was exceedingly stormy and unfavorable, and cod were unusually scarce on the inshore grounds.

On December 8 I resumed command of the vessel, and on that afternoon we sailed for Wood's Holl, where we arrived at 3.50 p. m. on the following day, and began to transfer the live fish from the well to the cars. On this occasion 297 fish were landed, of which 287 were cod.

On December 11, at the request of Lieut. J. H. Weber, of the U. S. Signal Service, we made an attempt to sweep the submarine cable between Martha's Vineyard and Naushon Island, which had been broken a short time previously by the anchor of a coasting vessel. Lieutenant Weber and his assistant were on board, but the attempt to grapple the cable was a failure. The apparatus we had on board being too frail for the purpose was broken by being caught on the rocky bottom. After the failure of our attempt to get the cable, Lieutenant Weber and his assistant were, at their request, landed on Naushon Island.

Mr. Atkins informed me that cod had been found in abundance about No Man's Land, as also on the grounds westward of Vineyard Sound; and suggested that it would be desirable to make an attempt to fish in that locality. Accordingly, a supply of bait was obtained, and a pilot familiar with those grounds was engaged to go with us. He belonged at Vineyard Haven, and after landing Lieutenant Weber and his companion we went over to the Haven, so that the pilot might get such clothing as he needed for the trip.

On the following morning we started for the fishing-grounds above mentioned, with a gentle but increasing wind from ENE. to NE. By the time, however, that we had reached the Vineyard light-ship the wind was blowing fresh, and the weather was threatening. We therefore steered for Newport, where we arrived at 3.40 p. m.

At 6.40 a. m., December 14, we got under way at Newport for the fishing-grounds, the wind at that time being NW. by W., and the weather generally clear. Outside of the harbor there was a heavy ground-swell, and the wind rapidly increased in force. Before we reached the grounds the wind was too heavy to carry on fishing operations; we therefore steered for Wood's Holl, where we arrived at 2.30 p. m.

On December 15 we left Wood's Holl, and at 2.10 p. m. tried for cod on Brown's Reef, to the westward of Vineyard Sound light-ship. No fish of any kind were taken. The weather was then very threatening, with indications of the near approach of a snow-storm. For this reason we went back to Vineyard Sound, and, at midnight, anchored off Falmouth.

A heavy storm prevailed on December 16, but the weather cleared on the following day. We left Falmouth at 6.25 a. m., December 17, and at 9.20 p. m. on the same day arrived at Gloucester.

After transferring the command of the vessel to the first mate, I went on shore. The Grampus continued to fish off Cape Ann and in Ipswich Bay whenever it was possible to get out of the harbor. The weather was exceedingly boisterous and cold, with frequent storms, so that there was very little time when fishing could be prosecuted. I would say, as illustrative of the extreme inclemency of the weather in which it was necessary to fish, that on January 19 the Grampus visited the fishing-ground and the crew hauled her gear when the temperature ranged from 2° to 7° below zero Fahrenheit. The vapor was unusually dense, and seamen Collins and Campbell were considerably frost-bitten. Besides this adverse condition of the weather, cod were unusually scarce for this season of the year, and few were taken under the most favorable circumstances.

On January 23 I resumed command, and we left Gloucester for Wood's Holl. At 6.55 a. m. on the same day we anchored off Cape Cod, north of Chatham, the wind being to the southward and weather foggy. The wind blew a gale from SSW. to NW. on the 24th, and on the following day we reached Wood's Holl at 3.38 p. m., and immediately commenced to transfer the live fish from the vessel's well to the tanks beneath the hatching house. On that evening and the following day 219 fish were landed.

On January 27 we took on board 2,000,000 young cod and sailed from Wood's Holl for Gloucester, getting under way at 10.10 a. m. On the morning of the 28th the young fish were put overboard in 29 fathoms of water, Race Point bearing east 3½ miles distant, temperature of air and water each 33½° Fahrenheit. Shortly after noon we arrived in Gloucester, and I then transferred the command of the vessel to First Mate Collins, after which I went on shore to engage in other duties which demanded my attention. At this time the vessel had become very foul, and on January 31 she was hauled out on the marine railway to be cleaned, after which, on the following day, she was launched.

It had now been decided by the Commissioner to try the experiment of taking eggs from the cod on the fishing-grounds, by sending one or more men on board of the fishing-vessels to collect them. Accordingly, Mr. G. H. Tolbert, expert spawn-taker, who had been ordered to join the Grampus, reported on board the vessel on February 3. From that date until the close of the season's work eggs were obtained on every occasion when it was possible to get them, and were shipped to Wood's Holl either by express or in charge of Mr. Tolbert. I went on the vessel only on one occasion after Mr. Tolbert joined her, which was on February 18, when about one million eggs were obtained from the fishing-schooners off Eastern Point, Gloucester.

On February 25, in compliance with orders received from the Commissioner, I left Gloucester for Washington for a stay of several months, the Grampus being left in command of the first mate.

The work of collecting cod eggs was continued whenever opportunity offered until March 14, at which date 5,000,000 eggs were taken. It may be explained that the statistics of fish landed at Wood's Holl do not by any means represent the number taken. In many cases, as for example in that of the pollock, not 5 per cent. of the catch lived until the vessel reached Wood's Holl, and the mortality to the other species was always large.

The Commissioner having decided to send the Grampus on a cruise to the southern mackerel grounds, orders were issued for the work of collecting fish eggs to be brought to a close and for the necessary preparations to be made to fit the vessel for the intended cruise.

In concluding this report upon the operations of the Grampus it is only just to say that the officers and men under my command have exerted themselves to the utmost to carry on successfully the work in which they were engaged. Hardships and dangers, which might intimidate and discourage men unaccustomed to the vicissitudes and perils of a fisherman's life, were cheerfully borne, and no opportunity was lost to obtain fish and fish eggs. Mr. D. E. Collins, while in command, not only exhibited much energy in carrying out his instructions, but he also exercised care and prudence in the mangement of the vessel, which met with no damage whatever during the winter, though she was constantly going in an out of crowded harbors, often at night and not unfrequently in thick weather.

Record of dredgings and trawlings of the U. S. Fish Commission schooner Grampus on the trip to the tilefish ground.

Serial number.	Date.	Hour.	Position.						Temperatures.		Depth.
			Lat. N.			Long. W.			Air.	Surface.	
	1880.		°	′	″	°	′	″	°	°	*Fathoms.*
5001	Aug. 15		39	59	00	70	15	00	63	70¼	*96
5002	Aug. 16		39	54	00	70	16	30	74	74	118
5003	Aug. 18		39	59	00	70	17	15	74	73	110
5004	Aug. 18		39	56	00	70	40	30	69½	76	108
5005	Aug. 19	a. m	40	01	00	71	05	00	70½	75	104
5006	Aug. 19	m	39	58	00	71	13	15	67	75	155
5007	Aug. 20	7.45 a. m.	39	40	00	71	39	15	70	72	100
5008	Aug. 20	2.45 p. m.	39	34	00	71	50	30	70¼	72	105
5009	Aug. 21	6 a. m.	39	27	00	71	58	45	71¼	73½	135
5010	Aug. 21	10.10 a. m.	39	20	00	72	04	15	71	72	145
5011	Aug. 21	3.30 p. m.	39	33	00	72	05	45			60
5012	Aug. 21	5.30 p. m.	39	38	15	72	07	45			45

* For sounding we used an ordinary cotton fishing line, marked at every ten *fathoms*, and a deep-sea sounding lead of 16 pounds weight. The depths given in this report may not on this account be deemed absolutely accurate, but will not in any case vary more than a few fathoms—probably in no case more than 2 or 3 fathoms—from the actual depth. The reason for using this method of sounding was threefold: (1) It was not deemed essentially necessary to make accurate hydrographic records; (2) our "Tanner machine" was not ready to use, and consequently we had to depend on the ordinary line, and (3) it would be impracticable to use the machine, even if it was ready, in carrying on rapid fishing operations, since the time required to make soundings, etc., would very much interfere with the time absolutely required for fishing, and where the vessel has only a small force, as in the present case, it was necessary to adopt the most feasible method.

Serial number.	Character of bottom.	Direction of wind.	Instrument used.	Fish caught.
5001		NNE	3 trawls, 3,000 hooks	16 silver hake (Merlucius), 2 skate (Raia).
5002	White sand with black specks.	SSE	2 trawls, 2,100 hooks	11 silver, 3 common hake (Phycis chuss), 3 slime eels, crustacea, etc.
5003	Muddy	NE	do	2 silver, 1 common hake, 1 spear-fish (Tetrapturus albidus, Poey).
5004	do	NE	1 trawl, 1,050 hooks*	6 silver hake.
5005	Fine sandy	ENE	Trawl	115 common, 11 silver hake.
5006	Muddy	ENE	do	5 common, 33 silver hake.
5007	do		do	18 common, 4 silver hake, 3 squid.
5008	do		do	3 common, 2 silver hake.
5009	do		do	18 common, 17 silver hake.
5010	do		do	5 common, 3 silver hake, 1 slime eel.
5011	Sandy and muddy		Dredge	Mud, gray sand, shells, shrimp
5012			do	Shells.

* In setting the trawl on this occasion we adopted a new method. Two dories were put out, each taking one tub of trawl, the ends of which were bent together; the dories then pulled in opposite directions at right angles to the wind, and when the line was out they let go the anchors and each boat lay by its respective end. This method of setting has a considerable advantage over the ordinary method, when quick work is desirable, for as soon as the men weigh the anchors and get them on board, there is comparatively little strain on the trawl, and it can be quickly and easily pulled in.

WASHINGTON, D. C., *May* 25, 1887.

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[NOTE.—The references are to page-figures in brackets.]

XI.—REPORT OF OPERATIONS AT COLD SPRING HARBOR, NEW YORK, DURING THE SEASON OF 1886.

BY FRED MATHER.

On the work done in hatching and distributing different fishes for the U. S. Fish Commission at this station, which is leased by the New York Fish Commission, I have the honor to report as follows:

CODFISH (GADUS MORRHUA).

Early in January, 1886, we had 2,000,000 eggs in the house, which were doing well, and we could see the embryos in the eggs, but on January 11 a cold northeast wind blew through our old hatchery and froze our salt water solid, and they all perished.

WHITEFISH (COREGONUS CLUPEIFORMIS).

On January 7, 1886, we received from Mr. Frank N. Clark, of the Northville, Mich., station, one case containing 1,000,000 whitefish eggs in excellent order, the temperature of the eggs in the packages being 44° Fahr. They were placed in seven McDonald hatching-jars and did very well, the loss being 57,700, or a little less than 6 per cent., and 942,300 were distributed to the different waters on Long Island, but thus far I am unable to report any captures of these fish in waters on the island previously stocked. They are deep, cold lakes containing plenty of small crustaceans and other food, but, no net-fishing being allowed in them, it is possible that the fish may be there, but have not been seen.

LAKE TROUT (SALVELINUS NAMAYCUSH).

On December 19, 1885, we received from F. N. Clark, Northville, Mich., one case containing 150,000 eggs in good condition. Of these we lost 12,000 eggs and fry before distributing, and tried the experiment of keeping 50,000 until they should be a year old or so, in our rearing ponds. They were put in the upper ponds in the coolest water, and before September the last one had died. My experience with this fish is that they are the most delicate of all the *Salmonidæ* which I have had any experience with, and that they require colder water than any others of the family that I know. Our fish took food very well until some time in June, when the temperature in their ponds reached 60° Fahr., and then they began to die. A table of distribution will be found at the close of the report.

ATLANTIC OR PENOBSCOT SALMON (SALMO SALAR).

This was the third season of operations with this fish at this station, and the fourth in which plantings in the Hudson River were made. The first plant in the Hudson was from Roslyn, Long Island, in 1882, when I obtained the use of the stream and hatchery building of Mr. Thomas Clapham of that place, to carry on the work; and the captures of salmon in the Hudson River during the summer of 1886, which will be detailed further on, have given us great encouragement.

On January 7, 1886, we received from Mr. Charles G. Atkins, in charge of the salmon station at Bucksport, Me, three cases containing 240,000 eggs, which were in excellent condition; and on the following day we received four cases, containing 260,000 eggs, which were also in good condition. The fry were placed in tributaries of the Hudson, Saint Lawrence, and Lake Ontario, the details of which are in the tables of distribution appended to this report.

In May, 1885, we made plantings of salmon in Paulinskill and the Pequest River, New Jersey, tributaries of the Delaware River, and the fry have been seen there, as is shown by the following letters from one of the fish commissioners of New Jersey:

"NEWTON, N. J., *November* 13, 1886.

"FRED MATHER, Esq.:

"DEAR SIR: Yours of the 8th ultimo is at hand, making inquiries about the salmon fry placed in the Pequest, Paulinskill, and Musconetcong rivers, they being tributaries of the Delaware. These salmon were placed in the streams about 20 miles from where they empty into the Delaware, and were found in the Paulinskill in September, 1885, in the small spring-runs near the main stream. In May of the present year I learned that some had been taken by a party while fishing for trout at a point about 5 miles below where they were placed the year before. The party that caught them at first thought they were rainbow trout, but on examination I learned they were young salmon, from 4½ to 6 inches long. They were taken with a common angle-worm bait, and seemed to be quite numerous at this point. I have seen them, during the early part of last September, in the same stream, and have no doubt that they have done equally well in the two other streams. There were, perhaps, about forty taken at this point, and nearly all of them were returned to the stream. I am satisfied, from this experience, that the planting of the fry in the headwaters of the tributaries, in natural trout water, is the best way to stock the

Delaware, and if the effort to do so succeeds, it must be done in this manner. Allow me to congratulate you on the success, so far, of this experiment.

"I am yours, etc.,

"F. M. WARD,

"*New Jersey Commissioner of Fisheries,*
in charge of Northern New Jersey."

Mr. Ward wrote again on the subject of salmon, as follows:

"NEWTON, N. J., *April* 29, 1887.

"FRED MATHER, Esq.:

"MY DEAR SIR: I wrote you, some months since, that in May and June of last year there were taken from the Paulinskill, in the headwaters of which you caused to be placed some of the salmon fry two years ago, what I supposed to be young salmon, from 5 to 6 inches long. For a few weeks past they have been taken in small numbers, at the same point, from 8 to 9 inches in length, but, on examination, I doubt their being young salmon, the sides having the bright red spots of our brook trout, and all the other marks of the oquassa or Dolly Varden trout, as described in recent reports by the U. S. Commission of Fisheries. Presuming that you might be interested in this unlooked-for development and may be able to account for it, I have been induced to write you in relation to it.

"Yours, etc.,

"F. M. WARD,

"*Commissioner of Fisheries for New Jersey.*"

To which I made the following reply:

"COLD SPRING HARBOR, N. Y., *May* 2, 1887.

"F. M. WARD, Esq.:

"MY DEAR SIR: I have yours in reference to some fish taken in Paulinskill, where we planted the salmon fry two years ago, and which were then from 5 to 6 inches long. You now say that for a few weeks past they have been taken in small numbers from 8 to 9 inches in length, but doubt their being young salmon because of the sides having little red spots like a brook trout. Now, the fact is that young salmon have these red spots during the first year or 'parr' stage, but they can easily be distinguished from the trout on account of the forked tail. The second year they assume the 'smolt' stage, and are then silvery, the red spots having gone never again to appear. But I should think that they would have gone farther down the river by this time; but your letter is a very valuable contribution to their life history, and I am exceedingly obliged to you for it, for I have not the slightest doubt that the red-spotted fish were young salmon which had not yet taken on the silvery coat. I should much like to have a specimen, if possible.

"Very truly, yours,

"FRED MATHER."

For information concerning the captures of adult salmon in the Hudson we are greatly indebted to Mr. A. N. Cheney, of Glens Falls, N. Y., a gentleman who is well known as an angling authority in this and other countries, and who has taken a great interest in the work of stocking the waters with fish. He writes me, under date of March 23, 1887, as follows:

"Last year twenty-four salmon were taken in the Hudson River at the places named:

Troy Dam	9
An island, below Troy	2
Stockport	2
Albany	2
Rhinebeck	2
Poughkeepsie	3
Yonkers	4
	24

"The New York Herald also reports some taken at Staten Island."

The largest salmon taken in the Hudson, of which we have any account, was caught at the State dam, at Troy, and weighed 14½ pounds. This fish was seen by Dr. H. P. Schuyler, of Troy, who has also taken a great interest in the stocking of the river, and who has said that he believes that the waters in the vicinity of the dam contain many salmon that are unable to get farther. In addition to the list of twenty-four salmon given by Mr. Cheney, I am able to add one which I saw in Fulton Market, which weighed about 10 pounds, and was captured by John Denyse, of Gravesend, in Gravesend Bay, some time in the latter part of May, 1886. Several gentlemen, among whom are Messrs. Cheney and Schuyler, before referred to, and Dr. Samuel B. Ward, of Albany, president of the Eastern New York Fish and Game Protective Association, have moved to induce the State legislature to make an appropriation for fishways, to be placed in the Troy and other dams, in order that the salmon may reach the breeding grounds. If they accomplish this, and the fish have proper protection, it is among the possibilities that we may yet take eggs from salmon which have been artificially hatched and planted in the Hudson, a feat which we might justly regard as one of the greatest triumphs in fish-culture.

LANDLOCKED OR SCHOODIC SALMON (SALMO SALAR *var.* SEBAGO).

On March 18, 1886, there was received from Mr. H. H. Buck, of Grand Lake Stream, one case containing 34,000 eggs in exceedingly good condition, only 76 being dead. After hatching, the fry were planted in Adirondack lakes by request of General R. U. Sherman, of the New York Fish Commission.

BROWN OR EUROPEAN TROUT (SALMO FARIO).

Three lots of brown-trout eggs were received from Germany. On March 1, 1886, one case came from the Deutscher Fischerei-Verein containing 64,000 eggs. These were in very bad condition, one-fourth had hatched in the package, and the remainder of the eggs were dead. It was evident that they had not been iced on the ship. On March 20 we received from the Fischerei-Verein a case containing 40,000 eggs which were in better condition, only 4,134 being dead. Ten thousand were sent to Mr. F. N. Clark, of Northville, Mich., and 3,000 to George A. Seagle, of Wytheville, Va. On April 16 we received from Herr Max von dem Borne, of Berneuchen, two cases containing 50,000 eggs, which were in very good order, about 500 being dead. Thirteen thousand were repacked and sent to Mr. Clark, at Northville, and 1,000 to James Nevin, superintendent of the Wisconsin Fish Commission at Madison.

SHAD (CLUPEA SAPIDISSIMA).

On April 26, 1886, we received from Central Station at Washington two cases containing 546,000 eggs, which were all dead on arrival. On April 29 we received from the same place five cases containing 1,250,000 eggs. These were not in good condition, and the loss in hatching was very great, but we succeeded in getting 100,000 good fry, which were planted in the Hudson, near Troy.

SMELTS (OSMERUS MORDAX).

We have succeeded in hatching large numbers of smelts, the parent fish being obtained on the south side of Long Island and brought here in cans. The glutinous nature of the eggs has rendered their hatching very difficult, but we have managed to bring out about 50 per cent. of the eggs taken, and in the spring of 1886 turned out over 2,000,000 fry in Cold Spring Harbor. There has been no smelt in the harbor for a number of years, but in the spring of 1887 a number were reported to have been taken in Oyster Bay, which connects with the harbor; and at the upper end of Cold Spring Harbor we have seen several male fish in the little streams where our plants have been made for the past two years, but no females were observed.

TOMCOD (MICROGADUS TOMCODUS).

These little fish, although very plentiful here, are more numerous than ever since our efforts in cultivating them. The eggs are free and heavy enough to hatch well in the McDonald jars. They are about one-seventeenth of an inch in diameter. A small Bar glass, 2¼ inches high, 1½ inches at the bottom and 2¼ inches at the top, inside measurements, holds 20,000 eggs when filled up to a height of about 2 inches. Two million two hundred and twenty-five thousand of these eggs were taken and placed in hatching-jars, and at about the time when the embryos in the eggs could be seen, a blizzard blew through our old building and froze them all.

LOBSTERS (HOMARUS AMERICANUS).

On May 29, 1886, I brought from the United States hatching station at Wood's Holl, Mass., 5,000 young lobsters which had been hatched there and also 50,000 lobster eggs. The eggs were all dead on arrival at the Cold Spring Harbor hatchery, but the young lobsters were in very good condition. They were placed in small aquariums and fed on soft clams (*Mya arenaria*), and did very well for a few days until they began to molt, when as soon as one little fellow cast his shell his brethren would devour him. I think that Prof. J. A. Ryder, who hatched these lobsters, told me they had molted twice before and that they were then between two and three weeks old. After losing perhaps two hundred of them I decided to plant them, and did so on June 5, six days after receiving them, off Rocky Point in Cold Spring Harbor. When planted the young were about five-sixteenths of an inch in length. There have been no lobsters in this harbor for a number of years, and in September, 1886, Capt. S. A. Walters and Capt. Bunce each caught young lobsters while working on their oyster-beds, which they informed me measured about an inch and a half in length, but I have been unable to secure specimens.

GENERAL REMARKS.

As before stated the grounds are leased by the New York Fish Commission, and much work was done for that commission which is not here reported. The codfish work mentioned was done at the expense of the State. The building used for a hatchery is an old mill nearly ready to tumble down and not worth repairing. A bill has been introduced into the New York legislature to appropriate $5,000 for the purpose of building a new hatchery, and at present writing (May, 1887) it has passed the assembly, and there is every reason to hope that it will become a law.*

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* Since the above was written, the following law has been passed (chapter 613, Laws of New York):

"An act to provide for the erection of a fish-hatchery at Cold Spring Harbor, and making an appropriation therefor. Passed June 18, 1887, three-fifths being present.

"The People of the State of New York, represented in the senate and assembly, do enact as follows:

"SECTION 1. There shall be appropriated from any funds in the treasury of the State, not otherwise appropriated, for a new hatchery building and improvement of grounds at the Cold Spring Harbor station of the commissioners of fisheries, $5,000, or so much thereof as shall be necessary, to be expended under the direction of the commissioners of fisheries on vouchers to be approved by the comptroller; but no money shall be paid out of the appropriation till a lease of the lands and water rights now occupied for such hatchery shall be executed to the State, rent free, from the owner, for such period as the same may be occupied as a public hatchery, which lease, when accepted by the commissioners, shall be filed in the office of the secretary of state."

Such a lease was given by the owner, Mr. John D. Jones, and the building is now (October 26, 1887) in process of erection. The contract requires its completion by January 1, 1888, which will be in time for the salmon work of that year. In the mean time a small building outside the grounds is being used for trout and other fishes.

In case we have a new building there will be no danger of such accidents by freezing as that referred to, and we shall be enabled to have our work all on one floor and to do much better than has been done, both in salt and in fresh water.

The following tables show the distribution of the various kinds of fish handled at this station during the season:

TABLE I.—*Distribution of whitefish from Cold Spring Harbor in* 1886.

Date.	Messenger.	Where planted.	Number.
Feb. 16	C. H. Walters	Large mill-pond near Riverhead, N. Y	500,000
Feb. 23	O. V. Rogers	Ronkonkoma Lake, Long Island	400,000
Mar. 12	O. V. Rogers	Saint John's Lake, Long Island	30,000
Apr. 3	O. V. Rogers	Saint John's Lake, Long Island	12,300
	Total		942,300

TABLE II.—*Distribution of lake trout from Cold Spring Harbor in April and May*, 1886.

Date.	At whose request.	Messenger.	Where planted.	Number.
Apr. 3	J. H. Perkins	O. V. Rogers	Riverhead, L. I	15,000
Apr. 9	H. Shoskinsky	Delivered	Breslau, L. I	5,000
Apr. 18	Prof. S. F. Baird		Ponds at hatchery	27,775
Apr. 20	R. U. Sherman	F. A. Walters	In Adirondack waters	50,000
Apr. 22	Prof. S. F. Baird	Delivered	Gloucester, Mass	5,000
Apr. 27	A. N. Cheney	O. V. Rogers	Lake George, N. Y	30,000
May 2	E. G. Blackford	O. V. Rogers	Monroe, N. Y	5,000
	Total			137,775

TABLE III.—*Distribution of Atlantic salmon from Cold Spring Harbor in April and May*, 1886, *on account of the U. S. Fish Commission.*

Date.	Messenger.	Place of deposit.	Fish supplied.	Loss in transit.	Fish planted.
Apr. 12	C. H. Walters	Carr's Brook, Hudson River	50,000	200	49,800
Apr. 12	F. A. Walters	Raymond Brook, Hudson River	50,000	200	49,800
Apr. 20	C. H. Walters	St. Regis and Brandon Lakes, St. Lawrence River.	50,000	500	49,500
Apr. 27	O. V. Rogers	Clendon Brook, Hudson River	20,000	300	19,700
Apr. 29	C. H. Walters	Oswego River, Lake Ontario	50,000	300	49,700
May 3	C. H. Walters	Eldridge Brook, Hudson River	60,000	200	59,800
May 3	O. V. Rogers	Oak Orchard Creek, Lake Ontario	50,000	500	49,500
May 7	C. H. Walters	Roaring Brook, Hudson River	60,000	200	59,800
May 10	O. V. Rogers	Balm of Gilead Brook, Hudson River.	59,073	100	58,973
	Total		449,073	2,500	446,573

TABLE IV.—*Distribution of landlocked salmon from Cold Spring Harbor in May*, 1886.

Date.	At whose request.	Messenger.	Where planted.	Number.
May 13	R. U. Sherman	F. A. Walters	St. Regis Lake, Franklin County, N. Y.	15,000
May 13	R. U. Sherman	F. A. Walters	Clear Pond, Franklin County, N. Y.	16,020
	Total			31,020

TABLE V.—*Distribution of brown trout from Cold Spring Harbor in April and May, 1886.*

Date.	Messenger.	Place of deposit.	Fish supplied.	Loss in transit.	Fish planted.
Apr. 20	....	Large reservoir at hatchery.......	8,000	....	8,000
Apr. 27	O. V. Rogers	Clendon Brook, Hudson River.....	8,000	1,000	7,000
May 13	F. A. Walters.....	Lake Brandon, near Adirondack Hatchery.	8,000	....	8,000
May 27	Delivered.........	Pond of Mr. Beekman, Oyster Bay.	500	....	500
	Total	....	24,500	1,000	23,500

TABLE VI.—*Distribution of shad, smelts, and lobsters from Cold Spring Harbor in 1886.*

Date.	Kind.	Messenger.	Where planted.	Number.
May 10	Shad..............	O. V. Rogers	Hudson River, at Albany, N. Y	100,000
Apr. 20	Smelts	F. A. Walters......	Saranac Lake, Franklin County, N. Y..	50,000
Apr. 25	Smelts............	O. V. Rogers	Cold Spring Harbor, N. Y..............	50,000
Apr. 27	Smelts............	C. H. Walters.....	Cold Spring Harbor, N. Y..............	2,000,000
June 5	Lobsters..........	....	Cold Spring Harbor, N. Y..............	5,000

COLD SPRING HARBOR, N. Y., *May* 16, 1887.

XII.—REPORT OF OPERATIONS AT THE MICHIGAN STATIONS OF THE U. S. FISH COMMISSION FOR THE YEAR 1886-'87.

By Frank N. Clark.

During the summer of 1886 the whitefish hatchery at Alpena was closed, as usual. At Northville the small force employed at this season was engaged chiefly in work that is current the year round—the care of ponds and stock fish, &c.—devoting such time as could be spared from this work to preparing for the operations of the ensuing season. The hatching boxes, trays, tanks, &c., were repaired or renewed, and coated with asphaltic varnish. It was necessary also to refill with flannel trays the transportation cases that had been emptied by the egg shipments of the previous winter and spring.

The following table summarizes the receipts and shipments of eggs and fish at both the stations in Michigan:

Summary of eggs and fish handled at the Michigan stations in the year 1886-'87.

Kind of fish.	Eggs received.	Eggs shipped.	Fish shipped.	Fish retained at station.
Brook trout	[1]180,750	82,000	527	4,000
Rainbow trout	[2]198,850	50,000	[3]4,920	25,000
Lake trout	....	....	6,150	....
Brown trout	[4]29,400	7,500	....	10,000
Saibling	[5]15,000	....	....	15,000
Whitefish	[6]120,400,000	32,600,000	62,070,000	....
Total	129,830,000	32,730,500	62,081,597	54,000

[1] From ponds at Northville Station.
[2] 196,350 from ponds at Northville, and 2,500 from Baird station.
[3] Of this number 300 were shipped as fry to J. F. Miller, Richmond, Ind., the remainder being yearlings or two-year-olds.
[4] 20,000 from Fred Mather, and 9,400 from ponds at Northville.
[5] From Fred Mather.
[6] From Lakes Erie, Huron, and Michigan.

WHITEFISH.

The funds available for the collection of whitefish eggs being less than in either of the two preceding years, the field-work was confined to fewer points. Operations in Lake Erie were confined to the fisheries of North Bass, Middle Bass, and Put-in-Bay Islands, and the penning of fish in Put-in-Bay; in Lake Huron to the fisheries along the west shore from Alpena to Oscoda, and at Detour and vicinity on the north shore;

and in Lake Michigan to the north shore fisheries at Thompson. The points that had heretofore furnished more or less eggs, but which were not included in last fall's programme, are Monroe, Toussaint, and Catawba Island, Lake Erie; Hammond's Bay, and some unimportant fisheries of Thunder Bay, Lake Huron; and Epoufette and Naubinway, north shore of Lake Michigan. Penning operations were transferred from Monroe to Put-in-Bay. The only new territory worked was at Detour and vicinity, on the north shore of Lake Huron.

Whitefish commenced spawning at the Lake Erie islands on November 7. The first eggs were taken on that date from the pound-net fisheries at North Bass, while the last eggs were taken from penned fish on December 2. The pound and gill net fisheries of Lake Erie furnished 39,600,000 eggs, and the penned fish 4,000,000, all of which were received at Northville in good condition. The weather as a whole was quite unfavorable, a series of heavy blows occurring during the best of the spawning season. On December 2, Put-in-Bay was entirely frozen over, while outside large fields of ice bore down from the westward and damaged or destroyed quite a large amount of twine, nearly one-third of which was still in the lake.

The collection of spawn from the pound-net fisheries along the west shore of Lake Huron, below Alpena, occurred between November 4 and 25, and these shore fisheries furnished 38,000,000 eggs, which were forwarded to Alpena. At Detour the spawning commenced November 6, and 16,800,000 eggs were taken here and sent to Alpena. The gill-net tugs fishing out of Alpena furnished only 2,000,000 eggs, the first of which were taken November 22. The total number of eggs placed in the Alpena house was 56,800,000.

The spawning season at Thompson, north shore of Lake Michigan, occurs nearly one month later than elsewhere. The run is quite heavy, and usually begins from December 1 to 5 and ends December 15 to 20. The grounds are several miles out, and steam-tugs and gill-nets are employed. From December 5 to 13, Mr. Tulian, with a force of four men, secured 29,000,000 eggs from the tugs fishing out of Thompson and Manistique. The weather was very severe, the temperature frequently being at or below zero; and it was therefore impossible to effect a high percentage of impregnation, and nearly one-half of these eggs were afterwards drawn from the hatching-jars and thrown away. Mr. Tulian brought the eggs to Northville in one lot of ten large cases, by steamer from Manistique to Escanaba, thence by rail to Milwaukee, thence by steamer to Ludington, thence by rail to Northville, arriving at night on December 16. The eggs were transferred to hatching-jars the following morning, filling one hundred and forty-five jars. The total receipts of whitefish eggs at Northville, direct from the spawning grounds, were 72,600,000. The total collection of whitefish eggs at both stations was 129,400,000. On January 29, 21,000,000 were transferred from Alpena to Northville, by car No. 2, in charge of George H. H. Moore.

The whitefish eggs were carried forward in hatching-jars, as usual, and no special features attended their development. On November 28 about 30,000 eggs were taken from two whitefish from the pond of three-year-olds raised at the Northville Station, and a fair percentage of impregnation was obtained. The incident is worthy of record only from the fact that it is doubtless the first and only instance of the taking of eggs from whitefish hatched and reared wholly by artificial treatment.

Shipments of whitefish eggs from Northville Station, season of 1886–'87.

Date.	Destination.	Number.
1886.		
Dec. 1	Delivered to car No. 3, Wilmington, Del	100,000
29	Dr. E. G. Shortlidge, Wilmington, Del	1,000,000
1887.		
Jan. 3	William Buller, Erie, Pa	5,000,000
5	Charles R. Buckland, San Francisco, Cal., for New Zealand	1,500,000
12	William Buller, Erie, Pa	5,000,000
15	E. G. Blackford, New York, for London, England	1,500,000
17	Fred Mather, Cold Spring Harbor, N. Y	1,000,000
19	Central Station, Washington, D. C	2,500,000
22	E. G. Blackford, New York, for Germany	1,000,000
26	Dr. R. O. Sweeny, Saint Paul, Minn	5,000,000
Feb. 3	Central Station, Washington, D. C	2,500,000
9	Dr. R. O. Sweeny, Saint Paul, Minn	5,000,000
19	E. G. Blackford, New York City, for London, England	1,000,000
22	Dr. E. G. Shortlidge, Wilmington, Del	500,000
	Total	32,600,000

Whitefish eggs began hatching at Northville on March 11, and the last eggs were hatched on April 12. At Alpena the hatching season commenced April 22 and closed May 8. The distribution from Northville was successfully made by car No. 2, in charge of George H. H. Moore; from Alpena, by steam-tugs and the regular lines of steamers. The tables of distribution of whitefish fry during the spring of 1887 are as follows:

FROM NORTHVILLE STATION.

Date.	Lake.	Place near which deposited.	Number of fry planted.
1887.			
Mar. 25	Lake Michigan	Ludington, Mich	3,000,000
27	Lake Huron	Bay City, Mich	3,000,000
31	Lake Michigan	Grand Haven, Mich	3,000,000
Apr. 2	......do	Ludington, Mich	3,000,000
5	Lake Erie	Monroe, Mich	3,000,000
6	Lake Michigan	Michigan City, Ind	3,000,000
9	Lake Ontario	Oswego, N. Y	3,000,000
12	Lake Erie	North Bass Island, Ohio	3,000,000
13	......do	Monroe, Mich	3,000,000
18	......do	Sandusky, Ohio	3,000,000
20	Lake Michigan	Saint Joseph, Mich	3,000,000
	Total		33,000,000

FROM ALPENA STATION.

Date.	Lake.	Place near which deposited.	Number of fry planted.
1887.			
Apr. 30	Thunder Bay, Lake Huron	Whitefish Point, Mich	3,000,000
May 2	......do	Sulphur Island, Mich	3,000,000
3	Lake Huron	Alcona, Mich	3,000,000
4	......do	......do	3,000,000
6	Thunder Bay, Lake Huron	North Point, Mich	3,000,000
7	Lake Huron	Oscoda, Mich	3,000,000
8	......do	......do	3,000,000
11	......do	Detour, Mich	2,000,000
16	Lake Michigan	Thompson, Mich	2,000,000
17	Thunder Bay, Lake Huron	North Point, Mich	1,000,000
18	......do	Whitefish Point, Mich	1,000,000
19	Lake Huron	Sand Beach, Mich	2,000,000
20	Long Lake	Alpena County, Mich	20,000
24	Clear Lake	Oscoda County, Mich	50,000
	Total		29,070,000

Summary of whitefish fry distributed in the Great Lakes, spring of 1887.

Lake Huron	30,000,000
Lake Michigan	17,000,000
Lake Erie	12,000,000
Lake Ontario	3,000,000
Clear Lake	50,000
Long Lake	20,000
Total	62,070,000

Summary by States.

Michigan	50,070,000
Ohio	6,000,000
Indiana	3,000,000
New York	3,000,000

BROOK TROUT.

The spawning season of brook trout in the Northville ponds began October 14 and closed December 31, 1886. In all, 186,750 eggs were taken, from which 82,000 were shipped and 4,000 fry hatched and retained at the station.

The record of the number of eggs taken from females of different ages, and the table of shipments of brook-trout eggs, are as follows:

ONE YEAR OLD.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1886.			1886.		
October 19	1	200	November 12	11	2,000
October 21	2	350	November 14	1	200
October 24	2	500	November 15	6	1,000
October 25	1	200	November 17	10	2,000
October 28	2	800	November 19	25	4,200
October 30	6	2,100	November 20	14	2,800
November 1	3	1,000	November 22	18	3,800
November 2	1	400	November 23	5	1,000
November 3	3	1,000	November 24	19	4,600
November 6	12	2,400	November 27	15	2,600
November 7	2	400	November 30	10	1,800
November 8	3	600	December 3	3	400
November 9	9	2,000	December 7	17	6,000
November 10	8	1,600			
November 11	4	700	Total	213	47,250

TWO YEARS OLD.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1886.			1886.		
October 14	1	600	November 15	9	3,200
October 18	1	400	November 16	7	2,800
October 22	1	400	November 17	18	5,800
October 23	4	2,000	November 18	7	1,600
October 25	6	3,600	November 20	19	9,200
October 26	2	800	November 21	3	1,800
October 27	7	3,400	November 22	11	4,400
October 28	8	3,800	November 23	5	2,200
October 29	5	2,600	November 24	5	1,800
October 30	4	1,600	November 25	15	4,800
October 31	6	2,400	November 27	5	2,800
November 1	5	3,400	November 28	1	400
November 2	15	6,200	November 30	7	2,300
November 3	6	2,300	December 3	7	2,800
November 4	7	3,100	December 9	8	2,800
November 5	3	1,600	December 11	6	1,400
November 6	10	4,600	December 13	3	2,000
November 7	5	2,400	December 14	2	600
November 8	2	900	December 18	6	1,800
November 9	8	2,800	December 21	3	1,000
November 10	8	3,200	December 31	6	3,200
November 11	9	4,200			
November 12	21	7,400	Total	301	124,200
November 13	4	1,800			

THREE YEARS OLD.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
October 14	1	1,000	November 24	1	400
October 24	1	1,200	November 25	8	2,800
October 25	1	800	November 26	1	1,200
October 31	1	800	November 27	1	1,000
November 1	8	5,500			
November 14	1	600	Total	19	15,300

Shipments of brook-trout eggs during the season of 1886–'87.

Date.	Destination.	No. of eggs.
1886.		
Dec. 28	Wytheville station, Wytheville, Va	30,000
29	Dr. E. G. Shortlidge, Wilmington, Del	10,000
29	E. H. Frishmuth, jr., Philadelphia, Pa	5,000
1887.		
Jan. 10	Dr. R. O. Sweeny, Saint Paul, Minn	15,000
15	E. G. Blackford, New York city, for London, England	10,000
25	Central Station, Washington, D. C	5,000
Feb. 9	Dr. R. O. Sweeny, Saint Paul, Minn	7,000
	Total	82,000

RAINBOW TROUT.

The spawning of rainbow trout occurred from January 6 to April 25. The total number of eggs taken was 196,350; total results, 50,000 eggs shipped, and 25,000 fry hatched. Of the latter, 300 were shipped to J. F. Miller, Richmond, Ind., and the remainder were retained at the station.

About one-half the eggs were carried forward in hatching boxes as usual, and the remainder on gravel. The loss on the eggs in trays ranged from 80 to 95 per cent., while with those on gravel the loss in no instance was more than 50 per cent., and in some cases only 5 per cent., the average being about 30 per cent. A number of experiments were made in carrying forward eggs of the same taking by two systems, and the results in every instance were greatly in favor of the gravel treatment. Arrangements for handling a good portion of this fall's crop of brook-trout eggs on gravel will be provided, and further comparative experiments of the two systems made.

A case of 20,000 rainbow-trout eggs arrived March 19 from Baird station, Cal., in a very poor condition. They had evidently been exposed to a high temperature in transit, as the ice was all gone and the eggs mostly hatched. About 2,500 eggs were picked out and placed in hatching boxes, where they soon hatched. The fry seemed feeble, and a large percentage of them died within a few weeks.

Shipments of rainbow-trout eggs were made as follows: March 21, 25,000 to the Michigan Fish Commission, Paris, Mich.; and April 6, 25,000 to Eugene G. Blackford, New York city, for shipment to France.

The spawning record for the rainbow trout during the season is as follows:

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1887.			1887.		
January 6	3	2,400	March 5	4	1,800
January 7	1	600	March 6	4	2,500
January 9	1	600	March 7	8	4,800
January 12	1	1,000	March 8	10	5,250
January 13	1	1,000	March 9	4	3,000
January 15	1	1,200	March 10	7	3,900
January 16	1	1,500	March 11	8	4,300
January 17	1	1,200	March 12	13	7,000
January 19	2	2,400	March 13	11	5,100
January 21	1	1,300	March 14	2	1,200
January 22	3	2,300	March 15	4	2,100
January 23	4	2,700	March 16	10	3,000
January 24	1	600	March 17	2	1,050
January 25	1	400	March 18	1	450
January 28	1	1,600	March 19	6	1,000
January 29	1	400	March 20	25	10,900
January 30	3	1,800	March 21	18	6,700
February 1	2	1,200	March 22	5	2,950
February 3	5	3,600	March 24	6	1,300
February 4	1	550	March 25	2	700
February 5	1	700	March 26	6	2,500
February 6	1	900	March 27	2	1,000
February 7	1	600	March 28	8	2,500
February 9	1	600	March 29	2	750
February 11	1	150	March 30	2	550
February 12	1	900	March 31	11	3,950
February 13	4	2,800	April 1	12	5,400
February 14	6	3,550	April 2	6	3,400
February 15	9	6,800	April 3	6	3,600
February 16	9	5,800	April 4	4	2,400
February 17	3	2,400	April 5	4	1,700
February 18	6	3,000	April 7	2	700
February 19	1	700	April 8	5	1,800
February 20	1	500	April 9	2	600
February 21	4	2,000	April 10	3	1,000
February 22	4	2,900	April 11	4	1,400
February 23	5	3,000	April 12	1	300
February 24	11	6,900	April 13	3	1,200
February 26	3	1,600	April 14	3	1,000
February 27	2	900	April 15	6	2,200
February 28	1	600	April 21	3	1,500
March 1	2	1,800	April 22	1	200
March 2	4	3,000	April 25	1	150
March 3	5	3,300			
March 4	7	3,900	Total	375	196,350

BROWN TROUT AND SAIBLING.

A case containing 20,000 brown-trout eggs and 15,000 saibling eggs, shipped from Cold Spring Harbor, N. Y., by Fred Mather, arrived at Northville on March 17 in first-class condition. The saibling hatched soon after, but the fry refused to eat, and most of them died of "blue sac" and starvation. Shipments of brown-trout eggs were made as follows: March 21, 2,500 to Michigan fish commission, Paris, Mich.; and March 28, 5,000 to Wisconsin fish commission, Madison, Wis. There was considerable loss before hatching, but nearly 9,000 fry were hatched and retained at station.

Between November 18 and December 21 a total of 9,400 eggs of brown trout were taken from stock fish in the Northville ponds, but they turned out quite poorly, and only 1,500 fry were hatched. The spawning record is as follows:

Record of brown-trout spawning, season of 1886.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1886.			1886.		
Nov. 18	6	1,200	Dec. 13	11	5,000
22	1	250	14	5	1,600
23	1	350	18	2	400
25	1	300	21	1	100
26	1	200	Total..	29	9,400

LAKE TROUT.

No lake-trout eggs were taken, owing to a lack of funds available for the purpose. This is greatly to be regretted, as no fish of equal rank is more easily propagated, and, if held in confinement until of suitable size and age, it is remarkably adapted for diffusion to a large range of waters into which the whitefish, brook trout, rainbow trout, and other high-grade varieties cannot be established. As compared with other trouts, the cost of obtaining the eggs is greatly in favor of lake trout, as is also the percentage of young that can be reared in confinement until of suitable size and age for distribution. During the fiscal year a total of 6,150 of the lake trout, hatched in January and February, 1886, were delivered to cars No. 2 and No. 3, and distributed chiefly in Ohio, Indiana, Kentucky, and Tennessee.

During the fiscal year a total of 11,297 trout, ranging from eight months to two years old—6,150 lake trout, 4,620 rainbow trout, and 527 brook trout—were distributed, as is shown by the following table:

Distribution of trout from December 1, 1886, to March 3, 1887.

Date.		Kind of fish.	Age of fish.	Car used.	Number of fish.
Dec.	1	Rainbow trout	8 months	No. 3	850
	1	Brook trout	2 years	No. 3	252
	1	Lake trout	9 months	No. 3	1,300
Jan.	18	Rainbow trout	2 years	No. 2	1,560
	18	Lake trout	1 year	No. 2	300
	20	Rainbow trout	2 years	No. 2	640
	20	......do	1 year	No. 2	600
	20	Lake trout	1 year	No. 2	300
	28	Rainbow trout	1 and 2 years	No. 2	250
	28	Brook trout	1 and 2 years	No. 2	250
Feb.	1	Rainbow trout	1 year	No. 2	460
	1	Lake trout	1 year	No. 2	1,300
	12	Rainbow trout	2 years	No. 2	100
	12	Lake trout	1 year	No. 2	1,350
	21	......do	1 year	No. 2	1,300
Mar.	2	Rainbow trout	1 and 2 years	No. 2	100
	2	Lake trout	1 year	No. 2	300
	3	Brook trout	1 year	(*)	25
		Total			11,297

* Delivered to Frank Elwell, Owosso, Mich.

NORTHVILLE, MICH., *August* 16, 1887

XIII.—REPORT OF OPERATIONS AT THE U. S. SALMON AND TROUT STATIONS ON THE M'CLOUD RIVER, CALIFORNIA, FOR THE YEARS 1885-'87.

BY LIVINGSTON STONE.

SALMON.

Matters in relation to salmon at this station remain in much the same condition as at the close of my last report. The property was left in charge of Mr. Robert Radcliff; but, for various reasons, no active operations were carried on during these years.

TROUT.

The operations in trout breeding at this station during the past two years developed no new items of special interest. The fishing in the McCloud River for breeders was continued very much the same as in previous years, and the station was conducted according to the same methods as heretofore.

A few improvements were made during the year, among which may be mentioned the building of two or three new boats, and the constructing of some ponds for growing the young trout, which ponds Mr. Loren W. Green, the superintendent of the station, says are so carefully and securely built that nothing can get into or out of them without his knowledge.

The date of the beginning of the spawning season for the trout in the ponds at this station has receded till now the first eggs are obtained late in December,* the first for this season being 12,500 eggs which were taken on December 26, 1885. Operations in taking eggs continued from this date until May 10, 1886, when the spawning season closed for that year. More than 220,000 eggs were obtained, as shown in Table I, accompanying this report, which were distributed as shown in Table III. In 1886-'87 over 268,000 eggs were taken, of which 184,300 were disposed of as per Table IV.

This total number of eggs taken in 1885-'86 was not so large as usual, owing chiefly to two misfortunes that befell the trout during the year. The first was another outbreak of the mysterious disease described in

* It used to begin in January.

my last report, and referred to more at length under the heading below, which carried off a great many of the breeding trout; and the second was a terrible rain-storm which visited the McCloud River in December, 1885, just before the trout began to spawn, and which forced so much mud and sand into the ponds that many fish died from the effects of earthy matter collecting in their gills. Specimens of trout that died of the disease and of some that died of earthy matter in their gills were sent to Prof. S. A. Forbes, of Illinois, for examination.

Some brief memoranda, which are given in Table VI from Mr. Green's diary, contain information in regard to the weather, the trout fishing, and other matters, from September 7, 1885, to December 31, 1886. Table V is also added, showing the temperatures of air and water at the station between the same dates.

DISEASE AFFECTING RAINBOW TROUT.—Mr. Green, superintendent of the trout ponds at the McCloud River station, described a disease which affected the rainbow trout in the ponds and river at this station during the fall of 1885, and caused the death of many breeding fish, substantially as follows: *

The fish all died in the same way, being apparently in perfect health up to the time of their being taken with this disease, while none that were taken ever recovered. By watching them closely, the first symptom discovered is that the fish begin to grow dark colored, some of them nearly black, and about the second day after this they refuse food and seem inclined to keep very quiet, and remain most of the time resting on their left sides at the bottom of the pond. This symptom differs from any I have ever witnessed in trout before. I have seen a great many fall sick and die, some from old age, others from bruises or fungus or other causes, but they almost invariably rise near the surface, and sometimes so near the top that their back fins will be out of water, and as they grow weaker they keep falling off towards the back screens; but such is not the case with any of these fish dying of this disease, as they lie on the bottom all day long unless disturbed, while if disturbed they swim off apparently all right. If taken from the water they seem to shake or quiver, and will splash around quite lively for a moment. They remain in this state from three to six days, breathing very naturally. I have kept them seven days after this, always lying on their sides and breathing faster each day. They seem to be in no pain, but simply stupefied. I think they would live even longer than this if it was not for the sediment that gathers in their gills from their being so quiet in the water. Some of them seem to cramp and their bodies will be crooked and it is almost impossible to straighten them. I have given them earth, salt, and everything I could think of as remedies, but to no avail. After they stop breathing it is eight or ten hours before they begin to get stiff or look like dead fish, and I have opened them forty-

* For previous references to this disease see F. C. Report for 1885, p. 134, and F. C. Bulletin for 1885, p. 472.

five minutes after there was no sign of breathing and no feeling, and still found the heart beating. The fish are all fat and nice to look at, and I can find no trouble with eyes or gills or any other part, except the stomach seems a little hard and drawn up, and a hard and contracted yellow substance sometimes appears around the heart and stomach.

The disease has been very severe in the McCloud River, and I feel sure that it was introduced into the ponds by transferring fish to them from the river. It seems to be a clearly contagious disease, as in one pond, which received no fish from the river and where the water flows directly to the pond from the flume without running over any other fish, no trout have been affected.

The water in the river this autumn has been much lower than I have ever known before, and has been of a milky, muddy color all summer, owing to the overflow from Ash Creek. The very hot weather melts the snow on Mount Shasta, which has been reduced much more than usual this summer and fall, some of which empties through this creek, and when very high the creek overflows its banks and carries quantities of ashes into the McCloud River.

The large trout suffered from this disease much more than the small ones. It was thought that the changed weather and heavy rains late in the fall would stop the progress of the disease, but it did not seem to do so. The temperature of the water while the fish were dying was about 58 or 60 degrees Fahrenheit.

Some specimens of these diseased trout were sent to Prof. S. A. Forbes, of Champaign, Ill., with the result of his making a careful examination and reporting as follows:

In these six specimens the kidneys were evidently the principal seat of disorder, the spleen being also considerably affected, and the liver much less so. The muscular tissue of the heart was involved in the single specimen that I examined in that particular.

The kidneys were as black as coal and as soft as mush, a condition explained by microscopic sections, which show the urinary tubules little altered, with their epithelial lining intact, but all the other tissues (the connective tissue, capillaries, &c.) almost wholly replaced by a mere pulp of pigmented corpuscles, black pigment granules, and micrococci, in which lie imbedded vast numbers of spherical corpuscles each containing an embryo parasite. These encysted parasites are so numerous that the kidney pulp is seen to be everywhere thickly speckled with them.

The spleen is much pigmented, like the kidneys, but less so, and the liver still less than the spleen, the pigment cells being much the most abundant about the blood-vessels, and often blocking the capillaries, especially in the liver, and causing the degeneration of large tracts of the gland substance. A similar disorganization of the liver cells frequently appears at a distance from arteries or veins. The spleen and liver are free from parasites. On the other hand, my sections of the heart show great numbers of the kidney parasites all through the walls of that organ. I counted thirty-three in a single thin section. A hasty examination of the muscular tissue of the back showed none, and the brain does not contain them.

As matters are, I cannot doubt that these kidney parasites caused the death of these fish. In my previous and first examination of these fish I was misled by the fact that the first specimens from which sections were obtained contained relatively few of these parasites, while the general appearance of the organs in other respects was closely like that of the diseased herring from Lake Mendota.

Of course, no practical conclusion can be drawn from this until we know what these parasites are and where they came from, or in what other host they continue their development; and for this a general study of the subject on the spot would be necessary.

CHARLESTOWN, N. H., *April* 30, 1887.

TABLE I.—*Record of trout eggs taken at McCloud River Station during the season of* 1885-'86.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1885.			March 6	18	20, 200
December 26	12	12, 500	March 16	13	11, 500
1886.			April 3	10	10, 050
January 4	12	12, 200	April 5	10	20, 150
January 13	23	21, 000	April 12	4	5, 025
January 18	13	12, 100	April 20	8	10, 000
January 23	15	15, 300	April 27	10	10, 000
January 24	10	10, 100	May 5	12	13, 000
February 1	12	10, 150	May 10	10	8, 000
February 9	11	10, 050			
February 14	14	10, 100	Total	226	221, 425

TABLE II.—*Record of trout eggs taken at McCloud River Station during the season of* 1886-'87.

Date.	Females.	Eggs.	Date.	Females.	Eggs.
1886.			February 17	30	28, 000
December 26	8	7, 500	February 23	10	10, 000
1887.			February 25	12	10, 000
January 4	20	20, 500	March 3	21	20, 500
January 12	7	7, 200	March 9	5	5, 200
January 14	4	3, 000	March 20	21	20, 000
January 26	15	13, 000	March 29	16	12, 000
January 27	18	13, 200	April 5	10	10, 000
January 31	20	18, 000	April 8	23	24, 000
February 3	22	20, 300	April 11*	4	2, 000
February 12	15	11, 000			
February 15	12	13, 000	Total	299	268, 400

* At this date there are 53 more fish which are expected to spawn.

TABLE III.—*Disposition of trout eggs from McCloud River Station during the season of* 1886.

Date.	Disposition.	Number of eggs.
1886.		
Jan. 12	Central Station, Washington, D. C	12,000
21	......do	12,000
29	Lost by high and muddy water	20,000
Feb. 3	E. B. Hodge Plymouth, N. H	12,000
9	H. M. Garlichs, Saint Joseph, Mo	15,000
10	Hatched for trout ponds	10,000
17	H. M. Garlichs, Saint Joseph, Mo	10,000
25	H. A. Cutting, Plymouth, N. H	10,000
Mar. 2	B. E. B. Kennedy, Omaha, Nebr	10,000
23	Otto Gramm, Laramie City, Wyo	20,000
31	A. W. Aldrich, Anamosa, Iowa	10,000
Apr. 15	Lost by high and muddy water	10,000
18	H. M. Garlichs, Saint Joseph, Mo	20,000
27	Hatched for river	5,000
	Total	176,000

TABLE IV.—*Disposition of trout eggs from McCloud River Station during the season of* 1887.

Date.	Disposition.	Number of eggs.
1887.		
Jan. 14	Central Station, Washington, D. C	5,000
19	E. D. Carlton, Spirit Lake, Iowa	20,000
29	B. E. B. Kennedy, Omaha, Nebr	10,000
Feb. 12	R. O. Sweeny, Saint Paul, Minn	25,000
17	H. M. Garlichs, Saint Joseph, Mo	20,000
Mar. 9	F. N. Clark, Northville, Mich	20,000
19	Central Station, Washington, D. C	20,000
24	R. Kroeck, Denver, Colo	5,000
Apr. 6	Central Station, Washington, D. C	20,000
8	Hatched and planted in McCloud River	17,000
11	......do	22,300
	Total sent	184,300
	Lost from various causes	84,100
	Total eggs taken	268,400

TABLE V.—*Temperatures of air and water at noon at McCloud River Station from September 7, 1885, to December 31, 1886.*

Day of month.	1885.								1886.							
	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March.		April.	
	Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1	.....	.....	78	60	68	58	58	52	54	52	68	52	60	53	54	56
2	.....	.....	86	60	52	53	60	52	52	50	68	52	60	54	56	54
3	.....	.....	88	60	52	53	62	52	46	50	68	52	58	54	58	54
4	.....	.....	89	60	52	53	62	52	48	50	68	52	60	54	56	54
5	.....	.....	87	60	54	54	66	52	46	50	62	53	60	54	56	54
6	.....	.....	86	60	50	50	60	52	48	48	64	53	60	54	56	54
7	78	60	86	58	50	50	56	52	46	48	62	54	60	54	60	54
8	76	60	85	58	52	50	54	52	48	48	60	54	60	54	58	54
9	78	60	84	58	46	48	54	52	48	48	66	54	60	55	60	54
10	80	60	83	58	48	48	58	52	46	48	66	54	60	54	60	54
11	80	60	82	58	48	48	56	52	50	48	60	54	60	56	60	54
12	84	60	81	58	48	48	60	52	56	48	66	54	48	56	58	54
13	80	60	80	56	46	48	60	52	60	50	60	54	50	54	58	54
14	82	60	80	56	48	48	60	52	50	50	68	54	48	54	58	54

TABLE V.—*Temperatures of air and water at noon at McCloud River Station, etc.*—Cont'd.

Day of month.	1885. Sept. Air.	1885. Sept. Water.	Oct. Air.	Oct. Water.	Nov. Air.	Nov. Water.	Dec. Air.	Dec. Water.	1886. Jan. Air.	Jan. Water.	Feb. Air.	Feb. Water.	March. Air.	March. Water.	April. Air.	April. Water.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
15	80	60	79	56	44	46	56	52	56	50	72	54	48	54	59	54
16	88	60	78	58	42	46	56	52	44	48	72	54	48	54	60	54
17	88	60	78	56	44	44	56	52	46	48	74	54	49	54	60	54
18	88	60	80	56	50	46	60	52	38	48	74	54	50	54	64	54
19	84	60	58	56	50	46	58	52	48	50	72	53	56	54	66	56
20	88	60	80	56	48	47	58	52	48	50	72	54	58	54	66	56
21	86	60	76	56	46	49	60	52	53	51	72	54	58	54	68	56
22	88	60	74	56	46	50	58	52	53	51	72	54	58	54	72	56
23	82	60	74	56	50	50	56	52	60	51	73	54	60	54	74	56
24	64	60	74	56	53	50	58	53	56	50	72	54	58	54	82	56
25	68	60	78	56	48	51	60	52	58	50	72	54	58	54	86	56
26	76	60	76	56	46	51	58	52	56	50	70	54	60	54	78	56
27	76	60	80	58	54	52	52	52	60	51	64	54	60	54	78	56
28	76	60	80	58	54	52	54	52	62	50	46	52	64	54	90	56
29	80	60	78	56	56	52	56	52	68	50	....	....	62	54	60	56
30	78	60	76	56	54	52	56	52	66	52	....	....	60	54	70	54
31	....	....	78	56	....	....	52	52	66	52	....	....	60	54	....	....

Day of month.	1886. May. Air.	May. Water.	June. Air.	June. Water.	July. Air.	July. Water.	Aug. Air.	Aug. Water.	Sept. Air.	Sept. Water.	Oct. Air.	Oct. Water.	Nov. Air.	Nov. Water.	Dec. Air.	Dec. Water.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
1	74	56	100	60	98	60	100	60	78	58	66	56	48	50	44	48
2	73	57	102	60	96	60	98	60	80	58	70	56	48	50	44	48
3	73	57	98	60	98	60	110	62	84	58	66	55	49	50	46	48
4	68	58	98	60	96	60	98	60	86	58	66	55	50	50	50	49
5	68	57	96	60	94	60	98	60	80	58	64	55	46	49	52	49
6	69	57	98	60	93	60	102	60	84	58	66	55	44	49	52	49
7	56	57	98	60	92	60	98	60	78	58	64	54	44	49	48	48
8	56	56	96	60	94	60	94	60	78	58	60	54	50	49	46	48
9	56	58	98	60	98	60	90	59	90	58	62	54	48	49	50	49
10	64	58	96	60	100	60	88	59	98	59	60	54	46	49	52	49
11	64	58	80	60	102	60	90	59	102	60	58	54	49	49	50	49
12	68	58	80	60	104	61	98	59	100	60	58	54	44	48	48	48
13	70	59	88	60	108	62	100	60	91	59	56	53	46	48	48	48
14	76	59	82	60	108	62	100	60	94	59	56	53	40	48	46	48
15	82	59	84	60	110	62	96	60	96	59	58	53	42	48	44	47
16	92	59	86	60	104	61	98	60	98	59	56	53	38	48	46	48
17	90	59	86	60	100	60	80	60	88	58	50	52	42	48	48	48
18	92	59	88	60	98	60	88	59	86	58	58	52	42	48	50	48
19	92	59	90	60	102	60	90	59	84	58	62	52	50	49	52	48
20	94	60	98	60	104	61	92	59	80	58	62	52	38	48	52	48
21	92	59	106	61	98	60	90	59	78	58	60	52	40	48	54	49
22	90	59	98	60	96	60	88	59	82	58	58	52	42	48	56	50
23	90	59	92	60	102	60	84	58	88	58	60	52	40	48	56	50
24	92	59	90	60	98	60	80	58	90	58	59	52	44	48	58	50
25	94	59	86	60	96	60	82	58	84	58	60	52	42	48	60	52
26	90	59	90	60	90	59	84	58	80	58	60	52	44	48	58	52
27	92	59	92	60	98	60	78	58	80	58	56	51	42	48	50	51
28	94	59	88	60	98	60	80	58	72	57	54	50	40	48	52	51
29	92	59	92	60	100	60	86	58	70	57	52	50	48	48	54	51
30	98	60	94	60	96	60	84	58	68	56	52	50	46	48	54	51
31	102	60	....	....	94	60	86	58	....	....	50	50	....	....	52	51

TABLE VI.—*Memoranda relating to the weather, etc., at McCloud River Station from September 7, 1885, to December 31, 1886.*

Date.	Condition of weather, etc.
1885.	
Sept. 7	Weather clear and moderate; caught 5 small trout; trout biting very poorly.
Sept. 8	Weather clear; water in river quite muddy; caught 7 small and 1 large trout.
Sept. 9	Weather very nice; 4 small trout.
Sept. 10	Clear and nice; 6 small trout.
Sept. 11	Weather same as usual; no trout.
Sept. 12	Clear and warm; no trout.
Sept. 13	Clear and nice; 1 small trout.
Sept. 14	Weather very nice; no trout.
Sept. 15	Two very large trout and 2 small ones.
Sept. 16	Three large trout and 7 small ones.
Sept. 17	Weather nice; 1 large and 5 small trout.
Sept. 18	Weather nice; 1 large and 15 small trout.
Sept. 19	Cool; 2 small trout; bait very scarce; very few salmon in river.
Sept. 20	No trout; have sent to Sacramento for salmon eggs for trout bait.
Sept. 21	Weather very nice; 7 trout.
Sept. 22	Weather nice, but rather warm; 1 large trout; some trout in river looking dull and sick.
Sept. 23	Weather very nice; 2 large trout.
Sept. 24	Raining quite hard.
Sept. 25	Weather very nice; no more rain; no trout.
Sept. 26	Two large trout, 9 small ones.
Sept. 27	Weather nice, but warm; 4 small trout.
Sept. 28	Weather nice; 5 small trout, found 4 dead trout in river.
Sept. 29	No trout; several trout in river lying on their sides, but not dead.
Sept. 30	Two large and 2 small trout; trout dying quite fast in river.
Oct. 1	No trout; trout still dying in river.
Oct. 2	Caught 3 small trout; 3 dead trout in river.
Oct. 3	Weather nice; no trout.
Oct. 4	No trout; more dead trout in river.
Oct. 5	No trout; trout in ponds acting very strangely.
Oct. 6	Weather very nice; 2 large trout and 4 small ones; some in ponds refusing food; some lying on their sides.
Oct. 7	Five large and 10 small trout; some in ponds still refusing food.
Oct. 8	Two large and 2 small trout.
Oct. 9	Weather cool; 2 large and 6 small trout; 3 that were lying on their sides are dead; a disease never known before; seemingly nice, bright fish.
Oct. 10	Weather nice; caught 4 large trout.
Oct. 11	Two large and 5 small trout.
Oct. 12	Six large trout; more trout in ponds lying on their sides and refusing to eat.
Oct. 13	Fifteen large trout; 5 trout dead in ponds.
Oct. 14	Two large and 5 small trout.
Oct. 15	Have no bait; sent after some salmon eggs, but got none.
Oct. 16	Weather nice; no trout.
Oct. 17	No trout; some more trout in ponds lying on their sides, but not dead.
Oct. 18	Trout still lying on their sides.
Oct. 19	Quite windy; 9 large and 3 small trout.
Oct. 20	Clear; 7 large and one small trout; fish in ponds looking quite sickly.
Oct. 21	Seven large trout; 10 large trout in ponds died to-day; all look very fat and healthy.
Oct. 22	Clear; 7 large and one small trout.
Oct. 23	No trout; those in ponds still looking badly.
Oct. 24	No trout; trout in ponds refusing food.
Oct. 25	No trout; they bite very badly; 3 dead trout in ponds; all look fat; no known cause for the disease.
1885.	
Oct. 26	Clear; caught 1 trout.
Oct. 27	Four large and 2 small trout; some trout dying in river, but more in ponds.
Oct. 28	Clear; no trout.
Oct. 29	No trout; 5 dead ones in ponds; look fat.
Oct. 30	No trout; still looking badly in ponds.
Oct. 31	Raining a little; no trout.
Nov. 1	Raining quite hard in afternoon.
Nov. 2	Still raining slowly; no trout.
Nov. 3	Still raining; no trout; they bite very poorly.
Nov. 4	Raining quite hard; water risen considerably.
Nov. 5	Heavy rain; water still rising.
Nov. 6	Raining very hard; water rising.
Nov. 7	Still raining quite hard.
Nov. 8	Raining; trout in ponds looking badly; 4 dead ones.
Nov. 9	Raining not quite so hard.
Nov. 10	Clear; 3 more dead trout in ponds.
Nov. 11	Clear; no trout.
Nov. 12	Clear; more trout in ponds looking sick.
Nov. 13	No fishing yet, water too high; trout still dying.
Nov. 14	Eight dead trout in ponds; no idea what ails them.
Nov. 15	Raining all day; trout still look badly.
Nov. 16	Raining hard; water rising; 3 dead trout in ponds.
Nov. 17	Raining hard; caught 2 large trout in fish-trap.
Nov. 18	Water rising fast; 1 trout in trap.
Nov. 19	Pleasant; no trout.
Nov. 20	Trout still dying in ponds; took out 8 to-day.
Nov. 21	Raining hard all day; water rising fast.
Nov. 22	Raining very hard; water high and still rising; took out of ponds 5 dead trout.
Nov. 23	Water still rising; 15 feet high now; logs running over tops of traps; 3 dead trout in ponds.
Nov. 24	Water very high and still rising; one boat swept away, and one trap washed out; water 20 feet high.
Nov. 25	Raining quite hard, but water falling some; snowing high up on mountains; 5 dead trout in ponds.
Nov. 26	Raining slowly; water high; very dangerous crossing river; traps all filled up with sand and rocks.
Nov. 27	Still raining; water high; 8 dead trout in ponds.
Nov. 28	Raining slowly; water rising; snow melting on mountains.
Nov. 29	Raining slowly; fish still dying; no apparent cause.
Nov. 30	Raining a little; water falling; caught 2 trout in trap; took 13 dead trout out of ponds.
Dec. 1	Clear; water rising; snow on mountains melting.
Dec. 2	Clear; water falling.
Dec. 3	Clear; water falling; 10 dead trout in ponds.
Dec. 4	Cloudy, but no rain; water falling; trout dying fast.
Dec. 5	Clear; water falling; 15 dead trout in ponds.
Dec. 6	Morning foggy; no rain; fish still dying.
Dec. 7	Water low; 16 dead trout in ponds; all look fat.
Dec. 8	Cloudy; some fish in ponds looking sick.
Dec. 9	Cloudy, but no rain; shipped 4 specimens of diseased trout to Professor Forbes; took 18 dead trout from ponds.

TABLE VI.—*Memoranda relating to weather, etc.*—Continued.

Date.	Condition of weather, etc.
1885.	
Dec. 10	Raining, but water falling; fish still dying.
Dec. 11	Clear; 13 dead trout in ponds.
Dec. 12	Clear; took 8 dead trout out of ponds.
Dec. 13	Clear; fish in ponds looking sick.
Dec. 14	Clear; some fish in ponds refusing food.
Dec. 15	Raining hard all day; 20 dead trout in ponds.
Dec. 16	Raining hard, water standing about the same.
Dec. 17	Raining; water 3 feet higher; 11 dead trout in ponds.
Dec. 18	Clear; 5 dead trout in ponds.
Dec. 19	Clear; water low.
Dec. 20	Cloudy; water low; 8 dead trout in ponds.
Dec. 21	Raining all day; 6 dead trout in ponds.
Dec. 22	Raining all day; caught 10 large trout in trap.
Dec. 23	Raining hard; water rising fast; cannot cross river; caught 7 trout in trap; water in ponds muddy.
Dec. 24	Water 10 feet high, running over top of traps; raining hard; 14 dead trout in ponds; ponds very muddy.
Dec. 25	Raining very hard; water 15 feet high, but not rising any more; trout in ponds still dying.
Dec. 26	Clear, and water falling; water very high in creek; can not get in traps; began to take eggs.
Dec. 27	Clear; water falling fast; nights cool; eggs doing well; 8 dead trout in ponds.
Dec. 28	Cloudy; more rain; water rising.
Dec. 29	Raining; water high; eggs doing well.
Dec. 30	Clear; water falling; 3 dead trout in ponds.
Dec. 31	Clear; nights cool, eggs doing nicely.
1886.	
Jan. 1	Clear; water falling.
Jan. 2	Clear; 5 dead trout in ponds.
Jan. 3	Clear; eggs doing well.
Jan. 4	Clear.
Jan. 5	Clear; no trout running up traps.
Jan. 6	Clear; eggs doing well.
Jan. 7	Clear; 4 dead trout in ponds.
Jan. 8	Clear; disease seems to be leaving trout a little.
Jan. 9	Clear; eggs doing nicely.
Jan. 10	Clear; fish seem to be looking a little better.
Jan. 11	Clear; 3 dead trout in ponds.
Jan. 12	Cloudy; eggs doing well.
Jan. 13	Raining a little; 1 dead trout in ponds.
Jan. 14	Raining all day, but not hard.
Jan. 15	Still raining.
Jan. 16	Clear; eggs looking well.
Jan. 17	Clear, though evening a little cloudy.
Jan. 18	Snowstorm of about 2 inches.
Jan. 19	Raining hard all day.
Jan. 20	Raining hard; water rising fast.
Jan. 21	Clear; water falling.
Jan. 22	Raining very hard; water high; no trout running.
Jan. 23	Raining hard; water rising fast; caught 8 trout in trap.
Jan. 24	Raining very hard; water high, and still rising.
Jan. 25	Clear in morning, sunshine at noon, and cloudy and raining in evening; water rising; caught 3 trout in trap; 2 dead trout in ponds; water muddy.
Jan. 26	Raining hard all day; caught 2 large trout in trap; water rising; expect to lose 20,000 eggs by high water.
Jan. 27	Raining hard; water very high; water coming into hatching-house thick with mud.
Jan.	Raining hard; water rising and muddy; no fish to-day.
1885.	
Jan. 29	Raining hard; water high; no trout; lost 20,000 eggs.
Jan. 30	No rain, but cloudy; no mail; can not cross rivers.
Jan. 31	Clear; water falling a little; 1 dead trout in ponds.
Feb. 1	Clear; water falling; caught 3 trout in trap; mail came to-day.
Feb. 2	Cloudy and misty; no hard rain; water falling.
Feb. 3	Clear, and water falling; trout in ponds looking much better, and eating well.
Feb. 4	Clear; water getting quite low; caught in trap 5 female trout and 4 males.
Feb. 5	Clear; water falling; no trout to-day.
Feb. 6	Clear; no trout; fish in ponds looking well.
Feb. 7	Clear; water low; no fish running.
Feb. 8	Clear; fish in ponds eating, and looking nicely.
Feb. 9	Cloudy, but no rain; eggs doing well.
Feb. 10	Clear.
Feb. 11	Cloudy, and a little rain in morning; afternoon clear.
Feb. 12	Clear; young trout hatched out and looking nicely.
Feb. 13	Clear; fish in ponds doing well, and young fish doing splendidly.
Feb. 14	Clear; water low; no fish.
Feb. 15	Clear; water low.
Feb. 16	Clear; eggs doing well.
Feb. 17	Clear; water very low.
Feb. 18	Clear.
Feb. 19	Clear; eggs doing well.
Feb. 20	Clear; water low.
Feb. 21	Clear; all the fish doing very well.
Feb. 22	Clear; eggs doing well.
Feb. 23	Clear; water low.
Feb. 24	Clear; little fish looking very nicely.
Feb. 25	Clear; all the fish eating nicely.
Feb. 26	Clear; water low.
Feb. 27	A little cloudy.
Feb. 28	Heavy snow-storm, very large flakes; raining at noon, mountains covered with snow; sun shining by spells in the afternoon.
Mar. 1	Clear; water very low.
Mar. 2	Clear; fish doing splendidly.
Mar. 3	Cloudy, but no rain.
Mar. 4	Raining slowly, eggs doing well.
Mar. 5	Raining slowly; fish doing nicely.
Mar. 6	Still raining a little.
Mar. 7	Raining a very little.
Mar. 8	Clear; fish looking splendidly.
Mar. 9	Rather rainy.
Mar. 10	Clear.
Mar. 11	Clear; eggs doing well.
Mar. 12	Clear; all fish doing well.
Mar. 13	Clear.
Mar. 14	Clear; little fish eating nicely.
Mar. 15	Clear.
Mar. 16	Cloudy, but very little rain.
Mar. 17	Rather cloudy; eggs and fish doing well.
Mar. 18	Cloudy; all fish looking well.
Mar. 19	Cloudy; water low.
Mar. 20	Clear.
Mar. 21	Do.
Mar. 22	Clear; a little wind.
Mar. 23	Cloudy.
Mar. 24	Clear; strong north wind.
Mar. 25	Cloudy and windy; all fish looking well.
Mar. 26	Clear; eggs doing well.
Mar. 27	Clear.
Mar. 28	Do.
Mar. 29	Clear and very pleasant.
Mar. 30	Clear.
Mar. 31	Clear; all fish looking nicely.
Apr. 1	Clear; little fish growing rapidly.
Apr. 2	Clear; water low.
Apr. 3	Clear.
Apr. 4	Clear; water very low.

TABLE VI.—*Memoranda relating to the weather, etc.*—Continued.

Date.	Condition of weather, etc.
1886.	
Apr. 5	Clear; eggs doing well.
Apr. 6	Clear; fish all eating well.
Apr. 7	Began raining, very dismal day.
Apr. 8	Raining hard; river rising.
Apr. 9	Still raining quite hard.
Apr. 10	Still raining; eggs doing well.
Apr. 11	Not raining quite so hard.
Apr. 12	Raining hard; water rising.
Apr. 13	Still raining hard; water high and fast rising.
Apr. 14	Still raining; water rising fast.
Apr. 15	Raining very hard; water higher than before this winter.
Apr. 16	Still raining a little; water high; snow on mountains.
Apr. 17	Not raining much; water still rising.
Apr. 18	No rain; water very high, but not rising.
Apr. 19	No rain; water still pretty high.
Apr. 20	No rain; water falling; little fish doing well.
Apr. 21	Clear and nice; water falling fast.
Apr. 22	Very nice; fish all doing well.
Apr. 23	Splendid day; water quite low.
Apr. 24	Very nice and warm; water low.
Apr. 25	Splendid weather; little fish growing rapidly.
Apr. 26	Very nice; fish-traps all very badly damaged by recent high water.
Apr. 27	Splendid weather; clearing out fish-traps.
Sept. 6	Weather clear, with strong north wind; began fishing to-day; caught 1 large and 5 small trout.
Sept. 7	Continued north wind; almost impossible to stay on the water.
Sept. 8	North wind; no trout.
Sept. 9	North wind; caught 6 small trout.
Sept. 10	North wind in forenoon; clear and still in afternoon; caught 5 small trout.
Sept. 11	Hot and smoky, no wind; caught 4 small trout; large trout very scarce.
Sept. 12	Hot and smoky; no trout.
Sept. 13	Do.
Sept. 14	Clear; no trout.
Sept. 15	Clear; caught 1 large trout; fishing very poor.
Sept. 16	Caught 3 small trout.
Sept. 17	Clear; fishing poor.
Sept. 18	Clear; trout not biting.
Sept. 19	Clear.
Sept. 20	Caught 18 nice trout.
Sept. 21	Clear; no trout.
Sept. 22	Clear; caught 7 small trout.
Sept. 23	Clear; no trout.
Sept. 24	Do.
Sept. 25	Clear; 6 small trout.
Sept. 26	Clear; no trout.
Sept. 27	Clear; 5 small trout; few large ones in river.
Sept. 28	Clear; 6 small trout.
Sept. 29	Clear; water low; no trout.
Sept. 30	Strong north wind; no trout.
Oct. 1	Do.
Oct. 2	Clear; no fish.
Oct. 3	Clear; 9 small trout.
Oct. 4	Clear; no trout.
Oct. 5	Do.
Oct. 6	Do.
Oct. 7	Do.
Oct. 8	Clear; 2 small trout.
Oct. 9	No trout; moved boat up the river.
Oct. 10	Clear; no trout.
Oct. 11	Do.
Oct. 12	Clear; 6 large trout and 12 small ones.
Oct. 13	Clear; no trout.
Oct. 14	Cloudy; no trout.
Oct. 15	Raining hard in evening.
1886.	
Oct. 16	Clear; 15 large and 3 small trout.
Oct. 17	Strong north wind; no trout.
Oct. 18	North wind and very cloudy; no trout.
Oct. 19	Clear; no trout.
Oct. 20	Do.
Oct. 21	Clear; no trout biting.
Oct. 22	Cloudy; no trout.
Oct. 23	Do.
Oct. 24	Do.
Oct. 25	Clear; no trout.
Oct. 26	Cloudy, without rain; no fish.
Oct. 27	Cloudy; fish not biting.
Oct. 28	Clear; no trout.
Oct. 29	Do.
Oct. 30	Do.
Oct. 31	Do.
Nov. 1	Clear; nights cool.
Nov. 2	Clear and pleasant.
Nov. 3	Do.
Nov. 4	Clear; trout not biting.
Nov. 5	Do.
Nov. 6	Do.
Nov. 7	Do.
Nov. 8	Very cloudy, with some rain; trout not biting.
Nov. 9	Days clear and nights cool.
Nov. 10	Do.
Nov. 11	Clear; no trout biting.
Nov. 12	Do.
Nov. 13	Do.
Nov. 14	Cloudy, but no wind.
Nov. 15	Cloudy, with wind.
Nov. 16	Cloudy, with strong north wind.
Nov. 17	Cloudy; no trout biting.
Nov. 18	Do.
Nov. 19	Cloudy; caught 13 trout.
Nov. 20	Heavy rain all night.
Nov. 21	Cloudy; night cool.
Nov. 22	Cloudy, but no rain.
Nov. 23	Do.
Nov. 24	Do.
Nov. 25	Clear and pleasant.
Nov. 26	Do.
Nov. 27	Cloudy; caught 13 trout.
Nov. 28	Cloudy; no trout.
Nov. 29	Cloudy; 13 trout.
Nov. 30	Clear; 5 trout.
Dec. 1	Cloudy; no trout.
Dec. 2	Do.
Dec. 3	Clear and pleasant; no trout.
Dec. 4	Do.
Dec. 5	Do.
Dec. 6	Clear.
Dec. 7	Do.
Dec. 8	Clear, with north wind.
Dec. 9	Do.
Dec. 10	Cloudy, with south wind.
Dec. 11	Very cloudy.
Dec. 12	Do.
Dec. 13	Do.
Dec. 14	Very cloudy, but no rain.
Dec. 15	Do.
Dec. 16	Raining slightly.
Dec. 17	Cloudy, but not raining.
Dec. 18	Clear and pleasant.
Dec. 19	Cloudy, but no rain.
Dec. 20	Cloudy; working on fish-traps.
Dec. 21	South wind; working on fish-traps.
Dec. 22	Began raining in afternoon.
Dec. 23	Raining slowly; fishing in river all done; no trout in fish-traps as yet.
Dec. 24	Water 3 feet higher than usual.
Dec. 25	Raining slowly.
Dec. 26	Raining again quite hard.
Dec. 27	Raining very hard.
Dec. 28	Water very muddy and rising.
Dec. 29	Raining, but water falling.
Dec. 30	Clear; water falling.
Dec. 31	Rained hard all night.

XIV.—REPORT ON THE PROPAGATION OF PENOBSCOT SALMON IN 1886-'87.

By Charles G. Atkins.

The number of salmon purchased for breeding purposes at the Penobscot Station in 1886 was limited to 205, which were received between May 29 and June 8. By collecting them thus early it was hoped that we might avoid in great measure the losses that annually decimate the stock of salmon during the transfer from the weirs to the inclosure, and also while confined during the summer months in Dead Brook. These hopes were only partially realized. There were, to be sure, no deaths in transit, but out of the 205 placed in the inclosure only 147 (or 72 per cent.) were recaptured in the fall. This is a less favorable result than in 1885, when the collection of salmon was continued till June 20, and when 72 per cent. of the whole number purchased and 82 per cent. of those actually placed in the inclosure were saved and made serviceable in the fall. The deaths in the inclosure occurred for the most part, as usual, soon after the salmon were inclosed, and thus before the height of the summer's drouth or heat. Of 48 whose remains were found 33 were discovered in June, 9 in July, and 6 in August, the last 6 bearing evidence of having been dead from ten to twenty days.

This was a year of large salmon in the Penobscot. The average of the estimates of the entire stock collected was 16.47 pounds. At the spawning season those remaining on hand were found to average 14.47 pounds in weight and 34 inches in length, including all the males and gravid females.

The spawn was taken at the usual date, and the 101 females recovered yielded a total of 1,158,776 eggs, an average of 11,473 each.

The development of the embryos up to the shipping point was attended with a loss of 59,776, or 5.2 per cent. The loss from non-impregnation was estimated at 21,035, or 1.8 per cent. Among the rejected eggs was an entire lot of very small and evidently worthless eggs which were thrown out in a mass soon after placing them in the hatchery. Leaving these out of the account, the total loss appears to have been but 3.9 per cent., a very satisfactory result.

The net stock of eggs available for division among the subscribers to the fund was 1,099,000, of which there were awarded to the State of

Massachusetts 320,000, and to the U. S. Commission of Fisheries 779,000. Out of the latter, 25,000 were reserved for experiments in rearing and feeding at the Bucksport Station, but were subsequently liberated (June 13) in Craig's Pond. The remainder were distributed as per following schedule:

TABLE I.—*Statement of shipments of salmon eggs from the Penobscot Station in 1887, from the stock collected in 1886.*

Date.	Consignee and address.	Belonging to Massachusetts.	Belonging to United States.	Total.	Number of cases.	Time en route.	Condition on unpacking.	Dead on unpacking.
1887.						Days.		
Feb. 1	F. Mather, Cold Spring Harbor, N. Y	....	250,000	250,000	4	3	Excellent.	479
2	F. A. Walters, Bloomingdale, N. Y	....	250,000	250,000	4	6	Good.	58
3	E. B. Hodge, Plymouth, N. H	110,000	100,000	210,000	3	2	Good.	23
8	E. B. Hodge, Plymouth, N. H	210,000	....	210,000	4	2	Good.	40
21	F. Mather, Cold Spring Harbor, N. Y	....	40,000	40,000	1	3	Excellent.	38
23	F. Mather, Cold Spring Harbor, N. Y	....	10,000	10,000	1	3	Excellent.	40
24	W. H. Munson, Grand Lake Stream, Me	....	89,000	89,000	2	3	Good.	37
28	W. H. Munson, Grand Lake Stream, Me	....	15,000	15,000	1	3	Good.	0
	Total	320,000	754,000	1,074,000	20	......	....	715

TABLE II.—*Observations on temperature of Eastern River at Orland Lower Dam, June, 1886.*

[During the period while breeding salmon are usually collecting.]

Date.	Hour.	Temperature.	Date.	Hour.	Temperature.
1886.		°F.	1886.		°F.
June 1	6 p. m	66	June 14	8 a. m	69
2	8 a. m	65	14	5½ p. m	70
2	6 p. m	64	15	8 a. m	68
3	8 a. m	62	16	8 a. m	69
3	5½ p. m	64	17	7½ a. m	69
4	8 a. m	63½	17	5½ p. m	71
4	5 p. m	66	18	8 a. m	70
5	8 a. m	65	18	5½ p. m	71
5	5 p. m	66½	19	8 a. m	70
6	No observation	....	19	5½ p. m	71
7	8 a. m	66	20	8 a. m	70
7	5½ p. m	68	20	5½ p. m	71
8	8 a. m	67	21	8 a. m	71
8	5½ p. m	68	21	5½ p. m	72
9	7 a. m	67	22	7 a. m	72
10	7 a. m	67	25	5 p. m	71
11	8 a. m	68	26	8 a. m	70
12	8 a. m	68	28	4½ p. m	71
13	No observation	....			

TABLE III.—*Observations on temperature of Dead Brook (at the salmon inclosures)*, 1886.

[NOTE.—These observations were taken between 5 and 6 a. m.]

Day of month.	June.	July.	August.	September.	October.	Day of month.	June.	July.	August.	September.	October.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*		° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1	....	54	64	56	52	17	60	60	52	52	35
2	....	58	64	54	50	18	62	62	52	52	36
3	57	64	63	54	44	19	56	62	52	54	52
4	54	62	63	54	44	20	56	58	58	52	37
5	55	60	58	55	46	21	56	58	52	48	37
6	54	60	58	55	45	22	57	58	58	44	40
7	53	65	57	62	43	23	60	52	58	42	37
8	56	66	60	61	47	24	61	55	52	44	36
9	56	63	60	60	48	25	59	55	52	44	36
10	58	63	59	62	47	26	58	62	58	48	35
11	60	59	60	63	48	27	60	62	58	54	34
12	58	58	62	61	48	28	60	62	60	50	40
13	55	58	60	60	47	29	58	63	60	52	40
14	55	60	60	60	45	30	55	62	54	52	....
15	56	62	58	56	55	31	....	65	60	....	....
16	58	60	56	51	45						

TABLE IV.—*Observations on temperature of water in the hatchery at Craig's Brook, October, 1886, to June, 1887.*

[Taken in the morning.]

Day of month.	1886.			1887.					
	October.	November.	December.	January.	February.	March.	April.	May.	June.
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
1	....	51	39	34	33	32	34	....	54
2	....	52	36	34	33	32	34	36	56
3	....	52	36	33	32	33	34	38	56
4	....	52	32	32	32	33	34	38	55
5	....	52	33	34	32	33	34	38	54
6	....	52	34	34	32	33	34	42	56
7	....	50	33	34	32	33	34	43	58
8	....	46	34	33	32	33	33	42	58
9	....	44	36	32	33	33	34	44	58
10	....	48	33	32	33	34	35	44	57
11	....	50	36	32	34	33	35	42	57
12	....	46	36	34	34	33	34	43	57
13	....	42	36	33	33	33	34	43	57
14	....	44	34	31	33	34	34	44	....
15	....	41	34	32	34	34	34	47	....
16	....	41	33	32	34	34	34	48	....
17	....	42	32	31	34	34	34	48	....
18	....	42	32	32	34	34	34	50	....
19	....	43	34	31	33	34	34	52	....
20	....	42	34	32	34	34	35	54	....
21	....	42	34	34	32	34	35	54	....
22	....	40	34	34	34	34	34	53	....
23	....	40	34	34	34	34	36	56	....
24	....	44	34	34	34	33	36	56	....
25	....	40	34	34	33	33	36	56	....
26	....	40	33	34	34	33	35	56	....
27	....	38	34	32	33	33	35	56	....
28	48	36	34	32	33	34	35	54	....
29	50	36	34	34	....	34	36	54	....
30	52	42	32	34	....	34	36	55	....
31	50	....	32	34	....	34	....	56	....
Mean	50	44.3	34	33	33.1	33.4	34.5	48	56.4

BUCKSPORT, ME., *November* 8, 1887.

XV.—REPORT ON THE PROPAGATION OF SCHOODIC SALMON AT GRAND LAKE STREAM, MAINE, IN 1886-'87.

By Chas. G. Atkins.

The management of the Schoodic Station for this year was placed in the hands of the assistant superintendent, Mr. W. O. Buck, of Bucksport, whose chief helper was the experienced foreman, Mr. William H. Munson, of Princeton, who has served the station in that capacity since its organization, and to whose skill and fidelity the success of the work has been largely due.

Mr. Munson began work the first of September and placed the barrier-nets across the outlet of Grand Lake on the 15th of that month. The pounds were built at the usual date, and made ready for the capture of fish on the 28th of October. The run of fish was rather small, not quite equal to that of 1885. Of the 752 taken in all, 505, or 67 per cent., were females, and 247, or 33 per cent., males. The fish proved of satisfactory size and fecundity, the females yielding an average of 1,935 eggs each, a higher rate than ever before observed, except in 1884, when the yield was 2,349 eggs per fish.

The fishing and spawn-taking was accomplished under the disadvantage of very low water and a current too sluggish to attract the fish into the inclosures so freely as desirable, and a larger number than usual spawned on the shallows above our nets. But for extra exertions to capture the recusants, by stretching additional nets, the loss from this cause would have been very serious.

In 1885, at the close of the work of spawn-taking, the greater number of the salmon in hand were marked by cutting out a V-shaped piece from the outer margin of the anal fin. This year all the salmon that were handled were closely scrutinized for these marks, and 56 of them (5 males and 51 females) were found to bear what appeared to be the mark sought for. In each of these cases there was a distinct, well-defined triangular transparent spot in the requisite position. It appeared as though the rays and integuments had been reproduced so as to completely fill out the outline of the fin, but that the new growth had as yet assumed no color. So distinct were these marks that both Mr. Buck and Mr. Munson were fully convinced that they were the marks of 1885. Such a result was unexpected and great interest will attach to a repetition of the experiment. These 56 marked fish average in weight 3.4 pounds, and in length 20.5 inches, in both points less than the general average of 1885. For a more exact experiment Mr. Buck has devised a system of marks consisting of holes to be punched through the fins, by which numerals can be indicated and individual fishes identified on their return, and these marks were applied to a large part of the fishes handled in 1886.

The eggs obtained numbered in all 942,500. They were all placed for development in the cold water of the river house, and there remained till the month of February, when they were removed to the cove house, preparatory to division and shipment, which was accomplished in March. The losses from lack of impregnation and other causes reduced the eggs available for division to 855,500. The legal reserve took from these 214,000, and the remaining 641,500 were divided among the subscribers to the fund as follows: Massachusetts, 132,000; New Hampshire, 132,000; United States, 377,500.

The eggs for shipment were packed as usual in Sphagnum moss, and transferred by express, over the usual route, including a ride of 36 miles in the open air, and all reached their destination safely.

The 214,000 eggs reserved for Grand Lake were hatched and planted with the very small loss of 1,044 eggs and fry. A lot of 104,000 sea-salmon eggs were sent over from Bucksport by the Maine Commissioners and hatched at the Schoodic Station to be planted in waters tributary to the St. Croix. They were likewise successfully hatched with a loss of but 255 eggs and fry, and were planted in Junior Stream and Upper "Dobsey" Stream June 15, 17, and 20, 1887.

The following tabular statements will be found to give additional details of interest:

TABLE I.—*Fishing record at Grand Lake Stream, Maine, 1886.*

[Each day of 24 hours, ending at 7 a. m.]

Date.	Day weather.	Night weather.	Height of Grand Lake.	Temperature, 7 a. m.	
				Air.	Water.
1886.			Ft. In.	°	°
Oct. 28-29	Clear a. m., overcast p. m.; light easterly wind.	Partly overcast, wind increasing, more northerly.	1 8	32	46
Oct. 29-30	Mostly clear, northerly wind; moderate.	Sprinkling at p. m., raining balance of night; light E. wind.	1 7	37	46
Oct. 30-31	Raining a. m., light E. winds; misty p. m.	Cloudy and damp; calm, little or no rain.	1 7	43	46
Oct. 31-Nov. 1.	Cloudy a. m., calm p. m.	Clear, 9 p. m.; misty in morning.	......	44	48
Nov. 1- 2	Misty morning, clearing toward noon.	P. m. fine; light W. wind, becoming misty toward morning.	......	40	48
Nov. 2- 3	Misty morning, wind SE.; misty all day.	Overcast, wind rising and veering to W.	......	......	......
Nov. 3- 4	Misty morning, clearing with shower in p. m.	Clear, bright night; calm; growing colder.	......	48	49
Nov. 4- 5	Clear, frosty morning, bright, light W. wind.	Grew colder till midnight; frosty, then damp and warmer.	......	25	49

TABLE I.—*Fishing record at Grand Lake Stream, Maine,* 1886—Continued.

Date.	Day weather.	Night weather.	Height of Grand Lake.	Temperature, 7 a. m.	
				Air.	Water.
1886.			*Ft. In.*	°	°
Nov. 5- 6	Calm, cloudy morning, white frost; cloudy all day.	Wind rising SE.; heavy showers; gale from SE.	......	38	46
Nov. 6- 7	Cloudy, high wind from SE.; heavy rain a. m., clearing p. m.	Beautiful evening; moderate W. wind.	1 6	51	51
Nov. 7- 8	Fine morning, overcast, noon clearing.	Clear, W. wind; becoming overcast.	......	24	45
Nov. 8- 9	Chilly, overcast, moderating wind.	Clear, becoming cloudy; wind veering to E.	......	23	43
Nov. 9-10	Cloudy, calm	Calm, cloudy, damp; a little rain.	......	28	43
Nov. 10-11	Light E. wind, misty, clearing.	Calm, clearing........	......	38	44
Nov. 11-12	Light W. wind, becoming northerly; fair.	Fair; becoming cloudy; light E. and NE. wind rising.	......	29	44
Nov. 12-13	Snow about 7 a. m., wind NE.; rain p. m.	Rain, NE. wind first part, cloudy latter.	......	29	42
Nov. 13-14	Snow and rain, NE. wind, becoming NW.; noon snow-squalls.	Colder, with snow-squalls; less cloudy.	......	32	42
Nov. 14-15	Wind NW., growing more cloudy.	NW. gale, moderating toward morning.	......	27	40
Nov. 15-16	High NW. wind; fair; wind moderating at night.	Calm, cloudy	......	20	37
Nov. 16-17	Calm, overcast	Snow, followed by icy rain....	......	20	37
Nov. 17-18	Rain, E. wind, becoming southerly.	....	......	32	37

Date.	Adult Schoodic salmon.						Salmon, parr, and smolts.	Remarks.
	Daily catch.			Daily summary.				
	Males.	Females.	Total.	Males.	Females.	Total.		
1886.								
Oct. 28-29	19	6	25	......	......	......	2 p.	2 suckers, 2 small salmon, lot of chubs; 3 gates open.
Oct. 29-30	19	10	29	38	16	54	3 p.	3 parr, lot of suckers and chubs; 5 gates open at night.
Oct. 30-31	......	......	......	......	......	......	......	
Oct. 31-Nov. 1..	48	32	80	86	48	134	2 p.	2 suckers, 1 sea-salmon, 2 parr; 3 gates open.
Nov. 1- 2	26	26	52	112	74	186	1 p.	3 gates open.
Nov. 2- 3	20	42	62	132	116	248	2 p.	Do.
Nov. 3- 4	17	21	38	140	137	286	......	1 togue, 2 whitefish; 3 gates open.
Nov. 4- 5	25	51	76	174	188	362	1 p.	1 togue, 4 pickerel, meshed; 3 gates open.
Nov. 5- 6	21	85	106	195	273	468	......	4 togue, 5 pickerel, meshed, 2 whitefish; 3 gates open.
Nov. 6- 7	9	52	61	204	325	529	1 p.	6 pickerel, meshed, 1 sucker, 4 togue; 3 gates open.
Nov. 7- 8	19	75	94	223	400	623	......	1 pickerel, meshed; 3 gates open.
Nov. 8- 9	9	18	27	232	418	650	......	3 brook-trout, 3 suckers, 2 brook-trout, 1 pickerel, meshed; 3 gates open.
Nov. 9-10	3	10	13	235	428	663	......	
Nov. 10-11	3	16	19	238	444	682	......	
Nov. 11-12	1	22	23	239	466	705	......	4 pickerel, meshed, 4 suckers, 1 whitefish in trap.
Nov. 12-13	1	21	22	240	487	727	......	
Nov. 13-14	3	2	5	243	489	732	......	1 pickerel.
Nov. 14-15	2	10	12	245	499	744	......	1 whitefish.
Nov. 15-16	......	4	4	245	503	748	1 p.	1 parr.
Nov. 16-17	2	......	2	247	503	750	......	1 brook-trout.
Nov. 17-18	......	2	2	247	505	752	......	

TABLE II.—*Record of spawning operations, Grand Lake Stream,* 1886.

Date.	Fish at first handling. Total.	Males.	Females. Total.	Unripe.	Ripe.	Spent.	Diseased.	Females spawned. First time.	Second time.	New females yielding some defective eggs.	Eggs taken. Weight. Lbs.	ozs.	Number.
1886. Oct. 29	25	19	6	2	3	1	0	4	0	1	1	9	3, 900
30	29	19	10	5	5	0	0	5	0	2	3	5	8, 200
Nov. 1	82	50	32	10	22	0	0	26	8	4	18	7	45, 700
2	52	26	26	6	18	2	0	23	26	6	19	6	48, 200
3	62	20	42	12	29	1	0	29	24	(?)	23	3	57, 700
4	38	17	21	2	19	0	0	27	30	5	22	2	55, 100
5	76	25	51	8	41	2	0	54	27	10	42	11	106, 350
6	106	21	85	11	70	4	0	76	52	17	56	10	141, 000
7	61	9	52	7	44	1	0	44	0	8	32	4	80, 350
8	94	19	75	20	47	8	0	56	111	(?)	55	4	137, 700
9	27	9	18	8	9	1	0	20	56	2	19	7	48, 400
10	13	3	10	2	7	1	0	22	17	....	13	8	33, 600
11	19	3	16	6	9	1	0	21	19	....	16	14	42, 055
12	23	1	22	0	14	7	1	15	22	....	15	2	39, 100
13	22	1	21	2	11	8	0	30	14	3	18	12	46, 742
14	5	3	2	0	2	0	0	6	24	....	5	4	13, 030
15	12	2	10	2	6	2	0	12	5	....	9	2	22, 730
16	4	0	4	0	1	3	0	8	12	....	4	1	10, 120
17	2	2	0	0	0	0	0	0	5	....	0	13	2, 523
18	2	0	2	0	0	2	0	......	......	....	......		....
	754	249	505	103	357	44	1	487	452	....	277	12	942, 500

TABLE III.—*Statement of shipments of eggs of Schoodic salmon from Grand Lake Stream, Maine, in March,* 1887.

Date.	Consignee and address.	Number of eggs— Belonging to States.	Belonging to United States.	Total.	Number of cases.	Distance transported (estimated).	Time en route.	Condition on unpacking.	Dead on unpacking.
1887.						*Miles.*	*Days.*		
Mar. 2	E. D. Carlton, Spirit Lake, Iowa.	....	30, 000	30, 000	1	1, 820	8	Fair	96
	R. O. Sweeny, Saint Paul, Minn.	....	30, 000	30, 000	1	1, 938	5	Good	39
	Baker Bros., Rome City, Noble County, Ind.	....	2, 500	2, 500	1	1, 380	7	....do	6
	F. A. Walters, Bloomingdale, N. Y.	....	30, 000	30, 000	1	790	8	....do	100
	G. W. Delawder, Baltimore, Md.	....	10, 000	10, 000	1	805	......		
5	E. G. Blackford, New York, N. Y.	....	65, 000	*65, 000	3	615	......	Reported arrived in good order at final destination.	
7	E. Z. Leiter, Lake Geneva, Wis.	....	5, 000	5, 000	1	1, 500	5	Good.	
	George A. Seagle, Wytheville, Va.	....	50, 000	50, 000	1	1, 150	6	Very good	44
	F. Mather, Cold Spring Harbor, N. Y.	....	40, 000	40, 000	1	640	3	Excellent	150
	H. T. Root, Providence, R. I.	....	10, 000	10, 000	1	434	3	....do	8
8	E. A. Brackett, Winchester, Mass.	132, 000	30, 000	162, 000	3	398	3	Good.	
9	E. B. Hodge, Plymouth, N. H.	132, 000	25, 000	157, 000	4	516	3	Fair	144
	W. D. Marks, Paris, Mich.	....	25, 000	25, 000	1	1, 431	5	Good	247
24	F. Mather, Cold Spring Harbor, N. Y.	....	25, 000	†25, 000	1	640	5	Excellent.‡	
		264, 000	377, 500	641, 500	21				

* To Germany, 40,000; England, 25,000.
† To France.
‡ Mr. Mather's report of condition on arrival at Cold Spring Harbor.

Observations on temperature, etc., at Grand Lake Stream, Maine, from September 13, 1886, to June 29, 1887.

Date.	Temperature at 7 a. m.					Height of Grand Lake.	Rain.		Snow.	
	Air.	Water.								
		River or lake.	River house.	West aqueduct.	South aqueduct.		Hour when measured.	Rain-gauge.	Hour when measured.	New snow.
1886.	°	°	°	°	°	*Ft. In.*		*Inches.*		*Inches.*
Sept. 13	49	66				2 2	7 a. m.	1½		
14	36	65½								
15	53	64				2 1½				
16	41	63								
17	60½	64					7 a. m.	0½		
18	59	63				2 2				
19	42½									
20	45									
21	35	62				2 1½				
22	32½									
23										
24	44	60½				2 1				
25	36½									
26	51									
27	50	58				1 11				
28	43	57								
29	48					2 0	8 a. m.	1½		
30	36	56								
Total								3½		
Means	44.8	61.7								
Oct. 1	53	56				2 0				
2	36	54				1 11				
3	32	54½								
4	33½	54								
5	36	55				1 11				
6	41	55½								
7	38	54								
8	33½	54								
9	45	54								
10	46	54½				1 10				
11	50	56½								
12	52									
13	35	55				1 10				
14	34									
15	47	51½								
16	35									
17	27½	48				1 9½				
18	35									
19	27									
20	30									
21	52	47								
22	33½									
23	31									
24	29	45				1 7				
25	27½									
26	35									
27	26½									
28	38									
29	32	46				1 6				
30	38	46								
31	43	48					1 p. m.	0⅝		
Total								0⅝		
Means	37.1	52								
Nov. 1	43	48	48			1 6				
2	37	47	47							
3	42	48	48							
4	48	48	48			1 6½				
5	25	46	46							
6	40	46	46			1 6½				
7	51	51	51				3 p. m.	0⅞		
8	24	45	44½							

Observations on temperature, etc., at Grand Lake Stream, Maine, etc.—Continued.

Date.	Temperature at 7 a. m.					Height of Grand Lake.	Rain.		Snow.	
	Air.	Water.								
		River or lake.	River house.	West aqueduct.	South aqueduct.		Hour when measured.	Rain-gauge.	Hour when measured.	New snow.
1886.	°	°	°	°	°	Ft. In.		Inches.		Inches.
Nov. 9	23	43	43	......	......	1 6½	......	......	......	......
10	28	43	43	......	......	......	......	......	......	......
11	38	44	44	......	......	......	......	......	......	......
12	28	44	44	......	......	......	......	......	......	......
13	29	42	41	......	......	1 6	......	......	11 a. m.	1⅜
14	34	42	42	......	......	......	7 a. m.	1	......	......
15	27	40	40	......	......	......	......	......	7 a. m.	0⅜
16	20	37	36	......	......	......	......	......	......	......
19	33	38	38	......	......	1 8	7 a. m.	1⅞	......	......
20	24	37	36½	......	......	......	......	......	......	......
21	20	36	36	......	......	......	......	......	......	......
22	21	36	36	......	......	......	......	......	......	......
23	19	35	34½	......	......	1 9	......	......	6 p. m.	1
24	41	37	37	......	......	......	7 a. m.	0¾	......	......
25	24	36	36	......	......	......	......	......	......	......
26	31	35	35	......	......	......	......	......	......	......
27	12	35	35	......	......	......	......	......	......	......
28	20	35	34½	......	......	......	......	......	......	......
29	22½	36	36	......	......	......	......	......	......	......
30	42	37	37	......	......	1 11	7 a. m.	0¾	......	......
Total	......	......	......	......	......	......	......	5.2	......	2⅝
Means	30.2	41	40.8	......	......	......	......	......	......	......
Dec. 1	43	37½	37½	40	38	......	7 a. m.	0⅛	......	......
2	21	......	37	......	......	2 0	......	......	......	......
3	3	......	34	......	......	......	......	......	7 a. m.	10
4	−5	......	32½	......	......	......	......	......	......	......
5	−10	33	32½	37½	35	2 0½	......	......	......	......
6	9	......	33	......	......	......	......	......	7 a. m.	3½
7	11	......	33	......	......	......	......	......	......	......
8	16	......	33	......	......	......	......	......	7 a. m.	4½
9	22	......	33	......	......	......	......	......	......	......
10	−5	33	32½	39½	38	2 1	......	......	......	......
11	30	......	32½	......	......	......	......	......	......	......
12	17	......	33	......	......	......	......	......	......	......
13	16½	33½	33½	39	37½	2 1	......	......	......	......
14	10	......	33½	......	......	......	......	......	......	......
15	16	......	33½	......	......	......	......	......	10 a. m.	1
16	17	34	33½	......	......	2 1½	......	......	......	......
17	−6	......	32½	......	......	......	......	......	7 a. m.	4½
18	7	......	32½	......	......	......	......	......	8 p. m.	2
19	31	......	33	40	37½	......	......	......	......	......
20	0	33	32½	......	......	2 2	......	......	......	......
21	19	......	32½	......	......	......	......	......	......	......
22	20	......	33	......	......	......	......	......	......	......
23	24½	33	33	40	38	2 2	......	......	......	......
24	28	......	33	......	......	......	......	......	......	......
25	34½	......	33	......	......	......	7 a. m.	0⅞	......	......
26	5	......	33	......	......	......	......	......	......	......
27	16½	34	33½	40	38½	......	......	......	......	......
28	−4	......	32½	......	......	......	......	......	7 a. m.	2½
29	−10	......	32½	......	......	......	......	......	......	......
30	−18	......	32½	......	......	......	......	......	......	......
31	−8	33	32½	39	37	......	......	......	......	......
Total	......	......	......	......	......	......	......	1⅜	......	27¾
Means	11.3	33.8	33.1	39.4	37.4	......	......	......	......	......
1887.										
Jan. 1	26½	33	32½	39	37	......	......	......	7 a. m.	2½
2	16	......	33	......	......	......	......	......	3 p. m.	4½
3	−8	......	32½	......	......	......	......	......	......	......
4	−22	......	32½	......	......	......	......	......	......	......
5	−11	32½	32½	38½	37	......	......	......	......	......
6	25	......	33	......	......	......	......	......	3 p. m.	4
7	20	......	32½	......	......	......	......	......	......	......

Observations on temperature, etc., at Grand Lake Stream, Maine, etc.—Continued.

Date.	Temperature at 7 a. m.					Height of Grand Lake.	Rain.		Snow.	
	Air.	Water.					Hour when measured.	Rain-gauge.	Hour when measured.	New snow.
		River or lake.	River house.	West aqueduct.	South aqueduct.					
1887.	°	°	°	°	°	*Ft. In.*		*Inches.*		*Inches.*
Jan. 8	—16		32½							
9	—24		32½							
10	8		32½	39½	38				1 p. m.	3⅞
11	—10	33	32½							
12	17		33							
13	10		33							
14	— 1		33							
15	10		33						7 a. m.	8½
16	2½	33	32½	40	37½					
17	3		32½						7 a. m.	2¾
18	12½		32½							
19	—24		32½							
20	— 7	32½	32½							
21	34		33							
22	— 4		33	40	38½				5 p. m.	1¼
23	35		33							
24	26½		33				7 a. m.	0½		
25	13		33½				7 a. m.	0¾		
26	30½	34½	34	37	36					
27	—10		32½						7 a. m.	1
28	— 4		33							
29	47		34							
30	44		34							
31	24	35	34	37½	36					
Total								1¼		28
Means	8.5	33.4	32.9	38.8	37.1					
Feb. 1	0	35½	34	37	35½					
2	— 8		33½							
3	4		33½							
4	17		33½						7 a. m.	2
5	— 6	34	33	36	35				5 p. m.	1
6	2		33							
7	4		33						6 p. m.	4½
8	3		33							
9	34	34	34	36	35		7 a. m.	0½		
10	0		34							
11	28½		34							
12	14		33½						7 a. m.	6
13	—10	33	33							
14	—21		32½							
15	26		33	36½	35				3 p. m.	2½
16	30½		33½	36½	35					
17	29	34½	34	37	35				7 a. m.	2
18	— 1		33½	37	35					
19	38		34	37	35½				7 a. m.	5½
20	24½	34½	34	37	35½					
21	12		34	37	35½					
22	—11		34	37	35½					
23	3½		33½	37	35½				7 a. m.	1⅞
24	14		34	37½	36					
25	— 1½		33	37½	36				7 a. m.	7½
26	— 5		33	38	36					
27	32		34	37½	36				7 a. m.	5
28	12½		33	37	36					
Total										37.9
Means	9.5	34.2	33.5	37	35.5					
Mar. 1	— 8	33	33	37	36					
2	— 1		33	37	36					
3	10		33	37½	36					
4	—13		33	37½	36					
5	—20		32½	37	36					
6	— 7		33	37	36					

Observations on temperature, etc., at Grand Lake Stream, Maine, etc.—Continued.

Date.	Temperature at 7 a. m.					Height of Grand Lake.	Rain.		Snow.	
	Air.	Water.					Hour when measured.	Rain gauge.	Hour when measured.	New snow.
		River or lake.	River house.	West aqueduct.	South aqueduct.					
1887.	°	°	°	°	°	*Ft. In.*		*Inches.*		*Inches.*
Mar. 7	15	......	33½	37½	36	......	......	......		
8	30	34½	34	37½	36	......	......	......	7 a. m.	2
9	4	......	34	37½	36½	......	......	......	......	......
10	23	......	34½	38	36½	......	......	......	......	......
11	26	......	34½	38	36½	......	......	......	......	......
12	32½	......	34½	38	36½	......	......	......	7 a. m.	6½
13	33	......	35	38	36	......	......	......	......	......
14	28	......	35	37½	36	......	......	......	......	......
15	27	34½	34½	37½	36	4 5	......	......	......	......
16	24½	......	34	37	35½	......	......	......	......	......
17	32½	......	34	37	35	......	......	......	10 a. m.	1½
18	38	......	34½	37½	35½	......	......	......	......	......
19	40½	......	34½	37½	35½	......	......	......	......	......
20	25	......	34½	37½	36	4 5	......	......	......	......
21	21½	......	35	38	36	......	......	......	......	......
22	34	......	35	38	36½	......	......	......	......	......
23	35½	......	......	38	36½	......	......	......	7 a. m.	.12
24	7	......	......	38	36	......	......	......	......	......
25	32	......	......	37½	36	......	......	......	11 a. m.	1⅜
26	15½	34	......	37	35½	4 5½	......	......	......	......
27	22	......	......	37	36	......	......	......	......	......
28	26	......	......	37	36	......	......	......	11 a. m.	3
29	28	......	......	37½	36	......	......	......	......	......
30	14	......	......	37½	35½	......	......	......	......	......
31	18½	......	......	37½	35½	4 6	......	......	......	......
Total	......	......	......	......	......	......	......	......	......	23.4
Means	19.2	34	34	37.4	36	......	......	......	......	......
Apr. 1	7	34½	......	37	36	4 6	......	......	......	......
2	25	......	......	37	36	......	......	......	......	......
3	29	......	......	37	36	......	......	......	7 a. m.	8
4	27½	......	......	36½	36	......	......	......	......	......
5	35	34½	......	36½	35½	4 7	......	......	......	......
6	24	......	......	36½	35½	......	......	......	......	......
7	13	......	......	36	36	......	......	......	......	......
8	18½	......	......	36	36	......	......	......	......	......
9	27	......	......	36	35½	......	......	......	......	......
10	40	......	......	36	35	......	......	......	......	......
11	44½	34½	......	35½	35	4 9	......	......	......	......
12	26	......	......	35½	35	......	......	......	......	......
13	20	......	......	35½	35	......	......	......	......	......
14	28	......	......	35½	35½	......	......	......	......	......
15	30	......	......	35½	35½	......	......	......	......	......
16	29	......	......	35½	35	......	......	......	......	......
17	40	34½	......	35½	35½	4 10	......	......	7 a. m.	⅛
18	26	......	......	35	35	......	......	......	......	......
19	30	......	......	35½	35	......	......	......	......	......
20	33½	......	......	35	35	......	......	......	......	......
21	32	......	......	35	35	......	......	......	......	......
22	37	......	......	35	35	......	......	......	......	......
23	38	36	......	35	35	5 4	......	......	......	......
24	31	......	......	35½	35	......	......	......	......	......
25	28	......	......	35½	35	......	......	......	......	......
26	32	......	......	35½	35½	......	......	......	6 p. m.	2½
27	36	37½	......	36	35½	5 7	......	......	......	......
28	38	......	......	36½	36	......	......	......	......	......
29	40	......	......	37	36	......	......	......	......	......
30	43	38	......	37½	36½	6 3	6 p. m.	2⅞	......	......
Total	......	......	......	......	......	......	......	2.9	......	11.1
Means	30.3	35.6	......	35.7	35.4	......	......	......	......	......
May 1	34	38½	......	38	37	6 4	......	......	......	......
2	30	......	......	38½	37	6 5	......	......	......	......
3	40	......	......	38½	37	6 5½	......	......	......	......

Observations on temperature, etc., at Grand Lake Stream, Maine, etc.—Continued.

Date.	Temperature at 7 a. m.					Height of Grand Lake.	Rain.		Snow.	
	Air.	Water.								
		River or lake.	River house.	West aqueduct.	South aqueduct.		Hour when measured.	Rain-gauge.	Hour when measured.	New snow.
1887.	°	°	°	°	°	*Ft. In.*		*Inches.*		*Inches.*
May 4	45½			39½	38	6 7½				
5	46	39		40	38	6 8½				
6	43			41	38½	6 9				
7	39			42	39	(*)				
8	44			42	39					
9	42½			42½	39½					
10	41	39½		42½	39½					
11	48			43	39½					
12	50			43	40½					
13	39			43½	41					
14	42			44	42½					
15	51½			44½	43½					
16	48	44		45	44					
17	38			45	44½					
18	50			45	44½					
19	52½			45	45					
20	56	46		45½	45					
21	59			45½	45					
22	45			46	45½					
23	49			46	46					
24	60	47		47	46½					
25	58½			47½	47					
26	57			48	47½		7 a. m.	0⅓		
27	47			48	47½					
28	44	47		48	47					
29	49			47½	46½		7 a. m.	0¾		
30	49			46	46					
31	52	48		46	46					
Total								1.2		
Means	46.7	43.6		43.9	43.6					
June 1	52	48½		46	46½					
2	54			46	46½					
3	60			46½	46½					
4	49½			47	48		7 a. m.	1⅝		
5	52			47	48					
6	58	55		47	48					
7	64			47½	48½					
8	61			47½	48					
9	57			47½	49½		10 a. m.	0⅝		
10	58½	50		47	49					
11	60			47	49					
12	59			47	49					
13	63	60		47	49					
14	56			47	49					
15	(†)									
16	(†)						7 p. m.	0½		
17	60			47½	49					
18	52			47½	49					
19	58	62		47½	49					
20	(†)									
21	(†)									
22	56			48½	50		7 a. m.	0¾		
23	63½			49½	51		7 a. m.	0¼		
24	61			50	52½		9 a. m.	1		
25	(†)									
26	(†)									
27	(†)									
28	(†)									
29	68	64		51½	52½					
Total								4.5		
Means	58.2	58.1		47.6	48.9					

* Water-gauge swept away by ice. † Observer absent distributing fry.

BUCKSPORT, ME., *November* 8, 1887.

XVI.—REPORT OF OPERATIONS AT BATTERY STATION, HAVRE DE GRACE, MD., FOR THE YEAR ENDING DECEMBER 31, 1886.

By W. de C. Ravenel.

This year was ushered in at Battery Station by a continuance of work on the breakwater at west end of carp pond. This was interrupted early in January by bad weather and ice, so that but 12 feet were added to the work of December, making 92 feet to the end of January. One hundred and fifty tons of ice were cut and stored in this month; 26 iron cots were finished, which completed the 30 originally intended. The boilers and engines of the launches were thoroughly overhauled, as also the pumps. One of the station carpenters assisted in work on steamer Halcyon for fifteen days during January. On the 30th, at 9.30 p. m., 200 feet of the crib at the outer end of the wharf were carried away to low-water mark by ice and overthrown into the carp pond. The damage is estimated at $1,000. On 31st, the entire force was at work cutting ice to move pile-driver to a place of safety. The presence of ice made it necessary to use sledge-boats in trips to Havre de Grace for mail, provisions, etc.

A very small portion of February was suitable for outdoor operations, it being generally too cold. But very little work was done to the new breakwater; the piles pushed off the main wharf by ice were recovered, and such timbers from the broken wharf as could be got at and wedged apart were saved. The general and routine work was carried on; repairs to launches were made in the way of stanchions, fenders, scraping, and sand-papering. The barge kitchen and mess-room were given two coats of paint inside, and tinware used in hatching operations was painted outside.

Ice covered the head of the bay all the first portion of February. A heavy movement of ice occurred on 13th at 4 p. m., lasting thirty minutes, crushing about 20 feet of the sheet-pile dike erected during the winter. At midnight, same date, a movement lasting ten minutes crushed about 25 feet of the southern end of the same work. The damage by ice this month is about $180. The ice piled 15 feet above wharves on north side of island.

During the early part of March, work on the machinery, etc., of the launches was pushed to completion, and, as soon as the weather permitted, all of the boats, scows, etc., belonging to the station were overhauled, painted, and launched. Six new flat-bottom row-boats were purchased, making the number of this class available 20. Two new round-bottom gilling skiffs, 21 feet long, with masts, oars, and anchors, were also purchased for use in the shad work. Two gilling nets of 100 fathoms each were added to the outfit, and the seine was hung and tarred. The seine haul was well dragged and cleared of snags and stumps, and all necessary work for putting the station in order for the hatching operations was done.

The shad season opened on April 18 and closed June 10, during which time the station collected 60,766,000 shad eggs and 600,000 eggs of the rockfish. A full report of these operations has been submitted by Mr. L. R. Grabill, the superintendent of the station at that time.*

At the conclusion of the shad work the temporary force was discharged, the equipment dismantled and stored, and the seine cut out. A drive-well was started on the island, with the view of obtaining an artesian water supply. The well was carried to a depth of 150 feet by July 1. The Assistant Commissioner obtained authority from the U. S. Geological Survey to have a geologist examine this well, and Mr. W. J. McGee proceeded to Battery Station during the first half of July. His report, however, was adverse, and the well was abandoned.

In the middle of July, Mr. Grabill left the station temporarily to assume charge of some dredging operations to be conducted at Saint Jerome Station. This work occupied him until August 5, when the dredging-machine, which had been borrowed from the Navy Department, was brought to this station in tow of the steamer Fish Hawk. The report of the work accomplished will be embodied in the annual report of Mr. W. de C. Ravenel, superintendent of St. Jerome Station.

In the mean time, the routine work of the station was carried on under the supervision of Mr. William P. Sauerhoff, and the roof of hatching-house was painted and work was done to pumps, etc. The launch Blue Wing arrived at the station on August 10, and was at once dismantled and the machinery removed for overhauling, and the launch towed to Havre de Grace to be hauled out for repairs to hull and condenser. She was returned to Battery Station on August 21 and hauled out.

On Mr. Grabill's return with the dredging-machine, he proceeded to cut a channel from the main channel to pool gates, and completed this between the 9th and 14th of August; the cut was 20 feet wide with a depth of 8½ feet at low water, mean. The remaining work in this line was completed by August 21, and Colonel Abert, deciding to postpone further dredging at Saint Jerome, the proposed return to that point was given up. Mr. Spencer agreeing to make certain concessions as to the use of his railway at Havre de Grace if permitted to do one day's dredging with the mud-machine, the dredge was towed to that point on the 23d, the work he desired performed, and then the machine returned to the station. The well-driving equipment was transferred to the steamer

* See F. C. Bulletin for 1886, p. 361.

Fish Hawk, and on the 21st transported to Saint Jerome Station, to be used there in securing an artesian water supply. On the 24th of August the dredge force was discharged, the machine laid up, and Mr. L. R. Grabill left the service of the Fish Commission to return to the U. S. Engineer service under Col. S. T. Abert. The station was then transferred to the charge of Mr. William P. Sauerhoff.

After Mr. Sauerhoff assumed charge of the station, and up to the latter part of September, the small force under him was engaged in routine work of painting flat-boats and deck of Blue Wing and interior of launches, and in repairs to pile-driver, gill-boat sails, pumping out dredge and pile-driver, work on pile-driver, engines, etc. The well-driving equipment sent to Saint Jerome by the Fish Hawk was returned to this station on September 6. September 22 Maj. N. H. Hutton visited the station to obtain information as to the depth of water around the island, etc. His visit was followed by those of Captain McCullough and Mr. Glenn in reference to the engineer work provided for by act of Congress.

Mr. McGee arrived at station on 21st, and on 22d and 23d used launch in his investigations as to the geology of the surrounding country. Towards the latter part of October the United States engineer force began to arrive at the station and soon had preparations for their work completed. The operations were commenced October 27 and continued until December 23, when work was suspended on account of ice. The work of extending the hatching-house was commenced in the first part of November, and was vigorously pushed during the following weeks. The foundation for the new storehouse was started, and the men from the Fish Hawk, which had arrived on the 4th of November, and from the Halcyon, assisted the station force in these operations. The Assistant Commissioner frequently visited the station to supervise the work.

On November 20, Mr. W. de C. Ravenel, superintendent of Saint Jerome Station, was transferred to the charge of this station and took the work in hand. During the latter part of November and through the month of December the work on the hatching-house was carried forward with all energy. The force was increased by details from the Fish Hawk and Halcyon. In the machinery department, all pumps and machinery were overhauled, as were launches, small boats, etc.

HAVRE DE GRACE, MD., *September* 9, 1887.

XVII.—REPORT OF OPERATIONS AT SAINT JEROME OYSTER-BREEDING STATION FOR THE YEAR 1886.

By W. de C. Ravenel.

During the greater parts of the months January, February, and March the channel to station and the upper part of the creek was frozen over, stopping all oystering and communication by water. Records of the temperature and density of water in the ponds and bay were kept during that time when practicable.

It having been decided to continue the experiments in artificial propagation by means of artificially-impregnated spawn on a much larger scale than before and without confining it to ponds in which the water was filtered, and also to give Prof. John A. Ryder's system of spat collection a fair trial, 300 bushels of oysters were purchased in April and bedded in lower pond for the artificial propagation, and 75 bushels were put in pond 5 to furnish spawn for the Ryder experiment, the flume used to connect pond and channel having been taken out.

I was ordered to Battery Station on April 21 to assist in the shad-hatching operations and returned to Saint Jerome on May 26. During the month of June a zigzag canal 270 feet in length, 4 feet deep, and 3½ feet wide, connecting pond 5 and main channel, was dug, sheathed up, and baskets made, which, soon after the 1st of July, were filled with clean shells and placed in canal.

The bank around the lower pond was wattled from the south end of piles to wharf on Deep Point; piles were driven around the mouth of terra-cotta pipe connecting bay and pond 4 and inclosed with wire netting to keep out sea-weed and trash. A large quantity of sea-weed having settled at wharf, the men were employed two days removing a part of it; the *Halcyon* arriving on 30th with the Assistant Commissioner, finished this work by means of her propeller.

The laborers employed in digging canal, handling baskets, and other general work were hired from the immediate vicinity at $1.50 per day.

On June 23 ripe oysters were found in sufficient numbers to commence spawning regularly. The force, consisting of four men, was employed daily during the season in collecting ripe oysters, distributing the artificially-fertilized spawn in ponds 1, 2, 3, 4, and 5, and at other points, and putting out collectors of slate and tile, coated with mortar, placed in frames of various designs, so as to be in horizontal and upright positions. Wire trays, covered with oysters and slate, resting on trestles about 8 inches high, were used in the ponds where artificially-fertilized spawn was distributed. In addition to these, plastering laths and shingles nailed to strips were made use of in the ponds and surrounding waters, fixed so that where some floated on the surface, others rested on the bottom or were anchored midway. Shells were also used as formerly, strung on galvanized wire.

The Steamer *Fish Hawk* arrived July 11 with dredge and two scows. Leaving them she proceeded to Battery Station, returning on the 16th with two launches and a large force of men to work the dredge and sink an artesian well under the direction of Mr. Grabill, superintendent Battery Station, who, immediately upon his arrival, commenced sinking the well at the north-east corner of wharf. After several attempts to get water near the surface, the pipe was driven down about 80 feet and then abandoned, in consequence of the pumps being out of order.

The dredge commenced work in front of wharf to dig out a basin 150 feet wide by 9 feet deep, and to continue deepening the channel leading to station. Very little progress was made, owing to the poor condition of machinery, the difficulty of getting fresh water, and the hardness of the soil. On the 24th the dipper-pole broke and was not replaced until the 28th, when work was resumed.

The Assistant Commissioner arrived on steamer *Halcyon* on 30th instant to inspect the general work of station.

During this month all the shells in the baskets were washed, as much sediment had collected on them; very few young oysters were found at that time on them.

In August spawning was pushed with energy, new collectors being put out daily until the 24th, when these operations ceased. The first appearance of spat was in pond 2 on July 29, when oysters one-eighth of an inch in diameter were found. Mr. Grabill left for Battery Station August 3, sending the dredge, scows, and a launch by the *Fish Hawk* to same point; leaving Launch No. 55 and crew to assist in spawning at this station.

On August 18 Machinist Glennan and a carpenter reported for duty with a pump borrowed from the Fort Washington Station and work was resumed on the well. After several ineffectual attempts to drive the pipe deeper it was given up and a new one commenced, which had been sunk to a depth of 94 feet when Passed Assistant Engineer Reeves arrived on *Fish Hawk* with a large force of men to take charge. The work was now pushed night and day until, on the 26th, when a depth of 303 feet had been obtained, the pipe wrung off 23 feet below the surface. It was then abandoned and the *Fish Hawk* left for Wood's Holl, Mass., taking with her the carpenters, the greater part of the engineer force, and the well-driving equipment. The rest of the men, except Coxswain Jones, were sent to Battery Station on the 31st.

During the months of September and October all collectors put out were taken up and overhauled. The set of spat was exceedingly poor on collectors from channel and lower ponds, though 183 oysters were found on one slate collector from Wrightson's Bar. About 500 were found on collectors in ponds 1, 2, 3, and 4. All those with spat were placed in ponds 1 and 2 on wire trays, resting on bottom.

On September 13, finding the oysters in pond 5 dying in great numbers from the effect of sand, I had them all taken up and put in lower pond. Upon thoroughly overhauling the baskets of shells and finding about 40 oysters to the basket, the shells were scattered in the channel and pond west of cottage.

Having observed a very heavy set of spat in parts of the outer creek, at the suggestion of the Assistant Commissioner, a careful examination of this, with Point Lookout and Smith's Creeks, was instituted. In the former the set of spat was phenomenally large for about one-half mile up both branches, while in the others the set was quite poor, though oysters were plentiful. It would therefore appear that Saint Jerome Creek had been advantageously affected by the large quantity of artificially-fertilized spawn distributed by the station.

The *Fish Hawk* arrived here on 3d of November, left well-tower and equipment, and taking Coxswain Jones and Launch 55, proceeded to Battery Station. The Herreshoff pump borrowed from the carp pond in Washington was returned November 8.

November 14 the *Halcyon* arrived with the Assistant Commissioner, who, after inspecting the station, instructed that it be closed and put in charge of a watchman and the superintendent report to Battery Station. All collectors with oysters attached were left in ponds 1, 2, and 3; about 350 oysters obtained from collectors placed in outer creek were put into three caissons and placed in pond 3. The station was turned over to the watchman, S. B. Wrightson, on 20th of November.

Appended is a table of weather variations and density and temperature, etc., of water at Saint Jerome Station.

HAVRE DE GRACE, *October* 28, 1887.

Table of temperatures, weather, and densities of water at Saint Jerome Station from January 1, 1886, to April 17, 1886, and from July 1, 1886, to November 7, 1886, inclusive.

NOTE.—Salinometer No. 5317 was in use during the following periods: January 17 to February 17; March 16 to April 3; April 5 to April 17; August 4 to September 28. Salinometer No. 5319 was in use during the following periods: January 1 to January 9; February 18 to February 26; March 1 to March 15; July 1 to August 3, and September 29 to November 7.

Date.	State of tide.	State of weather.	Direction of wind.	Temperature of air.	Water at wharf.		Water of oyster ponds.		Water at canal.		Water at lower pond.		Water at Deep Point.		Water in the bay.	
					Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.
1886.				°	°		°		°		°		°		°	
January 1, 10 a. m	High	Clear	NW.	42	41	1.0114	41	1.0110	40	1.0110	41	1.0114	41	1.0114	41	1.0114
January 1, 4 p. m	Low	Clear	NW.	50	45	1.0110	45	1.0110	45	1.0110	44	1.0112	44	1.0112	44	1.0112
January 2, 11 a. m	High	Clear	NW.	43	42	1.0112	42	1.0112	42	1.0114	42	1.0110	42	1.0112	42	1.0110
January 2, 5 p. m	Low	Clear	NE.	45	44	1.0112	44	1.0112	44	1.0112	44	1.0112	44	1.0112	44	1.0112
January 3, 12 m	High	Cloudy	E.	55	47	1.0112	47	1.0112	47	1.0112	47	1.0110	47	1.0116	47	1.0110
January 3, 6 p. m	Low	Cloudy	E.	55	47	1.0112	47	1.0112	47	1.0112	47	1.0112	47	1.0112	47	1.0112
January 4, 7 a. m	Low	Rain	SE.	50	46	1.0110	46	1.0110	46	1.0110	46	1.0110	46	1.0110	46	1.0110
January 4, 1 p. m	High	Rain	S.	52	46	1.0110	48	1.0110	48	1.0110	46	1.0110	48	1.0110	48	1.0110
January 5, 8.30 p. m	Low	Clear	W.	45	46	1.0108	44	1.0106	44	1.0106	44	1.0106	44	1.0110	42	1.0122
January 5, 2 p. m	High	Clear	NW.	50	46	1.0104	46	1.0104	46	1.0106	45	1.0108	42	1.0112	42	1.0122
January 6, 9.30 a. m	Low	Clear	NW.	38	41	1.0106	40	1.0108	40	1.0104	40	1.0110	40	1.0114	40	1.0118
January 6, 3.30 p. m	High	Cloudy	NW.	44	45	1.0106	42	1.0106	42	1.0106	42	1.0110	42	1.0118	43	1.0120
January 7, 10.15 a. m	Low	Cloudy	NW.	30	38	1.0114	37	1.0104	36	1.0100	38	1.0114	36	1.0114	37	1.0114
January 7, 4.15 p. m	High	Clear	NW.	34	38	1.0114	38	1.0110	38	1.0110	38	1.0114	38	1.0114	38	1.0114
January 8, 11 a. m	Low	Cloudy	NE.	30	34	1.0110	34	1.0106	34	1.0106	34	1.0110	34	1.0110	34	1.0116
January 8, 5 p. m	High	Snow	NE.	30	34	1.0114	34	1.0106	34	1.0106	34	1.0114	34	1.0114	34	1.0116
January 9, 12 m	Low	Clear	NW.	22	31	1.0100	31	1.0100	31	1.0102	32	1.0104	33	1.0110	33	1.0110
January 9, 6 p. m	High	Clear	NW.	20	31	1.0100	31	1.0100	31	1.0102	31	1.0104	31	1.0106	31	1.0106
January 17, 10 a. m*	High	Clear	NW.	32	.....	....	.....	....	.....	....	.....	....	33	1.0100	34	1.0100
January 17, 4 p. m	Low	Clear	NW.	32	.....	....	.....	....	.....	....	.....	....	34	1.0100	34	1.0100
January 18, 11 a. m	High	Clear	E.	38	.....	....	.....	....	.....	....	.....	....	35	1.0100	35	1.0100
January 18, 5 p. m	Low	Clear	E.	35	.....	....	.....	....	.....	....	.....	....	36	1.0100	36	1.0100
January 19, 12 m	High	Rain	SW.	38	.....	....	.....	....	.....	....	.....	....	38	1.0098	36	1.0098
January 19, 6 p. m	Low	Rain	SW.	40	.....	....	.....	....	.....	....	.....	....	38	1.0096	38	1.0096
January 20, 7 a. m	Low	Clear	NE.	32	.....	....	.....	....	.....	....	.....	....	36	1.0096	36	1.0094
January 20, 1 p. m	High	Clear	NE.	.....	37	1.0050	.....	....	.....	....	.....	....	35	1.0096	35	1.0096
January 21, 8 30 a. m	Low	Rain	SE.	32	40	1.0070	.....	....	.....	....	.....	....	40	1.0074	40	1.0074
January 21, 2.30 p. m	High	Rain	SW.	40	40	1.0660	.....	....	.....	....	.....	....	40	1.0070	40	1.0070
January 22, 10 a. m	Low	Clear	NE.	35	38	1.0070	38	1.0070	38	1.0070	36	1.0076	36	1.0092	37	1.0092
January 22, 4 p. m	High	Clear	E.	45	40	1.0480	36	1.0070	36	1.0072	37	1.0078	37	1.0078	37	1.0088
January 23, 11 a. m	Low	Clear	NE.	32	36	1.0076	33	1.0070	33	1.0070	34	1.0086	33	1.0090	34	1.0090
January 23, 5 p. m†	High	Clear	NE.	30	33	1.0070	33	1.0070	33	1.0070	33	1.0080	32	1.0092	32	1.0092
January 27, 8 a. m	High	Rain	NE.	38	35	1.0064	35	1.0074	34	1.0070	35	1.0088	35	1.0088	34	1.0088

January 27, 2 p. m	Low	Rain	NE.	38	34	1.0060	34	1.0074	34	1.0070	36	1.0088	36	1.0088	36	1.0088
January 28, 9 a. m	High	Rain	N.	38	35	1.0020	35	1.0060	35	1.0060	36	1.0084	36	1.0068	40	1.0090
January 28, 3 p. m	Low	Rain	NE.	38	35	1.0020	35	1.0069	35	1.0060	35	1.0070	35	1.0088	37	1.0090
January 29, 10 a. m	High	Cloudy	NE.	42	40	1.0050	40	1.0050	40	1.0030	40	1.0080	39	1.0090	38	1.0092
January 29, 3.30 p. m	Low	Cloudy	NE.	45	38	1.0050	38	1.0050	38	1.0040	40	1.0070	40	1.0080	40	1.0092
January 30, 11 a. m	High	Snow	NE.	32	37	1.0040	35	1.0060	37	1.0018	37	1.0088	35	1.0088	35	1.0090
January 30, 4.30 p. m	Low	Snow	NW.	32	35	1.0040	35	1.0050	35	1.0020	36	1.0080	37	1.0080	37	1.0090
January 31, 12 m	High	Clear	NW.	40	35	1.0060	35	1.0070	33	1.0076	33	1.0090	33	1.0090	33	1.0090
January 31, 5.30 p. m	Low	Cloudy	SW.	37	35	1.0070	35	1.0070	35	1.0078	35	1.0088	36	1.0090	36	1.0090
February 1, 12.30 p. m	High	Cloudy	N.	32	35	1.0034	34	1.0066	34	1.0042	35	1.0090	35	1.0090	35	1.0090
February 1, 6 p. m	Low	Cloudy	N.	32	35	1.0040	35	1.0066	35	1.0040	35	1.0090	35	1.0090	36	1.0090
February 2, 6.30 a. m	Low	Clear	SW.	26	34	1.0064	36	1.0074	33	1.0066	33	1.0080	33	1.0090	35	1.0098
February 3, 1 p. m	High	Clear	SW.	36	34	1.0064	36	1.0070	33	1.0070	33	1.0090	33	1.0090	35	1.0098
February 13, 10 a. m ‡	High	Rain	SW.	45	42	1.0010	42	1.0010	42	1.0010	42	1.0010	42	1.0030	40	1.0104
February 13, 4 p. m	Low	Rain	SW.	45	43	1.0010	43	1.0010	43	1.0010	43	1.0010	43	1.0040	45	1.0104
February 14, 11 a. m	High	Clear	SW.	57	44	1.0060	44	1.0040	42	1.0040	44	1.0070	44	1.0080	44	1.0094
February 14, 5 p. m	Low	Clear	S.	52	45	1.0050	45	1.0040	45	1.0040	45	1.0060	45	1.0060	46	1.0092
February 15, 12 m	High	Clear	S.	54	45	1.0092	44	1.0092	44	1.0092	46	1.0092	46	1.0094	46	1.0094
February 15, 6 p. m	Low	Cloudy	SW.	53	44	1.0090	46	1.0090	46	1.0090	46	1.0088	46	1.0090	46	1.0094
February 16, 7 a. m	Low	Clear	NW.	35	44	1.0094	43	1.0088	43	1.0088	43	1.0094	41	1.0108	41	1.0108
February 16, 1 p. m	High	Clear	NW.	38	44	1.0094	44	1.0080	44	1.0080	44	1.0094	44	1.0098	45	1.0108
February 17, 8 a. m	Low	Cloudy	NE.	32	38	1.0098	35	1.0094	35	1.0094	35	1.0098	36	1.0104	36	1.0104
February 17, 2 p. m	High	Snow	NE.	36	38	1.0104	35	1.0104	35	1.0104	34	1.0104	35	1.0104	35	1.0104
February 18, 9 a. m	Low	Clear	S.	38	36	1.0112	38	1.0094	37	1.0100	36	1.0116	36	1.0116	40	1.0114
February 18, 3 p. m	High	Clear	S.	45	37	1.0116	37	1.0110	37	1.0110	38	1.0110	37	1.0118	42	1.0116
February 19, 10 a. m	Low	Clear	SW.	40	42	1.0112	42	1.0110	42	1.0110	42	1.0112	42	1.0112	46	1.0112
February 19, 4 p. m	High	Clear	SW.	48	42	1.0112	42	1.0112	41	1.0112	41	1.0112	41	1.0112	48	1.0114
February 20, 10 a. m	Low	Clear	NW.	45	36	1.0116	40	1.0094	39	1.0100	36	1.0114	39	1.0118	40	1.0116
February 20, 4.15 p. m	High	Cloudy	NW.	30	40	1.0116	36	1.0106	36	1.0110	36	1.0116	36	1.0116	36	1.0116
February 21, 10.15 a. m	Low	Clear	NW.	32	42	1.0112	42	1.0110	42	1.0110	42	1.0112	41	1.0112	46	1.0112
February 21, 4.30 p. m	High	Clear	NW.	36	42	1.0112	40	1.0110	40	1.0110	41	1.0112	41	1.0112	42	1.0112
February 22, 11 a. m	Low	Clear	NW.	40	42	1.0110	40	1.0108	42	1.0100	41	1.0110	40	1.0112	44	1.0112
February 22, 5 p. m	High	Clear	SW.	42	42	1.0110	42	1.0110	41	1.0108	40	1.0112	42	1.0112	44	1.0114
February 23, 12 m	Low	Clear	NE.	40	42	1.0118	42	1.0108	42	1.0112	42	1.0112	44	1.0114	44	1.0114
February 23, 6 p. m	High	Clear	E.	40	42	1.0118	42	1.0108	42	1.0112	42	1.0112	44	1.0114	44	1.0114
February 24, 7 a. m	High	Clear	W.	36	42	1.0114	40	1.0110	40	1.0110	40	1.0112	40	1.0110	42	1.0114
February 24, 1 p. m	Low	Cloudy	SW.	45	41	1.0112	42	1.0110	42	1.0110	42	1.0112	42	1.0112	44	1.0114
February 25, 8 a. m	High	Rain	S.	50	44	1.0114	44	1.0110	44	1.0112	44	1.0110	44	1.0112	46	1.0114
February 25, 2 p. m	Low	Rain	SW.	56	44	1.0114	45	1.0110	46	1.0110	44	1.0112	46	1.0112	46	1.0114
February 26, 9 a. m	High	Clear	N.	28	38	1.0110	38	1.0114	38	1.0110	38	1.0114	38	1.0114	38	1.0116
February 26, 3 p. m	Low	Clear	N.	29	36	1.0110	36	1.0108	36	1.0108	36	1.0110	36	1.0110	36	1.0110
February 27, 9.30 a. m	High	Clear	N.	28	46	1.0100	48	1.0112	48	1.0080	48	1.0110	46	1.0104	48	1.0104
February 27, 3.30 p. m	Low	Clear	N.	34	44	1.0098	44	1.0110	42	1.0100	42	1.0104	42	1.0104	44	1.0104
February 28, 10 a. m	High	Clear	N.	30	42	1.0098	42	1.0110	42	1.0104	42	1.0104	42	1.0108	44	1.0108
February 28, 4 p. m	Low	Clear	NE.	30	42	1.0098	43	1.0098	45	1.0098	45	1.0104	42	1.0104	44	1.0104
March 1, 11 a. m	High	Clear	NE.	30	46	1.0098	46	1.0110	48	1.0106	46	1.0110	46	1.0110	48	1.0110
March 1, 5 p. m	Low	Clear	NW.	30	46	1.0100	46	1.0110	46	1.0112	48	1.0110	48	1.0110	48	1.0112
March 4, 12.30 p. m §	High	Clear	NE.	40	38	1.0110	40	1.0108	40	1.0104	38	1.0110	38	1.0112	38	1.0110
March 4, 6.30 p. m	Low	Clear	NE.	34	38	1.0110	38	1.0110	38	1.0110	38	1.0112	38	1.0110	38	1.0110

* Everything frozen up and no record kept until the 17th, when the bay and deep ponds became free of ice.

† Everything frozen up until 27th.

‡ Very heavy fall of snow and intensely cold weather; everything frozen up.

§ Creek and bay frozen on the 2d and 3d; no record kept.

Table of temperatures, weather, and densities of water at Saint Jerome Station from January 1, 1886, to November 7, 1886, inclusive—Continued.

Date.	State of tide.	State of weather.	Direction of wind.	Temperature of air.	Water at wharf.		Water of oyster ponds.		Water at canal.		Water at lower pond.		Water at Deep Point.		Water in the bay.	
					Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.
1886.				°	°		°		°		°		°		°	
March 5, 7 a. m	Low	Clear	NE.	34	38	1.0110	40	1.0106	38	1.0110	38	1.0108	40	1.0108	40	1.0110
March 5, 1.30 p. m	High	Clear	E.	44	40	1.0110	40	1.0110	40	1.0110	40	1.0112	40	1.0112	40	1.0112
March 6, 8 a. m	Low	Clear	NE.	38	44	1.0106	42	1.0106	42	1.0106	42	1.0106	42	1.0106	44	1.0106
March 6, 2.30 p. m	High	Clear	NE.	44	42	1.0108	42	1.0106	43	1.0106	43	1.0108	44	1.0108	44	1.0106
March 7, 8.30 a. m	Low	Clear	NE.	38	44	1.0106	42	1.0106	42	1.0106	42	1.0104	42	1.0104	44	1.0104
March 7, 3 p. m	High	Clear	NE.	48	44	1.0106	44	1.0106	44	1.0106	44	1.0106	44	1.0106	44	1.0106
March 8, 9.15 a. m	Low	Snow	SW.	38	40	1.0106	38	1.0106	38	1.0106	38	1.0104	38	1.0104	42	1.0104
March 8, 3.45 p. m	High	Clear	W.	38	40	1.0106	40	1.0106	40	1.0106	40	1.0106	40	1.0106	40	1.0106
March 9, 10 a. m	Low	Clear	NE.	42	46	1.0102	46	1.0102	46	1.0102	46	1.0100	46	1.0102	48	1.0102
March 9, 4 p. m	High	Clear	N.	48	46	1.0102	46	1.0100	47	1.0100	48	1.0100	48	1.0102	48	1.0102
March 10, 10.30 a. m	Low	Clear	NE.	44	44	1.0100	44	1.0100	42	1.0100	44	1.0100	44	1.0100	44	1.0100
March 10, 5 p. m	High	Clear	NE.	44	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100
March 11, 11.15 a. m	Low	Clear	NW.	50	38	1.0100	40	1.0100	38	1.0100	38	1.0100	38	1.0100	38	1.0100
March 11, 5.30 p. m	High	Clear	NW.	45	38	1.0100	38	1.0100	38	1.0100	38	1.0100	38	1.0100	38	1.0100
March 12, 12 m	Low	Rain	W.	50	38	1.0100	42	1.0100	40	1.0100	40	1.0100	40	1.0100	40	1.0100
March 12, 6 p. m	High	Rain	W.	42	40	1.0100	40	1.0100	40	1.0100	40	1.0100	40	1.0100	40	1.0100
March 13, 7 a. m	High	Rain	W.	40	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100
March 13, 1 p. m	Low	Cloudy	W.	46	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100	44	1.0100
March 14, 8 a. m	High	Clear	SW.	43	44	1.0100	44	1.0100	44	1.0100	42	1.0100	42	1.0100	42	1.0100
March 14, 2 p. m	Low	Clear	SW.	50	44	1.0100	42	1.0100	42	1.0100	42	1.0100	42	1.0100	44	1.0102
March 15, 9 a. m	High	Clear	W.	55	50	1.0100	48	1.0100	48	1.0100	48	1.0100	50	1.0100	50	1.0100
March 15, 3 p. m	Low	Clear	W.	63	50	1.0100	50	1.0100	50	1.0100	50	1.0100	50	1.0100	50	1.0100
March 16, 9.30 a. m	High	Clear	NW.	69	54	1.0104	56	1.0094	53	1.0094	53	1.0102	52	1.0102	52	1.0102
March 16, 3.30 p. m	Low	Clear	NE.	70	58	1.0100	58	1.0100	58	1.0098	58	1.0098	56	1.0100	56	1.0100
March 17, 10 a. m	High	Clear	NE.	45	47	1.0104	47	1.0100	47	1.0100	45	1.0104	45	1.0104	44	1.0100
March 17, 4 p. m	Low	Clear	NE.	65	52	1.0100	53	1.0100	52	1.0100	51	1.0100	51	1.0100	50	1.0100
March 18, 10.30 a. m	High	Clear	SE.	49	48	1.0102	47	1.0102	47	1.0102	48	1.0104	48	1.0106	50	1.0102
March 18, 4.30 p. m	Low	Clear	SE.	55	50	1.0100	50	1.0100	50	1.0100	50	1.0102	50	1.0102	50	1.0102
March 19, 11 30 a. m	High	Cloudy	SE.	54	50	1.0100	50	1.0100	50	1.0100	50	1.0100	50	1.0100	52	1.0102
March 19, 5.30 p. m	Low	Cloudy	SE.	50	50	1.0100	50	1.0100	50	1.0100	50	1.0100	50	1.0100	54	1.0100
March 20, 12.30 p. m	High	Rain	SW.	54	52	1.0100	52	1.0100	52	1.0100	52	1.0100	52	1.0104	53	1.0106
March 20, 6.30 p. m	Low	Rain	SE.	50	52	1.0100	53	1.0100	53	1.0100	53	1.0100	53	1.0100	54	1.0100
March 21, 7.30 a. m	Low	Clear	W.	50	54	1.0100	54	1.0100	54	1.0100	54	1.0100	54	1.0100	54	1.0100
March 21, 1.30 p. m	High	Clear	W.	58	54	1.0100	54	1.0100	55	1.0100	56	1.0100	56	1.0100	56	1.0102
March 22, 8.30 a. m	Low	Clear	NW.	48	50	1.0100	50	1.0100	50	1.0100	50	1.0100	50	1.0100	48	1.0104
March 22, 2.30 p. m	High	Clear	W.	50	58	1.0100	56	1.0100	56	1.0104	56	1.0110	56	1.0110	56	1.0110
March 23, 9.30 a. m	Low	Clear	NW.	38	45	1.0104	44	1.0102	44	1.0102	44	1.0104	45	1.0104	45	1.0106
March 23, 3.30 p. m	High	Clear	NW.	40	44	1.0104	44	1.0104	44	1.0104	44	1.0104	44	1.0106	44	1.0106

*March 24**																
*March 25**																
*March 26**																
March 27, 7.30 a. m	*High*	*Rain*	E.	44	46	1.0104	46	1.0104	46	1.0102	44	1.0104	46	1.0104	46	1.0104
March 27, 1.30 p. m	Low	Rain	E.	48	48	1.0104	48	1.0104	48	1.0104	48	1.0102	48	1.0102	48	1.0104
March 28, 8.30 a. m	High	Rain	E.	44	48	1.0102	48	1.0102	48	1.0102	48	1.0102	48	1.0102	46	1.0102
March 28, 2.30 p. m	Low	Cloudy	E.	50	48	1.0102	48	1.0102	50	1.0102	50	1.0102	50	1.0102	50	1.0102
March 29, 10 a. m	High	Rain	E.	48	44	1.0102	44	1.0102	44	1.0102	46	1.0100	46	1.0102	46	1.0102
March 29, 4 p. m	Low	Rain	E.	46	46	1.0102	46	1.0102	46	1.0100	46	1.0102	46	1.0102	46	1.0102
March 30, 11 a. m	High	Rain	E.	53	48	1.0084	48	1.0084	48	1.0088	48	1.0094	48	1.0088	48	1.0098
March 30, 5 p. m	Low	Cloudy	SE.	52	48	1.0084	50	1.0084	50	1.0084	50	1.0094	50	1.0094	50	1.0098
March 31, 11 30 a. m	High	Rain	SE.	55	52	1.0092	52	1.0088	52	1.0086	52	1.0090	52	1.0090	52	1.0092
March 31, 5.30 p. m	Low	Rain	SE.	56	52	1.0092	52	1.0084	52	1.0090	52	1.0092	52	1.0092	52	1.0092
April 1, 12.30 p. m	High	Clear	W.	52	52	1.0084	52	1.0090	51	1.0082	51	1.0090	51	1.0090	51	1.0098
April 1, 6.30 p. m	Low	Clear	W.	48	52	1.0084	52	1.0084	52	1.0084	52	1.0084	52	1.0090	52	1.0096
April 2, 7.30 a. m	Low	Clear	SE.	48	52	1.0082	52	1.0084	52	1.0096	52	1.0088	53	1.0092	53	1.0094
April 2, 1.20 p. m	High	Clear	SE.	63	59	1.0082	58	1.0084	56	1.0096	58	1.0088	59	1.0092	58	1.0094
April 3, 8.30 a. m	Low	Rain	W.	48	51	1.0100	51	1.0094	51	1.0094	51	1.0094	49	1.0102	48	1.0108
April 3, 2.30 p. m	High	Rain	W.	55	51	1.0100	51	1.0100	51	1.0100	51	1.0102	51	1.0100	54	1.0110
April 4, 9.30 a. m	Low	Cloudy	NE.	42	51	1.0106	46	1.0102	46	1.0104	46	1.0110	44	1.0110	46	1.0110
April 4, 3.30 p. m	High	Rain	E.	44	44	1.0102	45	1.0104	46	1.0104	46	1.0110	46	1.0110	46	1.0112
April 5, 10 a. m	Low	Rain	SE.	46	48	1.0100	48	1.0094	48	1.0094	48	1.0098	48	1.0098	48	1.0100
April 5, 4 p. m	High	Rain	SE.	47	46	1.0100	47	1.0094	47	1.0094	47	1.0094	48	1.0098	48	1.0100
April 6, 10.30 a. m	Low	Rain	W.	45	48	1.0090	48	1.0090	48	1.0090	48	1.0096	48	1.0090	48	1.0100
April 6, 4.30 p. m	High	Clear	W.	48	48	1.0090	48	1.0090	48	1.0094	48	1.0098	48	1.0096	48	1.0100
April 7, 11 a. m	Low	Cloudy	W.	44	48	1.0090	48	1.0094	48	1.0092	48	1.0090	48	1.0096	48	1.0100
April 7, 5 p. m	High	Clear	W.	49	48	1.0090	48	1.0090	48	1.0096	48	1.0098	48	1.0098	48	1.0100
April 8, 12 m	Low	Cloudy	NW.	45	47	1.0094	46	1.0082	46	1.0090	46	1.0094	46	1.0094	45	1.0096
April 8, 5.30 p. m	High	Cloudy	NW.	46	48	1.0080	48	1.0080	48	1.0080	48	1.0080	48	1.0080	48	1.0090
April 9, 12.30 p. m	Low	Clear	NE.	52	48	1.0080	48	1.0074	48	1.0074	48	1.0080	48	1.0080	50	1.0090
April 9, 6 p. m	High	Clear	SE.	46	48	1.0080	48	1.0074	48	1.0070	48	1.0080	48	4.0080	50	1.0090
April 10, 7 a. m	High	Clear	SE.	45	50	1.0080	54	1.0070	54	1.0070	52	1.0074	54	1.0076	56	1.0080
April 10, 1 p. m	Low	Clear	SW.	50	50	1.0080	54	1.0072	54	1.0072	54	1.0076	56	1.0074	56	1.0080
April 11, 8 a. m	High	Clear	E.	48	54	1.0070	54	1.0074	54	1.0074	54	1.0070	54	1.0070	54	1.0070
April 11, 2 p. m	Low	Cloudy	E.	50	54	1.0070	56	1.0070	56	1.0068	56	1.0068	54	1.0070	56	1.0070
April 12, 9 a. m	High	Clear	E.	50	56	1.0074	56	1.0070	56	1.0070	56	1.0068	56	1.0068	56	1.0068
April 12, 3 p. m	Low	Clear	E.	......	56	1.0068	56	1.0068	56	1.0060	56	1.0070	57	1.0070	58	1.0070
April 13, 10 a. m	High	Clear	SE.	65	66	1.0064	66	1.0064	66	1.0064	66	1.0064	64	1.0064	64	1.0066
April 13, 4 p. m	Low	Cloudy	SE.	58	66	1.0062	64	1.0062	64	1.0062	65	1.0064	64	1.0064	64	1.0064
April 14, 11 a. m	High	Clear	SE.	68	64	1.0064	66	1.0064	66	1.0064	66	1.0064	66	1.0066	66	1.0070
April 14, 5 p. m	Low	Clear	SE.	66	66	1.0062	66	1.0062	66	1.0062	66	1.0062	66	1.0068	66	1.0070
April 15, 11.30 a. m	High	Clear	E.	60	62	1.0070	60	1.0066	60	1.0066	60	1.0066	60	1.0066	60	1.0066
April 15, 5.30 p. m	Low	Clear	E.	59	60	1.0070	60	1.0066	60	1.0064	60	1.0064	60	1.0064	60	1.0066
April 16, 12.30 p. m	High	Cloudy	E.	58	60	1.0062	60	1.0066	60	1.0066	60	1.0060	60	1.0054	62	1.0064
April 16, 6.30 p. m	Low	Clear	E.	54	60	1.0060	60	1.0060	60	1.0062	60	1.0064	60	1.0064	62	1.0060
April 17, 7 30 a. m	Low	Clear	E.	54	58	1.0062	58	1.0064	58	1.0064	58	1.0056	60	1.0058	62	1.0060
April 17, 1.30 p. m	High	Clear	E.	60	62	1.0060	60	1.0054	60	1.0056	60	1.0060	60	1.0058	64	1.0060

* No record kept.

Table of temperatures, weather, and densities of water at Saint Jerome Station from January 1, 1886, to November 7, 1886, inclusive—Continued.

Date.	State of tide.	State of weather.	Direction of wind.	Temperature of air.	Water at wharf.		Water of oyster ponds.		Water at canal.		Water in the bay.	
					Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.
1886.				°	°		°		°		°	
July 1, 7.30 a. m	Low	Stormy	E.	70	70	1.0080	70	1.0080	70	1.0780	72	1.0080
July 1, 1 p. m	High	Stormy	SE.	78	75	1.0080	76	1.0780	76	1.0080	76	1.0080
July 2, 8 a. m	Low	Stormy	SE.	72	72	1.0080	72	1.0080	72	1.0760	72	1.0080
July 2, 2 p. m	High	Stormy	SE.	82	78	1.0680	78	1.0680	78	1.0070	78	1.0070
July 3, 9 a. m	Low	Clear	NW.	74	74	1.0080	74	1.0080	74	1.0760	74	1.0760
July 3, 3 p. m	High	Clear	NW.	74	75	1.0080	75	1.0080	75	1.0780	75	1.0740
July 4, 10 a. m	Low	Clear	NW.	75	74	1.0070	74	1.0070	74	1.0070	74	1.0070
July 4, 4 p. m	High	Clear	NW.	78	74	1.0070	75	1.0070	75	1.0068	75	1.0066
July 5, 11 a. m	Low	Clear	SE.	74	76	1.0076	76	1.0076	76	1.0076	76	1.0076
July 5, 5 p. m	High	Clear	SE.	78	82	1.0064	82	1.0066	82	1.0066	82	1.0066
July 6, 12 m	Low	Clear	SE.	74	75	1.0074	75	1.0070	75	1.0072	75	1.0074
July 6, 6 p. m	High	Clear	SE.	80	82	1.0062	82	1.0060	82	1.0060	82	1.0060
July 7, 7 a. m	High	Clear	W.	82	80	1.0070	80	1.0064	80	1.0064	80	1.0068
July 7, 1 p. m	Low	Clear	SW.	87	82	1.0058	82	1.0058	82	1.0064	82	1.0062
July 8, 8 a. m	High	Clear	E.	80	80	1.0070	80	1.0070	80	1.0072	80	1.0080
July 8, 2 p. m	Low	Clear	E.	84	82	1.0060	82	1.0060	82	1.0064	82	1.0064
July 9, 9 a. m	High	Clear	NW.	75	75	1.0074	75	1.0066	75	1.0076	75	1.0076
July 9, 3 p. m	Low	Clear	NW.	80	85	1.0060	85	1.0060	85	1.0060	85	1.0060
July 10, 9.30 a. m	High	Clear	W.	79	80	1.0074	80	1.0070	80	1.0070	80	1.0064
July 10, 3.30 p. m	Low	Clear	W.	85	82	1.0060	82	1.0060	82	1.0060	82	1.0060
July 11, 10 a. m	High	Clear	SE.	78	81	1.0064	81	1.0060	81	1.0064	81	1.0064
July 11, 4 p. m	Low	Clear	E.	81	84	1.0052	84	1.0052	84	1.0058	84	1.0060
July 12, 10.30 a. m	High	Clear	E.	75	80	1.0070	80	1.0066	80	1.0064	80	1.0066
July 12, 4.30 p. m	Low	Clear	E.	79	82	1.0060	82	1.0068	82	1.0062	82	1.0062
July 13, 11 a. m	High	Cloudy	SW.	74	75	1.0060	75	1.0062	75	1.0054	75	1.0074
July 13, 5 p. m	Low	Rain	SW.	75	80	1.0060	80	1.0052	80	1.0048	80	1.0064
July 14, 11.30 a. m	High	Stormy	SW.	76	76	1.0062	76	1.0070	76	1.0052	76	1.0066
July 14, 5.30 p. m	Low	Stormy	SW.	72	76	1.0054	76	1.0062	76	1.0062	76	1.0064
July 15, 12.15 p. m	High	Cloudy	SE.	75	78	1.0072	78	1.0072	78	1.0074	78	1.0070
July 15, 6.15 p. m	Low	Cloudy	SE.	72	76	1.0062	76	1.0070	76	1.0050	76	1.0070
July 16, 7 a. m	Low	Clear	S.	70	74	1.0062	74	1.0064	74	1.0064	74	1.0084
July 16, 1 p. m	High	Clear	S.	78	78	1.0058	78	1.0060	78	1.0062	78	1.0080
July 17, 8 a. m	Low	Clear	W.	75	78	1.0064	78	1.0060	78	1.0060	78	1.0070
July 17, 2 p. m	High	Clear	W.	80	82	1.0060	82	1.0054	82	1.0060	82	1.0062
July 18, 9 a. m	Low	Clear	SW.	78	80	1.0060	80	1.0060	80	1.0060	80	1.0064
July 18, 3 p. m	High	Clear	SW.	82	84	1.0056	84	1.0056	84	1.0058	84	1.0062
July 19, 10 a. m	Low	Clear	NE.	77	75	1.0070	75	1.0070	75	1.0072	75	1.0070
July 19, 4 p. m	High	Clear	NE.	80	84	1.0064	84	1.0066	84	1.0074	84	1.0070

July 20, 11 a. m	Low	Clear	SE.	78	80	1.0064	80	1.0070	80	1.0064	80	1.0070
July 20, 5 p. m	High	Clear	S.	82	82	1.0062	82	1.0060	82	1.0066	82	1.0066
July 21, 12 m	Low	Clear	SW.	73	78	1.0072	78	1.0076	78	1.0074	78	1.0080
July 21, 6 p. m	High	Clear	NW.	76	78	1.0070	78	1.0070	78	1.0070	78	1.0074
July 22, 7 a. m	High	Clear	W.	74	77	1.0078	77	1.0072	77	1.0074	77	1.0076
July 22, 12.30 p. m	Low	Clear	W.	82	84	1.0062	84	1.0060	84	1.0070	84	1.0064
July 23, 7.15 a. m	High	Clear	SE.	75	76	1.0074	76	1.0074	76	1.0074	76	1.0074
July 23, 12.45 p. m	Low	Cloudy	SE.	80	82	1.0064	82	1.0066	82	1.0066	82	1.0072
July 24, 7.30 a. m	High	Clear	S.	75	76	1.0082	76	1.0078	76	1.0084	76	1.0082
July 24, 1 p. m	Low	Clear	S.	76	84	1.0078	84	1.0070	84	1.0070	84	1.0072
July 25, 8 a. m	High	Clear	S.	75	74	1.0080	74	1.0080	74	1.0082	74	1.0082
July 25, 1.30 p. m	Low	Clear	S.	80	80	1.0070	80	1.0072	80	1.0070	80	1.0074
July 26, 9 a. m	High	Clear	S.	80	80	1.0080	80	1.0080	80	1.0076	80	1.0072
July 26, 3 p. m	Low	Cloudy	S.	82	84	1.0070	84	1.0070	84	1.0072	84	1.0072
July 27, 10 a. m	High	Clear	S.	78	80	1.0072	80	1.0072	80	1.0070	80	1.0072
July 27, 4 p. m	Low	Clear	S.	82	84	1.0072	84	1.0070	84	1.0072	84	1.0066
July 28, 10.30 a. m	High	Clear	SE.	80	80	1.0074	......	1.0074	......	1.0072	......	1.0076
July 28, 4.30 p. m	Low	Clear	SW.	86	86	1.0064	......	1.0064	......	1.0066	......	1.0068
July 29, 11 a. m	High	Clear	SW.	82	80	1.0072	......	1.0074	......	1.0074	......	1.0070
July 29, 5 p. m	Low	Clear	SW.	85	88	1.0064	......	1.0064	......	1.0064	......	1.0062
July 30, 12 m	High	Clear	SW.	88	88	1.0063	......	1.0064	......	1.0072	......	1.0070
July 30, 6 p. m	Low	Clear	SE.	82	82	1.0060	......	1.0060	......	1.0064	......	1.0060
July 31, 1 p. m	High	Cloudy	SE.	89	89	1.0066	......	1.0066	......	1.0070	......	1.0070
July 31, 7 p. m	Low	Cloudy	SW.	80	85	1.0060	......	1.0066	......	1.0066	......	1.0066
August 1, 8 a. m	Low	Clear	SW.	77	77	1.0076	......	1.0076	......	1.0076	......	1.0080
August 1, 2 p. m	High	Cloudy	SW.	82	84	1.0070	......	1.0070	......	1.0076	......	1.0076
August 2, 9 a. m	Low	Clear	NW.	78	78	1.0072	......	1.0072	......	1.0072	......	1.0078
August 2, 3 p. m	High	Clear	NW.	84	82	1.0070	......	1.0070	......	1.0070	......	1.0076
August 3, 10 a. m	Low	Clear	NE.	77	78	1.0086	......	1.0082	......	1.0084	......	1.0086
August 3, 4 p. m	High	Clear	SE.	73	76	1.0080	......	1.0076	......	1.0078	......	1.0078
August 4, 11 a. m	Low	Clear	E.	77	73	1.0086	......	1.0086	......	1.0090	......	1.0090
August 4, 5 p. m	High	Clear	SE.	70	80	1.0076	......	1.0076	......	1.0080	......	1.0078
August 5, 12 m	Low	Clear	SW.	76	75	1.0084	......	1.0082	......	1.0082	......	1.0082
August 5, 6 p. m	High	Cloudy	SW.	72	78	1.0074	......	1.0078	......	1.0080	......	1.0080
August 6, 7 a. m	High	Rain	SW.	72	73	1.0082	......	1.0078	......	1.0080	......	1.0086
August 6, 12.30 p. m	Low	Rain	SW.	73	76	1.0070	......	1.0080	......	1.0080	......	1.0086
August 7, 8 a. m	High	Rain	NE.	72	74	1.0082	......	1.0080	......	1.0076	......	1.0080
August 7, 1 p. m	Low	Cloudy	NE.	77	76	1.0070	......	1.0078	......	1.0068	......	1.0080
August 8, 8.30 a. m	High	Clear	NW.	72	74	1.0082	......	1.0080	......	1.0078	......	1.0080
August 8, 2 p. m	Low	Clear	NW.	76	82	1.0070	......	1.0070	......	1.0068	......	1.0070
August 9, 10 a. m	High	Cloudy	SW.	74	75	1.0078	......	1.0078	......	1.0080	......	1.0082
August 9, 4 p. m	Low	Clear	SW.	76	78	1.0070	......	1.0080	......	1.0078	......	1.0078
August 10, 11 a. m	High	Rain	SW.	78	78	1.0074	......	1.0074	......	1.0070	......	1.0070
August 10, 5 p. m	Low	Cloudy	SW.	80	80	1.0070	......	1.0072	......	1.0070	......	1.0070
August 11, 12 m	High	Cloudy	W.	82	82	1.0070	......	1.0060	......	1.0062	......	1.0066
August 11, 6 p. m	Low	Clear	W.	84	82	1.0060	......	1.0060	......	1.0062	......	1.0064
August 12, 7 a. m	Low	Clear	E.	76	75	1.0076	......	1.0076	......	1.0084	......	1.0082
August 12, 1 p. m	High	Clear	E.	85	86	1.0066	......	1.0060	......	1.0060	......	1.0066
August 13, 8 a. m	Low	Clear	SE.	80	82	1.0076	......	1.0062	......	1.0072	......	1.0070
August 13, 2 p. m	High	Clear	SE.	82	80	1.0072	......	1.0068	......	1.0070	......	1.0064
August 14, 9 a. m	Low	Rain	W.	78	80	1.0076	......	1.0070	......	1.0078	......	1.0080
August 14, 3 p. m	High	Clear	W.	82	80	1.0074	......	1.0070	......	1.0072	......	1.0074

Table of temperatures, weather, and densities of water at Saint Jerome Station from January 1, 1886, to November 7, 1886, inclusive—Continued.

Date.	State of tide.	State of weather.	Direction of wind.	Temperature of air.	Water at wharf.		Water of oyster ponds.		Water at canal.		Water in the bay.	
					Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.
1886.				°	°		°		°		°	
August 15, 10 a. m	Low	Clear	SW.	76	78	1.0076	......	1.0076	......	1.0090	......	1.0086
August 15, 4 p. m	High	Clear	W.	80	82	1.0074	......	1.0072	......	1.0070	......	1.0078
August 16, 10.15 a. m	Low	Cloudy	W.	76	74	1.0074	......	1.0064	......	1.0074	......	1.0074
August 16, 4.15 p. m	High	Cloudy	W.	80	82	1.0072	......	1.0070	......	1.0072	......	1.0070
August 17, 10.30 a. m	Low	Clear	W.	83	84	1.0074	......	1.0070	......	1.0066	......	1.0078
August 17, 4.30 p. m	High	Clear	W.	86	84	1.0064	......	1.0061	......	1.0062	......	1.0070
August 18, 11 a. m	Low	Rain	SE.	72	76	1.0074	......	1.0074	......	1.0080	......	1.0082
August 18, 5 p. m	High	Rain	E.	72	76	1.0078	......	1.0080	......	1.0032	......	1.0094
August 19, 11.45 a. m	Low	Clear	NE.	76	77	1.0080	......	1.0080	......	1.0078	......	1.0080
August 19, 5.45 p. m	High	Clear	NE.	74	75	1.0082	......	1.0084	......	1.0084	......	1.0086
August 20, 12.30 p. m	Low	Clear	NE.	72	71	1.0090	......	1.0086	......	1.0086	......	1.0090
August 20, 7 p. m	High	Clear	NE.	74	75	1.0082	......	1.0080	......	1.0082	......	1.0090
August 21, 8 a. m	High	Clear	E.	72	72	1.0088	......	1.0090	......	1.0092	......	1.0092
August 21, 2 p. m	Low	Clear	E.	78	80	1.0072	......	1.0084	......	1.0080	......	1.0080
August 22, 8.30 a. m	High	Clear	NE.	68	70	1.0080	......	1.0080	......	1.0082	......	1.0080
August 22, 2.30 p. m	Low	Clear	NE.	74	78	1.0094	......	1.0090	......	1.0090	......	1.0094
August 23, 9 a. m	High	Cloudy	E.	80	82	1.0072	......	1.0074	......	1.0074	......	1.0074
August 23, 3 p. m	Low	Cloudy	E.	84	85	1.0074	......	1.0066	......	1.0062	......	1.0072
August 24, 9.30 a. m	High	Clear	E.	80	82	1.0070	......	1.0074	......	1.0074	......	1.0080
August 24, 3.30 p. m	Low	Clear	E.	82	84	1.0070	......	1.0076	......	1.0074	......	1.0072
August 25, 10 a. m	High	Clear	E.	82	84	1.0074	......	1.0070	......	1.0072	......	1.0076
August 25, 4 p. m	Low	Clear	E.	84	84	1.0076	......	1.0074	......	1.0074	......	1.0076
August 26, 10.30 a. m	High	Clear	SW.	88	86	1.0074	......	1.0074	......	1.0070	......	1.0068
August 26, 4.30 p. m	Low	Clear	SW.	90	88	1.0074	......	1.0072	......	1.0072	......	1.0068
August 27, 11.20 a. m	High	Clear	S.	84	86	1.0070	......	1.0074	......	1.0074	......	1.0068
August 27, 5 p. m	Low	Clear	S.	86	88	1.0074	......	1.0074	......	1.0070	......	1.0068
August 28, 12 m	High	Clear	SW.	84	86	1.0074	......	1.0074	......	1.0074	......	1.0072
August 28, 6 p. m	Low	Clear	SW.	82	84	1.0072	......	1.0072	......	1.0070	......	1.0070
August 29, 7 a. m	Low	Clear	SW.	82	84	1.0070	......	1.0074	......	1.0074	......	1.0074
August 29, 1 p. m	High	Clear	SW.	86	86	1.0070	......	1.0070	......	1.0070	......	1.0068
August 30, 8 a. m	Low	Clear	SW.	71	74	1.0084	74	1.0084	......	1.0084	......	1.0088
August 30, 2 p. m	High	Cloudy	SW.	80	78	1.0078	......	1.0080	......	1.0078	......	1.0078
August 31, 9 a. m	Low	Rain	NE.	76	76	1.0084	......	1.0072	......	1.0056	......	1.0080
August 31, 3 p. m	High	Rain	NE.	76	78	1.0082	......	1.0082	......	1.0084	......	1.0070
September 1, 10 a. m	Low	Clear	NE.	72	72	1.0094	72	1.0096	72	1.0098	72	1.0094
September 1, 4 p. m	High	Clear	E.	74	74	1.0094	74	1.0082	76	1.0092	76	1.0082
September 2, 11 a. m	Low	Clear	E.	74	72	1.0098	72	1.0090	72	1.0094	72	1.0088
September 2, 5 p. m	High	Clear	NE.	72	72	1.0094	72	1.0090	72	1.0090	72	1.0092

September 3, 11.30 a. m	Low	Clear	NE.	72	70	1.0086	72	1.0088	72	1.0090	72	1.0090
September 3, 5.30 p. m	High	Clear	E.	70	72	1.0090	72	1.0090	72	1.0092	72	1.0090
September 4, 12 m	Low	Clear	E.	74	74	1.0094	74	1.0096	74	1.0098	74	1.0094
September 4, 6 p. m	High	Clear	SE.	74	74	1.0090	76	1.0084	78	1.0090	76	1.0098
September 5, 7 a. m	High	Clear	E.	72	72	1.0090	72	1.0092	70	1.0094	72	1.0092
September 5, 1 p. m	Low	Cloudy	E.	76	74	1.0090	74	1.0096	74	1.0096	76	1.0092
September 6, 8 a. m	High	Cloudy	NE.	72	72	1.0096	72	1.0096	72	1.0096	72	1.0090
September 6, 2 p. m	Low	Clear	E.	80	80	1.0082	78	1.0080	78	1.0080	78	1.0090
September 7, 9 a. m	High	Clear	E.	76	74	1.0098	74	1.0090	74	1.0090	74	1.0090
September 7, 3 p. m	Low	Clear	E.	86	86	1.0078	82	1.0080	82	1.0076	84	1.0074
September 8, 10 a. m	High	Cloudy	E.	78	76	1.0090	76	1.0082	78	1.0088	78	1.0084
September 8, 4 p. m	Low	Cloudy	E.	80	78	1.0078	78	1.0080	78	1.0082	78	1.0078
September 9, 11 a. m	High	Rainy	E.	78	78	1.0078	78	1.0078	78	1.0080	80	1.0080
September 9, 5 p. m	Low	Rainy	E.	76	78	1.0078	78	1.0078	80	1.0074	78	1.0080
September 10, 12 m	High	Clear	W.	80	80	1.0072	80	1.0076	80	1.0078	80	1.0076
September 10, 6 p. m	Low	Clear	W.	76	78	1.0078	78	1.0078	78	1.0078	78	1.0078
September 11, 12.30 p. m	High	Clear	NE.	80	78	1.0078	80	1.0072	78	1.0078	78	1.0074
September 11, 6.30 p. m	Low	Clear	E.	78	80	1.0080	78	1.0082	80	1.0072	78	1.0076
September 12, 7.30 a. m	Low	Clear	E.	76	76	1.0090	78	1.0082	78	1.0084	78	1.0084
September 12, 1.30 p. m	High	Clear	SE.	82	78	1.0084	78	1.0084	78	1.0084	78	1.0084
September 13, 8.30 a. m	Low	Clear	W.	72	72	1.0092	72	1.0090	72	1.0090	70	1.0096
September 13, 2.30 p. m	High	Cloudy	W.	76	72	1.0088	71	1.0086	76	1.0086	76	1.0086
September 14, 9 a. m	Low	Clear	W.	75	70	1.0090	70	1.0096	70	1.0090	70	1.0096
September 14, 3 p. m	High	Clear	W.	80	79	1.0080	76	1.0080	74	1.0088	76	1.0084
September 15, 9.30 a. m	Low	Clear	W.	75	72	1.0088	72	1.0088	72	1.0092	72	1.0090
September 15, 3.30 p. m	High	Clear	W.	78	74	1.0088	74	1.0084	72	1.0086	74	1.0088
September 16, 10.15 a. m	Low	Clear	W.	76	74	1.0088	74	1.0086	74	1.0090	74	1.0090
September 16, 4.20 p. m	High	Clear	W.	78	76	1.0086	76	1.0084	76	1.0084	76	1.0088
September 17, 11 a. m	Low	Clear	SW.	80	78	1.0090	78	1.0084	78	1.0082	78	1.0084
September 17, 5 p. m	High	Clear	SW.	84	82	1.0074	80	1.0080	82	1.0086	80	1.0086
September 18, 12 m	Low	Clear	NE.	78	78	1.0086	78	1.0080	76	1.0088	76	1.0090
September 18, 6 p. m	High	Clear	E.	76	76	1.0080	76	1.0080	79	1.0084	76	1.0086
September 19, 12.30 p. m	Low	Cloudy	SW.	78	74	1.0086	74	1.0086	73	1.0090	73	1.0080
September 19, 6.30 p. m	High	Cloudy	SW.	72	72	1.0096	72	1.0096	73	1.0094	72	1.0096
September 20, 7.30 a. m	High	Clear	N.	72	72	1.0098	74	1.0094	72	1.0100	72	1.0100
September 20, 1.30 p. m	Low	Clear	N.	74	72	1.0098	72	1.0090	72	1.0096	74	1.0098
September 21, 8 a. m	High	Clear	NE.	64	66	1.0104	66	1.0104	66	1.0104	68	1.0104
September 21, 2 p. m	Low	Clear	NE.	72	70	1.0100	72	1.0096	70	1.0098	70	1.0096
September 22, 8.30 a. m	High	Clear	SW.	66	68	1.0106	68	1.0100	68	1.0104	70	1.0100
September 22, 2.30 p. m	Low	Clear	SW.	76	72	1.0102	72	1.0094	72	1.0100	74	1.0094
September 23, 9.30 a. m	High	Clear	W.	70	68	1.0104	68	1.0106	68	1.0104	68	1.0100
September 23, 3.30 p. m	Low	Clear	W.	76	74	1.0094	72	1.0094	74	1.0096	72	1.0092
September 24, 10.30 a. m	High	Clear	NE.	70	68	1.0100	68	1.0100	68	1.0100	68	1.0106
September 24, 4.30 p. m	Low	Clear	E.	74	74	1.0098	74	1.0096	74	1.0100	76	1.0100
September 25, 11.15 a. m	High	Clear	W.	78	72	1.0090	74	1.0096	74	1.0092	74	1.0098
September 25, 5.15 p. m	Low	Clear	W.	76	76	1.0090	78	1.0088	76	1.0094	78	1.0090
September 26, 12 m	High	Clear	SW.	82	78	1.0092	78	1.0090	78	1.0090	78	1.0092
September 26, 6 p. m	Low	Clear	SW.	78	76	1.0090	76	1.0088	78	1.0090	78	1.0090
September 27, 7 a. m	Low	Clear	SE.	76	74	1.0102	72	1.0090	74	1.0100	74	1.0100
September 27, 12.30 p. m	High	Clear	SW.	82	78	1.0092	78	1.0092	78	1.0092	80	1.0090
September 28, 7.30 a. m	Low	Clear	SW.	80	78	1.0094	76	1.0092	78	1.0094	78	1.0096
September 28, 1.30 p. m	High	Clear	SW.	86	82	1.0080	82	1.0088	84	1.0082	80	1.0090

Table of temperatures, weather, and densities of water at Saint Jerome Station from January 1, 1886, to November 7, 1886, inclusive—Continued.

Date.	State of tide.	State of weather.	Direction of wind.	Temperature of air.	Water at wharf.		Water of oyster ponds.		Water at canal.		Water in the bay.	
					Temperature.	Density.	Temperature.	Density.	Temperature.	Density.	Temperature.	Density.
1886.												
September 29, 8.30 a. m	Low	Cloudy	N.	65	68	1.0112	70	1.0100	68	1.0108	68	1.0112
September 29, 2.30 p. m	High	Clear	N.	68	68	1.0110	70	1.0108	70	1.0110	70	1.0110
September 30, 9 a. m	Low	Clear	E.	65	64	1.0110	64	1.0110	64	1.0110	66	1.0108
September 30, 3 p. m	High	Clear	E.	78	70	1.0106	70	1.0104	68	1.0112	70	1.0110
October 1, 9.45 a. m	Low	Clear	N.	65	70	1.0110	70	1.0106	70	1.0110	72	1.0108
October 1, 3.45 p. m	High	Clear	N.	65	66	1.0110	68	1.0110	68	1.0110	68	1.0112
October 2, 10.30 a. m	Low	Clear	N.	59	54	1.0120	54	1.0104	54	1.0120	56	1.0120
October 2, 4.30 p. m	High	Clear	NE.	60	62	1.0110	52	1.0120	62	1.0110	62	1.0110
October 3, 11.30 a. m	Low	Clear	SW.	70	64	1.0110	64	1.0110	64	1.0110	64	1.0110
October 3, 5.30 p. m	High	Clear	SW.	60	64	1.0110	66	1.0108	68	1.0108	64	1.0110
October 4, 12.30 p. m	Low	Clear	SW.	68	62	1.0114	62	1.0110	62	1.0112	62	1.0110
October 4, 6 30 p. m	High	Clear	SW.	60	66	1.0110	68	1.0108	68	1.0108	68	1.0110
October 5, 7.30 a. m	High	Clear	N.	60	62	1.0110	62	1.0108	62	1.0110	62	1.0110
October 5, 1.30 p. m	Low	Clear	NE.	68	66	1.0108	68	1.0110	68	1.0112	68	1.0112
October 6, 8.30 a. m	High	Cloudy	NE.	65	68	1.0108	68	1.0106	68	1.0110	70	1.0110
October 6, 2.30 p. m	Low	Cloudy	NE.	68	66	1.0108	66	1.0112	66	1.0112	60	1.0112
October 7, 9.15 a. m	High	Clear	NE.	64	62	1.0116	62	1.0114	62	1.0114	64	1.0112
October 7, 3.15 p. m	Low	Clear	NE.	68	66	1.0110	68	1.0108	66	1.0110	66	1.0110
October 8, 10.30 a. m	High	Clear	NE.	62	64	1.0110	64	1.0112	64	1.0110	64	1.0110
October 8, 4.50 p. m	Low	Clear	E.	65	68	1.0108	68	1.0104	68	1.0108	70	1.0110
October 9, 12 m	High	Clear	SW.	74	64	1.0112	64	1.0110	64	1.0110	66	1.0108
October 9, 6 p. m	Low	Clear	SW.	68	68	1.0110	70	1.0104	68	1.0106	70	1.0110
October 10, 7 a. m	Low	Clear	SW.	68	64	1.0110	64	1.0110	66	1.0108	66	1.0110
October 10, 1 p. m	High	Clear	SW.	72	68	1.0110	68	1.0104	68	1.0106	70	1.0110
October 11, 7.30 a. m	Low	Clear	NE.	65	68	1.0112	66	1.0106	68	1.0102	66	1.0108
October 11, 1.30 p. m	High	Clear	E.	72	70	1.0104	70	1.0100	70	1.0100	70	1.0100
October 12, 8.30 a. m	Low	Clear	W.	70	66	1.0110	66	1.0106	66	1.0112	60	1.0108
October 12, 2.30 p. m	High	Clear	W.	74	72	1.0102	72	1.0100	72	1.0100	72	1.0100
October 13, 9 a. m	Low	Clear	NE.	70	68	1.0106	68	1.0106	68	1.0104	68	1.0106
October 13, 3 p. m	High	Clear	SE.	.....	.....	.....	.....	.....	.....	.....	.....	.....
October 14, 9 a. m	Low	Cloudy	SE.	68	68	1.0110	66	1.0108	66	1.0108	68	1.0112
October 14, 3 p. m	High	Cloudy	SE.	74	70	1.0108	68	1.0106	68	1.0110	71	1.0112
October 15, 9.15 a. m	Low	Clear	NW.	70	70	1.0112	68	1.0108	68	1.0106	70	1.0108
October 15, 3.15 p. m	High	Clear	N.	60	68	1.0110	68	1.0108	68	1.0110	68	1.0112
October 16, 10 a. m	Low	Clear	N.	55	56	1.0122	58	1.0112	58	1.0120	58	1.0122
October 16, 4 p. m	High	Clear	NW.	65	62	1.0122	60	1.0114	60	1.0122	60	1.0124
October 17, 10.45 a. m	Low	Clear	SW.	52	56	1.0120	54	1.0122	54	1.0122	54	1.0122
October 17, 5 p. m	High	Clear	SE.	64	58	1.0122	60	1.0124	58	1.0124	60	1.0124

October 18, 11 a. m	Low	Clear	W.	64	58	1.0124	58	1.0120	58	1.0120	60	1.0124
October 18, 6 p. m	High	Clear	W.	60	66	1.0120	66	1.0114	66	1.0118	66	1.0118
October 19, 12 m	Low	Clear	W.	70	60	1.0122	62	1.0112	62	1.0114	62	1.0118
October 19, 6.30 p. m	High	Clear	W.	62	64	1.0120	64	1.0112	66	1.0114	66	1.0120
October 20, 7 a. m	High	Clear	SE.	66	66	1.0118	66	1.0116	66	1.0118	66	1.0118
October 20, 1 p. m	Low	Clear	SE.	68	66	1.0118	66	1.0118	66	1.0118	66	1.0118
October 21, 8 a. m	High	Cloudy	SE.	60	64	1.0122	64	1.0116	64	1.0118	64	1.0120
October 21, 2 p. m	Low	Cloudy	SE.	68	68	1.0120	68	1.0118	68	1.0120	68	1.0120
October 22, 9 a. m	High	Clear	NW.	58	60	1.0124	60	1.0122	58	1.0124	58	1.0128
October 22, 3 p. m	Low	Clear	NW.	62	64	1.0122	62	1.0112	64	1.0120	64	1.0120
October 23, 10 a. m	High	Clear	NW.	62	60	1.0122	60	1.0124	60	1.0124	60	1.0124
October 23, 4 p. m	Low	Clear	NE.	68	64	1.0118	64	1.0118	64	1.0118	68	1.0120
October 24, 11 a. m	High	Clear	E.	66	62	1.0120	62	1.0118	60	1.0118	60	1.0120
October 24, 5 p. m	Low	Clear	E.	60	66	1.0120	64	1.0118	64	1.0118	66	1.0120
October 25, 6 a. m	Low	Clear	NW.	60	62	1.0124	60	1.0122	62	1.0124	62	1.0124
October 25, 12 m	High	Clear	NW.	64	64	1.0120	64	1.0118	64	1.0120	64	1.0118
October 26, 7 a. m	Low	Cloudy	E.	64	64	1.0120	64	1.0118	64	1.0118	64	1.0120
October 26, 1 p. m	High	Cloudy	E.	68	66	1.0118	66	1.0118	66	1.0118	66	1.0118
October 27, 8 a. m	Low	Rain	NE.	64	64	1.0110	64	1.0112	64	1.0116	64	1.0116
October 27, 2 p. m	High	Rain	NE.	66	66	1.0112	66	1.0112	66	1.0116	66	1.0116
October 28	.....	Cloudy	NE.	.....	.....	.....	.....	.....	.....	.....	.....	.....
October 28	.....	Cloudy	NE.	.....	.....	.....	.....	.....	.....	.....	.....	.....
October 29	Low	Rain	NE.	58	58	1.0120	58	1.0122	58	1.0128	58	1.0124
October 29, 4 p. m	High	Rain	N.	60	58	1.0126	60	1.0116	60	1.0124	58	1.0124
October 30, 11 a. m	Low	Cloudy	N.	52	52	1.0124	54	1.0120	52	1.0122	52	1.0124
October 30, 5 p. m	High	Cloudy	N.	54	54	1.0120	54	1.0120	56	1.0120	56	1.0122
October 31, 12.30 p. m	Low	Clear	N.	54	54	1.0124	54	1.0120	54	1.0120	54	1.0124
October 31, 7 p. m	High	Cloudy	N.	62	62	1.0114	62	1.0114	62	1.0112	58	1.0116
November 1, 7.30 a. m	High	Clear	NW.	52	52	1.0126	52	1.0116	52	1.0126	52	1.0126
November 1, 1.30 p. m	Low	Clear	NW.	62	62	1.0114	62	1.0112	62	1.0114	62	1.0116
November 2, 8.30 a. m	High	Clear	NW.	54	56	1.0124	56	1.0124	56	1.0120	56	1.0124
November 2, 2.30 p. m	Low	Clear	S.	60	60	1.0116	60	1.0118	60	1.0118	60	1.0118
November 3, 9 a. m	High	Clear	SW.	64	62	1.0120	62	1.0120	62	1.0120	62	1.0120
November 3, 3 p. m	Low	Clear	SW.	68	62	1.0120	64	1.0116	64	1.0116	66	1.0118
November 4, 9.30 a. m	High	Clear	N.	62	58	1.0122	58	1.0120	58	1.0122	58	1.0124
November 4, 3.30 p. m	Low	Clear	N.	66	60	1.0120	60	1.0118	60	1.0118	60	1.0120
November 5, 10 a. m	High	Clear	S.	58	56	1.0126	56	1.0124	56	1.0124	54	1.0126
November 5, 4 p. m	Low	Clear	S.	62	60	1.0120	62	1.0120	62	1.0120	60	1.0124
November 6, 10.30 a. m	High	Cloudy	SW.	64	60	1.0122	58	1.0122	60	1.0122	60	1.0122
November 6, 4.30 p. m	Low	Rain	SW.	62	60	1.0120	60	1.0120	60	1.0120	56	1.0122
November 7, 11.30 a. m	High	Clear	NW.	44	46	1.0126	46	1.0130	46	1.0126	48	1.0130
November 7, 5.30 p. m	Low	Clear	NW.	40	48	1.0128	48	1.0128	48	1.0130	48	1.0130

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XVIII.—REPORT ON THE ARTIFICIAL PROPAGATION OF THE CODFISH AT WOOD'S HOLL, MASS., FOR THE SEASON OF 1885-'86.

By JAMES CARSWELL.

Having received instructions on the 1st of December to proceed to Wood's Holl, Mass., and report to Capt. H. C. Chester to assist in codfish hatching, I left Washington December 2 for that place, taking with me all the necessary apparatus.

On my arrival at Wood's Holl Captain Chester was engaged in carrying on a series of experiments for the hatching of codfish eggs, and after conference with him I learned that his idea was that in order to secure success the eggs must have motion, and that all the apparatus he had tried previous to that time, and was still using, was constructed under this impression. He had several boxes fitted up with jets of water let in, one so as to merely move the eggs, the others varying in velocity from 1 to 4 miles an hour; but all of these arrangements resulted in failure. I had been sent on with apparatus constructed by Colonel McDonald, designed for using the tidal motion, but Captain Chester appeared to be thoroughly convinced that motion was the thing. There was also at the station an arrangement of barrels put up by direction of Major Ferguson which failed, and the only success which had been attained up to this time was by a series of cones, which Captain Chester called the "Tanner arrangement." In this a very small percentage was hatched out; but it had the effect of changing our minds in regard to the necessary motion, as the eggs worked very slowly with a tidal motion.

On the 4th I fitted up two tubs and glass aquaria with side and center jets, siphon bag in center, and water escaping at the bottom. On the 5th I procured 400,000 eggs and placed an equal number in each of the two apparatus. I was very much pleased with the motion, which was just enough to force the eggs slowly to the bottom, diffusing them well through the water, and then rising toward the surface. Having had no previous experience, I thought by what I had learned from Captain Chester and by examining his apparatus that I had combined all the necessary conditions to secure success. The eggs looked all right and seemed to be doing very well, although a great many adhered to the siphon cloth. This, however, was easily remedied by giving the siphon bag a slight shake hourly.

On the morning of the 7th I found a great many dead eggs in both apparatus, and the following day all were dead in the aquarium. I attributed the mortality to the fact of this adhesion to the siphon cloth and to the sediment in the water.

On the 9th Colonel McDonald arrived at the station, and after talking the matter over we concluded that there was too much motion. I put 100,000 more eggs into the aquarium, using as little motion as possible, and entirely filtered the water. The eggs in the tub were still doing well, although under exactly similar circumstances as those in the aquarium, so I thought the advantage of the former over the latter was due to the larger area. I then started a large tub, fitted up in the same manner as before, with a fresh lot of eggs and a moderate circular motion. They all did well until the 13th, when I found it was necessary to do something else with them, as they were clotted together and sunk to the bottom. The fish at this time could be seen distinctly. I took them out and, after cleaning them off, placed them in a McDonald jar and worked the same as with shad. I was also compelled to transfer those in the large tub to jars, working with a small jet of water applied to the surface, which made them swing gently around the jar, but not enough to drive them to the bottom.

On the 15th all the eggs taken on the 5th, which were worked in the aquarium for five days and afterwards transferred to jars, were dead; but they were well developed and would probably have hatched out in a few days.

On the 16th I was obliged to take all the eggs out of jars and aquaria for the same reason as before, and I am convinced that cod eggs sink to the bottom as they grow older and as the young fish begin to develop. I then placed them in three jars, working one with top motion, one with bottom motion, and the other with a combined motion of top and bottom; but this resulted, as before, in their gradually dying, and on the eleventh day after they were taken all were dead. In one jar the eggs were left to adhere constantly to the siphon bag for eight days. For the first six days they did well, but after that they began dropping off, and at the end of the eighth day they had all dropped off and were dead. I tried the tubs once more with slightly altered conditions, but the result was the same. In all the methods and motions tried a great many of the eggs lived until the hearts of the young fish could be seen to beat.

Captain Chester also had two boxes fitted up, one with a copper screen in the bottom, and in another he put two of the hatching jars, but covered them with copper-wire screens. All of these experiments resulted in naught, but the experiments had been continued long enough to satisfy us that it was better than anything heretofore discovered. In putting in the next lot of eggs Captain Chester used cheese-cloth instead of copper wire to cover the jars and placed these in the box with tidal motion as before. This lot of eggs was hatched out with a small percentage of loss.

From my own experience I have come to the conclusion that cod eggs will float for five or six days, but at the end of that time they begin clotting together and sink.

It would be impossible for me to give in detail all the different appliances and means that were resorted to, but they were all carried on with the view that it is necessary for the cod eggs to be submerged for awhile and then allowed to rise to the surface, and every motion that could be conceived was tried to attain this end. I think it a great mistake to use any metal whatever in fitting up any kind of apparatus for cod hatching.

Although prepared for applying the tidal motion, I had never up to this time fitted the tubs up, applying this motion. On the 23d of December I fitted up one glass aquarium and wash-tub with tidal motion, using cheese-cloth screens made to fit tight on the inside, about 4 inches from the bottom.

On the 25th I found that most of the eggs had gone to the bottom in both apparatus, owing to the density of the water having fallen from .025 to .021 degrees, and upon examination found that the pumps were drawing fresh as well as salt water, which, of course, put an end to this experiment, as the eggs were all destroyed.

On the 28th I put in another lot of eggs, which did very well, but do not think that I got more than 50 per cent. of young fish; but even this was an improvement on anything heretofore accomplished.

On the 6th of January, 1886, I put a fresh lot of eggs in the aquarium and one tub, which did well until the 9th; but for some unaccountable reason at least one-half the eggs in the aquarium had gone to the bottom and were dead, while those in the tub were still doing splendidly. These commenced hatching on the 19th, and by the 22d all had hatched out, not more than 10 per cent. having been lost.

After the many experiments tried both by Captain Chester and myself I have no hesitation in saying that the best conditions for success in cod-hatching are:

(1) As little motion as possible, with just sufficient change of water to keep it fresh.

(2) To use entirely filtered water, which can be easily done by filling a McDonald jar with cotton, and fitted up as is done in shad work.

(3) To avoid the use of anything like metal in fitting up an apparatus.

The work now ceased for a time, as the codfish in live cars had all died on account of the extremely cold weather, and I was instructed to proceed to Florida with half a million of the young fry. Up to the time I left I estimate that we had taken about 15,000,000 eggs, all of which were lost in experimenting, with the exception of about 2,000,000, Five hundred thousand of these were deposited in the waters of the Gulf and 100,000 in Chesapeake Bay. The remainder, 1,400,000, were planted in Wood's Holl Harbor. The shipment to the Gulf was sent in my charge, while that to the Chesapeake Bay was made by Messrs. Moore and Robinson.

On my return to Washington I was ordered to the *Fish Hawk* to continue the collection of codfish eggs off the Isle of Shoals. In consequence of the rough weather there was only one day on which we succeeded in collecting eggs, when we procured about 8,000,000, half of which were shipped to Captain Chester by express in transfer cans, and the other half were placed in large glass aquaria which I had fitted up on board the *Fish Hawk*, applying the tidal motion, but owing to the extremely cold weather and to an accident to the vessel these were all lost. We made several attempts subsequent to this to collect more eggs, but without avail. Of the lot forwarded to Wood's Holl I am informed that one-third were received alive. These were hatched out with a small per cent. of loss and turned into the Wood's Holl Harbor.

WASHINGTON, D. C., *February* 10, 1886.

XIX.—REPORT ON THE ARTIFICIAL PROPAGATION OF CODFISH AT WOOD'S HOLL, MASS., FOR THE SEASON OF 1886-'87.

By Charles G. Atkins

The experiments in the hatching of codfish at the Wood's Holl Station for the season of 1886-'87 extended, in point of time, from the 16th of November to the 6th of April. The spawn was obtained, for the most part, from codfish brought in by the schooner *Grampus* from the Gulf of Maine, a single lot of 170 adults having been secured from local fishermen who had caught them at Nantucket Shoals and about 11,000,000 eggs having been taken by the *Grampus* from the fish on the fishing-grounds off Cape Ann. The hatching was all conducted in the hatching-room of the laboratory, and all, with the exception of a few experiments, in the Chester hatching-boxes. The total number of eggs handled was 43,575,000, of which 22,040,000, or a little more than 50 per cent., were hatched, and 19,495,000 were liberated alive in the waters of the adjacent coast.

The scale of operations, which under favorable circumstances might be greatly extended, was limited by the difficulties attending the collection of the parent fish. The first fish that came to hand were collected by the schooner *Grampus* to the eastward of Cape Cod and brought to the station on the 16th of November to the number of 195 codfish, together with a few pollock, haddock, hake, and cusk. Only the codfish yielded spawn. Another lot of adults, numbering 273 live codfish, were brought in by the *Grampus* from the same waters on the 9th of December; on the 11th of December 170 codfish were obtained from Nantucket Shoals; and, finally, on the 25th of January, 219 more were brought in from the Gulf of Maine by the *Grampus*. By the latter date the temperature of the sea along the coast, especially in the harbors, had fallen to so low a point that it seemed quite probable that an attempt to collect codfish and bring them to the station in the well of the *Grampus*, as had been done with the lots brought in by her so far, would fail by the death of the fish from the excessive cold to which they would be exposed should the vessel be compelled to seek a harbor during the trip.

The result of the observations heretofore made on this point is, in general, that codfish will live in water not colder than 30° Fahrenheit, but that when it falls to 29° they all die, apparently through actual freezing. It has several times occurred at the Wood's Holl Station that all the adult fish on hand have died in this way in a single night. At the suggestion of Captain Collins, it was determined to attempt the collection of eggs directly from the fish on the fishing-grounds and transfer them to the Wood's Holl Station by rail. Mr. George H. Tolbert was sent from Washington charged with the manipulation of the eggs; and, with the assistance of the officers and crew of the *Grampus*, he collected and transferred all the eggs obtained after the 25th of January.

In an ordinary season the weather and other circumstances would be much more favorable to the capture of codfish than the winter of 1886–'87, and there would be no great risk attending their transfer from the Gulf of Maine to Wood's Holl up to the 1st of February. It might, therefore, be reasonably expected that a sufficient stock of breeding codfish could be gathered at Wood's Holl before the end of January to supply all the eggs that could be profitably incubated there.

The fish brought in by the *Grampus* were taken from her well in fairly good condition and placed in cars in one of the basins at the station. On the approach of dangerously cold weather in the winter an inclosure was made in the basement of the hatchery and the fish then on hand, and afterwards received, were placed therein. The experience of a single winter seems to warrant the belief that in such an inclosure fish will be safe from freezing in the severest weather.

The fish were overhauled from time to time, generally at intervals of two to four days, and the spawn and milt extruded into large pans containing a little sea-water, from which they were in a very short time washed off and placed carefully in the hatching-jars. The total number of gravid females found during the season was 108, and their average yield of eggs was about 300,000 each.

The first lot of eggs, taken on the 18th of November, began to hatch on the 26th, eight days from impregnation. The temperature of the water, which up to this time had been above 50°, fell steadily, until, on the 19th of January, it reached 32° Fahrenheit, the lowest reached in the hatchery during the season. The development of the spawn was, in consequence, so retarded that the lots taken in January and February were from twenty to twenty-five days in incubation. The best success attended the incubation of the eggs that were taken from the fish at the station in December and January. In several lots as high as 85 per cent. of the eggs put into the jars were successfully hatched, and in most cases all of the fry were liberated alive. Some of the lots of those months were, however, less satisfactory, the ratio of fry hatched being in some cases as low as 50 and 40 per cent., and the results obtained from those taken in November, and from those taken at sea and brought overland to the station in February and March, were even less satisfactory. From 11,150,000 transferred overland, but 722,500 were hatched.

It is a matter of common experience among fish-culturists that the individuals that mature earliest in the season yield less healthy eggs than those spawning in the height of the season, and we may suppose that the eggs taken in November were from fish prematurely ripe. The unsatisfactory results from the eggs brought overland must, however, be attributed to the conditions under which they were taken and transferred. They were taken frequently under the great difficulties attendant on a boisterous sea and extremely cold weather, had generally to be kept over night, while awaiting shipment, in jars or other vessels, and their transfer by express involved their confinement for many hours, in a crowded condition, in small jars of water hermetically closed, with at best a scanty allowance of air. I do not think the ill success attending these transfers at all settles the question of the practicability of this method of collection under varied conditions. It might be possible to bring them through in perfect health by more careful attention to the necessity of a constant æration of the water. This, however, is a matter for future experiment.

As a rule the fry were liberated as soon as practicable after they were hatched. If, as was commonly the case, the period of hatching out was protracted, those first breaking the shell were taken out of the jars and liberated, while the remainder of the lot were left in the jars to hatch. A single lot of the fry, numbering 2,050,000, was taken by the *Grampus*, on the 27th day of January, and liberated near Race Point in Cape Cod Bay. All the others were liberated in the immediate vicinity of Wood's Holl, sometimes on the flood tide, which would carry them into Vineyard Sound, and sometimes on the ebb, which would carry them into Buzzard's Bay.

The experiment was tried in several instances of keeping the fry in aquaria until they should attain some growth. The conditions of these experiments were greatly varied, but no satisfactory result was obtained in any case. Although appearing to be in good health when put into the aquaria, the fry invariably dwindled away until all or nearly all were gone. Egress was so guarded against that there seems little doubt that in most cases the disappearance was the result of death. It seemed impossible to so arrange the screens that the young cod would not be drawn against them and die. Whether the egress of the water was constant or intermittent (which latter condition we obtained by means of a tidal movement), in every case the result was practically the same.

A determination of the conditions under which cod fry can be reared, even to the age of a few weeks, presents to us, therefore, an unsolved problem. It will be necessary to inquire whether the difficulty does not arise, in part at least, from the crowded condition of the eggs in the hatching jars. These jars are of glass, 9 inches in diameter and 15 or 16 inches deep, and eggs enough are placed in one of them to form a layer at the surface a large fraction of an inch in thickness. When this apparatus is in operation the jar is covered closely with cheese-cloth and placed in the hatching-box in an inverted position, the water, aerated by the artificial tidal motion, which is the most essential feature of this arrangement, rising and falling through the cheese-cloth and the complementary supply of air having ingress and egress through a hole bored in the upturned bottom of the jar. It is supposed that the ingress of water from the bottom disturbs the eggs enough to change their position and gives each egg its share of the water-supply; but it is questionable whether the arrangement secures sufficient change of water throughout the mass of eggs to maintain them in a condition of healthy and normal development. As yet there has been no opportunity of comparing the artificially hatched fry with those hatched in the natural way in the open sea.

A very important improvement has been effected in the water service during the past season. Two circular tanks with an aggregate net capacity of 17,000 gallons, have been erected alongside the coal-shed, and are served with a system of piping of which the mains are formed of log pipe wound with iron and covered with coal-tar, and the smaller pipes of hard rubber. We are consequently now entirely free from the difficulties that used to arise from the presence of iron rust in the pipes and hatching apparatus and which was, in fact, a very serious difficulty. The new system was put in operation on the 7th of December, and, with the exception of an occasional muddiness, resulting from heavy rainfall, the water has been admirably pure ever since.

The number of hatching boxes brought into operation during the winter was 24. They were arranged in series of three boxes each, and the amount of water fed to each series amounted to 150 gallons per hour, or a total of 1,200 gallons per hour. The total net capacity of the tanks is 17,000 gallons, so that in case of a suspension of pumping the hatchery can be made to run about fourteen hours without any curtailment of the quantity before the supply would be exhausted.

The Chester hatching boxes appear to be well adapted to the purpose of hatching buoyant eggs, yet, like most other new inventions, to be capable of simplification. A few boxes on essentially the same plan, but with simplified details, were constructed and found to work quite as well as those built on the original design. With the ordinary water-supply, which was about 150 gallons per minute, the period of each tidal pulsation was about ten minutes. The automatic action of the apparatus is well-nigh perfect, interference of the attendant being rarely necessary. It was, however, not considered prudent to leave the boxes without attention during the night, and the night watchman made regular examinations.

Observations on the temperature and density of the water in the hatchery were made daily through the months of December, January, February, and March. From these it appears that the density was very uniform, ranging from 1.0250 to 1.0260, and that the temperature of the water ranged from 49° to 32°, the mean for the months being 38.7°.

Subjoined will be found the report of Mr. James Carswell, who was in charge of the manipulation of the eggs and of the water observations.

REPORT OF MR. CARSWELL.

As desired, I submit the following report of cod-hatching for the winter of 1886–'87.

On my arrival at the station, on the 29th of November, I found in the hatchery a few cod eggs and fry. Some of the latter I put in an aquarium, but all got drawn upon the siphon bag and were lost. This I attributed to their sickly condition when put in.

On the 9th of December the *Grampus* arrived with 273 live codfish, and a smack, on the 11th of the same month, with 170, all of which were put into the live cars, and all proved to be good spawners. The first eggs taken were a small lot on the day of arrival, but these and the two following lots turned out badly, not hatching over 50 per cent. At the time they were taken I did not think they were likely to turn out well, because they scattered too much in the water when put in the hatching jars. Cod eggs when taken should at once rise to the surface of the water after being impregnated, and remain there until hatched; although in the case of very low temperature, when a long time is taken to hatch, the eggs will sometimes get coated with a very fine sediment and sink. Still, if they are far enough advanced for the young fish to be seen with the naked eye, they will hatch out, notwithstanding they have sunk to the bottom.

The codfish in live cars were examined every other day with varied success, the smallest number of eggs taken being 75,000, and the largest 3,200,000. All the eggs taken from the 13th to the 31st of December—about 18,000,000—turned out well, the average loss, as near as I could estimate, being about 20 per cent., but in several instances it did not exceed 5 per cent. I think the cod-hatching apparatus now in use at the Wood's Holl Station will compare favorably with any apparatus known to me and which is used for the hatching of other species of fish.

Experience has proved that it is not advantageous to have the temperature of the water above 40°. In warmer water the eggs hatch out too rapidly, the fry are weak and sickly, and a very large percentage of them die after hatching. I consider the best temperature to be from 34° to 38°, when the eggs will take from eighteen to twenty-five days in hatching; then the fry straighten out soon after hatching, look strong and vigorous, and invariably stay on the surface of the water. My experience is, the stronger the fry the nearer the surface they will remain.

From the 13th to the 31st of December I made several experiments in trying to keep the young fry alive in aquaria. First with the usual siphon-bag as in shad work; but in every case this resulted in drawing all the fry onto the cheese-cloth, where they would remain until they died. Next I fitted up three aquaria (see plans) and applied the tidal motion in three different ways, but this also resulted in the death of the fry after a time; not, however, on account of their sticking to the cheese-cloth, as the draught was very slight and only lasted from five to fifteen minutes, when the return would come, releasing any that might have got onto the cloth, but from other causes which I am unable to account for. The best success obtained was in one of the smaller aquaria (No. 1), with a lot of very strong and healthy fry, which were put in on the 22d of January and did very well for some time, but all gradually died, and on the 14th of February all were gone. I also kept some of this lot in the hatching-jars, but they, too, died about the same time. I noticed that the sacs of most of them were gone before they died.

On the 25th of January the *Grampus* arrived with 162 live cod, which were put in the basement, and they lived equally as well there as in the cars. My experience in keeping large codfish alive is they will live anywhere, provided they have a plentiful supply of fresh salt-water and the temperature never goes below 30°; for at 29° all will die. Very few eggs were obtained from this lot of fish, as the majority were males and the females had mostly spent, and even those taken turned out badly on account of the poor condition of the fish when received.

I fitted up two tubs with the tidal motion and put in 1,000,000 eggs, which did very well for a few days, but owing to the high temperature of the hatchery and the large surface exposed to it, the temperature of the water in the tubs got too high and killed them all. I did not get another opportunity of trying the tubs, but from former experience I am satisfied good hatching can be done with them.

Several lots of eggs were received by express from Gloucester, and Mr. Tolbert brought three lots, in all about 11,000,000; and on each occasion from one-third to one-half died in transportation. On examining the apparently good ones with a microscope very many of them were found to be more or less defective, and, consequently, but few healthy fry were hatched out.

I submit the following suggestions for another season's work:

1. That there should be a supply of not less than 1,000 codfish at the station by the 1st of November, or as soon as they can be obtained from Nantucket Shoals.

2. That arrangements should be made for getting a monthly supply of at least 500 more. By this means the number would be kept up, and I think would furnish all the eggs the present force could handle.

3. That the basement be fitted up with a number of small pools, conveniently arranged, so the fish can be easily overhauled and get a plentiful supply of fresh water. This will obviate the chances of their getting killed by frost and afford an opportunity of examining them at any time.

Accompanying this you will find copies of the daily record kept during the season.

WOOD'S HOLL, MASS., *March* 25, 1887.

Record of cod-hatching at Wood's Holl, winter of 1886-'87.

[Prepared by James Carswell.]

Date of taking eggs.	From what fish taken.	No. fish yielding eggs.	Eggs obtained.	Date of hatching. Begin-ning.	Date of hatching. Ending.	Fry hatched.	Planted.	Date of planting.	Remarks.
1886.				1886.	1886.			1886.	
Nov. 18	Brought by Grampus	....	150,000	Nov. 26	....	25,000	....	....	Nearly all lost by accidental cessation of water-supply.
	......do	....	800,000	....	Dec. 6	400,000	....	....	
Dec. 9	Cars	2	75,000	Dec. 21	Dec. 24	37,500	37,500	Dec. 24	*Eggs not very good when taken and temperature of water rather high.*
10	......do	7	900,000	Dec. 21	Dec. 24	*450,000*	*450,000*	*Dec. 24*	*Do.*
11	......do	5	1,500,000	Dec. 23	Dec. 29	750,000	750,000	Dec. 29	Do.
					1887.			1887.	
13	......do	8	1,800,000	Dec. 26	Jan. 3	1,530,000	1,530,000	Jan. 3	
14	......do	1	*600,000*	*Dec. 27*	*Jan. 5*	480,000	480,000	Jan. 5	
15	......do	6	2,500,000	Dec. 28	Jan. 9	1,125,000	1,125,000	Jan. 5, 10	Put 1,000,000 in hatching-tubs and lost them on account of high temperature.
				1887.					
18	......do	9	3,000,000	Jan. 3	Jan. 14	2,550,000	2,550,000	Jan. 12, 14.	
20	......do	8	*2,500,000*	*Jan. 4*	Jan. 17	2,000,000	2,000,000	Jan. 14, 17.	
22	......do	8	3,200,000	Jan. 10	Jan. 22	2,720,000	*2,000,000*	*Jan. 19, 25.*	*Lost 720,000 fry by keeping in aquaria.*
24	......do	7	1,400,000	Jan. 14	Jan. 21	980,000	980,000	Jan. 19, 21.	
27	......do	10	2,500,000	Jan. 18	Jan. 27	*2,000,000*	*1,000,000*	*Jan. 27*	*1,000,000 fry kept in hatching-jars and small aquaria.*
31	......do	6	1,400,000	Jan. 20	Jan. 27	1,050,000	1,050,000	Jan. 27	The fry put in aquaria all died by the 14th February and those in jars by the 16th.
1887.									
Jan. 3	......do	4	1,500,000	Jan. 25	Jan. 29	750,000	750,000	Jan. 29	
6	......do	7	*2,600,000*	*Jan. 28*	*Feb. 4*	1,300,000	1,000,000	Feb. 5	300,000 kept in large aquaria; all died by the 17th February.
12	......do	4	1,000,000	Feb. 3	Feb. 8	600,000	500,000	Feb. 11	100,000 kept in small aquaria; all died by the 16th February.
25	Basement	6	*2,500,000*	*Feb. 12*	Feb. 20	1,000,000	1,000,000	Feb. 19, 22.	
27	......do	2	800,000	Feb. 17	Feb. 22	320,000	320,000	Feb. 25	
28	......do	1	*300,000*	Feb. 18	Feb. 22	240,000	240,000	Feb. 25	
29	......do	6	1,200,000	Feb. 18	Feb. 22	810,000	*840,000*	*Feb. 25*	
31	......do	1	200,000	Feb. 20	Feb. 23	170,000	170,000	Feb. 25	
Feb. 7	Grampus	....	500,000	Mar. 1	Mar. 12	*50,000*	*50,000*	*Mar. 13*	Received from Gloucester by express at 6.50 p. m. February 8.
10	......*do*	....	500,000	....	....	None.	....	....	Received from Portsmouth by express; dead on arrival, 7 p. m. February 12.
13	......do	....	150,000	Mar. 5	Mar. 15	22,500	22,500	Mar. 21	Tolbert brought from Gloucester 12 m. February 19.
17, 18	......do	....	1,250,000	Mar. 9	Mar. 18	*250,000*	*250,000*	*Mar. 21*	Do.
Mar. 2, 3	......do	....	2,500,000	Mar. 24	....	*250,000*	250,000	Apr. 4	Tolbert brought from Gloucester 12 m. March 4.
9	......do	....	1,250,000	Mar. 29	....	150,000	150,000	Apr. 6	Received from Gloucester by express at 7 p. m. March 10.
14	......do	....	5,000,000	....	....	None	....	....	*Tolbert brought from Gloucester 7 p. m. March 15; all died by the 24th February.*
	Total	....	43,575,000	....	....	*22,040,000*	*19,495,000*		

Record of the planting of cod fry during the winter of 1886–'87.

[Prepared by James Carswell.]

Date.	Where planted.	By whom.	Number.	Species.
1886.				
Dec. 24	Wood's Holl Harbor	Olmston and Barry	487,500	Common cod.
29	...do	...do	750,000	Do.
1887.				
Jan. 3	...do	...do	1,530,000	Do.
5	...do	...do	880,000	Do.
10	...do	...do	725,000	Do.
12	Small Pool	Carswell	500,000	Do.
14	Wood's Holl Harbor	Olmston and Barry	2,050,000	Do.
17	...do	...do	2,000,000	Do.
19	...do	...do	2,500,000	Do.
21	...do	...do	480,000	Do.
27	Race Point, Cape Cod Bay	Captain Collins	*2,050,000	Do.
29	Wood's Holl Harbor	Olmston and Barry	750,000	Do.
Feb. 5	...do	...do	1,000,000	Do.
11	...do	...do	500,000	Do.
19	...do	Olmston	750,000	Do.
22	...do	...do	250,000	Do.
25	...do	...do	1,570,000	Do.
Mar. 13	Small Pool	Barry	50,000	Do.
21	...do	...do	272,500	Do.
Apr. 4	Wood's Holl Harbor	Olmston	250,000	
6	...do	...do	150,000	
	Total		19,495,000	

* Captain Collins reported the fry planted in splendid condition.

The fry put in harbor were sometimes put in on the flood tide, when they would be drawn into Vineyard Sound, and sometimes on the ebb, when they would be drawn into Buzzard's Bay.

Record of temperature and density of water, winter of 1886–'87.

[Prepared by James Carswell.]

Date.	Temperature of water.			Density of water.		
	Morning.	Noon.	Evening.	Morning.	Noon.	Evening.
1886.	°	°	°			
Dec. 1	49	49	49	1.0253	1.0253	1.0253
2	49	48	47	1.0253	1.0253	1.0253
3	43	43	43	1.0256	1.0256	1.0256
4	43	44	42	1.0256	1.0256	1.0256
5	43	43	39	1.0256	1.0256	1.0256
6	40	39	38	1.0258	1.0258	1.0258
7	39	38	38	1.0258	1.0258	1.0258
8	37	37	38	1.0258	1.0258	1.0258
9	38	38	38	1.0257	1.0257	1.0256
10	39	39	40	1.0256	1.0256	1.0256
11	40	40	40	1.0256	1.0256	1.0256
12	40	40	41	1.0256	1.0256	1.0256
13	41	41	42	1.0256	1.0256	1.0256
14	42	41	41	1.0256	1.0256	1.0256
15	41	42	42	1.0256	1.0256	1.0256
16	41	41	41	1.0253	1.0253	1.0253
17	41	38	41	1.0258	1.0258	1.0258
18	41	41	40	1.0258	1.0258	1.0256
19	40	40	40	1.0256	1.0256	1.0256
20	40	39	39	1.0256	1.0256	1.0256
21	40	39	39	1.0256	1.0256	1.0256
22	39	39	39	1.0256	1.0256	1.0256
23	39	39	39	1.0256	1.0256	1.0256
24	39	40	40	1.0256	1.0256	1.0256
25	41	41	40	1.0256	1.0256	1.0256
26	39	39	39	1.0256	1.0256	1.0256
27	39	39	39	1.0256	1.0256	1.0256
28	38	38	38	1.0256	1.0256	1.0256
29	37	38	37	1.0256	1.0256	1.0256
30	36	36	36	1.0254	1.0254	1.0254
31	36	36	36	1.0254	1.0254	1.0254
Mean	40			1.02559		

Record of temperature and density of water, winter of 1886-'87—Continued.

Day of month.	January, 1887.		February, 1887.		March, 1887.	
	Temperature of water at 2 p. m.	Density of water at 2 p. m.	Temperature of water at 2 p. m.	Density of water at 2 p. m.	Temperature of water at 2 p. m.	Density of water at 2 p. m.
	°		°		°	
1	37	1.0255	37	1.0255	34	1.0258
2	37	1.0255	37	1.0255	35	1.0257
3	36	1.0255	37	1.0255	35	1.0257
4	36	1.0255	37	1.0255	35	1.0260
5	35	1.0255	35	1.0256	35	1.0260
6	35	1,0255	34	1.0255	34	1.0260
7	36	1.0254	34	1.0255	34	1 0259
8	35	1.0254	34	1.0255	35	1.0260
9	34	1.0254	35	1.0555	35	1.0260
10	34	1.0254	35	1.0255	35	1.0258
11	33	1.0256	36	1.0255	35	1.0260
12	33	1.0256	36	1.0254	35	1.0258
13	34	1.0256	35	1.0254	36	1.0257
14	35	1.0256	34	1.0255	35	1.0250
15	35	1.0256	34	1.0254	35	1.0252
16	34	1.0256	35	1.0255	36	1.0252
17	33	1.0256	35	1.0255	35	1.0254
18	34	1.0226	35	1.0255	36	1.0252
19	32	1.0256	35	1.0255	36	1.0252
20	33	1.0257	36	1.0255	36	1.0252
21	34	1.0256	36	1.0255	37	1.0252
22	34	1.0256	36	1.0255	37	1.0252
23	35	1.0256	36	1.0254	37	1.0252
24	36	1.0256	36	1.0256	37	1.0254
25	36	1.0256	37	1.0258	37	1.0254
26	37	1.0257	36	1.0258	37	1.0254
27	35	1.0255	36	1.0258	37	1.0252
28	36	1.0255	34	1.0258	38	1.0252
29	38	1.0255	....	....	38	1.0250
30	38	1.0255	....	....	....	....
31	37	1.0255	....	....	....	....
Mean	35	1.02554	35.4	1.02553	*35.8	*1.02552

* 29 days.

XX.—REPORT OF OPERATIONS AT THE WYTHEVILLE STATION, VA., FROM JANUARY 1, 1885, TO JUNE 30, 1887.

BY MARSHALL MCDONALD.

The plans projected during 1884 for extending and improving the facilities for work at this station were carried out during the summer and fall of 1885, under the direction of the Commissioner of Fisheries for the State of Virginia, and the cost of the extensive improvements made was defrayed by the State Commission.

The station is now substantially complete in its equipment and appointments. Additional ponds will be needed from time to time to provide increased capacity for rearing trout and other species for distribution.

Much also remains to be done in providing access to and circulation through the grounds by the construction of good graded roads, in erecting substantial inclosures for protection from depredations, and in improving the amenities of the grounds by planting trees and shrubs, clearing up the undergrowth, and turfing bare and unsightly spots. But the station may now be regarded as fully equipped for its work; and a description of its location, buildings, ponds, and grounds, and its facilities for production and distribution of the Salmonidæ will well illustrate its importance and value to the work of the U. S. Fish Commission.

(1) *Location.*—The station is situated in southwestern Virginia, about 3 miles east of the town of Wytheville and immediately on the line of the Atlantic, Mississippi and Ohio Railroad, which, with its extensive connections northeast and southwest, traverses that broad belt of mountain region which stretches from New York to Georgia and Alabama and is the natural trout region of the Middle and South Atlantic States. The facilities thus afforded for expeditious and satisfactory distribution to the most distant points are all that can be desired.

A railroad siding, not a hundred yards from the station and accessible by a good graded road, affords every convenience for satisfactory distribution by car and messenger service.

(2) *Water supply.*—This, which aggregates 1,100 gallons per minute, is afforded by two bold springs, coming to the surface in an oval depres-

sion or basin in the hillside to the north of the hatchery. The water supply for the hatching-house is drawn from the upper spring (see Plate I) through a 4-inch iron pipe conveying about 120 gallons of water per minute. The excess of water from the upper spring is conducted by shallow flumes, which also serve as spawning races, through the two ponds, 12 by 50 feet, which are reserved for the oldest breeding trout. Escaping from the lower of these the discharge unites with that from the lower spring and is conveyed by a tunnel under the hatchery to the sloping hillside south of this building, and the whole discharge from the springs is thus utilized for the supply of the succession of trout-rearing ponds constructed on the rather abrupt slope extending from the hatchery to the valley below.

The station, it will be seen (Plate II), presents remarkable advantages in the large water supply available for fish-cultural operations, and in the fact that the distribution both to the hatching-house and ponds can be made by gravity, thus eliminating one very considerable item in the cost of maintenance of stations where circumstances require the water to be pumped to a higher level before it can be utilized. One serious trouble relating to the water supply yet remains to be corrected.

During the seasons of heavy and prolonged rainfall the springs become muddy, and although the muddy water does not appear to be directly injurious, the fact that proper observation and attention can not be given to the eggs and young fish may give rise to serious losses. Where this muddy condition is prolonged the gills of the larger trout become congested or inflamed, and many of our losses of fish have doubtless originated from the abnormal condition of water, if not directly attributable to it.

It is expected to get rid of this trouble and embarrassment to the work either by the use of a settling reservoir or by devising effective methods of filtration. Experiments are now in progress with a view to determining the most convenient and available means to accomplish the desired end.

(3) *Hatchery.*—The building first occupied as a hatchery was an old, log still-house, fitted up with hatching troughs affording capacity for the development and hatching of 300,000 trout eggs. In the spring of 1886 this building was removed, and on its site was erected the present comfortable, convenient, and well-equipped station. It is shown in elevation in the general view of buildings, ponds, and grounds (Plate II). Details of interior construction and arrangements are given in Plates III, IV, V.

The building is 50 feet by 25 feet and two stories high. The basement or lower story is of stone, the floor of concrete, so that it may be flushed with water and thoroughly cleaned whenever necessary. This floor constitutes the hatchery proper, and is fitted up with troughs and hatching jars, as shown in Plate III. As at present arranged, about

800,000 trout eggs can be incubated conveniently; by crowding, provision could be made for 1,200,000 eggs. Under the hatching troughs and supplied by the overflow of the water from these are an equal number of nursing troughs for the young trout.

Experience has shown that it will not do to transfer them to the open-air ponds until they are several months old. It is proposed to make additional provision for twenty-five more nursing troughs in a separate building, and so increase the capacity of the station as to enable us to rear and furnish for distribution each season not less than 200,000 yearling trout.

The second story of the hatchery is framed, and the interior is arranged for office, storage, and quarters, as shown in Plate IV.

(4) *Work done.*—The work of the station was at first directed with the view of producing the eggs and young of the Rainbow Trout (*Salmo irideus*) for distribution. The breeding fish have been reared from eggs obtained from native wild fish at Baird Station, California. These spawned first in the winter of 1883–'84, and, in the winter of 1886–'87, we obtained from our own stock of the Rainbow Trout, 220,000 eggs. The work of the station has been by degrees extended and diversified so as to provide for the pond-culture of Carp, the Goldfish, the Rock Bass, and the small-mouthed Black Bass.

For the better economy and distribution of the work of the station, arrangements were begun in 1885 to accumulate a stock of the native or red-spotted trout of the Eastern States by the collection of wild fish from streams of Virginia and by hatching and rearing breeding fish at the station from eggs obtained both from Michigan and from the Northeastern States. The eggs from the West gave fry of feeble vitality, and the percentage reared was very small. The stock of breeding fish on hand consists of a few hundred of the native Brook Trout and about 2,500 one and two-year old fish reared from eggs hatched at the station. It is probable that a few thousand eggs will be obtained during the winter of 1887–'88. Only a small number, however, will mature enough to spawn before the winter of 1888–'89.

The current work of production and distribution for the fiscal year beginning July 1, 1886, is given in the following tables. The receipts of fish and eggs by collection from our breeding fish and from open waters and by transfer from other stations are given in Table I. The distribution of fish and eggs from the station during the fiscal year beginning July 1, 1886, is given in Table II.

TABLE I.—*Receipts of fish and eggs at Wytheville Station for the year ending June 30, 1887.*

Species.	Whence received.	Date.	Eggs.	Fish.
California trout	Central Station, by W. F. Page	Apr. 14		*5,000
Do	Central Station, by W. A. Dunnington	May 4		*3,000
	Collected at Wytheville Station		220,500	
	Total		220,500	8,000
Brook trout	Northville Station, by R. S. Johnson	Dec. 11		†193
Do	Northville Station, by express	Jan. 2	26,508	
Do	Richard E. Follett, Windham, Conn	Jan. 8	75,000	
Do	Central Station, by W. F. Page	Apr. 14		*5,000
	Total		101,508	5,193
Brown trout	Fred. Mather, Cold Spring Harbor, N. Y	Mar. 17	9,100	
Do	Central Station, by W. A. Dunnington	May 4		*3,000
Landlocked salmon	Chas. G. Atkins, Grand Lake Stream, Me	Mar. 13	50,000	
Red-eye perch	Peak Creek, Pulaski County, Va	Aug. 16		‡2,125
Do	do	Aug. 16		†58
Do	Reed Creek, Wythe County, Va	June 23		†19
	Total			2,202
Black bass	New River, Giles County, Va	Aug. 16		‡100
Do	Reed Creek, Wythe County, Va	June 23		†11
	Total			111
Carp (leather)	Central Station, Washington, D. C	Nov. 11, 20		‡3,000
Do	do	Mar. 1		†12
Do	do	Apr. 14		†2
Do	do	May 4		†3
Carp (scale)	do	Jan. 6		†450
Do	do	Apr. 14		†2
	Total			3,469
Tench	Central Station, Washington, D. C	Jan. 6		‡450
Do	do	Apr. 14		†2
	Total			452

* Fry. † Breeders. ‡ Yearlings.

TABLE II.—*Distribution of fish and eggs from Wytheville Station for the year ending June 30, 1887.*

Species.	Where sent.	Date.	Eggs.	Fish.
California trout	H. C. Parsons, Natural Bridge, Va	Aug. 11		*100
Do	M. C. Treiber, Staunton, Va	Aug. 11		*100
Do	North River, Weyer's Cave, Va	Aug. 11		*497
Do	A. Y. Stevens, Nashville, Tenn	Aug. 17		*100
Do	Edward D. Hicks, Nashville, Tenn	Aug. 17		*50
Do	J. D. Eads, Warrensburgh, Mo	Aug. 17		*75
Do	Tributary of Maramec River, Mo	Aug. 17		*925
Do	Tributary of Gasconade River, Mo	Aug. 17		*750
Do	Tributary of Osage River, Mo	Aug. 17		*950
Do	Tributary of Neosho River, Mo	Aug. 17		*925
Do	Tributary of White River, Ark	Aug. 17		*1,110
Do	George L. Harman, Olympic, Va	Aug. 20		*50
Do	do	Aug. 21		*50
Do	William Spangler, Speedwell, Va	Sept. 2		*20
Do	Stony Fork of Reed Creek, Wythe County, Va	Sept. 20		†100
Do	Eli F. Thomas, Grant, Va	Sept. 21		*25
Do	Headwaters of James River, Va	Sept. 23		*400
Do	Stony Fork of Reed Creek, Wythe County, Va	Sept. 23		*500
Do	Cacapon River, W. Va	Oct. 12		*400
Do	Henry Stewart, Highland, N. C	Oct. 19		*300
Do	D. B. Mackall, messenger, Washington, D. C	Nov. 7		*300
Do	J. W. Davis, Atkin's Tank, Va	Nov. 13		*25
Do	D. B. Mackall, messenger, Washington, D. C	Nov. 15		*250
Do	V. G. Shepard, Faber's Mills, Va	Nov. 15		*100
Do	Newton Simmons, messenger, Washington, D. C	Jan. 6		*225
Do	M. McDonald, Washington, D. C	Jan. 21	5,000	
Do	Max von dem Borne, Berneuchen, Germany	Jan. 24	10,000	
Do	N. Jeunet, Paris, France	Feb. 2	5,000	
Do	Deutsche Fischerei-Verein, Berlin, Germany	Feb. 7	15,000	
Do	do	Feb. 14	15,000	
Do	National Fish-Culture Association, London, England.	Feb. 21	10,000	

* Yearlings. † Two years or more.

TABLE II.—*Distribution of fish and eggs from Wytheville Station, etc.*—Continued.

Species.	Where sent.	Date.	Eggs.	Fish.
California trout	M. V. Osborne, Cold Creek Hatchery, Ohio	Feb. 21	10,000	
Do	E. G. Shortlidge, Wilmington, Del	Feb. 21	5,000	
Do	E. H. Frishmuth, Philadelphia, Pa	Feb. 26	5,000	
Do	J. W. Hoxie & Co., Carolina, R. I	Feb. 26	3,000	
Do	Charles F. Hardie, New York, N. Y	Mar. 1	10,000	
Do	G. W. Delawder, Baltimore, Md	Mar. 1	5,000	
Do	Long Meadow Run, near Hagerstown, Md	Mar. 31		*622
Do	Almshouse Run, near Hagerstown, Md	Mar. 31		*622
Do	Rush Run, near Hagerstown, Md	Mar. 31		*622
Do	Walker's Run, near Hagerstown, Md	Mar. 31		*622
Do	South Fork of Reed Creek, Wythe County, Va	May 19		†65
Do	Holston River, near Marion, Va	May 20		*500
Do	Cove Creek, Wythe County, Va	May 24		*250
Do	Walker's Creek, Bland County, Va	May 27		*250
Do	North Fork of Reed Creek, Wythe County, Va	June 1		†100
Do	L. S. Allison, Wythe County, Va	June 20		*250
	Total		38,000	12,230
Brook trout	Long Meadow Run, near Hagerstown, Md	Mar. 31		‡622
Do	Almshouse Run, near Hagerstown, Md	Mar. 31		‡622
Do	Rush Run, near Hagerstown, Md	Mar. 31		‡622
Do	Walker's Run, near Hagerstown, Md	Mar. 31		‡622
Do	Cove Creek, Wythe County, Va	May 24		*250
Do	Walker's Creek, Bland County, Va	May 27		*250
Do	L. S. Allison, Wythe County, Va	June 20		*250
	Total			3,238
Lake trout	H. C. Parsons, Natural Bridge, Va	Aug. 11		*100
Do	M. C. Treiber, Staunton, Va	Aug. 11		*100
Do	Tributary of Gasconade River, Mo	Aug. 17		*50
Do	William Spangler, Speedwell, Va	Sept. 2		*20
Do	Eli F. Thomas, Grant, Va	Sept. 21		*25
Do	S. N. Hufford, Wytheville, Va	Oct. 9		*25
Do	D. B. Mackall, messenger, Washington, D. C	Nov. 15		*250
Do	do	Nov. 23		*600
Do	Newton Simmons, messenger, Washington, D. C	Jan. 30		*30
	Total			1,200
Landlocked salmon	Tributary of Shenandoah River, Staunton, Va	Aug. 11		*1,097
Do	South Fork of Shenandoah River, Waynesborough, Va.	May 19		*11,000
	Total			12,097
Red-eye perch	W. L. Bumgardner, Staunton, Va	Aug. 11		*25
Do	I. G. W. Steedman, St. Louis, Mo	Aug. 17		*60
Do	Cowpasture River, Bath County, Va	Sept. 23		*600
Do	Cacapon River, West Virginia	Oct. 12		*500
Do	W. O. Watson, Charlottesville, Va	Oct. 12		*200
Do	W. E. Grant, Grantland, Va	Oct. 15		*100
Do	D. B. Mackall, messenger, Washington, D. C	Nov. 7		*400
Do	V. G. Shepard, Faber's Mills, Va	Nov. 15		*100
Do	L. S. Pendleton, Frederick's Hall, Va	Nov. 15		*50
Do	Fred Mather, Cold Spring Harbor, N. Y	Dec. 12		*50
Do	Newton Simmons, messenger, Washington, D. C.	Jan. 6		§6
Do	E. M. Robinson, messenger, Washington, D. C.	Feb. 25		§12
	Total			2,103
Black bass	J. D. Eads, Warrensburgh, Mo	Aug. 17		*48
Carp (leather)	Ninety-one applicants in southwest Virginia and east Tennessee.			1,925
Carp (scale)	South Fork of Reed Creek, Wythe County, Va	Jan. 8		450
	Total			2,375
Tench	South Fork of Reed Creek, Wythe County, Va	Jan. 8		*450
Goldfish	Mrs. O. J. Smythe, Wytheville, Va	July 13		6
Do	J. C. Ewald, Paris, Tex	July 17		4
Do	Mrs. Emma W. Guy, Glade Spring, Va	Aug. 5		6
Do	Miss Daisy Bedford, Vicksburg, Miss	Aug. 10		6
Do	E. M. Robinson, Fayetteville, N. C	Dec. 21		8
Do	Charles Hancock, Wytheville, Va	Jan. 12		4
Do	J. G. Hollbrook, Wytheville, Va	Jan. 22		6
Do	Charles Ewald, Wytheville, Va	Mar. 6		4
Do	Hon. C. F. Trigg, Abingdon, Va			6
	Total			50

* Yearlings. † Two years or more. ‡ Fry. § Breeders.

From the eggs hatched at the station during the season we have now in our ponds for distribution during the fall of 1887, according to the estimates of the superintendent of the station, about 60,000 California and Eastern brook trout, from 3 to 5 inches in length.

During the spring of 1887 our facilities for pond-culture were extended by the construction of a series of ponds covering about 2 acres, for the cultivation of the rock bass (*Ambloplites rupestris*), a species well adapted for pond-culture and rapidly growing in favor with those desiring a species of easy cultivation, with gamy characteristics and of good flavor.

The landlocked salmon bred during the season were held in ponds at the station until June, 1887, and then transferred to the headwaters of the Shenandoah River, in Augusta County, Va. They were from 2½ to 3 inches in length when planted, and about 25 per cent. only of the eggs received survived.

The stocking of the headwaters of the Shenandoah with salmon is to be regarded as an experiment in acclimation rather than assured fish-cultural work. It is hoped that by the selection of a variety of salmon that has largely lost its migratory instincts and by hatching it and constraining it to live for some months in a much higher range of temperature than is natural to it, it may become habituated to its new environment and become resident in the Potomac River basin. Should but a few survive and spawn it is probable that the young will exhibit considerable modification of habit and be in better accord with their environment, and after a succession of generations develop a distinct race, finding congenial habitat in streams with a higher range of temperature than is found in the natural salmon streams of the Northeast.

It is not possible to report even a fair measure of success in hatching eggs of the Brown Trout of Europe (*Salmo fario*). From the Deutsche Fischerei-Verein we obtained about 2,000 fish, which, at the age o six months, are from 4 to 6 inches long and growing rapidly. The very large percentage of loss occurred during the period intervening between hatching and beginning to feed.

(5) *Provision for pond culture.*—In the oval depression north of the hatchery (Plate I) are two ponds, 12 by 50 feet, provided with spawning races. These are reserved for our breeding trout. They are constructed entirely of plank, sides and bottom, and at first the sides projected above the level of the soil. The considerable losses occurring among the breeders during the hot weather of summer indicated unhealthy conditions, which were attributed to the exposed sides, which became heated during the day, thus causing a considerable rise in the temperature of the water. This was remedied by banking up the sides with earth and sodding the slopes. The plank bottoms at the upper ends of the ponds were also covered by broken stone and coarse gravel. These changes were marked by the greater improvement in the condition of the fish in the ponds. Losses are now comparatively rare, and are almost entirely confined to the males, being usually the result of injuries

inflicted in the fierce fights they wage with each other during the breeding season.

A general view of the series of ponds to the south of the hatchery is given in Plate VI. The four ponds lying upon the slope immediately below the hatchery are each 8 feet by 50 feet, and are reserved for the larger trout which are being reared at the station to maintain the succession of breeders or for distribution after attaining considerable size.

The eight ponds at the base of the hill, between the superintendent's house and Tate's Run, are also appropriated to the rearing of trout for distribution. All of these ponds have earth sides and bottom, and each has an independent water supply and drainage. The series of four large ponds on the opposite side of Tate's Run, near the railroad, is appropriated to the pond culture of the carp and other species requiring warm waters for their successful cultivation. The water supply for this series of ponds is conducted from the springs in a 4-inch pipe, and, with the view of securing the warming of the water as much as possible by exposure to summer temperature, the water supply is reduced to an amount barely sufficient to replace the losses by evaporation and leakage. The extent of surface exposed to the air and the presence of abundant vegetation in the ponds are relied upon to maintain the water in healthy condition.

A series of six ponds, covering about 3 acres, has been constructed in the area of ground lying between Tate's Run and the series of carp ponds. These are not shown in the general view of ponds in Plate VI.

They have been constructed especially with a view to the breeding of the red-eyes and the small-mouth black bass for distribution. The water supply is drawn from Tate's Run, and carries into the pond an abundant supply of food both for the parent fish and the young.

(6) *Capabilities of the station.*—As now equipped this station may safely be looked to to furnish each season 400,000 or 500,000 eggs of the rainbow trout for distribution or for hatching and rearing. Equally good results may be expected from the work with Eastern brook trout in a year or two.

The trout ponds at the station are of sufficient extent to permit the carrying of 150,000 fish up to the age when they are of sufficient size to permit their introduction with safety into open waters infested by predaceous fish. The arrangements for pond culture are sufficiently extensive and the results of such work well enough assured to enable us to look with confidence to the Wytheville station to provide for all demands for the streams and ponds of Virginia, North Carolina, Tennessee, Maryland, and West Virginia. The distribution of trout fry from this station has been conspicuous by the failure to secure appreciable results in the improvement of the streams stocked. Rarely did we find any evidence of success from such work, so far as it has come under my observation.

The change in our methods of handling the trout, namely, rearing them at the station and distributing after they have attained a length of 5 inches to 6 inches has, on the other hand, met with most encouraging success. The *irideus* has been established in several of the streams of southwest and Piedmont Virginia, and in Maryland and in a number of ponds in Virginia and Tennessee.

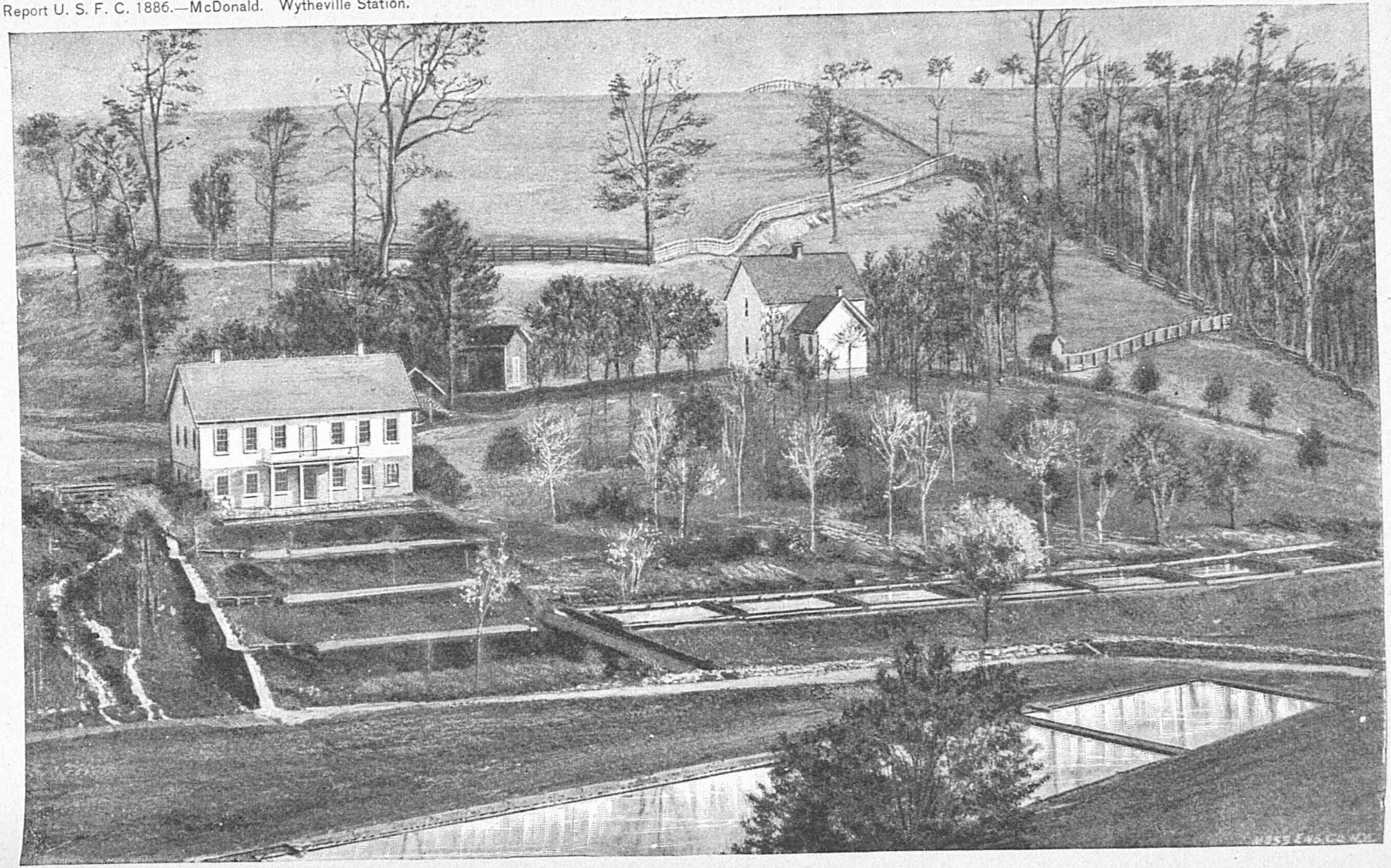
A remarkable comparison of the different results of the two methods is given by the experiments conducted under my own observation and direction with a view of stocking the natural trout stream flowing through the grounds of the station. For several years in succession this stream was stocked with the fry of both the California and Eastern brook trout. The aggregate number planted was not much short of 100,000. No appreciable results followed from this work. In August, 1886, about 400 fingerling trout from 4 to 5 inches in length were released into the stream. During the ensuing fall and winter about 100 of these were captured at the head of a little fishway fed by the waste water discharged from the ponds. They had attained a length of 7 to 8 inches, and the brightness and clearness of their color were in marked contrast to the duller hues of the fish of same age in the ponds. An examination of the stream subsequently showed that the trout were still quite numerous in the stream in the vicinity of the hatchery.

The important lesson to be drawn from these experiments is that in stocking streams infested by small predaceous fish we can only assure success by stocking with trout of sufficient size to dominate the water. Under the circumstances indicated experience shows that several hundred yearling trout are sufficient to stock a stream presenting suitable habitat. On the other hand, we can rarely expect success in stocking such waters with any number of the fry, however great. It may be assumed as a rule that a pair of yearling trout are fully the equivalent of several thousand fry in stocking streams presenting the conditions to be found in the trout region of Pennsylvania, Maryland, Virginia, and States farther to the south.

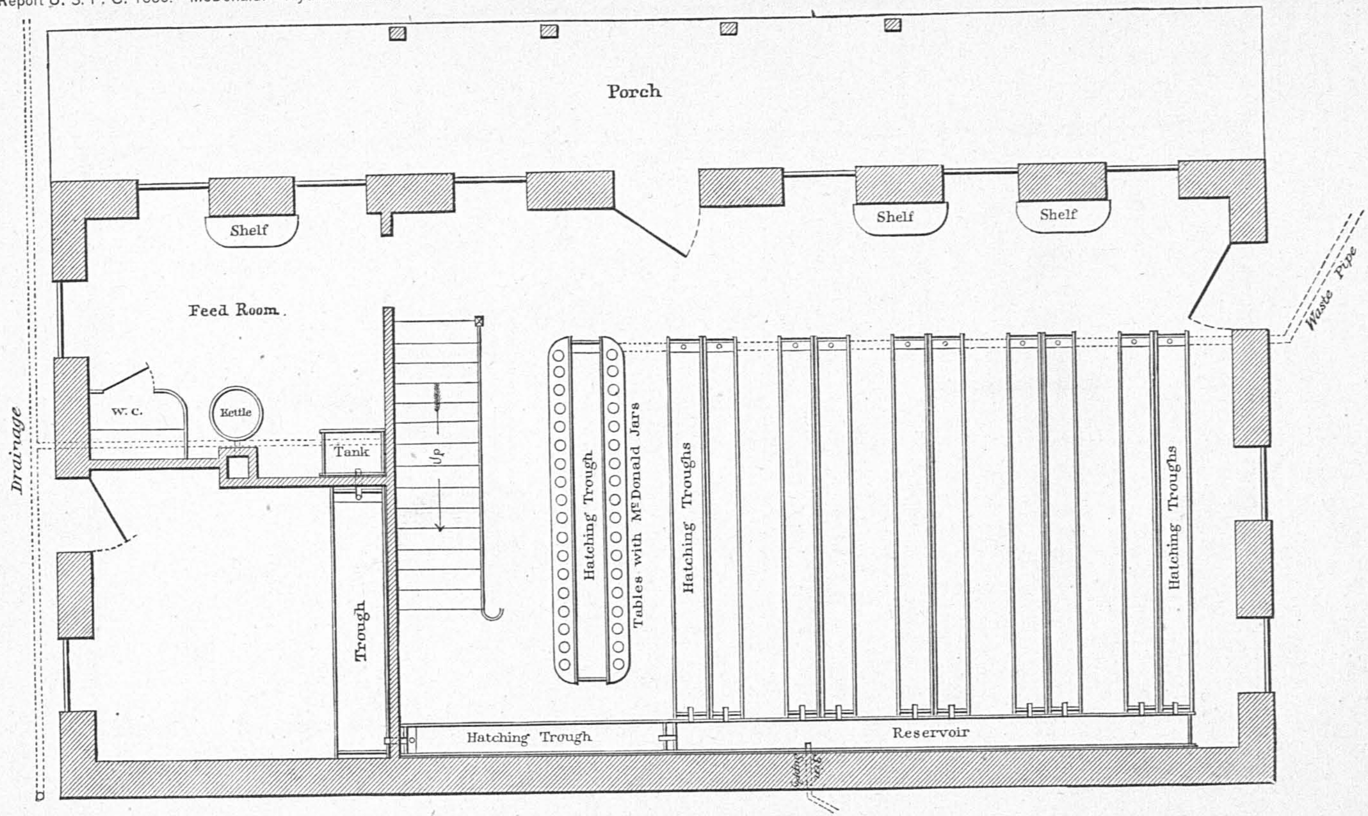
WASHINGTON, D. C., *November* 19, 1887.

LIST OF PLATES.

WATER SUPPLY AND PONDS FOR BROOD FISH.

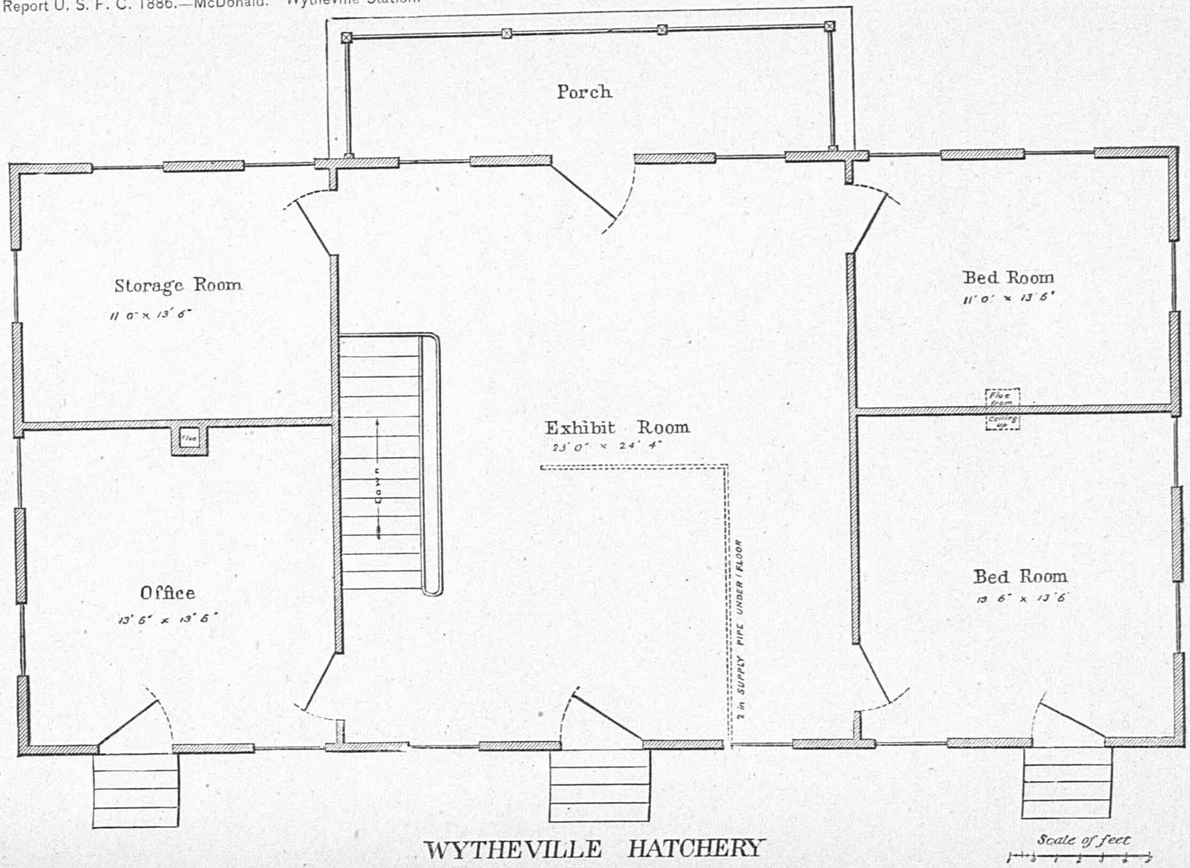


GENERAL VIEW OF BUILDINGS AND GROUNDS.



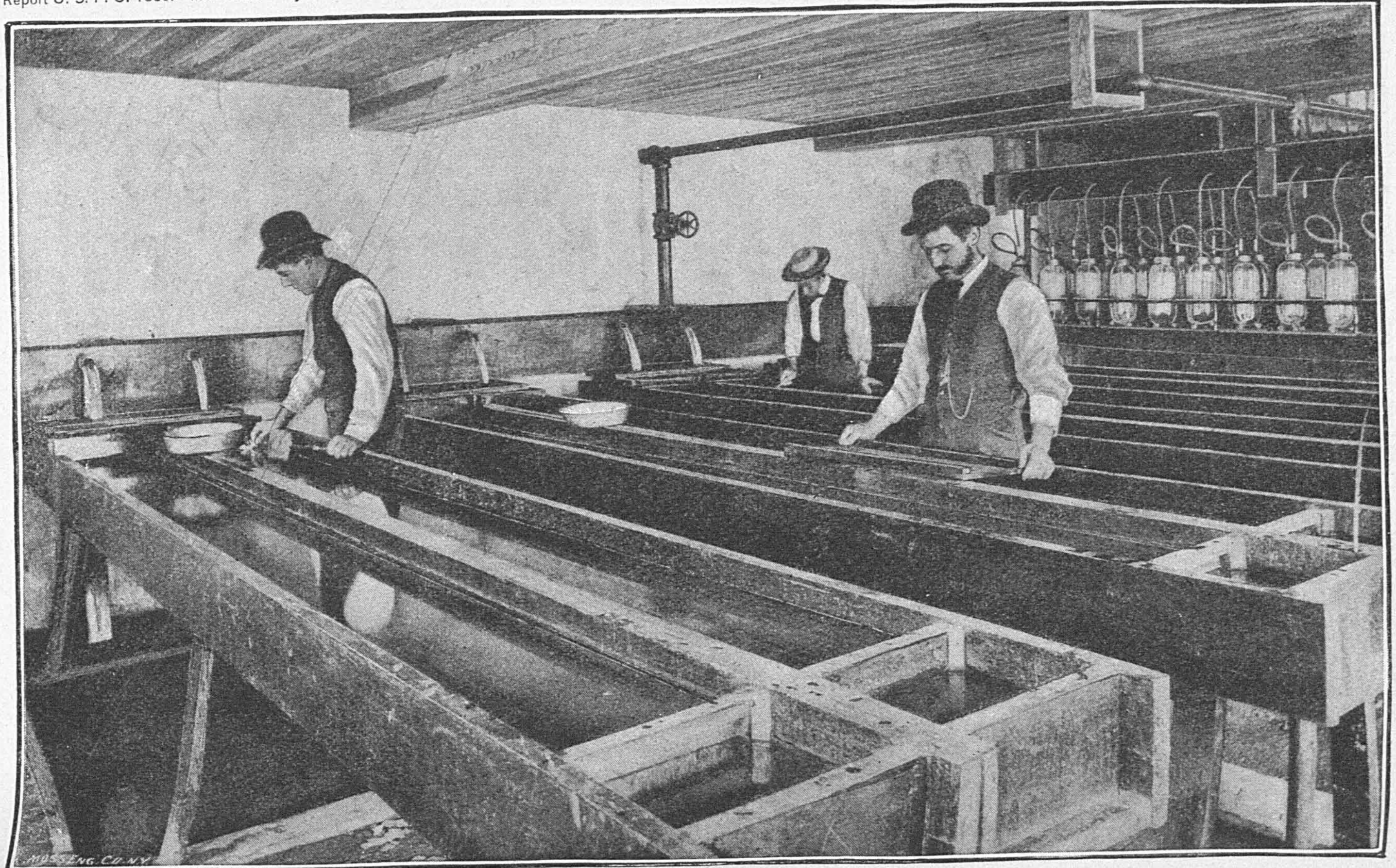
WYTHEVILLE HATCHERY

Plan of First Floor.

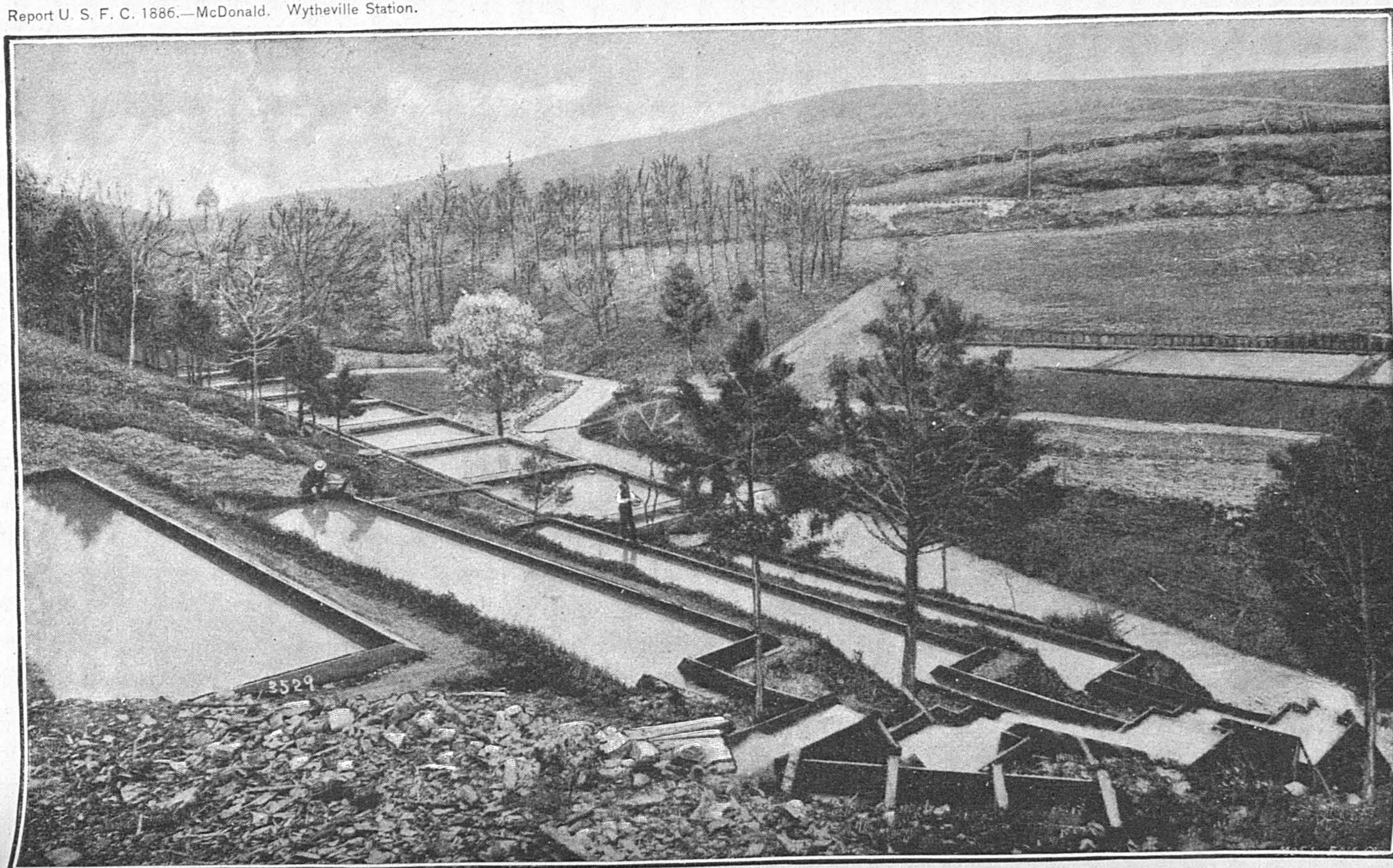


WYTHEVILLE HATCHERY

Plan of Second Floor.



VIEW OF INTERIOR SHOWING DETAILS OF EQUIPMENT.



GENERAL VIEW OF PONDS.

XXI.—REPORT OF SHAD DISTRIBUTION FOR THE SEASON OF 1886.

BY MARSHALL MCDONALD.

The work of shad propagation and the production of the young for distribution was conducted on the Potomac River at Fort Washington and Central Stations, on the Susquehanna at Battery Station and by the steamer Lookout, and on the Delaware River by the steamer Fish Hawk. Shad for distribution were contributed as follows:

Battery Station, Susquehanna River	43,776,000
Central Station, Potomac River	28,151,000
Steamer Fish Hawk, Delaware River	21,018,000
Steamer Lookout	310,000
Total	93,255,000

The aggregate number of fry actually planted was 92,679,000. In this distribution liberal plants of shad fry have been made in the Potomac, the Susquehanna, the Delaware, and other tributaries of Chesapeake and Delaware Bays. The following is a summary by river basins of shad distributed during the season of 1886:

River basin.	Received from station.	Actually planted.	Lost in transit.
Tributaries of Narragansett Bay	2,534,000	2,534,000	....
Tributaries of Long Island Sound	832,000	749,000	83,000
Hudson River	2,312,000	2,312,000	....
Delaware River	21,618,000	21,618,000	....
Tributaries of Chesapeake Bay	52,923,000	52,835,000	88,000
Tributaries of Albemarle Sound	1,990,000	1,990,000	....
Streams draining into the Atlantic south of Albemarle Sound	4,288,000	4,183,000	105,000
Mississippi River and minor tributaries of the Gulf of Mexico	4,758,000	4,758,000	....
Colorado River, Gulf of California	1,000,000	850,000	150,000
Columbia River basin	1,000,000	850,000	150,000
Total	93,255,000	92,679,000	576,000

The localities at which the plants were made, the streams in which they were made, and the number of fish included in each deposit are given in the following table:

Record of distribution of shad from Central Station, Washington, D. C., and from Battery Station, Havre de Grace, Md., season of 1886.

CENTRAL STATION.

Date.		Stream stocked.	Tributary of—	Place of deposit.	Fish shipped.	Died in transit.	Planted.
1886.							
Apr.	24	Potomac River	Chesapeake Bay	Little Falls, Md	918,000		918,000
	25	......do	......do	......do	364,000		364,000
	27	Rivanna River	James River	Charlottesville, Va	534,000		534,000
	28	Rappahannock River	Chesapeake Bay	Rappahannock Station, Va	340,000		340,000
	28	Rapidan River	Rappahannock River	Rapidan Station, Va	341,000		341,000
	29	Occoquan River	Potomac River	Woodbridge Station, Va	579,000		579,000
	30	Rappahannock River	Chesapeake Bay	Near Fredericksburgh, Va	730,000		730,000
May	1	Mattapony River	York River	Near Milford Station, Va	391,000		391,000
	1	North Anna River	Pamunkey River	C. & O. Junction, Va	391,000		391,000
	1	Fork of Shenandoah River	Potomac River	Near Waynesborough, Va	557,000		557,000
	2	Acquia Creek	......do	Near Quantico, Va	389,000		389,000
	2	Accokeek Run	Acquia Creek	Brooke's Station, Va	290,000		290,000
	2	Rivanna River	James River	Near Charlottesville, Va	700,000		700,000
	3	Appomattox River	......do	Near Mattoax, Va	379,000		379,000
	3	Monocacy River	Potomac River	Near Frederick Junction, Md	603,000		603,000
	3	Patuxent River	Chesapeake Bay	Laurel, Md	609,000		609,000
	3	Shenandoah River	Potomac River	Waynesborough, Va	200,000		200,000
	3	Rapidan River	Rappahannock River	Rapidan, Va	629,000		629,000
	4	James River	Chesapeake Bay	One mile above Bosher's Dam, Va	380,000		380,000
	5	Occoquan River	Potomac River	Bristoe, Va	531,000		531,000
	5	Chickahominy River	James River	Hunslett Station, Va	310,000		310,000
	7	Pamunkey River	York River	Near White House Station, Va	385,000		385,000
	7	Mattapony River	......do	Near Milford, Va	367,000		367,000
	8	Dan River	Roanoke River	Two miles from Danville, Va	329,000		329,000
	9	Chickahominy River	James River	Fives miles from Ashland, Va	316,000		316,000
	10	Colorado River of the West	Gulf of California	The Needles, Colo	1,000,000	150,000	850,000
	10	Cheat River	Monongahela River	Three miles from Rowlesburgh, W. Va	356,000		356,000
	11	Chattahoochee River	Appalachicola River	West Point, Ga	370,000		370,000
	12	Stony Creek	Nottoway River	Near Stony Creek Station, Va	364,000		364,000
	13	Meherrin River	Chowan River	Near Belfield, Va	415,000		415,000
	14	......do	......do	1½ miles above Belfield, Va	314,000		314,000
	15	......do	......do	Near Margarettsville, N. C	300,000		300,000
	15	Fountaine's Creek	......do	......do	40,000		40,000
	16	Savannah River	Atlantic Ocean	Augusta, Ga	301,000	30,000	271,000
	16	Nottoway River	Chowan River	Near Stony Creek, Va	228,000		228,000
	17	Monongahela River	Ohio River	Two miles from Fairmont, W. Va	281,000		281,000
	21	......do	......do	Near Fairmont, W. Va	210,000		210,000
	21	Housatonic River	Long Island Sound	Birmingham, Conn	832,000	83,000	749,000
	22	Will's Creek	Potomac River	Cumberland, Md	532,000		532,000
	22	Rapidan River	Rappahannock River	Rapidan Station, Va	259,000		259,000
	23	Neuse River	Pamlico Sound	Goldsborough, N. C	200,000	20,000	180,000

24	Tar River	Pamlico Sound	Two miles above Rocky Mount Station, N. C	448,000		448,000
25	Youghiogheny River	Monongahela River	Connellsville, Pa	991,000		991,000
26	Mattawoman Creek	Potomac River	Mattawoman Station, Md	463,000		463,000
26	Quantico Creek	......do	1½ miles from Quantico, Va	548,000		548,000
27	Patuxent River	Chesapeake Bay	2½ miles from Marlborough, Md	528,000		528,000
28	Hudson River	Atlantic Ocean	Catskill, N. Y	921,000		921,000
31	......do	......do	Albany, N. Y	1,036,000		1,036,000
31	Taunton River	Narragansett Bay	Dighton, Mass	1,034,000		1,034,000
June 3	Catawba River	Santee River	Near Morganton, N. C	365,000		365,000
4	Crab-Tree Creek	Neuse River	Near Raleigh, N. C	374,000		374,000
5	Acquia Creek	Potomac River	2½ miles from Quantico, Va	370,000		370,000
8	Hudson River	Atlantic Ocean	Catskill, N. Y	355,000		355,000
(*)			Cold Spring Harbor, N. Y. †	1,586,000		1,586,000
(*)	Potomac River	Chesapeake Bay	Fort Washington, Md	3,154,000		3,154,000
	Total			29,737,000	283,000	29,454,000

BATTERY STATION.

1886. Apr. 25	Susquehanna River	Chesapeake Bay	Near Station, Md	25,000		25,000
26	......do	......do	......do	1,421,000		1,421,000
27	......do	......do	......do	2,431,000		2,431,000
27	......do	......do	......do	325,000		325,000
28	......do	......do	......do	860,000		860,000
28	Northeast River	......do	P., W. & B. R. R., Md	500,000		500,000
29	Susquehanna River	......do	Near Port Deposit, Md	1,055,000		1,055,000
29	Bush River	......do	Bush Station, Md	500,000		500,000
29	Elk River	......do	Elkton, Md	500,000		500,000
30	Susquehanna River	......do	Near Station, Md	50,000		50,000
30	Gunpowder River	......do	P., W. & B. R. R., Md	500,000		500,000
30	Northeast River	......do	......do	500,000		500,000
May 1	......do	......do	......do	500,000		500,000
1	Patapsco River	......do	Near Relay Station, Md	500,000		500,000
1	Bush River	......do	Bush River Station, Md	600,000		600,000
1	Elk River	......do	Elkton, Md	600,000		600,000
3	Susquehanna River	......do	Above Harrisburg, Pa	1,621,000	48,000	1,573,000
3	......do	......do	Near Station, Md	1,952,000		1,952,000
5	......do	......do	......do	804,000		804,000
6	Palmer River	Narragansett Bay	Near Providence, R. I	1,500,000		1,500,000
6	Susquehanna River	Chesapeake Bay	Near Station, Md	1,245,000		1,245,000
8	Chester River	......do	Near Chestertown, Md	500,000		500,000
9	Columbia River	Pacific Ocean	Wallula Junction, Wash	‡1,000,000		300,000
9	Willamette River	Columbia River	Albany, Oreg		150,000	550,000
9	Patuxent River	Chesapeake Bay	Odenton, Md	650,000		650,000
11	......do	......do	Laurel, Md	500,000		500,000
11	Gunpowder River	......do	P., W. & B. R. R., Md	600,000		600,000
11	Bush River	......do	......do	300,000		300,000

* At sundry dates.

† Sent to Fred Mather to hatch and deposit.

‡ In addition to the fish, 585,000 eggs were shipped, hatched in transit, and are included in the 850,000 planted in Columbia and Willamette Rivers.

Record of distribution of shad from Central Station, Washington, D. C., and from Battery Station, Havre de Grace, Md., &c.—Continued.

Date.		Stream stocked.	Tributary of—	Place of deposit.	Fish shipped.	Died in transit.	Planted.
May	11	Northeast River	Chesapeake Bay	Bull's Mount, Md	1,500,000		1,500,000
	12	Elk River	......do	Elkton, Md	300,000		300,000
	12	Northeast River	......do	P., W. & B. R. R., Md	300,000		300,000
	12	Susquehanna River	......do	Near Station, Md	1,500,000		1,500,000
	12	Broad River	Congaree River	Columbia, S. C	750,000		750,000
	12	Saluda River	......do	......do	750,000		750,000
	13	Monongahela River	Ohio River	Grafton, W. Va	250,000		250,000
	13	Sassafras River	Chesapeake Bay	Ordinary Point, Md	1,000,000		1,000,000
	15	Chester River	......do	Crumpton, Md	600,000	40,000	560,000
	15	James River	......do	Clifton Forge, Va	250,000		250,000
	15	Susquehanna River	......do	Near Port Deposit, Md	370,000		370,000
	16	Ocklockonnee River	Gulf of Mexico	S., F. & W. R. R., Ga	750,000		750,000
	16	Withlacoochee River	......do	......do	750,000		750,000
	16	Brandywine River	Delaware River	Wilmington, Del	450,000		450,000
	17	Cheat River	Monongahela River	Rowlesburgh, W. Va	300,000		300,000
	18	Nanticoke River	Chesapeake Bay	Seaford, Del	450,000		450,000
	19	Wicomico River	Tangier Sound	Salisbury, Md	450,000		450,000
	19	Chester River	Chesapeake Bay	Millington, Md	600,000		600,000
	20	Patuxent River	......do	Patuxent, Md	540,000		540,000
	22	West Fork River	Monongahela River	Clarksburgh, W. Va	300,000		300,000
	24	Susquehanna River	Chesapeake Bay	Near Columbia, Pa	900,000		900,000
	25	......do	......do	Near Port Deposit, Md	750,000		750,000
	26	......do	......do	Peach Bottom, Pa	836,000		836,000
	26	......do	......do	Marietta, Pa	1,500,000		1,500,000
	27	Nanticoke River	......do	Seaford, Del	977,000		977,000
	28	Susquehanna River	......do	Conowingo, Md	500,000		500,000
	31	Deep River	Cape Fear River	Moncure, N. C	1,100,000	55,000	1,045,000
	31	Monongahela River	Ohio River	Fairmont, W. Va	200,000		200,000
June	1	Susquehanna River	Chesapeake Bay	Safe Harbor, Pa	550,000		550,000
	1	......do	......do	Tide's Eddy, Pa	500,000		500,000
	2	......do	......do	Above Havre de Grace, Md	100,000		100,000
	5	......do	......do	......do	228,000		228,000
	7	......do	......do	Near Station, Md	429,000		429,000
	9	......do	......do	......do	472,000		472,000
	10	......do	......do	......do	298,000		298,000
	12	......do	......do	......do	481,000		481,000
	13	......do	......do	......do	256,000		256,000
		Total			43,776,000	293,000	43,483,000

EGGS FOR EUROPE.—In addition to the distribution covered by this table, 50,000 shad eggs were sent from Battery Station to Mr. H. C. Mercer, of Doylestown, Bucks County, Pennsylvania. Mr. Mercer had arranged to sail for Europe on the North German Lloyd steamer Eider April 28, and expected to reach Hüningen, Alsace, in ten days. He wished to take some shad eggs with him, and try to reach the Danube before they perished. He proposed to keep down the temperature of the eggs as much as possible while on board the steamer, by the use of ice. On April 27, 1886, Mr. Grabill forwarded the eggs to him. When he reached Southampton he found many of them dead, and the remainder died before he reached Bremen, to his great disappointment.

STOCKING THE COLORADO.—An attempt to acclimate shad in the Colorado River of the West, and to establish fisheries on the Colorado, Gila, and other tributaries of the Gulf of California, was commenced by the deposit of 983,000 fish in 1884 and 998,000 eggs in 1885, and was continued the present season by a deposit of 850,000 eggs, thus making a total of 2,831,000, all of which were deposited at The Needles. These plants are considered sufficient to determine whether the waters present such conditions as will assure the establishment of a run of shad in the streams tributary to this gulf. The evidence of success will be looked for in the capture of mature shad in the season of 1888, or possibly of male or buck shad in 1887. It is not proposed to prosecute this experiment further.

STOCKING THE COLUMBIA RIVER.—An unsuccessful attempt was made in 1886 to transfer shad from the Atlantic to the Pacific coast. Detentions on the way consumed so much time that the fry were all lost. In order to guard against loss occasioned by delay *en route*, the present year arrangements were made to send eggs as well as fry. Car No. 3, with J. F. Ellis in charge, was detailed for the purpose. The car was equipped with tanks for storing and a steam-pump for circulating the water. Two stands of McDonald jars, with specially designed glass aquaria for collecting and holding the fry, completed the equipment of the car as a moving hatchery. The car left Havre de Grace May 9 with 1,000,000 young shad, 200,000 eggs on trays, and 385,000 eggs in the McDonald hatching-jars. Mr. E. M. Robinson went on board to take charge of the hatching. The fry were transported with a loss of 50 per cent, while the eggs on trays were all lost. The 385,000 eggs in jars hatched and were planted in the Willamette River, with a loss of less than 10 per cent. The success of this experiment has so important a bearing upon the methods of our work, and points out such possibilities, that Mr. Ellis's report relative to the incubation and hatching of the eggs on the way is given.*

WASHINGTON, D, C., *March* 1, 1887.

* *May* 9, 1886. The 585,000 eggs arrived at the car at 2.20 p. m., 200,000 of which were put on trays in an ice-box. The other 385,000 came to the car in two Wroten buckets, and were put in four McDonald jars at 3.30 p. m. The pump was then started and a

slow motion given to the eggs. At 8.25 p. m. on May 6th 210,000 of these eggs had been taken, and 175,000 at 9.30 p. m. on May 7. The temperature of water at Battery Station when the eggs were taken was 56 degrees; the temperature of water in car was 60 degrees. Took on fresh water at York, Pa., at 10 o'clock p. m., from engine-tank, using our suction-hose and pumping about 30 minutes. Pumped the water through the ice-coil during the night, so the temperature was brought down to 58 degrees. Took on fresh water at Altoona, Pa., and after that pumped water from engine-tank three times each day.

May 10. The temperature was from 58 degrees to 60 degrees. The eggs worked nicely, with only a small loss. About a dozen or so of those taken on the 6th instant hatched this afternoon. The eggs look rather light in color, and the fish can be seen moving lively in the eggs. One jar of eggs went over in the aquaria last night; replaced them in jar at 6 o'clock a. m.

May 11. The temperature was from 56 degrees to 58 degrees. Only a few more fish hatched out, as the fall in the temperature of the water seemed to retard them. They all look well, and are developing slowly.

May 12. Got on a little alkali to-day; this did not seem to have any effect on the eggs. Those taken on the 6th instant are hatching to-day. Temperature of water 58 degrees. The fish look well, and have a large sac. Those taken on the 7th instant are almost ready to come out, and a few hatched before night. Worked all the dead eggs off and measured those left in jars; found the loss on the 210,000 eggs taken May 6 to be 10 per cent, and the loss on the 175,000 eggs taken May 7 to be 8 per cent. This would make an average loss of 9 per cent. We lost very few, if any, after this. The eggs were hatching slowly this evening. The water in tanks got a little low, so the pump was used to get some air into the water. The air-bubbles attached themselves to the young fish and turned them head down; also collected around the jars and aquaria. This caused some trouble, which was overcome a little by keeping the lower tanks as full of water as possible.

May 13. The eggs of the 6th instant are hatching rapidly; temperature of water 58 degrees. The fish look healthy and strong, with large sacs. Those of the 7th are hatching slowly. Put up at 11 a. m. 25,000 fish in five cans, and 25,000 more at 5.30 p. m. The air-bubbles were still troubling the young fish a little, so took them from aquaria as fast as hatched.

May 14. Almost all the eggs of the 6th instant hatched to-day. The temperature of water went down to 56 degrees this morning. This retards the eggs of the 7th a little. The air-bubbles in the water seem to collect on some of the eggs, making them come to top of jar; so can give them but very little motion or they will go over in the aquaria. This air-bubble has been the only difficulty we have had to contend with, which seems strange, as the air-pump has not been in use on the trip. The air also collects on the shells and causes them to come to the top, when they can be easily skimmed off. Removed the young fry from the collecting aquaria to transportation cans as fast as they were hatched. Planted 25,000 of these fish in the Columbia River, at Wallula Junction, at 11.30 to-night. They were in fine condition.

May 15. The car arrived at Portland at 10.30 this morning. All the eggs of the 6th were hatched, and those of the 7th hatched rapidly all day, the temperature of water gradually going up to 62 degrees. The air-bubbles entirely disappeared this morning. The car was taken to the Willamette, at Albany, at 9.30 p. m., and the young fry planted at 11.30 p. m. The eggs did not quite all hatch to-day, so ran the pump up to 10 o'clock May 16, at which time all the eggs had hatched, with a total loss of 9 per cent. The experience of this trip makes it safe to recommend the shipping of eggs instead of the young fry on all long trips, as this is perhaps the most difficult trip in the country. The water is very cold, going as low as 44 degrees in a great many places. The alkali, too, is very strong. I think without doubt this car can take 2,000,000 eggs to any stream in the United States, and hatch them in as good condition as they come from the hatcheries, and with as small a loss.

XXII.—REPORT OF OPERATIONS AT THE SHAD-HATCHING STATION ON BATTERY ISLAND, NEAR HAVRE DE GRACE, MD., DURING THE SEASON OF 1886.

By L. R. Grabill.

The first run of shad was perceived on April 18, and 35 ripe shad were taken on April 19. This run continued for a week, and was larger in number than had been known for 20 years. Both shad and herring came in enormous quantities. It was impossible to obtain the catch of shad at the seines during this run. The catch of Mr. Osmond's seine in shad for one day alone was more than 5,000.

The collection of spawn for the station was done by men and boys hired temporarily for the purpose. As many as 40 men and boys in addition to the station's ordinary force were employed. These were paid monthly wages, each being allowed $10 a month for subsistence. It was endeavored to station men permanently at all the seines, and to attend to as many gill-nets as possible. The men were graded as first and second class spawn-takers, and apprentices. Besides these, boys were used merely as oarsmen.

Experience shows, however, that it will be better in the future to employ 3 men to every boat, 2 of whom are apprentices; these 2 to take nightly turns at receiving instruction. Boys, unless quite large and strong, cannot care for boats in a squall. Large as was the collecting force it could not attend to more than one-half of the gilling boats on nights when all of the fishermen were out. As a rule it was found more profitable to attend gill-nets than seines.

Collection was continued from April 19 to June 10, the total number of eggs collected being 60,766,000. Of this number there were received from the steamer Fish Hawk 2,099,000, and from the steamer Lookout 2,433,000, the total received from other sources thus being 4,532,000.

The Commission's gill-nets were put in use during the latter part of the season, there being no scarcity of male fish during the first part. Notwithstanding the smaller mesh of the net, it was not noticed that there was a large difference from other nets in the proportion of male fish caught. The largest roe fish seen during the season was caught in one of the Commission's small-mesh gill-nets. On a few occasions these nets served a good purpose in supplying male fish for impregnating eggs, but they did not supply these male fish nearly so often as they were supplied from ordinary nets near at hand. The Commission's gill-nets, being fished by expert fishermen, caught about as many fish, both male and female, as most of the gill-nets fishing in the same locality.

At the beginning of the season the hatching department was not prepared to do the work that was forced upon it by the early and immense run of shad. The connections for the hatching apparatus and for the water supply were inadequate to the demand, and the supply of hatching apparatus on hand was insufficient. To increase the hatching room an addition, covered with canvas, was made, accommodating 2 tables additional with 50 McDonald jars. The store-room used for the seine was furnished with sky-lights, and 28 hatching cones were placed in it, and about 30 cones in all conditions of repair were hastily fitted up outside of all shelter. Notwithstanding the increase thus made, the cones and jars constantly carried twice as many eggs as they should have done, and much loss was the result. But by far the greater loss was caused by being obliged to allow eggs brought in to stand in buckets, &c., until room could be made for them. In many cases eggs nearly hatched were compelled to be placed in the river to make room for new ones. About 170 McDonald jars and 58 cones were in constant use, supplemented by wire-gauze cylinders, buckets, pans, and all kinds of arrangements for hatching.

Three experts were employed during most of the season in the hatching-house. Three apprentices were also employed most of the time as assistants. These men received and cared for all eggs, cared for the fish when hatched, filled the cans for shipment, and loaded them in the launch or scow.

Notwithstanding the losses, the number of shad fry hatched was 45,231,000. These numbers are based on the measurement of the perfectly cleaned eggs in the jars just before hatching in every case, and are as nearly accurate as these figures can be made. It is believed that this is rather under than over the actual result. The percentage of hatching during the season was 74.4. The total number of fry shipped and receipted for by messengers was 43,776,000. The total loss of fish was 1,455,000. Three tables are appended to this report, which give details concerning the collection of the eggs, the shipments of the fry, and meteorological observations during most of the season.

The collecting force was entirely disbanded after June 10, when gilling is no longer permitted by Maryland laws. On June 13 all the eggs on hand had hatched, and the hatching department was then closed. But few eggs, however, were taken after June 1, the date on which the greater part of the force was discharged. After the close of the hatching season the time of the small number remaining was given to storing the equipment, and in work upon a drive-well, which was begun with the hope of finding an artesian water supply. This well was carried to a depth of about 150 feet by July 1.

There is little doubt but that the area of 4 or 5 square miles immediately surrounding Battery Station is as large as any, if not the largest, spawning ground for shad on the coast. The station is well located for reaching every part of this ground. The possibilities of the station are almost unlimited. Fishermen and fishing boats cover the bay during the season, and every ripe egg taken in fish in the nets would be lost if it was not taken by the collectors of the station, impregnated, and hatched. One need only to see the bay studded with the lights of the fishing boats on a night in May to convince him that but for the Commission's work very few fish could come from eggs naturally deposited. But, large as was the Commission's force last year, I am satisfied that not over one-half of the ripe fish taken in the bay by fishermen were stripped by its collectors, as they could not possibly attend to all.

It is fairly demonstrated by this season's work that collecting from gillers produces a better result than hauling the Commission's seine. Two or 3 men can secure as many ripe fish from gillers in a day as 30 men would secure if employed in hauling the seine. Moreover, hauling the seine by the employees of the station necessarily involves the Fish Commission in the care and disposal of the fish taken, while it seems to antagonize the fishermen, and is an unnecessary cost. With a good run of fish in the coming year, if the collecting force is doubled and their work thoroughly systematized, perhaps double the number of eggs secured last season can be obtained during 1887. The collection of eggs in 1886 was stimulated also by giving small rewards to those gathering the greatest amount of good spawn.

PENNING SHAD.—Out of a large number of shad full of roe, but not ripe at the time of introduction, which were placed in the pool and kept for a space of time ranging from a few days to 2 weeks, not one ever produced eggs that would hatch, though apparently ripe when stripped. It would seem that possibly the fright at being taken in the net, or of confinement in the pool, prevents the eggs from further development. All of the fish placed in the pool become more or less diseased after a short time, which may be due partly to the muddy bottom. This interesting experiment has hitherto met with such small success as to warrant its being dropped hereafter.

HERRING.—Herring were taken continually and sometimes in such quantities as to retard the hauling of the seines. No account was kept of them, as they were considered valueless in most cases, and they were shoveled back dead into the river or allowed to escape through the large meshes before completely hauling in the seine.

ROCKFISH OR STRIPED BASS.—Experiments were made in hatching the eggs of the rockfish, the greatest success being obtained by swinging a cylinder with gauze ends in a sluice-way through which a current, caused by the tide, constantly flowed. It appears, however, that even with very fine gauze the eggs in a certain state are forced through. Owing to want of time, caused by pressure of other matters, sufficient attention could not be devoted to these experiments, and most of the eggs taken were lost. In all, 600,000 rockfish eggs were taken, and 75,000 fry were shipped to Lake Ontario, near Oswego, N. Y.*

WASHINGTON, D. C., *December* 20, 1886.

* For notice of their successful planting, see F. C. Bulletin for 1886, p. 137.

TABLE I.—*Record of the shad-hatching operations conducted at Battery Station, Maryland, from April 19 to June 13, 1886, under direction of L. R. Grabill, superintendent.*

Date.		Fish obtained from—		Taken by haul-seines.†		Taken by gill-nets.	Ripe shad.		Eggs obtained.	Loss.		Fish hatched.‡	Fish deposited in local waters.	Fish deposited in other waters.
Day of week.	Day of month.	Length of haul-seines visited.*	Length of gill-nets visited.	Shad.	Rockfish.	Shad.	Males.	Females.		Eggs.	Fish.			
		Fathoms.	*Fathoms.*		*Pounds.*									
Monday	Apr. 19	2,500	2,190	3,587	....	816	20	39	1,782,000	[1]170,000	....	....	....	....
Tuesday.....	Apr. 20	2,200	1,955	2,188	....	620	35	71	3,112,000	....	....	....	....	....
Wednesday..	Apr. 21	2,700	3,200	2,600	....	1,389	45	91	3,899,000	....	....	....	....	....
Thursday....	Apr. 22	2,700	6,425	1,700	....	2,009	90	145	4,859,000	....	....	....	....	....
Friday.......	Apr. 23	2,500	4,582	1,500	400	1,144	56	119	3,780,000	[2]763,000	....	....	....	....
Saturday	Apr. 24	1,800	1,625	1,000	....	244	10	17	467,000	[3]375,000	....	....	....	....
Sunday	Apr. 25	....	4,150	....	....	767	20	36	785,000	[4]122,000	....	1,327,000	25,000	....
Monday	Apr. 26	800	5,725	484	....	521	20	28	1,228,000	[5]389,000	....	2,119,000	1,421,000	....
Tuesday.....	Apr. 27	800	5,420	168	....	588	85	50	1,475,000	....	....	2,431,000	2,431,000	([6])
Wednesday..	Apr. 28	1,500	5,505	191	300	693	30	47	1,541,000	....	....	3,064,000	860,000	[7]1,500,000
Thursday....	Apr. 29	1,900	4,870	1,056	....	306	20	30	1,040,000	....	[8]169,000	1,000,000	1,055,000	....
Friday.......	Apr. 30	2,000	5,430	1,199	500	405	20	33	1,013,000	....	[9]277,000	1,177,000	50,000	[10]1,430,000
Saturday	May 1	1,500	2,375	175	....	324	....	22	1,179,000	....	....	200,000	....	1,200,000
Sunday	May 2	....	4,150	....	....	398	....	19	[11]3,070,000	[12]50,000	[12]50,000	771,000	....	....
Monday	May 3	1,700	11,390	2,437	800	2,314	....	123	3,594,000	....	....	1,500,000 [13]1,952,000	[13]1,952,000	1,621,000
Tuesday.....	May 4	2,300	8,625	1,315	500	2,311	....	210	5,648,000	....	20,000	1,000,000	....	....
Wednesday..	May 5	2,600	8,550	1,850	....	1,954	....	110	4,046,000	....	10,000	1,814,000	804,000	1,500,000
Thursday....	May 6	1,800	9,510	1,325	300	894	....	108	3,295,000	....	10,000	1,103,000	503,000	....
Friday.......	May 7	1,860	2,700	450	200	104	....	31	944,000	....	....	689,000	742,000	....
Saturday	May 8	....	....	....	....	....	....	....	....	....	....	1,000,000	....	500,000
Sunday	May 9	1,100	2,250	200	....	60	....	4	112,000	....	10,000	2,156,000	....	[14]1,650,000
Monday......	May 10	2,600	1,950	334	200	40	....	3	[15]32,000	66,000	50,000	2,000,000	....	2,000,000
Tuesday.....	May 11	2,600	4,200	413	600	41	....	4	[16]1,127,000	....	40,000	3,000,000	....	2,400,000
Wednesday..	May 12	1,800	4,550	135	50	99	....	5	193,000	....	30,000	1,593,000	1,503,000	850,000
Thursday....	May 13	2,500	1,525	243	100	21	....	1	248,000	....	6,000	1,300,000	....	1,900,000
Friday.......	May 14	2,800	9,100	333	150	238	....	26	828,000	....	20,000	1,700,000	....	[17]2,350,000
Saturday	May 15	1,600	600	230	100	12	....	6	265,000	33,000	....	1,370,000	370,000	....
Sunday	May 16	....	....	....	....	....	....	....	....	....	20,000	300,000	....	450,000
Monday	May 17	2,800	5,850	300	250	148	....	10	305,000	50,000	20,000	414,000	....	300,000
Tuesday.....	May 18	3,600	7,150	502	75	152	....	43	1,469,000	138,000	30,000	130,000	....	1,050,000
Wednesday..	May 19	2,900	11,785	400	100	377	....	61	1,710,000	482,000	30,000	....	....	990,000
Thursday....	May 20	1,100	8,425	....	....	240	....	50	1,544,000	295,000	....	200,000	....	....
Friday.......	May 21	2,300	6,400	40	25	198	....	41	1,317,000	269,000	10,000	300,000	....	300,000
Saturday	May 22	1,100	4,035	266	....	211	....	40	1,070,000	196,000	....	700,000	....	....
Sunday	May 23	....	1,650	....	....	48	....	9	265,000	37,000	....	245,000	....	....

Monday	*May 24*	*1,300*	*8,150*	*50*	*[18]150*	*211*	...	*25*	*622,000*	*123,000*	*30,000*	*1,500,000*	...	*895,000*
Tuesday	*May 25*	...	*750*	...	...	*24*	...	*4*	*60,000*	*45,000*	...	*1,255,000*	...	...
Wednesday	*May 26*	...	*600*	...	...	*20*	...	...	...	...	*60,000*	*1,000,000*	*750,000*	*2,836,000*
Thursday	*May 27*	...	*600*	...	...	*4*	...	...	...	...	*30,000*	*1,013,000*	...	*977,000*
Friday	May 28	1,300	780	60	[19]150	16	...	4	158,000	34,000	20,000	1,000,000	...	500,000
Saturday	May 29	1,300	*1,100*	23	[19]100	...	...	...	...	...	30,000	...	...	1,100,000
Sunday	May 30	...	...	...	...	35	...	5	112,000	21,000	*10,000*	200,000	...	200,000
Monday	May 31	...	1,350	...	...	134	...	22	508,000	96,000	20,000	499,000	...	550,000
Tuesday	June 1	...	1,750	...	...	99	...	14	*259,000*	...	*20,000*	45,000	...	*500,000*
Wednesday	June 2	...	1,100	...	...	61	...	22	545,000	[20]134,000	...	...	100,000	...
Thursday	June 3	...	1,150	...	...	31	...	8	*189,000*	...	...	124,000	...	...
Friday	June 4	...	1,250	...	...	18	...	6	64,000	...	...	100,000	...	...
Saturday	June 5	...	700	...	...	28	...	3	82,000	...	10,000	177,000	[21]228,000	...
Sunday	June 6	...	200	...	...	5	...	3	78,000	...	...	416,000	...	...
Monday	June 7	...	1,100	...	...	123	...	19	476,000	...	20,000	312,000	[21]429,000	...
Tuesday	June 8	...	1,750	...	...	111	...	16	371,000	...	...	151,000	...	...
Wednesday	June 9	...	400	...	...	3	...	...	...	...	20,000	147,000	[21]472,000	...
Thursday	June 10	...	200	...	...	2	...	...	...	...	10,000	78,000	[21]298,000	...
Friday	June 11	...	...	...	...	...	...	...	...	...	...	403,000	...	...
Saturday	June 12	...	...	...	...	...	...	...	...	...	20,000	256,000	[21]481,000	...
Sunday	June 13	...	...	...	...	...	...	...	...	...	10,000	...	[21]256,000	...
		...	...	...	...	...	...	...	...	...	[22]343,000	...	...	...
Total	...	65,800	185,777	26,754	5,050	20,611	401	1,783	60,766,000	3,888,000	1,455,000	45,231,000	14,727,000	29,049,000

* Records for the haul-seines are very incomplete. No hauling of seines is allowed by Maryland law after June 1.

† Herring were taken in great numbers, but no account of them was kept.

‡ 74.4 per cent of all eggs taken were hatched.

[1] Kept too long in buckets.

[2] No room for them in hatching-house.

[3] Kept on shore all night.

[4] Not good.

[5] Put on trays in refrigerator because hatching-house was full.

[6] Fifty thousand eggs sent to H. C. Mercer, to be put into Danube River.

[7] Sent to car No. 1.

[8] Eighty thousand hatched from 200,000 eggs in refrigerator, and died in a few hours; *69,000 lost by* overflow of aquariums.

[9] *Lost by overflow of aquariums.*

[10] Shipped by car No. 1.

[11] *From steamer* Fish Hawk, 2,099,000.

[12] On account of lack of water.

[13] Eggs nearly hatched and put overboard to make room.

[14] Also *585,000* eggs in best condition received this day.

[15] *Also* received 600,000 rockfish eggs.

[16] From steamer Lookout, 992,000.

[17] *Also shipped 75,000 rockfish to Oswego*, N. Y.

[18] Two hundred pounds of other fish taken.

[19] Five hundred pounds of other fish taken.

[20] Over mature.

[21] Deposited in Susquehanna River, for want of means of removal.

[22] Not assignable to particular date or dates.

TABLE II.—*Record of meteorological observations made at Battery Station, Maryland, from May 1 to June 12, 1886, by William P. Sauerhoff and D. W. Kenly.*

Date.	Temperature of air.			Temperature of surface water.			Temperature of bottom.			Direction of wind.			Intensity of wind.			Condition of sky.			Condition of water.	State of tide.		
	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.	7 a. m.	4 p. m.	11 p. m.		7 a. m.	4 p. m.	11 p. m.
	°	°	°	°	°	°	°	°	°													
May 1	56	59	59	61	60	59	61	60	59	NE.	NE.	N.	Strong	Strong	Fresh	Cloudy	Cloudy	Cloudy	Clear	High	Ebb	Ebb.
2[1]	57	66	61	57	62	60	57	62	60	N.	E.	SE.	Fresh	Light	Light	...do	...do	...do	...do	Flood	Flood	Do.
3	60	66	66	60	64	64	60	64	64	SW.	SW.	SW.	Light	...do	...do	Clear	Clear	Clear	...do	...do	...do	Do.
4	67	67	65	64	64	64	64	64	64	SW.	SW.	SW.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.
5	62	70	67	64	65	64	64	65	64	S.	NW.	W.	...do	Fresh	...do	...do	...do	Cloudy	Muddy	...do	Ebb	Do.
6[2]	65	68	64	64	65	64	64	65	64	SE.	SW.	S.	Fresh	Light	...do	Cloudy	...do	Clear	Clear	...do	...do	Do.
7[3]	63	63	60	63	65	62	63	65	62	E.	E.	E.	Light	Strong	Strong	...do	Cloudy	Cloudy	Muddy	Ebb	...do	Flood.
8[4]	59	59	58	62	60	60	62	60	60	NE.	N.	NW.	Strong	...do	Light	...do	...do	Clear	...do	...do	...do	Do.
9[5]	55	62	62	56	60	60	56	60	60	NW.	......	......	Fresh	Calm	Calm	Clear	Clear	Cloudy	...do	...do	...do	Do.
10[6]	60	62	63	60	60	60	60	60	60	NE.	N.	SE.	Light	Light	Light	...do	Cloudy	...do	...do	...do	...do	Do.
11	59	62	60	59	60	60	59	60	60	NE.	N.	SE.	...do	...do	Strong	Cloudy	...do	...do	...do	...do	...do	Do.
12	59	62	60	59	62	61	59	62	61	SE.	SE.	SE.	...do	Calm	Light	...do	...do	...do	...do	...do	...do	Low.
13[7]	58	58	57	58	58	58	58	58	58	SE.	NE.	NE.	...do	Fresh	...do	...do	...do	Clear	...do	...do	Flood	Ebb.
14	57	57	58	58	58	58	58	58	58	NE.	SE.	SE.	...do	Light	Fresh	...do	...do	Cloudy	...do	...do	...do	Do.
15[8]	57	59	60	58	59	60	58	59	60	SE.	......	......	Fresh	Calm	Calm	...do	...do	...do	...do	Flood	...do	Do.
16[9]	58	59	57	58	60	58	58	60	58	NW.	NW.	NW.	...do	Strong	Light	Clear	Clear	Clear	...do	...do	Ebb	Flood.
17[10]	54	59	57	57	60	58	57	60	58	NW.	N.	S.	Light	Light	...do	...do	...do	...do	...do	...do	Flood	Ebb.
18[11]	55	60	58	57	61	61	57	61	61	S.	SW.	SE.	...do	Brisk	Fresh	...do	Cloudy	Cloudy	Clear	...do	...do	Do.
19[12]	59	63	60	59	61½	60½	59	61½	60½	S.	S.	S.	...do	Light	Light	Cloudy	...do	...do	...do	...do	Ebb	Do.
20[13]	58	74	68	60	62	61½	60	62	61½	SE.	SW.	NW.	...do	...do	...do	...do	...do	Clear	...do	...do	...do	Do.
21	63	72	64	60½	64	62	60½	64	62	N.	S.	......	...do	...do	Calm	Clear	Clear	...do	...do	...do	...do	Flood.
22	65	74	70	62	66	66	62	66	66	SW.	S.	E.	...do	...do	Strong	...do	...do	Cloudy	...do	Ebb	...do	Do.
23[14]	70	74	71	65	69	69	65	69	69	SW.	SW.	SW.	...do	...do	Light	...do	Cloudy	...do	...do	...do	...do	Do.
24[15]	68	66	68	68½	68	69	68½	68	69	SW.	NW.	NE.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.
25	68	59	59	68	68	65	68	68	65	N.	NW.	NW.	...do	Fresh	Strong	Cloudy	...do	Clear	...do	...do	...do	Do.
26	54	59	59	65	64	62	65	64	62	NW.	NW.	NW.	Fresh	...do	Light	Clear	Clear	...do	Muddy	...do	...do	Do.
27[16]	58	62	64	60	64	63	60	64	63	S.	S.	NW.	Light	Light	...do	Cloudy	...do	...do	...do	...do	...do	Ebb.
28	60	67	64	60	65	64	60	65	64	N.	N.	NW.	...do	...do	...do	Clear	...do	...do	Clear	...do	...do	Flood.
29	63	71	67	63	68	65	63	67	64	......	S.	SW.	Calm	...do	...do	...do	...do	...do	...do	...do	Flood	Ebb.
30	65	72	72	64	69	66	64	69	66	......	S.	NE.	...do	...do	...do	...do	...do	Cloudy	...do	Flood	...do	Flood.
31	69	......	......	66	......	......	66	......	......	NE.	......	......	Light	......	......	Cloudy	......	......	...do	...do	......	
June 1	61	70	65	65	66	65	64	66	65	......	NW.	NW.	Calm	Light	Light	Clear	Clear	Clear	...do	...do	Ebb	Ebb.
2[17]	60	78	71	65	70	70	65	70	70	NE.	SW.	SW.	Light	Brisk	...do	Cloudy	Cloudy	...do	...do	...do	...do	Do.
3[18]	71	68	65	69	70	68	69	70	68	SW.	NW.	NW.	Brisk	Light	Brisk	...do	Clear	...do	...do	...do	...do	Do.
4[19]	63	70	65	65	70	68	65	70	68	NW.	W.	......	...do	Very l't.	...do	Clear	...do	...do	...do	...do	...do	Do.

5	65	77	66	68	68	68	68	68	68	E.	E.	SE.	Very l't.	...do	Light	...do	...do	...do	...do	...do	...do	Flood.
6	68	77	65	68	69	68	68	69	68	S.	S.	......	...do	...do	...do	...do	...do	...do	...do	Ebb	...do	Do.
7[20]	65	70½	70	69	71	70	69	71	70	SE.	SE.	......	Light	Light	...do	...do	...do	...do	...do	...do	...do	Do.
8	73	75	72	71	74	73	71	74	73	N.	N.	S.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.
9[21]	69	71	72	73	73	73	73	73	73	S.	SE.	SW.	...do	Fresh	...do	...do	Cloudy	Cloudy	...do	...do	...do	Do.
10[22]	71	76	77	72	76	75	72	76	75	NW.	SW.	N.	...do	Light	...do	Cloudy	Clear	...do	...do	...do	Flood	Do.
11	77	76	78	78	76	75	78	76	75	N.	NW.	N.	...do	...do	...do	Clear	...do	Clear	...do	...do	...do	Ebb.
12	71	78	71	76	76	75	76	76	75	NE.	N.	SE.	...do	...do	...do	...do	...do	...do	...do	...do	...do	Do.

[1] Tide very low; no water in tank from 2 a. m. to 3.18 a. m.
[2] Rain from 4 a. m. to 6.30 a. m.
[3] Rain at 11 a. m.
[4] Rain; stopped at 4 p. m.
[5] Water very muddy.
[6] Rain from 10.20 p. m. to 11 p. m.
[7] Rain from 6.30 a. m. to 9.15 p. m.
[8] Rain from 6.30 p. m. to 11 p. m.
[9] Strong wind and current, making ebb run over its time.
[10] Water began to clear at 4 p. m.; current falling fast.
[11] Rain at 11 p. m.
[12] Stopped raining at 9 a. m.
[13] Rain from 4 a. m. to 2.45 p. m.
[14] Rain from 1.15 a. m. to 3.45 a. m.
[15] Rain from 11.50 a. m. to 2 p. m.
[16] Rain from 8.45 a. m. to 11.45 a. m.
[17] Day rather warm; light drizzle in early morning.
[18] West wind making very high tides.
[19] Wind blowing northwest for several days kept tide back.
[20] Rain from 1 p. m. to 2 p. m.
[21] Rain from 12.50 p. m. to 5 p. m.
[22] Began raining at 7 p. m.

TABLE III.—*Statement of shipments of shad fry made from Battery Station, Havre de Grace, Md., in April, May, and June, 1886.*

State.	Place of deposit.	Stream.	Date.	Number sent.
Maryland	Near Battery Station[1]	Susquehanna River	Apr. 25	25,000
Do	do[1]	do	Apr. 26	1,421,000
Do	Below Port Deposit[1]	do	Apr. 27	2,431,000
			Apr. 27	([2])
Maryland	Near Battery Station[1]	Susquehanna River	Apr. 28	860,000
Do		Northeast, Gunpowder, and Bush Rivers.[4]	Apr. 28	1,500,000
Do	Above Havre de Grace[1]		Apr. 29	1,055,000
Do	Near Battery Station[1]		Apr. 30	50,000
Do		Gunpowder, Northeast, and Patapsco Rivers.[4]	Apr. 30	1,430,000
Do		Bush and Elk Rivers[4]	May 1	1,200,000
Pennsylvania	Harrisburg[4]	Susquehanna River	May 3	1,621,000
Maryland	Near Battery Station[1]		May 3	[5]1,952,000
Rhode Island	Providence[4]	Narragansett Bay	May 5	1,500,000
Maryland	Near Battery Station[1]		May 5	804,000
Do	Below Port Deposit[1]		May 6 May 7	1,245,000
Do		Chester River[6]	May 8	500,000
Do		Patuxent River[6]	May 9	650,000
Oregon		Columbia River.[7]	May 9	1,000,000
Do		do[7]	May 9	([8])
Maryland		Northeast River[6]	May 10	500,000
South Carolina	Columbia[4]	Broad and Saluda Rivers	May 10	1,500,000
Maryland		Gunpowder River[6]	May 11	600,000
Do		Bush River[6]	May 11	800,000
Do		Northeast River[9]	May 11	1,500,000
Do		Northeast and Elk Rivers[6]	May 12	600,000
Do		Northeast River and flats off Locust Point.[10]	May 12	1,500,000
West Virginia	Grafton[11]	Monongahela River	May 12	250,000
Maryland		Brandywine and Nanticoke Rivers.[6]	May 13	900,000
Do	Off Ordinary Point[9]	Sassafras River	May 13	1,000,000
Georgia		Withlacoochee and Ocklockonnee Rivers.[4]	May 14	1,500,000
Virginia	Clifton Forge[11]	James River	May 14	250,000
New York	Near Oswego[6]	Lake Ontario	May 14	([12])
Maryland		Chester River[3]	May 14	600,000
Do	Below Port Deposit[1]	Susquehanna River	May 15	370,000
Delaware		Brandywine River[3]	May 16	450,000
West Virginia	Rowlesburgh[11]	Cheat River	May 17	800,000
Maryland	Millington[3]	Chester River	May 18	600,000
Delaware	Seaford[6]	Nanticoke River	May 18	450,000
Maryland	Salisbury[6]	Wicomico River	May 19	450,000
Do		Patuxent River[3]	May 19	540,000
West Virginia		Monongahela River[11]	May 21	300,000
Pennsylvania	Near Columbia[9]	Susquehanna River	May 24	895,000
Maryland	Above Port Deposit[6]	do	May 25	750,000
Pennsylvania	Peach Bottom[6]	do	May 26	836,000
Do	Marietta[4]	do	May 26	1,500,000
Delaware	Seaford[7]	Nanticoke River	May 27	977,000
Maryland	Conowingo[6]		May 28	500,000
North Carolina	Fayetteville[4]	Cape Fear River	May 29	1,100,000
West Virginia	Fairmont[11]	Monongahela River	May 30	200,000
Pennsylvania	Safe Harbor[6]	Susquehanna River	May 31	550,000
Do	Tides Eddy[6]	do	June 1	500,000
Maryland	Above Havre de Grace[3]	do	June 2	100,000
Do	Below Havre de Grace[1]	do	June 5	228,000
Do	do[1]	do	June 7	429,000
Do	Near Battery Station[1]	do	June 9	472,000
Do	do[1]	do	June 10	298,000
Do	do[1]	do	June 12	481,000
Do	do[1]	do	June 13	256,000
Total				43,776,000

[1] By employees of station.
[2] Fifty thousand eggs on trays shipped to H. C. Mercer, by steamship Eider, for Danube River.
[3] By R. H. Dana.
[4] By N. Simmons, car No. 1.
[5] Eggs almost hatched when put into river.
[6] By F. L. Donnelly.
[7] By J. F. Ellis, car No. 3.
[8] Delivered 585,000 eggs in good order.
[9] By steamer Lookout.
[10] By launches Nos. 68 and 82.
[11] By H. E. Quinn.
[12] Seventy-five thousand rockfish.

XXIII.—REPORT OF SHAD PROPAGATION ON THE POTOMAC RIVER DURING THE SEASON OF 1886.

BY MARSHALL McDONALD.

The organization and conduct of the work was the same, in general, as during the season of 1885. The facilities for collecting eggs were greatly improved by substituting for the launch heretofore employed in the collection service the small steamer Lilla, chartered for the season, but at the close of the season purchased by the U. S. Fish Commission.

The eggs collected from the fishing-shores and gillers were transferred to the field station at Fort Washington, where they were kept and developed until hardened, so as to permit safe transportation to Central Station, Washington. Here the hatching was completed, and the distribution of the fry conveniently made by car and messenger service. Several million eggs were retained and hatched at Fort Washington for stocking waters in the immediate vicinity of the station.

COST AND RESULTS OF THE WORK.

For the conduct of the work, in accordance with the program submitted and approved, the Commissioner authorized an expenditure not to exceed $5,000. At Fort Washington Station the actual cost of collecting, developing, and transporting the eggs was $2,879.90; at Central Station, for hatching and distribution, $916.55; total, $3,796.45. The total number of eggs obtained was 36,362,000, and the losses during incubation were 6,625,000, leaving the aggregate number furnished for distribution from the Potomac River stations 29,737,000. The percentage of loss during incubation was 18 per cent, and shows marked improvement over the results of previous seasons. The cost of production was $127.66 per million, or 78 shad for each cent of expenditure.

FORT WASHINGTON STATION.

On March 26 the station was occupied by a small force. The men were employed in tarring and rigging the seine, cleaning up the shore, and getting everything in readiness for active work when the run of shad should begin.

The first haul of the Commission seine was made April 12, and the first ripe fish was taken on the 16th. The run of fish steadily increased from that time to the 22d, as did also the proportion of ripe females. On the afternoon and night of the 22d of April 3,503,000 shad eggs were taken and impregnated. This was the maximum number taken in one day during the season. The period of maximum production was from April 20 to 27, inclusive; the total production for the period referred to being 16,017,000, or nearly one-half of the entire number obtained during the season.

The eggs which were hatched and planted in local waters (3,154,000) and forwarded to Central Station (33,208,000) were derived as follows:

From the Fish Commission seine at Fort Washington	11,848,000
From Chapman's Point hauling-seine	5,506,000
From Ferry Landing hauling-seine	4,349,000
From White House hauling-seine	1,487,000
From Stony Point hauling-seine	2,191,000
From the gillers	10,981,000
Total	36,362,000

The records of the Commission seine fished on the Fort Washington reservation have been carefully kept, and are here published, so as to preserve important data in a shape accessible to fish-culturists generally. These show the fluctuations from season to season, not only in the aggregate catch of shad on the same shore, but also the variations in the proportion of males to females, in the time of maximum run, and in the date at which the proportion of ripe fish reaches its maximum, and the interval during which the largest numbers of eggs are taken.

Record of seine-hauling at Fort Washington shore during the season of 1886.

Date.	Number of shad.	Males.	Females.	Ripe females.	Eggs taken.	Temperature of water during impregnation.	Date.	Number of shad.	Males.	Females.	Ripe females.	Eggs taken.	Temperature of water during impregnation.
						°							°
April 15*	2	1	1	....	....	57	May 10‡	......	......	......	....	....	63
16	85	68	27	3	95,000	57	11‡	......	......	......	....	....	62
17	116	88	28	1	40,000	58	12§	150	130	20	7	189,000	65
18	150	111	30	1	7,000	61	13‖	467	385	82	13	385,000	64
19	264	201	63	9	205,000	61	14¶	234	199	85	17	548,000	63
20	216	129	87	5	184,000	65	15†	188	159	29	8	211,000	61
21	238	164	74	6	211,000	63	16*	2	2	0	0	....	63
22	294	194	100	16	391,000	63	17†	215	195	20	8	52,000	66
23	103	62	41	11	380,000	60	18	179	154	25	2	65,000	63
24	200	112	88	27	767,000	69	19	296	195	101	24	824,000	63
25	359	203	156	15	492,000	69	20	170	124	46	11	522,000	65
26	336	168	168	20	705,000	70	21	145	107	38	9	274,000	66
27	185	99	86	20	610,000	68	22	144	96	48	24	611,000	67
28	186	122	64	18	541,000	67	23	164	102	62	22	650,000	71
29	177	97	80	15	464,000	66	24	130	86	44	10	294,000	71
30†	166	121	45	7	195,000	65	25	65	44	21	4	131,000	70
May 1†	38	24	14	3	80,000	62	26	109	79	30	11	239,000	71
2†	289	231	58	2	21,000	63	27	109	88	21	5	161,000	69
3†	202	188	14	0	....	64	28	104	80	24	4	110,000	68
4	207	178	29	5	138,000	64	29	86	66	20	12	389,000	70
5	179	139	40	1	14,000	65	30	75	55	20	3	60,000	71
6†	248	192	56	10	245,000	66	31	31	19	12	6	175,000	69
7†	111	81	30	5	149,000	66	June 1**	5	3	2	0	....	69
8‡	......	......	......	....	....	64							
9‡	......	......	......	....	....	63	Total..	7,419	5,331	2,088	305	11,848,000	....

* Seine hauled but once.
† One haul omitted.
‡ No hauls, on account of the high wind or heavy current.
§ Current lighter and running down very fast.
‖ Rain all day.
¶ New current beginning to run.
** Cut seine out after first haul.

A comparison of the records of the seine-hauling in 1885 and 1886, for which seasons only we have reliable records, affords contrasts as interesting as they are perplexing. These may be summarized as follows:

Years.	Total catch.	Males.	Females.	Ripe females in total catch.	Ripe females to entire number of females.	Maximum production of eggs for entire river.	
						Date.	Period.
		Pr. ct.	Pr. ct.	Pr. ct.	Pr. ct.		
1885	2,696	45.7	54.3	9.0	17.0	May 16	May 5-11
1886	7,419	71.8	28.2	5.3	14.1	Apr. 22	Apr. 20-27

A considerable proportion of the excess of males was made up of small two-year-old "buck shad," called by the fishermen "skimmers," which, being too small to count, are sold by the bunch. The preponderance of these during the season gives promise of an increased run of full-sized spawning fish in 1887.

Transportation of eggs.—The transfer of impregnated eggs from Fort Washington to Central Station was made by the steamer W. W. Corcoran, plying daily between Washington and Mount Vernon, the transportation being uniformly made on trays, by the "dry method," inaugurated by me in 1881. The total number of eggs forwarded from Fort Washington Station was 33,208,000. Of these 4,925,000 died in transit.

CENTRAL STATION.

The total number of eggs received in good condition, the number of eggs and fry distributed, and the average percentage of loss in hatching are given in the following summary for the season of 1886:

Eggs transferred to other stations	1,586,000
Fish distributed	24,997,000
Eggs lost in hatching, 7 per cent	1,700,000
Total eggs received alive from Fort Washington	28,283,000

The records of the station contain a history of each lot of eggs received from the Fish Commission seine, giving the temperature of impregnation, the maximum, minimum, and mean of water temperatures during the period of incubation, and the percentage of loss in hatching, data which it is important to preserve for reference, but which it is hardly necessary to publish.

Comparison of the catch of 1885 *and* 1886.—The catch of shad in the Potomac varies greatly from one season to another. The aggregate number* taken in 1885 was 157,697; in 1886 it was 275,422, the increase of 1886 over the previous season being 117,725.

* See reports of Gwynn Harris, inspector of marine products, in U. S. F. C. Bulletin, Vol. V, p. 192, and Vol. VI, p. 202.

XXIV.—REPORT ON THE SHAD WORK OF THE STEAMER FISH HAWK DURING THE SEASON OF 1886.*

By Mate James A. Smith, U. S. N.

The shad work prosecuted by the U. S. Fish Commission steamer Fish Hawk during the season of 1886 covers the period from April 25 to June 3, inclusive. Most of the operations were conducted on the Delaware River, though some of the work in the first part of the season was done on the northern end of Chesapeake Bay.

On April 24 the Fish Hawk arrived at Battery Station from Wood's Holl, Mass., and on the 25th preparations for the season's work were begun. On the 26th the vessel proceeded across to the east side of the bay and took up a position in the mouth of North East River, from which the spawn-takers could conveniently visit the fishing-shores and the gillers in the vicinity, and arrangements were made for paying the fishermen for the ripe shad furnished. This work was continued until May 1, when orders were received to proceed to the Delaware River. Up to this time 2,192,500 eggs had been taken, which, on May 2, were transferred to Battery Station, and on the 3d the vessel proceeded down Chesapeake Bay bound for the Delaware.

On May 5 arrived in the Delaware River, and at 1 p. m. anchored off Gloucester City, N. J. This point was the headquarters for most of the subsequent operations on the river, as from it most of the gillers and fisheries could easily be reached by the spawn-takers. Found the U. S. Fish Commission steamer Lookout at anchor at this place, and on the 6th received from her 1,156,000 eggs. The Lookout was of assistance also by towing the spawn-boats to and from some of the various fishing-shores, and by transporting the spawn-takers. On May 6 the Fish Hawk steamed down the river, stopping at the different shores, where the proprietors were seen and arrangements made about paying them for shad spawn taken. At 10.30 p. m. of the 7th the vessel grounded on the mud-flats off the mouth of Mantua Creek, where she remained till 4 a. m. of the 8th.

On May 11 transferred to Dr. E. G. Shortlidge, of the Delaware fish commission, 660,000 eggs; while in the channel off Gloucester, deposited 1,140,000 fry from eggs obtained on the river. On the 12th went down the river to Wilmington, Del., where arrangements were made to

*This report was compiled from the records of Lieut. L. W. Piepmeyer, U. S. N., who was in charge of the vessel when the work was done.

repair steam-launch No. 55, just arrived from Battery Station. Sent to Dr. Shortlidge* 450,000 more eggs, after which returned to the usual anchorage off Gloucester. On the 13th launch No. 55 arrived from Wilmington and began to render service in distributing spawn-takers and tending the different fishing-shores. The fishermen reported a great decrease in the catch of shad for the week ending May 15, and attributed this to the constant easterly weather. Almost daily deposits of fry were made in the river, as will be seen from the appended table.

Owing to heavy rains the river was very muddy during the middle part of May, and some of the eggs in the jars and cones were covered with a muddy sediment and died. This led to the use of raw cotton in the jars for the purpose of filtering the water.

On May 27 William P. Sauerhoff reported for duty from Battery Station, to assist in shad-hatching work. On the 31st orders were received to discontinue gathering spawn.

On June 3 transferred to Dr. E. G. Shortlidge 180,000 fry; a shipment was also made to Philadelphia, in launch No. 55, of fifteen cans containing 1,940,000 fry, which were delivered to U. S. Fish Commission car No. 2. As there were no more eggs or fry on hand, this terminated the shad-hatching operations of the Fish Hawk for the season of 1886. Appended will be found a table giving details of the work, showing especially the number of eggs taken, the number of fish hatched, the number deposited, and the times and places of deposit, with other statements of particulars in this connection.

U. S. FISH COMMISSION STEAMER FISH HAWK,
Wood's Holl, Mass., October 11, 1886.

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* Dr. Shortlidge reported that the general condition of the 1,110,000 eggs which he received from the Fish Hawk on May 11 and 12 was bad, as at least one-third were found dead on unpacking. The subsequent loss on these eggs was about one-eighth. All the fry were planted in the Brandywine Creek, near Wilmington. July 21 a small shad was caught in Brandywine Creek, supposed to have been one of those planted in May.

Record of shad operations by the Fish Hawk on the Susquehanna and Delaware Rivers, during the season of 1886.

Date.	Fishery.	Number of— Males.	Number of— Females.	Number of— Eggs taken.	Time put in cones.	Time began hatching.	Number hatched.	Number deposited.	Time deposited.	State of water.	Temperature of surface. Max.	Temperature of surface. Min.	Temperature in cones. Max.	Temperature in cones. Min.
1886.											°	°	°	°
Apr. 26	Red Bank	1	1	30,000	9.15 p. m			(*)		Clear	67	65	64	64
27	...do	1	1	30,000	9.15 p. m					...do	65	65	65	63
28	Gillers	6	8	150,000	1.50 a. m					...do	66	65	65	64
28	...do	9	6	180,000	3.00 a. m					...do	65	64	65	64
28	Carpenter's Point	3	3	128,000	8.15 p. m					Partly muddy	63	61	65	64
28	Gillers	4	4	120,000	9.30 p. m					...do	61	60	65	64
29	...do	2	2	72,000	2.00 a. m					...do	62	61	65	64
29	...do	6	6	262,500	8.00 p. m					...do	62	60	63	63
29	...do	7	8	400,000	11.20 p. m					...do	62	60	63	63
29	...do	9	9	330,000	11.30 p. m					...do	62	60	63	63
30	...do	2	3	82,500	10.00 p. m					...do	63	61	63	63
30	...do	3	3	127,500	11.30 p. m					...do	63	61	64	62
May 1	...do	9	9	280,000	4.30 a. m				(†)	...do	61	60	63	63
5	Faunce's	5	5	200,000	11.00 p. m	May 10	160,000	160,000	May 11	Muddy	61	59	61	61
5	Eagle Point	1	1	40,000	11.00 p. m	May 10	35,000	35,000	May 11	...do	61	59	63	61
6	Lookout	10	12	568,000		May 9	465,000	465,000	May 11	...do	62	61	63	61
6	...do	8	10	588,000		May 9	480,000	480,000	May 11	...do	62	61	63	61
6	Faunce's	3	3	195,000	5.30 p. m	May 10	170,000	170,000	May 12	...do	62	61	63	61
6	Howell's Cove	3	3	161,000	6.30 p. m	May 10	140,000	140,000	May 12	...do	62	61	63	61
6	Gloucester Point	4	4	262,500	8.00 p. m	May 10	220,000	220,000	May 12	...do	62	61	63	61
6	Howell's Cove	16	10	578,000	9.00 p. m	May 10	470,000	470,000	May 12	...do	62	61	63	61
6	Eagle Point	3	3	157,500	11.00 p. m	May 10	135,000	135,000	May 12	Partly muddy	62	61	63	61
6	Faunce's	6	6	208,000	11.00 p. m	May 10	166,000	166,000	May 14	...do	62	61	63	61
6	Woodbury	7	7	397,500	11.00 p. m	May 10	320,000	320,000	May 14	...do	62	61	63	61
7	Lookout			500,000	7.00 a. m	May 10	400,000	400,000	May 14	...do	62	62	63	62
7	Howell's Cove	2	2	75,000	7.30 p. m	May 11	65,000	65,000	May 15	...do	62	62	63	62
7	Gloucester Point	8	8	583,000	7.30 p. m	May 11	480,000	480,000	May 15	...do	62	62	63	62
7	Woodbury	5	5	240,000	11.00 p. m	May 11	200,000	200,000	May 15	...do	62	62	63	62
7	Eagle Point	1	1	45,000	11.00 p. m	May 11	40,000	40,000	May 15	...do	62	62	63	62
8	Faunce's	9	9	380,000	3.30 p. m	May 12	345,000	345,000	May 17	...do	61	61	61	60
10	Howell's Cove	10	10	630,000	7.00 p. m	May 15	450,000	450,000	May 17	...do	62	61	62	60
10	Faunce's	13	13	548,000	7.30 p. m	May 15	400,000	400,000	May 17	...do	62	61	62	60
10	Bennett's	15	15	855,000	Midnight	May 15	400,000	400,000	May 17	...do	62	61	62	60
10	Woodbury	4	4	255,000	10.00 p. m	May 15	160,000	160,000	May 17	...do	62	61	62	60
10	Howell's Cove	14	14	‡1,042,000	Midnight	May 15	191,000	191,000	May 17	...do	62	61	62	60

* All fry were deposited in the Delaware River, except as otherwise indicated.
† The 2,192,500 eggs taken in the Chesapeake were transferred to Battery Station on May 1.
‡ Delivered 660,000 eggs to Dr. E. G. Shortlidge on May 11.

Record of shad operations by the Fish Hawk on the Susquehanna and Delaware Rivers, during the season of 1886—Continued.

Date.		Fishery.	Number of—			Time put in cones.	Time began hatching.	Number hatched.	Number deposited.	Time deposited.	State of water.	Temperature of surface.		Temperature in cones.	
			Males.	Females.	Eggs taken.							Max.	Min.	Max.	Min.
1886.												°	°	°	°
May	10	Gloucester Point	4	4	210,000	1.00 a. m.	May 15	170,000	170,000	May 17	Muddy	62	61	62	60
	10	Faunce's	12	12	420,000	11.30 p. m.	May 15	335,000	335,000	May 17	...do	62	61	62	60
	11	Gloucester Point	1	1	37,000	4.00 p. m.	May 15	20,000	20,000	May 17	...do	61	59	60	59
	11	Howell's Cove	20	20	1,298,000	10.30 p. m.	May 16	1,046,000	1,046,000	May 17	...do	61	59	60	59
	11	Faunce's	12	12	457,500	11.00 p. m.	May 16	367,000	367,000	May 18	...do	61	59	60	59
	12	Woodbury	3	3	150,000	7.00 a. m.	May 17	120,000	120,000	May 18	...do	59	59	60	59
	12	Bennett's	22	22	*884,000	7.00 a. m.	....	....	....	....	...do	59	59	60	59
	12	Faunce's	7	7	309,000	7.30 p. m.	May 17	246,000	246,000	May 18	...do	59	59	60	59
	12	Howell's Cove	7	7	349,000	7.30 p. m.	May 17	280,000	280,000	May 18	...do	59	59	60	59
	12	Gillers	3	3	90,000	7.30 p. m.	May 17	80,000	80,000	May 18	...do	59	59	60	59
	13	Faunce's	13	13	510,000	9.00 p. m.	May 18	260,000	260,000	May 20	...do	59	59	59	59
	13	Howell's Cove	4	4	220,000	9.30 p. m.	May 18	110,000	110,000	May 20	...do	59	59	59	59
	14	Bennett's	7	7	345,000	9.30 p. m.	May 19	315,000	315,000	May 21	...do	59	58	59	58
	14	Woodbury	1	1	40,000	9.30 p. m.	May 19	32,000	32,000	May 22	...do	59	58	59	58
	14	Faunce's	6	6	190,000	9.30 p. m.	May 19	190,000	190,000	May 22	...do	59	58	59	58
	14	Howell's Cove	6	6	315,000	9.30 p. m.	May 19	283,000	283,000	May 21	...do	59	58	59	58
	15	Gloucester Point	2	2	120,000	6.00 a. m.	May 20	96,000	96,000	May 22	...do	59	58	59	58
	15	Howell's Cove	3	3	165,000	5.00 p. m.	May 20	140,000	140,000	May 24	...do	59	58	59	58
	15	Woodbury	1	1	23,000	8.00 p. m.	May 20	19,000	19,000	May 24	...do	59	58	59	58
	15	Faunce's	6	6	258,000	8.00 p. m.	May 20	206,000	206,000	May 24	...do	59	58	59	58
	17	Gloucester Point	2	2	106,000	5.30 p. m.	(†)	....	....	....	....	59	58	59	58
	17	Howell's Cove	9	9	330,000	7.30 p. m.	May 22	265,000	260,000	May 24	Muddy	59	58	60	59
	17	Faunce's	7	7	350,000	7.30 p. m.	May 22	280,000	275,000	May 24	...do	59	58	60	59
	17	Woodbury	5	5	155,000	8.00 p. m.	May 22	120,000	118,000	May 24	...do	59	58	60	59
	18	Gloucester Point	4	4	242,000	6.30 p. m.	May 22	205,000	200,000	May 24	...do	60	59	60	59
	18	Gillers	1	1	60,000	7.00 p. m.	May 22	55,000	55,000	May 24	...do	60	59	61	60
	18	Howell's Cove	22	22	1,160,000	8.00 p. m.	May 22	880,000	870,000	May 24	...do	60	59	61	60
	18	Faunce's	7	7	375,000	8.30 p. m.	May 22	310,000	300,000	May 24	...do	60	59	61	60
	18	Woodbury	1	1	46,000	8.30 p. m.	May 22	38,000	37,000	May 24	...do	60	59	61	60
	19	Gloucester Point	6	6	246,000	8.30 p. m.	May 23	208,000	205,000	May 25	...do	64	60	61	60
	19	Gillers	4	4	164,000	8.30 p. m.	May 23	150,000	150,000	May 25	...do	64	60	60	60
	19	Howell's Cove	36	36	1,815,000	8.30 p. m.	May 23	1,455,000	1,450,000	May 25	...do	64	60	60	60
	19	Faunce's	8	8	344,000	9.00 p. m.	May 23	290,000	280,000	May 25	...do	64	60	60	60
	19	Woodbury	2	2	67,000	8.30 p. m.	May 23	57,000	57,000	May 25	...do	64	60	60	60
	20	Gloucester Point	2	2	79,000	8.30 p. m.	May 24	70,000	70,000	May 26	...do	61	60	61	61
	20	Gillers	1	1	39,000	8.30 p. m.	May 24	36,000	36,000	May 26	...do	61	60	61	61
	20	Howell's Cove	21	21	1,140,000	9.30 p. m.	May 24	1,025,000	1,025,000	May 26	...do	61	60	61	61
	20	Faunce's	6	6	300,000	10.00 p. m.	May 24	275,000	275,000	May 26	...do	61	60	61	61

20	Woodbury	3	3	135,000	10.00 p. m.	May 24	125,000	125,000	May 26	....do	61	60	61	61
21	Faunce's	4	4	240,000	7.00 p. m.	May 24	225,000	225,000	May 26	....do	62	60	62	60
21	Gloucester Point	5	5	262,000	8.30 p. m.	May 24	245,000	245,000	May 26	....do	62	60	62	60
21	Howell's Cove	28	28	1,350,000	10 30 p. m.	May 24	830,000	830,000	May 26	....do	62	60	62	60
22	Gloucester Point	1	1	30,000	9.00 a. m.	May 25	25,000	25,000	May 27	....do	64	64	66	64
22	Faunce's	2	2	70,000	4.00 p. m.	May 25	60,000	60,000	May 27	....do	64	64	66	64
22	Howell's Cove	5	5	390,000	5.00 p. m.	May 25	215,000	214,000	May 27	....do	64	64	66	64
22	Gloucester Point	2	2	95,000	8.00 p. m.	May 25	85,000	85,000	May 27	....do	64	64	66	64
24	......do	1	1	35,000	9.00 a. m.	(‡)	....	....	....	....	68	67	68	66
24	Howell's Cove	38	38	1,637,000	9.30 p. m.	May 27	1,030,000				68	67	68	66
24	Faunce's	23	23	1,024,000	9.30 p. m.	May 27	625,000	1,844,000	May 30	....do	68	67	68	66
24	Gloucester Point	7	7	376,000	10.30 p. m.	May 27	169,000				68	67	68	66
25	Faunce's	20	20	632,000	9.30 p. m.	May 29	428,000				66	65	66	65
25	Howell's Cove	22	22	1,110,000	10.00 p. m.	May 29	742,000	1,495,000	June 2	....do	66	65	66	65
26	......do	9	9	465,000	8.00 p. m.	May 30	325,000				64	64	65	64
27	Faunce's	6	6	301,000	7.20 p. m.	May 30	252,000				65	65	65	65
27	Howell's Cove	20	29	1,111,000	7.30 p. m.	May 30	918,000				65	65	65	65
28	Faunce's	5	5	176,000	7.00 p. m.	May 31	160,000	(§)			65	65	65	65
28	Howell's Cove	16	16	718,000	8.30 p. m.	May 31	610,000		....	....	65	65	65	65
29	......do	4	4	133,000	4.30 p. m.	May 31	90,000				65	65	65	65
29	Bennett's	4	4	115,000	5.30 p. m.	May 31	90,000				65	65	65	65
	Total	720	726	34,454,500	....	....	23,196,000	21,018,000						

* Four hundred and thirty-four thousand died, and 450,000 eggs were delivered to Dr. Shortlidge on May 12.
† All died.
‡ Lost overboard.
§ On June 3, 1,940,000 fry were shipped to U. S. Fish Commission car No. 2, and 180,000 fry were sent to Dr. Shortlidge.

XXV.—REPORT ON THE SHAD WORK OF THE STEAMER LOOKOUT DURING THE SEASON OF 1886.

BY MATE JAMES A. SMITH, U. S. N., COMMANDING.

The work in gathering, transferring, and hatching the spawn and depositing the fry of shad, performed by the U. S. Fish Commission steamer Lookout during the season of 1886, covered the time from April 27 to May 23, inclusive. The greater part of the eggs obtained came from the Delaware River, but about one-third were gathered at the northern end of Chesapeake Bay and its inflowing streams. Most of the eggs were transferred to Battery Station or to the Fish Hawk, while some were hatched on board and deposited from the Lookout. During the season 3,000,000 fry were received from Battery Station and deposited in the tributaries of the Upper Chesapeake.

The season's work began on April 27 in the mouth of the Susquehanna River, where the floats and gill-boats were visited, but no ripe spawn was obtained. On the 29th received 500,000 shad fry from Battery Station and deposited them in the mouth of North East River. From the gill-boats in this vicinity obtained 520,000 eggs, which were transferred the next day to Battery Station. On the 30th left this station, passed through the Chesapeake and Delaware Canal to the Delaware River, communicated with some of the fishing-shores, and late at night anchored off Gloucester City, N. J., a few miles below Philadelphia, which was a convenient point from which to visit many of the most important shad fisheries in the river.

On May 3 went to Wilmington, Del., for the purpose of having some repairs made, but returned to the spawn-taking work on the river during the afternoon. On the 5th the Fish Hawk arrived, and the Lookout received orders to co-operate with her in gathering spawn, in obedience to which, the work was carried on conjointly for several days. On the 8th passed through the canal to Chesapeake Bay, and proceeded to Battery Station.

On May 10 Commissioner S. F. Baird and Assistant Commissioner T. B. Ferguson came on board at Havre de Grace, and were taken to Battery Station. All the eggs obtained during the last few days were transferred to the station, and several deposits were made on that and subsequent days in the Susquehanna, North East, and Sassafras Rivers, of fry received from the station. Many of the fishing-shores and gillers in this region were visited almost daily, but comparatively small numbers of eggs were taken, as the shad were becoming scarce, and these were duly transferred to the station. On the 15th proceeded to Baltimore.

On May 18 left Baltimore and returned to Battery Station, where the gathering and transferring of spawn were resumed. On the 22d some of the fisheries had ceased operations and most of the gillers on the east side of the bay had stopped fishing for the season, so the spawn-takers from the Lookout were sent out to gather spawn in the immediate vicinity of the station and to attend the gillers above the station, which resulted in getting 218,000 eggs on the 22d and 23d.

On May 23, as the fishing season was about ended, orders were received to discontinue the operations by the Lookout.

Appended will be found tables giving records of the shad operations during the season and of meteorological observations made in the vicinity of Havre de Grace and on the Delaware River during a portion of the month of May. The total number of eggs procured by the crew of the vessel was 4,561,000.

TABLE I.—*Record of shad operations conducted near Havre de Grace, Md., and on the Delaware River, on the U. S. Fish Commission steamer Lookout.*

Date.	Ripe fish.		Eggs obtained.	Whence obtained.	Transferred to—		Fish deposited.	
	Males.	Females.			Battery Station.	Fish Hawk.	Number.	Place.
1886. Apr. 29	8	11	520,000	North East River.	520,000		*500,000	Mouth of North East River.
30	3	5	185,000	Delaware River				
May 1								
2								
3	4	6	222,000	Delaware River				
4	11	14	904,000	do				
5	9	11	637,000	do				
6	7	11	500,000	do		1,156,000		
7	12	12	672,000	do		500,000	150,000	Opposite Billingsport, Delaware River.
8								
9							50,000	In channel, opposite Battery Station.
10				Gillers	992,000		110,000	In channel, opposite Battery Station.
11	2	2	84,000	North East River.	84,000		*1,500,000	North East River, between Carpenter's Point and Red Bank.
12	1	1	25,000	do	25,000			
13	4	6	222,000	do	222,000		*1,000,000	Opposite Ordinary Point, Sassafras River.
14	2	3	110,000	do	110,000			
15								
16								
17								
18	1	1	40,000	North East River.	49,000			
19								
20	3	4	130,000	North East River.	130,000			
21	2	3	83,000	do	83,000			
22	3	4	103,000	do	103,000			
23	4	5	115,000	do	115,000			
Total	76	99	4,561,000		2,433,000	1,650,000	3,310,000	

*Received from Battery Station.

TABLE II.—*Record of temperature observations made at Havre de Grace, Md., and on the Delaware River, on the U. S. Fish Commission steamer Lookout, from May 1 to May 10, 1886.*

Date.	Temperature of air.			Temperature of surface water.			Temperature of bottom.			Condition of sky.		
	8 a. m.	4 p. m.	12 mid-night.	8 a. m.	4 p. m.	12 mid-night.	8 a. m.	4 p. m.	12 mid-night.	8 a. m.	4 p. m.	12 mid-night.
1886.	°	°	°	°	°	°	°	°	°			
May 1*	50	56	52	58	60	56	58	58	58	Overcast	Overcast	Overc'st.
2	55	72	53	57	61	59	53	60	59	Clear ...	Clear ...	Clear.
3	70	80	54	62	62	59	......	60	59	...do ...	Partly Cloudy	Do.
4	66	75	64	60	62	61	60	60	61	...do	Cloudy.	Cloudy.
5	66	78	62	61	62	62	60	62	62	...do	...do	Overc'st.
6	70	80	58	61	64	61	61	63	61	Cloudy .	...do	Clear.
7	67	60	64	62	63	61	61	63	61	Clear ...	Rain....	Rain.
8	64	59	58	61	63	59	61	63	59	Cloudy .	Cloudy .	Cloudy.
9	60	75	70	58	63	61	58	63	60	Clear ...	Clear ...	Do.
10	65	78	....	60	62	....	60	62	....	Cloudy .	...do	

Date.	Wind, direction.			Wind, intensity.			State of tide.		
	8 a. m.	4 p. m.	12 mid-night.	8 a. m.	4 p. m.	12 mid-night.	8 a. m.	4 p. m.	12 mid-night.
1886.									
May 1*	NE.	NE.	NE.	9	8	9	Flood	Ebb	Flood.
2	NE.	NE.	NE.	8	5	4	Ebb........	...do	Do.
3	Calm.	SW.	SW.	0	1	2	...do........	...do	Do.
4	SW.	SSW.	S.	1	3	2	...do........	...do	Do.
5	SW.	SW.	SE.	4	7	8	...do........	...do	Do.
6	NE.	NW.	S.	1	1	1	...do........	...do	Do.
7	E.	NE.	NE.	3	8	10	...do........	Flood.....	Do.
8	NE.	NE.	NW.	4	10	3	...do........	Ebb	Do.
9	NW.	Calm.	Calm.	3	0	0	...do........	...do	Do.
10	SE.	Calm.	....	2	0	....	...do........	...do	

* The bottom thermometer in use was No. 5264.

XXVI.—REPORT OF EGGS SHIPPED TO AND RECEIVED FROM FOREIGN COUNTRIES AT THE COLD SPRING HARBOR, NEW YORK, STATION DURING THE SEASON OF 1886-'87.

By FRED MATHER.

SHIPPED TO GERMANY.

(A) SUNFISH (*Eupomotis aureus*).—Some time in the summer of 1886, I shipped to Max von dem Borne, of Berneuchen, 125 sunfish about 1 inch in length. The fish were captured from the mill-pond of Mr. Townsend Jones at Cold Spring Harbor and sent to Mr. Blackford in Fulton Market for shipment. The wisdom of introducing these fish in Germany was rather questionable, but after repeatedly warning Von dem Borne of their predatory character and that their only value was as an aquarium fish, he still wished them. No report of their arrival has been received.

(B) WHITE PERCH (*Roccus* [*Morone*] *americanus*).—Three shipments of fish from 5 to 6 inches long were made to von dem Borne as follows: October 9, 1886, 36 fish were sent in six cans by steamer *Aller*, but they died on the fifth day out. On December 22, 16 fish in four cans, per steamer *Werra*, which arrived in Germany in a frozen condition, all dead. On March 1, 1887, 16 fish of the same size as those sent before were shipped in four cans, but only 3 of them reached von dem Borne alive. These fish were taken from the mill-pond at Cold Spring Harbor by permission of Mr. Townsend Jones.

(C) ROCK BASS (*Ambloplites rupestris*).—On March 1, 1887, there were sent to Herr von dem Borne 25 rock bass of about an inch in length. They were put in one can and 20 of them reached him alive. These fish came from New River, Virginia, and were forwarded by order of Col. M. McDonald from the Wytheville Station.

(D) BROOK PIKE (*Esox americanus*).—On December 22, 1886, I sent von dem Borne 14 brook pike per steamer *Werra*, at the same time that one shipment of white perch mentioned above was made. The fish were all dead on arrival. The only thing that survived in the cans were some very small *cyprinidæ* put in as food for the pike. The fish were furnished by Mr. M. B. Hill, superintendent of the New York hatchery at Clayton.

SHIPPED TO FRANCE.

(A) LAND-LOCKED SALMON (*Salmo salar*, var. *sebago*).—On April 1, 1887, there was packed and shipped to Mr. M. D. Hallay, vice-president of the Fish Commission of the Lower Seine, Gonzerville, France, one case containing 25,000 eggs of the land-locked salmon, per steamer *La Bretagne*. These eggs came some days before from Grand Lake Stream, Maine, and were in good condition for the voyage. No word has been received from them, but from the appended letter of Mr. Louis De Bibian, agent General Transatlantic Company, dated New York, April 2, 1887, and relating to their care on shipboard, there is every reason to believe they will get to their destination in safety:

"Your telegram of 31st March and letter of April 1 at hand. The case reached me this morning and goes on *La Bretagne*, sailing to-day, in care of an officer whom I have given instructions in reference to keeping the box cool and adding ice thereto. I have sent the case to our agent's care in Havre and written him to reship by express on arrival there."

RECEIVED FROM SCOTLAND.

(A) LOCH-LEVEN TROUT (*Salmo levinensis*).—On January 14, 1887, there were received from Sir James Gibson Maitland, Bart., proprietor of the Howietoun Fishery, Stirling, Scotland, three cases of eggs of the Loch-leven trout, per steam-ship *Bothnia*. The cases contained 16,000 each, or 48,000 in all. The eggs on the upper trays were in good condition, but the lower trays in all the boxes contained only dead eggs, owing to the wet condition of the moss and a rise in the temperature. The eggs were all clean and entirely free from fungus, and had they been iced on the ship and the temperature kept down they would have arrived in splendid condition, for those which contained dead embryos had not been dead long and merely showed the white line in the egg. We took out 20,300 dead ones, and the loss since that time has been trifling. The fry from the good eggs are as strong and healthy as any fish ever hatched here. The packing at Howietoun is most excellently done.

RECEIVED FROM GERMANY.

(A) SAIBLING (*Salvelinus salvelinus*).—On February 9, 1887, there were received from Herr Max von dem Borne, proprietor of the fish-cultural establishment at Berneuchen, one case containing 20,000 Saibling eggs, from which there were taken 8,000 dead. In reply to an order to send one-fourth of the eggs to Col. E. B. Hodge, commissioner of fisheries of New Hampshire, 3,000 were repacked and shipped to the hatchery at Plymouth, N. H. He reported their arrival in good condition. On March 9 another case of Saibling eggs was received from Herr von dem Borne, containing 20,000, of which 5,500 were dead. Through a misunderstanding these were mixed with an installment of brown trout eggs received the same day from Germany, and the 14,500 good eggs were distributed with the brown trout to the hatcheries at Corry, Pa.; Wytheville, Va.; Northville, Mich.; and Cold Spring Harbor, N. Y.

On the same date there were received 20,000 eggs of the Saibling from Herr von Behr, president of the Deutsche Fischerei-Verein, from which we removed 5,000 dead and sent the remainder to Mr. F. N. Clark, Northville, Mich., who reported their arrival in good order.

(B) BROWN TROUT (*Salmo fario*).—On March 4, 1887, there was received from Herr von dem Borne, per steamer *Elbe*, one case containing 8,000 brown trout eggs, which arrived in very good condition, very few being dead; and, in accordance with orders, they were kept at Cold Spring Harbor. On March 22 there were received from von dem Borne 50,000 brown trout eggs, in two cases. They were in very bad condition, many being hatched. On the first day 30,000 dead were removed. These eggs not being fit to send out were placed in the troughs to hatch, the prospect of getting any good fish at all from them being very small. At the present time there are about 3,000 fry which are two weeks old and looking well. Probably six hours more in the package would have ruined them.

On March 9 there were received from Herr von Behr, of the Deutsche Fischerei Verein, per steamer *Werra*, one case containing 50,000 eggs of the brown trout, which were in excellent condition, although 13,000 from the lower trays were dead. These eggs were sent out as follows:

E. B. Hodge, Plymouth, N. H.	5,000
Central Hatching Station, at Washington, D. C.	5,000
F. N. Clark, Northville, Mich.	20,000
Pennsylvania Hatchery, Corry, Pa.	10,000
Wytheville, Va., Hatchery	10,000

The above figures include the 14,500 saibling, which, as already explained, had been mixed with them. All except Colonel Hodge got a portion of them.

This station has received on account of the New York Fish Commission the following eggs shipped to Commissioner E. G. Blackford: twenty thousand eggs of the grayling (*Thymallus vexillifer* Ag.), of which only 300 eggs were good, and 10,000 eggs of the brown trout from Herr von Behr, which came in excellent condition.

COLD SPRING HARBOR, N. Y., *April* 8, 1887.

XXVII.—REPORT OF DISTRIBUTION OF FISH AND EGGS BY THE U. S. FISH COMMISSION FROM JANUARY 1, 1886, TO JUNE 30, 1887.*

By M. McDONALD.

The aggregate number of fish and eggs distributed by the U. S. Fish Commission, as collated from the reports of stations, in the period comprised between January 1, 1886, and June 3, 1887, was 210,628,413. The actual number distributed, however, was several hundred thousand less than this, the discrepancy resulting from the fact that the eggs of Salmonidæ produced at one station have been transferred to and hatched out at other stations and consequently have been reported twice, once as eggs and again as fry or older fish. The aggregate distribution by species is shown in the following summary, from which it will be seen that the whitefish, the shad, and the carp still constitute the main features of the work of the U. S. Fish Commission.

Summary of distribution.

Species.	Eggs.	Fish.	Total.
Whitefish (*Coregonus clupeiformis*)	32,000,000	62,070,000	94,670,000
Brook trout (*Salvelinus fontinalis*)	82,000	[1]9,199	91,199
Lake trout (*Salvelinus namaycush*)		[2]162,723	162,723
Rainbow trout (*Salmo irideus*)	420,000	[3]66,412	495,412
Atlantic salmon (*Salmo salar*)	754,000	446,588	1,200,588
Land-locked salmon (*Salmo salar*, subsp. *sebago*)	377,500	44,017	421,517
Brown trout (*Salmo fario*)	84,500	26,500	111,000
Shad (*Clupea sapidissima*)	10,718,000	99,752,000	110,470,000
Carp (*Cyprinus carpio*)		136,163	136,163
Gold-fish (*Carassius auratus*)		2,805	2,805
Black bass (*Micropterus dolomiei*)		48	48
Red-eye perch (*Ambloplites rupestris*)		2,328	2,328
Grayling (*Thymallus tricolor*)		2	2
Tench (*Tinca vulgaris*)		1,202	1,202
Saibling (*Salvelinus salvelinus*)	18,000		18,000
Smelt (*Osmerus mordax*)		2,100,000	2,100,000
Lobsters		5,000	5,000
White perch (*Roccus [Morone] americanus*)		68	68
Sunfish (*Eupomotis aureus*)		125	125
Brook pike (*Esox americanus*)		14	14
Soles		19	19
Eels		200	200
Rock-fish (*Roccus striatus*)		75,000	75,000
Codfish (*Gadus morrhua*)		662,000	662,000

[1] Of this number 1,711 were one or more years old.
[2] Of this number 6,923 were one or more years old.
[3] Of this number 16,482 were one or more years old.

* This report includes also the distribution of 1885–'86 from Baird Station, California, and Cold Spring Harbor Station, New York, not previously reported.

The following summary of fish and eggs furnished for distribution, arranged by stations, will indicate the character and extent of the work accomplished by each station.

Summary of fish and eggs furnished for distribution by the stations during the season.

Stations.	Species.	Eggs.	Fry.	Large fish.
Alpena, Mich	Whitefish	*29,070,000		
Baird, Cal	Rainbow trout	†136,000		
Do	do	*145,000	*39,300	
Bucksport, Me	Atlantic salmon	*754,000		
Central Station, D. C	Whitefish		†1,191,000	
Do	do		*3,900,000	173
Do	Lake trout		†18,025	719
Do	Rainbow trout		†5,300	
Do	do		*5,330	2
Do	Grayling			15
Do	Atlantic salmon			*193
Do	Brook trout		*6,000	
Do	Brown trout		*3,000	
Do	Shad	*8,718,000	*36,018,000	*7
Do	Carp (from Ft. Washington seine)			*2
Do	Tench			*200
Do	Red-eye perch			
Cold Spring Harbor, N. Y	Whitefish		†942,300	
Do	Lake trout		†137,775	
Do	Brown trout	†27,000	†23,500	
Do	do	*50,000		
Do	Saibling	*18,000		
Do	Atlantic salmon		†446,573	
Do	Land-locked salmon	*25,000	†31,020	
Do	Shad		†100,000	
Do	Smelt		†2,100,000	
Do	Lobsters		†5,000	*25
Do	Red-eye perch			*68
Do	White perch			*125
Do	Sunfish			*14
Do	Brook pike			*19
Do	Soles			
Carp ponds	Carp for public waters		*5,974	
Do	Carp for private ponds		*95,135	
Do	Carp for State commissioners		*32,660	
Do	Goldfish		*2,755	*12
Do	Breeding carp to other stations			
Do	Tench		*750	*200
Do	Eels			
Steamer *Fish Hawk*	Shad	*3,330,000	*18,934,000	
Fort Washington Station, Md	do	*57,385,000	*2,050,000	
Grand Lake Stream, Me	Land-locked salmon	*352,500		
Steamer *Lookout*	Rockfish		†75,000	
Havre de Grace, Md	Shad		*42,650,000	
Northville Station, Mich	Whitefish	*32,600,000	*33,000,000	*6,550
Do	Lake trout			*3,397
Do	Rainbow trout	*50,000		*768
Do	Brook trout	*82,000		
Do	Brown trout	*7,500		
Wood's Holl, Mass	Codfish		†662,000	*1,200
Wytheville, Va	Lake trout			*12,366
Do	Rainbow trout	*98,000		*750
Do	Brook trout		*2,488	*12,997
Do	Land-locked salmon			*2,103
Do	Red-eye perch			*48
Do	Black bass			
Do	Tench		*450	
Do	Carp for private ponds		*1,025	
Do	Carp for open river		*450	
Do	Goldfish		*50	

* Season of 1886–'87. † Season of 1885–'86.

By comparison with reports of distribution of previous years it will be seen that the trout work is growing very much in importance, and to make adequate provisions for the rapidly increasing demand for the Salmonidæ will necessitate considerable extension of the work of the U. S. Fish Commission in this direction.

The details of distribution of the most important species, as summarized above, are as follows:

(*a*) WHITEFISH (*Coregonus clupeiformis*).

Of this species 32,600,000 eggs were distributed from Northville Station, Michigan, the present season and were allotted as follows:

To the State Commissioners, to be hatched and planted in public waters	22,500,000
To foreign countries (international exchange)	5,000,000
To other U. S. Fish Commission stations	5,100,000
Total	32,600,000

The eggs which were retained and hatched at the Michigan stations yielded 62,070,000 fry, which were distributed as follows:

To Lake Ontario	3,000,000
To Lake Erie	12,000,000
To Lake Huron	30,000,000
To Lake Michigan	17,000,000
To Long Lake	20,000
To Clear Lake	50,000
Total	62,070,000

(*b*) BROOK TROUT (*Salvelinus fontinalis*).

Eggs of this species are collected at the Northville Station from fish reared in the ponds. The number furnished for distribution during the season of 1886–'87 was 82,000, which were assigned as follows:

To State commissioners and individuals	37,000
To Central and Wytheville Stations, for hatching and rearing	35,000
To foreign countries (international exchange)	10,000
Total	82,000

(*c*) LAKE TROUT (*Salvelinus namaycush*).

No eggs of this species were collected during the season.

(*d*) RAINBOW TROUT (*Salmo irideus*).

Eggs of this species are collected for propagation and distribution at Baird Station, California, Northville Station, Michigan, and Wytheville Station, Virginia. At Baird Station the eggs are obtained chiefly from wild native fish. At Northville and Wytheville Stations the breeders have been reared from eggs artificially impregnated at Baird Station and hatched and reared at the stations.

The total production available for distribution was as follows:

	Season 1885-'86.	Season 1886-'87.	Total
From Baird Station, California:			
Hatched and planted in McCloud River	5,000	39,300	44,300
Hatched for ponds at station	10,000	....	10,000
Distributed to applicants and eastern United States stations	131,000	145,000	276,000
From Northville Station, Michigan:			
To Michigan State commission	....	....	25,000
To foreign countries (international exchange)	....	....	25,000
Hatched for rearing at station	....	....	....
From Wytheville Station, Virginia:			
To Central Station	....	....	5,000
To State commissioner and individuals	....	....	38,000
To foreign countries (international exchange)	....	....	55,000
Hatched for rearing at station	....	....	....
Total	....	....	478,300

(*e*) ATLANTIC SALMON (*Salmo salar*).

Eggs of this species distributed by the Commission are all furnished by the collecting station at Bucksport, Me. The production for the year was 779,000, which were distributed as follows:

Date.	Consignee.	Address.	Number.	Condition on arrival.
Feb. 1	F. Mather	Cold Spring Harbor, N. Y.	250,000	Excellent.
2	F. A. Walters	Bloomingdale, N. Y	250,000	Good.
3	E. B. Hodge	Plymouth, N. H	100,000	Do.
21	F. Mather	Cold Spring Harbor, N. Y.	40,000	Excellent.
23	......do	......do	10,000	Do.
24	W. H. Munson	Grand Lake Stream, Me	89,000	Good.
28	......do	......do	15,000	Do.
	Total shipped on account United States.		754,000	
	Retained at hatchery for rearing		25,000	
	Total		779,000	

(*f*) SCHOODIC OR LAND-LOCKED SALMON.

The station at Grand Lake Stream, Me., reported 352,500 eggs of this species as available for assignment. These were distributed as follows:

Date.	Consignee.	Address.	Number.	Condition on arrival.
Mar. 2	E. D. Carleton	Spirit Lake, Iowa	30,000	Fair.
2	R. O. Sweeny	Saint Paul, Minn	30,000	Good.
2	Buker Bros	Rome City, Ind	2,500	Good.
2	F. A. Walters	Bloomingdale, N. Y	30,000	
2	G. W. Delawder	Baltimore, Md	10,000	
5	Herr von Behr, care E. G. Blackford	New York, N. Y	30,000	
5	Max von dem Borne, care E. G. Blackford.	......do	10,000	
5	National Fish Culture Association, care E. G. Blackford.	......do	25,000	
7	H. T. Root	Providence, R. I	10,000	Excellent.
7	L. Z. Leiter	Lake Geneva, Wis	5,000	Good.
7	G. A. Seagle	Wytheville, Va	50,000	Very good.
7	F. Mather	Cold Spring Harbor, N. Y.	40,000	Excellent.
8	E. A. Brackett	Winchester, Mass	30,000	Good.
9	E. B. Hodge	Plymouth, N. H	25,000	Fair.
22	F. Mather	Cold Spring Harbor, N. Y.	25,000	
	Total		352,500	

SUMMARY.

To State commissioners and individuals	287,500
Deutsche Fischerei-Verein	30,000
Max von dem Borne	10,000
National Fish Culture Association	25,000
Total	352,500

(g) Brown trout (*Salmo fario*).

To the courtesies of Herr von Behr, president of the Deutsche Fischerei-Verein, and Herr Max von dem Borne, of Berneuchen, Germany, the U. S. Fish Commission is indebted for several consignments of eggs of the brown trout. The number received, their condition as reported on arrival, and the assignments made of the eggs are given below:

From Herr von Behr (international exchange)	37,000
From Herr Max von dem Borne	22,500
	59,500

They were distributed as follows:

To Pennsylvania commission	10,000
To Wytheville Station	10,000
To Northville Station	20,000
To Cold Spring Harbor Station	9,500
To New Hampshire commission	5,000
To Central Station	5,000
	59,500

A shipment of 50,000 brown trout eggs sent by Herr von dem Borne were three-fifths dead on arrival, and the balance will probably prove a total loss.

(h) Saibling (*Salvelinus salvelinus*).

The Commission is indebted also for eggs of the saibling to Herr von Behr and Herr Max von dem Borne. The number received and their distribution is as follows:

From Herr von Behr	15,000
From Herr Max von dem Borne	12,000
	27,000

Their distribution was:

Northville Station	15,000
Cold Spring Harbor Station	9,000
New Hampshire commission	3,000
	27,000

(i) Shad (*Clupea sapidissima*).

The total distribution of shad for the season was 110,370,000, which were contributed as follows:

Battery Station, Susquehanna River	42,650,000
Fish Hawk Station, Susquehanna River	20,934,000
Central Station, Potomac River	44,736,000
Fort Washington Station, Potomac River	2,050,000

A summary of the distribution of fry by river basins is as follows:

Penobscot River	922,000
Kennebec River	1,047,000
Tributaries of Narraganset Bay	1,275,000
Hudson River and tributaries	*2,185,000
Tributaries of Delaware Bay	†5,099,000
Tributaries of Chesapeake Bay	70,199,000
Tributaries of Albermarle Sound	5,322,000
Tributaries of South Atlantic coast	3,569,000
Tributaries of Gulf of Mexico	7,048,000
Inland waters	1,014,000
Total	97,680,000

(*j*) CARP (*Cyprinus carpio*).

The production of this species for distribution the present season was not sufficient to meet all requests filed by applicants and gave rise to considerable dissatisfaction on the part of those who expected to be supplied. The diminished production was occasioned by the work of reclamation of the Potomac flats, which necessitated the interruption of the drainage of the ponds and prevented their proper preparation for the spawning of the fish. This cause is, of course, temporary, and we may reasonably expect in the future to be able to produce the carp in sufficient numbers to supply all demands. The total distribution of carp for the season aggregated 133,769 in thirty-two States and four Territories, as follows:

Distribution of carp by U. S. Fish Commission during season 1886–'87.

State.	Point of distribution.	Counties included.	Applicants supplied.	Fish issued— To individual applicants.	Fish issued— To State commissioners.	Total issued.
Alabama	Birmingham and Greenville	45	152	3,110		3,110
California	San Francisco	23	33	660		660
Florida	Jacksonville	14	77	2,260	‡475	2,735
Connecticut	Boston, Mass	8	36	720		720
Delaware	Washington, D. C	3	18	360	400	760
District of Columbia	do		3	60		60
Georgia	Atlanta	67	181	3,725	250	3,975
Illinois	Quincy	75	221	4,520		4,520
Indiana	Indianapolis	73	257	5,250		5,250
Idaho Territory	Salt Lake City, Utah	4	7	140		140
Iowa	Des Moines	90	187	3,970	5,520	9,490
Kansas	Kansas City	83	607	12,620	400	13,020
Kentucky	Lexington	42	98	2,150	§249	2,399
Maine	Boston, Mass	15	61	1,250		1,250
Maryland	Washington, D. C	10	31	650	1,200	1,850
Massachusetts	Boston	13	37	770		770
Minnesota	Saint Paul	29	53	1,060	3,500	4,560

* Does not include the product of 6,661,000 eggs shipped to Cold Spring Harbor to be hatched and turned into Hudson River and tributaries.

† Does not include the product of 4,074,000 eggs shipped to Wilmington, Del., to be hatched and turned into the tributaries of Delaware Bay.

‡ Planted in Lake Emma, Florida.

§ Deposited in city reservoir at Lexington, Ky.

Distribution of carp by U. S. Fish Commission during season 1886-'87—Continued.

State.	Point of distribution.	Counties included.	Applicants supplied.	Fish issued.		Total issued.
				To individual applicants.	To State commissioners.	
Michigan		(*)	(*)	....	....	....
Missouri		(*)	(*)	....	....	....
Nebraska	Omaha	48	109	2,230	....	2,230
New Hampshire	Boston, Mass	6	11	220	....	220
New Jersey	New York and Washington, D. C.	17	35	770	....	770
New York	New York City	52	236	5,050	3,310	8,360
North Carolina	Raleigh and Charlotte	52	207	4,190	....	4,190
Ohio	Columbus	81	284	5,710	†4,750	10,460
Pennsylvania	Washington, D. C	61	319	6,980	....	6,980
Rhode Island	Boston, Mass	5	8	170	2,000	2,170
South Carolina	Columbia and Charleston	24	91	1,870	....	1,870
Tennessee	Nashville	47	149	2,980	....	2,980
Utah Territory	Salt Lake City	20	544	10,880	1,080	11,960
Vermont	Boston, Mass	12	29	580	1,000	1,580
Virginia	Washington, D. C., and Wytheville.	68	241	4,910	‡500	5,410
West Virginia	Washington, D. C	24	47	940	1,500	2,440
Wisconsin	Madison	52	168	3,780	12,000	15,780
Colorado	Denver	18	28	560	....	560
Wyoming	Laramie	2	2	40	500	540
Total		1,183	4,599	95,135	38,634	133,769

* Supplied from stock belonging to State fish commission.
† Deposited in Muskingum River, at McConnelsville, Ohio.
‡ Deposited in Reed Creek, Virginia.

(*k*) GOLDFISH (*Carassius auratus*).

The total distribution of this ornamental species for the season aggregated 2,755, which were distributed to 392 applicants in twenty-two States and two Territories in lots of from 4 to 10.

The summary of distribution by States is as follows:

State.	Number of applicants.	Number of fish.	State.	Number of applicants.	Number of fish.
Alabama	3	24	New Jersey	4	24
Connecticut	1	4	New York	11	62
Florida	2	12	North Carolina	4	36
District of Columbia	273	1,630	Ohio	4	24
Georgia	11	256	Pennsylvania	11	84
Illinois	3	18	Rhode Island	1	6
Indiana	3	18	South Carolina	1	12
Iowa	10	72	Tennessee	5	30
Kansas	1	50	Utah	3	87
Maryland	14	102	Virginia	19	114
Massachusetts	3	18	West Virginia	2	12
Michigan	1	4	Total	392	2,755
Minnesota	2	56			

CAR AND MESSENGER SERVICE.

During the season of 1886 the cars of the Commission were moved 45,861 miles, as follows:

	Paid.	Free.	Total.
	Miles.	*Miles.*	*Miles.*
Car No. 1:			
Carp distribution	3,559		3,559
Shad distribution	4,183		4,183
Car No. 2:			
Carp distribution	4,390	1,313	5,703
Shad distribution	10,327	74	10,401
Whitefish distribution	637	3,919	4,556
Trout distribution	6,153	2,356	8,509
Car No. 3:			
Carp distribution	2,536		2,536
Trout distribution	922		922
Shad distribution	5,004	488	5,492
Total	37,711	8,150	45,861

Of the above transportation 8,150 miles were furnished by the railroads gratuitously, and 37,711 miles paid for at an average rate of 20 cents per mile.

The number of miles traveled by messengers on detached service was as follows (all paid):

	Miles.
Carp distribution	13,701
Shad distribution	12,259
Whitefish distribution	7,784
Trout and perch distribution	6,802
Soles distribution	989
Total	41,535

As heretofore many of the railroads, especially the great continental lines, have responded freely and generously to requests for free transportation, and we have thus been enabled to extend the benefits of the distribution to remote sections of the country, which it would otherwise have been impracticable for us to supply on account of the enormous expense of such distribution.

The following is a list of the railroads which furnished free transportation:

CAR No. 2.

Date.		Species.	Railroad.	Route.	Distance.
1886-'87.					*Miles.*
Nov.	20	Carp	Missouri Pacific	Saint Louis to Kansas City and return.	574
	23	do	do	Kansas City to Omaha	213
Dec.	1	do	Utah Central	Ogden to Salt Lake City and return	74
	4	do	do	Salt Lake City to Milford and return	452
Aug.	19	Trout	Saint Louis and San Francisco.	Saint Louis to Verona	274
	20	do	do	Verona to Nichols	32
	22	do	do	Nichols to Kansas City	242
		do	Kansas City, Fort Scott and Gulf.	Nichols to Mammoth Springs and return.	288
Feb.	2	do	Flint and Pere Marquette	Northville, Mich., to Reed City and return.	326
	12	do	do	Northville, Mich., to Toledo and return.	124

CAR No. 2.—Continued.

Date.	Species.	Railroad.	Route.	Distance.
1886-'87.				*Miles.*
Feb. 22	Trout	Flint and Pere Marquette	Northville, Mich., to Wayne Junction and return.	22
25	...do	...do	Northville, Mich., to Detroit and return.	52
Mar. 3	...do	...do	Northville, Mich., to East Saginaw and return.	160
Feb. 7	...do	...do	Northville, Mich., to Detroit	26
Feb. 22	...do	Michigan Central	Wayne Junction to Jackson and return.	116
	...do	Lake Shore and Michigan Southern.	Jackson and Auburn Junction	78
2	...do	Grand Rapids and Indiana	Reed City to Richmond, Ind., and return.	606
	Shad	Utah Central	Salt Lake City to Ogden, Utah, and return.	74
	Whitefish	Flint and Pere Marquette	Northville to Ludington and return.	434
	...do	...do	Northville to Holly, Mich., and return.	58
	...do	...do	Northville to Wayne Junction and return.	22
	...do	...do	Northville to Ludington and return.	434
	...do	...do	Northville to Monroe, Mich., and return.	74
	...do	...do	Northville to Detroit, Mich., and return.	56
	...do	...do	Northville to Toledo and return	124
	...do	...do	...do	124
	...do	...do	Northville to Wayne Junction and return.	22
	...do	...do	Northville to Toledo and return	124
	...do	...do	Northville to Bay City and return	186
	...do	...do	Toledo, Ohio, to Northville	62
	...do	Detroit, Grand Haven and Milwaukee.	Holly to Grand Haven and return	244
	...do	Michigan Central	Wayne Junction to Michigan City and return.	420
	...do	...do	Wayne Junction to New Buffalo and return.	400
	...do	Canada Southern	Detroit to Suspension Bridge and return.	456
	...do	Rome, Watertown and Ogdensburgh.	Suspension Bridge to Oswego, N.Y., and return.	302
	...do	Lake Shore and Michigan Southern.	Toledo to Sandusky and return	98
	...do	...do	...do	98
	...do	...do	Monroeville to Toledo, Ohio	53
	...do	Chicago and West Michigan	New Buffalo to Saint Joseph and return.	54
		Total		3,919

CAR No. 3.

May 22	Shad	Easton	Boston, Mass., to Portland, Me	108
23	...do	Maine Central	Portland to Bangor, Me	136
24	...do	...do	Bangor to Portland, Me	136
25	...do	Easton	Portland, Me., to Boston, Mass	108
		Total		488

HATCHING OF SHAD EGGS EN ROUTE.

The first successful attempt in this direction was made in the spring of 1886, when 600,000 shad eggs were transferred from the Susqehanna River Station to Portland, Oregon, successfully hatched after arrival at destination and the fry deposited in good condition in the Columbia and Willamette Rivers in the State of Oregon.

The application of this method during the season of 1887 has greatly increased our facilities for distribution and, by enlarging the carrying capacity of the cars, has introduced a corresponding reduction in the cost of distribution.

Only one car (No. 3) is as yet equipped for this service. This made three trips, carrying each time, in addition to its full complement of fish, 1,200,000 eggs, and experience has shown that the hatching of the eggs in this moving station can be conducted as conveniently and with as good results as at the fixed stations. The number of hatching-jars in use was 12, each requiring one-half a gallon of water per minute and having a capacity of 90,000 eggs.

It is desirable that the equipment of car No. 3 should be increased to 60 jars, which will afford hatching room for 5,000,000 shad eggs or about 8,000,000 whitefish eggs. It is recommended that car No. 2 be similarly equipped and provided with circulating hatching and collecting apparatus, thus giving each a carrying capacity four-fold greater than if young fish only are transported.

Should the increase of the work of shad production necessitate, as is probable, the construction of another car, it is desirable that this should be built and equipped with special reference to its use as a field or moving station for the hatching of eggs of shad and whitefish.

TRANSFER OF EGGS TO DISTANT STATIONS.

The number of shad eggs collected during the season was greater than we could care for at Battery and Central Stations. The necessity of making proper provision for this excess led to the application of the methods of transportation now in use for the transfer of eggs from Fort Washington to Central Station to the transfer of large lots of eggs to remote stations, where the eggs were hatched and planted in adjacent waters.

The eggs, packed on shallow, cloth-lined wooden trays, were crated up in packages of convenient size for handling (each package containing 250,000 eggs), packed in the refrigerators of car 3, the temperature regulated so as to stand at about 60° F., and transferred to destination. Of the four lots of 2,000,000 each, moved in this way, two arrived at destination in good condition, one in inferior condition, and one proved almost a total loss. This lot, however, was delayed 12 hours en route, and the eggs for safety stored in a refrigerating apartment where the temperature approached freezing. To this is doubtless to be attributed the loss of this shipment.

We have yet to learn much as to the conditions determining the successful transfer before we can be assured of uniform success in making shipments of eggs instead of fish to distant points, but doubtless the movement of eggs instead of fish will be the main feature of future distributions, since eggs can be transferred in large numbers at little relative cost to distant points convenient to the waters to be stocked, and hatched out there in improvised field stations or in a car equipped as a hatching station.

WASHINGTON, D. C., *July* 25, 1887.

XXVIII.—DISTRIBUTION OF DUPLICATE SETS OF MARINE INVERTEBRATES, 1879-1886.

In the Commissioner's report for several years past, reference has been made to the work done by the U. S. Fish Commission in distributing to museums specimens of the lower forms of aquatic life; but as in no case has a detailed report been made, it has been deemed proper to present one at this time. Thus in the report for 1882 it was stated:

"The Commission has also made very large collections of aquatic animals, especially of fishes, shells, corals, crustaceans, star-fishes, etc., and after submitting them to a careful investigation for monographic research and setting aside a full series for the National Museum, the remainder has been made up into well-identified and labeled sets for distribution to colleges, academies, and other institutions of learning throughout the United States. The educational advantages of this last measure have proved to be of the utmost value and are thoroughly appreciated by teachers throughout the country. Applications for these sets are being continually received, and several hundreds of them have already been supplied, a number of persons being occupied for a good part of their time in preparing to meet additional calls. There is nothing which so much increases the interest in natural history as the opportunity of examining actual specimens of rare and usually unprocurable species, instead of depending upon descriptions or drawings; and as the possibility of obtaining these series becomes the better known it is quite likely that all the resources of the Commission for making collections, great as they are, will be fully taxed.

"The calls for these specimens are usually made through the member of Congress representing the district in which the institution is established; or, if made direct to the Commission, they are referred to the member for his indorsement and recommendation."

Again, in his report for 1884, the Commissioner said:

"The Fish Commission has been enabled to do a great deal incidentally in the way of promoting science and education; especially by the discovery of many rare forms of life in the waters, and by the accurate labeling and extensive distribution of duplicates of these objects to colleges and academies throughout the country; the reserve specimens, of course, going, under the law, to the National Museum."

In his report for 1885 he wrote:

"There has also been hearty co-operation with the work of investigation by various men of science, notably by those connected with Government bureaus of this and other countries, and with many of the leading colleges and educational organizations of the country. To the latter it has been possible for the Commission to supply, in return, collections of marine forms and other material of great value for class-room instruction and for museum purposes. These collections involve no expense to the recipients beyond the cost of freight, of alcohol, and of suitable receptacles for exhibition and storage, and are assigned to schools and colleges upon recommendation of the member of Congress from the district in which the institutions are located."

The following is a copy of the circular which was usually sent to applicants for these specimens:

"Some of the duplicate specimens of marine invertebrates collected by the U. S. Fish Commission have been arranged into sets for distribution to educational establishments throughout the country. They are partly dry and partly in alcohol, each specimen accompanied by a printed label giving name, locality, etc. The sets contain about 105 species each, and represent many of the principal families, orders, and genera of Crustaceans, Mollusks, Radiates, and Sponges of the North Atlantic.

"To obtain one of these sets application must be made through and indorsed by a member of Congress and must contain an assurance that the expense of proper exhibition will be met. Alcoholic specimens are packed in a number of storage jars, from which they must be removed and each placed in a separate bottle. The cost of jars and alcohol generally amounts to from $25 to $40, but these materials are not furnished by the Fish Commission."

These series of duplicates were all prepared by Mr. Richard Rathbun, the first series at New Haven, Conn., under the direction of Prof. A. E. Verrill, the remainder at the National Museum. The following explanatory remarks are quoted from the official lists:

"The specimens included in the following list are preserved in alcohol, unless otherwise stated. The authority given for the name is usually the author who first used the *combined binomial* name herein adopted, and is not necessarily that of the author who first described the species or gave the *specific* name. (A name in parentheses is authority for the specific name only.)

"The species are not all included in each of the fifty sets, but those sent in each numbered set are checked on the list bearing the corresponding number. The species now distributed are not to be considered as *the most common*, but simply those which happen to be at present most abundantly represented in the collections of the Fish Commission, or

*Proceedings of the United States National Museum, 1879, pp. 227-232; 1881, pp. 298-303, 304-307; 1883, pp. 212-216.

those which, for other reasons, can be most conveniently distributed at this time, and have been so selected as to give representatives of most of the important groups. It will also be understood that the species included in this list form but a very small proportion (less than one-twelfth) of the total number of species contained in the collections made by the Fish Commission on the New England coast." (Explanatory of Series I.)

"The species enumerated in the present list were collected by the U. S. Fish Commission, mainly during the past four years, and represent a portion of the duplicate material resulting from their sea-coast explorations, and now available for distribution. Several of the species included in these duplicate sets are recent additions to science, obtained by the U. S. Fish Commission steamer *Fish Hawk*, from the inner edge of the Gulf Stream slope, south of Martha's Vineyard, during the summers of 1880 and 1881. This region, which was first explored in 1880, has proved to be the richest dredging ground yet discovered upon our coast, both as regards variety of life and abundance of specimens.

"Nearly all the species enumerated are included in each set, but of a few species only enough duplicates were secured to supply a portion of the sets. The sets will number about one hundred. The crustacea have been identified, for the most part, by Prof. S. I. Smith, and most of the other species by Prof. A. E. Verrill. The names are mainly those used in the Preliminary Check-list of the Marine Invertebrata of the Atlantic Coast, by A. E. Verrill, edition of 1879. A considerable number of species that have since been described are, however, here included." (Explanatory of Series II.)

Five series, containing 360 sets in all, have been prepared, and of these, 247 sets have been distributed to date. The following lists of institutions and individuals supplied are furnished by Mr. Rathbun, who has had charge of the distribution:

List of institutions and individuals supplied with sets of duplicate specimens of marine invertebrates from the collections of the U. S. Fish Commission to December 31, 1886.

1.—FOREIGN.

Country.	City or town.	Institution or individual.	Series No.
Argentine Republic	Buenos Ayres	Museo Publicodo Buenos Aires	1
Australia	Brisbane	Queensland Museum	1
	Melbourne	Victoria Museum	1
	Elizabeth Bay, Sydney	William Macleay	2
	Sydney	Australian Museum	1
Belgium	Brussels	Musée Royal d'Histoire Naturelle	1
Canada	Kingston	Queen's University	2
	Montreal	Peter Redpath Museum, McGill University	2
	Ottawa	Geological and Natural History Survey	4
	Sherbrooke	Sherbrooke Library, Art, and Natural History Association.	4
	Toronto	Trinity College	4
	Do	Trinity Medical School	4
	Do	University College	2
	Quebec	Université Laval	2
Chili	Santiago	Museo Nacional	1

List of institutions and individuals supplied with sets of duplicate specimens of marine invertebrates, etc.—Continued.

1.—FOREIGN—Continued.

Country.	City or town.	Institution or individual.	Series No.
Denmark	Copenhagen	Royal Zoological Museum	1
England	Cambridge	John W. Clark, Cambridge University	5
	Fence Houses, County Durham.	Rev. A. M. Norman	5
	Liverpool	Derby Museum	1
	London	British Museum	1
	Manchester	Manchester College and Museum	2
	Oxford	Prof. H. N. Moseley	5
	Sunderland	Prof. George S. Brady	5
France	Nantes	Société d'Histoire Naturelle	4
	Paris	Museum-Jardin des Plantes	1
Germany	Berlin	Zoological Museum	1
	Dresden	Royal Zoological Museum	1
Greece	Athens	The Greek Government	2
Holland	Leyden	Neder. Dierk. Vereeniging	1
	Do	Netherlands Museum	1
Italy	Florence	Reale Museo di Fisico e Storia Naturale	1
	Genoa	Museo Civico di Storia Naturale	1
Japan	Tokio	Mombusho Museum	1
Manitoba	Winnipeg	Manitoba Historical and Scientific Society	3
Mexico	Mexico	Museo Nacional	1
	Guanajuato	Prof. Alfredo Duges	2
	Mexico	Prof. F. Ferrari Perez, Mexican Exploring Commission.	4
New Brunswick	Fredericton	New Brunswick University	1
	St. John	Society of Natural History	4
New Zealand	Christ Church	Canterbury Museum	1
	Dunedin	Otago Museum	1
	Wellington	Colonial Museum	1
Norway	Bergen	Bergens Museum	1
	Christiana	University Museum	1
Nova Scotia	Windsor	King's College	3
Peru	Lima	Facultad de Medicina de Lima	2
Portugal	Lisbon	Zoological Museum	1
Russia	St. Petersburg	University of St. Petersburg	1
Scotland	Edinburgh	University of Edinburgh, Prof. J. C. Ewart	5
	Do	Sir C. Wyville Thomson	1
Sweden	Stockholm	Prof. Sven Loven, Royal Academy	5
	Do	Museum of the Academy of Science	1

2.—DOMESTIC.

State.	City or town.	Institution or individual.	Series No.
California	San Francisco	California Academy of Sciences	1
Colorado	Fort Collins	Agricultural College	3
	South Pueblo	A. H. Danforth, president board of education	4
Connecticut	Hartford	Trinity College	2
	Middletown	Wesleyan University	1
District of Columbia	Washington	High School	3
	Do	National Deaf Mute College	3
	Do	U. S. steamer *Albatross*	2
Georgia	Atlanta	Atlanta University	3
Illinois	Abingdon	Hedding College	3
	Bloomington	Illinois Wesleyan University	2
	Cairo	Cairo public schools	4
	Champaign	Illinois University Museum	1
	Chicago	Chicago Academy of Sciences	1
	Do	North Division High School	4
	Lake View	Lake View High School	4
	Elgin	Elgin Scientific Society	4
	Evanston	Northwestern University	1
	Galesburgh	Knox College	2
	Hyde Park	Hyde Park School	4
	Jacksonville	Jacksonville Female Academy	4
	Moline	W. S. Mack, superintendent public schools	4
	Naperville	Northwestern College	4
	Do	P. Thompson, president board of education	4
	Normal	Illinois Museum of Natural History	1
	Quincy	Chaddock College	4
	Rockford	Rockford Seminary	8
	Rock Island	Augustana College	4

List of institutions and individuals supplied with sets of duplicate specimens of marine invertebrates, etc.—Continued.

2.—DOMESTIC—Continued.

State.	City or town.	Institution or individual.	Series No.
Illinois	Springfield	State Natural History Society	1
	Virginia	Central Illinois Science Society	3
Indiana	Bloomington	Indiana State University	1
	Crawfordsville	Wabash College	2
	Crown Point	Crown Point Public School Museum	4
	Delphi	Delphi High School	4
	Franklin	Franklin College	3
	Hanover	Hanover College	2
	Indianapolis	Indiana Institute for Educating the Deaf and Dumb.	4
	La Fayette	High School	4
	Do	Purdue University	1
	Moore's Hill	Moore's Hill College	4
	Paxton	John W. Spencer	3
	Richmond	Earlham College	4
	Terre Haute	Indiana State Normal School	4
Iowa	Cedar Rapids	Coe College	4
	College Springs	Amity College	4
	Davenport	Davenport Academy of Natural Sciences	3
	Do	Griswold College	3
	Do	C. T. Lindley	3
	Fairfield	Fairfield Museum and Library	3
	Do	Parson's College	4
	Grinnell	H. W. Parker	3
	Iowa City	Museum of Natural History, State University	4
	Osage	Cedar Valley Seminary	3
	Oskaloosa	Penn College	4
	Tabor	Tabor College	2
Kansas	Emporia	State Normal School	4
	Lindsborg	Bethany Normal Institute	4
	Manhattan	Kansas State Agricultural College	4
	Topeka	Washburn College	4
Kentucky	Bowling Green	Ogden College	3
	Lexington	Kentucky University	2
	Louisville	Polytechnic Society of Kentucky	2
	Paducah	Female College	3
	Richmond	Central University	4
Maine	Brunswick	Bowdoin College	1
	Kent's Hill	Maine Wesleyan Seminary and Female College	3
	Orono	Maine State College	3
	Portland	Portland Society of Natural History	2
Maryland	Baltimore	Friends' Academy	3
	Do	Johns Hopkins University	2
	Do	E. McDowell Agassiz Association, Chapter 387	4
	McDonogh	McDonogh School	4
	Woodstock	Woodstock College	3
Massachusetts	Amherst	Amherst College	1
	Do	Massachusetts Agricultural College	2
	Auburndale	Lasell Seminary	4
	Do	Williams School	4
	Boston	The Lowell School	4
	Do	Massachusetts Institute of Technology	4
	Brighton	St. John's Ecclesiastical Seminary	4
	Chelsea	Chelsea High School	4
	Leicester	Leicester Academy	4
	Martha's Vineyard.	Martha's Vineyard Summer Institute	2
	Medford	Tufts College	4
	Northampton	Smith College	2
	Pittsfield	Berkshire Athenæum	4
	South Boston	Perkins Institute and Massachusetts School for the Blind.	4
	South Hadley	Mt. Holyoke Female Seminary	3
	Wellesley	Wellesley College	2
	Williamstown	Williams College	2
Michigan	Albion	Albion College	2
	Detroit	Detroit High School	4
	Lansing	Agricultural College	1
	Olivet	Olivet College	4
	Ypsilanti	Michigan State Normal School	4
Minnesota	Minneapolis	Minnesota Academy of Sciences	4
	Do	University of Minnesota	1
	Saint Cloud	State Normal School	4
	Winona	State Normal School	3
Missouri	Camden Point	Female Orphan School	4

List of institutions and individuals supplied with sets of duplicate specimens of marine invertebrates, etc.—Continued.

2.—DOMESTIC—Continued.

State.	City or town.	Institution or individual.	Series No.
			2
Missouri	Columbia	University of the State of Missouri	3
	Kansas City	Kansas City Academy of Science	4
	Parkville	Park College	4
	Saint Joseph	St. Joseph's Commercial College	4
	Do	State Insane Asylum	4
	Sedalia	Sedalia Natural History Society	4
	Do	Sedalia University	4
	Springfield	Drury College	4
Nebraska	Crete	Doane College	4
	Lincoln	Nebraska Fish Commission	2
	Do	University of Nebraska	3
	Neligh	Gates College	4
	Weeping Water	High School	2
New Hampshire	Hanover	Dartmouth College	3
	Meriden	Kimball Union Academy	2
New Jersey	Princeton	College of New Jersey	3
New York	Brooklyn	Adelphi Academy	3
	Do	Long Island Historical Society	2
	Buffalo	Buffalo Society of Natural History	4
	Canton	St. Lawrence University	4
	Clifton Springs	Foster School	2
	Ithaca	Cornell University	2
	New York	College of New York	3
	Do	Ida M. Elliott, 9 West Thirty-ninth street	1
	Oswego	State Normal School	3
	Pittsford	Rochester Society	3
	Plattsburgh	High School	4
	Potsdam	Normal School	3
	Poughkeepsie	Poughkeepsie Society of Natural History	2
	Do	Vassar College	2
	Rochester	Rochester University	1
	Schenectady	Union College	2
	Skaneateles	Skaneateles Library Association	2
	Syracuse	Syracuse University	2
North Carolina	Chapel Hill	University of North Carolina	4
Ohio	Ada	Northwestern Ohio Normal School	2
	Cincinnati	Cincinnati University	3
	Do	Cuvier Club	2
	Do	Normal School	1
	Do	Society of Natural History	1
	Cleveland	Kirtland Society of Natural History	4
	Dayton	St. Mary's Institute	2
	Delaware	Museum of the Ohio Wesleyan University	3
	Do	Normal School, Ohio Wesleyan University	3
	Fremont	Birchard Library and Museum	4
	Granville	Denison University	3
	Hudson	Western Reserve College	3
	Oberlin	Oberlin College	4
	Piqua	High School	4
	Westerville	Otterbein University	4
	Wilmington	Wilmington College	4
Pennsylvania	Bainbridge	Mr. F. G. Galbraith	3
	State College	State College	4
	Gettysburgh	Pennsylvania College	3
	Greenville	Theil College	4
	Haverford College	Haverford College	4
	Huntingdon	Brethren's Normal College	4
	Lewisburgh	University	4
	Meadville	Allegheny College	4
	Ogontz	Ogontz School	1
	Philadelphia	Academy of Natural Sciences	2
	Do	Bryn Mawr College	2
	Do	Department of Biology, University of Pennsylvania.	4
	Do	Friends' Central School, Fifteenth and Race streets	4
	Do	Pennsylvania Institution for Instruction of the Blind.	4
	Do	Wagner Free Institute of Sciences	3
	Saint Clair	Agassiz Association	2
	Swarthmore	Swarthmore College	4
	Wallingford	Wallingford Natural History Society	3
	Washington	Washington and Jefferson College	4
	West Chester	State Normal School	4
	Westtown	Westtown Boarding School	4
	Williamsport	Williamsport Dickinson Seminary	1
Rhode Island	Providence	Brown University	3
	Do	Providence Franklin Society	

List of institutions and individuals supplied with sets of duplicate specimens of marine invertebrates, etc.—Continued.

2.—DOMESTIC—Continued.

State.	City or town.	Institution or individual.	Series No.
Rhode Island	Providence	State Normal School	4
South Carolina	Charleston	Avery Normal Institute	3
Tennessee	Clarksville	Southwestern Presbyterian University	4
	Cleveland	Centenary Female College	4
	Columbia	Female Institute	3
	Morristown	Morristown Seminary and Normal Institute	4
	Nashville	Meharry Medical College	3
	Spring Hill	Beechcroft School	4
Texas	College Station	State Agricultural and Mechanical College	4
Vermont	Barre	Goddard Seminary	4
	Burlington	University of Vermont	1
	Middlebury	Middlebury College	2
Virginia	Crozet	Miller Manual Labor School	4
	Hampton	Hampton Normal and Agricultural Institute	3
West Virginia	Morgantown	West Virginia University	4
Wisconsin	Elkhorn	Elkhorn High School	4
	Lake Geneva	Geneva Public School	4
	Madison	University of Wisconsin	1
	Milwaukee	Public Museum of the City of Milwaukee	3
	Ripon	Ripon College	2

RECAPITULATION.

Number of sets of Series I distributed	49
Number of sets of Series II distributed	46
Number of sets of Series III distributed	49
Number of sets of Series IV distributed	97
Number of sets of Series V distributed	6
Total	247

The number of species in each series was as follows:

Series I	198
II	183
III (first educational)	102
IV (second educational)	110
V (for exchange only)	213

The following single list, containing 260 items, has been compiled from the five lists upon which the specimens were sent out. The series which contain representatives of each species are denoted by Roman numerals so placed in columns as to indicate the place from whence the specimens were obtained.

List of species of marine invertebrates from the Atlantic

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
CRUSTACEA.									
DECAPODA.									
Gelasimus pugnax Smith. Fiddler crab									
Gelasimus pugilator Latreille. Fiddler crab									
Callinectes hastatus Ordway. Blue crab; Edible crab									
Platyonichus ocellatus Latreille. Lady crab; Sand crab									
Carcinus mænas Leach. Green crab									
Panopeus sayi Smith. Mud crab									V
Cancer irroratus Say. Rock crab; Jonah crab							I		
Cancer borealis Stimpson. Rock crab; Jonah crab					I				
Hyas coarctatus Leach				I, II					
Libinia emarginata Leach. Spider crab									
Libinia dubia Edwards. Spider crab									
Zoeas and Megalopas of crabs									
Euprognatha rastellifera Stimpson. Maioid crab									
Hippa talpoida Say. Sand-bug; Bait-bug									
Eupagurus bernhardus Brandt. Hermit crab							I		
Eupagurus politus Smith. Deep-sea hermit crab									
Eupagurus pubescens Brandt. Hermit crab				I		II, V			
Eupagurus kröyeri Stimpson									
Eupagurus longicarpus Stimpson. Hermit crab									
Eupagurus pollicaris Stimpson. Hermit crab									
Catapagurus sharreri A. M. Edwards. Deep-sea hermit crab									
Parapagurus pilosimanus Smith. Hairy-clawed hermit crab									
Pinnotheres maculatus Say. Oyster-crab									
Munida, Sp									
Homarus americanus M. Edwards. American lobster									IV
Cambarus affinis Erichs. Crayfish									
Crangon vulgaris Fabricius. Common shrimp									
Pontophilus norvegicus M. Sars									V
Pontophilus brevirostris Smith									
Hippolyte securifrons Norman. Shrimp									V
Hippolyte spina Leach. Shrimp		I						I	
Pandalus Montagui Leach. Deep-water prawn									
Pandalus propinquus G. O. Sars. Deep-water prawn								I	II
Pandalus borealis Kröyer. Deep-water prawn									
Pandalus leptocerus Smith. Deep-water prawn									
Palæmonetes vulgaris Stimpson. Common prawn									
Sergestes arcticus Kröyer									
SCHIZOPODA.									
Thysanopoda inermis Kröyer									
Thysanopoda norvegica M. Sars. Surface shrimp		I–III, V						I, V	
Mysis mixta Lilljeborg. Opossum shrimp									
Mysis americana Smith. Opossum shrimp									
CUMACEA.									
Diastylis quadrispinosus G. O. Sars									

[1] Chesapeake Bay.
[2] Coast of New England.
[3] Le Have Bank.
[4] Off Chesapeake Bay.

coast used in making up sets for distribution.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
I	......	......	IV	......	......	......	......	II, V	......	......	I, III	......	......	......
......	......	......	II, IV	I, V	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	I	......	......	III[1]
I	......	......	......	I, II, IV, V	......	......	......	IV	......	......	......	......	......	......
......	......	......	......	......	......	......	II, V	......	......	......	......	......	......	......
......	......	......	......	II, V	......	......	......	......	......	......	......	......	......	......
......	......	......	......	I–III, V	......	......	......	II, V	......	......	......	......	......	......
......	......	II	......	......	......	......	V	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	IV,[2] V[3]
......	......	......	......	I–III, IV	......	......	......	II, V	......	......	......	......	......	......
......	......	......	V	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	IV	......	......	......	......	......	......	......	......	......	......
......	II, III, V	IV	......	......	......	......	......	......	......	......	......	......	......	......
IV	......	......	II–V	......	......	......	......	......	......	......	......	......	......	......
......	......	II	......	......	......	......	V	......	......	......	......	......	......	......
......	......	II, V	......	......	......	......	......	......	......	......	......	......	......	I, V[4]
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	......	V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	II–V	......	......	......	......	......	......
......	I	......	......	I, II, V	......	......	......	......	......	I	III, IV	......	......	......
......	......	II, IV	......	......	......	......	......	......	......	......	......	......	......	......
......	......	II, III, V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	II	......	......	......	......	......	......	......	......	......	......
......	......	II–V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	I, IV	......	II, V	......	......	......	......	I	......	......	II[5]
......	......	......	......	......	......	......	......	......	......	......	......	......	......	IV[6]
......	......	......	......	II, V	......	......	......	III	......	......	......	......	......	I[7]
......	......	II, V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	II, V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	......	V	......	......	......	......	......	......	......	......	......	......	......	II[8]
......	......	......	......	......	......	......	......	......	......	......	......	......	......	V[7]
......	......	II–V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	II, V	......	......	......	......	......	......
......	......	V	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	I[9]
......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
IV	......	......	......	......	......	......	......	......	......	......	......	......	......	......
......	......	......	......	II	......	......	......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	......	......	......	I[10]

[5] New England coast.
[6] Potomac River.
[7] Massachusetts coast.
[8] *Off Delaware Bay.*
[9] Cape Cod from whale's stomach.
[10] Off Grand Menan.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
CRUSTACEA.—Continued.									
AMPHIPODA.									
Ptilocheirus pinguis Stimpson									
Orchestia agilis Smith. Sand flea; Beach flea									
Talorchestia longicornis Smith. Large sand flea									I
Gammarus locusta Fabricius. Scud									
Gammarus natator Smith. Fresh-water shrimp							I		
Unciola irrorata Say. Sand flea									
Themisto bispinosa Bœck									
ISOPODA.									
Idotea irrorata Edwards									
Idotea robusta Kröyer									
Ligia oceanica Fabricius. Marine sow-bug									
Æga psora Kröyer. Salve bug									
Cirolana concharum Harger									
Gygo hippolytes Kröyer									V
ENTOMOSTRACA.									
Artemia gracilis Verrill. Brine shrimp									
Temora longicornis Müller. Menhaden feed									
CIRRIPEDIA.									
Lepas fascicularis Ellis and Solander. Clear goose barnacle									
Lepas anatifera Linné. Goose barnacle									
Balanus balanoides Stimpson. Rock barnacle; Acorn shell									
PYCNOGONIDA.									
Nymphon hirtum Fabricius									
Phoxichilidium maxillare Stimpson					I				
MEROSTOMATA.									
Limulus polyphemus Latreille. King crab; Horse-shoe crab; Horsefoot									
ANNELIDA.									
CHÆTOPODA.									
Lætmatonice armata Verrill									
Lepidonotus squamatus Kinberg. Scaly worm		I, III	II, V						
Harmothoe imbricata Malmgren		I							
Nephthys cæca Johnston						III, V			
Nephthys incisa Malmgren									II, V
Podarke obscura Verrill									
Nereis virens Malmgren; Clam worm; Bait worm									
Nereis pelagica Linné							I		
Nothria conchylega Malmgren				I, II, V					
Nothria opalina Verrill				I					
Arabella opalina Verrill									
Hyalinœcia artifex Verrill. Deep-sea tube-dwelling worm									
Euglycera dibranchiata Verrill									
Chætopterus pergamentaceus									
Clymenella torquata Verrill							I		

[1] George's Bank, on codfish.

[2] Off Nova Scotia, on cod and halibut.

used in making up sets for distribution—Continued.

Cape Cod Bay.	*Nantucket or vicinity.*	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
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[3] Off Halifax, Nova Scotia.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
ANNELIDA—Continued.									
CHÆTOPODA—continued.									
Cirratulus grandis Verrill									
Trophonia affinis Verrill									
Sternaspis fossor *Stimpson*								I	
Amphitrite ornata Verrill									
Thelepus cincinnatus Malmgren		III, V							
Potamilla reniformis Malmgren									
Spirorbis lucidus Mörch									
Spirorbis borealis Daudin							I		
Clitellio irrorata Verrill							I		
GEPHYREA.									
Phascolosoma gouldii Diesing. Sipunculoid worm									
Phascolion strombi Theel. Sipunculoid worm									
CHÆTOGNATHA.									
Sagitta elegans Verrill									
NEMERTINA.									
Cerebratulus ingens Verrill							I		
Cerebratulus roseus Verrill							I		
MOLLUSCA.									
CEPHALOPODA.									
Ommastrephes illecebrosa Lesueur. Short-finned squid; *Sea-arrow; Flying calamary*									
Loligo pealei Lesueur. Common squid									
Heterotenthis tenera Verrill[1]									
Octopus bairdii Verrill									
GASTROPODA.									
Fulgur carica *Conrad. Periwinkle; Winkle*; Ribbon whelk									
Sycotypus canaliculatus Gill. Periwinkle; Winkle; Hairy whelk									
Buccinum undatum Linné. Whelk		I	III						
Neptunea decemcostata H. & A. Adams			I						
Tritia trivittata H. & A. Adams									
Ilyanassa obsoleta Stimpson. *Black mud-snail*; Sea-snail							I, III		
Urosalpinx cinerea *Stimpson. Drill*; Rough whelk									
Purpura lapillus Lamarck. Purple sea-snail					I		I		
Anachis avara Perkins									
Astyris lunata Dall							I		
Lunatia heros H. & A. Adams. Sea-snail									
Neverita duplicata Stimpson. Sea-snail									
Littorina littorea Menke. Pennywinkle; Periwinkle; Sea-snail							I, III		
Littorina palliata Gould. Small perwinkle					I		I, III		
Littorina rudis Gould					I		I		
Lacuna vincta Turton									
Bittium nigrum *Stimpson*									
Crepidula fornicata Lamarck. Double decker; Boat-shell									

[1] Naushon Island, Mass.
[2] Off Chatham, Mass.
[3] Halifax, Nova Scotia.

used in making up sets for distribution—Continued.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
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							II, V	IV						
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				I–V										
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		II, V												
		V												
				I				II, V						
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			IV	I			II, V							
			IV				II, V							III[5]
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			IV				II, V							
			IV				II, V							
			II, IV, V	I										
				I	II, IV, V						III			

[4] New England coast.

[5] Barnstable, Mass.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
MOLLUSCA—Continued.	•								
GASTROPODA—continued.									
Crepidula plana Say. Sea-snail; Slipper-shell									
Margarita helicina Möller									
Acmæa testudinalis Hanley. Limpet			II–V		I				
Trachydermon ruber Carpenter			I, II, V						
Trachydermon albus Carpenter			III						
Pleurobranchia tarda Verrill									
Melampus lineatus Say. Salt-marsh snail									
SOLENOCONCHA.									
Dentalium striolatum Stimpson. Tusk-shell; Tooth-shell			I–III, V						
LAMELLIBRANCHIATA.									
Teredo megotara Hanley. Ship-worm									
Ensatella americana Verrill. Razor shell; Razor clam									
Mya arenaria Linné. Long clam; Soft clam; Mannanose							III, V		
Saxicava arctica Deshayes					I				
Cyrtodaria siliqua (Spengler) Woodward									V
Clidiophora trilineata Carpenter									
Spisula solidissima Gray. Sea clam; Surf clam; Hen clam									
Spisula ovalis Gould. Surf clam						I			
Mulinia lateralis Gray									
Macoma sabulosa Mörch. Tellen				I				I	
Tagelus gibbus Gray									
Petricola pholadiformis Lamarck									
Venus mercenaria Linné. Round clam; Quahog; Hard clam									
Callista convexa (Say) H. & A. Adams									
Tottenia gemma Perkins									
Cyprina islandica Lamarck. Sea clam				I				I	
Venericardia borealis Carpenter. Cockle									
Astarte undata Gould. Cockle			I						
Nucula proxima Say									
Yoldia limatula Woodward									
Yoldia sapotilla Stimpson									
Yoldia thraciformis Stimpson				I				I	
Scapharca transversa H. & A. Adams									
Argina pexata Gray. Bloody clam									
Modiola modiolus Turton. Horse mussel			II, III, V				I		
Modiola plicatula Lamarck. Ribbed mussel; Grooved mussel									
Mytilus edulis Linné. Common mussel									
Pecten irradians Lamarck. Common scollop									
Pecten tenuicostatus Mighels. Smooth scollop; Giant scollop; Great scollop									
Pecten vitreus Woodward									
Anomia aculeata Gmelin					I				
Anomia glabra Verrill. Silver-shell; Gold-shell; Jingle-shell									
Ostrea virginica Gmelin. American oyster									
TUNICATA.									
Ascidia mollis Verrill. Ascidian; Sea-squirt				I					
Ascidiopsis complanata Verrill. Sea potato		I	II, III, V						

[1] Grand Menan. [2] Barnstable, Mass. [3] Guilford, Conn.

used in making up sets for distribution—Continued.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, *Mass.*	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	*Southern coast of New England.*	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
				I			II, V							
														I[1]
		II, IV, V												
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		II, V												
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			II, IV.											I[3]
				I	II–V									
				I									II, V	
								II, III, V						
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														V[4]
	I					V					I			II[5]
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II–V														
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			IV				II, III, V				I			
					IV		II, III, V				I			
II, V				I	III	IV								
		II–V					II, V		I					
		V												
					II, III, V	IV								
											I			III[6]

[4] Coast of New England. [5] Coast of Middle Atlantic States. [6] Chesapeake Bay.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
TUNICATA—Continued.									
Ciona occellata Verrill									
Molgula retortiformis Verrill		I							
Molgula manhattensis Verrill									I
Molgula arenata Verrill									
Glandula arenicola Verrill									
Halocynthia partita Verrill									
Halocynthia echinata Verrill									
Halocynthia pyriformis Verrill. Sea-peach		I							
Boltenia bolteni Linné. Stemmed sea-peach			I–V						
Perophora viridis Verrill									
Botryllus gouldii Verrill									
Amorœcium pellucidum Verrill									
Amorœcium stellatum Verrill									
Amorœcium constellatum Verrill									
Leptoclinum albidum Verrill									
Leptoclinum albidum, var. luteolum Verrill									
Salpa caboti Desor									
Salpa									
MOLLUSCOIDA.									
BRACHIOPODA.									
Terebratulina septentrionalis Gray. Lamp shell			I–III, V		I				
POLYZOA.									
Crisia eburnea Lamouroux							I		
Alcyonidium ramosum Verrill									
Flustrella hispida Gray							I		
Vesicularia dichotoma Verrill									
Cellularia ternata Johnston									II, IV
Bugula flabellata Busk									
Bugula murrayana Busk									
Bugula turrita Verrill									
Gemellaria loricata Busk									I, II, IV, V
Membranipora pilosa Farre							I		
Lepralia americana Verrill							I		
Discopora nitida Verrill									
Escharina isabelliana Orbigny									
Hippothoa hyalina Smitt									
ECHINODERMATA.									
HOLOTHURIOIDEA.									
Lophothuria fabricii Verrill								I	
Pentacta frondosa Jæger. Sea-cucumber	V	I							
Thyone briareus Selenka. Sea-cucumber									
Leptosynapta girardii Verrill									I
ECHINOIDEA.									
Schizaster fragilis Düben & Koren									
Echinarachnius parma Gray. Sand-dollar									
Echinus gracilis A. Agassiz									
Strongylocentrotus dröbachiensis A. Agassiz. Common sea-urchin; Green sea-egg; Sea-egg			I						I
Arbacia punctulata Gray. Purple sea-urchin									

used in making up sets for distribution—Continued.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	*Miscellaneous.*
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			III, IV	I			II, V							
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[1] Race Point, Cape Cod, Mass.

[2] Grand Menan.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
ECHINODERMATA—Continued.									
ASTERIOIDEA.									
Asterias forbesii Verrill. Green star-fish; Common star-fish							I		
Asterias vulgaris Stimpson. Common star-fish									
Asterias stellionura Perrier									
Leptasterias compta Verrill									
Cribrella sanguinolenta Lütken		V		I				I	
Diplopteraster multipes Verrill									
Porania grandis Verrill									
Odontaster hispidus Verrill									
Ctenodiscus crispatus Düben & Koren. Velvet star								I–V	
Archaster americanus Verrill									
Archaster agassizii Verrill									
Archaster floræ Verrill									
OPHIUROIDEA.									
Ophioglypha sarsii Lyman. Sars's serpent-star								I	
Ophioglypha robusta Lyman		I							
Ophiacantha millespina Verrill									
Ophiopholis aculeata Gray. Variegated serpent-star		I		I, III				I	
Amphiura macilenta Verrill									
Ophiocnida olivacea Lyman									
Ophioscolex glacialis Müller & Troschel									
Astrochele lymani Verrill									
Astrophyton agassizii Stimpson. Basket-fish			I						I–V
Astrophyton lamarckii Müller & Troschel. Basket star-fish	V								
CRINOIDEA.									
Antedon dentatum (Say) Verrill (=Sarsii Düben & Koren). Feather star									
CŒLENTERATA.									
ANTHOZOA.									
Pennatula aculeata Dan. Spiny sea-feather; Sea feather									
Pennatula borealis Sars. Sea-pen	V								
Balticina finmarchica Gray. Finmark sea-feather	V								
Renilla reniformis Cuvier									
Virgularia grandiflora Verrill	V								
Acanella normani Verrill. Jointed bush-coral									
Acanthogorgia armata Verrill									
Primnoa reseda Verrill. Bush-coral; Tree coral	I, V								
Paragorgia arborea Edwards & Haime	I, V								
Anthomastus grandiflorus Verrill	V								
Alcyonium carneum Agassiz					I				I
Metridium marginatum Edwards & Haime. Common sea-anemone									
Sagartia abyssicola Verrill. Deep-water sea-rose									
Urticina nodosa Verrill. Warty sea-rose				I					
Urticina callosa Verrill									
Bolocera tuediæ Gosse. Sea-rose				I					
Halocampa producta Stimpson									
Epizoanthus americanus Verrill									
Epizoanthus paguriphila Verrill									
Astrangia Danæ Agassiz									

[1] Halifax, Nova Scotia. [2] Off Nova Scotia.

used in making up sets for distribution—Continued.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Neport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
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......	......	II–V	......	......	......	......	......	......	......	......	......	......	......	I[2]
......	......	II, V	......	......	......	......	......	......	......	......	......	......	......	....
......	......	II, V	......	......	......	......	......	......	......	......	......	......	......	....
......	......	......	......	......	......	......	II,V	......	......	......	......	......	......	....
......	......	II–V	......	......	......	......	......	......	......	......	......	......	......	....
......	......	II,III,V	......	......	......	......	......	......	......	......	......	......	......	....
......	......	......	V	......	......	......	......	......	......	......	......	......	......	....

[3] Beaufort, N. C.

[4] Fishing banks off Nova Scotia.

List of species of marine invertebrates from the Atlantic coast

Name.	Fishing banks of eastern N. A.	Bay of Fundy.	Eastport, Me.	Gulf of Maine.	Casco Bay, Maine.	Cape Ann or vicinity.	Gloucester, Mass.	Massachusetts Bay.	Off Cape Cod.
CŒLENTERATA—Continued.									
HYDROIDEA.									
Sertularia cupressina Linné									
Sertularia pumila Linné							I		
Obelia geniculata Hincks									
Obelia dichotoma Hincks					I				
Hydrallmania falcata Hincks		I							IV, V
Sertularella tricuspidata Hincks		I							IV, V
Sertularella polyzonias Gray									
Diphasia fallax Agassiz		I	II, III, V						
Globiceps tiarella Ayres									
PORIFERA.									
SILICEA.									
Microciona prolifera Verrill. Red sponge; Oyster sponge									
Chalina oculata Bowerbank. Finger-sponge					I				
Cliona sulphurea Verrill. Boring sponge								III, V	
Suberites compacta Verrill									
Tethya gravata Hyatt									
Cladorhiza grandis Verrill	V								
Raphiodesma lingua Bowerbank		I							
PROTOZOA.									
RHIZOPODA.									
Astrorhiza arenacea (Sch.)									

[1] George's Bank.

For convenience of reference there is added an index to genera and brackets on the inside of each page.

used in making up sets for distribution—Continued.

Cape Cod Bay.	Nantucket or vicinity.	Off Martha's Vineyard.	Wood's Holl, Mass.	Vineyard Sound, Massachusetts.	Buzzard's Bay, Massachusetts.	Southern coast of New England.	Newport, R. I., or vicinity.	Narragansett Bay, Rhode Island.	Block Island or vicinity.	Noank, Conn., or vicinity.	New Haven, Conn.	Long Island Sound.	Cape May, N. J.	Miscellaneous.
	I													
		IV		I			II, V		III					
														II [1]
				I										
					IV		II, III, V							
				I							II, V			
				I				III						
				I, IV	III			II, V						
I	I				*IV*									
					I, II, V									
									II, III, V					

species contained in the above list, with page references to figures in

INDEX.

[NOTE.—The references are to page-figures in brackets.]

APPENDIX E.

MISCELLANEOUS.

TABLE OF CONTENTS.

XXIX.—LISTS OF THE DREDGING STATIONS OF THE U. S. FISH COMMISSION, THE U. S. COAST SURVEY, AND THE BRITISH STEAMER CHALLENGER, IN NORTH AMERICAN WATERS, FROM 1867 TO 1887, TOGETHER WITH THOSE OF THE PRINCIPAL EUROPEAN GOVERNMENT EXPEDITIONS IN THE ATLANTIC AND ARCTIC OCEANS.

PREPARED BY SANDERSON SMITH.

PREFACE.

The records of the dredgings and trawlings executed by the U. S. Fish Commission from 1871 to 1879 were published in the Fish Commission Report for 1879 by the author and Mr. Richard Rathbun; those of the *Fish Hawk* from 1880 to 1882 in the Bulletin of U. S. Fish Commission for 1882, by Mr. Richard Rathbun; those of the *Albatross* from 1883 to 1886 in various volumes of the Fish Commission reports. The dredgings of the *Fish Hawk* from 1883 to 1887 and of the *Albatross* in 1887 have not yet been published.

Although separate copies were printed of the lists from 1871 to 1882, the scattered manner in which most of these lists appeared in various publications and associated with great masses of other material has rendered it very difficult to bring together a complete series of them.

The completion of the accompanying series of charts, on which all the dredging positions of the U. S. Fish Commission, the U. S. Coast Survey, and the British steamer *Challenger* in North American waters are laid down, has rendered it desirable to bring together and complete all these scattered lists, together with those of the Coast Survey and the *Challenger*. The opportunity has at the same time been taken to collect together the records of the dredging operations undertaken by the British, French, Italian, Norwegian, Swedish, and other European Governments in the Atlantic and Arctic, the results of which are of almost as much importance to us as of those carried on upon our own coasts. These are scattered through a great number of works in various languages, and many of them very difficult to find, and have in many cases never been reduced into the form of tables; so that the task of bringing them together and putting them into shape has been a somewhat laborious one. It has been endeavored to present as nearly complete a set of these records as possible, but no doubt some will be found to have been omitted which ought to have been included. Excepting in the Arctic seas series consisting mainly of shallow-water dredgings, such as those in the Baltic, have not been included. Of other expeditions which have made important dredgings no lists, so far as is known, have ever been published. It will be noticed, also, that the amount of detailed information given in these lists varies very much, some giving only the position, depth, and kind of bottom, whilst others contain full particulars of temperature of air, surface, and bottom, drift, etc. They are here presented essentially as originally published, with some slight changes of arrangement for the sake of uniformity, and with foreign measures or temperatures accompanied with their American equivalents. The sources from which they were derived are, as a rule, stated, but with some exceptions.

A large part of the dredging positions of the Coast Survey were published by Professor Agassiz in the Bulletin of the Museum of Comparative Zoology at Cambridge, Mass. Those of 1867, 1868, and 1869 made by Count Pourtales have, however, been rendered definite by reference to the original charts and records in the Coast Survey Office; those of 1872, made by Dr. William Stimpson, have been added from the same sources, and a few other additions and corrections have been made.

The prefatory notes attached to each, both of the American and foreign lists, will render unnecessary any further explanation of their sources or peculiarities here.

The five large charts accompanying these lists require but little explanation. They relate only to the work of the Fish Commission, Coast Survey, and *Challenger* on and near our Atlantic coast, as it was not found practicable to publish at present charts illustrating the dredgings in other parts of the Atlantic and Arctic, although such have been prepared.

Every dredging made by the Fish Commission or the Coast Survey has been placed upon one or the other of these charts, except where the scale compels their omission or where the position was originally so indefinitely stated as to render it impossible to place it accurately. Of both these classes special lists are given on the charts, pointing out the nearest station which is placed on the chart.

A few words may be added to explain the special objects of the four small charts and sections placed upon the chart of the Caribbean Sea. The little chart of the Gulf of Mexico and the northwestern part of the Caribbean Sea serves to show parts of the Gulf not included on any of the large charts, to give additional contour lines, and to direct attention to the remarkable regions of deep water existing in both seas, and especially to that one marked as the Sigsbee Deep in the Gulf of Mexico. The bottom of this is almost a perfect plain, varying in depth over a very large area only from 2,000 to 2,050 fathoms, as is shown by the east and west section across the Gulf, which is also given.

The three sections, from the Cultivator Shoal, or George's Bank, from Hatteras, and from Charleston, illustrate the general fact of the very gentle slope of the sea bottom along our eastern coast until the depth of about 100 fathoms is reached and of its very abrupt descent beyond that line, whilst they show the very different distances from shore at which this line is found.

The two sections showing the temperatures in the Mediterranean and the Caribbean Sea illustrate the fact that in a deep basin closed by a barrier of shallower soundings no change of temperature occurs from a depth corresponding with that of the barrier to the very greatest depths. In the Mediterranean the temperature found at a depth of about 120 fathoms, that of the Straits of Gibraltar, is about 57½° Fahr. and does not vary to a depth of more than 2,000 fathoms, whilst in the Caribbean and Gulf of Mexico the deepest channel communicating with the ocean appears to be about 800 fathoms, corresponding to a temperature of 39½° Fahr., and below this depth this temperature is invariably found down to 2,000 fathoms and more. The temperatures marked upon the section of the Gulf of Mexico illustrate this fact more fully.

The other temperature sections show the very rapid diminution of temperature from the surface and the very low temperatures reached in great depths.

As, after the preparation of the chart of the Carribbean Sea, the sections illustrating depths and temperatures were found, when reduced, to be too small for convenient use, enlarged copies of them are given as separate plates, numbered 5*a*, 5*b*, and 5*c*.

The tables of serial temperatures, taken by the *Speedwell*, *Fish Hawk*, and *Albatross*, afford the means of studying these changes of temperature in greater detail. These tables, like those of positions, have been scattered through numerous volumes, and, as requiring the aid of charts for their intelligent use, it has been considered best to bring them together in connection with these.

The hydrographic stations of the *Albatross* having been published for the most part by the Hydrographic Office as well as in the Fish Commission reports, and requiring only very rarely to be referred to by their serial numbers, the lists of them have not been reprinted.

LIST OF CHARTS.

LISTS OF THE DREDGING STATIONS OF THE U. S. FISH COMMISSION FROM 1871 TO 1879, INCLUSIVE, WITH TEMPERATURE AND OTHER OBSERVATIONS.

[Arranged for publication by SANDERSON SMITH and RICHARD RATHBUN.]

The following lists include all the recorded dredging stations made by, or in connection with, the United States Fish Commission, from its organization up to date. The stations are, for the most part, arranged chronologically, and are designated by four series of numbers or letters, as follows: One series of numbers, from 1 V to 87 V, with letters appended, represents the stations for 1871. The 1872 stations (in the Bay of Fundy) are designated by letters from *t* to *z*. Those for 1873 are indicated by a second series of numbers, from 1 to 212, with B. (*Bache*) or Bl. (*Bluelight*) added, according as the dredgings were carried on from the steamers *Bache* or *Bluelight*. In this series, however, are also included the stations of the *Bache* for 1872 and 1874, as well as those for 1873. The last series combines all the stations from 1874 to 1879, inclusive (omitting 1876, during which year sea-work was suspended), in numbers running from 1 to 769. For the sake of obtaining greater uniformity in recording the stations on charts, as explained further on, the stations for 1874 and 1875, originally numbered separately, have been united with those from 1877 to 1879, and given numbers following 1879. The numbers for these later years run as follows: 1874, from 400 to 580; 1875, from 600 to 769; 1877, from 1 to 128; 1878, from 129 to 238; 1879, from 239 to 378.

The stations of the *Speedwell* for 1877, 1878, and 1879 are indicated by numbers only, and are readily distinguished from those of the *Bache* and *Bluelight*, which have B. or Bl. affixed to them. In the following tables the localities given are taken from the original record books, whenever such exist (*i. e.*, for all the work of the *Speedwell* and much of that of the *Bluelight*—101 Bl. to 166 Bl.), with some other notes added to facilitate the finding of the localities on the chart. In many cases the positions were marked, at the time, on the steamers' charts by the commanding officer, and all such positions have been adopted, even though differing somewhat from those given by the record books. From the nature of the operations of dredging and trawling, it becomes almost impossible to estimate exactly the changes of position caused by currents, etc., especially when out of sight of land, and in a few cases the positions were not placed on the charts at the time, and the bearings given do not suffice to fix them very accurately. It is believed, however, that but few positions are rendered uncertain to any great extent by either of these causes. A large part of the positions determined by the *Bache* were originally given by latitude and longitude. The other latitudes and longitudes given in the tables are intended to serve as the readiest means of finding the localities, all of which are either thus designated or are referred to as being near others which are so. The bearings given for the *Speedwell's* work in 1878 are true; the others, with a few (unrecognizable) exceptions, are magnetic.

In the last column of the tables the letter indicates the apparatus employed in dredging: D., Dredge; Ag. D., Agassiz Dredge; R. D., Rake Dredge; T., Trawl; Ag. T., Agassiz Trawl; O. T., Otter Trawl; Tan., Tangles.

STATIONS FOR 1871, IN AND ABOUT VINEYARD SOUND, MASSACHUSETTS.

During this, the first year of the Commission, the dredgings in shallow water were made partly from a sail-boat and partly from a steam-launch, and those in the deeper waters from the United States revenue-cutter *Moccasin*, Capt. J. G. Baker. The dredging stations numbered in all about 250, but to avoid confusion in laying them out on the chart, they were combined into 87 groups or lines, each including from 2 to 9 stations, the lines being designated by numbers, the stations by letters. In this manner they were represented on the large chart accompanying the Report of the United States Fish Commissioner for 1871–'72. In making up the present list the same arrangement has also been followed, and where all the stations of a group were of the same nature, they have been located collectively; otherwise the exact position of each station has been given.

Dates are not prefixed to all of the inner groups, as many of these include stations made on different days. Temperature observations (with Miller-Casella self-registering thermometers) were taken at most of the outer stations, as recorded in the list, but were omitted at the inner ones. The dredge was the implement most commonly used for scraping the bottom, but the beam-trawl was also frequently employed on the smooth inner grounds. The rake-dredge was worked a few times off Gay Head and the tangles very rarely, in only a few places. The characters of the many localities gone over in 1871, as well as the species of animals found inhabiting them, are fully discussed in the "Report upon the Invertebrate Animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region," by Prof. A. E. Verrill; contained in the Report of the United States Fish Commissioner, Part I, for 1871–'72.

NOTE.—The serial numbers in this table from 1 to 87, inclusive, should be read 1 v, 2 v, 3 v, etc., to correspond with the charts upon which the positions are so designated.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature.		
					Air.	Surface.	Bottom.
	1871.						
1	....	*a, b.* Off Little Harbor, Wood's Holl...	1½–2	Covered with eel-grass	....	......	....
2	June 30	*a, b.* Off Little Harbor, Wood's Holl, between Nobska Point and Nonamesset Island.	2–3¾	Rocky, small stones...	....	......	....
3	July 11	*a, b, c.* Off Great Harbor, Wood's Holl, from south of buoy R. No. 4 to Great Ledge.	2½–9¾	Rocks, gravel, &c.....	....	......	....
4	June 30	*a, b, c, d, e.* Beginning nearly the same as No. 3 and extending to beyond buoy R. No. 2.	3½–12¼	Rocks, small stones, &c	....	......	....
5	....	Wood's Holl:					
		a, b. Southeast of Nonamesset Island..	3¾–5¼	Sand, gravel	....	......	....
		c, d. Between Nonamesset Island and Great Ledge.	3¾	Rocks, stones, dead shells.	....	......	....
		e. Off Mink Point, Nonamesset Island..	8½	....do	....	......	....
		f, g. Mouth of Great Harbor..........	5¾–9¾	....do	....	......	....
6	July 20	Vineyard Sound:					
		a, b. Between Nobska Point and Falmouth.	2–3	Covered with eel-grass	....	......	....
		c. Between Nobska Point and Falmouth.	3–5	Gravel and shells.....	....	......	....
		d. About ⅝ mile south of Falmouth....	4¾	....do	....	......	....
		e, f. Between Falmouth Harbor and Western end of L'Homme Dieu Shoal.	5½–9	....do	....	......	....
7	....	*a.* Lackey's Bay, Vineyard Sound.....	....	Covered with eel-grass	....	......	....
		b, c, d. Lackey's Bay, Vineyard Sound.	....	Gravel	....	......	....
8	June 30	*a, b, c, d, e, f, g.* Vineyard Sound, off Nonamesset Island and Wood's Holl.	7–10	Rocks, gravel, small stones.	....	......	....
9	June 29	*a, b, c, d.* Vineyard Sound, south of Little Harbor, Wood's Holl, ½ to 1½ miles from Nobska Point.	7–12	Rocks.			
10	July 24	Wood's Holl:					
		a, b, c. Passages between Nonamesset and Naushon Islands.	1½–2⅝	Soft mud	....	......	....
		d. Hadley Harbor	3½	....do	....	......	....
		e, f. Between Long Neck and Nonamesset Island.	3–6¼	Hard gravel	....	......	....
11	....	Wood's Holl Passage:					
		a, b, c. Off Nonamesset Island.........	3¾–4½	Fine gravel, dead weeds.	....	......	....
		d, e, f, g. Off Uncatena Island	3½–5	Sand, stones	....	......	....
12	....	*a, b, c.* Wood's Holl Passage, between Long Neck and Nonamesset Island.	2½–5¾	Sand, gravel	....	......	....
13	....	*a, b.* Mouth of Great Harbor, Wood's Holl, from off Bar Neck wharf to midway between Mink Point and Parker's Neck.	1½–7	Gravel, &c	....	......	....
14	....	Wood's Holl, in the passage-way to the east and south of Ram and Bluff Islands:					
		a, b	3¼–5¼	Rocky	....	......	....
		c, d	2½–5¼	....do	....	......	....
		e, f, g. In Great Harbor..............	5–10	Rocky, sand	....	......	....
15	....	*a, b, c.* Wood's Holl, buoy No. 3, Middle Ledge to Lone Rock Spindle.	⅝–2½	Gravel, small stones, shells.	....	......	....
16	....	*a, b, c.* Great Harbor, Wood's Holl, near buoys No. 12 and 14.	1½–14	Rocks	....	......	....
17	....	Mouth of Great Harbor, from Bar Neck to east of Nonamesset Island.	1⅝–14½	....	....	......	....
		a, b	....	Mud and eel-grass	....	......	....
		c, d, e, f	....	Rocks, &c.	....	......	....
18	July 24	*a, b, c, d.* Mouth of Great Harbor, from off Bar Neck wharf to midway between Parker's Neck and Nonamesset Island.	2½–12¼	Hard gravel............	....	......	....
19	....	*a, b.* Mouth of Great Harbor, between Parker's Neck and Lone Rock Spindle.	1–8¾	Gravel, mud, weeds	....	......	....
20	....	*a, b, c.* Mouth of Great Harbor, between Nonamesset Island and Parker's Neck.	1½–6¾	Gravel, &c	....	......	....
21	June 27 } June 28 }	*a, b, c, d, e.* Vineyard Sound, southeasterly from Nobska Point about ¾ mile; all near together.	6–10	Rocks, gravel, small stones.	....	......	....
22	....	Vineyard Sound, between Nobska Point and Falmouth Harbor.	4–5½	....	....	......	....
		a, b, c	....	Stones, dead shells....	....	......	....
		d	....	Sand, gravel	....	......	....

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Surface.	Bottom.
	1871.						
23	June 30, July 3, July 8	*a, b, c, d, e, f.* Between Nobska Point and Falmouth, and south of Falmouth, about 1 mile.	4½–10	Gravel, small stones, shells.	....	....	....
24	....	Vineyard Sound:					
		a, b. About 1⅜ miles south of Falmouth.	5½–10	....	....	....	....
		c, d. North of west end of L'Homme Dieu Shoal.	5–13	....	....	....	....
25	....	*a, b, c, d, e.* Vineyard Sound, between Waquoit Bay and Falmouth.	3–5	Sand, shells, eel-grass.	....	....	....
26	....	*a, b, c, d, e.* Vineyard Sound; a line of dredgings parallel to No. 25, and from ⅜–¾ mile further south.	5–13	Gravel, shells	....	....	....
27	....	*a, b.* Vineyard Sound, about midway between the western part of L'Homme Dieu Shoal and the mainland.	5¼–13	Sand, shells, eel-grass .	....	....	....
28	July 20	Vineyard Sound:					
		a, b. Off western entrance to channel between L'Homme Dieu Shoal and Hedge Fence.	5–6	Sand, stones, sea-weeds	....	....	....
		c, d, e, f. South of western end of Hedge Fence.	10–12	Sand, gravel, small stones.	....	....	....
29	....	*a, b, c.* Vineyard Sound; a line parallel to, and just south of, eastern half of Hedge Fence.	5½–12	Gravel, &c	....	....	....
30	....	*a, b.* Mouth of Vineyard Haven, between East and West Chop.	5–7	Sand, eel-grass, algæ...	....	....	....
31	July 20	Vineyard Sound:					
		a, b. Between Hedge Fence and East Chop.	10–13	Sand, gravel, small stones.	....	....	....
		c, d, e. North of East Chop and off Vineyard Haven.	9–11¾	....do	....	....	....
32	....	*a, b, c.* Vineyard Sound; line running east and west, north of eastern half of Hedge Fence.	11–12¼	Gravel, &c	....	....	....
33	....	Vineyard Sound:					
		a, b. South of eastern end of L'Homme Dieu Shoal.	5¼–13¾	....do	....	....	....
		c, d. Southeast of same shoal	5–8½	....do	....	....	....
34	....	*a, b, c, d, e, f.* Vineyard Sound, between eastern end of L'Homme Dieu Shoal and Wreck Shoal.	5–7	Gravel, hard mud, sand.	....	....	....
35	....	*a, b, c, d, e.* Vineyard Sound; line running east and west between Wreck Shoal and 1 mile off Waquoit Bay.	4–7¾	Gravel, shells..........	....	....	....
36	....	*a, b, c, d.* Nantucket Sound, between Wreck Shoal and Horse-Shoe Shoal.	4¾–15½	Astrangia, sponges, &c	....	....	....
37	....	Vineyard Sound, off north side of Martha's Vineyard and nearly parallel with the shore, distant from shore ¼–½ mile:					
		a, b, c, d. Between Martha's Vineyard and Middle Ground.	5–11	Gravel, stones, rocks..	....	....	....
		e, f, g. Off West Chop..........	9–13	Rocks, sand	....	....	....
		h, i. Off East Chop..........	4¼–9	Sand, stones	....	....	....
38	....	Vineyard Sound:					
		a. About ⅞ mile north of center of Middle Ground.	10–14	Gravel..........	....	....	....
		b, c. Just off center of Middle Ground..	9½–13½	....do	....	....	....
39	June 29	*a, b.* Vineyard Sound, about midway between Nobska Point and Middle Ground.	12–13¼	Stones, gravel..........	....	....	....
40	....	*a, b, c, d.* Vineyard Sound, between Wood's Holl and Middle Ground.	10–13	Gravel, stones, sand...	....	....	....
41	....	Vineyard Sound:					
		a. About 1¼ miles east of Nobska Point.	4½–6½	Small stones	....	....	....
		b. About 1⅞ miles southeast of Nobska Point.	10–12	....do	....	....	....
42	July 17	*a, b.* Vineyard Sound, off Tarpaulin Cove.	10¾–15¾	Gravel..........	....	....	....
43	....	Vineyard Sound:					
		a, b, c. Line of dredgings off northern half of Naushon Island, parallel to shore, distant about ½ mile.	10¼–13¾	Gravel, hard sand.....	....	....	....
		d. Continuation of same, ⅝ mile off Nonamesset Island.	10¼–11½	Gravel..........	....	....	....

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Surface.	Bottom.
	1871.						
44		*a, b, c, d, e.* Vineyard Sound; line about parallel to last, off northern half of Naushon Island, about 1 mile from shore.	10½–15¼	Gravel			
45		*a, b.* Vineyard Sound, off Quick's Hole.	6½–8¾	Coarse gravel, shells			
46		Vineyard Sound, off the Elizabeth Islands.	7–14¾				
		a, b. Off Pasque Island		Sand, shells			
		c. Off Robinson's Hole		...do			
		d, e. Off south end of Naushon Island		Sand, shells, and gravel			
47		*a, b, c, d, e.* Vineyard Sound, off west side of Martha's Vineyard, between Menemsha Bight and Cedar Tree Neck, ½ to 1¼ miles from shore, and nearly parallel to it.	10–17¾				
		a, b, c, d		Black mud, dead mussels, &c.			
		e		Sand			
48		*a, b, c, d.* Vineyard Sound, same as last, ¼–½ mile from shore, and extending about 1½ miles both north and south of Cape Higgon.	4¾–11	Sand, gravel, shells			
49		Vineyard Sound:					
		a. About northeast of Gay Head, 4¼ miles.	7¾–18				
		b. About west of Lucas Shoal, 1⅛ miles	5–6				
50		*a, b.* Vineyard Sound, Menemsha Bight.	4–8				
51		Vineyard Sound, Menemsha Bight:					
		a, b, c	1⅝–2½	Mud, fine sand			
		d	4¾	...do			
		e	6–9	...do			
52	July 14 } July 17 }	*a, b, c, d.* Vineyard Sound, north of southwestern extremity of Martha's Vineyard, ½–1 mile from shore (*c, d,* off Menemsha Bight).	10–12	Sand			
53	July 14	*a, b, c, d, e.* Vineyard Sound, north and northeast of Devil's Bridge, Gay Head, ⅜ to 1 mile from shore.	5–12	Sand, rocks			
54		Vineyard Sound, north of Gay Head:					
		a. About 1½ miles from shore	16½	Mussels			
		b. About 2¼ miles from shore	14–15½	...do			
55	July 22	*a, b, c.* Vineyard Sound, north of Devil's Bridge, Gay Head, ¾ mile.	6¾–13½	Rocky, dead mussels, &c.			
56	July 22	*a, b, c, d.* Vineyard Sound, northwesterly from Gay Head, about 1 mile.	5–11	...do			
57		*a, b, c, d, e.* About same position as last, forming a line about ⅛ mile further off.	5–13½	Rocky			
58		*a, b, c, d, e.* Vineyard Sound, northwesterly from Gay Head, 1¾–2 miles.	10–16				
		a, b, c		Rocky			
		d		Mud, dead mussels			
59		*a, b, c.* Vineyard Sound, northwesterly from Gay Head, ½–1⅝ miles.	5¾–11¼	Rocky			
60		*a, b, c.* Vineyard Sound, northwesterly from Gay Head, 1–2 miles.	6–11½	...do			
61		*a, b, c.* Vineyard Sound, northwesterly from Gay Head, 1–2 miles; more easterly than 60.	5½–13¾	...do			
62		*a, b, c.* Vineyard Sound, northwesterly from Gay Head, 1–2 miles; more easterly than 61.	5½–10½	...do			
63		*a, b, c, d.* Vineyard Sound, north of Devil's Bridge, Gay Head, ⅛–¼ mile.	6–8¾	Rocks, sand, shells			
64	July 12	Buzzard's Bay, Cataumet Harbor:					
		a. In harbor	3½	Sand, eel-grass			
		b. At mouth of harbor	3½–4½	...do			
65		*a, b.* Buzzard's Bay, off Cataumet Harbor.	4¼	...do			
66		*a, b.* Buzzard's Bay, between Long Neck and Quamquisset Harbor.	5–6¼	Hard sand			
67	July 24	*a, b.* Just outside of 66	5–6¼	Sand, mud			
68		Buzzard's Bay, west of Quamquisset Harbor:					
		a. About 2 miles	7¼	Fine sandy mud			
		b. About 1 mile	7¼	...do			
		c. About ¾ mile	6–7	Mud			
69		*a, b.* Buzzard's Bay, west of Quamquisset Harbor, about 1½ miles.	5¼–7¼				

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.
	1871.						
70		*a, b, c, d.* Buzzard's Bay, westward of Quamquisset Harbor, about 1¾–2½ miles.	7½	Sand, gravel, stones			
71		*a, b.* Wood's Holl Passage, between Long Neck and Uncatena Island.	3¾–6¼	Fine gravel			
		c, d. West of Long Neck, ¼–⅜ mile	3¾–6¼	Rocks, hard sand			
72		*a, b, c, d.* Buzzard's Bay, northward from Woepecket Island, 1¼–2 miles, forming a line running about northeast and southwest.	7½–8½				
73		Buzzard's Bay, north of northern part of Naushon Island:					
		a, b, c. Parallel and near to shore from Uncatena Island to south of Woepecket Island.	6½–10½	Sand, mud			
		d. About west of Woepecket Island, ¼ mile.	6¾	Rocks			
		e, f, g. Northwesterly from Woepecket; *e*, ½ mile; *f*, 1 mile; *g*, 1½ miles.	7½–8½	Sand and muddy sand.			
74		*a, b.* Buzzard's Bay, northward of Woepecket Island, 1¾–2¾ miles.	7½	Mud			
75		Buzzard's Bay, forming a line of dredgings parallel to the Elizabeth Islands and distant from them ⅜–¾ mile.	7–9				
		a, b, c. Off Naushon Island		Blue mud			
		d, e. Off Pasque Island		....do			
		f, g, h. Off Cuttyhunk Harbor	3½–5				
76		*a, b, c.* Buzzard's Bay, between Quick's Hole and Lone Rock.	3¼–8½	Gravel, dead weeds, &c			
77		*a, b, c, d, e, f.* Quick's Hole, between Pasque Island and Nashawena Island.	5½–8¾	Rocks, gravel, sand			
78		*a, b, c, d, e.* Buzzard's Bay, off northern entrance to Robinson's Hole.	3¾–7½				
		a		Mud, eel-grass, and dead weeds.			
		b		Black mud			
		c		Blue clay			
79		In channel between Chappaquiddick Island, Martha's Vineyard, and Hawe's Shoal:					
		a. Northern part of channel	8¼–4½				
		b. Southern part of channel	4½–5				
80	Sept. 12	Southeasterly from Martha's Vineyard, 3½ to 9 miles:					
		a. 10 miles south from Cape Poge	10½	Sand and silicious sponges.		64	60
		b. 13 miles south from Cape Poge	18½	Sand		64	59
		c. 1½ miles west of *b*	21	Sandy mud		61.5	59
81	Sept. 12	South of Martha's Vineyard, 5 to 8 miles:					
		a. Southeast of Gay Head, 12½ miles	10½	Sand			
		b. Southeast of Gay Head, 8 miles	10½	....do			61
82	Sept. 9	South and southwest from Gay Head, about 5 miles; northwest of No-man's Land:					
		a. 5 miles south-southwest of Gay Head.	8–12	Gravel and stones			
		b. 5 miles south of Gay Head	16	....do			62
83		*a, b, c, d.* Vineyard Sound, off Gay Head, parallel to No. 58, and slightly more distant from shore.	10–16	Rocky			
84	Sept. 11	South and southwest of Gay Head:					
		a. 1½ miles southwest of Gay Head	13	Rocks, gravel			
		b. 4 miles southwest of Gay Head	10½	Sandy mud			
		c. 2¾ miles a little west of south of Gay Head.	12	Rocks, gravel			
		d. 8½ miles a little east of south of Gay Head.	7	....do			
85	Sept. 9	West of Gay Head, 2 to 5 miles:					
		a. 3 miles; *b*, 3½ miles; west of Gay Head.	15½	Sand		67	63
		c. 4 miles west of Gay Head	18	Soft, sticky mud		62	58
		d. 1 mile north-northwest from *c*	19	....do		62	57
		e. 5 miles a little north of west from Gay Head.	11	....do		63	59
86	Sept. 13	West-southwest of Gay Head, 10 to 13 miles:					
		a. 13 miles west-southwest from Gay Head.	25	Gravel, sand, with some mud.			
		b. 10½ miles west-southwest from Gay Head.	25	....do		64	

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature.		
					Air.	Surface.	Bottom.
87	1871. Sept. 14	*a.* 19½ miles west-southwest of Gay Head.	29	Sandy mud	....	......	....
		b. 18½ miles west-southwest of Gay Head.	29	....do	....	62	59

STATIONS FOR 1872, WITH HEADQUARTERS AT EASTPORT, ME.

The dredgings for 1872 were mostly carried on from a large sail-boat; but those in the deeper waters of the Bay of Fundy were made from the United States revenue-cutter Mosswood, Captain Hodgdon. The regions explored were about as follows: Eastport Harbor, South Bay, and Passamaquoddy Bay, all of which are comparatively shallow-water areas; the shallow waters about the island of Grand Menan, especially those among the small islands to the east of Grand Menan; and the deeper waters east of Campobello Island, west of Grand Menan; and toward the center of the Bay of Fundy, between Grand Menan and Nova Scotia.

In connection with the shallow-water dredgings no complete record of observations was kept, but the collections made were appropriately labeled with the precise locality, depth of water, nature of bottom, &c. The more important hauls in deep water, mostly accompanied by temperature observations, are as follows, the letters used to designate them being the same as were employed in the original records:

Serial letter.	Date.	Locality.	Depth in fathoms.	Temperatures.		
				Air.	Surface.	Bottom.
				°	°	°
t.	1872. Aug. 24	Bay of Fundy, off Grand Menan, beginning at a point 8 miles SE. by E. of north end of White Head Island, and running NE. for a distance of nearly 3 miles. (Temperatures taken at the beginning and close, and the same at both.)	106–90	......	48	38
t'.	...do ...	Bay of Fundy, off Grand Menan, north of last; beginning 8½ miles E. of White Head Island, and extending about 2 miles SW.	96–100	......	......	37¾
u.	Aug. 23	Bay of Fundy, E. of Grand Menan, about 2½ miles E. of north end of White Head Island.	28–52	......	53	39½
u'.	...do ...	Bay of Fundy, E. of Grand Menan, 1⅝ miles E. by S. ¾ S. of north end of White Head Island.	29	......	......	44
v.	Aug. 28	Grand Menan channel, west of Grand Menan Island; 2⅜ miles N. by W. ½ W. of Southern Head, G. M.	40	......	48	45½
v'.	...do ...	Grand Menan channel, west of Grand Menan Island; 4¼ miles NNW. ½ W. of Southern Head, G. M.	54	......	47	40
v''.	...do ...	Grand Menan channel, west of Grand Menan Island; 6 miles N. ½ W. of Southern Head, G. M.	55	......	......	40
w.	Aug. 16	Bay of Fundy, about 3½ miles east of Herring Cove Head, Campobello Island. (Soft muddy bottom.)	60	......	......	43
w'.	...do ...	Bay of Fundy, just off Herring Cove, Campobello Island..	27	......	......	46
x.	Aug. 2	Bay of Fundy, 2½ miles, about SE. of Head Harbor Light, Campobello Island.	90	......	48½	39¾
x'.	...do ...	About 2¼ miles ENE. of Head Harbor Light, Campobello Island.	77	......	......	42
x''.	...do ...	About 1⅝ miles NE. of Head Harbor Light	30	......	......	46
x'''.	...do ...	Midway between Head Harbor Light and Spruce Island..	73	......	48	45
y.	Aug. 5	Passamaquoddy Bay, off North Harbor, Deer Island	25	......	57½	47
z.	...do ...	Passamaquoddy Bay, 1½ miles north of last	32	......	58	46

STATIONS FOR 1873, WITH HEADQUARTERS AT PEAK'S ISLAND, CASCO BAY, MAINE; AND ALSO STATIONS OF THE UNITED STATES COAST SURVEY STEAMER BACHE FOR 1872, 1873, AND 1874, IN THE GULF OF MAINE, ETC.

In this list the dredgings indicated by the above heading have been grouped together, as they appear on the chart prepared for publication. Numbers ranging from 1 B. to 78 B. were originally assigned to the *Bache* dredgings for 1873 and 1874, in papers published by Professor Verrill in the American Journal of Science for April, 1874, and June, 1875, and elsewhere. To these the dredging stations of the *Bache* for 1872, 18 in number, have been added, thus increasing the list to 97 B. As to the regular series of dredgings made by the *Bluelight*, under command of Lieut. Commander L. A. Beardslee, in and off Casco Bay, no serial numbers were given to the hauls until the commencement of the temperature observations, July 21. To the numbers (1 to 66), given to such of the subsequent hauls as were accompanied by temperature observations, 100 has been added (101 Bl. to 166 Bl.), and numbers from 167 Bl. to 190 Bl. have been given to the hauls from July 12 to July 21, and from 191 Bl. to 212 Bl. to those taken after July 20, but not included in the temperature series. The descriptions of localities from 101 Bl. to 166 Bl. are taken from the record books for temperatures, with some additions, and from 167 Bl. to 212 Bl. from the eight books of dredging lists, which were kept. Additions to 101 Bl. to 166 Bl., taken from the dredging books, are marked D. L.

The dredging stations of the *Bache* for 1872 were on and about Saint George's Bank and La Have Bank, and extended as far as Halifax, N. S.; in 1873 they were mostly in the Gulf of Maine, especially in the region of Jeffrey's and Cashe's Ledges, a few being made in Massachusetts Bay; those for 1874 were entirely in the Gulf of Maine.

DREDGINGS BY THE BACHE, 1873.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Apparatus used.
		° '	° '				°	°	°	
1 B	Sept. 3	....	....	Off Monhegan Island	52	Soft gray mud	58	55	{ 42 / 44	
2 B	...do	43 39	69 22	7 miles SW. from Monhegan Island	....	Soft mud	58	55	42½	
3 B	...do	43 38	69 17	8 miles S. from Monhegan Island	64	Mud and sand	56	54	{ 43 / 44	
4 B	...do	43 37	69 05	13 miles SE. by S. from Monhegan Island	60	Brown mud, sand	60	55	{ 43½ / 45½	
5 B	...do	43 37	68 59	17 miles SE. from Monhegan Island	72	Brown mud	60	54	{ 43 / 44	
6 B	...do	43 38	69 01	15 miles SE. from Monhegan Island	82	......do	...	...	...	
7 B	...do	43 38	69 01	......do	82	......do	...	...	...	
8 B	...do	43 36	68 32	18 miles SE. by S. from Matinicus Rock	94	Mud and gravel	56	55	...	
9 B	...do	43 36	68 24	23 miles SE. from Matinicus Rock	107	Sticky brown mud	56	57	39½	
10 B	Sept. 4	43 34	68 27	22 miles SE. by S. from Matinicus Rock	104	Soft brown mud	56	57	{ 40 / 41	
12 B	Sept. 13	43 20	68 33	Jeffrey's Bank	60	Brown mud	56	54	42	
13 B	...do	43 23	68 30	......do	105½	......do	56	54	40	
14 B	...do	43 25½	68 40	......do	80	......do	62	60	43	
15 B	...do	43 23	68 44	......do	72½	......do	60	58	{ 42½ / 47	
16 B	...do	43 19	68 49	......do	79	......do	62	58	40½	
17 B	...do	43 15½	68 54	SW. from Jeffrey's Bank	100	Brown mud, gravel	59	57	52	
18 B	...do	43 15½	69 06	......do	106	Brown mud	58	56	40	
20 B	Sept. 16	43 01	70 10	15 miles SE. from Boon Island Light	95	Mud	58	58	{ 37½ / 40½	
21 B	....	42 49	68 50	Cashe's Ledge	52–90	Rocky	52	57	43	
22 B	....	42 52	69 23	56 miles E. of Cape Ann	90	Blue mud	52	56	{ 40 / 43	
23 B	....	42 52	69 35	47 miles E. of Cape Ann	118	Mud	54	57	39	
24 B	....	42 56	70 09	E. of Jeffrey's Ledge	114	Soft mud	59	57	39	
24a B	....	42 56	70 17½	6 miles farther W	114	....	58	58	{ 36½ / 40	
25 B	....	42 28	70 44	3½ miles SE. from Halfway Rock	29	....	...	54	43½	
26 B	....	42 32½	70 50	Salem Harbor	6	....	...	...	...	
27 B	....	42 40	70 27½	Jeffrey's Ledge, 6 miles E. of Thatcher's Island Lights	24	Gravel and stones	57	58	46	
28 B	....	42 41½	70 24½	8 miles E. by N. of Thatcher's Island Lights	26	......do	57	58	48	
29 B	....	42 47½	70 20½	14 miles NE. by E. ½ E. from Thatcher's Island Lights	33	......do	70	54	{ 46 / 49	
30 B	....	42 26	70 35	Massachusetts Bay	50	Soft mud	60	58	{ 42 / 45	

DREDGINGS BY THE BACHE, 1873—Continued.

Serial number.	Date.	Latitude.		Longitude.		Locality.	Depth in fathoms.	Nature of bottom.	Temperature.			Apparatus used.
									Air.	Surface.	Bottom.	
		°	′	°	′				°	°	°	
31 B.	....	42	19	70	29	Massachusetts Bay	66	Mud	62	60	41½ / 44	
32 B.	....	42	19	70	23	West of Stellwagen's Bank	29	Hard, rocky	64	58	48½ / 50½	
33 B.	....	42	20	70	18	On Stellwagen's Bank	22	......do	64	....	48½ / 50½	
34 B.	....	42	22	70	11	East of Stellwagen's Bank	44½	Sand	61	....	41½ / 44	
35 B.	....	42	08	70	15	Between Stellwagen's Bank and Race Point	34	......do	59	57	48 / 50	
36 B.	....	42	18	69	49	23½ miles ENE. ½ N. from Race Point	142	Soft blue mud	60	58	39 / 42	
37 B.	....	42	20	70	00	19½ miles NE. from Race Point	117	......do	....	....	....	

No record exists of any hauls corresponding to Nos. 11 B. and 19 B.

DREDGINGS BY THE BACHE, 1874.*

Serial number.	Date.	Latitude.		Longitude.		Locality.	Depth in fathoms.	Nature of bottom.	Air.	Surface.	Bottom.	Apparatus used.
		°	′	°	′							
38 B.	Sept. 2	42	48½	70	37	Thatcher's Island Light, about 10 miles south	41	Soft blue mud	70	63	45	
39 B.	...do	42	51½	70	36½	Thatcher's Island Light, about 13 miles south	48	Mud	70	69	45½	
40 B.	...do	42	54½	70	35½	Thatcher's Island Light, about 16 miles south	43	Blue mud	70	69	47	
41 B.	...do	42	57½	70	35	Thatcher's Island Light, about 18½ miles south	36–27	Mud and rocks	70½	69	47½	
42 B.	Sept. 3	43	05½	70	20	Boon Island Light, NW. by W. ½ W. 6 miles	68	Brown mud	69½	67	52½	
43 B.	...do	43	04½	70	28	Boon Island Light, N. by E.; hotel on Isles of Shoals, SW. by W. ½ W.	43	......do	75	65	47	
44 B.	...do	43	00½	70	35	Star Island, SW.; Duck Island, W.	25	Rocky	75	67½	51	
45 B.	Sept. 4	43	05	70	11½	Boon Island Light, WNW. 12½ miles	88	Soft mud	65	67	40	
46 B.	...do	43	03	70	04	Agamenticus Mountain, NW. by W. ½ W.	51	Hard sandy mud	65	69½	42	
47 B.	...do	43	02½	70	03	Jeffrey's Ledge, near No. 46 B.	25	Sand and gravel	64	58½	45½	
48 B.	...do	43	01½	70	03½	Jeffrey's Ledge, near No. 47 B.; Agamenticus Mountain, NW. ½ W.	36	Gravel	64	56½	47½	
49 B.	...do	43	02½	69	52	Boon Island Light, WNW. 27 miles	118	....	64	65	40	
50 B.	...do	43	01½	69	45	....	100	....	60	56	40	
51 B.	Sept. 5	42	56	69	08	W. of Cashe's Ledge	105	Mud and gravel	60	55	41	
52 B.	...do	42	51	68	52½	Cashe's Ledge	27	Rock and gravel	60	55	42	
53 B.	...do	42	51	68	50	......do	73	Soft mud	63	55	42	
54 B.	...do	42	49	68	48½	Off SE. edge of Cashe's Ledge	110	Mud	61	61	42	
55 B.	...do	42	53½	68	53½	Cashe's Ledge	40	Gravel	60½	65	43	

56 B	do	42	52½	68	54	do	30	do	62	59	46
57 B	do	42	51½	68	52½	do	37	Rocky			
57* B	do	42	51½	68	52½	do	39	do			
58 B	do	43	04	69	05	NW. of Cashe's Ledge	65	Mud and gravel	60½	57	40
59 B	do	43	22	69	17		92	Mud	61	55	41
60 B	Sept. 6	43	17	69	24		65	Mud and sand	61	57	41
61 B	do	43	51	69	38	*Booth Bay Harbor, Maine*	5	Mud	64	58	51
62 B	Sept. 7	43	40½	69	27	Pemaquid Point, N. 10 miles	48	do	62	62½	47
63 B	do	43	43½	69	30	Pumkin Island, NW. 4 miles	42	Brown mud	68	65	48
64 B	do	43	38½	69	26½	Pemaquid Point, N. 12 miles	58	Mud	61½	57	42½
65 B	do	43	44½	69	22	Monhegan Island, E. by N. 2 miles	47	Soft mud	64½	59	44
66 B	Sept. 8	43	34½	69	31½	Monhegan Island, NE. ¾ E. 14 miles	65	Brown mud and gravel	66	64	40
67 B	do	43	25	69	34½	Seguin Island Light, N. 8° W. 19 miles	86	Brown mud	68	64	40
68 B	do	43	31	69	31½	Seguin Island Light, NW., near No. 67 *B*	91	Mud	64½	59	40
69 B	do	43	11	69	35	On Platt's Bank	32	Sand	64	60	46
70 B	do	43	03	69	36		91	Mud	61½	58	40
71 B	Sept. 9	42	55	69	36		96	Brown mud	61	58	40
72 B	do	42	57	69	50		125	do	61	57	39½
73 B	do	42	58½	70		E. of Jeffrey's Ledge	102	do	62	59	40
74 B	do	43	01	70	09	W. of Jeffrey's Ledge	88	do	62	60	39
75 B	do	43	02	70	15	do	92	do	64	64	40
76 B	do	43	03	70	25	SW. of Boon Island	51	Mud and gravel	64	63	42
77 B	do	42	58½	70	33	White Island Light, E. ¾ S. 3½ miles	33	Rocky	69	65	44
78 B	Sept. 12	43	04	70	30	Agamenticus Mountain, NW. by N. ½ N., near Jeffrey's Ledge	35	Blue clay, mud, sand	61½	60	43

* The surface temperatures taken this year were quite unreliable, in consequence of an erroneous *method of observation.*

DREDGINGS BY THE *BACHE*, *1872.*

[The letters preceding the serial numbers are the same *used to distinguish* the hauls in Smith and Harger's Report on the Saint George's Bank Dredgings (Trans. Conn. Acad., vol. iii), and in Professor Verrill's papers in American Journal of Science. The bottom temperatures this year are quite unreliable, manifestly too high in general.]

			°	′	°	′				°	°	°
a	79 B	Aug. 29	41	40	68	10	*On northwest part of Saint George's Bank*	25	Soft sand			
b	80 B	do	41	40	68	10	do	30	do			
c	81 B	Sept. 16	41	25	66	45	East of Saint George's Bank	28	Coarse sand			
d	82 B	Aug. 31	41	25	66	24½	do	50	Sand and shells	66	62	45
e	83 B	Sept. 16	41	25	65	58.3	do	60	do	61	58	58
f	84 B	Sept. 15	41	25	65	50.3	do	65	Dead shells	64	60	55
g	85 B	do	41	25	65	42.3	do	430	Sand, gravel, stones	66	65	51
h	86 B	Sept. 12	42	56½	64	51.3	On La Have Bank	45	Gravel and stones	64	61	36
i	87 B	do	42	44	64	36	South of La Have Bank	60	Gravel, stones, sponges	62	62	
j	88 B	Sept. 11	44	30	63	30	Off Chebucto *Head, Nova Scotia, entrance Halifax* Harbor	20	Mud and fine sand			
o	89 B–91 B		43	05	67	49	Off northwest border of Saint George's Bank	110	Soft mud and sand		56	49
p	92 B		42	03	67	49	do	85	do		56	49
q	93 B, 94 B		42	00	67	42	Off north border of Saint George's Bank	45	Coarse sand			
r	95 B		42	03	67	31	do	40	do			
s	96 B, 97 B		42	11	67	17	Off northeast border of Saint George's Bank	150	Soft sandy mud		52	52
	98 B–100 B						(There are no hauls corresponding to these numbers)					

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Apparatus used.
		° ′	° ′				°	°	°	
101 Bl.	July 21	43 32	70 05½	Cape Elizabeth Light, NW. ½ W.; Portland Head Light, N. by W.	24	Gravelly	....	51	44¾	
102 Bl.	July 22	43 44	70 03½	Casco Bay, Stockman's Island, W.; Upper Flag Island, E. by S.	16–22½	Sandy	....	57	50	
103 Bl.	...do ...	43 42	70 03¼	Casco Bay, Broad Sound, Bates Island, W.; Eagle Island, E.	22–34	Gravel, br. shells	....	52	48	
104 Bl.	July 24	43 41½	70 08	Casco Bay, Luckses' Sound	12½	Muddy	80	56½	46½	T.
105 Bl.	...do ...	....	....	Casco Bay, Broad Sound, between Stockman's and Little Birch Islands.	16½	Fine sand	84	62	49½	
106 Bl.	...do ...	....	....	Casco Bay, Broad Sound, between Eagle and Bates Islands.	31	Gravel	80	65	45½	
107 Bl.	July 26	....	....	Casco Bay, Broad Sound, between Stockman's and Upper Flag Islands.	16½	Sand	68	56½	47½	
108 Bl.	...do ...	....	....	......do	....	....	....	57½	....	
109 Bl., 110 Bl	July 27	....	....	Casco Bay, Bluelight Cove (channel between Peak's, Great and Little Hog Islands).	3	Muddy	60 / 61	59	56	
111 Bl.	July 28	43 40	70 12	Casco Bay, Bluelight Cove, off Evergreen Landing	3	......do	65	60	56	
112 Bl.	...do ...	43 39½	70 13½	Portland Harbor, between Fort Gorges and Fort Preble	11½	Hard	65	59	52	
113 Bl.	...do ...	....	....	Bluelight Cove	3	Muddy	65	60	56	
114 Bl.	...do ...	....	....	......do	3	......do	66	62	58	
115 Bl.	July 29	....	....	......do	1¾	......do	60	58	56	
116 Bl.	.. do ...	....	....	......do	2	......do	66	60	57	
117 Bl.	July 30	....	....	Casco Bay, Broad Sound, between Bates and Eagle Islands.	16–22	Gravel and sand	67	60	49½	
118 Bl.	.. do ...	43 43	70 05½	Casco Bay, Broad Sound, between Little Bangs and Stave Islands.	9½–12	Soft gravel, br. shells	66	60	53	
119 Bl.	...do ...	....	....	Casco Bay, Broad Sound, between Stockman's and Little Birch Islands.	17 (14?)	Sand, gravel, shells	66	60	53	
120 Bl.	...do ...	....	....	Bluelight Cove	1¾	Muddy	68	64	60	
121 Bl.	...do ...	....	....	......do	2	......do	70	66	61	
122 Bl.	July 31	43 38	70 12½	Portland Light, SSW. ¾ of a mile	13½	Sandy	69	59½	49½	
123 Bl.	...do ...	....	....	Bluelight Cove	2	Muddy	71	62	58	
124 Bl.	...do ...	....	....	......do	2	......do	66	62	59	
125 Bl.	Aug. 1	....	....	......do	2	......do	62	60	56	
126 Bl.	Aug. 2	43 42	70 07	Casco Bay, Luckses' Sound, between Hope and Crotch Islands.	11	......do	71	61	47	
127 Bl.	...do ...	43 44	70 01	Casco Bay, Harpswell Sound, SW. end of Bailey's Island, S. by E.; Ram Island, N. by W.	12½	......do	69	63½	45	
128 Bl.	...do ...	43 42	70 11	Casco Bay, between Cow Island and Cow Island Ledge	9	Sandy mud, gravel, shells.	67	62	54½	
129 Bl.	...do ...	....	....	Bluelight Cove	2	Muddy	68	63	57	
130 Bl.	Aug. 3	....	....	......do	2	......do	66	61	57	
131 Bl.	Aug. 4	43 41½	70 10½	Casco Bay, Cow Island, W. ½ mile	12	Gravelly	70	65	61	

132 Bl	...do	43 40	70 05	Casco Bay, between Halfway Rock and Inner Green Island	12½	Gravel and shells	73	63	48½	
133 Bl	...do	43 38½	70 04¾	Mouth Casco Bay, Halfway Rock, E. by N. about 3 miles	19	Sandy and rocky	75	62	46½	
134 Bl	...do	43 40½	70 03½	Mouth Casco Bay, Halfway Rock, SSE.; Eagle Island, NE. ½ N.	18½	Coarse sand, gravel	74	60	43½	
135 Bl	...do			Bluelight Cove	3½	Muddy	71	68	56	
136 Bl	...do			......do	3	......do	70	62	58	
137 Bl	Aug. 5	43 35½	70 04½	West Cod Ledge, off Portland, Cape Elizabeth, W. ½ S.; Halfway Rock Light, NE. ½ N.	13	Sandy and rocky	72	64	46	
138 Bl	...do	43 32	69 58	Portland Head Light, NW. ½ W. 15 miles; Seguin Island, NE. by E. 15 miles ("18 miles off Cape Elizabeth" D. L.)	48–54	Muddy	65	64	39½	D. and T.
139 Bl	Aug. 6			Bluelight Cove	3	......do	68	63	57	
140 Bl	...do			......do	2¾	......do	68	62	59	
141 Bl	...do	43 31	69 59½	Cape Elizabeth, NW. by W. about 14 miles; Seguin Island, NE. by E. about 16 miles.	48–54½	......do	69	64	38	D. and T.
142 Bl	...do	43 28½	69 59	Cape Elizabeth, NW. 15 miles; Seguin Island Light, NE. by E. ½ E. 18 miles.	48	Stones and mud	72	64	37½	T.
143 Bl	...do	43 27½	69 57	2 miles SE. of 142 Bl	64	Muddy	68½	65	36	D.
144 Bl	...do			Bluelight Cove	2	......do	64	61	57	
145 Bl	Aug. 7			......do	2	......do	65	61	58	
146 Bl	...do	43 43	70 08½	Casco Bay, Chandler's Cove, Great Chebeag Island	7	Mud, dead eel-grass	70	59	54	
147 Bl	Aug. 11			Casco Bay, Broad Sound, between Bates Island and Eagle Island.	25	Gravelly	65	57	47½	
148 Bl	...do			Casco Bay, Luckses' Sound, between Stepping Stones and Crotch Island.	15	Soft mud	65	55½	45	
149 Bl	Aug. 12	43 35	70 05	West Cod Ledge, off Portland, Cod Ledge (buoy?) NE. ½ E. 1 mile.	13	Sandy, with shells	63	61	47	
150 Bl	...do	43 28½	69 52½	Cape Elizabeth, NW. by W. ½ W. about 20 miles; Seguin Island, NE. by N., about 15 miles.	68	Muddy	64	62½	38	T.
151 Bl	Aug. 13	43 42½	69 47	Seguin Island, E. by S. 1 mile; Jackknife Ledge buoy, N. by E. ¾ mile.	12	Sandy	64	52	47	T.
152 Bl	...do	43 42	69 38	Seguin Island, WNW. 5 or 6 miles	33	Sandy and rocky, some mud	64	57	41½	
152ª Bl	...do			Same locality, Cod Stomach						
153 Bl	Aug. 14			Bluelight Cove	3	Mud	60	58	56	
154 Bl	...do	43 39	70 13	Main channel, Portland Harbor	9	Sand and mud	62	57	55½	
155 Bl	...do	43 42¾	70 10¾	Casco Bay, between Clapboard and Long Islands	9	Muddy	64	55½	54	T.
156 Bl	Aug. 19			Bluelight Cove	2	......do	61	58	57	
157 Bl	Aug. 20	43 35½	69 38	Seguin Island, NNW. 9 miles	75	......do	62	59	38	
158 Bl	...do	43 40	69 39½	Seguin Island, NW. 5 miles (about same as No. 201 Bl)	40	Sand and gravel, rocks	65	58	38½	
159 Bl	Aug. 24			Bluelight Cove	2	Muddy	63	61	60	
160 Bl	...do			......do	2	......do	62	58	57	
161 Bl	Aug. 25			......do	2	......do	61	58	56	
162 Bl	Aug. 27			......do	2	......do	60	58	57	
163 Bl	Aug. 29			......do	2	......do	60½	61	57	
164 Bl	{Aug. 30} {Sept. 1}	43 38	70 09	Off Portland, Witch Rock buoy 1 mile west	11–14	Rocky	58	54	50½	
165 Bl	Sept. 8	43 47½	69 55	Casco Bay, Quahog Bay, east of south end of Pole Island	5	Muddy	63	59½	53	
166 Bl	...do	43 47½	69 55	Casco Bay, Quahog Bay, east of north end of Pole Island	6	......do	63	59	54½	
167 Bl	July 11	43 41	70 11	Casco Bay, off Cow Island	16	Mud				
168 Bl	...do	43 40½	70 10¾	Casco Bay, middle of Hussey Sound	17	Rocky				
169 Bl	...do			Casco Bay, off Cow Island	(?)	Sand and rocks				
170 Bl	...do			......do	(?)	(?)				Tan.
171 Bl	...do			Casco Bay, off Hog Island	29	Sand and stones				

DREDGINGS BY THE BLUELIGHT, 1873—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Apparatus used.
		° ′	° ′				°	°	°	
172 Bl	July 11			Casco Bay, off Crotch Island	(?)	(?)				T.
173 Bl	July 14			Casco Bay, off Overset Island	16	Clean gravel				
174 Bl	do			Casco Bay, off mouth of Bluelight Cove, drifting north	15–19	Sand and sponge				
175 Bl	do			Casco Bay, off north end of Hog Island	15	Sand				
176 Bl	do	43 44	70 09½	Casco Bay, between Great Chebeag and Basket Islands	7–8	Mud				
176a Bl	do			do (?)	(?)	(?)				Tan.
177 Bl	do			Casco Bay, off North end of Long Island	(?)	Mud				
178 Bl	July 15			Mouth Casco Bay, off Inner Green Island	22	Rocky				
179 Bl	do			do	17	Sandy				
180 Bl	do	43 40½	70 04	Casco Bay, off Jewell's Island	(?)	(?)				T.
181 Bl	July 16			(?)	(?)	Muddy				
182 Bl	do			(?)	15–23	Shelly and Spongy				
183 Bl	do			(?)	(?)	do				
184 Bl	July 17	43 36½	70 02	Off Portland, ENE. of West Cod Ledge	14–20	Hard and rocky				
185 Bl	do			Off Portland, WSW. of West Cod Ledge 1½ miles	10–15	do				
186 Bl	do			Off Portland, near 185 Bl	10	do				
187 Bl	do	43 34½	70 08	Off Portland, SSW. of West Cod Ledge 3 miles	20–22	do				T.
188 Bl	July 18			Casco Bay, off Cow Island	17	Sandy				
189 Bl	do			do	13½	Sand and stones				
190 Bl	do			Casco Bay, between Cow Island and Crow Island	14	do				
191 Bl	July 21	43 36½	70 04½	Off Portland, near West Cod Ledge	28	Mud and stones				
192 Bl	do			Entrance to Portland Harbor, little west of 122 Bl	10	Rocky and shelly				
193 Bl	July 22			Casco Bay, off Whaleboat Island	(?)	(?)				T.
194 Bl	July 24			Casco Bay, off Bateman's (Bates?) Island	13½	Gravel and br. shell				
195 Bl	do			Casco Bay, between Ministerial and Eagle Islands, the monument on Mark Island showing over north end of Eagle Island.	32	Gravel and stones				
196 Bl	July 31	43 35½	70 01	Off Portland, 1 mile east of East Cod Ledge	(?)	(?)				
197 Bl	do			Entrance to Portland Harbor, near 192 Bl	11	Hard				
198 Bl	Aug. 4			Casco Bay, Haddock Grounds, Broad Sound	12–18	Gravel and shells				
199 Bl	do	43 46	70 05	Casco Bay, off Chebeag Point	11½	Mud				
199a Bl	do	43 43½	70 10	Casco Bay, between Basket and Little Chebeag Islands	(?)	(?)				
200 Bl	Aug. 13	43 39½	69 38	Seguin Island, NW. 6 miles (see 152 Bl)	35	Muddy				
201 Bl	Aug. 20	43 37½	69 51	Seguin Island, NW. 5 miles	45	Rocky and sandy				
202 Bl	Aug. 25			Off Portland, East Cod Ledge	(?)	(?)				
203 Bl	Aug. 27			Casco Bay, between Peak's Island and Overset Island	18	Rock and sponges				
204 Bl	do	43 37	70 01½	Off mouth Casco Bay, 2 miles off Halfway Rock; the locality mentioned on page 357 of Professor Verrill's Explorations of Casco Bay, Proc. Am. Ass. Adv. Sci., 1873.	27½	Sand, gravel, shells, mud				

205 Bl	Aug. 28					Casco Bay, off Whaleboat Island	18	Gravel and shells				
206 Bl	Aug. 29					Off mouth of Casco Bay, west of Halfway Rock	(?)	Muddy, etc.				
207 Bl	do					Casco Bay, Broad Sound	(?)	Muddy and hard, mixed				
208 Bl	Aug. 30					Mouth Casco Bay, off Ram Island	18	Sandy, muddy, etc.				
209 Bl	do	43	39	70	08	Mouth Casco Bay, SW. of Outer Green Island to Long Island.	15	Rocky				
210 Bl	do					Casco Bay, off Stepping Stones	12	Muddy ?				
211 Bl	do	43	34½	70	07½	Off Portland, Cod Ledge Rock	12½	(?)				T.
212 Bl	(?)	43	29½	69	30	Cape Elizabeth, WNW. 30 miles	95	Muddy				

STATIONS FOR 1874 AND 1875, WITH HEADQUARTERS AT NOANK, CONN., AND WOOD'S HOLL, MASS.

In 1874, the headquarters of the United States Fish Commission were established at Noank, Conn., and the area covered by its dredgings included Fisher's Island Sound; the eastern part of Long Island Sound; Block Island Sound; and Gardiner's and Peconic Bays; and also extended some distance to the east, south, and southwest of Block Island. In 1875, with headquarters at Wood's Holl, Mass., dredgings were carried on in Vineyard and Nantucket Sounds; Buzzard's Bay; over a portion of Nantucket Shoals; to the southward of Nantucket Island and Martha's Vineyard; and also on and about Southwest Shoal. The dredgings were all made by the United States steamer Bluelight, Commander L. A. Beardslee, and a separate series of numbers, to designate the stations, was employed for each year. To facilitate the recording of all the dredging stations of the United States Fish Commission on charts, and to bring the southern ones into uniformity with those made to the north of Cape Cod in more recent years, and already recorded both on charts and in reports prepared for publication in a single series of numbers ranging from 1 to 378, 400 has been added to the 1874 dredgings and 600 to those of 1875. In this way all the dredging stations from 1874 to 1879, inclusive, are included in a single series.

The temperature observations recorded in the two following tables were mostly taken with much care. Former experiences had proved that the Miller-Casella thermometers were slow in acting, requiring from three to ten minutes (according to the depth of water) to obtain a correct reading, and they were, therefore, always left down a suitable length of time. The bottom and surface temperatures, in nearly all cases, were taken with Miller-Casella self-registering thermometers; occasionally a United States naval thermometer was employed for surface temperatures, and the same instrument was generally employed for the air.

STATIONS FOR 1874.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1874.				°	°	°	
401	July 13	Fisher's Island Sound, West Clump, bearing S.	7½	Mud	......	......	......	D.
402	13	Fisher's Island Sound	9½	Sand	......	......	......	D.
403	13	......do	11½	....do	......	......	......	D.
404	13	Fisher's Island Sound, off Latimer's Reef.	3½	Rocky	......	......	......	D.
405	....	(No record.)						
406	July 14	Fisher's Island Sound, N. of Young's Rock.	11	Rocky	......	......	......	D.
407	14	Fisher's Island Sound, NW. of Seal Rocks.	9	Sand, stones	......	......	......	D.
408	14	Fisher's Island Sound, N. by E. of Wicopessit.	11½	Clay	......	......	......	D.
409	14	Fisher's Island Sound, Lord's Channel.	11½	Rocky	......	......	......	Tan.
410	14	Fisher's Island Sound, off Napatree Point.	2½	Sand	......	......	......	T.
411	16	Watch Hill Light-House, R. I., NNW., distant about ⅝ mile.	11	....do	......	......	......	D.

STATIONS FOR 1874—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1874.				°	°	°	
412	July 16	Watch Hill Light NNE., distant nearly ½ mile.	5	Rocky				Tan.
413	16	......do	5	....do				Tan.
414	16	Fisher's Island Sound, off Groton Long Point.	7	Gravel				D.
415	16	Fisher's Island Sound, Groton Long Point NW. by N. ½ mile.	7	....do				D.
416	17	Fisher's Island Sound, ¾ mile W. by N. of N. Hammock Light-House.	6	Sand, mud				D.
417	17	Long Island Sound, New London Light N. by W., distant about 2¼ miles.	8	Sand				D.
418	17	Long Island Sound, New London Light N., distant 1⅞ miles.	9	Sand, mud				T.
419	17	Long Island Sound, Little Gull Island Light bearing S. by E. 2 miles.	40	Gravel				D.
420	20	Fisher's Island Sound, ¼ mile N. of West Clump.	11½	...do				D.
421	20	Fisher's Island Sound, N. Hammock Light W. by S. ½ mile.	12½	Sand, gravel				D.
422	20	Fisher's Island Sound, N. Hammock Light S. by W. ½ W. ¼ mile.	13	....do				D.
423	20	Fisher's Island Sound, N. Hammock Light E. ½ mile.	17	Gravel				D.
424	20	Fisher's Island Sound, N. Hammock Light E. by N. 1 mile.	7½	Sand, mud				D.
425	20	Fisher's Island Sound, N. Hammock Light NE. by E. ½ E. 1¼ miles.	10¾	Mud				D.
426	20	Fisher's Island Sound, near Middle Clump.	8	Sand				T.
427	22	Fisher's Island Sound, ¼ mile NW. of Middle Clump.	11½–9½	Sand, shells	65	64	62.5	D.
428	22	Fisher's Island Sound, ½ mile NNW. of Middle Clump.	11	....do	65	64	62.5	D.
429	22	Fisher's Island Sound, ½ mile NNE. of W. Clump.	8	....do	65	64	63	D.
430	23	Fisher's Island Sound, Eelgrass Light-Ship E. by W., distant ½ mile.	7	Sand, gravel	66	64	62.5	D.
431	23	Fisher's Island Sound, between Latimer's Reef and Young's Rock.	10½	Sand, gravel, shells.	65.5	62.5	61.5	D.
432	23	Fisher's Island Sound, eastward of Latimer's Reef.	11	Coarse sand, shells, rocks.	65	62.5	61	D.
433	24	Fisher's Island Sound, Groton Long Point NE. by N., distant ½ mile.	8	Sand, shells	72	66	63	D.
434	24	Fisher's Island Sound, between Sea-Flower Reef and Groton Long Point.	7	....do	71	65.5	62.5	D.
435	24	Long Island Sound, Race Point bearing E., distant 2½ miles.	50	Rocky, with mussels.	72	68	59	D.
436	24	Long Island Sound, about ½ mile SW. of 435.	50	Rocks, gravel	69	68	58	D.
437	24	Block Island Sound, off Culloden Point, Long Island.	12½	Sand, mud	74	66	61	T.
438	24	Block Island Sound, NW. of Culloden Point, Long Island.	13	Sand				D.
439	27	Fisher's Island Sound, eastern part of Sweeper Sound.	4	Sand, shells	70.5	66.5	65	D.
440	27	Fisher's Island Sound, house on Ram Island bearing NE. ½ E.	4	Sand	68.5	66.5	65.5	D.
441	27	Fisher's Island Sound, SW. of Ram Island ¼ mile.	8½	....do	68.5	66.5	65	D.
442	27	Fisher's Island Sound, off Middle Clump.	14	Stones, gravel	68.5	66.5	64	D.
443	27	......do	10½	....do	67	66	64.5	D.
444	29	Fisher's Island Sound, NW. of Eel grass Light-Ship, distant about ⅜ mile	7	Sand, gravel, shells				D.

STATIONS FOR 1874—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures.			Apparatus.
					Air.	Surface.	Bottom.	
	1874.				°	°	°	
445	July 30	Block Island Sound, SE. ½ E. of Race Rock nearly 3 miles; E. of Little Gull Island Light-House 5⅝ miles.	45	Sand	76	62.5	57	D.
446	30	Block Island Sound, ¾ mile about W. by S. of 445.	40	....do	......	......	......	D.
447	30	Block Island Sound, 1⅝ miles about W. by S. of 445.	24	....do	......	......	......	D.
448	30	Mouth of Gardiner's Bay, Long Island, Gardiner's Point Light-House S. about ¾ mile.	14½	Gravel	71	66	63.5	D.
449	30	Gardiner's Bay, Long Island	6½	Mud	71.5	67.5	64.5	D.
450	30	......do	4½	Sand	72	66.5	65	D.
451	30	......do	3	Gravel	72	66.5	65	T.
452	30	......do	6½	Mud	69.5	68.5	65	D.
453	31	Block Island Sound, Watch Hill Light N. by W. 3 miles.	18	Sand	68	66	56	D.
454	31	Block Island Sound, Watch Hill Light N. by E. 3 miles.	13½	Mud, shells	......	......	......	T.
455	Aug. 3	Long Island Sound, Bartlett's Reef Light-Ship E. about 1½ miles.	22	Sand, mud	60.5	64.5	63.5	D.
456	3	Long Island Sound, Bartlett's Reef Light-Ship E. about 2½ miles.	14	Gravel, sand	59	64	63	D.
457	3	Long Island Sound, Bartlett's Reef Light-Ship E. ½ N. about 3 miles.	15½	Sand, gravel, shells	67	64.5	63.5	D.
458	3	Long Island Sound, Hatchett's Point NW. about 2 miles.	10	Gravel, shells	61.5	64	63	D.
459	3	Long Island Sound, off Saybrook, Conn.	4	Sand	67	64.5	63.5	T.
460	3	Long Island Sound, between Cornfield Point and Long Sand Shoal.	9	......	......	......	......	T.
461	4	Little Peconic Bay, Long Island	7½	Gravel, shells	66.5	74	71.5	D.
462	4	......do	7	Sand, shells	......	......	......	D.
463	4	......do	7	Gravel	......	......	72	T.
464	4	......do	13½–10	Sand, gravel	67	72	71.5	D.
465	4	......do	14	Sand, shells	......	......	......	D.
466	4	Great Peconic Bay, Long Island	5½	Mud, sand, gravel	67.5	74	72	D.
467	4	......do	5½	Sand	68	73	72.5	D.
468	4	......do	4½	Gravel	66.5	73	72.5	D.
469	4	Little Peconic Bay, Long Island	9½	Sand, shells	66	72.5	71	D.
470	4	......do	4	Sand	......	......	......	T.
471	5	Gardiner's Bay, Long Island	3½	....do	......	70.5	68	D.
472	5	......do	4	Sand, shells	......	......	......	T.
473	6	Block Island Sound, Watch Hill Light N. ½ W., distant 3 miles.	18–23	Sand	63	63	{59 / 60}	T.
474	6	Block Island Sound, Montauk Point SW. ½ S. 6 miles.	17	....do	......	63.25	60	D.
475	6	Block Island Sound, Block Island Light ENE., distant about 8 miles.	19½	Mud	......	63.5	60	D.
476	6	Block Island Sound, Block Island Light SE. by E. ½ E. about 4 miles.	18½	Sand, mud	......	64	60	D.
477	6	Block Island Sound, Block Island Light ESE., about 7 miles.	19	Mud	......	64	59	D.
478	6	Block Island Sound, Watch Hill Light NW. ½ W. about 4 miles.	24	Sand	70	64	58.5	D.
479	6	Block Island Sound, Watch Hill Light NW. ½ N. about 3 miles.	22	Sand, shells	......	......	......	T.
480	10	In West Harbor of Fisher's Island.	4	Sand	74	66.5	65.25	D.
481	10	......do	3½	....do	74	66.5	65.25	D.
482	10	In West Harbor of Fisher's Island, off Clay Point.	5½	Sand, mud	74	66.5	......	T.
483	10	Off Hawk's Nest Point, inner side of Fisher's Island.	5½–2½	Sand, gravel, to mud and weeds.	74	......	......	T.
484	10	Fisher's Island Sound, between Middle Clump and Ram Island Reef.	12½	Mud, shells	73.5	69	64.75	D.
485	11	Block Island Sound, about 1 mile S. of E. end of Fisher's Island.	15	Sand	75	66	61	D.

STATIONS FOR 1874—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surface.	Bottom.	Apparatus.
	1874.				°	°	°	
486	Aug. 11	Block Island Sound, about ¾ mile S. of E. end of Fisher's Island.	8½	Sand	75	65.5	62.5	D.
487	11	Block Island Sound, about ½ mile off centre of Fisher's Island.	8	Stones	72	65.5	63	D.
488	11	Block Island Sound, off Mount Prospect, Fisher's Island, about ¼ mile from land.	7½	....do	76	66.5	63	D.
489	11	Block Island Sound, about ½ mile westward of 488.	6	Stones, gravel	78	66.5	63.25	D.
490	11	Block Island Sound, about ¾ mile SE. of Race Point.	5½	....do	76.5	66.5	63.25	D.
491	11	Block Island Sound, about 1½ miles S. of Mount Prospect.	32½	Sand, shells	75	66.5	58.5	T.
492	12	Noank Harbor	2	Mud	......	......	......	D.
493	12	Fisher's Island Sound, between Sea-Flower and Horse-Shoe Reefs.	4½	Sand	76	67.5	62.5	D.
494	12	......do	4½	Sand, gravel	75	67	64.5	D.
495	12	Fisher's Island Sound, W. of Sea-Flower Reef Beacon.	6	Fine sand and mud.	......	67	64.5	T.
496	12	Fisher's Island Sound, W. of Sea-Flower Reef Beacon about 1 mile.	6	Sand, mud	72	67	64.5	T.
497	13	Block Island Sound, Montauk Point Light SSE. about 6 miles.	15½	Sand	74	65	64	D.
498	13	Block Island Sound, Montauk Point Light SSE. about 6½ miles.	9	Fine sand and gravel.	71	65	64	D.
499	13	Block Island Sound, Montauk Point Light SSE. about 7½ miles.	5½	Coarse sand and rocky.	72	65	64	D.
500	13	Block Island Sound, Montauk Point Light S. by E. 4½ miles.	19	Fine sand	72	65	63.5	D.
501	13	Block Island Sound, Montauk Point Light S. by W. about 3 miles.	20–8	Sand, shells	72	66	63.5	D.
502	13	Block Island Sound, Montauk Point Light SSW. about 2½ miles.	8	Stony	72.5	65	65	D.
503	13	Off Montauk Point, Light-House WSW. about 2 miles.	7½	Rocky	72	65	64.5	D.
504	13	Off Montauk Point, Light-House W. about 2 miles.	7½	....do	72	65	64.5	D.
505	14	Fisher's Island Sound, between Eelgrass Light-Ship and White Rock.	5½	Sand, gravel	67	66	64.5	D.
506	14	Fisher's Island Sound, about 1 mile E. by N. from Eelgrass Light-Ship.	6	....do	67	......	......	D.
507	14	Fisher's Island Sound, Stonington Light NE. ½ E. about 1 mile.	5	Sand	67	......	......	T.
508	14	Fisher's Island Sound, Eelgrass Light-Ship WNW. ¾ mile.	5½	Rocky	67	......	......	D.
509	17	Fisher's Island Sound, Eelgrass Light-Ship NW. by W. about ¾ mile.	7	Stones	69.5	67	63	D.
510	17	Fisher's Island Sound, Eelgrass Light-Ship WNW. 1 mile.	6½–3½	Sand, rocky	69.5	67	63	D.
511	17	Fisher's Island Sound, Eelgrass Light-Ship W. by N. about 1½ miles.	5½	Hard, rocky	69	......	......	Tan.
512	17	Fisher's Island Sound, Stonington Light ENE. about 1½ miles.	4	Sand	69	66.5	60.5	D.
513	17	Fisher's Island Sound, Eelgrass Light-Ship W. ½ N. about 1 mile.	7	Hard, stones	70	67	63	D.
514	17	Fisher's Island Sound, Eelgrass Light-Ship E. about 1 mile.	7½	Sand	70	66.5	63	D.
515	18	Off Block Island, Montauk Point W. about 9 miles.	20	....do	71	66	47.5	D.
516	18	Off Block Island, Montauk Point NW. by W. ½ W. about 11 miles.	25	Sand, shells	70	67.5	45.5	D.
517	18	......do	23½	....do	70	......	......	D.
518	18	......do	23½	....do	70	......	......	D.
519	18	Off Block Island, Old Harbor Point, Block Island N. 5 miles.	11	Sand, stones	......	67	55	D.

STATIONS FOR 1874—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surface.	Bottom.	Apparatus.
	1874.				°	°	°	
520	Aug. 18	Off Block Island; Old Harbor Point, Block Island, N. 5 miles.	11	Sand, stones	70	......	......	D.
521	18	Off New Shoreham, Block Island	14	Gravel, stones	70	66	57.5	D.
522	18	......do	18	Sand, gravel	70	66.5	52.5	D.
523	19	Off Block Island, New Shoreham NW. by N. about 6 miles.	14	....do	73	66.5	54	D.
524	19	Off Block Island, New Shoreham NNW.	14½	Coarse sand	73	66	50.5	D.
525	19	Off Block Island, SE. side	14½	Gravel	69.5	66.5	53	D.
526	19	SE. from Point Judith, Rhode Island, about 4 miles.	13½	Sand, gravel	75	67.5	54.5	D.
527	19	S. from Point Judith, Rhode Island, about 2½ miles.	9	Stones	......	60.5	61	D.
528	19	W. from Point Judith, Rhode Island, about 3 miles.	4	Rocks, sand	76	67.5	63	D.
529	19	Off Narraganset Beach, Rhode Island.	8½	Sand, gravel	......	......	......	T.
530	19	......do	10½	Stones, gravel	......	......	......	T.
531	21	Block Island Sound, Watch Hill Light N. ½ E., distant 3 miles.	21	Sand	80	67.25	56.5	D.
532	21	Block Island Sound, SW. ¾ S. of No. 531, distant ½ mile.	20	....do	80	67.25	......	T.
533	21	Block Island Sound, WSW. of No. 531, distant ⅝ mile.	17½	....do	79.5	67.25	......	T.
534	21	Block Island Sound, about S. ¾ E. of east point of Fisher's Island ⅞ mile.	9	Gravel	78	66.5	63.5	D.
535	21	Block Island Sound, east end of Fisher's Island N. by E. about 2 miles.	19½	Sand	78	67	57.5	D.
536	24	Fort Pond Bay, east end of Long Island.	7½	Mud	76	73.5	65.5	D.
537	24	Off Fort Pond Bay, east end of Long Island.	6½	Sand, gravel	......	......	......	T.
538	24	Napeague Bay, off Culloden Point, Long Island.	8½	Sand	......	67.5	65.5	D.
539	24	Napeague Bay, east end of Long Island.	5–8	....do	......	......	......	T.
540	24	......do	6–7	....do	......	......	......	D.
541	24	Block Island Sound, Race Point N. about 1½ mile.	42	Stony	70.5	66	......	D.
542	25	Off Hay Harbor, west end of Fisher's Island.	4½	Sand	70	65.5	64.5	D.
543	25	Off west end of Fisher's Island, Race Point about S., distant ½ mile.	7½	Mud, sand	70	65.5	64.5	D.
544	25	Off west end of Fisher's Island, Race Point SSE. 1 mile.	8½	Fine sand	......	......	......	T.
545	25	Off west end of Fisher's Island, Race Point about S. ¼ mile.	5½	Rocks	......	......	......	D.
546	25	Fisher's Island Sound, between East Clump and Ram Island buoy.	7½	Hard	74.5	65.5	65	D.
547	25	......do	14	....do	......	......	......	D.
548	25	Fisher's Island Sound, ESE. from house on Ram Island.	7½	....do	......	......	......	D.
549	27	Off Niantic Bay, Connecticut, W. of Two-Tree Island.	5	Sand	70.5	65	64	D.
550	27	Off Niantic Bay, Connecticut, between Black Point and Two-Tree Island.	5½	....do	......	......	......	T.
551	27	......do	5½	....do	......	......	......	D.
552	27	Long Island Sound, off Saybrook	6	....do	......	......	......	D.
553	27	Long Island Sound, Saybrook Light NE. 2 miles.	7½	....do	......	......	......	T.
554	27	Long Island Sound, Plum Island Light SE. by E. 3 miles.	22	Gravel	73.5	66	65	D.
555	27	......do	26	....do	73.5	66	65	D.
556	30	Off Cox Ledge, ESE. from Block Island about 20 miles. (The shallowest part of Cox Ledge lies in about 41° 11½′ N. Lat. and 71° 02′ W. Long.)	20	Rocky	......	......	......	D.
557	30	Off Cox Ledge	21	Sand, rocks	67	62	51.5	D.
558	30	......do	21	....do	......	......	......	Tan.
559	30	......do	21	....do	......	......	......	D.

STATIONS FOR 1874—Concluded.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1874.				°	°	°	
560	Aug. 30	About 11 miles SE. by E. from Old Harbor Point, Block Island.	21	Rocky				Tan.
561	30	About 10 miles SE. by E. from Old Harbor Point, Block Island.	34	Mud	70	64	52	D.
562	30	do	34	do	70	64	52	D.
563	31	Block Island Sound, Watch Hill Light N. by W. about 3½ miles.	19	Sand				T.
564	31	Block Island Sound, Watch Hill Light N. by W. ½ W. about 3½ miles.	18	Sand				O. T.
565	31	Block Island Sound, Watch Hill Light NNW. about 3⅝ miles.	17	do				O. T.
566	31	Block Island Sound, Watch Hill Light NNW. about 3⅛ miles.	18	do				D.
567	31	do	18	do				D.
568	Sept. 2	On Cox Ledge	19½	Rocky				D.
569	2	do	20	Sand				D.
570	2	do	18½	Rocky				D.
571	2	do	21	do				D.
572	2	do	21	do	72.5	62.5	50	D.
573	2	do	18½	do				D.
574	2	do	19	do				D.
575	2	do	18	do				D.
576	2	do	17	do				D.
577	3	About 8 miles SSE. from Block Island.	19	do				D.
578	3	Crab Ledge, about 7 miles SE. of Block Island.	10½	do				D.
579	3	Crab Ledge, about 8 miles SE. of Block Island.	10½	do				D.
580	3	About 7 miles off New Shoreham, Block Island.	8–10	do				D.

(There are no numbers 581–600.)

STATIONS FOR 1875.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1875.							
601	July 12	Vineyard Sound, Tarpaulin Cove Light W. by S., Job's Neck NE. by E. ¾ E.	11½	Sand, gravel	70			D.
602	12	Vineyard Sound, Tarpaulin Cove Light WSW. 1 mile.	11		70			D.
603	12	Vineyard Sound, Tarpaulin Cove Light NW. by W. ¾ mile.	17		70			D.
604	12	Vineyard Sound, Menemsha Bight.	8		70			D.
605	12	do	5–7					D.
606	12	do	5–7					D.
607	14	Vineyard Sound, Lackey's Bay	6½	Gravel				D.
608	14	Between Martha's Vineyard and No Man's Land, Gay Head Light N. ½ E. 2½ miles.	10	Sand, shells				D.
609	14	North of No Man's Land, Lone Rock S. ½ mile.	6	Rocky				D.
610	14	North of No Man's Land	4	Sand				T.
611	14	do	5	do				D.
612	14	Vineyard Sound, Menemsha Bight.	8	do				T.
613	14	Vineyard Sound, Tarpaulin Cove.	14½	Gravel				D.
614	15	Vineyard Sound, S. and E. of Davis Neck Shoal.	5½	Sand				D.
615	15	Vineyard Sound, S. of Monaut Point.	15	Sand, gravel				D.
616	15	Vineyard Sound, off Davis Neck Shoal.	13	Sand				T.
617	15	Vineyard Sound, off East Chop of Holmes' Hole.	13½	Hard				D.
618	15	Vineyard Sound, off Falmouth	4½	Sand				T.
619	15	do	5	do				T.
620	20	Vineyard Sound, Cuttyhunk Light NW. by N. 2½ miles, Sow and Pigs Light-Ship W. by N.	14	Hard				D.

STATIONS FOR 1875—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1875.				°	°	°	
621	July 20	Vineyard Sound, Cuttyhunk Light NW. by N. 3¾ miles, Sow and Pigs Light-Ship WNW.	10	Hard				D.
622	20	Vineyard Sound, Cuttyhunk Light N. 1¾ miles, Sow and Pigs Light-Ship W. by N.	10					D.
623	20	......do						D.
624	20	Vineyard Sound, Menemsha Bight.						T.
625	21	Nantucket Sound; Oak Bluffs Hotel W. by S., W. end of Squash Meadow E. by N.	5	Sand				D.
626	21	Nantucket Sound, between Oak Bluffs and Squash Meadow.	6	....do				D.
627	21	......do	6	....do				T.
628	21	Nantucket Sound, Oak Bluffs NW., Cape Pogo SE. by E.	5½	....do				T.
629	21	Nantucket Sound, about same as 628.	5½	....do				T.
630	21	......do	5	....do				D.
631	26	Nantucket Sound, Cross-Rip Light-Ship E. by S. ½ mile.	10½	Sand	76	69	68.5	D.
632	26	Nantucket Sound, close to Cross-Rip Light-Ship.	11½	Sand, gravel, shells.	76	69	69	D.
633	26	Nantucket Sound, Cross-Rip Light-Ship W. by S. ¾ mile.	12	Sand, gravel	76	69	69	D.
634	26	Nantucket Sound, Cross-Rip Light-Ship WNW. about 1 mile.	10	....do	76	69	69	D.
635	26	Nantucket Sound, Brant Point Light, Nantucket, S. by E. 4 miles.	7½	Muddy sand	76	71	69.5	D.
636	26	Nantucket Sound, Brant Point Light SSE. 2½ miles.	8	Mud	76			D.
637	28	Nantucket Shoals, Sankoty Head Light west, distant 10 miles.	16	Sand, shells		59	58	D.
638	28	Nantucket Shoals, about same as 637.	15½	....do		59	58	T.
639	28	Nantucket Shoals, Sankoty Head Light west about 9 miles.	14	Sand		60	59	D.
640	28	Nantucket Shoals (a little S. of 639?).	11	Sand, shells		60	59	D.
641	Aug. 4	Buzzard's Bay, Woepecket buoy W. by S. ¾ mile.	7	....do	75			D.
642	4	Buzzard's Bay	8	Hard		68	67	D.
643	4	......do	5	Sand		69	69	D.
644	4	......do	5	....do	75	69	69	D.
645	4	Buzzard's Bay, buoy No. 8 off Scraggy Neck NE. ½ mile.	6	Sand, shells				D.
646	4	Buzzard's Bay, off Cataumet Harbor.	6	Sand	75			T.
647	4	......do	6	....do	75			T.
648	4	Buzzard's Bay	6	....do	75			D.
649	5	Vineyard Sound, Tarpaulin Cove Light N. 1 mile.	16	Hard	71			D.
650	5	......do	18	....do	71	68	67	D.
651	5	Buzzard's Bay, ¾ mile N. of Penikese.	16	Sand		65	64	D.
652	5	......do	16	....do				D.
653	5	Buzzard's Bay	8½	Mud	71	68	66	D.
654	5	......do	9½	Soft mud	71			D.
655	5	......do	10	Sand, mud				T.
656	5	......do	8	Mud	71	68.5	66	D.
657	5	......do		....do	71			D.
658	10	About ¾ mile off Gay Head	9	Gravel		66	64	D.
659	10	......do	9	Hard	73	66	64	D.
660	10	......do	9	....do	73	66	64	D.
661	10	About 1¾ miles off Gay Head	13	Shells		67	65	D.
662	10	Vineyard Sound	10	Sand				T.
663	10	Vineyard Sound, off Tarpaulin Cove.	14½	Hard		68	66	D.
664	10	......do	16			67.5	66.5	D.
665	10	......do	13½	Hard		67.5		D.

STATIONS FOR 1875—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures.			Apparatus.
					Air.	Surface.	Bottom.	
	1875.				°	°	°	
666	Aug. 11	Off Chappaquiddick, SE. part of Martha's Vineyard.	3	Sand	......	......	......	T.
667	11	......do	5	Sand, stones	72	71.5	71	D.
668	11	......do	6	Sand, gravel	72	......	......	D.
669	11	Off Skiff Island, at SE. corner of Martha's Vineyard.	7	Mud, shells	72	......	......	D.
670	11	......do	29	Sand	74	68	66	D.
671	12	Great Point, Nantucket Island W. 5 miles.	7½	....do	72	56	56	D.
672	12	......do	8	....do	72	56	56	D.
673	12	......do	9	....do	72	......	......	T.
674	12	Sankoty Head, Nantucket Island, W. 1 mile.	6½	Sand, gravel	72	67	60	D.
675	12	Sankoty Head, Nantucket Island, WNW. 2 miles.	16	Hard	72	66	65	D.
676	12	A little west of 675	9	....do	76	......	......	D.
677	12	Sankoty Head, Nantucket, NW. 1 mile.	7½	....do	77	......	......	T.
678	12	Sankoty Head, Nantucket, W. ½ mile.	4½	Sand, shells	78	......	......	T.
679	13	Nantucket Sound, off west side Nantucket Island.	5½	....do	80	76	70	D.
680	13	......do	7	Mud	80	......	70.5	D.
681	13	......do	5	Sand	80	71.5	71	D.
682	13	Nantucket Sound, Cross-Rip Light-Ship NW. 2½ miles.	10	Shells, sand	79	......	......	D.
683	13	Nantucket Sound, Cross-Rip Light-Ship E. about 3 miles.	10½	Sand	79	71	70.5	D.
684	13	Nantucket Sound, Cross-Rip Light-Ship E., Cape Poge Light SSW. 2½ miles.	10½	....do	......	71	71	D.
685	13	Vineyard Sound, off Falmouth	5	....do	78	......	......	T.
686	17	Buzzard's Bay, off Nye's Neck	7½	Mud, hard	......	70	......	T.
687	17	......do	6	Sandy mud	......	......	......	T.
688	17	......do	5	....do	......	......	......	D.
689	17	......do	7	Sand	......	......	......	D.
690	17	......do	8	Sand, mud	......	......	......	D.
691	17	Buzzard's Bay, off Wild Harbor, near N. Falmouth.	8	Sand, gravel	75	......	......	D.
692	17	Buzzard's Bay, off West Falmouth ¾ mile.	7½	Shells, gravel	75	......	72	D.
693	17	Buzzard's Bay, SW. of No. 692 about ½ mile.	7	Mud	75	76	73	D.
694	17	Buzzard's Bay, off Hamlin Point	3½	Hard	75	......	......	D.
695	17	......do	5	....do	75	75.5	70.5	D.
696	17	Buzzard's Bay, off Quamquissett Harbor.	7	Sand, mud	75	78.5	70.5	D.
697	23	Vineyard Sound, S. entrance to Quick's Hole.	7½	Stony, mussels	......	67	67	D.
698	23	......do	6	Sand, rocks	64	68.5	68.5	D.
699	23	Vineyard Sound, off Quick's Hole	7½	....do	64	......	......	D.
700	23	Vineyard Sound, south of Cuttyhunk Light 1 mile.	9½	Sand	......	66	65.5	D.
701	23	Vineyard Sound, off Cuttyhunk Light 1 mile.	9	Rocky	64	......	......	D.
702	23	Near mouth of Buzzard's Bay, Cuttyhunk Light ESE. 1 mile.	8½	Gravel	......	66	65	D.
703	23	Vineyard Sound, off south side of Cuttyhunk Island.	9	......	......	......	......	T.
704	23	......do	9	......	......	......	......	T.
705	23	Vineyard Sound, off Robinson's Hole.	15	Sand, gravel	66	68.5	66	D.
706	25	Vineyard Sound, off Falmouth	4	......	69	......	......	T.
707	25	......do	4	......	......	......	......	T.
708	25	......do	6	Sand	68.5	73	72	D.
709	25	......do	5	......	......	......	......	D.
710	31	Vineyard Sound	9	Hard	76	69	69	D.
711	31	......do	10	....do	76	68.5	69	D.
712	31	......do	13	....do	76	69	69	D.
713	31	......do	8	Shells, gravel	76	70	69.5	D.
714	31	......do	6	......	76	70	69.5	D.
715	31	......do	13	Hard, gravel	75	70	70	D.
716	Sept. 1	Off Gay Head, 3 miles SW. buoy No. 25.	17	Mud	......	66	61.5	D.
717	1	Southwest of Gay Head, distant 4 miles.	19	....do	......	66	60	D.

STATIONS FOR 1875—Continued.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus.
	1875.				°	°	°	
718	Sept. 1	Southwest of Gay Head, distant 6½ miles.	19	Mud, sand		65.5	60	D.
719	1	Southwest of Gay Head, distant 8 miles.	19	Hard, sand		60	58.5	D.
720	1	Southwest of Gay Head, distant 8½ miles.	19	Sand				T.
721	1	Southwest of Gay Head, distant 10 miles.	12	Hard				D.
722	1	Southwest of Gay Head, distant 11 miles.	14	....do				D.
723	1	Off NW. end of Devil's Bridge Reef, Gay Head.	9	Rocky				D.
724	1	......do	9	....do				D.
725	3	South of Cape Poge, Martha's Vineyard, in north part of Muskeget Channel.	4–1¾	Sand				T.
726	3	About the same as 725	5	Sand, eelgrass				D.
727	3	......do	4	....do				D.
728	3	......do	1–4	....do				D.
729	3	About 3½ miles SE. of Cape Poge.	7½	Hard				T.
730	3	About 4 miles SSE. of Cape Poge.	9	Sand, gravel				D.
731	3	About ¾ mile S. of No. 730	9	....do				D.
732	....	(No record.)						
733	6	Off Martha's Vineyard	6	Hard			62	D.
734	....	(No record.)						
735	6	Off Martha's Vineyard, 1½ miles SE. of Squipnocket Point.	11	Sand			60	D.
736	....	(No record.)						
737	....	(No record.)						
738	7	Off Nantucket, ½ mile S. of Tuckernuck Island.	3½	Sand			65	D.
739	7	Off Nantucket, off S. side of Tuckernuck Island.	8	Coarse sand			65	D.
740	7	......do	8½	Sand				T.
741	7	......do	11	....do				D.
742	....	(No record.)						
743	8	2 miles S. of Great Round Shoal buoy, 6½ miles a little NE. of Great Point, Nantucket.	15½	Fine sand	65	60	58.5	D.
744	8	3 miles SE. of Great Round Shoal buoy, 9 miles from Great Point.	18	Sand, shells	65		58.5	D.
745	8	4 miles SSE. of Great Round Shoal buoy, 9 miles from Great Point.	15½	Sand			59	D.
746	8	Off Nantucket, N. of McBlair's Shoal.	13					T.
747	8	......do	13½					T.
748	8	......do	13½					T.
749	8	......do	13½					D.
750	15	8 miles east of Great Point, Nantucket.	15	Sand				D.
751	15	9 miles east of Great Point, Nantucket.	13	....do				
752	15	8 miles east of Great Point, Nantucket.	20	....do				
753	15	9 miles east of Great Point, Nantucket.	10	....do				
754	15	11 miles east of Great Point, Nantucket.	10	....do				
755	15	12 miles east of Great Point, Nantucket.	10	....do				
756	15	15 miles east of Great Point, Nantucket.	9	....do				
757	15	......do	9	....do				
758	15	16½ miles east of Great Point, Nantucket.	6	....do				
759	15	7½ miles east of Great Point, Nantucket.	9	....do				
760	15	7 miles east of Great Point, Nantucket.	15	....do				
761	15	7½ miles east of Great Point, Nantucket.	10	....do				
762	20	Off Southwest Ledge, Gay Head NE. 11½ miles.	10½	Gravel	64		60	D.

STATIONS FOR 1875—Concluded.

Serial number.	Date.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surface.	Bottom.	Apparatus.
	1875.				°	°	°	
763	Sept. 20	Off Southwest Ledge, ½ mile W. of 762.	17	Gravel, sand	64	......	60	D.
764	20	Off Southwest Ledge, ½ mile S. of 762.	......	......	......	......	......	
765	20	Off Southwest Ledge, ¾ mile W. of 763.	17	Sand, gravel	......	......	60	D.
766	20	On Southwest Ledge, ¾ mile NW. of 765.	17	....do	......	......	60	D.
767	20	Off Southwest Ledge, 1¼ miles W. of No. 762.	18	Sand	64	......	61	D.
768	20	9 miles SW. of Gay Head	20	....do	64	......	61	D.
769	20	6 miles SW. ¾ W. of Gay Head	20	....do	......	......	......	D.

STATIONS FOR 1877, 1878, AND 1879, WITH HEADQUARTERS AT SALEM, MASS., HALIFAX, N. S., GLOUCESTER AND PROVINCETOWN, MASS.

During these three years the dredgings were carried on from the U. S. Str. Speedwell, commanded in 1877 by Lieut. Commander A. G. Kellogg, in 1878 by Lieut. Commander L. A. Beardslee, and in 1879 by Lieut. Z. L. Tanner. In 1877, headquarters were first established at Salem, and the stations made from there covered the northern part of Massachusetts Bay, and portions of the Gulf of Maine, off Cape Ann. During the session of the commission of arbitration on the fishery claims, however, the headquarters were removed to Halifax, N. S., and dredgings were made in the waters off that coast, from the last of August to the first of October. The Speedwell also made a line of stations on her trip across the Gulf of Maine, from Cape Ann to Cape Sable, N. S. In 1878, with headquarters at Gloucester, Mass., the area dredged over included the northern and central parts of Massachusetts Bay, and the Gulf of Maine, off Cape Ann. In 1879, the dredging grounds were the southern part of Massachusetts Bay, and the Gulf of Maine, off Cape Cod. The bottom temperatures in 1877 were mostly taken with Miller-Casella self-registering, deep-sea thermometers, but in 1878 and 1879 Negretti-Zambra thermometers were used for that purpose. All the temperatures for 1879 were taken with more than usual care, the thermometers employed being frequently compared with a reliable standard.

DREDGINGS BY SPEEDWELL, 1877.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1877.	° ′	° ′				°	°	°	
1	Aug. 4	42 30	70 45	A little S. of E. from Salem, 4 miles SSE. of Baker's Island.	22	Gravelly	71	63 / 65	46	D.
2	...do			Same as No. 1	22	......do				T.
3, 4	...do			NW. of No. 1	22	......do	72?	60 / 62?	45?	D.
5	...do	42 28	70 42	Baker's Island NW. by N. 5½ miles, Eastern Point (south of Gloucester) NNE. 6¾ miles.	33	Sand and mud	72		45?	D.
6	...do			SW. of No. 5		......do				T.
7	...do			......do		......do				T.
8	Aug. 6			Halfway Rock NW. by W., Baker's Island NW. by N. ½ N. (true), close to No. 1.	20	Rocky	70	65½	55	D.
9	...do			S. of No. 8	25	Gravelly	69	63½	52½	Tan.
10	...do			Same as No. 8	20½	......do	69½	64½	50½	D. and Tan.
11	...do	42 26	70 37	Thatcher's Island Lights NE. by E. ½ E. 12¼ miles, Baker's Island Light NW. ½ N. 10 miles.	45	Mud	70	64½	48½	D.
12	...do			Same as No. 11						D.
13	...do			1 mile E. of No. 12	50					T.
14	...do			......do						T.
15	Aug. 7			Baker's Island NNW. ½ W. 3 miles, Halfway Rock NW. by W. 1½ miles, near Nos. 1 to 4, and 8 to 10.	19½	Gravelly	69	66	54½	D.
16	...do			Same as No. 15						Tan.
17	Aug. 8			Halfway Rock NW. by W. 3 miles, Baker's Island Light, NW. by N. 4½ miles; between No. 5 and No. 1.	32					T.
18	...do	42 29	70 38	Halfway Rock W. by N. ½ N. 6¾ miles, Eastern Point Light N. ¾ W. 5½ miles.	45	Mud				T.
19	...do			About same place	45	......do				T.
20	...do			......do	45	......do				T.
21, 22	Aug. 10			Halfway Rock W. by N. ½ N. 1½ miles, Baker's Island NW. ¾ N. 3 miles, near No. 1.	26	Hard gravel and stones				D.
23	...do			Halfway Rock W. by N. ½ N. 6 miles, Eastern Point Light N. ½ E. 5½ miles, near Nos. 18 to 20.	35	Mud and clay nodules				T.
24	Aug. 13	42 30	70 41	Halfway Rock W. by N. ½ N. 4½ miles, Eastern Point Light N. by E. ½ E. 7 miles.	33	Soft mud	70	67½	49½	D.
25	...do	42 27½	70 36	Halfway Rock NW. by W. ½ W. 8½ miles, Eastern Point N. by W. ½ W. 8 miles.	48	......do	69	67½	49½	D.
26–30	...do			Same as No. 25	48	......do				T.
31	...do			......do	48–50	Mud				D.
32	Aug. 14	42 30	70 20	Thatcher's Island Light NW. ¼ N. 13½ miles, Halfway Rock W. by N. 20 miles.	90	......do	78	68	38½ / 39	T.

33	...do ...	....	....	Same as No. 32	....	....	......	......	......	T.
34	Aug. 19	42 37	69 39	Gulf of Maine, Cape Ann W. by N. 42 miles	160	Soft mud	72	70	37½ / 38	Tan.
35, 36	...do ...	....	....	Nearly the same as No. 34	....	....	......	......	......	T.
37	Aug. 20	42 30	66 58	Gulf of Maine, 155 miles E. of Cape Ann	115	Gravelly	68½	59	38 / 39	D.
38	...do ...	42 42	66 58	Gulf of Maine	112	......do	......	......	......	T.
39	...do ...	42 44	66 27	......do	75	Sand and mud	66	55	38½ / 39½	D.
40	...do ...	42 46	66 27	About 2 miles N. of No. 39	75	Fine sandy mud	......	......	......	T.
41	....	42 49	66 19	W. of Brown's Bank	82	Rocks and barnacles	......	54½	......	D.
42	Aug. 21	43 04½	65 01½	SE. ½ S. from Cape Sable about 32 miles	88	Very fine sand	68	62½	33½ / 41	D.
43	...do ...	43 05½	65 02	SE. ½ S. from Cape Sable about 31 miles	*90	....	......	......	......	T.
44	...do ...	43 06	65 04½	SE. ½ S. from Cape Sable about 30 miles	*90	Fine sandy mud	60½	62¾	......	T.
45	...do ...	43 06	65 07	SE. ½ S. from Cape Sable about 28 miles	91	......do	......	......	33½ / 39	T.
46	...do ...	43 05½	65 09	SE. by S. from Cape Sable about 27 miles	*90	......do	......	......	......	T.
47	...do ...	43 10	65 12½	SE. ½ S. from Cape Sable about 22 miles	59	Pebbles and sand	......	......	......	D.
48	...do ...	43 11	65 14½	SE. ½ S. from Cape Sable about 20 miles	59	Rocky	......	......	......	T.
49	...do ...	43 13	65 17	SE. ½ S. from Cape Sable about 18 miles	56	Hard	68	64½	31½ / 40	Tan.
50, 51	...do ...	43 14	65 17½	Off Cape Negro, Nova Scotia, SE. ½ S. from Cape Sable 17 miles.	45–50	Large stones	......	......	......	D.
52	...do ...	43 26½	65 14	Off Shelburne, Nova Scotia, 19 miles south	47	Stony	68	64½	36 / 37	
53	Aug. 25	....	....	In Bedford Basin, north of Halifax	35	Mud	72	68½	34	T
54	...do ...	....	....	......do	35	......do	......	......	......	
55	...do ...	....	....	Mouth of Bedford Basin	33	......do	......	......	......	
56–58	...do ...	....	....	Halifax Harbor, off Herring Cove, between Mars Rock and Neverfail Shoal.	16	Sand	72	66½	46 / 46½	D. and T.
59	Aug. 28	....	....	Halifax Outer Harbor, ½ mile SSW. Rock Head buoy	25	Gravel	68½	65¾	43½	D.
60	...do ...	....	....	Halifax Outer Harbor. ½ mile N. Rock Head buoy	....	....	......	......	......	D.
61, 62	...do ...	....	....	Halifax Harbor, between Mars Rock and York Redoubt buoy, ½ mile distant.	20	Shingly	......	......	47 / 48½	D. and T.
63	Aug. 29	....	....	Bedford Basin, ½ across harbor from Navy Island	26	....	67½ / 67¾	66¾ / 67	34½ / 35	D.
64	...do ...	....	....	......do	40	Mud	......	......	......	T.
65	...do ...	....	....	......do	40	....	......	......	......	T.
66	...do ...	....	....	......do	41	....	68½	68	33 / 34	R. D.
67	...do ...	....	....	......do	....	....	......	......	......	T.
68	...do ...	....	....	Narrows at mouth of Bedford Basin, drifting in	16	....	69	68	44⅔ / 45	D.
69	Sept. 1	42 44	62 43	About 120 miles S. of Halifax	620	Without bottom	......	65½	36 / 38	
70	...do ...	42 45½	62 43	......do	190	Gravel and pebbles	72	66½	38½ / 39	D.
71	...do ...	42 46	62 44	About 118 miles S. of Halifax	95	......do	......	......	......	D.
72	Sept. 4	....	....	Sandwich Point (Halifax Harbor) W. ½ N. ½ miles	18	Fine sand	†66	......	39½ / 41½	D.

* Estimated. † Inside pilot-house.

DREDGINGS BY SPEEDWELL, 1877—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth, in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1877.	° ′	° ′				°	°	°	
73, 74	Sept. 4	....	....	Sandwich Point (Halifax Harbor) W. ½ N. ½ mile	....		......	......	......	T.
75	...do	....	....	......do	....	Fine sand and rocks	......	......	......	D.
76	...do	....	....	Halifax Harbor, half way between Litchfield and Mars Rocks.	18	Fine sand	......	......	......	D.
77	...do	....	....	½ mile to the eastward of No. 76	16	Rocky	......	......	......	D.
78	Sept. 5	....	....	Chebucto Head (entrance of Halifax Harbor) SW. by S. ¾ S. (SW. ¾ S?), ¾–1½ miles.	25	Rocks and nullipore	67	55½	33 37½	D.
79	...do	....	....	Farther S. and E. than No. 78	....	Fine sand	......	......	......	D.
80	...do	44 22	63 28	Chebucto Light N. ½ E. 9 miles	57	Muddy and pebbles	60	56½	32¾ 35¾	D.
81	...do	....	....	......do	57	Stony, with sponges and red algæ.	......	......	......	T.
82	...do	....	....	......do	57	Mud and sand	......	......	......	Tan.
83	...do	....	....	......do	57	Coarse gravel and stones, bryozoa.	......	......	......	D.
84	Sept. 6	44 04	63 27	Chebucto Head N. by E. ¼ E. 26 miles	101	Fine sand	65	63	30 38½	D.
85	...do	....	....	......do	....	....	......	......	......	T.
86	...do	....	....	......do	....	....	......	......	......	T.
87	Sept. 11	....	....	Mouth Halifax Harbor, Litchfield Rock NE. by E. ¾ E. 1½ miles, Automatic Buoy SE. ¾ S. 2¼ miles, dragging E. to 7 or 8 fathoms on Neverfail Shoal.	21	Very fine sand, stones, and algæ.	72	61½	48⅓ 49	D
88	...do	....	....	Sandwich Point S. ½ mile, drifting S. with tide parallel to shore until Sandwich Point was W. by N.	17	Kelp, red algæ, and fine sand.	74	62	......	T.
89	...do	....	....	Same as last	21	....	......	......	......	
90	...do	....	....	Head of Northwest Arm, Halifax Harbor	6½	Mud and eelgrass	74	62	49	D.
91	...do	....	....	Same as last	....	....	......	......	......	
92	...do	....	....	Halifax Harbor, Mouth of Northwest Arm, battery NE. by E. ½ E., quarry opposite.	7	....	70	62	58	D.
93	Sept. 13	....	....	Halifax Harbor, ¼ mile from shore off York Redoubt and Sandwich Point.	16	Sand and red algæ	......	......	......	T.
94	...do	....	....	Little farther E. and S. than last	....	....	......	......	......	T.
95	...do	....	....	Same as last	....	Very fine sand, ooze and red algæ.	......	......	......	D.
96	...do	....	....	......do	....	....	......	......	......	T.
97	...do	....	....	Midway between York Redoubt and McNab's Island Light, Halifax Harbor.	....	....	......	......	......	D.

98	Sept. 15					Midway between Sandwich Point and McNab's Island Light, Halifax Harbor.	18	Mud and fine sand	61	61	46 / 46½	T.
99	...do					...do						
100	...do	44	28	63	18	Off Halifax, Devil's Island Light N. by W. ¾ W. 9½ miles, Sambro Light W. by N. ¼ N. 10¼ miles.	42	Shingle	65	61½	34 / 34½	D.
101	...do					Off Halifax, Sambro Light W. by N. ¼ N. 9 miles	42	Fine sand with Ophioglypha.				
102	...do					...do	42	Rocks and sand				T.
103	Sept. 20	44	02	63	20	Sambro Light N. ¾ W. 26 miles, Egg Island NE. 41 miles, 29 miles S. of Chebucto Head.	92	Gravelly and rocky	64	63	35½ / 36½	D.
104	...do	44	01	63	20	29¾ miles S. from Chebucto Head	110	Fine sand and mud			35½ / 36	D.
105	...do					Near last		...do				T.
106-108	...do					Same as last						D. and T.
109	Sept. 21					Bedford Basin	37		57	57½	34	D.
110, 111	...do					...do						T.
112	Sept. 24					Chebucto Head Light NW. by W. about 8¾ miles	52	Fine sand and mud	64	60	35	D.
113	...do					...do	52	...do			35	T.
114-117	...do					...do	52	...do				T.
118	...do					Chebucto Head Light NW. by W. about 9 miles	53	Sand, mud, to rocks				T.
119	Sept. 27					Halifax Harbor, off York Redoubt						
120	...do					Halifax Outer Harbor	16					T.
121	...do						43					
122	...do						60		72	58	36	
123	...do					Off Sandwich Point, Halifax Harbor						T.
124	Oct. 17	42	32	70	22½	Thatcher's Island Light NW. ½ N. 11¾ miles, Halfway Rock W. ¾ N. 19½ miles.	51	Mud, gravel, and rocks	50	52	45	D.
125	...do					Cape Ann NW. ½ N. 12 to 14 miles	75		52			D.
126	...do					...do	75	Mud				D.
127	...do					...do						T.
128	...do	42	31½	70	37	Halfway Rock W. by S. 6¾ miles, Eastern Point N. by W. ½ W. 3¾ miles.	36	Mud and fine sand		55	43½	D.

DREDGINGS BY SPEEDWELL, 1878.

	1878.											
129	July 23	42	24	70	33½	Thatcher's Island Light N. ⅝ E. 13½ miles, Eastern Point N. by W. ¼ W. 11½ miles.	49		65	60½	38	T.
130	...do					About ⅝ mile NW. ¼ W. of No. 129	49	Mud	68	63		T.
131	...do					Thatcher's Island Light N. by E. ¾ E. 15 miles, 1 mile W. of No. 129.	45		68	62	38	T.
132	...do					Thatcher's Island Light N. ¾ E. 11½ miles, Eastern Point N. by W. ¼ W. 10 miles, 3 miles NW. of No. 129.	45	Mud	70	63	38	T.
132a	...do	42	28½	70	36	Thatcher's Island N. ¾ E. 10 miles, Eastern Point N. by W. ¼ W. 6 miles, Baker's Island W. ½ S. 9 miles.	40	...do				
133	...do	42	32	70	38½	Thatcher's Island NE. ¾ N. 7½ miles, Eastern Point N. ¼ W. 3⅛ miles, Baker's Island W. by N. ⅝ N. 6½ miles.	33	Rocky	67	61		D.

DREDGINGS BY SPEEDWELL, 1878—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1878.	° ′	° ′				°	°	°	
134	July 23	....	....	Thatcher's Island NE. ⅛ N. 6¾ miles, Eastern Point N. ⅝ E. 2¼ miles, Baker's Island W. ¾ N. 5½ miles, 1 mile NW. of No. 133	26	Pebbles and coarse sand..	68	61	......	D.
135	July 26	42 33½	70 38½	Eastern Point N. by W. ⅝ W. 2 miles, West Light Thatcher's Island NE. ¼ N. 5¾ miles, 2 miles N. of No. 133.	25	Stony and gravelly........	70	58½	40½	
135a	...do	....	....	About same as No. 135..........	*25	....	72	......	40	D.
136	...do	....	....	Short distance E. of No. 135 (southwesterly on original chart)	*26	Sand and stones..........	......	......	......	D. and T.
137	July 29	42 32½	70 23½	Eastern Point WNW. ¼ W. 16¼ miles, Thatcher's Island NW. ¾ W. 13½ miles.	53	Rocks, drifting into soft mud.	70	65	38½	D.
138	...do	42 33	70 26	Thatcher's Island NW. ¾ N. 9 miles, Baker's Island W. by N. 16½ miles.	59	Muddy..................	......	......	......	T.
139	...do	....	....	Drifting SW. from No. 138..........	59	......do	......	......	......	T.
140	...do	42 34	70 32	Eastern Point W. by N. ¼ N. 6 miles, Thatcher's Island N. by W. ½ W. 4½ miles.	38	......do	67	59½	40	D.
141	Aug. 1	....	....	Gloucester Harbor, Eastern Point Light ESE., Norman's Woe Rock SW. by S., Fresh Water Cove NW. by W. ½ W.	8½	Sandy..................	63	57½	44½	D. T.
142	...do	....	....	About as last..........	......	....	......	......	......	T.
143	...do	....	....	......do	9	....	......	......	50	T.
144	...do	....	....	......do	......	....	......	......	......	D.
145	...do	....	....	Gloucester Harbor, between Round Rock and Ten Pound Island Ledge.	8	Sandy..................	63½	56½	51	
146	Aug. 1	....	....	About same as No. 145..........	......	....	......	......	......	T.
147	Aug. 3	42 33	70 41½	Eastern Point Light NE. by E. ⅞ N. 2¼ miles, Baker's Island W. 4½ miles.	16	Gravel, stones, broken shells.	67½	56½	42½	D.
148	...do	....	....	⅜ mile S. by W. from No. 147..........	*16	Stony..................	66	......	......	D.
149	...do	....	....	About 2 miles SSW. of No. 148, Eastern Point NW. ⅞ N. 4½ miles, Baker's Island WNW. ½ N. 3¾ miles.	19½	Sand and gravel..........	66	61½	42	D.
150	...do	....	....	Gloucester Harbor, half a mile S. of Fresh Water Cove, between it and Eastern Point Light.	7½	Sand and mud............	70	61	51½	T.
151	...do	....	....	About the same ground..........	7–10	......do	......	......	......	T.
152	...do	....	....	About the same ground, just off Fresh Water Cove..........	......	....	......	......	......	D.
153	...do	....	....	......do	......	....	......	......	......	T.
153a	Aug. 8	....	....	Eastern Point Light, SW. 2 miles, (on schr. Hattie)..........	17	....	......	62	44½	
154	Aug. 15	42 35	70 31	Thatcher's Island NW. ¾ N. 4½ miles, Eastern Point W. ¾ N. 7 miles.	38	Pebbles, coarse sand......	69½	64½	41½	D.
155	...do	42 35	70 30	¾ mile ESE. of No. 154, Thatcher's Island NW. ½ W. 5 miles, Eastern Point W. ¾ N. 8 miles.	45	Muddy..................	......	......	......	D.
156	...do	....	....	A little E. of No. 155..........	42	Sand and mud............	70½	68½	41½	T.
157	...do	....	....	¾ mile W. of last place..........	40	Sand and rocks..........	73	......	42½	D.
158	...do	....	....	½ mile W. of last place..........	88	Mud and then rocks......	......	......	......	D.

159	...do			Gloucester Harbor, just off Fresh Water Cove	8	Sand	66½		44½	T.
160	Aug. 16	42 36	70 27	Eastern Point Light W. ⅜ N. 9 miles, Thatcher's Island Light, NW. ¾ W. 5¼ miles.	54	...do	71½		39½	D.
161	...do			A little S. by W. of No. 160	*54		64			T.
162	...do			About a mile S. of No. 160	*60	Mud	71¼		39½	T.
163	...do			West Light on Thatcher's Island NW. ¾ W. 6½ miles, Eastern Point Light W. ¾ N. 10 miles, a mile SE. ¾ E. from No. 160.	73	Fine sand	70½	65½		T.
164	...do			West Light Thatcher's Island WNW. ⅞ N. 7½ miles, Eastern Point Light W. ⅝ N. 10¾ miles, nearly 2 miles E. of No. 160.	75	...do			40	T.
165	Aug. 19	42 44½	70 38	Ipswich Bay, Straitsmouth Light, S. by E. 5 miles, Annisquam Light SW. ¾ W. 5¼ miles.	35	...do	71	64½	41½	D.
166	...do			About same as last						T.
167	...do			About same as last, ¼ mile N			71½			T.
168	...do			Straitsmouth Light SE. by S. 4¾ miles, Annisquam Light SSW. ⅜ W. 3¾ miles, 2 miles WSW. of No. 165.	21	Sand	71			T.
169	...do			About ½ mile W. of No. 168	19	...do			40½	T.
170	Aug. 24	42 33	69 59	Eastern Point Light W. by N. ¼ N. 30⅜ miles, Boone Island Light N. by W. ¼ W. 41½ miles.	90	Fine sandy mud with some gravel.			40	D.
171	...do			A little S. of last	*90	Similar, but more stony	67		39	T.
172	...do	42 33	69 57	Eastern Point Light W. by N. ¼ N. 32¼ miles, Boone Island Light NNW. ⅜ N. 42½ miles.	115	Sandy mud and fine gravel		65½		T.
173	...do			"Drifting towards the N"		...do	68½	65½	39½	D.
174	Aug. 27	42 37	69 40½	Thatcher's Island Light (Western) W. ¼ N. 38 miles, Eastern Point Light W. ¼ N. 42 miles.	140	Muddy	65½		39	T.
175	...do			About as last	*140	...do		66		T.
176	...do	42 38½	69 41½	2 miles N. of last place	175	Mud			38½	T.
177	...do			About as last						T.
178	...do			...do			68		38½	T.
179	Aug. 29			Gloucester Harbor, just off Fresh Water Cove	7	Fine sand	67	59	47	T.
180	...do			About same as last	10	...do				T.
181	...do	42 24	70 36	Eastern Point Light N. ½ W. 7 (11?) miles, Thatcher's Island Light N. by E. ½ E. 14½ miles.	45	Mud	73½	64½	41½	D.
182	...do			About a mile E. of No. 181						T.
183	...do	42 30½	70 38	Eastern Point Light N. ¾ W. 4¾ miles, Baker's Island Light SW. by S. ½ S. 7 miles.	45	Mud, gravel, and pebbles				D.
184	...do			A little to NE. of No. 183	45	Mud	75	65½	42½	T.
185	Aug. 31	42 33	69 55	Eastern Point Light W. by N. 33 miles, Boone Island Light NNW. 42½ miles, White Island Light NW. ½ N. 42 miles.	110	Muddy	68½	64½	39	D.
186	...do			About same as No. 185	*110	...do	73½			D.
187	...do			About same as last	110	Soft brown mud				T.
188	...do	42 33½	69 58½	About 2 miles W. of No. 187	85	Sandy mud and gravel	68½		40	Tan.
189	...do			About same as No. 188	85	Gravel and pebbles		65½	40	Ag. D.
190	...do			About same as last, drifting towards SE	*100	Muddy				T.
191	...do			About same as last, drifting towards E	*100	Soft brown mud				T.
192	...do			Somewhat E. of last	100–110	...do				T.
193	...do			Somewhat SSW. of last	*100–110	Mud, harder at end				T.
194	...do			Somewhat E. of last	*110	Muddy, harder than last				T.

* Estimated.

DREDGINGS BY SPEEDWELL, 1878—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1878.	° ′	° ′				°	°	°	
195	Sept. 2	42 27	70 19	Eastern Point Light NW. ½ W. 16¾ miles, Eastern Light Thatcher's Island NW. by N. 15½ miles.	33–29	Coarse sand	72½	63¾	45½; 48¼	D.
196	...do			¼ mile SSW. from No. 195	29	Stony, sponges and gravel.			47½	T.
197	...do	42 25½	70 23	Eastern Point Light NW. ½ N. 15 miles, Eastern Light Thatcher's Island NNW. 14¾ miles, 3½ miles W. from No. 195.	23	Stony and spongy			54½	T.
198	...do	42 31	70 20	Eastern Light Thatcher's Island NW. ½ N. 12¾ miles	50	Coarse sand and mud	72½			T.
199	...do			¾ mile S. No. 198, Eastern Light Thatcher's Island NW. ½ N. 13½ miles.	98	Muddy	71½	64¾	39¼	T.
200	Sept. 9			Gloucester Harbor, off Norman's Woe	10	Sandy and rocky	64½	60	56½	T.
201	...do			Gloucester Harbor, off Mussel Cove	8½	Sandy mud	63½	61	54	
202	...do			Gloucester Harbor, off Norman's Woe	8–10	Abundant red algæ				
203	Sept. 16	42 31	70 37	Off Gloucester, Eastern Point Light N. by W. ¾ W. 4¾ miles, Baker's Island Light WNW. 8 miles, drifting to SW.	42	Muddy with large stones	62½	60½	47½	D.
204	...do			¾ mile SW. by W. from No. 203	40	Soft brown mud	63	60½	48½	D.
205	...do			⅜ mile SW. by W. from No. 203	42	......do				T.
206	...do			⅜ mile NE. by E. from No. 203	42	Muddy				T.
207	...do			Same as No. 203	42	Soft brown mud	65			T.
208	...do	42 33	70 43	Off Gloucester, Baker's Island Light W. ½ S. 3¼ miles, Eastern Point Light ENE. ¼ N. 2¾ miles, Kettle Island N. by W. ⅞ miles.	19–23	Rocky	63½	60		D.
209	...do			⅝ mile N. by W. ½ W. from No. 208, ⅓ mile from Kettle Island.	17	Rock, gravel, and mud	64	60¾	48½	D.
210	Sept. 17	42 38	70 28½	Off Cape Ann, Salvages NW. 5 miles, Eastern Point W. ¾ S. 9 miles.	60	Soft dark-brown mud	66	60	43	D.
211	...do			About a mile E. of No. 210	60	......do				
212	...do			About ¼ mile S. by E. ½ E. of No. 210	68	......do	65½	60¾	42⅜	D.
213	...do			About ⅛ mile E. by S. ½ S. of No. 212	68	Soft dark-brown mud and hard concretions.				T.
214	...do			A little SW. of No. 213	57	Fine mud and sand				T.
215	Sept. 18	42 31	70 32	Eastern Point Light NW. ¼ N. 7¼ miles, Thatcher's Island Light N. ¼ W. 7¾ miles.	35	Fine sand and few small pebbles.	65½	62	50½	D.
216	...do			½ mile NNE. ½ E. from No. 215	35	Sandy				T.
217	...do	42 30	70 35	Eastern Point Light NNW. ½ W. 5¾ miles, Thatcher's Island Light N. by E. ⅛ E. 7⅞ miles, 2½ miles westerly from No. 215.	45	Soft dark-brown mud				T.
218	...do			Same as No. 217	45	......do				T.

219	...do	42	30	70	33	*Eastern Point Light NW. ⅝ N. 7¼ miles. Thatcher's Island Light, N. 8½ miles; a mile SW. from No. 215.*	32	*Rocky, stones of all sizes..*	70½	63	55¼	D.
220	...do	42	32	70	35	Eastern Point Light NW. ¾ N. 4¾ miles, Thatcher's Island Light N. by E. ¾ E. 6⅝ miles.	42	Soft brown mud	......	......	......	T.
221	Sept. 21	42	33	70	31	Eastern Point Light WNW. ½ N. 6⅝ miles, Thatcher's Island Light N. by W. ¼ W. 5⅝ miles.	37–38	Fine sandy mud	67½	62	49⅞	D.
222	...do	....		....		⅝ mile SE. by E. ¼ S. from No. 221	40	......do	......	......	......	T.
223	...do	....		....		About 1⅜ miles E. ½ S. from No. 221..........................	47	Soft brown mud	......	......	......	T.
224	...do	....		....		¼ mile E. by S. from No. 223..........................	47	..... do	......	......	......	T.
225	...do	42	33½	70	35½	Eastern Point Light NW. ¾ W. 3⅝ miles, Thatcher's Island Light N. by E. ¾ E. 5 miles.	26	Rocky	71½	62½	53	Tan.
226	Sept. 23	42	36	70	36	Off Cape Ann, Eastern Point Light W. by S. ½ S. 3 miles, Thatcher's Island Light NE. 2⅞ miles.	18	Irregular, rocky	......	......	......	D. and Tan.
227	...do	42	33½	70	40	Off Gloucester, Eastern Point Light NNE. 1¼ miles, S. end Kettle Island E. by S. ⅞ S. 2¼ miles.	23	Rock, sand, and gravel	64½	60½	58	D. and Tan.
228	...do	....		....		Eastern Point Light NE. 2¼ miles, 1½ miles SW. from No. 227.	19	Rock and sand..............	......	......	......	D. and Tan.
229	...do	....		....		Eastern Point Light NE. by N. ¼ N. ⅝ mile, ½ mile N. of No. 227.	19	Rocky and coarse sand....	......	......	......	D.
230	...do	....		....		S. end Kettle Island N. ½ W. ¾ mile, between Nos. 208 and 209	21	Rock, fine mud, and sand .	59½	60½	57¾	D.
231	...do	....		....		Gloucester Harbor, just outside Fresh Water Cove, Eastern Point Light SE.	7	Fine white sand and red algæ.	......	......	......	T.
232	Sept. 24	42	30½	70	38	Eastern Point Light N. ¾ W. 4⅝ miles, Thatcher's Island Light NNE. ½ E. 8½ miles.	45	Soft brown mud	62½	61½	42	D.
233	...do	....		....		½ mile S. by W. ¼ W. from No. 232..........................	45	......do	......	......	......	T.
234	...do	....		....		⅞ mile NE. by E. from No. 232; on chart NW. from No. 232, which is probably correct.	43	......do	......	......	......	T.
235	...do	42	33½	70	39	Eastern Point Light N. by W. ½ W. 1⅞ miles, Thatcher's Island Lights NE. ½ N. 5⅞ miles, close to No. 135.	22	Rocky	......	......	......	Tan.
236	Sept. 26	42	28	70	31	Eastern Point Light NW. by N. 9⅝ miles, Thatcher's Island Lights N. ½ W. 10⅝ miles.	28	Rocky, coarse sand, and pebbles.	68¾	61	48½	D.
237	...do	42	31	70	29	Eastern Point Light NW. ⅝ W. 9 miles, Thatcher's Island Lights N. by W. ½ W. 8½ miles.	38	Coarse sand and gravel ...	66	61¾	49¾	D.
238	...do	42	30½	70	38	Eastern Point Light N. by W. 4½ miles, Thatcher's Island Lights NNE. ¾ E. 7⅝ miles, close to No. 232.	43	Soft brown mud	69	61⅝	......	T.

DREDGINGS BY SPEEDWELL, 1879.

	1879.	°	′	°	′				°	°	°	
239	July 21	41	51	70	14	Cape Cod Bay, Wood End Light N. 15° E., Indian Hill N. 79° W.	13	Blue mud and fine sand...	70½	67	65½	D.
240	...do	41	52½	70	15	Wood End Light N. 19° E., Rocky Point N. 74° W	18	....	69½	67	64½	T.
241	...do	41	57	70	12	Wood End Light N. 16° E., Billingsgate Light S. 55° E......	19	Blue mud and fine sand...	......	......	......	D.
242	...do	41	59	70	13	Race Point Light N. 9° W., Cape Cod Light N. 66° E	21	Blue mud	72	67	62½	T.
243	...do	42	01	70	12	Race Point Light N. 25° W., Wood End Light N. 58° E	20	....	69	66½	60½	T.
244	July 22	42	04½	70	15½	Race Point Light S. 50° E. (dredge) 1 mile, (trawl) 1¾ miles..	25–30	Fine gray sand............	70	58	{40 / 45}	D. and T.
245	...do .. {	42 42	08 07½	70 70	17 13½	} Race Point Light S. 27° E. (dredge) 5¼ miles, S. 7 W. (trawl) 4 miles.	28	......do	......	......	......	D. and T.

DREDGINGS BY SPEEDWELL, 1879—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1879.	° ′	° ′				°	°	°	
246	July 25	42 06	70 14½	Race Point Light S. 11° E. 2¼ miles, "Spider Ground"	28	Fine gray sand	66	63	......	D.
247	...do	42 07	70 15½	Race Point Light S. 20° E. 3½ miles	34	......do	66	63	......	D.
248	...do	42 07	70 14	Race Point Light S. 1° W. 3¼ miles	33	......do	66½	63¼	......	D.
249	...do	42 08½	70 13	Race Point Light S. 13° W. 4½ miles	30	Coarse sand	65	62¼	......	T.
250	...do	42 09	70 13	Race Point Light S. 9° W. 5¼ miles	30	......do	66½	62¼	......	T.
251	...do	42 10	70 10½	Race Point Light S. 23° W. 6¾ miles	24½	Coarse sand and gravel	65½	60¼	......	D.
252	...do	42 09	70 09½	Race Point Light S. 34° W. 6¼ miles	27	Fine gray sand and gravel.	66¼	62¼	......	T.
253	July 28	41 57	70 17½	Cape Cod Bay, "Fishing Ledge," Wood End Light N. 50° E. 7 miles.	17	Rocky	72	65	......	D.
254	...do	....	....	......do	21	Sandy	75	65	......	D.
255	...do	....	....	......do	18	Rocky	76	66	......	D.
256, 257	...do	....	....	......do	16	......do	78	68	......	D.
258	...do	41 55	70 20	Cape Cod Bay, Wood End Light NE. ½ E. 9½ miles	20	Soft mud	72	64	......	T.
259	...do	41 57½	70 23½	Cape Cod Bay, Wood End Light ENE. 10¾ miles	24	Blue mud	71	64	......	T.
260	...do	41 58½	70 19	Cape Cod Bay, Wood End Light ENE. 7½ miles	25	Green mud	74	65	......	T.
261	...do	42 00	70 15	Cape Cod Bay, Wood End Light ENE. 3½ miles	26	Mud	74	......	......	T.
262	July 29	42 11	69 57	Off Cape Cod, Race Point Light S. 65° W. 14 miles	80	Blue mud	71	65½	......	D.
263	...do	....	....	......do	83	......do	71	65¼	......	D.
264	...do	42 10	69 56½	Off Cape Cod, Race Point Light S. 65° W. 15 miles	80	......do	71	65¼	......	T.
265	...do	42 09½	69 57	Off Cape Cod, Cape Cod Light S. 30° W. 8 miles	73	Gravel	71	65¼	......	T.
266	...do	42 12½	69 50	Off Cape Cod, Cape Cod Light S. 42° W. 13 miles	120	Blue mud	71½	66½	......	T.
267	July 31	42 13	69 40	Off Cape Cod, Race Point Light S. 81¾° W. 26 miles	135	......do	70¼	68½	41	D.
268	...do	42 12	69 40	Off Cape Cod, Race Point Light S. 84½° W. 26 miles	129	......do	71	67½	42	T.
269	...do	42 08	69 53	Off Cape Cod, Cape Cod Light S. 67½° W. 9 miles	53	Gravel	70¼	64½	39½	T
270	...do	42 06	69 55½	Off Cape Cod, Cape Cod Light S. 66¾° W. 7 miles	42	Blue sand and gravel	71	64½	39	T.
271	Aug. 1	42 06½	70 18	Off Cape Cod, Race Point Light S. 12° W. 2¾ miles	34	Fine yellow sand	70¼	66½	38¾	D.
272	...do	42 07	70 19	Off Cape Cod, Race Point Light S. 2° W. 3 miles	34	Yellow sand	70	66¾	38	T.
273	...do	42 07½	70 09½	Off Cape Cod, Race Point Light S. 40° W. 5¼ miles	25	Coarse yellow sand and gravel.	69	67	38½	D.
274	...do	42 09½	70 05	Off Cape Cod, Cape Cod Light S. 11° E. 7 miles	30	Coarse yellow sand and broken shells.	73½	68½	39	D.
275	...do	....	....	......do	29½	Green mud	72	66½	39½	T.
276	...do	42 08½	70 00	Off Cape Cod, Cape Cod Light S. 20° W. 6½ miles	47	Blue mud	71	66	37½	T.
277	...do	42 02	70 15	Cape Cod Bay, Wood End Light S. 76° E. 3 miles	28	Sand and shells	74	74½	42	T.
278	Aug. 4	....	....	Provincetown Harbor, Long Point Light N. 75° E. ½ miles	9	Sandy	70	69½	58	D.
279	...do	42 09½	70 15	On Stellwagen's Bank, Race Point Light S. 6¼ miles	13-13½	Sand	74	63	44½	D.
280	...do	42 09½	70 16½	On Stellwagen's Bank, Race Point Light S. 17° E. 6½ miles	12½-13½	Yellow sand and gravel	76	......	44	T.
281	...do	42 12	70 16½	On Stellwagen's Bank, Race Point Light S. 12° E. 8½ miles	14	Fine yellow sand and broken shells.	76	62.3	44	D.

282	...do	42	13	70	13½	On Stellwagen's Bank, Race Point Light S. 3° W. 9¼ miles..	13½	Sand and gravel	72½	61½	43	D.
283	...do	42	09½	70	22	Southwest of Stellwagen's Bank, Race Point Light S. 44° E. 8¼ miles.	31	Sand and green mud	70.7	65	38½	D.
284	...do ...	42	10	70	22	......do	31	....	70.7	65½	39	T.
285	Aug. 6	42	12	70	25	Southwest of Stellwagen's Bank, Race Point Light S. 44° E. 11 miles.	35½	Green mud	69	68	39	D.
286	...do	42	16½	70	23	West of Stellwagen's Bank, Race Point Light S. 14° E. 14 miles.	37	......do	71	67	39½	D.
287	...do	42	17½	70	25½	West of Stellwagen's Bank, Race Point Light S. 20° E. 16 miles.	47½	......do	68	67½	38½	T.
288	...do	42	20	70	27	West of Stellwagen's Bank, Race Point Light S. 20° E. 19 miles.	33	Fine blue sand and shells.	72	67.3	38½	T.
289	...do	42	19	70	25	Same as last in Record Book; nearly 2 miles SE. on chart ..	45	Fine gray sand	69½	68½	38	T.
290	Aug. 11	42	04¾	70	16	Mouth Cape Cod Bay, Race Point Light S. 86° E. 1½ miles...	31	......do	72	63½	38	D.
291	...do	42	04½	70	16¼	Mouth Cape Cod Bay, Race Point Light S. 55° E. 1¾ miles...	30	......do	......	64	40	T.
292	...do	42	03½	70	18½	Mouth Cape Cod Bay, Race Point Light N. 85° E. 2¾ miles..	29	Blue mud, fine sand......	69	65	41	D.
293	...do	42	03½	70	19½	Mouth Cape Cod Bay, Race Point Light N. 84° E. 3¾ miles..	27	Green mud	66	65½	39½	D.
294	...do	42	03½	70	23	Mouth Cape Cod Bay, Race Point Light N. 86° E. 6¾ miles..	26	......do	66½	66	39	T.
295	...do	42	03	70	24½	Mouth Cape Cod Bay, Race Point Light N. 82° E. 7¾ miles..	26	......do	67	65½	39½	R. D.
296	...do	42	02¾	70	26	Mouth Cape Cod Bay, Race Point Light N. 82° E. 9 miles...	26	......do	68½	65	39	D.
297	...do	42	02¼	70	29	Mouth Cape Cod Bay, Race Point Light N. 80° E. 11 miles..	22	Fine sand............	69	65	39½	T.
298	Aug. 20	42	01	70	32	Mouth Cape Cod Bay, Gurnet Point Light S. 79° W. 3¼ miles.	16	Fine brown sand.........	64	61½	55½(?)	D.
298a	...do	42	00½	70	30	Mouth Cape Cod Bay, Gurnet Point Light S. 88° W. 4¼ miles.	20	Brown sand and pebbles ..	68	59	44	D.
299	...do	42	01½	70	30	Mouth Cape Cod Bay, Gurnet Point Light S. 74° W. 4½ miles.	21	Fine brown sand.........	66	61½	45	T.
300	...do	42	01½	70	29	Mouth Cape Cod Bay, Gurnet Point Light S. 75° W. 5 miles, ½ mile S. of No. 297.	20	Brown sand and pebbles ..	68	61½	45	T.
301, 301a	...do	42	01½	70	20	Mouth Cape Cod Bay, Race Point Light N. 65° E. 5 miles ...	27	Soft brown mud	66	60	42½	D. and **R. D.**
302	Aug. 21	42	12½	69	46	Off Cape Cod, Cape Cod Light S. 51° W. 16¼ miles.........	124	Fine brown mud..........	68	60	41	D.
303	...do	42	11½	69	47	Off Cape Cod, Cape Cod Light S. 51° W. 15 miles.........	122	Soft brown mud	71	61½	41	T.
304	...do	42	10	69	45	Off Cape Cod, Cape Cod Light S. 61° W. 15 miles.........	122	......do	75½	61½	41	T.
305	...do	42	09½	69	41	Off Cape Cod, Cape Cod Light S. 68° W. 18 miles.........	118	......do	69	61	41	T.
306	Aug. 25	42	06½	70	20	Race Point Light S. 56° E. 5 miles..................	30	Blue mud.............	63	61	41	T.
307	...do	42	06½	70	18	Race Point Light S. 46° E. 4½ miles..................	31	Blue mud and fine sand ...	65	61¼	43½	T.
308	...do	42	08½	70	18	Race Point Light S. 28° E. 5½ miles, S. edge Stellwagen's Bank.	26	Fine sand and broken shells.	64	61⅛	41	D.
309	...do	42	08½	70	17	Race Point Light S. 23° E. 5½ miles, E. of No. 308.........	27	Fine yellow sand..........	66	60¾	40¾	T.
310	Aug. 29	42	01	70	11	Cape Cod Bay, Wood End Light N. 33° W. ½ mile.........	21	Blue mud, fine sand.......	63	60¾	47¾	D.
311	...do	42	00	70	10	Cape Cod Bay, Wood End Light N. 36° W. 1½ miles.........	16	......do	67½	61½	49	R. D.
312	...do	41	59½	70	09	Cape Cod Bay, Wood End Light N. 41° W. 2½ miles.........	15	Mud and sand	65	62	50	R. D.
313	...do	41	58	70	09	Cape Cod Bay, Wood End Light N. 26° W. 3½ miles.........	15	Blue mud..............	64	61	50½	R. D.
314	...do	41	56	70	07	Cape Cod Bay, Wood End Light N. 31° W. 6 miles.........	10	Coarse sand............	67	61½	61	R. D.
315	...do	41	55	70	07	Cape Cod Bay, Wood End Light N. 25° W. 7 miles.........	6	Coarse sand and gravel ...	66	63½	56	T.
316	...do	41	56½	70	06½	Cape Cod Bay, Wood End Light N. 36° W. 5¾ miles.........	8	......do	69	62	63	D.
317	Aug. 30	42	02	70	14	Cape Cod Bay, Race Point Light N. 3° W. 1½ miles	25	Blue mud..............	59	60	44¾	D.
318	...do	42	01½	70	15	Cape Cod Bay, Race Point Light N. 14° E. 2½ miles	28	......do	61	61½	44½	T.
319	...do	42	02½	70	15	Cape Cod Bay, Race Point Light N. 10° E. 1½ miles	26½	......do	60	60½	44½	T.
320	...do	42	02½	70	15	Cape Cod Bay, Race Point Light N. 38° E. 1½ miles	29	Fine gray sand	63½	61	44½	R. D.
321	...do	42	03	70	15	Cape Cod Bay, Race Point Light N. 62° E. 1 mile	29½	......do	65	61	44½	T.
322	Sept. 1	42	12½	70	01	Off Cape Cod, Cape Cod Light S. 9° W. 10 miles.........	67	Speckled sand, broken shells.	66	60	40½	D.
323	...do	42	13½	70	01½	Off Cape Cod, Cape Cod Light S. 6° W. 11 miles.........	60	Speckled sand	67½	58	40½	T.

DREDGINGS BY SPEEDWELL, 1879—Continued.

Serial number.	Date.	Latitude.	Longitude.	Locality.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Apparatus used.
	1879.	° ′	° ′				°	°	°	
324	Sept. 1	42 12¾	70 03	Off Cape Cod, Cape Cod Light S. 2° W. 11 miles	45	Coarse sand, black specks, broken shells.	67	61	40⅜	T.
325	...do	42 14½	70 00½	Off Cape Cod, Cape Cod Light S. 8° W. 13 miles	83	Green mud	67	61	40⅜	T.
326	...do	42 14½	70 02	Off Cape Cod, Cape Cod Light S. 4° W. 12¼ miles	75	......do	70	59½	40⅜	Ag. T.
327	Sept. 6	42 11	70 12½	S. end Stellwagen's Bank, Race Point Light S. 11° W. 7¾ miles.	17	Coarse sand, black specks.	61½	60	44½	D.
328	...do	42 10	70 13	Off S. end Stellwagen's Bank, Race Point Light S. 11° W. 6¼ miles.	23	......do	72	60½	42	O. T.
329	...do	42 09	70 12	Off S. end Stellwagen's Bank, Race Point Light S. 17° W. 5½ miles.	26	Fine brown sand, pebbles.	67½	60	42	R. D.
330	...do	42 09½	70 13	Off S. end Stellwagen's Bank, Race Point Light S. 8° W. 6 miles.	20	......do	68	60	42	T.
331	...do	42 09½	70 14	Off S. end Stellwagen's Bank, Race Point Light S. 2° W. 5½ miles.	28	Fine brown sand, black specks.	67	60½	41⅜	T.
332	...do	42 09	70 15	Off S. end Stellwagen's Bank, Race Point Light S. 6° E. 5½ miles.	28	Fine brown sand, shells	70	61	42	T.
333	...do	42 08½	70 16½	Off S. end Stellwagen's Bank, Race Point Light S. 18° E. 5¼ miles.	27	......do	71	61	42⅛	R. D.
334	...do	42 08½	70 18	Off S. end Stellwagen's Bank, Race Point Light S. 28° E. 5½ miles.	27	Fine yellow sand	74	61½	42	Ag. T.
335	Sept. 9	41 58¾	70 34½	Off Plymouth, Gurnet Point Light N. 30° W. 1¾ miles	7	Green mud, sand, with dead eel-grass.	62	61½	55	D.
336	...do	41 58	70 33½	Off Plymouth, Gurnet Point Light N. 40° W. 2¾ miles	11½	Brown sand, specks, eel-grass.	69	61½	50	T.
337	...do	41 57¾	70 30½	Off Plymouth, Gurnet Point Light N. 58° W. 4½ miles	16	Green mud and sand	70	62	47⅛	D.
338	...do	41 57½	70 28	Off Plymouth, Gurnet Point Light N. 66° W. 6¼ miles	18	Sand, blue mud	71	62½	49⅞	T.
339	...do	41 54	70 28	Cape Cod Bay, Manomet Point N. 67° W. 3½ miles, 3½ miles S. of No. 338.	15½	Mud and sand	75	63	47½	T.
340	...do	41 51	70 27½	Cape Cod Bay, Manomet Point N. 38° W. 6 miles	14	Brown sand and mud	66½	63	49⅜	D.
341	...do	41 51½	70 21½	Cape Cod Bay, Manomet Point N. 68° W. 9 miles	15½	Green mud, sand	65½	63 1/10	48	T.
342	Sept. 10	42 16	69 56	Off Cape Cod, Cape Cod Light S. 22° W. 14 miles	94	Brown mud	63½	58½	41½	T.
343	...do	42 17	69 51	Off Cape Cod, Cape Cod Light S. 33° W. 17½ miles	116	......do	63	57	41⅛	T.
344	...do	42 19	69 47½	Off Cape Cod, Cape Cod Light S. 35° W. 15 miles (20 miles on original chart).	130	......do	64	57½	41⅜	T.
345	Sept. 13	42 19½	70 45	Off Boston Harbor, Minot's Ledge Light S. 3¼ miles	16	Speckled sand and shells	60	61 8/10	46 8/10	D.
346	...do	42 16	70 38	Massachusetts Bay, Minot's Ledge Light W. 5½ miles	22	Pebbles and broken shells.	66½	61 7/10	44⅘	T.
347	...do	42 12½	70 33½	Massachusetts Bay, Minot's Ledge Light N. 66° W. 9 miles.	20	Speckled sand	65	61½	46½	T.
348	...do	42 09½	70 32½	Massachusetts Bay, Standish Monument (near Duxbury) N. 35° W. 10 miles.	16½	Gravel and sand	66	62½	46½	D.

349	*...do ....*	*42*	*10½*	*70*	*29*	*Standish Monument S. 36° W. 13 miles*	*26*	*Sand and mud*	*65*	*61 3/10*	*43¾*	*O. T.*
350	*...do ....*	*42*	*08¼*	*70*	*25*	*Standish Monument S. 56° W. 13½ miles*	*31*	*Blue mud*	*72½*	*61⅛*	*43 1/10*	*D.*
351	*...do ....*	*42*	*05½*	*70*	*22*	*Race Point Light S. 74° E. 6 miles*	*30*	*......do*	*67*	*62½*	*42⅜*	*Ag. T.*
352	Sept. 15	41	54½	70	07½	Cape Cod Bay, Billingsgate Light S. 53° E. 4 miles	10½	Sand and gravel	61½	64	62⅔	D.
353	...do	41	53	70	10	Cape Cod Bay, Billingsgate Light S. 76° E. 5 miles	14	Green mud	61	63 3/10	49⅛	T.
354	...do	41	50½	70	11½	Cape Cod Bay, Billingsgate Light N. 74 E. 6 miles	7	Coarse yellow sand	76½	65½	62	D.
355, 356	...do	41	48½	70	12	Cape Cod Bay, Billingsgate Light N. 56° E. 7¾ miles	7	Fine sand, pebbles	66	64	61⅛	D.
357	...do	41	49	70	09	Cape Cod Bay, Billingsgate Light N. 48° E. 5½ miles	7½	Fine brown sand	65	65 3/10	64	T.
358	...do	41	55	70	10	Cape Cod Bay, Billingsgate Light S. 63° E. 5¾ miles	15	Blue mud	65	64⅛	48⅛	T.
359	Sept. 18	42	04	69	22	Off Cape Cod, Cape Cod Light S. 86° W. 30 miles	105	Green mud	67	58¾	......	D.
360	...do	42	03	69	22	Off Cape Cod, Cape Cod Light S. 88° W. 30 miles	108	Gray mud	65	58½	......	T.
361	...do	42	02	69	28	Off Cape Cod, Cape Cod Light N. 89° W. 26 miles	102	......do	62	58⅓	......	T.
362	...do	42	01	69	34½	Off Cape Cod, Cape Cod Light N. 86° W. 21 miles	106	......do	62¼	59½	......	T.
363	...do	42	00	69	36	Off Cape Cod, Cape Cod Light N. 84° W. 20 miles	108	Mud, fine gravel	66	59¾	......	D.
364	...do	41	58½	69	44	Off Cape Cod, Cape Cod Light N. 75° W. 15 miles	70	Hard sand, broken shells	65	60	......	T.
365	Sept. 19	41	38	69	53	Off Chatham, Chatham Light N. 45° W. 2¾ miles	7½	Coarse sand	63	61⅞	......	T.
366	...do	41	37½	69	51	Off Chatham, Chatham Light N. 55° W. 4¼ miles	11	Fine sand	63	61	......	T.
367	...do	41	38	69	40	Off Chatham, Chatham Light N. 67° W. 5½ miles	12	......do	63½	61½	......	D.
368	...do	41	39	69	48	Off Chatham, Chatham Light N. 84° W. 6 miles	15	Coarse sand, gravel	63	61 1/10	......	D.
369	...do	41	41	69	47½	Off Chatham, Chatham Light S. 78° W. 6¼ miles	18	......do	64	61 1/10	......	T.
370	...do	41	35½	69	42	Off Chatham, Chatham Light N. 75° W. 12 miles	18	Speckled sand	61	57½	......	T.
371	...do	41	35½	69	35	Off Chatham, Chatham Light N. 72° W. 16 miles	34½	Coarse speckled sand	66	61½	......	T.
372	...do	41	40	69	28½	Off Chatham, Chatham Light W. 21 miles	70	Sand and pebbles	61½	59	......	T.
373	Sept. 26	42	07	69	59	Off Cape Cod, Cape Cod Light S. 32° W. 5 miles	42	Fine gray sand, black specks.	58	54	44	T.
374	...do	42	04	69	54	Off Cape Cod, Cape Cod Light S. 75° W. 6½ miles	46	Fine sand, broken shells	64	54½	43	T.
375	...do	42	04½	69	53¾	Off Cape Cod, Cape Cod Light S. 72° W. 7 miles	46	Coarse sand	59	54	45½	T.
376	...do	42	04½	69	54	......do	46	......do	59	54	45½	D.
377	...do	42	04	69	44½	Off Cape Cod, Cape Cod Light S. 85° W. 13 miles	94	Brown mud	58	57	41½	D.
378	...do	42	04½	69	30	Off Cape Cod, Cape Cod Light S. 85° W. 17½ miles	96	......do	......	......	......	D.

DREDGING STATIONS OF THE U. S. FISH COMMISSION STEAMER FISH HAWK, LIEUT. Z. L. TANNER COMMANDING, FOR 1880, 1881, AND 1882, WITH TEMPERATURE AND OTHER OBSERVATIONS.

[Arranged for publication by Richard Rathbun.]

In the summer of 1880, the headquarters of the United States Fish Commission were established at Newport, R. I., and the steamer Fish Hawk, then newly constructed, made its dredging and trawling trips from there, whenever the weather permitted. The field of explorations for the summer included Narragansett Bay, Sakonnet River, and the regions to the northward, eastward, and southward of Block Island. In September and the first part of October, three trips were made by the Fish Hawk to the inner edge of the Gulf Stream slope, between latitudes 40° 05′ 42″ N. and 39° 46′ N., and longitudes 70° 22′ 06″ W. and 71° 10′ W., in depths of 64 to 487 fathoms, resulting in the discovery of a new and exceedingly rich fauna, both as regards fish and marine invertebrates. On her passage to Washington in November, the Fish Hawk also trawled off the mouth of Chesapeake Bay, in depths of 18 to 300 fathoms.

During the summers of 1881 and 1882, the headquarters of the Commission were at Wood's Holl, Mass. As the shallow waters of this region had been quite fully explored by the Commission in 1871 and 1875, very little time was expended in work near land; but advantage was taken of all pleasant weather to still further investigate the rich faunal region of the Gulf Stream slope, discovered the previous year. Seven trips were made to this region, in 1881, between latitudes 39° 40′ N. and 40° 22′ N., and longitudes 69° 15′ W. and 71° 32′ W., in depths of 43 to 782 fathoms. A line of dredgings and trawlings, at intervals of about four miles, was made from off Noman's Land to the Gulf Stream slope, in order to connect the inshore with the offshore stations; and a few trips were also made in Vineyard Sound, Buzzard's Bay, and off Chatham, Cape Cod, on, and in the vicinity of, Crab Ledge. Cod trawl-lines were set on most of the outside trips, for the purpose of catching fish that would not enter the beam-trawl.

In 1882, five deep-water trips, were made to the same region, extending the area of dredgings considerably beyond its former eastern and western limits. A few hauls of the dredge and beam-trawl were taken in Vineyard Sound, and one trip was made to the one-hundred fathom line, off the eastern side of Cape Cod. The most eastern haul on the Gulf Stream slope for 1882, was in latitude 40° 08′ N. and longitude 68° 45′ W.; and the most western in latitude 39° 31′ N. and longitude 72° 06′ W.; the deepest haul was in 787 fathoms. Cod-trawls were set on two of the trips only.

The temperatures of the air were taken, in part, with a Jas. Green, in part with a Signal Service, thermometer; the temperatures of the bottom and surface waters were obtained by means of Negretti and Zambra deep-sea thermometers. The bearings are all magnetic. As the bearings and latitudes and longitudes indicate only the points at which the dredge or trawl was lowered upon the bottom, the direction of the drift of the vessel and the distance gone over in dredging and trawling have been given in most cases. to show the extent of the hauls. The figures in the column of "Drift" indicate the distance of the drift in miles. The abbreviations in the column of "Apparatus used" have the following significations: D., dredge; R. D., rake-dredge; O. D., oyster-dredge; T., trawl; O. T., otter-trawl; B. T., Blake-trawl; Tan., tangles; C. T., cod-trawl.

The New York fishing schooner, Josie Reeves, Capt. F. M. Redmond, employed by the Fish Commission to look for the tile fish (*Lopholatilus chameleonticeps*) in the neighborhood of the one-hundred fathom line, south of Martha's Vineyard, made five stations in that region, which for convenience sake have been given numbers in the regular series from 1145 to 1149, inclusive. She used cod trawl-lines and lobster-pots.

Dredging stations of the steamer Fish Hawk for 1880, 1881, and 1882.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surf.	Bottom.	Apparatus used.
	1880.		° ′ ″	° ′ ″	Narragansett Bay:							
770	Aug. 6	10 a. m.			Beaver Tail Light, SE. by S., ⅝ mile		8¼	Sand and shells	68.0	66.5	62.5	D.
771	Aug. 6	10.30			Beaver Tail Light, SE. ¼ S., ¾ mile		8¼	....do	68.0	66.5	62.5	T.
772	Aug. 6	11.35			Beaver Tail Light, S. by E., 1¼ miles		8	....do	72.0	69.5	67.0	D.
773	Aug. 6	11.45			Beaver Tail Light, S. by E., 1⅛ miles		8	....do	72.0	69.5	07.0	T.
774	Aug. 6	1 p. m.			North end Dutch Island, south, ½ mile		10½	Sand, mud, shells	72.0	72.0	69.0	D.
775	Aug. 6	1.35			North end Dutch Island, south, 1 mile		12	Gravel, sand, mud	79.0	72.0	68.0	T.
776	Aug. 7	9.45 a. m.			Fort Dumpling, NW. by W. ½ W., ⅝ mile		27½	Sand, shells	72.0	67.5	58.5	D.
777	Aug. 7	10.20			Fort Dumpling, NW. by W. ½ W., ⅝ mile		27½	Sand, shells, gravel	72.0	67.5	58.5	T.
778	Aug. 7	10.40			Fort Dumpling, N. ¾ E., 800 yards		26	Gravel, sand, broken shells	76.0	70.0	58.5	T.
779	Aug. 7	11.05			Fort Dumpling, NE., 1¼ miles		22½	Gravel, sand, shells	78.0	68.0	57.5	D.
780	Aug. 7	11.30			Beaver Tail Light, west, 1 mile		18	....do	79.0	69.0	57.5	T.
781	Aug. 7	12 m.			Beaver Tail Light, W. NW., 1 mile		16	Sand	75.0	69.0	57.0	T.
782	Aug. 12	9.30 a. m.			Beaver Tail Light, W. ¾ N., 1¼ miles		16	Sand, gravel, broken shells	68.0	70.0	60.0	D.
					Off Newport, R. I.:							
783	Aug. 12	10.15			Brenton's Reef Light-ship, N. by E., 1 mile.		17½	....do	70.0	70.0	55.0	T.
784	Aug. 12	10.50			Point Judith, W. ½ S., 4¾ miles		20	Fine sand and broken shells	71.5	71.0	53.5	D.
785	Aug. 12	11.30			Brenton's Reef Light-ship, N. ½ W., 2½ miles.		19½	Sand	72.0	71.0	54.5	T.
786	Aug. 12	2.35 p. m.			Brenton's Reef Light-ship, NW. ⅓ W., 4⅓ miles.		19	Mud and fine sand	74.0	71.0	53.5	D.
787	Aug. 12	3			Brenton's Reef Light-ship, N. NW. ½ W., 4 miles.		19	....do	74.0	71.0	53.5	T.
788	Aug. 13	10.40 a. m.			Brenton's Reef Light-ship, N. NW. ¾ W., 6 miles.		18	Fine sandy mud	70.0	71.0	54.0	D.
789	Aug. 13	11.05			Brenton's Reef Light-ship, N. NW. ¾ W., 5¼ miles.		17½	Sand and scallops	70.0	71.0	54.0	O. T.
790	Aug. 13	11.55			Point Judith, W. NW. ¾ W., 8⅓ miles		16	Fine sand	70.0	71.0	54.5	T.
791	Aug. 13	1.10 p. m.			Point Judith, W. NW., 12⅓ miles		20	Fine sandy mud	72.0	71.0	60.0	D.
792	Aug. 13	1.50			Point Judith, W. NW., 12 miles		18	....do	72.0	71.0	54.0	D.
793	Aug. 14	9 a. m.			Point Judith, W. NW. ½ W., 6 miles		19	Sand and broken shells	71.0	69.0	63.0	D.
794	Aug. 14	9.45			Point Judith, W. NW. ½ W., 5 miles		19	Sand	70.0	69.0	53.0	T.
795	Aug. 14	10.25			Point Judith, W. NW. ½ W., 4 miles		19	Fine sandy mud	71.0	69.0	53.0	D.
796	Aug. 14	11.00			Point Judith, W. NW., 3½ miles		19	....do	70.0	69.0	53.0	T.
797	Aug. 14	11.40			Point Judith, NW. by W. ¾ W., 2¼ miles		16½	Soft mud and coarse sand	70.0	68.5	55.0	D.
798	Aug. 14	12.10 p. m.			Point Judith, NW. by W. ¾ W., 1½ miles		12½	Sand, gravel, few large stones	71.0	66.0	59.0	D.
799	Aug. 14	12.30			Point Judith, W. ½ N., 1¾ miles		13	....do	70.0	67.0	61.0	D.
					Narragansett Bay:							
800	Aug. 16	11.35 a. m.			Poplar Point Lights, N. NW. ¾ W., 2¼ miles.		4	Sand	63.0	70.0	69.5	T.

Dredging stations of the steamer Fish Hawk for 1880, 1881, *and* 1882—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures.			Apparatus used.
									Air.	Surf.	Bottom.	
	1880.		° ′ ″	° ″	Narragansett Bay:							
801	Aug. 16	12.20 p. m.	....	....	Poplar Point Lights, W. by N., 2½ miles	....	4½	Mud	65.0	71.0	68.0	T.
802	Aug. 16	2.15	....	....	Halfway Rock, W., ¾ of a mile	....	12½	...do	68.0	70.5	62.0	T.
803	Aug. 16	3.25	....	....	Halfway Rock, N. by E. ¼ E., 2⅝ miles	....	20	Fine sandy mud	67.0	69.0	60.0	D.
					Off Newport, R. I. (Brown's Ledge):							
804	Aug. 17	11.15 a. m.	....	....	Cuttyhunk Light, NE. by E., 8¾ miles	NW. by W., ¼ mile.	11½	Rocks and sand	68.0	66.0	59.0	D.
805	Aug. 17	....	....	....	Close to No. 804		11¼	Fine gravel	......	......	......	D.
806	Aug. 17	12.00 m	....	....	Cuttyhunk Light, E.NE., 7¾ miles	W.SW., ⅛ mile	14	...do	69.0	67.0	56.0	Tan.
807	Aug. 17	12.50 p. m.	....	....	Cuttyhunk Light, NE. by E., ¾ E., 7¾ miles.	SW. by S., ¼ mile.	12¼	Fine gravel and stones	70.0	67.0	60.0	D.
808	Aug. 17	1.20	....	....	Cuttyhunk Light, NE. by E. ½ E., 8 miles.	SW. by S. ½ S., ¼ mile.	13	...do	70.0	67.0	60.0	D.
					Off Newport, R. I.; SW. of Brown's Ledge:							
809	Aug. 17	1.55	....	....	Cuttyhunk Light, NE. by E., 12 miles	W. ½ S., ¼ mile	21¼	Fine sand	70.0	67.0	52.0	D.
810	Aug. 17	2.15	....	....	Cuttyhunk Light, NE. by E., 12½ miles	W.NW., ¼ mile	21	Fine sand and gravel	70.0	67.0	52.0	T.
					Off Newport, R. I.; W. of Brown's Ledge:							
811	Aug. 17	2.20	....	....	Cuttyhunk Light, NE. by E., 12½ miles	SW., ¼ mile	19¼	Fine sandy mud	69.0	67.0	53.0	D.
					Off Block Island:							
812	Aug. 18	11.30 a. m.	....	....	Block Island Light, N.NW. ¼ W., 20 miles.	NW., ¼ mile	28½	Sand	70.0	66.0	46.0	D.
813	Aug. 18	11.55	....	....	Block Island Light, N.NW. ¼ W., 20 miles.	SE., ¼ mile	28½	...do	70.0	67.0	46.0	T.
814	Aug. 18	1.00 p. m.	....	....	Block Island Light, N.NW. ⅝ W., 18 miles.	SW., ¼ mile	27½	Sand and gravel	72.0	72.0	46.0	T.
815	Aug. 18	2.15	....	....	Block Island Light, NW. by N., 17 miles	SW., ¼ mile	29	Fine sand	72.0	72.0	48.0	R. D.
					Narragansett Bay:							
816	Aug. 23	10.25 a. m.	....	....	Brenton's Reef Light-ship, E. ¾ S., 2¾ miles.	SE., ¼ mile	8½	Sand and broken shells	71.0	69.0	66.0	D.
817	Aug. 23	11.00	....	....	Brenton's Reef Light-ship, E. ½ N., 3 miles.	SE., ¼ mile	10	...do	72.0	68.0	63.0	D.
818	Aug. 23	11.20	....	....	Brenton's Reef Light-ship, E. ½ N., 3¼ miles.	SE., ¼ mile	9½	...do	72.0	68.0	65.0	D.
819	Aug. 23	1.00 p. m.	....	....	South end Hope Island, SE. by E. ½ E., ⅓ mile.	W.SW., ¼ mile	6	Mud and broken shells	74.0	73.0	70.0	T.
820	Aug. 23	1.40	....	....	South end Hope Island, N.NE., ¼ mile	W. by S., ¼ mile.	5½	...do	76.0	72.0	70.0	T.
821	Aug. 23	2.15	....	....	South end Hope Island, N. by E., ½ mile	SW. ¼ mile	5	...do	78.0	72.0	70.0	T.
822	Aug. 23	3.00	....	....	South end Hope Island, NE., ⅛ mile	W., ¼ mile	4½	...do	78.0	71.0	70.0	T.
					North of Block Island:							
823	Aug. 24	12.35	....	....	North Light of Block Island, W. ½ S., 1½ miles.	NW., ¼ mile	15½	Sand	74.0	65.0	60.0	D.
824	Aug. 24	12.50	....	....	North Light of Block Island, SW. ¼ W., 1 mile.	NW., ¼ mile	13	...do	74.0	65.0	67.0	T.

825	Aug. 24	1.30	....	....	*North Light of Block Island, W. SW. ¾ W., 1¼ miles.*	*NW., ¼ mile....*	13	....do	73.0	67.0	60.0	O. T.
826	Aug. 24	2.40	....	....	*North Light of Block Island, W. NW. ½ W., 2½ miles.*	S. SW., ¼ *mile* ...	22	....do	73.0	67.0	57.0	D.
827	Aug. 24	3.05	....	....	*North Light of Block Island, W. NW. ½ W., 2½ miles.*	....	20½	....do	71.0	67.0	57.0	B. T.
828	Aug. 25	12.40	....	....	North Light of Block Island, SW. by W. ¾ W., 2½ miles.	E. NE., ¼ mile ...	15	....do	70.0	66.0	60.0	D.
					Mouth of Sakonnet River, R. I.:							
829	Aug. 27	10.45 a. m.	....	....	Cormorant Rock, NW. by N., ¼ mile	S. by E., ¼ mile..	9	Gravel and stones...........	63.0	66.0	65.0	D.
830	Aug. 27	11.15	....	....	West Island, SE. by E. ½ E., ¾ mile	NE. ½ E., ¼ mile.	10½	Sand and gravel............	64.0	66.0	65.0	D.
					Sakonnet River, R. I.:							
831	Aug. 27	12.30 p. m.	....	....	North end of Gould Island, SW. ¼ W., 350 yards.	S., ¼ mile........	6	Dark, soft fetid mud	68.0	71.0	71.0	D.
832	Aug. 27	12.45	....	....	North end of Gould Island, W., 150 yards.	S., ¼ mile........	9	....do	70.0	71.0	71.0	D.
833	Aug. 27	1.00	....	....	South end of Gould Island, W., 100 yards.	S., ¼ mile........	6½	....do	70.0	71.0	71.0	R. D.
834	Aug. 27	1.30	....	....	McCurry's Point, W. SW., ¾ mile	N. by E., ¼ mile..	11	....do	63.0	73.0	71.0	R. D.
835	Aug. 27	1.50	....	....	McCurry's Point, N. ¼ E., 1¼ miles......	N., ¼ mile	3½	Soft mud and broken shells..	68.0	73.0	71.0	R. D.
836	Aug. 27	2.25	....	....	Black Point, W. ¼ N., ½ mile	S. SW., ¼ mile. ..	5	Sand......................	66.0	71.0	71.0	R. D.
837	Aug. 27	2.45	....	....	Black Point, NW. by W. ½ W., ½ mile ..	S. by E., ¼ mile..	5	....do	69.0	71.0	71.0	T.
838	Aug. 27	3.15	....	....	Wood's Castle, W. by N., 1 mile.........	S. by E., ¼ mile..	5½	....do	66.0	70.0	68.0	T.
					Narragansett Bay:							
839	Aug. 31	9.50 a. m.	....	....	Dumplings, NW. ½ N., *300 yards*.........	SW., ¼ mile	27½	Gravel and sand	67.0	67.0	61.0	D.
840	Aug. 31	10.05	....	....	Dumplings, N. by W. ½ W., 100 yards....	SW., ¼ mile	20½	....do	67.0	67.0	61.0	D.
841	Aug. 31	10.45	....	....	Goat Island Light, NE. by E. ¾ E., ⅞ mile.	S., ¼ mile........	21	Mud, sand, large stones.....	68.0	67.0	60.0	D.
842	Aug. 31	11.00	....	....	Goat Island Light, E. NE. ½ E., ½ mile...	....	8	Sand......................	69.0	67.0	67.0	D.
843	Aug. 31	12.00 m.	....	....	North end Dyer's Island, NE. ½ E., ¾ mile.	N., ¼ mile	14½	....do	69.0	69.0	63.0	T.
844	Aug. 31	12.30 p. m.	....	....	North end Dyer's Island, SE. ½ E., ¼ mile.	W. SW., ¼ mile..	11½	....do	70.0	69.0	63.0	T.
845	Aug. 31	1.00	....	....	Prudence Light, N. ½ W., ¾ mile	....	14½	Gravel.....................	70.0	69.0	64.0	T.
846	Aug. 31	1.35	....	....	Prudence Light, N. by E. ¾ E., 1½ miles..	E. NE., ¼ mile ...	14½	Sandy mud and broken shells	70.0	68.0	63.0	R. D.
847	Aug. 31	2.15	....	....	Half-Way Rock, N. ¼ W., 1 mile	N. NE., ¼ mile ...	12½	Mud.......................	70.0	68.0	62.0	T.
848	Aug. 31	3.00	....	....	Bishop's Rocks, E. ½ mile..............	N., ¼.............	15½	Mud.......................	69.0	68.0	62.0	T.
849	Sept. 1	9.20 a. m.	....	....	Fort Dumpling, W. NW. ½ W., ¼ mile....	SW., ¼............	20	Sand, gravel, stones	67.0	67.0	63.0	R. D.
850	Sept. 1	9.40	....	....	Fort Dumpling, E. NE. ½ E., ½ mile	S. SW., ¼	14½	Sand and shells............	67.0	67.0	63.0	R. D.
851	Sept. 1	10.00	....	....	Beaver Tail Light, SW. ¼ W., 1¾ miles ..	S., ¼	12½	Sand and gravel	66.0	67.0	66.0	R. D.
852	Sept. 1	10.35	....	....	Beaver Tail Light, S. SW. ¾ W., 2½ miles .	S., ¼	2½	Sand......................	67.0	67.0	66.0	T.
853	Sept. 1	10.50	....	....	Beaver Tail Light, SW by S., 2 miles....	S., ¼	4½	Sand......................	68.0	67.0	67.0	T.
854	Sept. 1	11.10	....	....	Beaver Tail Light, SW. ¼ S., 1¾ miles....	S., ¼	6	Sand......................	69.0	67.0	67.0	T.
855	Sept. 1	11.40	....	....	Beaver Tail Light, SW. by S., 2 miles ..	S., ¼	3½	Sand......................	70.0	68.0	68.0	T.
856	Sept. 1	12.05 p. m.	....	....	Beaver Tail Light, SW. ½ W., 1½ miles...	S. SE., ¼	11	Sand, gravel, shells........	69.0	68.0	67.0	R. D.
857	Sept. 1	12.35	....	....	Beaver Tail Light, W. SW. ¾ W., 6/10 mile.	SE., ¼............	19	Sand......................	69.0	63.0	66.0	R. D
858	Sept. 1	1.05	....	....	Beaver Tail Light, W. NW. ¼ W., ½ mile..	E., ¼	14	Coarse sand, broken shells..	69.0	63.0	66.0	R. D.
					Vineyard Sound:							
859	Sept. 3	11.20 a. m.	....	....	Cuttyhunk Light, N. ½ W., 3 miles	W., ¼	17½	Sand and mud	68.0	66.0	63.0	R. D.
860	Sept. 3	11.55	....	....	Cuttyhunk Light, N. ½ W., 3 miles	W., ¼	17½	....do	70.0	66.0	64.0	R. D.
861	Sept. 3	12.20 p. m.	....	....	Cuttyhunk Light, N. ¾ W., 3¾ miles	S., ¼	17	Sand......................	69.0	66.0	61.0	T.
862	Sept. 3	12.55	....	....	Cuttyhunk Light, N., 4 miles	S., ¼	17	....do	68.0	66.0	64.0	T.
863	Sept. 3	1.40	....	....	Cuttyhunk Light, N. ½ E., 3¾ miles	S., ¼	18	Sand and mud	70.0	67.0	65.0	R. D.
864	Sept. 3	3.00	....	....	Gay Head Light, S. SW., ⅞ W., 5 6/10 miles.	S., ¼	13	Sand and broken shells	70.0	67.0	61.0	D.

Dredging stations of the steamer Fish Hawk for 1880, 1881, *and* 1882—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures.			Apparatus used.
									Air.	Surf.	Bottom.	
	1880.		° ′ ″	° ′ ″	Atlantic Ocean:							
865	Sept. 4	5.40 a. m.	40 05	70 23	Off Martha's Vineyard	E.NE., ¾	65	Compact fine sand and mud.	71.0	73.0	68.	T.
866	Sept. 4	6.30	40 05 18	70 22 18	......do	NE. by E., ½	65	Fine sand and mud	73.0	73.0	68.5	T.
867	Sept. 4	7.04	40 05 42	70 22 06	......do	E.SE., ¾	64	Compact hard sand and broken shells.	75.0	73.0	53.0	R. D.
868	Sept. 4	8.23	40 01 42	70 22 30	......do	NW., ¾	162	Fine sand and black specks.	75.0	75.0	47.0	T.
869	Sept. 4	9.27	40 02 18	70 23 06	......do	N.NE., ¾	192	Fine sand	80.0	76.0	50.0	T.
870	Sept. 4	10.50	40 02 36	70 22 58	......do	W. by N., 1	155	Mud and fine sand	80.0	77.0	......	T.
871	Sept. 4	11.40	40 02 54	70 23 40	......do	N.NW., ¾	115	Mud and fine sand	84.0	76.5	49.0	T.
872	Sept. 4	12.45 p. m.	40 05 39	70 23 52	......do	NW. by N., ½	86	Sand, gravel, shells, and sponge.	81.0	77.0	50.5	T.
873	Sept. 13	5.36 a. m.	40 02	70 57	......do	NW. by N., ½	100	Soft sticky mud	68.0	69.5	51.0	T.
874	Sept. 13	6.26	40 00 00	70 57 00	......do	NW., ½ mile	85	...do	70.0	70.0	51.0	T.
875	Sept. 13	7.51	39 57 00	70 57 30	......do	NE., ½ mile	126	...do	70.0	70.0	53.0	T.
876	Sept. 13	8.45	39 57 00	70 56 00	......do	N., ¾ mile	120	...do	68.0	70.0	53.0	T.
877	Sept. 13	9.40	39 56 00	70 54 18	......do	N.NW., ¾ mile	126	...do	71.0	71.0	57.0	T.
878	Sept. 13	11.00	39 55 00	70 54 15	......do	NW., ¾ mile	142½	Mud	72.0	71.0	52.0	T.
879	Sept. 13	1.20 p. m.	39 49 30	70 54 00	......do	N by W., ¾ mile.	225	Sand and blue mud	73.0	71.5	42.0	T.
880	Sept. 13	3.12	39 48 30	70 54 00	......do	W by N., ¾ mile.	252½	Mud	74.0	71.5	43.0	T.
881	Sept. 13	5.00	39 46 30	70 54 00	......do	W.NW., ½ mile	325	...do	70.0	71.0	42.0	T.
					Narragansett Bay:							
882	Sept. 17	10.56 a. m.	....	....	Halfway Rock, N. NE. ¼ E., 2⅜ miles	SW., ¼ mile	12½	Mud	68.0	65.0	67.0	T.
883	Sept. 17	11.35	....	....	Halfway Rock, NE. by N., 2¼ miles	SW., ½ mile	13	...do	70.0	65.0	63.5	T.
884	Sept. 17	2.10 p. m.	....	....	Hope Island, NE. ½ E., 200 yards	SW., ¼ mile	5	...do	72.0	65.0	63.5	R. D.
885	Sept. 17	3.15	....	....	Gould Island, N. by E. ¾ E., ⅜ mile	S., ¼ mile	16	Mud and shells	71.0	63.0	65.0	O. T.
					Off Block Island:							
886	Sept. 21	12.49	....	....	South Light of Block Island, N. ¾ E., 5¾ miles.	N., ¼ mile	19	Shells and coarse gravel	67.0	64.0	62.0	D.
887	Sept. 21	1.30	....	....	South Light of Block Island, N. ½ W., 5¾ miles.	W., ¾ mile	19	...do	67.0	64.0	62.0	T.
888	Sept. 21	2.00	....	....	South Light of Block Island, N. by E., 6 miles.	W., 1½ miles	19	...do	68.0	64.0	62.0	T.
889	Sept. 21	3.50	....	....	South Light of Block Island, W. ¼ S., 5 miles.	W.SW., ½ mile	11	Hard sand and rocks	63.0	64.0	61.5	D.
890	Sept. 21	4.15	....	....	South Light of Block Island, W. ¼ S., 4¾ miles.	W.SW., ½ mile	11	...do	68.0	64.0	61.5	D.
891	Oct. 2	6.00 a. m.	39 46 00	71 10 00	Atlantic Ocean, off Martha's Vineyard	N., ½ mile	480½	Soft, brown mud	60.0	67.0	......	T.
892	Oct. 2	8.46	39 46 00	71 05 00	......do	N.NE., 2 miles	487	Soft, brown mud and small stone.	64.0	65.0	......	T.
893	Oct. 2	11.23	39 52 20	70 58 00	......do	N., 1 mile	372	...do	63.0	64.0	40.0	T.
894	Oct. 2	1.10 p. m.	39 53 00	70 58 30	......do	N., 2 miles	365	...do	63.0	64.0	40.0	T.

895	Oct. 2	3.17	39 56 30	70 59 45	......do	N., 1½ miles	238	Soft mud	62.0	65.0	42.0	T.
896	Nov. 16	9.20 a. m.	37 26 00	74 19 00	Atlantic Ocean, off mouth of Chesapeake Bay.	W.NW., ½ mile	56	Sand, shells	52.0	62.0	55.0	T.
897	Nov. 16	10.10	37 25 00	74 18 00	......do	W., 1 mile	157½	Sand, mud	62.0	62.0	48.0	T.
898	Nov. 16	11.25	37 24 00	74 17 00	......do	W., 1 mile	300	Mud	60.0	62.0	44.0	T.
899	Nov. 16	1.55 p. m.	37 22 00	74 29 00	......do	SW., ¼ mile	57½	Sand	58.0	61.0	54.0	T.
900	Nov. 16	4.00	37 19 00	74 41 00	......do	W., ½ mile	31	Sand	55.0	59.0	56.0	T.
901	Nov. 16	7.15	37 10 00	75 08 00	......do	W., ½ mile	18	....do	53.0	60.0	......	T.
902 } 916 }	......	......	......	......	Shallow water dredgings on the oyster beds, off Point Lookout, Potomac River, Virginia, by the Fish Hawk.							
917	1881. July 16	4.10 a. m.	40 22 00	70 42 00	Atlantic Ocean, off Martha's Vineyard	NE., ¾ mile	44	Green mud	66.0	63.0	42.0	T.
918	July 16	5.33	40 20 24	70 41 30	......do	N. NE., 1 mile	46	....do	67.0	63.0	42.0	T.
919	July 16	7.00	40 16 18	70 41 18	......do	NE., 1 mile	53	....do	70.0	66.0	42.5	T.
920	July 16	8.20	40 13 00	70 41 54	......do	W. by S., 1 mile	63	....do	72.0	66.0	49.0	T.
921	July 16	9.40	40 07 48	70 43 54	......do	W., 1 mile	67	....do	75.0	70.0	52.0	T.
922	July 16	10.57	40 03 48	70 45 54	......do	N. by W., 1 mile	71	Green mud and sand	76.0	72.0	52.0	T.
923	July 16	12.27 p. m.	40 01 24	70 46 00	......do	W. NW., 1½ miles	98	Sand	74.5	72.0	52.0	T.
924	July 16	1.52	39 57 30	70 46 00	......do	NW., 2 miles	164	....do	74.5	71.0	44.5	T.
925	July 16	3.35	39 55 00	70 47 00	......do	NW. by W., 1½ miles.	229	Sand and mud	74.0	71.0	42.0	T.
926	July 16	5.24	39 56 00	70 46 00	......do	NW. ½ N., 2½ miles.	199	....do	74.0	71.0	44.0	T.
927	July 20	10.47 a. m.	......	......	Vineyard Sound: Menemsba Bight; Gay Head Light, W. by S. ⅜ S., 2½ miles.	W. NW., ½ mile	11	Sand	68.0	62.0	59.0	T.
928	July 20	11.30	......	......	Gay Head Light, W. ¾ S., 2⅛ miles	W. by N., ½ mile	10	....do	69.0	62.5	60.0	T.
929	July 20	12.35 p. m.	......	......	Off Quick's Hole; Gay Head Light, S. by W., 4¼ miles	SE. by S., ¾ mile	10	....do	66.0	63.0	62.0	D.
930	July 20	1.10	......	......	Gay Head Light, S. by W., 4¾ miles	S. ½ E., ½ mile	12	Sand and shells	65.0	63.0	62.0	D.
931	July 20	1.42	......	......	Off Robinson's Hole; Gay Head Light, SW. by S. ½ S., 5½ miles.	S. ½ W., ½ mile	16	....do	65.0	63.0	62.0	D.
932	July 20	2.43	......	......	Off Lackey's Bay; Tarpaulin Cove Light, W. by S. ½ S., 3 miles.	NW. by W., ¼ mile.	14	Rock	67.0	66.0	66.0	D.
933	July 20	3.30	......	......	West Chop Light, S. ¾ E., ¾ mile	E.NE., 2½ miles	14	Stones	68.0	65.0	64.0	D.
934	July 20	4.10	......	......	Nobska Light, W. ¾ S., 1¾ miles	N.NW., 1 mile	9	Sand and gravel	68.0	67.0	67.0	T.
935	Aug. 4	8.14 a. m.	39 45 00	69 44 45	Atlantic Ocean: Off Martha's Vineyard	NW. ½ N., 2½ miles	782	Green mud and sand	72.0	70.0	39.5	T.
936	Aug. 4	10.43	39 46 30	69 47 00	......do	NW. ¾ W., 2 miles	716	Green mud	78.0	71.0	39.5	T.
937	Aug. 4	12.45 p. m.	39 49 25	69 49 00	......do	N., 2½ miles	616	Green mud and sand, with lumps of clay.	75.0	72.0	40.5	T.
938	Aug. 4	2.44	39 51 00	69 49 15	......do	N.NW., 2 miles	317	Green mud and sand	80.0	72.5	42.0	T.
939	Aug. 4	4.25	39 53 00	69 50 30	......do	N.NW., 1½ miles	264	....do	78.0	73.0	47.0	T.
940	Aug. 4	5.30	39 54 00	69 51 30	......do	N.NW. ½ W., 2 miles.	134	Hard sand and sponges	76.0	72.0	52.0	T.
941	Aug. 4	7.45	40 01 00	69 56 00	......do	W.NW., 1½ miles	79	Hard sand and mud	74.0	71.0	52.0	T.
942	Aug. 9	6.15 a. m.	40 01 00	71 12 30	......do	SW. by W., 2 miles.	138	....do	72.0	69.0	50.0	D.
943	Aug. 9	7.10	40 00 00	71 14 30	......do	NW. by N., 2½ miles.	157	Mud, sand, and shells	76.0	70.0	49.0	D.

Dredging stations of the steamer Fish Hawk for 1880, 1881, *and* 1882—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures.			Apparatus used.
									Air.	Surf.	Bottom.	
	1881.		° ′ ″	° ′ ″	Atlantic Ocean:							
944	Aug. 9	8.27 a. m.	40 01 00	71 14 30	Off Martha's Vineyard	NW. by N., 1½ miles.	128	Mud, sand, and shells	78.0	70.0	51.0	T.
945	Aug. 9	12.05 p. m.	39 58 00	71 13 00	......do	NW. by N., 2 miles.	207	Green mud and sand	75.0	71.0	44.0	T.
946	Aug. 9	2.00	39 55 30	71 14 00	......do	NW. by W., 1½ miles.	247	....do	75.5	71.0	47.0	T.
947	Aug. 9	4.00	39 53 30	71 13 30	......do	W.NW., 3 miles.	319	Sand and mud	75.0	70.0	44.0	T.
					Buzzard's Bay:							
948	Aug. 13	5.20	....	....	Penikese Island east, 2 miles	W.SW., 1 mile	7	Black mud and shells	76.0	67.0	66.0	T.
					Atlantic Ocean:							
949	Aug. 23	4.20 a. m.	40 03 00	70 31 00	Off Martha's Vineyard	N.NW., 2 miles	100	Yellow mud	68.0	66.0	52.0	R.D.
950	Aug. 23	5.50	40 07 00	70 32 00	......do	N.NW., 1½ miles	71	Sand, shells, and mud	69.0	65.0	52.0	T.
951	Aug. 23	9.40	39 57 00	70 31 30	......do	N., 1⅓ miles	225	Mud	78.0	67.5	41.0	T.
952	Aug. 23	11.28	39 55 00	70 28 00	......do	NE. by N., 1½ miles.	396	Yellow mud and sand	82.0	68.0	40.0	T.
953	Aug. 23	2.30 p. m.	39 52 30	70 17 30	......do	N.NW., 1½ miles.	724	Mud	77.0	68.0	39.5	T.
954	Aug. 23	4.50	39 53 00	70 18 30	......do	N.NW., 2 miles	651	Sand and mud	74.5	68.0	39.5	T.
					Buzzard's Bay:							
955	Aug. 26	10.50 a. m.	....	....	Nye's Neck, E. by S., ¼ mile	W. by S. ¼ S., ½ mile.	7	Sand	69.0	67.5	68.0	T.
956	Aug. 26	11.26	....	....	Nye's Neck, S.SE. ¾ E., ⅛ mile	W. by S., ¼ mile.	5¼	....do	71.0	69.0	68.0	T.
957	Aug. 26	11.45	....	....	Nye's Neck, S.SE. ¾ E., ⅛ mile	W. ¾ N., ¼ mile	6	Sand and stones	73.0	69.5	68.0	T.
958	Aug. 26	12.20 p. m.	....	....	Nye's Neck, S. by E. ¼ E., ⅓ mile	W.SW., ⅓ mile	5	Sand, stones, shells	75.0	70.0	68.0	T.
959	Aug. 26	12.40	....	....	Nye's Neck, S., ⅓ mile	West, ⅓ mile	5	....do	72.0	69.0	68.0	T.
960	Aug. 26	1.10	....	....	Nye's Neck, S. ¾ E., ⅓ mile	SW. by W., ½ mile.	4½	....do	72.5	69.5	68.0	T.
961	Aug. 26	1.52	....	....	Nye's Neck, NE. ¾ E., 2¾ miles	W. by S., ¾ mile	8	Black mud	71.5	69.0	68.0	T.
962	Aug. 26	3.10	....	....	Woepecket Island, NE. ¾ E., 1¼ miles	W.NW., ½ mile	8	Black mud, sand	71.0	68.0	66.0	T.
963	Aug. 26	3.40	....	....	Woepecket Island, SE. ½ S., 1 mile	W.SW., ¾ mile	8½	Brown mud	70.0	68.0	66.0	D.
					Off Chatham, Cape Cod (Crab Ledge):							
964	Aug. 30	7.50 a. m.	....	....	Chatham Lights, NW. ½ W., 5 miles	S.SE., ⅛ mile	10	Sand, gravel	65.0	61.0	55.0	D.
965	Aug. 30	8.15	....	....	Chatham Lights, NW. by W., 6 miles	SE. by E., ⅓ mile.	15	....do	65.0	61.0	53.0	D.
966	Aug. 30	8.40	....	....	Chatham Lights, NW. by W. ¼ W., 6¼ miles	SE., ⅛ mile	16	Sand, small stones	65.0	61.0	52.0	D.
967	Aug. 30	8.50	....	....	Chatham Lights, NW. by W. ¼ W., 6¾ miles	SE., ⅛ mile	16	Sand, gravel	66.0	61.0	52.0	D.
968	Aug. 30	9.00	....	....	Chatham Lights, NW. by W. ¾ W., 7¼ miles.	NW. by W., ⅛ mile.	18	Gravel	66.0	61.5	50.5	D.
969	Aug. 30	9.10	....	....	Chatham Lights, NW. by W. ¾ W., 7 miles.	SE., ¼ mile	18	Sand, pebbles	66.0	61.5	51.0	D.
970	Aug. 30	9.43	....	....	Chatham Lights, W.NW. ¾ W., 6 miles	W.NW., ¼ mile	13	....do	67.0	61.0	54.0	D.
971	Aug. 30	10.05	....	....	Chatham Lights, W. ¾ N., 4½ miles	S.SE., ¼ mile	11	Sand, gravel, pebbles	67.0	61.5	54.0	D.

972	*Aug. 30*	*10.48*	....	....	*Chatham Lights, NW. by W. ⅜ W., 7½ miles.*	*NE., ⅛ mile*	*16*	*Sand, gravel, stones*	*67.0*	*62.0*	*52.0*	D.
973	Aug. 30	11.10	....	....	Chatham Lights, W.NW., 6¾ miles	W.SW., ⅛ mile..	17	....do	67.0	62.0	51.0	D.
974	Aug. 30	11.30	....	....	Chatham Lights, W.NW. ½ W., 6½ miles .	W.SW., ⅛ mile ..	16	....do	67.0	62.0	51.0	D.
975	Aug. 30	11.45	....	....	Chatham Lights, W.NW. ¼ W., 6¼ miles .	S., ⅛ mile........	16	....do	68.0	63.0	52.0	D.
976	Aug. 30	12.00 m.	....	....	Chatham Lights, W.NW. ⅜ W., 6 miles .	S. SW., ⅛ mile...	16	....do	69.0	63.0	52.0	D.
977	Aug. 30	12.20 p.m.	....	....	Chatham Lights, W.NW., 6¼ miles	W. by N., ¼ mile.	17	....do	70.0	64.0	52.0	D.
978	Aug. 30	12.30	....	....	Chatham Lights, W.NW., 6 miles	W. by N., ⅛ mile.	17	....do	70.0	64.0	52.0	D.
979	Aug. 30	12.40	....	....	Chatham Lights, W.NW. ¼ W., 6 miles..	W. by N., ⅛ mile.	16	Sand	70.0	64.0	52.0	D.
980	Aug. 30	1.00	....	....	Chatham Lights, NW. by W. ¼ W., 5¾ miles.	SW., ⅛ mile.....	14	Sand, stones, pebbles	70.0	62.0	53.0	D.
981	Aug. 30	2.10	....	....	Chatham Lights, W.NW., 16 miles	S. ¼ W., 1½ miles	43	Sand, gravel	65.0	63.5	49.0	T.
982	Aug. 30	2.45	41 36	69 35	Off Chatham, Cape Cod	S.SW., 1½ miles .	42	....do	65.0	63.5	41.5	T.
983	Aug. 30	3.23	41 33	69 32	......do	S. by E., ½ mile..	36	Sand	64.5	64.0	42.0	T.
984	Aug. 30	4.07	41 31	69 28	......do	S. ½ W., ½ mile..	33	Mud and sand	64.0	63.5	41.5	T.
					Atlantic Ocean:							
985	Sept. 7	12.55 p.m.	41	70 49	Off Martha's Vineyard	SW. by S., 1¼ miles.	26	Sand	73.0	66.0	50.0	T.
986	Sept. 7	2.00	40 55	70 48	......do	S. ½ W., 1 mile ..	28	....do	73.0	67.0	49.0	T.
987	Sept. 7	2.28	40 54	70 48 30	......do	S., ½ mile........	28	....do	73.0	67.0	49.0	R.D.
988	Sept. 7	3.30	40 49 30	70 47	......do	S., ½ mile........	30	....do	73.0	67.0	49.5	R.D.
989	Sept. 7	4.00	40 49	70 47	......do	S., ¾ mile........	30	....do	73.0	67.0	49.5	T.
990	Sept. 7	5.08	40 44	70 47	......do	S. ½ W., ¾ mile ..	34	Green mud and sand	71.5	66.0	47.0	T.
991	Sept. 7	6.05	40 39	70 46	......do	S. ¼ W., ¼ mile ..	34	....do	70.0	66.0	47.5	T.
992	Sept. 7	7.30	40 33	70 45	......do	S., ⅛ mile........	36	....do	69.0	65.0	48.0	T.
993	Sept. 7	8.20	40 28	70 44	......do	S., ⅝ mile........	39	Mud	69.0	65.0	46.5	T.
994	Sept. 8	4.50 a.m.	39 40	71 30	......do	W.NW., 2 miles.	368	....do	72.0	68.0	40.5	T.
995	Sept. 8	6.32	39 40 30	71 31	......do	W.NW., ⅛ mile .	358	Yellow mud and sand	72.0	68.0	40.5	T.
996	Sept. 8	7.35	39 41	71 31 37	......do	NW., ⅛ mile.....	346	....do	75.0	67.5	40.0	R.D.
997	Sept. 8	9.03	39 42	71 32	......do	N. by W., 1 mile.	335	Yellow mud	75.0	67.5	40.0	T.
998	Sept. 8	10.34	39 43	71 32	......do	N., 1¼ miles.....	302	Green mud	74.0	68.0	40.0	T.
999	Sept. 8	11.48	39 45 13	71 30	......do	N. NW., ¾ mile..	266	....do	73.0	68.0	......	R.D.
1000 } 1024 }	....	....	....	....	(Dredgings by steamer Lookout. Nos. 1006 to 1013, close off Gay Head; 1014 N. of Lucas Shoal, Vineyard Sound.)							
					Atlantic Ocean:							
1025	Sept. 8	1.05 p.m.	39 49	71 25	Off Martha's Vineyard	N. ¼ E., 1 mile...	216	....do	71.0	69.0	45.0	T.
1026	Sept. 8	2.55	39 50 30	71 23	......do	N. by E., 1½ miles	182	Green mud, sand	69.0	69.0	47.5	T.
1027	Sept. 14	7.23 a.m.	40 00	69 19	......do	N., ¾ mile	93	Fine sand	61.0	65.0	48.5	T.
1028	Sept. 14	9.01	39 57	69 17	......do	N. NE., ½ mile ..	410	Yellow mud	66.5	66.0	41.0	T.
1029	Sept. 14	12.13 p.m.	39 57 06	69 16	......do	NE. by N., 1 mile.	458	Yellow mud, sand	72.0	68.0	40.0	T.
1030	Sept. 14	1.52	39 58 30	69 15	......do	N. by W., 1½ miles.	337	Yellow mud	65.0	66.0	41.0	R.D.
1031	Sept. 14	2.54	39 57	69 19	......do	NW. by N., 1½ miles.	255	....do	64.0	65.0	46.0	T.
1032	Sept. 14	4.00	39 56	69 22	......do	NW., ¾ mile	208	....do	65.0	65.0	46.0	T.
1033	Sept. 14	4.55	39 56	69 24	......do	N. NW., 2 miles	183	Sand, gravel	66.0	63.0	......	T.
1034	Sept. 14	5.55	39 56	69 26	......do	N. NW., ½ mile .	146	Sand and yellow mud	66.0	62.0	46.5	T.
1035	Sept. 14	6.56	39 57	69 28	......do	N., ¾ mile	120	Sand	65.0	62.0	47.0	T.
1036	Sept. 14	7.54	39 58	69 30	......do	N. NW., 1½ miles	94	....do	62.0	61.5	51.0	R.D.

Dredging stations of the steamer Fish Hawk for 1880, 1881, *and* 1882—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surf.	Temperatures. Bottom.	Apparatus used.
	1881.		° ′ ″	° ′ ″	Off Gay Head, Martha's Vineyard:							
1037	Sept. 15	8.00 a. m.	....	....	Gay Head Light, NE. ¾ N., 4 miles	....	16	Sand	......	......	......	T.
					Atlantic Ocean:							
1038	Sept. 21	6.55	89 58	70 06	Off Martha's Vineyard	N. by E., 1 mile.	146	Sand and shells	67.0	67.0	47.0	T.
1039	Sept. 21	9.35	39 59	70 06	......do	N. by E., 2 miles	130	....do	66.5	67.0	50.0	T.
1040	Sept. 21	10.43	40 00	70 06	......do	N. by E., 2 miles	93	....do	64.0	68.0	66.0	D.
					Vineyard Sound, Mass.:							
1041	Sept. 22	12.35 p. m.	....	....	West Chop Light, E. ½ N., 1¾ miles	W.SW., ¾ mile	9	Sand and gravel	63.5	65.0	65.0	T.
1042	Sept. 22	1.17	....	....	West Chop Light, E. ½ N., 1½ miles	W. by N., ½ mile.	6	....do	63.5	65.0	65.0	T.
					Atlantic Ocean:							
1043	Oct. 10	7.17 a. m.	88 39	73 11	Off the Capes of Delaware	NW. by N., 1¾ miles.	130	Sand	63.5	65.5	49.0	T.
1044	Oct. 10	8.15	38 37	73 12	......do	W.NW., ½ mile	224	Gray mud	65.0	66.0	42.5	T.
1045	Oct. 10	9.32	38 35	73 13	......do	W. ¾ N., ¾ mile	312	....do	67.0	66.0	40.0	T.
1046	Oct. 10	11.14	38 33	73 18	......do	W.NW., ¾ mile	104	Sand	66.0	66.0	51.0	T.
1047	Oct. 10	12.15 p. m.	38 31	73 21	......do	NW., 1½ miles	156	....do	69.0	66.0	49.0	T.
1048	Oct. 10	1.55	88 29	73 21	......do	W., 2 miles	435	Mud	71.0	66.0	40.0	T.
1049	Oct. 10	3.30	38 28	73 22	......do	N.NW., 2 miles	435	....do	68.0	66.0	40.0	T.
	1882.				Chesapeake Bay:							
1050	Feb. 27	2.00 p. m.	....	....	Point No Point, N.NE., 1½ miles	....	3½	Mud, shells, gravel	50.0	41.0	......	O. D.
1051	Feb. 27	2.15	....	....	Point No Point, N. by E., 1 mile	....	2	Mud, grass	50.0	41.0	40.0	O. D.
1052	Feb. 27	2.30	....	....	Point No Point, N.NE., ¾ mile	....	1¾	....do	50.0	41.0	40.0	O. D.
1053	Feb. 27	2.45	....	....	Point No Point, N. by E., 1¼ miles	....	2¼	Mud, shells, oysters	50.0	41.0	40.0	O. D.
1054	Feb. 27	2.50	....	....	Point No Point, N. by E., 1¼ miles	....	2¾	....do	50.0	41.0	40.0	O. D.
					Patuxent River, Maryland:							
1055	Feb. 28	10.40 a. m.	....	....	Drum Point, NE., ½ mile	....	6	Brown mud, shells	46.0	40.0	......	D.
1056	Feb. 28	10.55	....	....	Drum Point, N.NE., ½ mile	....	6	....do	46.0	40.0	......	R.D.
					Chesapeake Bay:							
1057	Feb. 28	12.00 m.	....	....	South end Barren Island, E. by S., 1¾ miles.	W.NW., ½ mile	17-20	Brown mud	49.0	40.0	40.0	T.
1058	Feb. 28	12.10 p. m.	....	....	South end Barren Island, SE. by E. ½ E., 2 miles.	W.NW., ¾ mile	3-25	....do	49.0	40.0	40.0	T.
1059	Feb. 28	12.30	....	....	South end Barren Island, SE. ¾ E., 2 miles	W.NW., ¾ mile	2¾-25	....do	49.0	40.0	40.0	T.
1060	Feb. 28	4.40	....	....	Smith's Point, S.SW., 2 miles	SE. by S., ¾ mile.	7	Brown mud, shells	46.0	41.0	40.5	T.
1061	Mar. 2	11.20 a. m.	....	....	Smith's Point Light, S. by W. ½ W., 1½ miles.	S., ½ mile	11-16	....do	48.0	41.5	41.5	D.
1062	Mar. 2	11.40	....	....	Smith's Point Light, SW. ½ S., 1½ miles	S. by W., 1 mile.	16-9½	....do	48.0	41.5	41.5	T.
1063	Mar. 2	1.35 p. m.	....	....	South point Tangier Island, N. by E. ¾ E., 2¼ miles.	NE. by E., ½ mile.	10	....do	50.0	44.0	42.0	R.D.
1064	Mar. 2	2.17	....	....	South point Tangier Island, N.NW., 1 mile.	NE. by E., ½ mile.	20-9½	....do	50.0	42.0	42.0	R.D.

1065	Mar. 6	9.00 a.m.	....	....	Cherrystone Light, E. by N., 2 miles	....	25–12	Sand	56.0	45.0	46.5	T.
1066	Mar. 6	9.20	....	....	Cherrystone Light, E. by S., 8 miles	....	12–25	....do	56.0	45.0	45.0	T.
1067	Mar. 6	9.40	....	....	Cherrystone Light, SE. by E. ½ E., 8 miles	....	12–20	....do	56.0	45.0	47.0	T.
1068	Mar. 11	9.50 a.m.	....	....	Thomas Point Light, W.SW. ¼ W., 2 miles	....	14–9	Black mud	49.0	42.0	41.0	T.
1069	Mar. 11	10.20	....	....	Thomas Point Light, SW. by W. ¾ W., 2¼ miles.	....	18	....do	51.0	42.0	40.0	T.
1070	Mar. 11	10.45	....	....	Thomas Point Light, W. by S., 2 miles	....	15–10	....do	45.0	42.0	42.0	T.
1071	Mar. 11	11.22	....	....	Thomas Point Light, W.NW. ½ W., 2½ miles.	....	14–13	....do	49.0	42.0	40.0	T.
1072	Mar. 11	12.00 m.	....	....	Thomas Point Light, NW., 2¼ miles	....	16	....do	50.0	42.0	42.0	R.D.
1073	Mar. 11	12.25 p.m.	....	....	Thomas Point Light, NW. by N., 2½ miles	....	13	Black mud, shells	50.0	42.0	42.0	R.D.
1074	Mar. 11	1.10	....	....	Thomas Point Light, N. by W. ½ W., 4½ miles.	....	18–11	Black mud	51.0	43.0	41.0	T.
1075	Mar. 13	9.45 a.m.	....	....	Sandy Point Light, N. by W. ¼ W., 3½ miles.	....	14–11	Mud	45.0	43.0	40.0	T.
1076	Mar. 13	10.15	....	....	Sandy Point Light, N. by W. ¼ W., 3½ miles.	....	15	....do	45.0	43.0	40.0	T.
1077	Mar. 13	10.55	....	....	Sandy Point Light, NW. ¼ W., 2¼ miles	....	11–12	....do	49.0	43.0	40.0	T.
					Off Cape Cod:							
1078	Aug. 2	7.30 a.m.	....	....	Nausett Lights, NW. ¼ N., 10 miles	S. by W., ½ mile	55	Green mud, fine sand	72.0	63.0	37.0	T.
1079	Aug. 2	8.40	....	....	Nausett Lights, NW. by W. ¼ W., 8¾ miles	E.SE., 1 mile	61½	Fine sand	69.0	63.5	37.0	T.
1080	Aug. 2	9.40	....	....	Nausett Lights, NW. by W. ½ W., 6½ miles	W.NW., 1 mile	55	....do	69.0	61.5	37.0	T.
1081	Aug. 2	10.50	....	....	Nausett Lights, W. by S., 5½ miles	NW. by N., 1 mile.	33½	Coarse gravel and pebbles	69.0	59.0	39.0	T.
1082	Aug. 2	11.45	....	....	Cape Cod Light, NW. ¾ N., 11½ miles	NW. by N., ½ mile.	28	Coarse gravel	70.0	59.0	40.0	T.
1083	Aug. 2	12.45 p.m.	....	....	Cape Cod Light, W by N., 15 miles	W.SW., ½ mile	83½	....	77.0	64.0	38.0	T.
1084	Aug. 2	2.20	....	....	Cape Cod Light, W.NW. ¾ W., 8 miles	W.SW., 1 mile	37½	Coarse sand	78.0	62.5	38.0	T.
1085	Aug. 3	6.15 a.m.	....	....	Race Point Light, S. 33° E., 2 miles	S. by E., 1 mile	34½	Fine sand, green mud	67.0	64.0	39.0	T.
1086	Aug. 3	7.00	....	....	Race Point Light, S. 20° W., 2¾ miles	S., ¾ mile	34	Fine sand	74.0	64.0	39.5	T.
1087	Aug. 3	8.30	....	....	Cape Cod Light, S.SW., 7 miles	W.SW. ½ mile	44	Gray sand	84.0	62.5	39.0	T.
1088	Aug. 3	9.50	....	....	Cape Cod Light, SW. ¾ W., 9½ miles	NW., 1½ miles	90	Coarse sand	82.5	62.0	38.0	T.
1089	Aug. 3	11.10	....	....	Cape Cod Light, SW. ¾ W., 14 miles	NW. by W., ¾ mile.	110	Gray mud	78.0	63.0	38.5	T.
1090	Aug. 3	11.50	....	....	Cape Cod Light, SW. ¾ W., 13¾ miles	W.SW., 1 mile	110	....do	81.5	62.0	38.5	T.
					Atlantic Ocean:							
1091	Aug. 11	5.30 a.m.	40 03	69 44	Off Martha's Vineyard	NW. by W., ½ mile.	65	Gray sand, broken shells	77.0	75.0	46.0	T.
1092	Aug. 11	6.54	39 58	69 42	......do	N.NW., ¾ mile	202	Gray sand	79.0	75.0	41.0	T.
1093	Aug. 11	8.35	39 56	69 45	......do	N.NW., 1 mile	349	Blue mud, sand	82.0	75.0	40.0	T.
1094	Aug. 11	10.10	39 57	69 47	......do	NW. by N., 1 mile.	301	Blue mud	84.0	76.0	40.0	T.
1095	Aug. 11	11.55	39 55 28	69 47	......do	N.NW. ½ W., ¾ mile.	321	Soft green mud	82.0	76.0	40.0	T.
1096	Aug. 11	1.39 p.m.	39 53	69 47	......do	NW. ½ N., ½ mile	317	....do	78.0	75.5	40.0	T.
1097	Aug. 11	3.10	39 54	69 44	......do	N. ½ W., ½ mile	158	Fine sand	76.0	75.5	45.0	T.
1098	Aug. 11	4.35	39 53	69 43	......do	N. by E., ¾ mile	156	....do	78.0	75.0	43.5	T.
					Vineyard Sound:							
1099	Aug. 18	11.06 a.m.	....	....	Nobska Point Light, W.SW. ¼ W., 1⅝ miles.	NE. by N. ½ mile	6	Sand, gravel	76.0	72.0	71.5	T.
1100	Aug. 18	11.47	....	....	Nobska Point Light, W.SW. ¼ W., 1¼ miles.	NE. by N. ½ mile	4½	Sand, gravel, shells	77.0	72.0	71.5	T.

Dredging stations of the steamer Fish Hawk for 1880, 1881, *and* 1882—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surf.	Bottom.	Apparatus used.
	1882.		° ′ ″	° ′ ″	Vineyard Sound:							
1101	Aug. 18	12.15 p. m.	....	....	Nobska Point Light, W. by S. 1½ miles ...	NE., 1 mile	5	Sand, gravel, shells.........	78.0	72.0	71.0	T.
1102	Aug. 18	1.10	....	....	East Chop Light, NW. ¾ W., 2½ miles	E. by S., ½ mile .	5	Coarse sand..............	73.0	70.0	69.0	T.
1103	Aug. 18	1.42	....	....	East Chop Light, NW. by W., 2¾ miles...	E. by S., ½ mile .	5	....do	70.0	70.0	69.0	T.
1104	Aug. 18	2.12	....	....	East Chop Light, W.NW. ½ W., 4 miles ..	N. by W. ¾ W., ½ mile.	8½	Shells...................	79.0	70.0	69.0	T.
1105	Aug. 18	3.00	....	....	Cape Pogo Light, S. by W., 4 miles.......	NE. by E. ½ E., 2 miles.	10	Coarse sand..............	80.0	72.0	71.0	T.
1106	Aug. 18	3.35	....	....	Cape Pogo Light, S. by W. ½ W., 5½ miles.	NE. by N., ¾ mile	5	Sand, shells.............	80.0	72.5	72.0	T.
					Atlantic Ocean:							
1107	Aug. 22	6.00 a. m.	40 02	70 35	Off Martha's Vineyard..................	NW., 1 mile	116	Gray mud	69.5	71.0	48.0	T.
1108	Aug. 22	6.55	40 02	70 37 30	......do	NW., ¾ mile	101	Gray mud, fine sand........	69.5	71.0	48.0	T.
1109	Aug. 22	7.55	40 03	70 38	......do	N.NW., 1 mile..	89	Gray sand	70.5	71.0	49.0	T.
1110	Aug. 22	9.16	40 02	70 35	......do	N. by W. ½ W., 1 mile.	100	Green mud, fine sand......	75.0	72.0	47.0	T.
1111	Aug. 22	10.45	40 01 33	70 35	......do	N.NE. ½ E., 1 mile.	124	Fine sand................	76.0	72.0	47.0	T.
1112	Aug. 22	12.43 p. m.	39 56	70 35	......do	NW. by N., 1 mile.	245	Green mud, sand	72.0	72.0	43.0	T.
1113	Aug. 22	1.45	39 57	70 37	......do	N., 1 mile.......	192	Green mud................	75.0	72.0	43.0	T.
1114	Aug. 22	2.40	39 58	70 38	......do	N. by W., 1 mile	171	....do	74.0	72.0	43.0	T.
1115	Aug. 22	3.28	39 59	70 41	......do	W. by N., ¾ mile	146	Green mud, sand	75.0	72.5	45.0	R.D.
1116	Aug. 22	4.20	39 59	70 44	......do	NW. by W., 1 mile.	144	....do	77.0	72.0	46.0	T.
1117	Aug. 22	5.30	40 02	70 45	......do	N. by E., 1 mile	69	Fine sand	78.0	72.0	48.0	T.
1118	Aug. 22	6.20	40 03	70 45	......do	N.NW., ½ mile..	70	....do	74.0	72.0	49.0	T.
1119	Aug. 26	6.32 a. m.	40 08	68 45	......do	NE. ½ N., ¾ mile.	97	Sand, broken shells	68.0	65.0	48.0	T.
1120	Aug. 26	7.41	40 05	68 48	......do	NW., 1½ miles...	194	Fine sand, stones..........	69.0	65.0	43.5	T.
1121	Aug. 26	9.05	40 04	68 49	......do	W.NW., 1 mile..	234	...do	65.0	65.0	41.5	T.
1122	Aug. 26	10.28	40 02	68 50	......do	NW., 1 mile.....	351	... do	70.0	67.0	40.5	T.
1123	Aug. 26	12.00 m.	39 59 45	68 54	......do	N.NW., 1 mile..	787	Fine sand, green mud.......	70.0	69.0	39.0	T.
1124	Aug. 26	4.01 p. m.	40 01	68 54	......do	NW. by N., 1 mile	640	Fine sand, green mud, limestone nodules.	65.0	65.0	39.0	T.
1125	Aug. 26	5.45	40 03	68 56	......do	NW. by W., 1 mile.	291	Sand, mud................	65.0	64.0	40.0	T.
					Vineyard Sound, Menemsha Bight:							
1126	Aug. 28	1.46 p. m.	....	....	Gay Head Light-house, W.SW., 2¾ miles.	SE. by E., ¾ mile.	14	Sand, black mud	72.0	66.0	63.5	T.
1127	Aug. 28	2.30	....	....	Gay Head Light-house, W. by S., 3 miles.	E.SE., ½ mile....	10	Gray sand, mud	66.0	......	64.0	T.
1128	Aug. 28	3.10	....	....	Gay Head Light-house, W. ¾ S., 2¾ miles..	S. by E., ½ mile..	9	....do	69.0	66.0	65.0	D.
					North of Noman's Land:							
1129	Sept. 2	2.00	....	....	Fishing Village, S., ½ mile..............	NE. by E., ½ mile.	4	Sand, stones	72.0	65.0	62.0	D.
1130	Sept. 2	2.13	....	....	Fishing Village S. ½ E., ½ mile...........	NW. by N., ½ mile	4	....do	72.0	65.0	62.0	D.
1131	Sept. 2	2.29	....	....	Fishing Village, SE. by E., ½ mile	E. by N., ½ mile..	4	....do	72.0	65.0	63.0	D.

1132	*Sept. 2*	*2.45*	....	....	*Fishing Village, SE. by E., ¼ mile*	*N. NE., ½ mile*	*4*	*....do*	*72.0*	*65.0*	*62.0*	*D.*
1133	*Sept. 2*	*3.10*	....	....	*Fishing Village, SE. ¾ mile*	*E. by S., ¾ mile*	*4*	*.. do*	*72.0*	*65.0*	*62.0*	*D.*
					Vineyard Sound, Menemsha Bight:							
1134	Sept. 6	1.26 p. m.	....	....	Gay Head Light, W. SW. ¾ W., 2¾ miles	NW. by N., ½ mile	9½	Sand, mud	76.0	66.0	64.0	T.
1135	Sept. 6	2.20	....	....	Gay Head Light, W. ¼ S., 3 miles	NE., ½ mile	7½	....do	71.0	66.0	64.0	T.
1136	Sept. 6	3.50	....	....	Gay Head Light, W. SW. ⅞ W., 3 miles	NE., ½ mile	10	Mud	70.0	66.0	63.0	D.
					Atlantic Ocean:							
1137	Sept. 8	6.00 a. m.	39 40	71 52	Off Martha's Vineyard	N. NW., ½ mile	173	Fine sand, pebbles	68.0	70.0	46.0	T.
1138	Sept. 8	7.24	39 39	71 54	......do	NW., 1 mile	168	....do	72.0	71.0	46.0	T.
1139	Sept. 8	8.48	39 37	71 55	......do	NW. by W., 1½ miles.	291	Mud	74.0	72.0	44.0	T.
1140	Sept. 8	10.35	39 34	71 56	......do	N., 1 mile	374	Fine sand, soft mud, pebbles.	78.0	73.0	40.0	T.
1141	Sept. 8	12.27 p. m.	39 32	71 57	......do	W. by N., ½ N., 1 mile.	389	Sand and mud	80.0	74.0	40.0	T.
1142	Sept. 8	1.52	39 32	72 00	......do	W. by S., ½ mile.	322	Mud, with sand and pebbles.	80.0	74.0	41.0	T.
1143	Sept. 8	3.36	39 29	72 01	......do	NW., 2 miles.	452	Soft mud	80.0	74.0	40.0	T.
1144	Sept. 8	6.00	39 31	72 06	......do	N., 1 mile	386	....do	75.0	74.0	41.0	T.
1145*	Sept. 21	....	40 03	70 28	......do	....	135-160	....	.....	.....	.....	C. T.
1146	Sept. 21	....	40 02	70 41	......do	....	130-150	....	.....	.....	.....	C. T.
1147	Sept. 22	....	40 01	71 02	......do	....	125	....	.....	.....	.....	C. T.
1148	Sept. 23	....	39 54	71 22	......do	....	100-125	....	.....	.....	.....	C. T.
1149	Sept. 23	....	39 50	71 25	......do	....	110	....	.....	.....	.....	C. T.
1150	Oct. 4	6.35 a. m.	39 58	70 37	......do	E., ½ mile	140	Sand	65.0	62.0	47.0	T.
1151	Oct. 4	7.45	39 58 30	70 37	......do	E., 2 miles	125	....do	66.0	62.0	48.0	T.
1152	Oct. 4	8.42	39 58	70 35	......do	E., 1½ miles	115	....do	68.0	62.0	48.0	T.
1153	Oct. 4	10.45	39 54	70 37	......do	N., ½ W., 1½ miles.	225	Sand and mud	70.0	62.5	44.0	T.
1154	Oct. 4	12.10 p. m.	39 55 31	70 39	......do	N. by W., 1½ miles.	193	.. do	62.0	62.5	.....	T.
1155	Oct. 4	4.06	39 52	70 30	......do	N. NW., ½ mile	554	Soft mud	64.0	63.0	40.0	T.

* Nos. 1145-1149 indicate the stations of the fishing schooner *Josie Reeves*, using cod trawl-lines.

Dredging stations of the steamer Fish Hawk from 1883 *to* 1887.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Surf.	Bottom.	Apparatus used.
	1883.		° ′ ″	° ′ ″					°	°	°	
1156	Aug. 23	6.00 a. m.	40 13	70 29	Off Nantucket	NW., 1 mile	60	Mud	71.0	67.0	45.0	T.
1157	Aug. 23	6.35	40 14	70 29 15	....do	...do	62	Soft mud	73.0	70.0	45.0	T.
1158	Aug. 23	8.00	40 16	70 31	....do	W. by N., 1 mile	62	Soft green mud	74.0	67.0	45.0	T.
1159	Aug. 23	10.15	40 20	70 35	....do	N., 1 mile	55	Soft mud	74.0	67.5	44.0	T.
1160	Aug. 23	10.25	40 24	70 35	....do	WNW., ¾ mile	41	Black mud	76.0	70.0	43.0	T.
1161	Aug. 23	12.45 p. m.	40 28	70 37	....do	NW. by W., 1 mile	45	....do	77.0	69.0	44.0	T.
1162	Aug. 23	2.15	40 32	70 39	....do	N. by W., 1 mile	45	....do	77.0	68.0	46.5	T.
1163	Aug. 23	3.25	40 35 30	70 41	....do	NW. by W., ¾ mile	31	Sand and mud	77.0	71.0	46.0	T.
1164	Aug. 23	5.00	40 43	70 45	....do	WNW., ¼ mile	31	Mud	75.0	70.0	44.0	T.
1165	Aug. 23	6.25	40 50	70 49	....do		32	Gray sand	73.0	68.0	45.0	T.
					Off Menemsha Bight:							
1166	Aug. 27	1.00			Gay Head, W. ¼ S., 2 miles; north end of Nashawena, N. by W. ¼ W., 6 miles.	NW., ½ mile	8	Sand	77.0	66.5	65.5	T.
1167	Aug. 27	1.45			Gay Head, W. ¾ S., 2¼ miles; north end of Nashawena, NNW., 6 miles.	NW. by W., ½ mile	9	....do	77.0			T.
1168	Aug. 27	2.00			Gay Head, W. by S. ¾ S., 2¼ miles; north end of Nashawena, N. by W. ¾ W., 5½ miles.	ENE., ½ mile	11	....do	76.0			T.
1169	Aug. 27	2.30			Gay Head, W. by S. ¾ S., 2¾ miles; north end of Nashawena, NNW. ¼ W., 5¾ miles.	S., ½ mile	12	....do	77.0	66.0	64.5	T.
1170	Aug. 27	3.00			Gay Head, W. by S., 2¾ miles; north end of Nashawena, NNW., 6¼ miles.	NNW., ¾ mile	12	....do	77.0	67.0	65.0	T.
					Off Martha's Vineyard:							
1171	Sept. 6	12.05			Katama Point, E. ¾ S., 1 mile	W., ⅛ mile	2–4	....do	66.0	68.5	62.0	D.
1172	Sept. 6	12.15			Katama Point, E. ⅛ S., 1½ miles	...do	5	....do	66.0	68.0	62.0	D.
1173	Sept. 6	1.05			Katama Point, E. 2½ miles	...do	2½	....do	66.0	68.0	63.0	D.
1174	Sept. 6	1.43			Katama Point, E. 3¾ miles	S. by E., ⅛ mile	5	....do	67.0	68.0	63.0	D.
1175	Sept. 6	2.05			Katama Point, E. ⅛ S., 3¾ miles	S., ¾ mile	5½	....do	67.0	68.0	63.0	T.
1176	Sept. 6	3.12			SE. end of No Man's Land, W. by S., 7½ miles.	S. by W., ½ mile	13	....do	68.0	67.0	60.0	T.
	1884.				East of Martha's Vineyard:							
1177	Aug. 18	12.00 m.			Near Howe's Shoal and Buoy No. 4	W. by S. ½ S., ½ mile	3–7	....do	78.0	69.0		T.
					Menemsha Bight:							
1178	Aug. 25	12.30 p. m.			Gay Head, SW. ½ W., 1½ miles; S. end of Nashawena, NW., 3 miles.	NE	13	Hard	72.0	66.0		T.
1179	Aug. 25	1.15			Gay Head, SSW., ½ mile; S. end of Nashawena, N. ½ E.	NE., ½ mile	12½	Sticky	79.0	66.0		T.

1180	Aug. 25	1.45	....	....	Gay Head, SSW.; S. end of Nashawena, N. by E.	W. by S., ½ mile	12-14	....do	79.0	66.0	......	T.
					Buzzard's Bay:							
1181	Sept. 2	1.00	....	....	Penikese Island, S., 2½ miles; Hen and Chickens Light-ship, SW. ½ W., 3 miles.	NE., ¼ mile	12	Rocky	76.0	68.0	......	T.
1182	Sept. 2	1.30	....	....	Penikese Island, S., 2¾ miles; Hen and Chickens Light-ship, W. by S., 3½ miles.	NE., ¼ mile	9½	Hard sand	76.0	68.0	......	T.
1183	Sept. 2	2.25	....	....	Penikese Island, SSW., 3 miles Dumpling Light, N., 2¾ miles.	N., ½ mile	11	Sticky	76.0	68.0	......	T.
1184	Sept. 2	2.45	....	....	Dumpling Light, N., 3 miles; S. end of Pasque Island, S. by W., 2½ miles.	E. by S., ½ mile	10	....do	76.0	68.0	......	T.
1185	Sept. 2	3.15	....	....	Dumpling Light, NW. by W., 3¾ miles; NE. end of Pasque Island, S. by W., 2 miles.	ESE., 2 miles	10	....do	78.0	68.0	......	T.
1186	Sept. 2	4.00	....	....	NE. end of Pasque Island, SW. ½ S., 3 miles; to within ½ mile N. of Gt. Weepecket Island.	E., 3 miles	8	....do	78.0	68.0	......	T.
					Vineyard Sound:							
1187	Sept. 8	10.20 a. m.	....	....	Nobska Light, SW. by W., 2 miles; Falmouth Heights, NE. by E., 1½ miles.	S. by E., ½ mile	4-5	Hard sand	72.0	69.0	......	T.
1188	Sept. 8	10.40	....	....	Nobska Light, SW. by W., 2 miles; Falmouth Heights, NE. by E., 1½ miles.	S. by E., ½ mile	4½-5	....do	72.0	69.0	......	T.
1189	Sept. 8	11.20	....	....	Nobska Light, SSW., 2 miles; Falmouth Heights, ENE., 2½ miles.	NW., ½ mile	4¾-5	....do	72.0	69.0	......	T.
1190	Sept. 8	11.40	....	....	Nobska Light, WSW., 2 miles; Falmouth Heights, E. by S., 3 miles.	NNW., ½ mile	3-6	Hard and sticky......	72.0	69.0	......	R. D.
1191	Sept. 8	12.55 p. m.	....	....	Edgartown Light, S. by W., 3 miles; Cape Poge Light, SE., 3 miles.	NW., 1/10 mile	6	Hard and shells......	78.0	69.0	......	T.
	1886.				Menemsha Bight:							
1192	Sept. 4	9.35 a. m.	....	....	Gay Head Light, W., 4 miles; Tarpaulin Cove Light, N. by E. ½ E., 8 miles.	SW	8½	Soft..............	68.0	65.0	69.0	T.
1193	Sept. 4	10.02	....	....	Gay Head Light, W. by S. ½ S., 4 miles; Tarpaulin Cove Light, N. by E. ½ E., 8½ miles.	NE	10½	....do	70.0	65.0	67.0	T.
1194	Sept. 4	10.28	....	....	Gay Head Light, W. by S. ½ S., 4 miles; Tarpaulin Cove Light, N. by E. ½ E., 8½ miles.	NE	11	....do	70.0	65.0	66.0	T.
					Off Falmouth:							
1195	Sept. 4	12.18 p. m.	....	....	Nobska Light, W. by S. ¾ S., 2½ miles; West Chop Light, SE. by S., 9 miles.	....	4½	Hard	71.0	68.0	70.0	T.
1196	Sept. 4	12.34	....	....	Nobska Light, SE. by S., 2½ miles; West Chop Light, W. by S. ½ S., 9 miles.	....	4½	....do	72.0	69.0	70.0	T.

Dredging stations of the steamer Fish Hawk from 1883 *to* 1887—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surf.	Temperatures. Bottom.	Apparatus used.
	1887.				Off Falmouth:				°	°	°	
1197	Aug. 9	10.50	....	....	Nobska Light, S. by W. ½ W.; East Chop Light, SE. ¾ S. 9 miles; Falmouth Heights, EN. E.	....	4½	Shells, sand	72.0	72.0	71.5	T.
1198	Aug. 9	11.05	....	....	Nobska Light, W. ½ S., 2 miles; Falmouth, NE. by E., 1 mile.	E., ¼ mile	4¾	Shells, grass, sand	70.0	72.0	71.5	T.
1199	Aug. 9	11.28	....	....	Nobska Light, SW. by W. ½ W., 1½ miles; East Chop Light, SE., 9 miles.	ESE., ½ mile	4	Shells, sand, gravel, grass.	70.0	72.0	71.5	T.
1200	Aug. 9	11.49	....	....	Nobska Light, W. by S., 2 miles; Falmouth, NE. by E., 1½ miles; East Chop Light, SE. by S., 8½ miles.	S. by E., ½ mile	5½	Sand, shells, mud	70.0	71.0	72.0	T.
1201	Aug. 9	12.20 p.m	....	....	Nobska Light, SW. by W. ½ W., 1¼ miles; East Chop Light, SE. by S. ¾ S., 9 miles.	NE., ¼ mile	2½	Sand, gravel	71.0	71.0	72.0	T.
					Menemsha Bight:							
1202	Aug. 9	3.50	....	....	Gay Head Light, W. ½ S., 4½ miles; Centre Quick's Hole, N. by W. ¼ W.; Tarpaulin Cove, NNE. ¼ E. 7 miles.	NW. ¾ W., ½ mile	7	Hard sand	69.0	67.0	68.0	T.
1203	Aug. 9	4.07	....	....	Gay Head Light, W. by S.; Centre Quick's Hole, N. by W. ⅛ W.; Tarpaulin Cove, NNE. ⅜ E.	NW ¾ W., ¾ mile	8	....do	70.0	69.0	67.0	T.
1204	Aug. 9	4.25	....	....	Gay Head Light, WSW., 3 miles; Centre Quick's Hole, N. by W. ½ W. 3½ miles; Tarpaulin Cove, NE. by N. ½ N., 8 miles.	N. ¾ W., ½ mile	9	....do	70.0	69.0	68.0	T.
					Off East Chop:							
1205	Aug. 11	10.42 a.m	....	....	Nobska Light, NW. ¾ W.; West Chop, W. by N. ¾ N., 2 miles; East Chop, W. by N. ½ N.	W. by S., ¼ mile	10	Shells, sand, rock	73.0	71.0	72.0	D.
1206	Aug. 11	10.55	....	....	Nobska Light, NW. ¼ W., 5½ miles; West Chop, W. by N. ¾ N.; East Chop, W. ⅜ N.	E. by S., ½ S., ½ mile	11	Sand, shells, gravel, mud.	73.0	70.5	72.0	D.
1207	Aug. 11	11.10	....	....	Nobska Light, NW. by W. ¼ W.; West Chop W. by N. ½ N., 3 miles; East Chop, W. ⅝ N.	E. by S. ¼ S., ½ mile	11½	Sand, gravel	73.0	71.0	72.0	D.
1208	Aug. 11	11.29	....	....	Nobska Light, NW. ¾ N.; Edgartown Light, S. ½ W; East Chop, W. by N. ¾ N.	....	10	Sand, gravel, shells	73.0	70.5	72.0	D.

					Muskeget Channel:							
1209	*Aug. 11*	*12.50 p. m*	....	....	*SE. end Martha's Vineyard, SW. ⅜ S.; Cape Poge, N. ⅝ E.; Life-saving station on Muskeget Island, SE. ¾ E.*	*N. ¼ mile*	*5*	*Sand*................	*70.0*	*69.0*	*69.5*	*T.*
1210	Aug. 11	1.13	....	....	SE. end Martha's Vineyard, SW. by S. ¼ S.; Cape Poge, N. ¾ W.; Muskeget, SE. ½ E.	N. ¼ mile............	3	....do	70.5	70.0	71.0	T.
					Buzzard's Bay:							
1211 to 1221	Aug. 15	....	....	....	From West Island to N. end of Wood's Holl.	....	6–8½	Black mud, shells, grass.	69.5	70.0	71.1	D.&T.
					Vineyard Sound:							
1222	Aug. 27	10.08 a. m.	....	....	Nobska Light, N. by W. ½ W.; Tarpaulin Cove, W. ⅜ S.; West Chop, SE. ½ S.	W., ¾ mile............	12½	Sand, shells	67.0	68.0	69.0	D.
1223	Aug. 27	10.20	....	....	Nobska Light, NW. by N. ⅜ N.; Tarpaulin Cove, W. ½ S.; West Chop SE. ¼ S.	W., ¾ mile............	12	....do	67.0	68.0	68.0	D.
1224	Aug. 27	10.36	....	....	Nobska Light, N. ⅛ E.; Tarpaulin Cove, W. ⅜ S.; West Chop, SE. by E. ¾ E.	W., ½ mile............	11½	....do	67.0	68.0	68.0	D.
1225	Aug. 27	10.55	....	....	Nobska Light, N. by E. ¼ E.; Tarpaulin Cove, W. ¾ S.; West Chop, SE. by E. ¼ E.	W., ½ mile............	13	Shells, gravel, sand....	67.0	68.0	68.0	D.
1226	Aug. 27	11.14	....	....	Nobska Light, NNE.; Tarpaulin Cove, W. ⅛ S.; West Chop, E. by S. ⅜ S.	W., ¼ mile............	13	Sand, shells..........	67.0	68.0	68.0	T.
1227	Aug. 27	11.32	....	....	Nobska Light, NE. ¾ N.; Tarpaulin Cove, W. ⅛ S.; West Chop, E. by S. ⅛ S.	W., ¼ mile............	13	....do	67.0	68.0	68.0	T.
1228	Aug. 29	10 42	....	....	Vineyard Sound Light-ship W.; Cuttyhunk, NW. ⅞ W.; Gay Head, SE., ⅞ S.	W., ¼ mile............	18	Sand	65.0	64.0	61.0	T.
1229	Aug. 29	11.12	....	....	Vineyard Sound Light-ship, W. ⅛ S.; Cuttyhunk, NW. ⅛ N.	W., ½ mile............	15½	....do	66.0	64.0	62.0	T.
1230	Aug. 29	11.47	....	....	Vineyard Sound Light-ship, W. ⅜ N.; Cuttyhunk, N. by W. ¾ W.; Gay Head, SE. ⅛ E.	W., ¾ mile............	14	... do	65.0	64.0	61.0	T.
1231	Aug. 29	12.15 p. m.	....	....	Vineyard Sound Light-ship, W. by N. ½ N.; Cuttyhunk, N. by W. ¾ W.; Gay Head, SE. ¾ E.	W., ½ mile............	16	... do	65.0	64.0	62.0	D.
1232	Aug. 29	1.00	....	....	Vineyard Sound Light-ship, W. by N. ⅛ N.; Cuttyhunk, NW. by N. ⅛ N.; Gay Head, SE. ¼ E.	W., ¾ mile............	13	Mud, shells	65.0	64.0	62.5	T.
1233	Aug. 29	1.27	....	....	Vineyard Sound Light-ship, W. ⅞ N.; Cuttyhunk, NW. ⅝ N.; Gay Head, SE. ⅛ S.	W., ½ mile............	13½	Sand, shells..........	65.0	64.0	62.0	T.
1234	Aug. 29	1.49	....	....	Vineyard Sound Light-ship, W. ⅜ N.; Cuttyhunk, NW. by N. ⅛ N.; Gay Head, SE. ¼ E.	W., ¼ mile............	13½	....do	65.0	64.0	62.5	D.

Dredging stations of the Steamer Fish Hawk from 1883 *to* 1887—Continued.

Serial number.	Date.	Hour.	Latitude N.	Longitude W.	Locality.	Drift.	Depth in fathoms.	Nature of bottom.	Temperatures. Air.	Temperatures. Surf.	Temperatures. Bottom.	Apparatus used.
	1887.		° ′ ″	° ′ ″	Vineyard Sound—Continued.				°	°	°	
1235	Aug. 29	2.10 p.m.	....	....	Vineyard Sound Light-ship, W. by N. ½ N.; Cuttyhunk, NW. ⅛ N.; Gay Head, SE. by S. ⅛ S.	W., ¼ mile	12	Sand, shells	65.0	64.0	62.5	T.
					Block Island Sound:							
1236	Aug. 30	9.03 a.m.	....	....	Gay Head Light, NE. by E. ½ E.; Cuttyhunk Light, N. by E.; No Man's Land, SE. by E. ¼ E.	S. by E., ¾ mile	19½	Hard	65.0	62.0	60.0	T.
1237	Aug. 30	10.00	....	....	Gay Head Light, E. by N.; Cuttyhunk, NE. by N.; No Man's Land, SE. by E. ⅜ E.	¾ mile	20	do	67.0	64.0	59.0	T.
1238	Aug. 30	10.45	....	....	Gay Head Light, E. by N. ⅛ N.; Cuttyhunk, NE. by N. ⅜ N.; No Man's Land, ESE.	½ mile	20	Sand, broken shells	65.0	64.0	61.0	D.
1239	Aug. 30	11.35	....	....	Hen and Chickens Light-ship, N. by E. ¼ E.; Cuttyhunk, NE.; No Man's Land, SE. ¾ E.	½ mile	16	Hard	65.0	62.0	61.0	T.
1240	Aug. 30	12.44 p.m.	....	....	Gay Head Light, E. by S. ¾ S.; No Man's Land, SSE. ⅛ E.; Vineyard Sound Light-ship, NW. ⅛ W.	½ mile	18½	Blue mud	64.0	62.0	60.0	T.
					Nantucket Sound:							
1241	Sept. 5	10.27 a.m.	....	....	Bishop and Clerks Light-ship, E. ¾ N.; Succonesset Light-ship, W. by N. ¾ N.	ESE., ¼ mile	21	Sand, broken shells	70.0	68.0	69.5	D.
1242	Sept. 5	10.50	....	....	Bishop and Clerks Light-ship, E. ½ N.; Succonesset Light-ship, W. ½ N.	NNW., ¼ mile	18	Sand, shells	70.0	68.0	69.0	T.
1243	Sept. 5	11.15	....	....	Bishop and Clerks Light-ship, E. ½ N.; Succonesset Light ship, W. ½ N.	N. by E., ¼ mile	15½	Sand, shells, rocks	70.0	68.0	69.5	D.
1244	Sept. 5	11.54	....	....	Bishop and Clerks Light-ship, E. ½ N.; Succonesset Light-ship, W. ½ S., Hyannis Light, NE. by N. ½ N.	W. by N., ¼ mile	5½	Sand, shells, mud	70.0	67.0	69.5	D.
1245	Sept. 5	12.27 p.m.	....	....	Bishop and Clerks Light-ship, E. by S. ½ S.; Collins' Beacon, N. by W. ¾ W.; Hyannis Light, NE. ½ N.	W. by N., ½ mile	4½	Sand, shells	68.0	68.0	69.5	T.
1246	Sept. 5	1.00	....	....	Succonesset Light-ship, SW. ¾ S.; Collins' Beacon, N.; Hyannis Light, NE. ½ N.	W. by N., ½ mile	5½	do	68.0	68.0	69.5	T.
1247	Sept. 6	9.49 a.m.	41 00 45	71 00 05	Southwest of Gay Head	NE. ½ N., ⅜ mile	27	Sand	67.0	65.0	53.5	T.
1248	Sept. 6	10.39	41 02 00	71 00 00	do	do	26½	do	68.0	64.0	55.0	T.
1249	Sept. 6	11.29	41 04 00	70 59 30	do	do	22½	do	67.0	64.0	57.0	T.
1250	Sept. 6	12.30 p.m.	41 06 00	70 59 15	do	do	20½	do	67.0	64.0	58.5	T.
1251	Sept. 6	1.36	41 10 00	70 50 15	do	do	17	do	67.0	64.0	60.0	T.

REPORT OF DREDGINGS OF THE ALBATROSS FOR 1883, BY LIEUT. SEATON SCHROEDER, U. S. N., NAVIGATOR.

The cruising of the *Albatross* during this first year of service has been included between the parallels of 35° and 45° north latitude and the meridians of 64° and 77° west longitude. The number of days under way, the object of each trip, and the distances performed are given in the following table:

Date.	Object.	Miles.
December 30, 1882, to January 3, 1883	Wilmington, Del., to Washington, D. C	339.4
February 10 to February 14	Washington, D. C., to Wilmington, Del	391.9
March 21 to March 25	Dredging	425.4
April 24 to May 9	Dredging and investigating migrations of mackerel.	1,476.6
May 19 to May 29	do	1,025.1
June 17 to June 19	New York to Washington, D. C	426.1
July 6 to July 14	Investigating migrations of mackerel and menhaden.	816.2
July 18 to July 21	Dredging	446.6
July 25	Newport, R. I., to Wood's Holl, Mass	40.0
July 26 to August 3	Dredging	682.3
August 7 to August 10	Investigating migrations of mackerel and menhaden.	423.3
August 12	Newport, R. I., to Wood's Holl, Mass	40.0
August 13	Wood's Holl, Mass., to New Bedford, Mass	24.0
August 18	New Bedford, Mass., to Wood's Holl, Mass	24.0
August 21 to August 25	Investigating migrations of mackerel and menhaden.	951.1
August 29 to September 7	Dredging	859.5
September 11	Wood's Holl, Mass., to New Bedford, Mass	24.0
September 13	New Bedford, Mass., to Wood's Holl, Mass	24.0
September 20 to September 22	Dredging	263.5
September 30 to October 5	do	586.7
October 11	Wood's Holl, Mass., to Newport, R. I	40.0
October 17 to October 19	Investigating migrations of mackerel and menhaden.	286.5
October 22 to October 25	do	411.7
November 5 to November 14	Dredging	1,020.3
December 28 to December 29	Washington, D. C., to Baltimore, Md	180.0
Total, 121 days		11,228.2

I.—*Dredging and trawling record, U. S. Fish Commission steamer Albatross, Lieutenant-Commander Z. L. Tanner, U. S. N., commanding, season of* 1883.

ABBREVIATIONS FOR KINDS OF BOTTOM—C. for clay; g. for gravel; m. for mud; oz. for ooze; p. for pebbles; s. for sand; sh. for shells; sp. for specks; st. for stones; blk. for black; brk. for broken; bu. for blue; crs. for coarse; dk. for dark; fne. for fine; glob. for Globigerina; gn. for green; gy. for gray; wh. for white; yl. for yellow.

Serial number.	Date.	Hour.	Locality.		Temperatures.			Depth.	Kind of bottom.	Wind.		Drift.		Instrument used.
			Latitude north.	Longitude west.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1883.		° ′ ″	° ′ ″	°	°	°	Fathoms.					Miles.	
2001	Mar. 22	3.22 p. m.	37 46 30	74 00 00	36	.....	.....	519	Gn. m	NE.	3	NNW.	1.3	Deep-sea trawl.
2002	Mar. 23	5.50 a. m.	37 20 42	74 17 36	36	48	.....	641	Gn. m	N.	1	SSW.	1.3	Beam trawl.
2003	Mar. 23	8.44 a. m.	37 16 30	74 20 36	39	50	.....	641	.....	NE. to E.	1	NW. by W.	2	Do.
2004	Mar. 23	10.10 a. m.	37 19 45	74 26 06	45	51	.....	102	Gn. m., sh	ENE.	1	SW.	0.6	Do.
2005	Mar. 23	11.52 a. m.	37 18 11	74 27 36	43	50	.....	82	Bu. m. and s., brk. sh	ENE.	3	ENE.	0.5	Do.
2006	Mar. 23	12.58 p. m.	37 19 11	74 26 06	40	50	.....	512	Bu. m., fne. s	SSW.	4	W. by S.	0.5	Do.
2007	Apr. 27	8.00 a. m.	35 17 00	75 13 00	65½	56	68	15	Fne. s	Var.	0–1	ENE.	2	Do.
2008	Apr. 27	10.15 a. m.	35 09 40	75 04 36	67	72	74½	92	Bu. m., fne. s	W.	2	N. by E. ½ E.	1	Do.
2009	Apr. 28	8.45 a. m.	35 29 35	74 46 45	64	69	.....	531	.....	W.	2–3	NE.	2.5	Deep-sea trawl.
2010	Apr. 28	10.40 a. m.	35 30 00	74 44 45	65	61	.....	890	.....	SW.	3	W. by S.	2	Do.
2011	Apr. 30	9.00 a. m.	36 38 30	74 40 10	47	48	.....	81	S. and brk. sh	NNE.	3–4	N. by E.	1.5	Beam trawl.
2012	Apr. 30	10.15 a. m.	36 41 15	74 39 50	47	52	.....	66½	.....	NNE.	3–4	NNE.	1.5	Rake dredge.
2013	Apr. 30	1.05 p. m.	36 45 30	74 25 30	50	48	.....	888	Gn. m	NNE.	3	NW.	2	Beam trawl.
2014	May 1	6.35 a. m.	36 41 05	74 38 55	51½	47	.....	373	Gn. m., fne. s	ENE.	4	N.	2.5	Do.
2015	May 5	8.39 a. m.	37 31 00	74 53 30	49	48	.....	19	Fne. s. and sh	NE.	3	E. by N.	0.5	Do.
2016	May 5	9.06 a. m.	37 31 00	74 52 36	48½	47	45½	19	Fne. s. and sh	NE.	3	E by N.	1	Do.
2017	May 5	9.50 a. m.	37 30 48	74 51 24	47½	46½	45½	18	Fne. s. and sh	NE.	3	.....	.....	Rake dredge.
2018	May 7	12.07 p. m.	37 12 22	74 20 04	62	54	39	788	Bu. m	SW.	2	.....	.....	Deep-sea trawl.
2019	May 7	4.13 p. m.	37 13 52	74 23 52	56½	52¾	39	600	Bu. m	SSW.	2	.....	.....	Do.
2020	May 21	5.30 a. m.	37 37 50	74 15 30	56	54	.....	143	Bu. m., fne. s	SE.	3	SW.	1.5	Beam trawl.
2021	May 21	7.00 a. m.	37 36 00	74 15 00	58	54	45	179	Bu. m., fne. s	SE.	3	W. by S.	2	Do.
2022	May 21	10.00 a. m.	37 32 00	74 13 20	59	52	40	487	Bu. m	E.	3	SW. by S.	2	Deep-sea trawl.
2023	May 21	3.15 p. m.	37 48 00	74 01 30	62	56	.....	377	Blk. m., fne. s	SE.	3	NE.	2	Beam trawl.
2024	May 25	5.51 a. m.	40 02 10	70 27 00	52	49	40½	222	Dk. gn. m	NNW.	2	NW. by N.	2.5	Do.
2025	May 25	7.[illegible]0 a. m.	40 02 00	70 27 00	57	49	40½	239	Gn. m., fne. s	NNW.	2	NW. by N.	2.5	Do.
2026	May 25	9.00 a. m.	40 04 00	70 28 50	58	49	48	131	Gn. m. and s	NNW.	2	NW. ½ N.	1.5	Do.
2027	May 25	12.21 p. m.	39 58 25	70 37 00	56	52	43	198	Bu. m. and s	SW.	3	WSW.	2.5	Do.
2028	May 25	2.05 p. m.	39 57 50	70 32 00	56	52	41	209	Bu. m	SW.	3	WSW.	2.5	Do.
2029	May 25	5.13 p. m.	39 42 00	70 47 00	57	53	38½	1,168	Gy. m	SW.	3–4	WSW.	2	Dredge tangles.
2030	May 26	6.20 a. m.	39 29 45	71 43 00	56	49	.....	588	Bu. m	SW.	2	SW. ½ W.	2	Beam trawl.
2031	May 26	1.05 p. m.	39 29 00	72 19 55	55	50	49½	74	Gy. m., blk. and wh. s	SSW.	3–4	SE.	1.5	Do.
2032	May 26	2.10 p. m.	39 29 00	72 19 40	55	50	47½	74	Gn. m., fne. s., blk. sp	SSW.	3–4	S.	1	Do.
2033	May 26	5.00 p. m.	39 32 30	72 18 35	62	49½	41	379	Gn. m	SSW.	3–4	ENE.	1	Do.
2034	July 17	8.55 a. m.	39 27 10	69 56 20	69	72	38	1,346	Glob. oz	Var.	0–1	WSW.	2.5	Do.
2035	July 17	2.50 p. m.	39 26 16	70 02 37	73	71	.....	1,362	Glob. oz	SE.	2	SE.	2.3	Do.

2036	July 18	4.30 a. m.	38 52 40	69 24 40	82	76	38	1,735	Glob. oz	SE.	3	S.	3.8	Do.
2037	July 18	1.22 p. m.	38 53 00	69 23 30	79	76	38	1,731	Glob oz	NE.	2	E.	3.7	Do.
2038	July 26	2.32 p. m.	38 30 30	69 08 25	77	76½	......	2,033	Glob. oz	NE.	4	NE.	7.5	Deep-sea trawl.
2039	July 28	Noon.	38 19 26	68 20 20	77½	81	......	2,369	Glob. oz	S.	1	SE.	11	Do.
2040	July 29	4.20 a. m.	38 35 13	68 16 00	76	76	......	2,226	Glob. oz	SSW.	6	S. by E.	10	Do.
2041	July 30	3.15 a. m.	39 22 50	68 25 00	71	72	38	1,608	Glob. oz	NW.	3	NW.	10	Do.
2042	July 30	10.32 a. m.	39 33 00	68 26 45	74	71	38½	1,555	Glob. oz	NW.	4	NW.	12	Do.
2043	July 30	5.07 p. m.	39 49 00	68 28 30	71	72	38½	1,467	Glob. oz	W.	3	SW.	9	Do.
2044	July 31	5.25 a. m.	40 00 30	68 37 20	71	72	39	1,067	Oz	W.	2	NW.	7	Do.
2045	July 31	10.00 a. m.	40 04 20	68 43 50	75	72	40	373	Bu. m., fuc. sh	W.	2	WNW.	2.5	Beam trawl.
2046	July 31	Noon.	40 02 49	68 49 00	74	72	40	407	Bu. m	W.	3	WNW.	2.5	Do.
2047	July 31	2.15 p. m.	40 02 30	68 49 40	74	72	52	389	Bu. m	W.	3	WNW.	2.5	Deep-sea trawl.
2048	July 31	3.56 p. m.	40 02 00	68 50 30	73	72	29?	547	Crs. s., m., and g	W.	4	ENE.	2	Do.
2049	Aug. 1	3.35 a. m.	39 43 40	69 20 00	71	71	39	1,025	Bu. m	W.	3	W.	3	Do.
2050	Aug. 1	9.15 a. m.	39 42 50	69 21 20	72	72	44½	1,050	Glob. oz	SW.	3	SW. by S.	3.5	Beam trawl.
2051	Aug. 1	2.34 p. m.	39 41 00	69 20 20	74	72	39	1,106	Bu. m. and glob. oz	SW. by W.	2	SW.	4	Do.
2052	Aug. 1	6.16 p. m.	39 40 05	69 21 25	74	73	45	1,098	Glob. oz	SW. by W.	2	SW.	3	Do.
2053	Aug. 29	5.00 a. m.	42 02 00	68 27 00	60	61	......	105	Bu. m	ESE.	5	NE. by N.	1	Do.
2054	Aug. 29	6.20 a. m.	42 03 30	68 26 00	56	64	......	105	Bu. m	E.	6	NE. by N.	1.4	Dredge.
2055	Aug. 30	9.24 a. m.	42 32 00	68 17 00	60	60	......	99.5	Bu. m., s., and crs. g	E.	3	WSW.	1.5	Do.
2056	Aug. 30	3.23 p. m.	42 01 30	68 01 00	58	57	......	97	Bu. m., fne. s., and crs. g	E.	3	S.	1	Do.
2057	Aug. 30	4.26 p. m.	42 01 00	68 00 30	58	57	......	86	Crs. s., blk. sp., brk. sh	NE.	2	S.	2	Beam trawl.
2058	Aug. 30	6.39 p. m.	41 57 30	67 58 00	58	58	50	35	Gy. s	NNE.	2	SW.	1	Do.
2059	Aug. 31	5.00 a. m.	42 05 00	66 46 15	56	55	......	41	Bu. m. and s	ENE.	3	SSW.	2	Do.
2060	Aug. 31	7.10 a. m.	42 10 00	66 46 15	56	55	......	123	Gy. s., blk. sp., brk. sh	NNE.	4	W.	1.5	Do.
2061	Aug. 31	8.00 a. m.	42 10 00	66 47 45	58	54	40	115	Gy. s., blk. sp., bu. m	NE.	3	NW. by W.	1.5	Do.
2062	Aug. 31	10.47 a. m.	42 17 00	66 37 15	64	61	42	150	S. and g.	NE.	3	NE. by N.	1.5	Do.
2063	Aug. 31	1.26 p. m.	42 23 00	66 23 00	60	57½	46	141	S. and crs. g.	ENE.	3	SE.	1	Do.
2064	Aug. 31	4.32 p. m.	42 25 40	66 08 35	58	56	......	122	Crs. s. and g	N.	2	SE.	1	Do.
2065	Aug. 31	7.00 p. m.	42 27 00	66 00 45	60	55	44½	80	S., g., and brk. sh	N.	2	SE. by E.	1	Rake dredge.
2066	Sept. 1	5.00 a. m.	42 19 40	65 49 30	54	54	43½	65	S., st., and g	NE.	3-4	ENE.	1.5	Do.
2067	Sept. 1	7.05 a. m.	42 15 25	65 48 40	56	58	46	122	S. and g.	NE.	4	NE.	2	Beam trawl.
2068	Sept. 1	10.03 a. m.	42 03 00	65 48 40	60	56	42	131	S., fne. g., and c	ESE.	4	ENE.	2	Do.
2069	Sept. 1	1.34 p. m.	41 54 50	65 48 35	61	56½	42	101	S., st., g., p., and c	NE.	5	E. by N.	1.5	Grapnel dredge.
2070	Sept. 1	2.58 p. m.	41 53 30	65 47 10	61	57	42½	113	P. and c	E.	5	N.	1	Bar and tangles.
2071	Sept. 1	4.10 p. m.	41 56 20	65 48 40	61	57	......	113	P. and c	ENE.	5	N.	1	Grapnel dredge.
2072	Sept. 2	6.15 a. m.	41 53 00	65 35 00	70	56	39	858	Gy. m	S.	3	SE.	5	Beam trawl.
2073	Sept. 2	10.41 a. m.	41 54 15	65 39 00	67	58	40	586.5	Gy. s	SW.	3	NNE.	2	Do.
2074	Sept. 3	6.42 a. m.	41 43 00	65 21 50	71	69	40	1,309	M. and st	WSW.	5	SSE.	4	Do.
2075	Sept. 3	3.41 p. m.	41 40 30	65 35 00	58	58	39	855	Glob. oz	NW.	6	WSW.	2	Do.
2076	Sept. 4	3.20 a. m.	41 13 00	66 00 50	59	69	...	906	Bu. m	NE.	6	SW.	3	Do.
2077	Sept. 4	8.00 a. m.	41 09 40	66 02 20	57	68	39	1,255	Bu. m	NW.	2	NW.	5	Do.
2078	Sept. 4	1.40 p. m.	41 11 30	66 12 20	60	66	40	499	Gy. m. and s	NW.	2	W.	2	Do.
2079	Sept. 4	4.15 p. m.	41 13 00	66 19 50	60	67½	45	75	Wh. s	NW.	2	W.	1.5	Do.
2080	Sept. 4	5.10 p. m.	41 13 00	66 21 50	60	67½	46	55	Gy. s	WSW.	2	WSW.	1.5	Do.
2081	Sept. 4	6.50 p. m.	41 10 20	66 30 20	59	56	46	50	Wh. s., blk. sp	SW.	1	NW. by W.	1	Do.
2082	Sept. 4	7.41 p. m.	41 09 50	66 31 50	58	55	46½	49	Crs. yl. s	SW.	1	NW. by W.	1	Do.
2083	Sept. 5	4.30 a. m.	40 26 40	67 05 15	73	72	40	959	Gy. m	SW.	2	SSW.	2.5	Do.
2084	Sept. 5	9.09 a. m.	40 16 50	67 05 15	73	78½	40	1,290	Bu. m. and s	SW.	3	SSW.	4.0	Do.
2085	Sept. 20	6.56 a. m.	40 05 00	70 34 45	67	68	50	70	Bu. m	E.	3	N. by E.	1.5	Do.
2086	Sept. 20	9.20 a. m.	40 05 05	70 35 00	70	67	52½	69	Bu. m., gy. s	E.	3	NE. ½ E.	1.5	Do.
2087	Sept. 20	10.30 a. m.	40 06 50	70 34 15	71	67	50	65	Gn. m., wh. s	E.	3	NNE.	2	Do.

I.—*Dredging and trawling record, U. S. Fish Commission steamer Albatross, etc.*—Continued.

Serial number.	Date.	Hour.	Locality.		Temperatures.			Depth.	Kind of bottom.	Wind.		Drift.		Instrument used.
			Latitude north.	Longitude west.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1883.		° ′ ″	° ′ ″	°	°	°	*Fathoms.*					*Miles*	
2088	Sept. 20	12.40 p. m.	39 59 15	70 36 30	68	68	48	143	Yl. s	NE. by E.	3	S. by W.	1.5	Beam trawl.
2089	Sept. 20	3.13 p. m.	39 58 50	70 39 40	76	69	45	168	Gy. s	E.	3	N.	1.5	Do.
2090	Sept. 20	4.40 p. m.	39 59 40	70 41 10	71	68	48½	140	Gy. s., brk. sh	ENE.	3	NE.	1.5	Do
2091	Sept. 21	5.30 a. m.	40 01 50	70 59 00	68	69	49	117	Gn. m	E.	3	N.	2.5	Do.
2092	Sept. 21	7.50 a. m.	39 58 35	71 00 30	74	67½	45	197	Gn. m	E.	3	NE.	2.5	Do.
2093	Sept. 21	1.12 p. m.	39 42 50	71 01 20	75	69	39	1,000	Foraminifera, s., m	E.	3	N. by W.	5	Do.
2094	Sept. 21	5.07 p. m.	39 44 30	71 04 00	70	68	38½	1,022	Foraminifera, s., m	NE.	5	NNE.	5	Do.
2095	Sept. 30	9.02 a. m.	39 29 00	70 58 40	71½	69½	......	1,342	Glob. oz	SSW.	3	S.	2	Do.
2096	Sept. 30	2.07 p. m.	39 22 20	70 52 20	70	69	37½	1,451	Glob. oz	SSW.	2	SW.	1.5	Do.
2097	Oct. 1	5.30 a. m.	37 56 20	70 57 30	73	72½	......	1,917	Glob. oz	SW.	3	S. ½ W.	1.5	Do.
2098	Oct. 1	1.08 p. m.	37 40 30	70 37 30	73	72½	......	2,221	Glob. oz	NW.	4	W. by S.	2	Do.
2099	Oct. 2	5.30 a. m.	37 12 20	69 39 00	71	82	......	2,919	Glob. oz	SE.	6	SSW.	2	Do.
2100	Oct. 3	11.05 a. m.	39 22 60	68 34 30	63	69	37½	1,628	Glob. oz	WNW.	3	E.	2	Do.
2101	Oct. 3	4.31 p. m.	39 18 30	68 24 00	61	67	37	1,686	Glob. oz	WSW.	3	S.	2	Do.
2102	Nov. 5	6.53 a. m.	38 44 00	72 38 00	64	62½	39	1,209	Glob. oz	Var.	0-1	SSW.	1.7	Do.
2103	Nov. 5	11.14 a. m.	38 47 20	72 37 00	67	62	39	1,091	Glob. oz	SSW.	1	SSE.	1.5	Do.
2104	Nov. 5	3.41 p. m.	38 48 00	72 40 30	67	63	41½	991	Bu. m	SSE.	2	S.	0.5	Do.
2105	Nov. 6	6.06 a. m.	37 50 00	73 03 50	63	63	41	1,395	Glob. oz	SW.	3	S. by W.	3	Do.
2106	Nov. 6	Meridian.	37 41 20	73 03 20	66	63	42½	1,497	Glob. oz	SSW.	3	S. by W.	3	Do.
2107	Nov. 9	8.23 a. m.	35 19 30	75 15 20	71	76	......	16½	Fne. dk. gy. s., small sh	W.	3	S.	0.5	Do.
2108	Nov. 9	11.00 a. m.	35 16 00	75 02 30	76	78½	66	48	Bu. m., crs. s	SSW.	4	S. by W.	0.5	Do.
2109	Nov. 9	1.03 p. m.	35 14 20	74 59 10	74	76	50½	142	Bu. m	SSW.	4	S.	1	Do.
2110	Nov. 9	2.50 p. m.	35 12 10	74 57 15	76	75½	40	516	Bu. m	SSW.	4	S. by W.	0.8	Do.
2111	Nov. 9	5.25 p. m.	35 09 50	74 57 40	75	76	......	938	Gn. m	SW.	4	S.	1.5	Do.
2112	Nov. 10	9.15 a. m.	35 20 50	75 18 00	70	70	73½	15½	S., blk. sp	SW.	4	SW.	0.8	Do.
2113	Nov. 10	10.04 a. m.	35 20 30	75 19 00	72	70	72½	15	M., blk. s	SW.	4	SW.	1	Do.
2114	Nov. 10	11.15 a. m.	35 20 00	75 20 00	73	70	72	14	M., blk. s	SW.	4	SW. by S.	0.8	Do.
2115	Nov. 11	7.54 a. m.	35 49 30	74 34 45	77	78	39	843	M., fne. s	SW.	4	S. by W.	1.5	Do.
2116	Nov. 11	Meridian.	35 45 23	74 31 25	76	77	39	888	Bu. m., fne. s	WSW.	4	S.	1.5	Do.

REPORT OF DREDGINGS OF THE ALBATROSS FOR 1884, BY LIEUT. SEATON SCHROEDER, U. S. N., NAVIGATOR.

During the year 1884 the geographical limits of the cruising of the *Albatross* were the parallels of 8° 30′ and 43° north latitude and the meridians of 61° 30′ and 85° 30′ west longitude. The number of days at sea and the distances run, together with the object of each trip, are given in the following table:

Date.	Object.	Distance.
		Miles.
January 6 to 7	Baltimore to Norfolk	163
January 10 to 17	Sounding trip	1,417.5
January 24 to 30	Sounding and dredging trip	660.2
February 2	Swinging ship	20
February 3 to 11	Sounding and dredging trip	1,209.4
February 18 to 26	do	1,100.8
February 27 to March 1	do	333.8
March 12 to 16	do	605.1
March 22 to 26	do	420.4
April 2 to 5	do	253
April 9 to 15	do	813.1
April 29	Key West to Havana, Cuba	100
April 30 to May 7	Sounding and dredging trip	603.8
May 11 to 17	Sounding trip	1,279.5
July 13 to 14	Washington to Norfolk	174
July 20 to 26	Investigating migrations of menhaden and mackerel	651.7
July 31 to August 8	Dredging trip	486.4
August 19 to 25	do	429.2
August 27	Wood's Holl to Newport	42
August 28 to 31	Flagship of Honorable Secretary of the Navy	47
September 1	Newport to Wood's Holl	42
September 6 to 15	Dredging trip	943
September 25 to 29	do	424.1
October 8 to 9	Wood's Holl to New York	189
October 17 to 23	Dredging trip	797
December 25 to 26	Washington to Norfolk	174
Total, 134 days		13,388

The number of soundings taken during the year was 701, almost all of which were located with sufficient accuracy to be of hydrographic value; of these, 194 were also dredging stations.

During the winter and spring the vessel was employed in hydrographic work for the Navy Department; searching for reported dangers in the West Indies and between there and the Chesapeake; running lines of soundings across the Caribbean Sea and among some of the islands; taking serial temperatures and noting surface currents; making an examination of a part of Savanilla Bay, United States of Colombia, and establishing the longitude of Cape San Antonio light-house, Cuba.

Following is a list of reported dangers over or near which the depths were found in the positions given:

List of reported dangers.

Name.	Latitude north.	Longitude west.	Depth.
	° ′ ″	° ′ ″	*Fathoms.*
Orion Shoal	34 48 45	72 25 00	2,462
Ashton Shoal	33 50 20	71 42 00	2,953
Perseveranza Shoal	31 15 42	67 39 10	2,787
Mourand Shoal	24 35 14	65 13 07	3,006
Leighton Rock	17 39 30	73 22 15	2,490
Loos Shoal	17 48 00	73 34 15	2,369
Breakers	12 54 40	66 11 10	2,768
Vigia	12 10 30	66 11 00	2,707
Georgia Shoal	Many soundings.		(Least) 17
Tribune Shoal	12 11 30	74 27 30	2,057
Powhatan Shoal	11 11 00	75 50 30	1,195
Doubtful	14 53 40	80 20 00	1,151
Sancho Pardo Shoal	Off Cape San Antonio.		Many.
Albatross Shoal	22 49 20	84 15 00	950
Vigia	23 00 00	83 03 45	625
Huntley Shoal	30 46 00	78 35 00	470

The soundings were such as to prove the non-existence of all except the Georgia Bank off the east end of Jamaica, which had been recently searched for by several vessels. It was originally discovered by Capt. John S. Holt, of the American brig *Georgia*, in 1867, who reported 14 fathoms in about latitude 17° 46′ N., longitude 75° 45′ W. An extensive and careful search was made for this, resulting in the discovery of a bank with a least depth of 17 fathoms a little to the southward of the reported position, in latitude 17° 36′ to 17° 44′ N., longitude 75° 40′ to 75° 45′ W. The Navy Department has given it the name of Albatross Bank. This must not be confounded with the Albatross Shoal off the northwestern shore of Cuba, which was reported by the German gunboat of that name and not subsequently found.

One hundred soundings were taken off Cape San Antonio, extending to just beyond the range of the light, with deep water everywhere (up to 1,200 fathoms), and Sancho Pardo Shoal has, in consequence, been expunged from the charts of the Hydrographic Office, Navy Department.

Six lines of soundings were run across the Caribbean Sea, four between the Leeward Islands and the Main, and diagonal lines on and off the coast of the United States of Colombia. The eastern part of the Caribbean Sea is the deepest, the greatest depth being 2,844 fathoms, in latitude 13° 25′ N., longitude 66° 25′ W. Off the Honduras coast, however, still deeper water was found, there being 3,169 fathoms at 60 miles southwest of the Grand Cayman.

An interesting discovery was that of a submarine ridge connecting the islands of Santa Cruz and Puerto Rico, the least depth on which was 578 fathoms and the greatest 900, while on either side was found over 2,000 fathoms.

Aves Islet, 100 miles westward of Guadaloupe, was found to be the summit of a mountain, precipitous on its western slope and extending in a south-southeast direction over 150 miles to the 1,000-fathom curve.

During the summer and autumn of 1884 hydrographic work was merely incidental, as continuous dredging and trawling generally interfered with the correct locating of the stations. Still, a number of the soundings taken were considered plotted with sufficient accuracy to be of hydrographic value. This work was off the United States coast between Cape Hatteras and George's Banks.

Nothing of special interest was definitely ascertained. But in the course of the season it became very evident that in the vicinity of the 40th parallel and the 70th and 71st meridians there is an easterly and a westerly movement of the water, alternating at intervals of apparently about half a day. Circumstances prevented a close examination into this matter, but, as the approximate time of the change of the current was noticed on several occasions to be later each day, it is believed that the phenomenon may be attributed to the influence of the moon, and that probably there may be tidal currents, less pronounced, but as regular there as along shore.

Indications were also found of a pocket running in northward from the 600-fathom line on about the meridian of 70° 15′, differing from the contour lines on existing charts. But, owing to cloudy weather and the impossibility of keeping a good reckoning while trawling, the positions found were not considered sufficiently reliable to warrant making a report to the Hydrographic Office.

Dredging and Trawling Record of the United States Fish Commission steamer Albatross, Season of 1884.

ABBREVIATIONS USED IN THIS TABLE: m., mud; s., sand; g., gravel; co., coral; sh., shells; p., pebbles; sp., specks; c., clay; st., stones; r., rock; bk., black; wh., white; yl., yellow; gy., gray; bu., blue; dk., dark; lt., light; gn., green; br., brown; hrd., hard; sft., soft; fne., fine; crs., coarse; brk., broken; lrg., large; sml., small; rky., rocky; stk., sticky; oz., ooze; for., foraminifera; glob., globigerina; L. B. T., large beam-trawl; S. B. T., small beam-trawl; Tgl. bar, tangle-bar; Bl. Dr., Blake dredge; Sh. Dr., Ship's dredge. Bl. Dr. = D. S. (deep-sea dredge), and Sh. Dr. = M. B. (mud-bag).

Serial No.	Date.	Time.	Positions.		Temperatures.			Depth in fathoms.	Character of bottom.	Wind.		Drift.		Instrument used.
			Latitude N.	Longitude W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1884.		° ′ ″	° ′ ″									*Miles.*	
2117	Jan. 27	1.58 p. m.	15 24 40	63 31 30	84	78	39.75	683	yl. m. fne. s	ENE.	2	NW. by W.	2.5	L. B. T.
2118	Jan. 28	8.15 a. m.	13 32 40	62 54 00	76	77	....	690	gy. m. bk. s	SE.	2	ENE.	1.7	Do.
2119	Jan. 29	1.07 p. m.	11 48 30	62 17 30	75	77	39.25	1,140	gy. m	NE.	3	SW.	2.5	Do.
2120	Jan. 30	6.30 a. m.	11 07 00	62 14 30	76	76	....	73	bu. m	E.	2	N.	0.2	Dr. Tgl.
2121	Feb. 3	6.37 a. m.	10 37 40	61 42 40	76	77	67	31	dk. slate-col. m	NW. by W.	2	....	....	L. B. T.
2122	Feb. 3	7.18 a. m.	10 37 00	61 44 22	77	77	73	34	dk. slate-col. m	NW. by W.	2	....	....	Do.
2123	Feb. 3	8.45 a. m.	10 42 02	61 48 48	78	78	64.5	117	bu. m	NE. by N.	2	....	....	Do.
2124	Feb. 18	2.03 p. m.	11 34 30	69 02 10	77	74	59.5	122	fne. sh. gn. m	E. by S.	2	NW. by N.	....	Sh. Dr.
2125	Feb. 18	4.31 p. m.	11 43 00	69 09 30	75	74	50.7	208	yl. m. s. bk. sp	E. by N.	2	W. by S.	....	S. B. T.
2126	Feb. 19	10.11 a. m.	13 17 45	70 01 00	78	77	39.3	1,701	yl. m. crs. s. for	ENE.	3-4	NNE.	....	Do.
2127	Feb. 25	3.14 p. m.	19 45 00	75 04 00	78	77	....	1,639	gn. m	WSW.	3	W. $\frac{1}{8}$ S.	....	L. B. T.
2128	Feb. 27	10.58 a. m.	19 55 46	75 49 23	78	78	49.5	400	bu. m. fne. s	SE.	1	E. to ENE.	....	Tgl. bar.
2129	Feb. 27	12.25 p. m.	19 56 04	75 48 55	77	78	....	274	bu. m. fne. s	SE.	2	E. to ENE.	....	Do.
2130	Feb. 27	1.04 p. m.	19 56 25	75 49 49	77	79	....	175	gy. m. s. brk. sh	SE.	2	E. to ENE.	....	Do.
2131	Feb. 27	2.00 p. m.	19 56 44	75 50 49	78	79	....	202	hrd. crs. s	SE.	3	E. to ENE.	....	Do.
2132	Feb. 27	3.33 p. m.	19 55 38	75 49 16	78	79	....	478	yl. m. brk. sh	SE.	3	E. to ENE.	....	Do.
2133	Feb. 27	4.30 p. m.	19 55 55	75 48 03	79	79	....	290	wh. s. brk. sh	SE.	3	E. to ENE.	....	Do.
2134	Feb. 27	5.37 p. m.	19 56 06	75 47 32	77	78	....	254	....	SE.	3	ESE.	....	Do.
2135	Feb. 27	6.31 p. m.	19 55 58	75 47 07	77	77	....	250	hrd. co	SE.	3	ESE. to SSE.	....	Do.
2136	Feb. 29	2.04 p. m.	17 43 40	75 38 25	81	78	....	52	co. brk. sh	SE.	3	NW. by W. $\frac{3}{8}$ W.	....	Do.
2137	Feb. 29	2.29 p. m.	17 41 50	75 39 20	81	78	....	47	co. brk. sh	SE.	3	NW. by W. $\frac{3}{8}$ W.	....	Do.
2138	Feb. 29	5.36 p. m.	17 44 05	75 39 00	78	78	....	23	co. brk. sh	SE.	3	S. $\frac{1}{2}$ E.	....	Do.
2139	Mar. 11	2.56 p. m.	17 52 00	76 45 30	80	79	62.3	215	bk. m	ESE.	4	....	....	Do.
2140	Mar. 11	7.18 p. m.	17 36 10	76 46 05	80	78	39.7	966	s	E.	3	NNE. $\frac{3}{4}$ E.	....	S. B. T.
2141	Mar. 12	11.29 a. m.	17 25 00	75 59 55	78	77	....	5	co. s	E.	5	S. by E. $\frac{3}{4}$ E.	....	Tgl. bar.
2142	Mar. 23	4.05 p. m.	9 30 15	76 20 30	81	81	....	42	gn. m. s	WNW.	2	W. $\frac{1}{2}$ S.	....	S. B. T.
2143	Mar. 23	5.01 p. m.	9 30 45	76 25 30	80	80	....	155	gn. m	NNW.	2	W. $\frac{1}{8}$ S.	....	Do.
2144	Mar. 25	6.46 a. m.	9 49 00	79 31 30	78	79	....	896	gn. m	N.	1	SSW.	....	L. B. T.
2145	Apr. 2	10.41 a. m.	9 27 00	79 54 00	80	79	....	25	gn. m. brk. sh	NNE.	4	....	....	Sh. Dr.
2146	Apr. 2	12.03 p. m.	9 32 00	79 54 30	80	79	....	34	brk. sh	NNE.	4	....	....	L. B. T.
2147	Apr. 2	12.46 p. m.	9 32 20	79 54 45	80	79	78.5	34	co	NNE.	4	....	....	Tgl. bar

2148	Apr. 2	1.39 p. m.	9 85 00	79 55 30	81	79	78.25	130	hrd	NNE.	4			Do.
2149	Apr. 4	9.31 a. m.	13 01 30	81 25 00	80	78	39.7	992	yl. m	NE. by N.	3			Do.
2150	Apr. 9	9.15 a. m.	13 34 45	81 21 10	82	78	45.75	382	wh. crs. s	NNE.	3			Dr. & Tgl. bar.
2151	Apr. 10	11.03 a. m.	15 28 39	80 36 00	79	78	40.2	653	yl. for. oz	NE. to ENE.	3			L. B. T.
2152	Apr. 30	6.05 a. m.	2½ m. NW. of Havana Light.		71	77	49	387	co	ESE.	1			Tgl. bar.
2153	Apr. 30	7.11 a. m.	23 10 19	82 23 10	74	77	55.8	283	co	ESE.	2			Do.
2154	Apr. 30	8.08 a. m.	23 10 16	82 22 54	76	77	59.6	310	co	ESE.	2			Do.
2155	Apr. 30	9.09 a. m.	23 10 21	82 22 44	76	77		300	co	ESE.	3			Do.
2156	Apr. 30	10.42 a. m.	23 10 35	82 21 55	78	77	59.8	278	co	E. by N.	4			Do.
2157	Apr. 30	11.40 a. m.	23 10 04	82 21 07	78	77		29		ENE.	3			Do.
2158	Apr. 30	12.07 p. m.	23 10 25	82 20 36	78	77		86		ENE.	3			Do.
2159	Apr. 30	1.05 p. m.	23 10 39	82 20 09	80	77		98	co	ENE.	3			Do.
2160	Apr. 30	2.04 p. m.	23 10 31	82 20 37	79	77		167	co	ENE.	4			Do.
2161	Apr. 30	2.48 p. m.	23 10 36	82 20 28	78	78		146	co	ENE.	4			Do.
2162	Apr. 30	3.36 p. m.	23 10 30	82 20 25	79	78		122	co	ENE.	4			Do.
2163	Apr. 30	4.24 p. m.	23 10 31	82 20 29	79	78		133	co	ENE.	4			Do.
2164	May 1	6.21 a. m.	23 10 39	82 20 29	71	77		192	co	ESE.	2			Do.
2165	May 1	7.19 a. m.	23 10 39	82 20 28	71	77		200	co	ESE.	2			Do.
2166	May 1	8.27 a. m.	23 10 36	82 20 30	74	77	71.9	196	co	ESE.	3			Do.
2167	May 1	9.33 a. m.	23 10 40	82 20 30	80	78		201	co	ESE.	3			Do.
2168	May 1	10.24 a. m.	23 10 36	82 20 20	80	78		122	co	ESE.	3			Do.
2169	May 1	10.46 a. m.	23 10 28	82 20 27	79	78		78	co	ESE.	3			Do.
2170	July 20	11.40 a. m.	37 57 00	73 53 30	72	71		155	gy. s	NE.	2			Do.
2171	July 20	1.25 p. m.	37 59 30	73 48 40	75	75	39.5	444	gn. m	NNW.	2			Do.
2172	July 20	3.45 p. m.	38 01 15	73 44 00	76	76	39	568	gn. m	NW.	1			Do.
2173	July 21	6.26 a. m.	37 57 00	72 34 00	70	70	37	1,600	glob. oz	NNW.	1			Do.
2174	July 21	2.59 p. m.	38 15 00	72 03 00	73	76		1,594	gy. m	W.	4			Do.
2175	July 22	9.03 a. m.	39 33 00	72 18 30	69	68	40.5	452	gn. m.	WSW.	4			S. B. T.
2176	July 22	12.34 p. m.	39 32 30	72 21 30	71	68	41	302	bk. m	WSW.	3			L. B. T.
2177	July 22	3.40 p. m.	39 33 40	72 08 45	71	68	52	87	gn. m. s	W. by N.	3			Do.
2178	July 22	5.16 p. m.	39 29 00	72 05 15	70	68	42.3	229	gn. m. s	WSW.	4			Do.
2179	July 23	4.02 a. m.	39 30 10	71 50 00	68	67	39.5	510	bk. m	WSW.	4			Do.
2180	July 23	6.48 a. m.	39 29 50	71 49 30	72	68	39.5	523	bk. m	WSW.	3			Do.
2181	July 23	9.42 a. m.	39 29 00	71 46 00	75	68	39	693	gy. m. fne. s	WSW.	3			Do.
2182	July 23	12.58 p. m.	39 25 30	71 44 00	70	68	39	861	gn. m	SW.	5			Do.
2183	Aug. 2	11.52 a. m.	39 57 45	70 56 30	69	68	44.5	195	gn. m. s	SE.	1	NE.	.75	Do.
2184	Aug. 2	1.08 p. m.	40 00 15	70 55 30	71	70	48.9	136	gn. m. s	SE.	1	NE.	1	Do.
2185	Aug. 2	2.12 p. m.	40 00 45	70 54 15	74	69	51	129	gn. m. s	SE.	1	N. by E.	1	Do.
2186	Aug. 2	6.12 p. m.	39 52 15	70 55 30	70	69	39.7	353	gn. m. s	SW.	1	WNW.	.50	Do.
2187	Aug. 3	10.44 a. m.	39 49 30	71 10 00	70	68	39.7	420	gn. m. s	ESE.	3	ENE.	.75	Do.
2188	Aug. 3	1.54 p. m.	39 54 30	71 08 00	73	70	42.7	235	gn. m. s	ESE.	2	E. by S.	.75	Do.
2189	Aug. 4	4.16 a. m.	39 49 30	70 26 00	71	71	39.7	600	gn. m. s	WSW.	3	ESE.	1	Do.
2190	Aug. 4	10.42 a. m.	39 40 00	70 20 15	74	73		1,180	glob. oz	SSW.	4	ENE.	1	Do.
2191	Aug. 4	2.46 p. m.	39 45 30	70 17 00	74	73		961	gn. m	SW.	5	NE.	1	Lost trawl.
2192	Aug. 5	5.45 a. m.	39 46 30	70 14 45	76	72	38.6	1,060	gy. oz	SSW.	4	NNE.	.75	L. B. T.
2193	Aug. 5	11.04 a. m.	39 44 30	70 10 30	79	73	38.4	1,122	gn. m	SSW.	5	S.	1.5	Do.
2194	Aug. 5	2.54 p. m.	39 43 45	70 07 00	77	74	38.4	1,140	oz	SSW.	4	S. by E.	1.25	Do.
2195	Aug. 5	6.42 p. m.	39 44 00	70 03 00	83	74	38.4	1,058	gn. m	SSW.	4	S.	1 5	Do.
2196	Aug. 6	4.45 a. m.	39 35 00	69 44 00	74	74	38	1,230	gn. m	SSW.	3	NNW.	1.5	Do.
2197	Aug. 6	11.24 a. m.	39 56 30	69 43 20	77	74	52.3	84	s. brk. sh	S.	2	NE.	1.5	Do.
2198	Aug. 6	1.17 p. m.	39 56 30	69 43 20	78	74	52.3	84	s. brk. sh	SSW.	2	NE.	2	Do.
2199	Aug. 6	2.03 p. m.	39 57 30	69 41 10	77	74		78	gy. s	SSW.	2	WSW.	1	Do.

Dredging and Trawling Record of the United States Fish Commission steamer Albatross, Season of 1884—Continued.

Serial No.	Date.	Time.	Positions.		Temperatures.			Depth in fathoms.	Character of bottom.	Wind.		Drift.		Instrument used.
			Latitude N.	Longitude W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1884.		° ′ ″	° ′ ″									*Miles.*	
2200	Aug. 6	4.38 p. m.	39 53 30	69 43 20	77	74	45	148	crs. s. bk. sp	SSW.	2	SE. by E.	2	L. B. T.
2201	Aug. 19	6.10 a. m.	39 39 45	71 35 15	69	66	39.5	538	bn. m	NNE.	5	W.	2	Do.
2202	Aug. 19	9.23 a. m.	39 38 00	71 39 45	70	67	39.1	515	gn. m	N.	6	WSW.	1.75	Do.
2203	Aug. 19	12.29 p. m.	39 34 15	71 41 15	74	74	38.9	705	gn. m. s	NNW.	6	WSW.	2.5	Do.
2204	Aug. 19	4.32 p. m.	39 30 30	71 44 30	71	74	39.1	728	br. m	W.	4	WSW.	2.5	Do.
2205	Aug. 20	4.37 a. m.	39 35 00	71 18 45	68	73	38.1	1,073	gy. oz	NW.	4	W. by S.	1.25	Do.
2206	Aug. 20	9.16 a. m.	39 35 00	71 24 30	71	74	38.4	1,043	gn. m	NW.	2	NNE.	1.25	Do.
2207	Aug. 20	1.01 p. m.	39 35 33	71 31 45	77	74	38.6	1,061	gn. m	W.	1	NNE.	1.25	Do.
2208	Aug. 21	5.02 a. m.	39 33 00	71 16 15	75	74	38.4	1,178	gn. m	W by N.	3	WSW.	1	Do.
2209	Aug. 21	9.42 a. m.	39 34 45	71 31 30	76	74	39.5	1,080	gn. m. s	WNW.	2	E.	1.25	Do.
2210	Aug. 21	1.18 p. m.	39 37 45	71 18 45	75	74	38.1	991	glob. oz.	SW.	5	S. by W.	1.5	Do.
2211	Aug. 21	4.45 p. m.	39 35 00	71 18 00	74	74	38.3	1,064	gy. oz	SW by S.	3	S. by W.	2	Do.
2212	Aug. 22	4.48 a. m.	39 59 30	70 30 45	72	71	40	428	gn. m	SSW.	2	E.	.5	Do.
2213	Aug. 22	8.04 a. m.	39 58 30	70 30 00	73	71	39.5	384	gn. m	SSW.	2	S. by W.	1.5	Do.
2214	Aug. 22	11.30 a. m.	39 57 00	70 32 00	74	74	39.5	475	gn. m	SW.	3	SSW.	1.75	Do.
2215	Aug. 22	3.13 p. m.	39 49 15	70 31 45	77	74	....	578	lost ther	SSW.	4	SW.	1.5	Do.
2216	Aug. 22	5.38 p. m.	39 47 00	70 30 30	81	71	39.5	963	gn. m	SSW.	2	S.	1.75	Do.
2217	Aug. 23	4.49 a. m.	39 47 20	69 34 15	75	73	38.1	924	gy. m	SW.	3	S.	1.25	Do.
2218	Aug. 23	10.41 a. m.	39 46 22	69 29 00	72	74	38.8	948	gy. m	SW.	2	SE. by S.	1.75	
2219	Aug. 23	1.36 p. m.	39 46 22	69 29 00	72	74	38.8	948	gy. m	SW.	2	SE. by S.	1.75	
2220	Aug. 23	4.18 p. m.	39 43 30	69 23 00	75	74	38.3	1,054	gy. m	SW.	3	SE. by S.	1.5	
2221	Sept. 6	9.01 a. m.	39 05 30	70 44 30	77	75	36.9	1,525	gy. oz	WSW.	2	SW. ½ S.	1.25	
2222	Sept. 6	2.20 p. m.	39 03 15	70 50 45	74	73	36.9	1,537	gy. oz	WSW.	3	SW. ¼ S.	2	
2223	Sept. 7	5.07 a. m.	37 48 30	69 43 30	79	75	36.4	2,516	glob. oz.	NW.	3	SE.	2	
2224	Sept. 8	8.31 a. m.	36 16 30	68 21 00	78	79	36.8	2,574	glob. oz.	NW.	2	W.	3.5	
2225	Sept. 9	5.47 a. m.	36 05 30	69 51 45	77	78	36.7	2,512	yl. oz.	WSW.	2	SW. ½ S.	2.5	
2226	Sept. 10	5.06 a. m.	37 00 00	71 54 00	78	80	36.8	2,045	glob. oz.	SW.	4	S.	1	
2227	Sept. 10	12.24 p. m.	36 55 23	71 55 00	81	82	36.8	2,109	glob. oz.	SW.	3	SSW.	2	Lost trawl.
2228	Sept. 11	5.10 a. m.	37 25 00	73 06 00	77	77	36.8	1,582	br. m.	SW.	3	S.	2	L. B. T.
2229	Sept. 11	4.12 p. m.	37 38 40	73 16 30	79	75	37.7	1,423	glob. oz.	SW.	2	W. ½ N.	2	Do.
2230	Sept. 12	4.37 a. m.	38 27 00	73 02 00	75	75	36.8	1,168	gy. oz.	WSW.	2	W.	1.5	Do.
2231	Sept. 12	9.42 a. m.	38 29 00	73 09 00	77	75	36.8	965	gy. oz.	W.	3	NW.	1.5	Do.
2232	Sept. 12	2.48 p. m.	38 37 30	73 11 00	72	74	42.8	243	gn. m.	NE.	4	NNE.	1.5	Do.
2233	Sept. 12	4.16 p. m.	38 36 30	73 06 00	69	73	39.2	630	gn. m.	NE.	5	NNE.	1.5	Do.
2234	Sept. 13	4.30 a. m.	89 09 00	72 03 15	71	69	38.6	810	gn. m.	ENE.	3	NE. by N.	1.75	Do.
2235	Sept. 13	7.33 a. m.	39 12 00	72 03 30	76	72	38.8	707	gn. m.	NE.	4	NE. by E.	1.25	Do.
2236	Sept. 13	9.49 a. m.	39 11 00	72 08 30	68	72	39.5	636	gn. m.	NNE.	4	N. by E.	1.5	Do.
2237	Sept. 13	11.42 a. m.	39 12 17	72 09 30	70	72	39.5	520	gn. m.	NNE.	4	SW.	1.25	Do.

2238	Sept. 13	2.26 p. m.	39 06 00	72 10 00	71	72	38.7	904	gy. m.	N.	5	NNW.	1.75	Do.
2239	Sept. 26	5.05 a. m.	40 38 00	70 29 45	62	62	....	32	gn. m.	NNE.	5	SSW.	1	Do.
2240	Sept. 26	7.29 a. m.	40 27 30	70 29 00	62	61	....	44	gn. m.	NNE.	6	SSW.	1	Do.
2241	Sept. 26	9.20 a. m.	40 21 00	70 29 15	63	63	51.4	50	gn. m.	NE.	6	SW.	1	Do.
2242	Sept. 26	11.33 a. m.	40 15 30	70 27 00	63	63	51.4	58	gn. m	NE.	6	SW.	1	Do.
2243	Sept. 26	1.13 p. m.	40 10 15	70 26 00	65	64	52.4	63	gn. m	NE.	6	SW.	1	Do.
2244	Sept. 26	3.11 p. m.	40 05 15	70 23 00	66	71	52.9	67	gn. m. s	NE.	6	SW.	1	Do.
2245	Sept. 26	4.50 p. m.	40 01 15	70 22 00	61	61	50.9	98	gn. m. bk. s.	NE.	6	WNW.	1	Do.
2246	Sept. 26	6.42 p. m.	39 56 45	70 20 30	64	71	48.8	122	gn. m	NE.	6	NE. by N.	1.25	Do.
2247	Sept. 27	4.57 a. m.	40 03 00	69 57 00	61	70	51.9	78	gn. m. s	E.	3	ESE.	.5	Do.
2248	Sept. 27	6.50 a. m.	40 07 00	69 57 00	64	70	52.4	67	gn. m. bk. s	E.	3	N. by E.	.75	Do.
2249	Sept. 27	8.24 a. m.	40 11 00	69 52 00	64	70	51.4	53	gn. m. fne. s.	E.	4	E.	1	Do.
2250	Sept. 27	10.04 a. m.	40 17 15	69 51 45	63	68	51.4	47	gn m. fne. s.	E.	4	E.	.75	Do.
2251	Sept. 27	12.02 p. m.	40 22 17	69 51 30	62	65	50.9	43	gn. m. fne. s	E.	3	NNE.	.5	Do.
2252	Sept. 27	1.46 p. m.	40 28 00	69 51 00	62	63	50.3	38	gn. m. fne. s	SE.	2	NNE.	.5	Do.
2253	Sept. 27	3.11 p. m.	40 34 30	69 50 45	61	61	52.9	32	gy. s. bk. sp	E.	2	NNE.	.75	Do.
2254	Sept. 27	4.39 p. m.	40 40 30	69 50 30	61	61	54.4	25	gy. s. bk. sp	E.	2	NNE.	.75	Do.
2255	Sept. 27	6.10 p. m.	40 46 30	69 50 15	61	60	55.9	18	fne. s. bk. sp	E.	1	NNE.	.75	Do.
2256	Sept. 28	5.42 a. m.	40 38 30	69 29 00	62	61	52.9	30	yl. s.	SSW.	2	SSE.	1	Do.
2257	Sept. 28	7.17 a. m.	40 32 30	69 29 00	62	61	51.9	33	yl. s. bk. sp	SW.	2	S. by W.	1	Do.
2258	Sept. 28	8.34 a. m.	40 26 00	69 29 00	63	61	51.2	36	gy. s. bk. sp	SW.	2	S. by W.	.75	Do.
2259	Sept. 28	9.56 a. m.	40 19 30	69 29 10	64	61	50 2	41	gy. s. bk. sp	SW.	2	S. by W.	.75	Do.
2260	Sept. 28	11.13 a. m.	40 13 15	69 29 15	68	65	50.2	40	gy. s	SW.	3	S. by W.	.75	Do.
2261	Sept. 28	12.52 p. m.	40 04 00	69 29 30	69	66	53.9	58	gy. s. bk. sp	SW.	4	S. by W.	.75	Do.
2262	Sept. 28	2.51 p. m.	39 54 45	69 29 45	72	67	41.6	250	gn. m. s	SW.	4	S. by W.	.75	Do.
2263	Oct. 18	1.06 p. m.	37 08 00	74 33 00	67	66	....	430	gn. m.	W.	5	SSE.	1	Do.
2264	Oct. 18	2.37 p. m.	37 07 50	74 34 20	67	66	46.8	167	gy. s	W.	5	WSW.	1	Do.
2265	Oct. 18	3.47 p. m.	37 07 40	74 35 40	65	67	57.9	70	gn. m. gvl	W.	5	WSW.	1.5	Do.
2266	Oct. 19	6.00 a. m.	35 07 00	75 08 30	69	78	62.8	111	fne. s. bk. sp	NE.	5	N.	.5	S. B. T.
2267	Oct. 19	6.39 a. m.	35 08 50	75 07 20	67	79	72.8	68	gy. m.	NE.	5	NE.	2	Tgl. bar.
2268	Oct. 19	7.43 a. m.	35 10 40	75 06 10	67	79	71.3	68	gy. m.	NE.	5	NE.	2	Do.
2269	Oct. 19	8.46 a. m.	35 12 30	75 05 00	70	75	77	48	crs. gy. bk. s.	ENE.	4	WNW.	2	Do.
2270	Oct. 19	9.40 a. m.	35 14 15	75 07 00	70	75	76.3	32	fne. gy. s. bk. sp.	ENE.	4	W.	1.75	D. S. dredge.
2271	Oct. 19	10.45 a. m.	35 16 00	75 09 00	70	75	....	26	crs. gy. s. bk. sp.	ENE.	4	W.	2	S. B. T.
2272	Oct. 19	11.57 a. m.	35 20 10	75 14 00	69	75	....	15	gy. s. bk. sp	ENE.	3	WSW.	2	Do.
2273	Oct. 19	12.45 p. m.	35 20 30	75 17 30	69	72	72.3	17	gy. s. brk. sh	ENE.	3	WNW.	2	Do.
2274	Oct. 19	1.22 p. m.	35 20 35	75 18 05	68	71	....	18	gy. s. brk. sh	NE.	2	WSW.	1.5	Dr. S. dredge.
2275	Oct. 19	1.43 p. m.	35 20 40	75 18 40	67	71	....	16	gy. s. brk. sh	NE.	3	WNW.	1	Dr. & M. B.
2276	Oct. 19	2.08 p. m.	35 20 45	75 19 15	67	71	....	15	gy. s. brk. sh.	NE.	3	WNW.	1	Do.
2277	Oct. 19	2.21 p. m.	35 20 50	75 19 50	67	71	....	16	gy. s. brk. sh	NE.	3	WSW.	.75	Do.
2278	Oct. 19	2.45 p. m.	35 20 55	75 20 20	67	71	....	16	gy. s. brk. sh	NE.	3	WSW.	.75	L. B. T.
2279	Oct. 19	3.36 p. m.	35 20 55	75 20 55	67	71	....	16	gy. s. brk. sh	NE.	3	WSW.	.75	Do.
2280	Oct. 19	4.15 p. m.	35 21 00	75 21 30	67	70	....	16	gy. s. brk. sh	NE.	3	WSW.	.75	Do.
2281	Oct. 19	4.35 p. m.	35 21 05	75 22 05	67	70	....	16	gy. s. brk. sh	NE.	3	WSW.	.75	Do.
2282	Oct. 19	5.13 p. m.	35 21 10	75 22 40	68	70	....	14	bk. s	NE.	3	NW. by W.	.75	Do.
2283	Oct. 19	5.41 p. m.	35 21 15	75 23 15	68	70	....	14	gy. s	NE.	3	N. by W.	.5	Do.
2284	Oct. 19	6.09 p. m.	35 21 20	75 23 50	67	70	....	13	crs. gy. s	NE.	3	WNW.	.5	Do.
2285	Oct. 19	6.40 p. m.	35 21 25	75 24 25	67	70	....	13	crs. gy. s	NE.	3	WNW.	.75	Do.
2286	Oct. 19	7.13 p. m.	35 21 30	75 25 00	67	70	....	11	crs. gy. s	NE.	2	WNW.	.5	Do.
2287	Oct. 20	6.15 a. m.	35 22 30	75 26 00	68	69	....	7	crs. gy. s	ESE.	2	E. by N.	.5	Do.
2288	Oct. 20	6.45 a. m.	35 22 40	75 25 30	68	69	....	7	crs. s. brk. sh.	ESE.	2	E. by N.	.5	Do.
2289	Oct. 29	7.15 a. m.	35 22 50	75 25 00	70	69	....	7	crs. s. bk. sp	ESE.	2	E. by N.	.5	Do.

Dredging and Trawling Record of the United States Fish Commission steamer Albatross, Season of 1884—Continued.

Serial No.	Date.	Time.	Positions.		Temperatures.			Depth in fathoms.	Character of bottom.	Wind.		Drift.		Instruments used.
			Latitude N.	Longitude W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1884.		° ′ ″	° ′ ″									*Miles.*	
2290	Oct. 20	7.45 a. m.	35 23 00	75 24 30	70	69	....	9¼	s. brk. sh	ESE.	2	ENE.	.5	L. B. T.
2291	Oct. 20	8.45 a. m.	35 25 30	75 20 30	70	69	....	15	gy. s. brk. sh	ESE.	2	ENE.	.5	Do.
2292	Oct. 20	9.32 a. m.	35 27 20	75 16 30	72	70	....	17	gy. s. brk. sh	ESE.	2	E. by N.	.5	Do.
2293	Oct. 20	10.25 a. m.	35 29 10	75 12 30	71	71	....	18	crs. s. bk. sp	ESE.	2	E. by N.	.5	Do.
2294	Oct. 20	11.18 a. m.	35 31 00	75 08 30	73	71	....	19	crs. gy. s	ESE.	2	E. by N.	.5	Do.
2295	Oct. 20	12 03 p. m.	35 32 41	75 04 30	76	73	....	22	crs. gy. s	ESE.	2	E. by N.	.5	Do.
2296	Oct. 20	1.15 p. m.	35 35 20	74 58 45	75	71	....	27	crs. gy. s	SE.	2	E. by N.	.5	Do.
2297	Oct. 20	2.18 p. m.	35 38 00	74 53 00	75	73	....	49	bk. m. brk. sh	SE.	1	E. by N.	.75	Do.
2298	Oct. 20	2.55 p. m.	35 39 00	74 52 00	74	73	....	80	bk. m. brk. sh	SE.	1	E. by N.	.75	Do.
2299	Oct. 20	3.50 p. m.	35 40 00	74 51 30	74	73	....	296	bk. m	SE.	1	E. by N.	.75	Do.
2300	Oct. 20	5.20 p. m.	35 41 30	74 48 30	71	71	....	671	bk. m	SE.	1	E. by N.	1	Do.
2301	Oct. 21	6.10 a. m.	35 11 30	75 05 00	73	77	75	59	crs. s. bk. sp	SE.	1	NNE.	.5	Tgl. bar.
2302	Oct. 21	6.45 a. m.	35 14 00	75 03 00	74	77	71.4	49	s. co	ESE.	2	NE.	.25	Do.
2303	Oct. 21	7.11 a. m.	35 17 00	75 01 00	74	77	....	41	fne. gy. & bk. s	ESE.	2	NE.	.25	S. B. T.
2304	Oct. 21	7.40 a. m.	35 19 00	74 58 00	74	77	....	37	fne. gy. & bk. s	ESE.	2	E.	.5	Do.
2305	Oct. 21	8.36 a. m.	35 23 00	74 51 30	77	79	66.2	58	fne. gy. & bk. s	ESE.	2	E.	.5	Do.
2306	Oct. 21	11.00 a. m.	35 21 30	74 52 00	76	79	41.7	322	gy. m	ESE.	2	E.	.5	L. B. T.
2307	Oct. 21	4.11 p. m.	35 42 00	74 54 30	76	70	57.3	43	gy. & bk. s	ESE.	2	NE.	1	Do.
2308	Oct. 21	5.17 p. m.	35 43 00	74 53 30	72	71	....	45	gy. & bk. s	SE.	1	NE.	1	Do.
2309	Oct. 21	6.08 p. m.	35 43 30	74 52 00	72	71	....	56	gy. s. brk. sh	SE.	1	NE.	.5	Do.
2310	Oct. 21	6.59 p. m.	35 44 00	74 51 00	76	71	....	132	bk. m. fne. s	SE.	1	NE.	.5	Do.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, during the year ending December 31, 1885.

Serial number.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1885.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2311	Jan. 5	9.47 a. m.	32 55 00	77 54 00	69	72	59.1	79	crs. S. bk. Sp	SE.	3			L. B. T.
2312	Jan. 5	10.48 a. m.	32 54 00	77 53 30	69	73	57.8	88	crs. S. bk. Sp	ESE.	3			L. B. T.
2313	Jan. 5	12.17 p. m.	32 53 00	77 53 00	69	73	57.2	99	crs. S. bk. Sp. brk. Sh	ESE.	3			L. B. T.
2314	Jan. 5	3.06 p. m.	32 43 00	77 51 00	70	69	47.4	159	crs. S. bk. Sp. brk. Sh	SSE.	4			L. B. T.
2315	Jan. 15	2.17 p. m.	24 26 00	81 48 15	77	75		37	Co	ESE.	5			L. B. T.
2316	Jan. 15	3.21 p. m.	24 25 30	81 47 45	77	75	74	50		ESE.	5			L. B. T.
2317	Jan. 15	4.22 p. m.	24 25 45	81 46 45	77	75	75	45	Co	ESE.	5			L. B. T.
2318	Jan. 15	5.00 p. m.	24 25 45	81 46 00	77	75	75	45	Co	ESE.	5			L. B. T.
2319	Jan. 17	6.45 a. m.	23 10 37	82 20 06	71	76		143	gy. Co	ESE.	1			Tgls.
2320	Jan. 17	7.25 a. m.	23 10 39	82 18 48	72	76		130	fne. Co	ESE.	1			Tgls.
2321	Jan. 17	7.58 a. m.	23 10 54	82 18 00	74	77		230	fne. gy. S	ESE.	1			Tgls.
2322	Jan. 17	8.53 a. m.	23 10 54	82 17 45	75	77		115	Co	ESE.	1			Tgls.
2323	Jan. 17	10.04 a. m.	23 10 51	82 19 03	78	78		163	wh. br. Co	ESE.	2			Tgls.
2324	Jan. 17	11.17 a. m.	23 10 25	82 20 24	78	78	79.1	33	Co	ESE.	2			Tgls.
2325	Jan. 17	11.39 a. m.	23 10 48	82 19 54	78	78		170	lt. br. Co	ESE.	2			Tgls.
2326	Jan. 17	12.15 p. m.	23 11 45	82 18 54	79	78	62	194	br. Co	ESE.	2			Tgls.
2327	Jan. 17	12.53 p. m.	23 11 45	82 17 54	80	76		182	fne. br. S	SSE.	1			Tgls.
2328	Jan. 17	2.11 p. m.	23 11 03	82 19 15	81	75	58	203	fne. gy. Co	W.	1			Tgls.
2329	Jan. 17	2.45 p. m.	23 11 03	82 18 45	81	75		118	wh. Co	W.	1			Tgls.
2330	Jan. 17	3.50 p. m.	23 10 48	82 19 15	81	75		121	fne. gy. Co	W.	2			Tgls.
2331	Jan. 17	4.35 p. m.	23 10 31	82 19 55	80	75		114	Co	W.	1			Tgls.
2332	Jan. 19	6.48 a. m.	23 10 38	82 20 06	73	75		156	wh. gy. Co	SSE.	3			Tgls.
2333	Jan. 19	7.20 a. m.	23 10 36	82 19 12	73	75		169	fne. wh. Co	SSE.	3			Tgls.
2334	Jan. 19	8.00 a. m.	23 10 42	82 18 24	74	75		67	wh. Co	SSE.	3			Tgls.
2335	Jan. 19	9.00 a. m.	23 10 39	82 20 21	76	77		204		NE.	3			Tgls.
2336	Jan. 19	9.46 a. m.	23 10 48	82 18 52	77	77		157	Co	NE.	3			Tgls.
2337	Jan. 19	11.02 a. m.	23 10 39	82 20 21	78	78		199	Co	NE.	3			Tgls.
2338	Jan. 19	11.53 a. m.	23 10 40	82 20 15	79	78		189	Co	NE.	3			Tgls.
2339	Jan. 19	12.43 p. m.	23 10 40	82 20 15	79	78		191	Co	NE.	3			Tgls.
2340	Jan. 19	1.35 p. m.	23 10 47	82 20 06	80	78		234	Co	NE.	3			Tgls.
2341	Jan. 19	2.11 p. m.	23 11 00	82 19 06	79	78		143	Co	NE.	3			Tgls.
2342	Jan. 19	2.57 p. m.	23 10 39	82 20 21	78	78		201	Co	NE.	3			Tgls.
2343	Jan. 19	3.32 p. m.	23 11 35	82 19 25	78	78		279	fne. Co	NE.	3			Tgls.
2344	Jan. 19	4.40 p. m.	23 10 39	82 20 21	78	78		199	br. Co	NE.	3			Tgls.
2345	Jan. 20	12.36 p. m.	23 10 40	82 20 15	84	78		184	fne. gy. wh. Co	E.	4			Tgls.
2346	Jan. 20	1.24 p. m.	23 10 39	82 20 21	83	78		200	Co	E.	4			Tgls.
2347	Jan. 20	2.11 p. m.	23 10 39	82 20 21	82	78		216	Co	E.	4			Tgls.
2348	Jan. 20	3.04 p. m.	23 10 39	82 20 21	82	78		211	Co	E.	4			Tgls.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, etc.—Continued.

Serial number.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1885.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2349	Jan. 20	3.51 p. m.	23 10 40	82 20 15	82	78	......	182	Co	E.	4	......	......	Tgls.
2350	Jan. 20	4.37 p. m.	23 10 39	82 20 21	81	78	......	213	Co	E.	3	......	......	S. B. T.
2351	Jan. 21	9.02 a. m.	22 41 00	84 16 30	78	77	......	426	......	SSE.	2	......	......	L. B. T.
2352	Jan. 21	11.13 a. m.	22 35 00	84 23 00	79	77	45	463	wh. Co	Variable.	0-1	......	......	L. B. T.
2353	Jan. 22	9.23 a. m.	20 59 00	86 23 00	79	79	62.8	167	Co	NE.	1	......	......	Tgls.
2354	Jan. 22	10.17 a. m.	20 59 30	86 23 45	80	78	......	130	Co	NE.	1	......	......	S. B. T.
2355	Jan. 22	11.28 a. m.	20 56 48	86 27 00	83	78	......	399	yl. Oz	NE.	2	......	......	S. B. T.
2356	Jan. 29	1.29 p. m.	20 18 50	87 03 00	84	78	......	137	fne. wh. Co	ESE.	3	......	......	Tgls.
2357	Jan. 29	2.07 p. m.	20 19 00	87 03 10	81	78	......	178	wh. Co	ESE.	4	......	......	Tgls.
2358	Jan. 29	2.57 p. m.	20 19 00	87 03 30	82	78	......	222	fne. wh. Co	ESE.	4	......	......	S. B. T.
2359	Jan. 29	4.07 p. m.	20 19 10	87 03 30	84	78	50.8	231	wh. Co	ESE.	4	......	......	S. B. T.
2360	Jan. 30	7.42 a. m.	22 08 30	86 49 00	79	78	......	26	wh. Co	SE.	3	......	......	Tgls.
2361	Jan. 30	8.45 a. m.	22 08 15	86 51 15	80	78	......	25	Co. S	SE.	3	......	......	S. B. T.
2362	Jan. 30	9.18 a. m.	22 08 30	86 53 30	79	78	......	25	Co. S	SE.	3	......	......	S. B. T.
2363	Jan. 30	10.38 a. m.	22 07 30	87 06 00	78	77	......	21	wh. R. Co	SE.	3	......	......	S. B. T.
2364	Jan. 30	11.37 a. m.	22 08 40	87 06 00	79	77	......	22	Co. S	SE.	3	......	......	S. B. T.
2365	Jan. 30	3.00 p. m.	22 18 00	87 04 00	79	77	......	24	wh. R. Co	SSE.	2	......	......	S. B. T.
2366	Jan. 30	4.52 p. m.	22 28 00	87 02 00	77	76	......	27	fne. wh. Co	SSE.	2	......	......	S. B. T.
2367	Jan. 30	6.32 p. m.	22 38 00	87 00 00	75	76	......	124	wh. Co	Calm.	0	......	......	S. B. T.
2368	Feb. 7	12.11 p. m.	29 15 00	85 32 00	60	64	......	28	crs. gy. S. brk. Sh	SE.	2	......	......	Tgls.
2369	Feb. 7	12.46 p. m.	29 16 30	85 32 00	60	64	......	26	crs. gy. S. brk. Sh	S.	3	......	......	L. B. T.
2370	Feb. 7	1.16 p. m.	29 18 15	85 32 00	60	64	......	25	crs. gy. S. brk. Sh	S.	3	......	......	L. B. T.
2371	Feb. 7	2.16 p. m.	29 17 00	85 30 45	65	66	......	26	gy. S. brk. Sh	S.	3	......	......	L. B. T.
2372	Feb. 7	2.47 p. m.	29 15 30	85 29 30	64	64	......	27	G	S.	3	......	......	L. B. T.
2373	Feb. 7	3.27 p. m.	29 14 00	85 29 15	64	64	......	25	Co	S.	3	......	......	L. B. T.
2374	Feb. 7	4.27 p. m.	29 11 30	85 29 00	63	65	......	26	S. G. brk. Sh	S.	3	......	......	L. B. T.
2375	Feb. 7	5.15 p. m.	29 10 00	85 31 00	62	65	......	30	S. bk. Sp. brk. Sh	S.	4	......	......	L. B. T.
2376	Feb. 11	1.43 p. m.	29 03 15	88 16 00	50	62	46.5	324	gy. M	NE.	4	......	......	L. B. T.
2377	Feb. 11	3.44 p. m.	29 07 30	88 08 00	50	63	67	210	gy. M	E.	4	......	......	L. B. T.
2378	Feb. 11	5.40 p. m.	29 14 30	88 09 30	50	63	......	68	gy. M	NE.	4	......	......	L. B. T.
2379	Mar. 2	5.40 a. m.	28 00 15	87 42 00	60	66	......	1,467	yl. Oz	NE.	6	......	......	L. B. T.
2380	Mar. 2	10.43 a. m.	28 02 30	87 43 45	60	69	40.1	1,430	br. M	NNE.	3	......	......	L. B. T.
2381	Mar. 2	3.59 p. m.	28 05 00	87 56 15	59	69	......	1,330	lt. br. M	N.	2	......	......	L. B. T.
2382	Mar. 3	5.37 a. m.	28 19 45	88 01 30	59	62	39.6	1,255	gy. M	NE.	1	......	......	L. B. T.
2383	Mar. 3	10.23 a. m.	28 32 00	88 06 00	62	69	39.8	1,181	br. gn. M	NE.	2	......	......	L. B. T.
2384	Mar. 3	2.59 p. m.	28 45 00	88 15 30	70	67	39.6	940	br. gy. M	E.	2	......	......	L. B. T.
2385	Mar. 3	6.37 p. m.	28 51 00	88 18 00	68	67	40.1	730	gy. M	E.	2	......	......	L. B. T.
2386	Mar. 4	5.36 a. m.	29 15 00	88 06 00	62	67	61.8	60	bu. M	NE.	1	......	......	L. B. T.

2387	Mar. 4	7.46 a. m.	29 24 00	88 04 00	61	61	......	32	S. G. brk. Sh	NE.	2	......	......	L. B. T.
2388	Mar. 4	9.45 a. m.	29 24 30	88 01 00	61	61	......	35	yl. S. bk. Sp	NE.	2	......	......	L. B. T.
2389	Mar. 4	10.56 a. m.	29 28 00	87 56 00	64	62	......	27	gy. S. brk. Sh	NE.	2	......	......	L. B. T.
2390	Mar. 4	12.48 p. m.	29 27 30	87 48 30	62	62	......	30	crs. S. bk. Sp. Sh	NE.	2	......	......	L. B. T.
2391	Mar. 4	2.03 p. m.	29 32 00	87 45 00	61	59	......	25	gy. S. bk. Sp	ENE.	2	......	......	L. B. T.
2392	Mar. 13	5.27 a. m.	28 47 30	87 27 00	66	62	40.7	724	br. gy. M	SW.	3	......	......	L. B. T.
2393	Mar. 13	9.37 a. m.	28 43 00	87 14 30	70	64	41.1	525	lt. gy. M	NE.	1	......	......	L. B. T.
2394	Mar. 13	1.35 p. m.	28 38 30	87 02 00	70	66	41.8	420	gn. M	WSW.	2	......	......	L. B. T.
2395	Mar. 13	4.31 p. m.	28 36 15	86 50 00	72	66	44.1	347	gy. M	WSW.	2	......	......	L. B. T.
2396	Mar. 13	6.09 p. m.	28 34 00	86 48 00	68	66	......	335	gy. M	WSW.	3	......	......	L. B. T.
2397	Mar. 14	5.32 a. m.	28 42 00	86 36 00	64	65	46.1	280	gy. M	NE.	2	......	......	L. B. T.
2398	Mar. 14	8.24 a. m.	28 45 00	86 26 00	64	67	48.6	227	gy. M	NE.	2	......	......	L. B. T.
2399	Mar. 14	10.52 a. m.	28 44 00	86 18 00	70	68	51.6	196	gy. M	NE.	2	......	......	L. B. T.
2400	Mar. 14	1.23 p. m.	28 41 00	86 07 00	71	67	......	169	gy. M	ENE.	1	......	......	L. B. T.
2401	Mar. 14	4.01 p. m.	28 38 30	85 52 30	73	69	......	142	gn. M. brk. Sh	Calm.	0	......	......	L. B. T.
2402	Mar. 14	6.18 p. m.	28 36 00	85 33 30	65	63	......	111	gy. M	Calm.	0	......	......	L. B. T.
2403	Mar. 15	5.30 a. m.	28 42 30	85 29 00	67	65	......	88	gy. M	SW.	2	......	......	L. B. T.
2404	Mar. 15	7.45 a. m.	28 44 00	85 16 00	68	66	......	60	gy. S	SW.	1	......	......	L. B. T.
2405	Mar. 15	9.39 a. m.	28 45 00	85 02 00	68	68	......	30	gy. S. brk. Co	ESE.	1	......	......	L. B. T.
2406	Mar. 15	11.21 a. m.	28 46 00	84 49 00	67	64	......	26	crs. S. Co	SE.	2	......	......	L. B. T.
2407	Mar. 15	1.14 p. m.	28 47 30	84 37 00	64	63	......	24	Co. brk. Sh	SE.	2	......	......	L. B. T.
2408	Mar. 16	9.22 a. m.	28 28 00	84 25 00	60	64	......	21	Co	NE.	4	......	......	L. B. T.
2409	Mar. 18	1.12 p. m.	27 04 00	83 21 15	67	66	......	26	crs. gy. S. brk. Sh	W.	4	......	......	L. B. T.
2410	Mar. 18	3.52 p. m.	26 47 30	83 25 15	67	66	......	28	fne. wh. S. bk. Sp. brk. Sh	WNW.	4	......	......	Rake dredge.
2411	Mar. 18	6.21 p. m.	26 33 30	83 15 30	69	67	......	27	fne. wh. S. bk. Sp	NW.	4	......	......	L. B. T.
2412	Mar. 19	6.50 a. m.	26 18 30	83 08 45	62	66	......	27	fne. gy. S. bk. Sp. brk. Sh	NW.	3	......	......	L. B. T.
2413	Mar. 19	10.04 a. m.	26 00 00	82 57 30	68	66	......	24	fne. S. bk. Sp. brk. Sh	NNW.	2	......	......	L. B. T.
2414	Mar. 19	6.11 p. m.	25 04 30	82 59 15	67	69	......	26	fne. wh. S. brk. Sh	NW.	2	......	......	L. B. T.
2415	Apr. 1	5.31 a. m.	30 44 00	79 26 00	70	70	45.6	440	Co. crs. S. Sh. For	ENE.	3	......	......	L. B. T.
2416	Apr. 1	12.01 p. m.	31 26 00	79 07 00	70	74	53.8	276	Co. brk. Sh	ENE.	5	......	......	L. B. T.
2417	Apr. 2	12.13 p. m.	33 18 30	77 07 00	69	67	65.8	95	fne. gy. S	ESE.	4	......	......	L. B. T.
2418	Apr. 2	12.54 p. m.	33 20 00	77 05 00	69	67	65.8	90	gy. S	ESE.	4	......	......	L. B. T.
2419	Apr. 2	5.25 p. m.	33 34 00	76 40 30	69	72	60.3	107	fne. gy. S. bk. Sp	ESE.	3	......	......	L. B. T.
2420	Apr. 5	6.20 p. m.	37 03 20	74 31 40	50	48	47.7	104	bk. S. M. G	S. by E.	1	......	......	L. B. T.
2421	June 3	5.40 a. m.	37 07 00	74 34 30	61	61	......	64	fne. gy. S. P	NE.	2	......	......	L. B. T.
2422	June 3	9.55 a. m.	37 08 30	74 33 30	66	63	52.5	85	crs. gy. S. bk. Sp. brk. Sh	E.	4	......	......	L. B. T.
2423	June 3	3.11 p. m.	37 10 15	74 32 00	65	67	......	143	gn. M. fne. S	ENE.	3	......	......	L. B. T.
2424	June 4	4.30 a. m.	36 41 37	74 42 15	69	67	52.5	85	bk. M	S.	1	......	......	L. B. T.
2425	June 4	11.30 a. m.	36 20 24	74 46 30	72	69	51.5	119	dk. gy. M. fne. S	SSW.	2	......	......	L. B. T.
2426	June 4	4.49 p. m.	36 01 30	74 47 30	77	71	52.0	93	crs. gy. bk. S. brk. Sh	S.	3	......	......	L. B. T.
2427	June 23	6.00 a. m.	42 46 00	51 00 00	49	47	38.7	523	hrd	S.	1	......	......	L. B. T.
2428	June 23	8.18 a. m.	42 48 00	50 55 30	50	48	38.3	826	gn. M	S.	2	......	......	L. B. T.
2429	June 23	12.04 p. m.	42 55 30	50 51 00	51	45	38.7	471	gy. M	S.	3	......	......	L. B. T.
2430	June 23	3.05 p. m.	42 58 30	50 50 00	51	46	......	179	gn. S. P	S.	2	E. by N.	1.50	L. B. T.
2431	June 23	4.24 p. m.	43 00 00	50 47 30	51	46	33.5	129	yl. S. bk. Sp	S.	2	ESE.	1	L. B. T.
2432	June 23	5.28 p. m.	43 04 00	50 45 00	51	47	......	64	fne. gy. S	SSW.	3	ESE.	1	L. B. T.
2433	June 23	6.05 p. m.	43 05 00	50 43 00	52	48	33.0	57	gn. S	SW.	3	E.	1.50	L. B. T.
2434	June 23	7.20 p. m.	43 08 00	50 40 00	54	48	34.0	51	gn. M	SW.	3	E.	1.50	L. B. T.
2435	June 23	8.13 p. m.	43 12 00	50 38 45	54	48	34.0	47	bk. M	SW.	4	E.	1.50	L. B. T.
2436	June 24	4.22 a. m.	43 36 00	50 06 30	53	49	34.0	36	wh. S. bk. Sp. brk. Sh	SW.	4	ESE.	1	L. B. T.
2437	June 24	5.04 a. m.	43 36 00	50 05 00	53	49	35.8	37	crs. brk. Sh. brk. St	SW.	4	ESE.	1	L. B. T.
2438	June 24	5.40 a. m.	43 36 00	50 03 30	54	48	36.8	37	gn. S. bk. Sp. brk. Sh	SW.	4	ESE.	1	L. B. T.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, etc.—Continued.

Serial number.	Date.	Time.	Position. Lat. N.	Position. Long. W.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1885.		° ′ ″	° ′ ″	°	°	°	*Fath.*					*Miles.*	
2439	June 24	6.50 a. m	43 37 00	49 56 30	54	48	37.8	36	wh. S. bk. Sp	SW.	5	ESE.	1	L. B. T.
2440	June 24	7.55 a. m	43 38 00	49 49 30	54	48	38.3	33	fne. wh. S. bk. Sp	SW.	5	ESE.	1	L. B. T.
2441	June 25	5.05 a. m	45 27 00	49 42 00	45	43	33.0	34	wh. S. brk. Sh	W.	2	N. by E.	1.50	L. B. T.
2442	June 25	6.42 a. m	45 33 00	49 43 00	46	44	33.2	36	wh. S. brk. Sh	W.	3	NNE.	1	L. B. T.
2443	June 25	8.47 a. m	45 44 00	49 45 00	50	46	34.9	35	wh. S. brk. Sh	WNW.	2	NNE.	1	L. B. T.
2444	June 25	11.21 a. m	45 59 00	49 45 30	49	45	34.4	39	wh. S. brk. Sh	WNW.	2	NNE.	1	L. B. T.
2445	June 25	12.54 p. m	46 09 30	49 48 30	47	44	33.5	39	brk. Sh	SW.	3	NNE.	1	L. B. T.
2446	June 25	2.21 p. m	46 20 00	49 52 00	48	43	35.3	40	brk. Sh	SW.	3	NNE.	1	L. B. T.
2447	June 25	3.55 p. m	46 26 00	49 42 00	48	43	34.8	39	brk. Sh	WSW.	3	NNE.	1	L. B. T.
2448	June 25	4.40 p. m	46 28 00	49 39 30	48	43	33.9	40	S. G	WSW.	3	NNE.	1	L. B. T.
2449	June 25	7.03 p. m	46 37 00	49 50 30	46	42	33.0	39	brk. Sh	SW.	4	NNW.	1	L. B. T.
2450	June 25	8.33 p. m	46 45 00	50 02 30	45	42	31.0	44	P. brk. Sh	SSW.	4	NNW.	.50	L. B. T.
2451	June 26	4.19 a. m	46 58 00	50 34 00	41	40	29.7	67	S. Sh	SSW.	3	NW. by N.	1	S. B. T.
2452	June 26	6.14 a. m	47 04 00	50 48 00	54	40	29.7	89	fne. gn. S	SW.	3	NNW.	1	L. B. T.
2453	June 26	8.02 a. m	47 10 00	51 02 00	48	41	29.7	82	gn. M. fne. S	WSW.	3	NNW.	1	L. B. T.
2454	June 26	10.17 a. m	47 16 00	51 16 00	46	42	29.7	74	fne. gy. S	SW.	2	NNW.	1	L. B. T.
2455	June 26	12.25 p. m	47 21 00	51 38 30	45	43	30.0	81	br. S	SW.	2	W.	.75	L. B. T.
2456	July 2	8.00 a. m	47 29 00	52 18 00	47	46	......	86	G	SW.	2	S. by E.	1	Bl. Dr.
2457	July 2	10.48 a. m	47 13 00	52 24 00	48	47	29.5	86	gy. S	SW.	2	S. by E.	1	Bl. Dr.
2458	July 2	2.35 p. m	46 48 30	52 34 00	50	48	29.5	89	S. gn. M.	SSE.	2	S. by W.	1	Bl. Dr.
2459	July 2	6.10 p. m	46 23 00	52 45 00	50	49	29.5	88	crs. gy. S	SSW.	3	S.	1	Bl. Dr.
2460	July 3	4.45 a. m	45 50 00	54 06 00	50	47	30.0	67	gy. S. Sh	WSW.	1	WSW.	.50	Bl. Dr.
2461	July 3	6.03 a. m	45 47 00	54 13 30	54	48	30.0	59	fne. S. bk. Sp	WSW.	1	W.	.50	Sh. Dr.
2462	July 3	7.18 a. m	45 45 30	54 20 30	52	48	30.0	41	wh. S. bk. Sp	WSW.	2	W.	.50	Bl. Dr.
2463	July 3	8.30 a. m	45 44 00	54 27 00	51	50	30.0	45	brk. Sh	WSW.	2	W.	.75	Bl. Dr.
2464	July 3	10.14 a. m	45 40 00	54 41 00	52	47	32.0	42	wh. bk. S. brk. Sh	WSW.	2	W.	.75	Sh. Dr.
2465	July 3	12.15 p. m	45 35 00	55 01 00	52	48	30.0	67	bk. gy. S	WSW.	2	S.	.75	Sh. Dr.
2466	July 3	2.40 p. m	45 29 00	55 24 00	54	53	30.0	67	Co	SW.	2	SSW.	.75	Sh. Dr.
2467	July 3	5.31 p. m	45 23 00	55 41 00	58	52	35.8	38	fne. wh. S. bk. Sp	SW.	2	SSW.	.75	Bl. Dr.
2468	July 3	7.45 p. m	45 11 30	55 51 30	57	52	33.0	42	fne. bk. S	SW.	1	S. by W.	.50	Sh. Dr.
2469	July 4	4.29 a. m	44 58 37	56 20 45	55	54	40.5	201	gn. M	SW.	1	ESE.	1	L. B. T.
2470	July 4	7.37 a. m	44 47 00	56 33 45	56	54	40.2	224	gy. M	S.	1	ESE.	1.50	L. B. T.
2471	July 4	10.31 a. m	44 34 00	56 41 45	56	53	40.4	218	gy. M. S	S. by E.	3	SW. by W.	1.50	L. B. T.
2472	July 4	4.30 p. m	44 27 30	57 10 45	59	53	40.0	137	crs. S. G	S.	3	NW.	.50	Tgls. with grapnels.
2473	July 4	5.17 p. m	44 27 15	57 10 00	58	53	40.0	219	crs. S. brk. Sh	SW.	2	NNW.	.50	Tgls. with grapnels.

2474	July 4	6.07 p. m.	44 28 30	57 10 45	58	53	40.0	133	hrd	SW.	2	W.	.50	Tgls. with grapnels.
2475	July 4	6.50 p. m.	44 28 30	57 10 00	54	53	......	222	yl. S. P	SW.	3	WNW.	.50	Tgls. with grapnels.
2476	July 4	7.21 p. m.	44 28 50	57 10 30	54	53	......	200	yl. S. P	SW.	3	N. by W.	1	Tgls. with grapnels.
2477	July 4	8.05 p. m.	44 29 30	57 11 15	54	51	......	114	crs. wh. S. P	SW.	3	NNW.	.50	L. B. T.
2478	July 5	5.06 a. m.	44 05 30	57 16 30	53	52	......	191	fne. yl. S	WSW.	2	N. by W.	.75	Tgls.
2479	July 5	5.53 a. m.	44 05 45	57 16 45	53	52	......	129	wh. S. P	W.	2	NNW.	.50	Tgls.
2480	July 5	6.54 p. m.	44 06 00	57 16 30	54	52	......	189	wh. S. P	W.	2	NNW.	.75	Sh. Dr.
2481	July 5	7.56 a. m.	44 07 30	57 16 45	54	52	......	116	G	NW.	2	NE.	.75	Sh. Dr.
2482	July 5	8.38 a. m.	44 08 00	57 16 15	54	52	......	265	br. M	NW.	2	N. by W.	.50	Sh. Dr.
2483	July 5	10.18 a. m.	44 16 00	57 12 45	58	53	......	175	crs. G	NW.	2	NE.	.50	Sh. Dr.
2484	July 5	11.26 a. m.	44 20 00	57 11 15	59	54	......	204	fne. wh. S	NW.	2	N. by E.	.50	Sh. Dr.
2485	July 5	12.30 p. m.	44 24 00	57 09 50	58	54	......	205	fne. wh. S	NW.	2	N. by W.	.50	Sh. Dr.
2486	July 5	1.38 p. m.	44 26 00	57 11 15	58	54	39.7	190	crs. S. G	W. by N.	2	NNW.	.75	Sh. Dr.
2487	July 5	3.20 p. m.	44 28 30	57 14 45	57	54	......	39	gy. S. G	W. by N.	2	NNE.	1	Sh. Dr.
2488	July 5	5.02 p. m.	44 35 00	57 13 30	56	53	......	150	yl. S	NW.	2	ESE.	.50	Sh. Dr.
2489	July 5	7.17 p. m.	44 43 00	57 22 45	55	53	......	33	wh. S	NW.	2	ESE.	.75	Sh. Dr.
2490	July 6	4.44 a. m.	45 27 30	58 27 45	50	52	......	50	G. P	SSW.	1	WNW.	.50	Sh. Dr.
2491	July 6	6.06 a. m.	45 24 30	58 35 15	51	53	......	59	wh. S	SSW.	1	W.	.50	Sh. Dr.
2492	July 6	7.32 a. m.	45 22 00	58 43 45	51	53	33.3	75	wh. S	SSW.	2	W.	.50	Sh. Dr.
2493	July 6	8.53 a. m.	45 19 00	58 51 15	52	53	32.3	45	wh. S. brk. Sh	SSW.	2	W.	.50	Sh. Dr.
2494	July 6	10.40 a. m.	45 14 30	59 06 45	54	54	32.5	50	S. G	SSW.	1	W.	.25	Tgls.
2495	July 6	12.20 p. m.	45 10 00	59 23 45	54	54	32.5	44	hrd	SSW.	1	W.	.25	Tgls.
2496	July 6	1.30 p. m.	45 07 30	59 27 45	58	56	32.2	44	crs. yl. S. P	S.	1	W.	.25	Tgls.
2497	July 6	3.10 p. m.	45 04 00	59 36 45	58	55	33.0	57	yl. S. brk. Sh. hrd	S.	1	W.	.75	Sh. Dr.
2498	July 6	5.21 p. m.	44 54 00	59 46 45	63	57	......	65	fne. br. S	SSW.	2	W.	1	L. B. T.
2499	July 6	7.01 p. m.	44 46 30	59 55 45	62	57	35.8	130	bk. M	SSW.	2	W. by S.	1	L. B. T.
2500	July 7	7.10 a. m.	44 28 00	60 15 15	59	58	......	36	S. G	S.	2	W.	.50	L. B. T.
2501	July 7	8.02 a. m.	44 27 00	60 20 15	59	58	38.7	26	S. G	S.	2	W.	.50	L. B. T.
2502	July 7	11.09 a. m.	44 19 00	60 39 15	60	57	34.8	54	yl. S	S.	1	NNW.	.50	L. B. T.
2503	July 7	1.43 p. m.	44 22 30	61 00 15	63	60	35.0	47	P	SSW.	1	WNW.	.50	L. B. T.
2504	July 7	4.22 p. m.	44 23 00	61 22 45	65	62	40.6	82	bk. M. G	SSW.	1	WNW.	.50	Sh. Dr.
2505	July 7	6.46 p. m.	44 23 30	61 44 15	63	63	42.3	93	dk. br. M	SSW.	1	W. by S.	.50	L. B. T.
2506	July 8	4.15 a. m.	44 26 00	62 10 00	61	61	43.1	127	dk. br. M	SW.	1	WNW.	.50	L. B. T.
2507	July 8	6.46 a. m.	44 27 30	62 33 30	62	61	41.6	80	hrd	SW.	1	WNW.	.50	Sh. Dr.
2508	July 8	9.13 a. m.	44 28 30	62 56 00	62	61	39.7	72	br. M	Calm.	0	WNW.	.50	L. B. T.
2509	July 8	11.29 a. m.	44 30 00	63 18 00	64	61	34.8	43	crs. S	Calm.	0	WNW.	.50	Sh. Dr.
2510	July 11	10.45 a. m.	44 16 00	63 23 00	58	53	39.2	68	bk. M. brk. Sh	(*)	......	(*)	......	Dredge.
2511	July 11	12.29 p. m.	44 05 30	63 31 30	60	57	41.6	84	br. M	SW.	1	W. by N.	1	Sh. Dr.
2512	July 11	3.00 p. m.	43 48 00	63 46 30	62	58	42.6	103	br. M	SW.	2	W.	.50	Sh. Dr.
2513	July 11	5.38 p. m.	43 34 00	63 56 30	62	58	43.6	134	gy. Oz	SW.	2	SSW.	.50	S. B. T.
2514	July 11	7.16 p. m.	43 28 30	63 57 30	62	59	43.1	126	bk. M	SW.	2	SSW.	.50	S. B. T.
2515	July 12	4.21 a. m.	43 18 30	63 51 30	60	58	36.3	57	S. G	N.	2	W.	.50	Sh. Dr.
2516	July 12	5.35 a. m.	43 15 00	63 58 00	59	58	36.3	52	rky	NW.	2	WSW.	.50	Sh. Dr.
2517	July 12	9.02 a. m.	43 10 00	64 18 00	60	60	38.3	55	yl. S. bk. Sp	NNW.	2	W.	.50	Sh. Dr.
2518	July 12	11.16 a. m.	43 05 00	64 40 30	60	59	38.7	60	St	NNW.	2	W.	.50	Sh. Dr.
2519	July 12	2.11 p. m.	42 51 15	64 49 00	61	60	39.2	53	hrd	NW.	2	WSW.	.25	Sh. Dr.
2520	July 12	3.51 p. m.	42 41 00	64 55 30	60	60	40.6	62	rky	WNW.	3	SW. by S.	.25	Sh. Dr.
2521	July 12	5.26 p. m.	42 30 30	65 02 00	61	62	42.1	65	S. G	WNW.	3	SW. by S.	.25	Sh. Dr.
2522	July 12	7.05 p. m.	42 20 00	65 07 30	62	61	46.7	104	S. G	NW.	2	SW. by S.	.50	S. B. T.

* Dredge-rope parted, losing ship's dredge and 79 fathoms of wire rope.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, etc.—Continued.

Serial number.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1885.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2523	July 13	4.26 a. m	41 48 30	65 44 30	59	60	41.6	111	S. G. St	NNW.	2	W.	.25	Sh. Dr.
2524	July 13	5.14 a. m	41 48 45	65 47 00	60	60	42.6	85	S. G. St	ENE.	1	WSW.	.25	Sh. Dr.
2525	July 13	5.54 a. m	41 49 00	65 49 30	62	60	43.6	72	S. G. brk. Sh	E.	1	E. by N.	.25	Sh. Dr.
2526	July 13	8.49 a. m	41 40 45	65 46 00	65	66	......	121	P	NE.	1	NE. by E.	.50	Sh. Dr.
2527	July 13	1.30 p. m	41 59 00	65 35 30	66	61	......	117	S. G	(*)	....	(*)	......	(*)
2528	July 13	6.29 p. m	41 47 00	65 37 30	78	69	38.7	677	br. S	N.	1	WSW.	1	L. B. T.
2529	July 14	5.08 a. m	41 03 30	66 14 00	66	65	38.7	662	gy. M	SE.	1	SW. by S.	1	L. B. T.
2530	July 14	9.08 a. m	40 53 30	66 24 00	70	67	38.4	956	gy. Oz	SE.	1	SW. by W.	1	L. B. T.
2531	July 14	1.43 p. m	40 42 00	66 33 00	72	67	38.4	852	gy. M	SE.	2	SW. by W.	1	L. B T.
2532	July 14	5.57 p. m	40 34 30	66 48 00	75	67	38.7	705	gy. M	SE.	2	WSW.	1	L. B. T.
2533	July 15	4.34 a. m	40 16 30	67 26 15	72	68	38.7	828	br. Oz	WNW.	3	NNW.	1	L. B. T.
2534	July 15	9.22 a. m	40 01 00	67 29 15	66	70	37.8	1,234	gy. Oz	NW.	3	NE.	1	L. B. T.
2535	July 15	1.03 p. m	40 03 30	67 27 15	66	70	37.8	1,149	gy. Oz	WNW.	1	NW.	1.50	L. B. T.
2536	Aug. 7	5.46 a. m	39 56 15	70 47 30	69	74	......	157	gn. M. fne. S	N.	1	{ WNW. W.	.50 1	L. B. T.
2537	Aug. 7	6.53 a. m	39 56 45	70 50 30	71	74	46.2	156	gn. M. fne. S	NE.	1	NW. by N.	1	L. B. T.
2538	Aug. 7	7.48 a. m	39 57 30	70 51 15	71	71	46.2	150	gn. M. fne. S	NE.	1	N.	1	L. B. T.
2539	Aug. 7	8.57 a. m	39 59 45	70 53 00	71	74	47.7	133	gn. S	NE.	1	N.	1	L. B. T.
2540	Aug. 7	11.20 a. m	39 58 20	70 52 00	72	74	46.7	144	gn. S	NE.	1	N.	1	L. B. T.
2541	Aug. 7	12.00 m	39 57 45	70 50 30	73	73	47.7	134	gn. S. brk. Sh	NE.	1	N. by W.	1	L. B. T.
2542	Aug. 7	3.00 p. m	40 00 15	70 42 20	73	76	47.2	129	S. brk. Sh	NE.	2	NNW.	1	L. B. T.
2543	Aug. 7	4.27 p. m	39 58 15	70 42 30	72	76	45.2	166	gn. S. bk. Sp	NE. by E.	2	N.	1	L. B. T.
2544	Aug. 8	6.19 a. m	40 01 45	70 24 00	70	74	47.7	131	gn. S. bk. Sp	ENE.	3	N.	.50	L. B. T.
2545	Aug. 8	7.31 a. m	40 01 00	70 23 45	70	74	46.7	142	gn. S. bk. Sp	ENE.	4	N.	.50	L. B. T.
2546	Aug. 8	12.47 p. m	39 53 30	70 17 30	73	72	39.6	538	gn. M	ENE.	4	NW. by W.	1.50	L. B. T.
2547	Aug. 8	2.25 p. m	39 54 30	70 20 00	70	76	39.6	390	gn. M	ENE.	4	N.	1	L. B. T.
2548	Aug. 8	4.37 p. m	39 56 00	70 14 30	69	76	43.4	200	gn. S. bk. Sp	E.	4	N.	.50	L. B. T.
2549	Aug. 8	6.43 p. m	39 51 30	70 17 00	76	76	39.5	571	gn. M	E.	4	WNW.	1.50	L. B. T.
2550	Aug. 9	5.23 a. m	39 44 30	70 30 45	73	76	38.5	1,081	br. M	E. by N.	3	NW.	2	L. B. T.
2551	Aug. 9	8.47 a. m	39 46 00	70 36 30	77	77	38.7	778	gy. Oz	ENE.	4	......	......	
2552	Aug. 9	12.33 p. m	39 47 07	70 35 00	77	77	39.6	721	gy. Oz	ENE.	4	NNW.	1.50	L. B. T.
2553	Aug. 9	3.48 p. m	39 48 00	70 36 00	72	77	39.2	551	gn. M	ENE.	3	W. by N.	2	L. B. T.
2554	Aug. 9	5.56 p. m	39 48 30	70 40 30	71	77	39.6	445	gn. M	ENE.	4	N.	.50	L. B. T.
2555	Aug. 10	6.13 a. m	39 53 00	71 32 00	72	75	47.7	136	gn. M. S	E.	1	N.	.50	L. B. T.
2556	Aug. 10	7.39 a. m	39 52 15	71 32 00	72	75	......	180	gn. M. fne. S	E.	2	N.	.50	S. B. T.
2557	Aug. 10	9.00 a. m	39 53 10	71 31 00	76	75	46.7	154	gn. M	SE.	2	WNW.	.50	S. B. T.
2558	Aug. 10	12.16 p. m	39 47 15	71 50 30	76	76	50.3	123	gn. S	SE.	2	NE.	.50	S. B. T.
2559	Aug. 10	1.11 p. m	39 48 00	71 48 30	78	76	......	120	br. M. S	SE.	1	NNE.	1	S. B. T.

2560	Aug. 10	3.13 p. m.	39 48 10	71 48 40	78	76	50.7	114	br. M. S	SE.	1	NE.	.50	L. B. T.
2561	Aug. 10	5.53 p. m.	39 38 00	71 42 00	69	77	39.2	500	gn. M	SSE.	1	N. by E.	1	L. B. T.
2562	Aug. 11	5.53 a. m.	39 15 30	71 25 00	76	76	37.3	1,434	gy. Oz	S.	2	NE. by N.	1	L. B. T.
2563	Aug. 11	10.30 a. m.	39 18 30	71 23 30	82	77	37.4	1,422	gy. Oz	S.	1	N.	1	L. B. T.
2564	Aug. 11	3.22 p. m.	39 22 00	71 23 30	79	78	37.3	1,390	gy. Oz	SW.	2	NE. by N.	1	L. B. T.
2565	Aug. 28	1.15 p. m.	38 19 20	69 02 30	72	77	36.2	2,069	gy. and br. Oz	WSW.	2	E.	3	L. B. T.
2566	Aug. 29	5.39 a. m.	37 23 00	68 08 00	75	80	36.4	2,620	gy. Oz	NW.	4	SW. by S.	2	L. B. T.
2567	Aug. 30	5.27 a. m.	37 45 00	66 56 00	72	78	36.4	2,721	gy. Oz	ESE.	2	(†)	......	(†)
2568	Aug. 31	9.48 a. m.	39 15 00	68 08 00	72	75	36.9	1,781	gy. Oz	ENE.	2	N. by E.	1	L. B. T.
2569	Aug. 31	3.00 p. m.	39 26 00	68 03 30	74	75	37.0	1,782	gy. Oz	W.	1	SSW.	1	L. B. T.
2570	Sept. 1	7.12 a. m.	39 54 00	67 05 30	72	72	36.8	1,813	Glob. Oz	Calm.	....	N.	1	L. B. T.
2571	Sept. 1	1.37 p. m.	40 09 30	67 09 00	75	72	37.8	1,356	gy. Glob. Oz	WSW.	2	N.	1	L. B. T.
2572	Sept. 2	5.00 a. m.	40 29 00	66 04 00	72	72	37.8	1,769	gy. Oz	NW.	3	W.	.50	L. B. T.
2573	Sept. 2	12.12 p. m.	40 34 18	66 09 00	71	71	37.3	1,742	gy. M. S	NW.	5	WNW.	1	S. B. T.
2574	Sept. 3	7.19 a. m.	41 02 30	65 08 15	65	71	36.7	1,791	yl. Glob. Oz	NNW.	3	WNW.	1	(†)
2575	Sept. 3	1.43 p. m.	41 07 00	65 26 30	64	71	37.1	1,710	gy. Oz	NW.	1	W.	1	S. B. T.
2576	Sept. 4	1.58 p. m.	41 15 30	68 15 00	64	61	......	18	crs. wh. S. yl. Sp	SW.	2	NW. by W.	.25	S. B. T.
2577	Sept. 4	2.55 p. m.	41 17 00	68 21 00	64	61	......	32	yl. S. P. hrd	SW.	3	WNW.	.25	S. B. T.
2578	Sept. 4	4.34 p. m.	41 20 30	68 34 30	63	60	54.4	37	fne. wh. S. bk. Sp	S.	2	WNW.	.25	S. B. T.
2579	Sept. 4	6.20 p. m.	41 23 00	68 47 00	62	61	42.2	70	fne. dk. gy. S	S.	2	W.	.25	S. B. T.
2580	Sept. 4	8.10 p. m.	41 25 30	69 01 00	64	62	42.4	83	yl. S. bk. Sp	SSW.	4	W.	.25	S. B. T.
2581	Sept. 18	8.21 a. m.	39 43 00	71 34 00	66	70	......	394	gn. M	SW.	3	S.	......	L. B. T.
2582	Sept. 18	2.53 p. m.	39 50 00	71 43 00	68	70	47.2	137	gn. M	SSW.	4	NE.	......	L. B. T.
2583	Sept. 18	4.18 p. m.	39 50 45	71 43 00	68	70	......	131	gn. M. S	SSW.	4	SSW.	......	L. B. T.
2584	Sept. 19	7.02 a. m.	39 05 30	72 23 20	71	72	39.5	541	gy. M	SW. by W.	4	S.	......	L. B. T.
2585	Sept. 19	4.28 p. m.	39 08 30	72 17 00	74	73	39.0	542	dk. gy. M	W. by S.	1	(‡)	......	(‡)
2586	Sept. 20	9.33 a. m.	39 02 40	72 40 00	69	71	40.2	328	dk. gy. M	NNE.	3	W.	1	S. B. T.
2587	Sept. 20	11.40 a. m.	39 02 00	72 38 00	70	71	39.7	401	dk. gy. M	NNE.	5	W.	.50	S. B. T.
2588	Sept. 20	3.21 p. m.	39 02 00	72 36 00	70	71	39.5	479	gn. M	NE. by E.	6	W.	.50	S. B. T.
2589	Sept. 21	8.37 a. m.	38 55 00	72 50 30	66	70	44.2	231	gn. M. S	ENE.	3	N. by W.	.50	S. B. T.
2590	Sept. 21	10.28 a. m.	38 53 30	72 52 00	68	71	47.6	190	gn. M. S	ENE.	3	N. by W.	.50	S. B. T.
2591	Sept. 21	12.08 p. m.	38 53 30	72 52 00	67	71	......	188	gn. M. S	ENE.	3	N. by W.	.50	S. B. T.
2592	Oct. 17	11.14 a. m.	35 02 20	75 12 00	70	79	......	120	fne. gy. S	N.	4	S.	.50	L. B. T.
2593	Oct. 17	12.00 m	35 01 19	75 12 00	70	79	......	143	gy. S. bk. Sp	N.	4	NNE.	1	L. B. T.
2594	Oct. 17	1.25 p. m.	35 01 00	75 12 00	70	78	......	160	crs. gy. S. brk. Sh	N.	3	NNE.	1	L. B. T.
2595	Oct. 17	4.26 p. m.	35 08 00	75 05 30	78	78	......	63	gy. S. brk. Sh	N.	3	S.	.50	L. B. T.
2596	Oct. 17	5.52 p. m.	35 08 30	75 10 00	74	78	......	49	gy. S	N.	3	S.	.50*	L. B. T.
2597	Oct. 18	6.07 a. m.	34 57 00	75 43 30	69	76	......	15	crs. gy. S	NE.	2	SE.	.25	L. B. T.
2598	Oct. 18	7.18 a. m.	34 51 00	75 40 15	71	77	......	22	wh. S. brk. Sh	NE.	2	S. by E.	.25	L. B. T.
2599	Oct. 18	8.25 a. m.	34 45 20	75 38 10	72	77	......	25	wh. S. brk. Sh	NE.	2	S. by E.	.35	L. B. T.
2600	Oct. 18	9.39 a. m.	34 39 30	75 35 30	75	78	......	87	fne. gy. S. bk. Sp. brk. Sh	NE.	2	S. by E.	.25	L. B. T.
2601	Oct. 18	11.09 a. m.	34 39 15	75 33 30	74	78	......	107	gy. S. P	NE.	2	S. by E.	.25	L. B. T.
2602	Oct. 18	12.03 p. m.	34 38 30	75 33 30	74	78	......	124	S. R	NE.	2	S. by E.	.25	L. B. T.
2603	Oct. 18	1.33 p. m.	34 38 30	75 33 30	79	77	......	124	S. R	NE.	2	S. by E.	.25	L. B. T.
2604	Oct. 18	5.25 p. m.	34 37 30	75 39 45	76	78	......	34	yl. S. brk. Sh	ENE.	1	S. by E.	.25	L. B. T.
2605	Oct. 18	6.43 p. m.	34 35 30	75 45 30	75	78	......	32	wh. S. bk. Sp	Calm.	....	S. by W.	.25	L. B. T.
2606	Oct. 18	7.58 p. m.	34 35 15	75 52 00	73	78	......	25	wh. S. bk. Sp	WNW.	1	ENE.	.25	L. B. T.
2607	Oct. 19	6.15 a. m.	34 38 00	76 12 00	71	76	......	18	fne. gy. S	ENE.	3	SSE.	.25	L. B. T.
2608	Oct. 19	7.19 a. m.	34 32 00	76 12 00	71	76	......	22	crs. gy. S. bk. Sp	S.	1	SSE.	.25	L. B. T.
2609	Oct. 19	8.24 a. m.	34 26 00	76 12 00	74	78	......	22	fne. gy. S	S.	2	SSE.	.25	L. B. T.

* Dories lowered with trawl grapnels to drag for coral. Several sprays obtained. † Lost trawl. ‡ Dredge-rope parted, losing large beam-trawl and 321 fathoms of wire rope.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, etc.—Continued.

Serial number.	Date.	Time.	Position.		Temperature.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1885.		° ′ ″	° ′ ″	°	°	°	*Fath.*					*Miles.*	
2610	Oct. 19	9.32 a. m.	34 20 00	76 12 00	74	75	......	22	wh. S. bk. Sp. brk. Sh	S.	3	SSE.	.25	L. B. T.
2611	Oct. 19	10.35 a. m.	34 15 00	76 11 30	76	75	......	31	bk. S. brk. Sh	ESE.	3	SSW.	.25	L. B. T.
2612	Oct. 19	11.49 a. m.	34 11 00	76 10 30	77	78	......	52	crs. wh. S. brk. Sh	ESE.	3	NE. by N.	.25	L. B. T.
2613	Oct. 19	1.45 p. m.	34 09 00	76 02 00	77	78	......	168	gy. S. bk. Sp	SSE.	2	NE.	.50	L. B. T.
2614	Oct. 19	3.00 p. m.	34 09 00	76 02 00	77	78	......	168	gy. S. bk. Sp	SSE.	2	NE.	.50	L. B. T.
2615	Oct. 20	6.17 a. m.	33 45 00	77 25 00	76	75	......	18	gy. S	SSE.	3	SSE.	.25	Dredge.
2616	Oct. 20	7.20 a. m.	33 42 45	77 31 00	76	75	......	17	S. P	SSE.	3	SSE.	.25	Dredge.
2617	Oct. 20	10.00 a. m.	33 37 30	77 36 30	77	75	......	14	crs. yl. S. brk. Sh	SE.	3	E.	.25	Dredge.
2618	Oct. 20	10.55 a. m.	33 37 15	77 35 30	76	74	......	17	crs. yl. S. brk. Sh	SE. by S.	3	E.	.25	S. B. T.
2619	Oct. 20	11.19 a. m.	33 38 00	77 36 00	76	74	......	15	crs. yl. S. brk. Sp. rot. Co	SE.	3	SE.	.25	Dredge.
2620	Oct. 20	12.13 p. m.	33 37 45	77 36 30	78	75	......	15	gy. S. rot. Co	SE. by S.	3	ESE.	.25	S. B. T.
2621	Oct. 20	1.54 p. m.	33 34 00	77 42 00	76	75	......	9	gy. S. brk. Co	SE. by S.	3	ESE.	.25	S. B. T.
2622	Oct. 20	3.48 p. m.	33 38 00	77 36 00	76	74	......	15	gy. S. brk. Co	SE. by S.	3	ESE.	.25	S. B. T.
2623	Oct. 20	4.09 p. m.	33 38 00	77 36 00	76	74	......	15	gy. S. brk. Co	SE. by S.	3	ESE.	.25	S. B. T.
2624	Oct. 21	6.27 a. m.	32 36 00	77 29 15	71	78	......	258	gy. S. bk. Sp	WSW.	5	SSW.	.50	L. B. T.
2625	Oct. 21	7.50 a. m.	32 35 00	77 30 00	70	76	......	247	gy. S. bk. Sp	NE.	5	S. by E.	.50	L. B. T.
2626	Oct. 21	10.50 a. m.	32 27 30	77 20 30	69	76	......	353	fne. gy. S	SSW.	2	SE. by S.	.50	L. B. T.
2627	Oct. 21	2.06 p. m.	32 21 30	77 07 00	69	77	......	437	yl. M	SSW.	4	E.	.50	L. B. T.
2628	Oct. 21	3.51 p. m.	32 24 00	76 55 30	70	77	......	528	yl. M	SSW.	2	W.	.50	L. B. T.

In the preceding and following tables the abbreviations for the characters of the bottom and the instrument used are from the following code:

Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.
C	Clay.	P	Pebbles.	lge	large.	stf	stiff.	br	brown.	L. B. T.	Large beam-trawl.
Co	Coral.	Oz	Ooze.	rky	rocky.	slat	slate color.	choc	chocolate color.	S. B. T.	Small beam-trawl.
St	Stones.	R	Rock.	rot	rotten.	yl	yellow.	gn	green.	Bl. Dr.	Blake dredge (deep-sea dredge).
G	Gravel.	Sh	Shells.	stk	sticky.	bk	black.	lt	light.	Sh. Dr.	Ship's dredge (mud-bag).
S	Sand.	Glob	Globigerina.	crs	coarse.	bu	blue.	dk	dark.	Tgls	Tangles.
For	Foraminifera.	Sp	Specks.	hrd	hard.	gy	gray.				
Pter	Pteropods.	brk	broken.	sml	small.	rd	red.				
M	Mud.	fne	fine.	sft	soft.	wh	white.				

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, from January 1 to October 26, 1886.

Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1886.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2629	Mar. 8	12.07 p. m.	23 48 40	75 10 40	73	73	38.4	1,169	Co. S	N.	1	S. by W. ¾ W.	2½	L. B. T.
2630	Mar. 12	2.10 p. m.	24 39 45	76 11 30	72	72	61.8	244	Co. S	SE.	4	ESE.	¼	Tgls.
2631	Mar. 12	3.03 p. m.	24 39 30	76 11 00	73	72	59.8	280	Co. S	SE.	4	NNW.	⅛	Tgls.
2632	Mar. 13	2.29 p. m.	24 30 43	76 23 45	75	73	39.4	791	Co. S. gy. Oz	SSE.	4	E. by N.	2	L. B. T.
2633	Apr. 7	8.05 a. m.	23 11 00	82 19 30	74	76	60.8	203	Co. S	NE.	3	......	......	Tgls.
2634	Apr. 7	8.48 a. m.	23 10 45	82 18 45	74	76	......	162	br. S. brk. Sh	NE.	3	......	......	Tgls.
2635	Apr. 7	10.05 a. m.	23 10 55	82 18 55	71	73	62.8	208	dead Co. Sh	N. by E.	3	......	......	Tgls.
2636	Apr. 7	10.52 a. m.	23 10 45	82 18 45	71	73	62.6	191	dead Co. Sh	N. by E.	3	......	......	Tgls.
2637	Apr. 7	11.32 a. m.	23 10 45	82 19 00	70	75	65.8	143	dead Co. Sh	N. by E.	3	......	......	Tgls.
2638	Apr. 7	2.09 p. m.	23 17 45	82 18 00	69	76	39.6	1,025	yl. S	N.	3	......	......	L. B. T.
2639	Apr. 9	6.05 a. m.	25 04 50	80 15 10	70	73	......	56	Co. S	NE.	4	NE. by N.	¼	Bl. Dr.
2640	Apr. 9	6.33 a. m.	25 05 00	80 15 00	70	73	......	56	Co. S	NE.	4	NE. by N.	¾	L. B. T.
2641	Apr. 9	8.14 a. m.	25 11 30	80 10 00	70	74	69.2	60	Co. S	NE.	4	NE. by N.	¼	L. B. T.
2642	Apr. 9	10.41 a. m.	25 20 30	79 58 00	71	74	42.6	217	gy. S	NE. by E.	4	NE. by N.	1	L. B. T.
2643	Apr. 9	11.54 a. m.	25 25 00	79 55 15	71	74	43.1	211	gy. S	NE. by E.	4	NE. by N.	1½	L. B. T.
2644	Apr. 9	2.01 p. m.	25 40 00	80 00 00	73	73	43.4	193	gy. S	NNE.	3	N. ¾ W.	¾	Bl. Dr.
2645	Apr. 9	3.15 p. m.	25 46 30	80 02 00	70	75	43.4	157	gn. S	NNE.	3	......	......	Bl. Dr.
2646	Apr. 9	4.14 p. m.	25 47 00	80 05 00	71	75	......	85	gy. S. For	NNE.	3	N.	½	Bl. Dr.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, etc.—Continued.

Serial number.	Date.	Hour.	Position.		Temperatures.			Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Lat. N.	Long. W.	Air.	Surface.	Bottom.			Direction.	Force.	Direction.	Distance.	
	1886.		° ′ ″	° ′ ″	°	°	°	Fath.					Miles.	
2647	Apr. 9	4.49 p. m	25 48 00	80 04 00	71	75	.....	85	gy. S. For	NNE.	3	N.	½	Bl. Dr.
2648	Apr. 9	5.17 p. m	25 53 00	80 03 30	71	73	.....	84	gn. M	NNE.	3	N.	½	Bl. Dr.
2649	Apr. 12	5.25 p. m	23 34 00	76 33 00	73	74	74.2	36	Co. S	SE.	6	.....	.....	Tgls.
2650	Apr. 12	6.01 p. m	23 34 30	76 34 00	73	74	57.8	369	Co. S. wh. Oz	SE.	6	SE. by E.	2	Tgls.
2651	Apr. 13	9.46 a. m	24 02 00	77 12 45	75	74	73.4	97	wh. Oz	E.	4	.....	.....	Tgls.
2652	Apr. 13	10.06 a. m	24 12 30	77 13 00	75	74	67.1	140	wh. M	E.	4	.....	.....	Bl. Dr.
2653	Apr. 14	11.35 a. m	24 52 30	77 39 00	78	74	39.1	1,000	lt. br. Oz	N.	3	NW. by W.	3	L. B. T.
2654	May 2	8.29 a. m	27 57 30	77 27 30	76	73	39.3	660	yl. Oz. bk. Sp	WNW.	2	NW. by W.	1	L. B. T.
2655	May 2	5.49 p. m	27 22 00	78 07 30	72	76	47.5	338	gy. S	NW.	3	NW. by W.	¾	L. B. T.
2656	May 3	5.24 a. m	27 58 30	78 24 00	69	71	41.2	572	For	N.	3	WNW.	1½	L. B. T.
2657	May 3	8.35 a. m	28 08 00	78 28 00	71	73	44.7	540	For	N.	3	WNW.	1¾	L. B. T.
2658	May 3	12.20 p. m	28 21 00	78 33 00	72	73	44.7	514	For. brk. Sh	N. by E.	3	NNW. ½ W.	1¼	L. B. T.
2659	May 3	3.35 p. m	28 32 00	78 42 00	73	74	45.2	509	br. For	N.	3	NW.	1	L. B. T.
2660	May 3	6.47 p. m	28 40 00	78 46 00	72	74	45.7	504	yl. For	NNE.	3	NW.	¼	L. B. T.
2661	May 4	5.29 a. m	29 16 30	79 36 30	70	75	45.5	438	gy. S. bk. Sp	ENE.	4	NNW.	1	L. B. T.
2662	May 4	8.19 a. m	29 24 30	79 43 00	72	75	43.7	434	gy. S. brk. Sh	ENE.	4	NNW.	¾	L. B. T.
2663	May 4	10.46 a. m	29 39 00	79 49 00	72	77	42.7	421	br. S	E.	4	NNW.	¾	L. B. T.
2664	May 4	2.26 p. m	29 41 00	79 55 00	74	75	42.7	373	Co. S	E.	2	N.	1	L. B. T.
2665	May 4	5.16 p. m	29 47 00	80 05 45	75	76	45.2	263	fne. gy. S	ESE.	3	SSE.	¾	L. B. T.
2666	May 5	5.26 a. m	30 47 30	79 49 00	70	74	48.3	270	gy. S	E.	1	NNE.	1¼	L. B. T.
2667	May 5	7.22 a. m	30 53 00	79 42 30	75	75	48.7	273	gy. S. bk. Sp	E.	2	NNE.	¾	L. B. T.
2668	May 5	9.37 a. m	30 58 30	79 38 30	73	76	46.3	294	gy. S. dead Co	E.	2	NNE.	¼	L. B. T.
2669	May 5	11.23 a. m	31 09 00	79 33 30	73	77	43.7	352	gy. S. dead Co	E.	2	NNE.	¼	L. B. T.
2670	May 5	1.52 p. m	31 20 00	79 22 00	73	74	44.5	280	gy. S. dead Co	E.	1	.....	.....	L. B. T.
2671	May 5	2.45 p. m	31 20 00	79 22 00	76	77	.....	280	gy. S. dead Co.	E. by S.	1	.....	.....	Tgls.
2672	May 5	5.55 p. m	31 31 00	79 05 00	73	77	54.3	277	crs. br. S	SE.	1	NE. by E.	¼	Tgls.
2673	May 6	5.17 a. m	32 26 00	77 43 30	72	77	51.6	240	Co. gy. S. bk. Sp	SW.	1	NE. by E.	½	L. B. T.
2674	May 6	8.45 a. m	32 32 00	77 17 00	72	76	46.0	316	gy. S. bk. Sp. Sh	SW.	2	E.	1½	L. B. T.
2675	May 6	10.00 a. m	32 32 30	77 15 00	73	75	45.8	327	gy. S. bk. Sp. Sh	SW.	2	E.	1	L. B. T.
2676	May 6	12.19 p. m	32 39 00	77 01 00	73	77	45.8	407	gn. Oz. gy. S	SW.	2	E.	1	L. B. T.
2677	May 6	2.49 p. m	32 39 00	76 50 30	75	78	39.3	478	gn. M	SW.	2	E.	1¼	L. B. T.
2678	May 6	5.42 p. m	32 40 00	76 40 30	74	77	38.7	731	lt. gy. Oz	SSW.	3	SSW.	1	L. B. T.
2679	May 6	8.14 p. m	32 40 00	76 40 30	72	75	38.6	782	lt. gy. Oz	SSW.	3	SW.	1½	L. B. T.
2680	July 16	9.27 a. m	39 50 00	70 26 00	75	73	.....	555	No specimen	S. by E.	5	SSE. ¼ E.	½	L. B. T.
2681	July 16	12.55 p. m	39 43 00	70 29 00	75	73	38.5	990	gn. M	S.	4	SE.	1	L. B. T.
2682	July 16	5.28 p. m	39 38 00	70 22 00	75	73	38.2	1,004	gn. M. S	WSW.	3	SE. by E.	1½	L. B. T.
2683	July 17	5.04 a. m	39 33 00	70 50 00	73	71	38.7	887	br. Oz	SSW.	2	SE. by S.	1	L. B. T.
2684	July 17	8.18 a. m	39 35 00	70 54 00	73	72	38.7	1,106	br. C. bk. Sp	SSW.	1	SSE.	1½	L. B. T.

2685	July 17	1.59 p. m	39 35 00	71 02 00	71 73 37.9	1,137	gn. M. wh. Sp	Calm.	0	S.	1¼	L. B. T.
2686	July 18	4 31 a. m	39 52 00	71 20 45	....	226	gn. M	SW.	2	W.	¾	L. B. T.
2687	July 18	6.12 a. m	39 46 00	71 19 00	....	326	gn. M	SW.	1	W.	¾	L. B. T.
2688	July 18	8.17 a. m	39 42 00	71 12 00	....	614	gn. M	SW.	1	SW. by W.	1	L. B. T.
2689	July 18	10.18 a. m	39 42 00	71 15 30	....	525	gn. M	SSW.	1	NW.	2	L. B. T.
2690	July 18	1.12 p. m	39 39 00	71 11 00	....	643	gn. M	Calm.	0	SW.	1	L. B. T.
2691	July 18	5.18 p. m	39 37 00	71 08 00	....	835	lt. gn. M	SSW.	2	NW.	1½	L. B. T.
2692	Aug. 11	10.49 a. m	46 50 00	44 35 00	....	73	gy. S. sml. bk. St	NW.	3	W. by S.	½	L. B. T.
2693	Aug. 11	12.09 p. m	46 53 00	44 39 30	....	78	rd. and gn. S. bk. and gy. P	NW.	2	W. by S.	1¼	L. B. T.
2694	Aug. 11	1.55 p. m	46 52 30	44 54 30	....	86	gy. S. bk. Sp	WSW.	3	WNW.	¼	L. B. T.
2695	Aug. 11	3.44 p. m	46 51 30	45 06 30	....	105	gy. S. bk. Sp. P	W.	3	NE.	½	L. B. T.
2696	Aug. 11	4.33 p. m	46 53 30	45 05 30	....	98	gy. S. bk. Sp	W.	3	NE.	½	L. B. T.
2697	Aug. 12	12.09 p. m	47 40 00	47 35 30	....	206	gn. M. bk. Sp	SSW.	2	SW. by S.	½	L. B. T.
2698	Aug. 22	8.10 a. m	45 07 00	55 09 00	....	90	gy. S. bk. Sp. P	SSW.	2	S. by W.	¼	L. B. T.
2699	Aug. 22	10.53 a. m	45 01 00	55 23 00	....	72	Co	WSW.	2	E. ¾ S.	½	L. B. T.
2700	Aug. 22	1.29 p. m	44 56 30	55 48 00	....	59	gy. S. bk. Sp	SW.	2	E. ¾ S.	½	L. B. T.
2701	Aug. 22	2.02 p. m	44 56 00	55 49 30	....	75	gy. S. bk. Sp	S.	2	E. ¼ S.	½	L. B. T.
2702	Aug. 22	5 25 p. m	44 50 00	56 19 30	....	215	gn. M	S.	3	W.	¾	L. B. T.
2703	Aug. 23	11.30 a. m	44 01 00	59 02 30	....	140	gy. S. bk. Sp	S. by W.	4	WSW.	½	L. B. T.
2704	Aug. 23	4.52 p. m	43 32 00	59 22 00	....	110	gy. S. bk. Sp	SW. by S.	6	WNW. ½ W.	¾	L. B. T.
2705	Aug. 24	9.11 a. m	42 47 00	61 01 00	....	1,255	lt. br. oz	N.	1	N. by E. ½ E.	2½	L. B. T.
2706	Aug. 27	9 33 a. m	41 28 30	65 35 30	....	1,188	gy. Oz. For	SE.	2	SW.	1½	L. B. T.
2707	Aug. 27	2 21 p. m	41 24 00	65 48 00	....	1,099	br. Oz. For	WSW.	3	SW. by W.	1½	L. B. T.
2708	Aug. 28	7.09 a. m	40 07 00	67 49 00	....	980	br. Oz	SW. by W.	4	W.	1	L. B. T.
2709	Aug. 28	9.55 a. m	40 07 00	67 54 00	....	866	br. M	WSW.	2	WNW.	¾	L. B. T.
2710	Aug. 28	2.45 p. m	40 06 00	68 01 30	....	984	gn. M	SSW.	3	....	......	L. B. T.
2711	Sept. 16	3.40 p. m	38 59 00	70 07 00	....	1,544	Glob. Oz	SE.	4	W.	1½	L. B. T.
2712	Sept. 17	5.49 a. m	38 20 00	70 05 30	....	1,867	br. Oz	Calm.	0	W.	1½	L. B. T.
2713	Sept. 17	11.20 a. m	38 20 00	70 08 30	....	1,859	br. Oz	Calm.	0	W.	1½	L. B. T.
2714	Sept. 17	4.58 p. m	38 22 00	70 17 30	....	1,825	br. Oz	WSW.	1	SW.	1½	L. B. T.
2715	Sept. 18	5.33 a. m	38 29 30	70 54 30	....	1,753	br. Oz	WSW.	2	WNW.	1½	L. B. T.
2716	Sept. 18	11.04 a. m	38 29 30	70 57 00	....	1,631	br. Oz. For	NW.	2	NW.	1½	L. B. T.
2717	Sept. 18	3.54 p. m	38 24 00	71 13 00	....	1,615	br. Oz	NE.	3	NW.	1	L. B. T.
2718	Sept. 19	5.38 a. m	38 24 00	71 52 00	....	1,569	br. Oz	E.	4	NNW.	2	L. B. T.
2719	Sept. 19	11.13 a. m	38 29 00	71 58 00	....	1,536	gy. Oz	ESE.	3	NW.	1½	L. B. T.
2720	Sept. 19	3.54 p. m	38 36 30	72 12 00	....	1,509	gy. Oz	S.	2	NE. by N.	2	L. B. T.
2721	Sept. 20	6.02 a. m	38 56 00	72 11 30	....	813	gy. Oz	W. by N.	4	NW.	1	L. B. T.
2722	Sept. 20	9.33 a. m	39 13 00	72 01 00	....	594	gn. M	N. by W.	6	WSW.	3	L. B. T.
2723	Oct. 23	5.42 a. m	36 47 00	73 09 30	....	1,685	gy. Oz. For	N. by W.	2	WSW. ¾ W.	1	L. B. T.
2724	Oct. 23	12.02 p. m	36 47 00	73 25 00	....	1,641	gy. Oz. For	NNW.	2	WSW.	2	L. B. T.
2725	Oct. 24	5.54 a. m	36 34 00	73 48 00	....	1,374	gy. Oz. For	NE.	5	W.	1½	L. B. T.
2726	Oct. 24	11.10 a. m	36 34 00	73 54 30	....	1,253	gy. Oz	NE.	4	W. by S.	1	L. B. T.
2727	Oct. 24	4.09 p. m	36 35 00	74 03 30	....	1,239	gy. Oz	ENE.	4	W.	1	L. B. T.
2728	Oct. 25	5.45 a. m	36 30 00	74 33 00	....	859	gy. Oz	NE. by E.	3	NW. ½ N.	1	L. B. T.
2729	Oct. 25	9.10 a. m	36 36 00	74 32 00	....	679	dk. gn. M	ENE.	2	NNE.	1	L. B. T.
2730	Oct. 25	12.28 p. m	36 42 00	74 30 00	....	727	gn. M. For	E.	2	N.	¾	L. B. T.
2731	Oct. 25	4.12 p. m	36 45 00	74 28 00	....	781	gy. Oz	Calm.	0	N. by E.	1	L. B. T.
2732	Oct. 26	6.09 a. m	37 27 00	73 33 00	....	1,152	dk. gn. M	SE.	1	WSW.	1½	L. B. T.
2733	Oct. 26	10.19 a. m	37 26 00	73 43 00	....	944	gn. M	SE.	2	SW. by W.	2	L. B. T.
2734	Oct. 26	1.52 p. m	37 23 00	73 53 00	....	841	sft. gn. M	SE.	2	WSW.	1½	L. B. T.
2735	Oct. 26	4.55 p. m	37 23 00	74 02 00	....	811	sft. gn. M	SE.	2	SW.	1¼	L. B. T.

Record of dredgings and trawlings of the U. S. Fish Commission steamer Albatross, from April 8 to September 19, 1887.

Serial number.	Date.	Hour.	Position. Lat. N.	Position. Long. W.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth.	Character of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Instrument used.
	1887.		° ′ ″	° ′ ″	°	°	°	*Fath.*					*Miles.*	
2736	Apr. 8	11.00 a. m	Hampton Roads.		...	...	....	11	No specimen	....	...	....	.....	S. B. T.
2737	Apr. 8	11.20 a. m	....	....	...	...	....	12	No specimen	....	...	....	.....	S. B. T.
2738	Sept. 16	3.14 p. m	36 52 00	74 23 00	70	70	37.9	958	br. Oz	N. by E.	5	NW. by W.	1	L. B. T.
2739	Sept. 17	8.00 a. m	37 34 30	73 58 00	65	69	38.1	811	gy. M	NNE.	4	NNW.	1	L. B. T.
2740	Sept. 17	11.50 a. m	37 40 00	73 50 00	65	70	37.9	1,011	br. Oz	NNE.	4	NW. by N.	1½	L. B. T.
2741	Sept. 17	3.30 p. m	37 44 00	73 57 00	64	70	37.9	852	gn. M	NE. by N.	3	N.	1	L. B. T.
2742	Sept. 17	6.25 p. m	37 46 30	73 56 30	64	69	37.9	865	gn. M	NE. by N.	3	NW. by N.	1	L. B. T.
2743	Sept. 18	8.06 a. m	38 31 00	72 53 00	62	67	37.7	1,155	gy. Oz	E. by S.	2	NW.	1	L. B. T.
2744	Sept. 18	11.48 a. m	38 35 00	73 05 15	65	69	38.9	554	bu. M	E. by S.	3	N. by E.	¼	L. B. T.
2745	Sept. 18	4.20 p. m	38 42 00	73 05 30	67	68	41.7	224	gn. M	SE. by E.	2	NNE.	½	L. B. T.
2746	Sept. 18	5.14 p. m	38 46 00	73 05 45	65	68	53.3	102	gn. S	SE. by E.	2	....	¾	L. B. T.
2747	Sept. 19	6.00 a. m	39 27 00	71 15 00	67	67	37.4	1,276	bu. M	SW. by W.	1	S.	1	L. B. T.
2748	Sept. 19	10.53 a. m	39 31 00	71 14 30	72	68	37.7	1,163	gy. M. For	Calm.	...	W.	1	L. B. T.
2749	Sept. 19	3.20 p. m	39 42 00	71 17 00	69	67	38.7	705	gn. Oz	S.	2	....	.....	L. B. T.

LIST OF DREDGING STATIONS OCCUPIED BY THE U. S. COAST SURVEY STEAMERS CORWIN, BIBB, HASSLER, AND BLAKE, FROM 1867 TO 1880.

The dredgings from 1867 to 1871, and those of the *Hassler* in 1872, were all made by Count L. F. Pourtales, Assistant U. S. Coast Survey, in a great measure under the direction of Prof. Louis Agassiz, who accompanied several of the expeditions. Their positions were originally published in the Bulletin of the Museum of Comparative Zoology at Cambridge, Mass., in September, 1879. A continuous series of numbers running from 1 P. to 224 P. has been assigned to them for convenience in placing them on charts without confusing them with other Coast Survey or Fish Commission dredgings.

The following stations were occupied by the *Corwin*, Acting Master R. Platt, U. S. Navy, commanding, in 1867, in connection with a survey for a telegraph cable between Key West and Havana. The expedition was cut short by the breaking out of yellow fever on board.

Serial number.	Date.	Depth.	Locality.
		Fathoms.	
1 P	May 17	90-100	5 miles SSW. of Sand Key, Fla.
2 P	May 24	270	1.6 miles from Chorrera, Cuba.
3 P	May 25	350	2 miles from Chorrera, Cuba.
4 P	May 29	270	1.6 miles from Chorrera, Cuba.

The dredging in 1868 and 1869 were made by the *Bibb*, Acting Master R. Platt, U. S. Navy, commanding. They are all situated in the Florida straits, between Tortugas and Cape Florida. The positions, as published in the Bulletin of the Museum of Comparative Zoology, were only given in a general way, and are here taken from Count Pourtales's original charts, preserved in the Coast Survey Office. A separate series of numbers is attached to each day's work, both on the charts and in the bulletin, and these numbers and the depths given correspond for the most part, except that the depth on the charts have been corrected whilst those in the bulletin are apparently from the original rough notes. In some cases, however, a different number is given to the haul on the chart from that in the bulletin. All notes here given on the character of the bottom are also derived from the charts. The number and letter assigned to each dredging on the original charts and record-books, the number given in the bulletin, and the depths given by them, respectively, are given in separate columns, so as to facilitate future comparisons. A few hauls, mostly shallow water ones, it has been impossible to place exactly.

Dredgings made by U. S. Coast Survey, 1868–'69.

Serial number.	No. on charts and record-books.	No. in bulletin.	Date.	Latitude N.	Longitude W.	Depth in fathoms (bulletin).	Depth given on chart, etc.	Nature of bottom.	Locality.
			1868.	° ′ ″	° ′ ″				
5 P.	......	2	Apr. 23	....	....	195	....	....	Off Sombrero.
6 P.	......	3	Apr. 23	....	....	115	....	....	Do.
7 P.	7 B.	7	May 1	24 28 50	81 03 10	111	111	Hard	Do.
8 P.	6 B.	6	May 1	24 25 15	81 01 30	121	121	....do	Do.
9 P.	5 B.	5	May 1	24 21 40	81 00 00	111	140	Rocky	Do.
10 P.	4 B.	4	May 1	24 18 00	80 58 30	152	152	....do	Do.
11 P.	3 B.	3	May 1	24 16 20	80 57 30	183	180	....do	Do.
12 P.	2 B.	2	May 1	24 14 20	80 57 00	262	228	....	Do.
13 P.	1 B.	1	May 1	24 12 30	80 55 30	517	517	Mud	Do.
14 P.	1 D.	1	May 4	24 33 30	81 19 00	19	19	....	Off Bahia Honda.
15 P.	4 D.	4	May 4	24 30 20	81 18 20	75	75	Sand	Do.
16 P.	5 D.	5	May 4	24 29 30	81 17 30	95	91	....	Do.
17 P.	6 D.	6	May 4	24 28 30	81 16 30	105	105	....	Do.
18 P.	7 D.	7	May 4	24 26 30	81 14 30	100	100	Rocky	Do.
19 P.	9 D.	9	May 4	24 22 30	81 10 30	119	112	....	Do.
20 P.	10 D.	10	May 4	24 19 40	81 07 00	128	128	....	Do.
21 P.	11 D.	11	May 4	24 17 00	81 03 20	176	167	....	Do.
22 P.	12 D.	12	May 4	24 14 20	80 59 40	324	310	....	Do.
23 P.	13 D.	13	May 4	24 12 50	80 58 00	418	400	Mud	Do.
24 P.	1 E.	1	May 6	24 30 20	81 30 30	16	16	Rotten shells	Off American Shoal.
25 P.	3 E.	3	May 6	24 28 30	81 30 30	43	43	Mud	Do.
26 P.	4 E.	4	May 6	24 28 00	81 30 15	55	55	....do	Do.
27 P.	5 E.	5	May 6	24 27 30	81 29 45	75	70	....do	Do.
28 P.	6 E.	6	May 6	24 27 00	81 29 00	83	83	....do	Do.
29 P.	7 E.	7	May 6	24 26 40	81 28 30	98	98	....	Do.
30 P.	8 E.	8	May 6	24 26 00	81 27 50	94	94	Rocky	Do.
31 P.	9 E.	9	May 6	24 25 20	81 27 00	100	99	Hard	Do.
32 P.	1 F.	1	May 8	24 24 40	81 29 00	111	111	Mud	Do.
33 P.	3 F.	3	May 8	24 20 30	81 24 30	150	129	Coral and rocky ..	Do.
34 P.	4 F.	4	May 8	24 18 10	81 22 10	135	132	....	Do.
35 P.	5 F.	5	May 8	24 15 50	81 19 40	266	260	....	Do.
36 P.	3 G.	2	May 9	24 27 15	81 39 20	34	34	Mud and sand	Off the Samboes.
37 P.	6 G.	4	May 9	24 26 00	81 38 40	67	67	Mud	Do.
38 P.	7 G.	5	May 9	24 25 05	81 38 00	80	80	....	Do.
39 P.	8 G.	6	May 9	24 24 00	81 37 10	93	93	Broken shells.....	Do.
40 P.	9 G.	7	May 9	24 23 20	81 36 15	96	96	Mud	Do.
41 P.	10 G.	8	May 9	24 22 40	81 35 00	101	100	....do	Do.
42 P.	11 G.	9	May 9	24 22 00	81 34 00	106	104	....do	Do.
43 P.	12 G.	10	May 9	24 21 20	81 33 00	106	106	....do	Do.
44 P.	13 G.	11	May 9	24 20 45	81 32 00	116	116	Hard	Do.
45 P.	14 G.	12	May 9	24 20 05	81 31 00	123	121	....	Do.
46 P.	15 G.	13	May 9	24 19 10	81 30 00	125	123	Coral, rock........	Do.
47 P.	16 G.	14	May 9	24 18 45	81 28 45	125	121	Hard	Do.
48 P.	18 G.	16	May 9	24 16 20	81 24 30	139	137	....	Do.
49 P.	19 G.	17	May 9	24 14 45	81 22 30	147	145	Hard	Do.
50 P.	20 G.	18	May 9	24 13 20	81 20 20	298	292	Sand and shells ...	Do.
51 P.	21 G.	19	May 9	24 12 40	81 19 25	237	312	Fine coral mud ...	Do.
52 P.	2 H.	2	May 11	24 26 10	81 47 30	26	26	Coral and shells ..	Off Sand Key.
53 P.	4 H.	3	May 11	24 25 15	81 47 30	54	54	Broken shells.....	Do.
54 P.	6 H.	4	May 11	24 24 20	81 47 00	67	67	....do	Do.
55 P.	8 H.	5	May 11	24 23 30	81 46 40	82	82	....do	Do.
56 P.	10 H.	6	May 11	24 22 50	81 46 20	94	94	....	Do.
57 P.	11 H.	7	May 11	24 22 00	81 46 00	103	103	....	Do.
58 P.	13 H.	9	May 11	24 20 20	81 45 20	119	115	Hard	Do.
59 P.	14 H.	10	May 11	24 19 30	81 45 00	119	119	....do	Do.
60 P.	15 H.	11	May 11	24 19 00	81 44 50	128	119	....	Do.
61 P.	16 H.	12	May 11	24 18 30	81 44 20	127	118	....	Do.
62 P.	17 H.	13	May 11	24 17 55	81 43 50	123	123	....	Do.
63 P.	18 H.	14	May 11	24 17 30	81 43 20	134	130	....	Do.
64 P.	19 H.	15	May 11	24 17 00	81 43 00	143	140	....	Do.
65 P.	20 H.	16	May 11	24 16 00	81 42 00	138	137	....	Do.
66 P.	21 H.	17	May 11	24 15 00	81 41 10	154	150	....	Do.
67 P.	23 H.	19	May 11	24 13 25	81 39 30	306	297	Mud	Do.
68 P.	24 H.	20	May 11	24 12 30	81 38 30	248	241	....do	Do.
69 P.	......	1	May 15	Nearly south from Sand Key.	....	100	....	....	Do.
70 P.	......	3	May 15		....	100	....	....	Do.
71 P.	......	4	May 15		....	100	....	....	Do.
72 P.	......	5	May 15		....	100	....	....	Do.
73 P.	.....	6	May 15		....	100	....	....	Do.
74 P.	......	1	May 16		....	120	....	....	Do.
75 P.	......	2 & 3	May 16		....	120	....	....	Do.
76 P.	......	4 & 5	May 16		....	120	....	....	Do.
77 P.	......	6	May 16		....	120	....	....	Do.
			1869.						
78 P.	......	1	Jan. 15		....	6–7	....	....	South of Tortugas.

Dredgings made by U. S. Coast Survey, etc.—Continued.

Serial number.	No. on charts and record-books.	No. in bulletin.	Date.	Latitude N.	Longitude W.	Depth in fathoms (bulletin).	Depth given on chart, etc.	Nature of bottom.	Locality.
			1860.	° ′ ″	° ′ ″				
79 P.	1 A.	2	Jan. 15	24 30 30	82 59 15	13	13	Broken shells	South of Tortugas.
80 P.	2 A.	3	Jan. 15	24 27 30	82 59 30	17	18	Mud	Do.
81 P.	3 A.	4	Jan. 15	24 24 45	82 59 45	34	34	...do	Do.
82 P.	6 A.	7	Jan. 15	24 16 00	83 00 45	260	261	...do	Do.
83 P.	(*)	1 & 2	Jan. 16	24 39 00	83 07 30	30–32	30–32	Sand and shells	Do.
84 P.	3 B.	3	Jan. 16	24 40 30	83 15 00	35	35	...do	Do.
85 P.	4 B.	4	Jan. 16	24 41 30	83 19 00	36	36	...do	Do.
86 P.	5 B.	5	Jan. 16	24 42 00	83 22 45	36	36	Sand, shells, sponges.	Do.
87 P.	6 B.	6	Jan. 16	24 42 30	83 26 30	35	35	...do	Do.
88 P.	7 B.	7	Jan. 16	24 43 30	83 30 30	35	36	...do	Do.
89 P.	8 B.	8	Jan. 16	24 43 40	83 34 30	37	37	Sand, grass	Do.
90 P.	9 B.	9	Jan. 16	24 44 00	83 38 30	37	37	Sand, shells, sponges.	Do.
91 P.	10 B.	10	Jan. 16	24 44 15	83 42 00	34	34	Coral	Do.
92 P.	11 B.	11	Jan. 16	24 44 15	83 46 00	43	43	...do	Do.
93 P.	12 B.	(†)	Jan. 16	24 44 15	83 49 20	42	42	...do	Do.
94 P.	1 C.	1	Jan. 17	24 48 11	83 49 00	43	43	...do	Do.
95 P.	3 C.	3	Jan. 17	24 48 45	84 01 00	124	124	Coarse sand	Do.
96 P.	5 C.	5	Jan. 17	24 49 00	84 13 00	502	502	Gray mud	Do.
97 P.	1 D.	1	Jan. 18	24 33 30	83 09 45	25	25	Gray sand, black specks.	Do.
98 P.	3 D.	3	Jan. 18	24 29 45	83 17 00	60	60	Rocky	Do.
99 P.	4 D.	4	Jan. 18	24 28 15	83 20 15	115	115	Mud	Do.
100 P.	5 D.	5	Jan. 18	24 26 15	83 24 00	214	214	...do	Do.
101 P.	6 D.	6	Jan. 18	24 25 00	83 27 45	306	316	...do	Do.
102 P.	7 D.	7	Jan. 18	24 22 45	83 32 00	389	389	...do	Do.
103 P.	8 D.	8	Jan. 18	24 20 30	83 37 00	468	450	...do	Do.
104 P.	1 E.	1	Jan. 22	24 33 45	82 44 15	13	13	Coarse sand, broken shells.	Do.
105 P.	2 E.	2	Jan. 22	24 29 15	82 44 00	11	11	...do	Do.
106 P.	3 E.	3	Jan. 22	24 26 30	82 43 40	16½	16½	Mud, coarse sand.	Do.
107 P.	4 E.	4	Jan. 22	24 23 00	82 43 15	47	37	White mud	Do.
108 P.	5 E.	5	Jan. 22	24 19 00	82 42 45	118	118	...do	Do.
109 P.	6 E.	6	Jan. 22	24 15 45	82 41 15	290	290	...do	Do.
110 P.	7 E.	7	Jan. 22	24 12 00	82 40 00	349	349	...do	Do.
111 P.	8 E.	8	Jan. 22	24 09 15	82 39 00	377	377	...do	Do.
112 P.	9 E.	9	Jan. 22	24 07 00	82 37 20	416	416		Do.
113 P.	1 F.	1	Jan. 23	24 24 00	82 24 30	34	34	Broken shells	Do.
114 P.	2 F.	2	Jan. 23	24 20 00	82 24 45	74	75	Gray mud	Do.
115 P.	1 G.	1	Feb. 10	24 26 00	82 11 00	42	42	Mud	Off Marquesas.
116 P.	......	2	Feb. 10	....	....	55	....		Do.
117 P.	......	3	Feb. 10	....	....	40	....		Do.
118 P.	......	(‡)	Feb. 10	....	....	12–15	....		Do.
119 P.	1 H.	1	Feb. 11	24 21 30	82 11 00	107	100	Mud	South of Marquesas.
120 P.	2 H.	2	Feb. 11	24 18 45	82 11 15	132	130	Rocky	Do.
121 P.	3 H.	3	Feb. 11	24 17 30	82 11 15	140	140	...do	Do.
122 P.	5 H.	5	Feb. 11	24 15 45	82 10 30	296	296	Mud	Do.
123 P.	6 H.	6	Feb. 11	24 13 40	82 09 00	333	333	...do	Do.
124 P.	5 J.	1	Feb. 15	24 22 15	82 02 30	105	105		Off Boca Grande.
125 P.	6 J.?	2	Feb. 15	24 21 00	82 01 30	122	122	Sandy mud	Do.
126 P.	6 J.?	3	Feb. 15	24 21 00	82 01 30	122	122	...do	Do.
127 P.	......	4	Feb. 15	....	....	125	....		Do.
128 P.	......	5	Feb. 15	....	....	125	....		Do.
129 P.	4 J.	6	Feb. 15	24 23 00	82 02 30	90	90		Do.
130 P.	1 K.	1	Feb. 16	24 19 20	82 06 30	125	125	Rocky	Do.
131 P.	3 K.	3	Feb. 16	24 13 40	82 09 00	327	....	Mud	Do.
132 P.	4 K.	4	Feb. 16	24 11 00	82 09 45	368	368	White mud	Do.
133 P.	5 K.	5	Feb. 16	24 08 15	82 10 45	405	403	Mud	Do.
134 P.	1 L.	1	Feb. 17	24 24 30	81 57 30	50	53	Sand, mud	Southwest of Sand Key.
135 P.	2 L.	2	Feb. 17	24 20 30	81 58 30	125	125	Rocky	Do.
136 P.	3 L.	3	Feb. 17	24 16 45	81 58 45	138	136	...do	Do.
137 P.	4 L.	4	Feb. 17	24 13 30	81 59 00	325	320	Mud	Do.
138 P.	5 L.	5	Feb. 17	24 23 00	81 55 30	87	85		Do.
139 P.	......	1	Mar. 4	....	....	450	....		Off Cojima, near Havana.
140 P.	2 M.	2	Mar. 5	23 27 30	80 55 30	638	638		Off Cruz del Padre, Cuba.
141 P.	1 N.	1	Mar. 10	23 57 30	80 29 15	315	315		Off Double-headed Shot Keys.
142 P.	......	1	Mar. 21	....	....	40	....		Off Conch Reef.
143 P.	......	2	Mar. 21	....	....	45	....		Off French Reef.

* 1 and 2 B. † 12 and 13. ‡ Several.

Dredgings made by U. S. Coast Survey, etc.—Continued.

Serial number.	No. on charts and record-books.	No. in bulletin.	Date.	Latitude N.	Longitude W.	Depth in fathoms (bulletin).	Depth given on chart, etc.	Nature of bottom.	Locality.
			1869.	° ″ ′	° ″ ′				
144 P.	......	3	Mar. 21	....	....	49	....	....	Off the Elbow Reef.
145 P.	1 O.	4	Mar. 21	25 08 30	80 11 15	70	70	Sand..............	Off Carysfort Reef.
146 P.	2 O.	5	Mar. 21	25 10 30	80 10 45	60	60	....do	Do.
147 P.	3 O.	6	Mar. 21	25 12 30	80 10 30	48	48	....do	Do.
148 P.	4 O.	7	Mar. 21	25 13 40	80 10 45	40	....	....do	Do.
149 P.	5 O.	8	Mar. 21	25 14 15	80 11 15	35	....	Sand, mud	Do.
150 P.	......	9	Mar. 21	....	....	12	....	....	Off Turtle Harbor.
151 P.	1 P.	1	Mar. 23	25 11 15	80 09 45	63	70	Broken shells.....	Off Carysfort Reef.
152 P.	2 P.	2	Mar. 23	25 10 30	80 06 00	116	102	....	Do.
153 P.	3 P.	3	Mar. 23	25 12 00	80 02 00	138	138	Sand..............	Do.
154 P.	4 P.	4	Mar. 23	25 13 20	79 57 00	293	293	....	Do.
155 P.	5 P.	5	Mar. 23	25 16 30	79 53 00	317	317	White mud	Do.
156 P.	6 P.	6	Mar. 23	25 20 00	79 50 00	320	320	....do	Do.
157 P.	7 P.	7	Mar. 23	25 23 00	79 48 00	351	351	...do	Do.
158 P.	1 Q.	1	Mar. 31	25 11 00	80 11 00	52	52	Rocky	Do.
159 P.	2 Q.	2	Mar. 31	25 08 30	80 06 00	117	118	....do	Do.
160 P.	3 Q.	3	Mar. 31	25 06 30	80 01 00	206	206	Sand..............	Do.
161 P.	4 Q.	4	Mar. 31	25 04 40	79 55 40	349	349	Mud	Do.
162 P.	......	2 & 3	Apr. 1	....	....	9	....	....	Off Orange Key, Bahamas.
163 P.	1 T.	1	Apr. 3	25 01 35	80 20 15	15	15	Rocky	Off French Reef.
164 P.	2 T.	2	Apr. 3	25 01 25	80 19 45	37	37	....	Do.
165 P.	3 T.	3	Apr. 3	25 01 20	80 19 30	44	44	....	Do.
166 P.	4 T.	4	Apr. 3	25 01 00	80 18 45	.....	50	Sand..............	Do
167 P.	5 T.	5	Apr. 3	25 00 00	80 16 30	75	70	Shells............	Do.
168 P.	6 T.	6	Apr. 3	24 58 40	80 14 15	100	94	Broken shells.....	Do.
169 P.	1 U.	1	Apr. 21	24 18 00	81 50 15	135	125	Rocky	Off Key West.
170 P.	2 U.	2	Apr. 21	24 14 00	81 51 45	295	290	Coral	Do.
171 P.	4 U.	3	Apr. 21	....	....	140	140	....	Do.
172 P.	5 U.	4	Apr. 21	....	....	140	134	....	Do.
173 P.	6 U.	5	Apr. 21	....	....	120	124	....	Do.
174 P.	1 X.	1	May 7	24 44 30	80 45 00	21	25	Sand..............	Off Tennessee Reef.
175 P.	2 X.	2	May 7	24 42 45	80 44 15	53	53	Mud	Do.
176 P.	3 X.	3	May 7	24 40 40	80 44 00	85	85	Shells............	Do.
177 P.	4 X.	4	May 7	24 38 30	80 42 45	108	105	Sand, shells......	Do.
178 P.	5 X.	5	May 7	24 36 30	80 41 00	114	114	Shells............	Do.
179 P.	6 X.	6	May 7	24 35 00	80 39 00	115	115	Sand, shells......	Do.
180 P.	7 X.	7	May 7	24 33 00	80 37 00	124	124	Coral	Do.
181 P.	8 X.	8	May 7	24 31 15	80 35 00	160	157	Shells............	Do.
182 P.	9 X.	9	May 7	24 29 15	80 33 00	174	174	Coral, shells	Do.
183 P.	10 X.	10	May 7	24 27 45	80 31 00	200	200	Rocky	Do.
184 P.	2 Y.	2	May 8	24 40 15	80 35 30	41	41	Mud	Off Alligator Reef.
185 P.	3 Y.	3	May 8	24 48 05	80 34 45	53	53	....do	Do.
186 P.	4 Y.	4	May 8	24 47 15	80 34 00	68	64	Shells............	Do.
187 P.	5 Y.	5	May 8	24 46 30	80 33 00	79	76	Broken shells.....	Do.
188 P.	6 Y.	6	May 8	24 47 15	80 32 15	88	88	Sand, broken shells	Do.
189 P.	7 Y.	7	May 8	24 44 45	80 31 30	110	110	Rocky	Do.
190 P.	8 Y.	8	May 8	24 43 40	80 30 45	110	113	....do	Do.
191 P.	9 Y.	9	May 8	24 42 45	80 28 40	113	113	Sand, broken shells	Do.
192 P.	10 Y.	10	May 8	24 41 45	80 27 45	118	118	Rocky	Do.
193 P.	11 Y.	11	May 8	24 40 30	80 25 35	138	135	Broken shells, coral	Do.
194 P.	12 Y.	12	May 8	24 39 30	80 23 15	147	147	....	Do.
195 P.	13 Y.	13	May 8	24 38 30	80 22 30	156	160	Shells............	Do.
196 P.	14 Y.	14	May 8	24 37 20	80 20 15	189	188	Broken shells.....	Do.
197 P.	15 Y.	15	May 8	24 26 00	80 18 05	238	238	Fine sand	Do.
198 P.	1 Z.	1	May 11	24 56 15	80 27 30	30	30	Broken shells.....	Off Conch Reef.
199 P.	2 Z.	2	May 11	24 55 40	80 26 30	39	39	....do	Do.
200 P.	3 Z.	3	May 11	24 54 15	80 25 20	49	48	....do	Do.
201 P.	4 Z.	4	May 11	24 53 15	80 23 30	60	60	....do	Do.
202 P.	5 Z.	5	May 11	24 52 20	80 22 20	77	77	Sand, shells......	Do.
203 P.	6 Z.	6	May 11	24 51 30	80 19 40	117	117	....do	Do.
204 P.	7 Z.	7	May 11	24 50 15	80 17 30	139	139	Broken shells.....	Do.
205 P.	8 Z.	8	May 11	24 49 20	80 14 30	157	137	....do	Do.
206 P.	9 Z.	9	May 11	24 48 00	80 11 30	169	108	Sand, shells......	Do.
207 P.	10 Z.	10	May 11	24 46 45	80 08 15	257	257	....	Do.
208 P.	1 Á.	1	May 13	25 19 20	80 08 15	30	30	....	Off Pacific Reef.
209 P.	2 Á.	2	May 13	25 19 30	80 07 30	40	49	Rocky	Do.
210 P.	3 Á.	3	May 13	25 19 40	80 06 30	60	60	Shells	Do.
211 P.	4 Á.	4	May 13	25 20 10	80 05 15	75	75	Fine sand.........	Do.
212 P.	5 Á.	5	May 13	25 21 00	80 03 00	98	98	....	Do.
213 P.	6 Á.	6	May 13	25 22 00	80 01 00	180	177	Mud	Do.
214 P.	7 Á.	7	May 13	25 23 15	79 59 15	233	222	....do	Do.
215 P.	8 Á.	8	May 13	25 25 00	79 58 00	283	243	....do	Do.
216 P.	9 Á.	9	May 13	25 27 00	79 57 00	287	287	....	Do.

On the voyage of the *Hassler*, Lieut. Commander R. P. Johnson, U. S. Navy, commanding, from Boston to San Francisco in 1871–'72, dredgings, numbered from 1 to 8, were made off Sandy Bay, Barbados, and twenty-six other dredgings were made in the South Atlantic, besides fifteen made off the coast of Chili. To the thirty-four hauls in the Atlantic, numbers from 217 P. to 250 P. have been assigned. The dredgings were made by Count Pourtales under the direction of Prof. Louis Agassiz.

Dredgings of the Hassler in 1871–'72.

Serial number.	Original number of dredging.	Date.	Latitude S.	Longitude W.	Depth in fathoms.	Locality.
		1871.				
217-20 P.	1-4	Dec. 29	....	....	75-100	Off Sandy Bay, Barbados.
221-24 P.	5-8	Dec. 30	....	....	17-100	Do.
		1872.				
225 P.	9	Jan. 18	11 49	Between 37° 10' and 37° 27' standing off and on shore.	15	Off coast of Brazil, north of Bahia.
226 P.	10	Jan. 18	11 49		17	Do.
227 P.	11	Jan. 18	11 49		40	Do.
228 P.	12	Jan. 18	11 49		560	Do.
229 P.	13	Jan. 18	11 49		20	Do.
230 P.	14	Jan. 18	11 49		75	Do.
231 P.	15	Jan. 18	11 49		200	Do.
232 P.	16	Jan. 20	....	....	30	Off the Abrolhos, Brazil.
233 P.	17	Jan. 20	....	....	20	Do.
234 P.	18	Jan. 20	....	....	26	Do.
235 P.	19	Jan. 20	....	....	44	Do.
236 P.	20	Jan. 22	....	....	35	Off Cape Frio, Brazil.
237 P.	21	Jan. 22	....	....	45	Do.
238 P.	22	Feb. 20	32 00	50 15	70	Off Coast of Brazil, north of river La Plata.
239 P.	23	Feb. 20	32 00	50 15	70	Do.
240 P.	24	Feb. 22	34 55	54 12	19	Off La Plata River.
241 P.	25	Feb. 29	35 12	55 30	7	In La Plata River.
242 P.	26	Mar. 1	37 42	56 20	44	Off La Plata River.
243 P.	27	Mar. 3	40 22	60 35	30	Off Bahia Blanca, Argentine Republic.
244 P.	28	Mar. 4	41 17	63 60	17	Off mouth of Rio Negro, Argentine Republic.
245 P.	29	Mar. 4	41 15	63 50	25	In Gulf of S. Matias, Argentine Republic.
246 P.	30	Mar. 7	41 40	63 13	30	Do.
247 P.	31	Mar. 9	44 52	64 10	55	Off Cape Raso, Patagonia.
248 P.	32	Mar. 11	49 40	66 50	57	Off Point S. Julian, Patagonia.
249 P.	33	Mar. 12	51 26	68 05	58	Off Coy Inlet, Patagonia.
250 P.	34	Mar. 13	....	....	22	Off Cape Possession, Patagonia.

The dredgings in 1872, except those of the *Hassler*, were made by Dr. William Stimpson. The first ones were made upon the *Bibb*, Acting Master R. Platt, U. S. Navy, commanding, those numbered 1 to 29 S. in this list being in the Yucatan Channel, following a proposed telegraph line, and 30 to 34 S. south of Sand Key, near Key West. Dr. Stimpson afterwards joined the *Bache*, Lieut. Commander I. A. Howell, commanding, and made dredgings numbered 41 to 60 S. Lieutenant Commander Howell had made a few dredgings in anticipation of Dr. Stimpson joining him, numbered 35 to 40 S. All the *Bache's* dredgings were off the west coast of Florida, except 56 to 60 S., which were southwest of the Tortugas.

Dredgings made by the Bibb and Bache in 1872.

Serial number.	Original number.	Date.	Latitude N.	Longitude W.	Depth.	Kind of bottom.	Locality.	Temperatures. Air.	Surface.	Bottom.
		1872.	° ′ ″	° ′ ″	*Fath.*			°	°	°
1 S.	1	Feb. 10	22 02 20	84 57 20	230	rky	In the Yucatan Channel.	....	....	....
2 S.	2	Feb. 10	22 00 30	85 00 00	317		....do	....	74	67
3 S.	3	Feb. 10	21 58 20	85 02 40	441	M	....do	....	75	48
4 S.	4	Feb. 10	21 55 45	85 05 50	663	Co. M	....do	....	74	42
5 S.	1	Feb. 16	22 01 35	84 57 00	25		....do	....	....	....
6 S.	2	Feb. 16	....		110		....do	....	....	....
7 S.	3	Feb. 16	22 01 20	84 57 20	162	Co. S	....do	....	....	....
8 S.	4	Feb. 16	22 00 30	85 00 50	203	Co. rky	....do	....	78	60½
9 S.	5	Feb. 16	21 59 10	85 04 10	377	Co. M. S	....do	....	74	51
10 S.	6	Feb. 16	21 54 15	85 01 30	584	Co. S. M	....do	....	79	41
11 S.	7	Feb. 16	21 52 20	85 00 10	403	M	....do	....	76	48
12 S.	1	Feb. 17	21 51 15	84 59 15	180	Co. S	....do	....	....	....
13 S.	2	Feb. 17	21 51 00	85 01 45	366		....do	....	77	52½
14 S.	3	Feb. 17	21 50 20	85 04 15	635	M. S	....do	....	78	40
15 S.	4	Feb. 17	21 48 40	85 09 10	963	crs. S. brk. Sh.	....do	....	77	39½
16 S.	5	Feb. 17	21 44 10	85 13 50	1,066	Co. M	....do	....	79	39½
17 S.	1	Feb. 18	21 45 20	85 23 50	940	crs. S. M	....do	....	78	39½
18 S.	2	Feb. 18	21 40 45	85 33 00	1,054	M	....do	....	78½	39½
19 S.	3	Feb. 18	21 35 45	85 44 15	1,164	S. M	....do	....	78½	39½
20 S.	1	Feb. 23	21 15 20	86 35 10	72	brk. Sh	....do	....	....	....
21 S.	2	Feb. 23	21 16 35	86 32 35	105		....do	....	79	66
22 S.	3	Feb. 23	21 18 00	86 30 00	153	rky	....do	....	76	51½
23 S.	4	Feb. 23	21 21 25	86 26 10	262	wh. S	....do	....	76	49½
24 S.	....	Mar. 6	21 29 00	86 40 00	17	M. Sh. rk	On Yucatan Bank	....	....	....
25 S.	....	Mar. 6	21 37 00	86 38 00	22	S. Sh	....do ——			
26 S.	1	Mar. 7	21 24 05	86 15 00	260	fne. Co. S	In the Yucatan Channel.	....	76	47
27 S.	1	Mar. 11	21 31 10	86 00 15	1,127	yll. M	....do	....	79½	40½
28 S.	2	Mar. 11	21 37 30	85 52 00	1,081	Co. M. S	....do	....	81	40
29 S.	3	Mar. 11	21 35 45	85 44 15	1,164	S. M	....do	....	78½	39½
30 S.	1	Mar. 29	24 17 00	81 54 00	133		Sand Key bears NE. ¼ E.	....	....	....
31 S.	2	Mar. 29	....	....	134	M	Near preceding	....	....	....
32 S.	3	Mar. 29	....	....	134		....do	....	....	....
33 S.	....	Mar. 29	....	....	125		Sand Key bears NE. by N. ¼ N.	....	....	....
34 S.	....	Mar. 29	....	....	119		Near preceding	....	....	....
35 S.	....	Feb. 17	25 03 00	82 13 00	12	brk. Sh	North of Marquesas	67	69	67
36 S.	....	Feb. 18	25 03 10	82 55 00	25	bl. M	North of Tortugas	66	70	67
37 S.	....	Feb. 18	25 03 30	83 14 05	33	bl. M	....do	66	69	64
38 S.	....	Feb. 18	25 03 40	83 26 50	35	gr. M	Northwest of Tortugas.	67	69	67
39 S.	....	Feb. 18	25 03 55	83 42 10	40	brk. Sh. Co	....do	74	70	68
40 S.	....	Feb. 18	24 56 30	84 14 00	169		do	76	78	55
41 S.	24	Apr. 19	27 07 00	82 47 00	13	Co. sponge	Off west coast of Florida.	75	78	83
42 S.	28	Apr. 19	27 07 00	82 51 00	14	gr. S. brk. Sh	....do	75	78	80
43 S.	32	Apr. 19	27 07 00	82 55 10	15	gr. S. brk. Sh.	....do	76	78	79
44 S.	65	Apr. 19	27 07 30	84 11 00	50	fne. gr. S. blk. Sp	....do	74	77	74
45 S.	70	Apr. 20	27 07 30	84 26 00	81	fne. gr. S	....do	75	77	76
46 S.	11	Apr. 23	26 17 25	84 36 00	132	wh. S. brk. Sh	....do	75	80	56
47 S.	13	Apr. 23	26 17 25	84 31 25	123		....do	73	80	57
48 S.	17	Apr. 23	26 17 20	84 21 20	100	gr. S. M	....do	78	81	60
49 S.	34	Apr. 23	26 16 50	83 40 25	45	S	....do	75	78	67
50 S.	35	Apr. 23	26 16 50	83 37 45	40	S	....do	74	78	....
51 S.	52	Apr. 24	26 16 30	82 57 20	23	gr. S. M	....do	72	78	....
52 S.	55	Apr. 24	26 16 25	82 50 10	19	gr. S. M	....do	71	74	....
53 S.	57	Apr. 24	26 16 25	82 47 25	18	gr. S. brk. Sh	....do	71	74	....
54 S.	57	Apr. 24	26 16 20	82 46 00	....		....do	71	74	....
55 S.	60	....	26 16 10	82 45 30	16	rky	....do	74	79	....
56 S.	1	May 13	24 34 25	82 57 00	8	Co. rky	Southwest of Tortugas.	74	78	....
57 S.	7	May 13	24 30 40	83 02 50	15	crs. S. brk. Sh	....do	74	78	85
58 S.	9	May 13	24 26 55	83 09 35	37	blk. sp. brk. Co	....do	76	78	....
59 S.	12	May 13	24 23 00	83 17 30	125	gr. M	....do	78	79	....
60 S.	15	May 13	24 19 50	83 24 00	600	gr. M	....do	79	82	....

NOTE.—Either the depth or the position of 60 S. must be erroneous, as there is less than 300 fathoms there.

During the season of 1877–'78 the dredging operations from December to March were in charge of Prof. Alexander Agassiz, and were conducted upon the *Blake*, Lieut. Commander C. D. Sigsbee, U. S. Navy, commanding. The cruise extended from Key West to Havana, from Havana westward along the north coast of Cuba, from Key West to the Tortugas, thence to the northern extremity of the Yucatan Bank and Alacran Reef, to Cape Catoche and across to Cape San Antonio, returning to Key West, and from Key West to the Tortugas, and northward to the mouth of the Mississippi River. The positions were originally published in the Bulletin of the Museum of Comparative Zoology at Cambridge, Mass., September, 1879. In giving these positions on the charts, etc., the word Ag. has been added to the numbers in the bulletin so as to distinguish them from the dredgings of the U. S. Fish Commission, Count Pourtales, etc. The positions from 1 Ag. to 4 Ag. are taken from Sigsbee's original charts.

Dredgings made by the Blake in 1877–'78.

Serial number.	Latitude N.	Longitude W.	Depth.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
	° ′ ″	° ′ ″	*Fathoms.*		°	°
1 Ag.	23 14 00	82 25 00	801	North of Havana	73	39¾
2 Ag.	23 14 00	82 25 00	805	......do	77	39¾
3 Ag.	23 31 00	82 16 00	924	......do	78½	39¾
4 Ag.	23 39 30	82 14 00	936	......do	77½	39½
5 Ag.	24 15 00	82 13 00	152–229	South of Marquesas Keys, Florida	76	49½
6 Ag.	24 17 30	82 09 00	137	......do	......	......
*	....	....	....	Only mud brought up	......	......
9 Ag.	....	....	111	Seven miles S. by W. from Sand Key	70	55½
10 Ag.	24 44 00	83 26 00	37	West of Tortugas	......	......
11 Ag.	24 43 00	83 25 00	37	......do	......	......
12 Ag.	24 34 00	83 16 00	36	......do	......	......
13 Ag.	.....	....	742	North of Havana	......	......
14 Ag.	23 18 00	82 21 00	850–900	......do	......	......
15 Ag.	23 14 00	82 25 00	785	......do	......	......
16 Ag.	23 11 00	82 23 00	292	......do	77	55½
17 Ag.	23 04 00	82 43 00	320	Off Mariel, Cuba	76	50½
18 Ag.	23 07 00	82 43 30	756	......do	76	40
19 Ag.	23 03 00	83 10 30	310	Off Bahia Honda, Cuba	73	52½
20 Ag.	23 02 30	83 11 00	220	......do	76	62
21 Ag.	23 02 00	83 13 00	287	......do	......	......
22 Ag.	23 01 00	83 14 00	100	......do	77	71
23 Ag.	23 01 00	83 14 00	190	......do	77	64
24 Ag.	23 02 30	83 13 00	342	......do	78	50
25 Ag.	23 04 00	83 12 30	635	......do	78	40½
26 Ag.	24 37 30	83 36 00	110	West of Tortugas	72	58½
27 Ag.	24 30 00	83 49 00	392	......do	73	44½
28 Ag.	24 34 00	84 00 00	863	......do	75	39½
29 Ag.	24 36 00	84 05 00	955	......do	......	39½
30 Ag.	24 33 00	84 34 00	968	......do	......	39½
31 Ag.	24 33 00	84 23 00	1,920	......do	......	39½
32 Ag.	23 32 00	88 05 00	95	North part of Yucatan Bank	......	......
33 Ag.	24 01 00	88 58 00	1,400 to 1,568	North of Yucatan Bank	72½	40½
34 Ag.	23 52 00	88 56 00	400–600	......do	81	†40½
35 Ag.	23 52 00	88 58 00	804	......do	78	40½
36 Ag.	23 13 00	89 16 00	84	North part of Yucatan Bank	74	60
37 Ag.	....	....	35	Northwest end of Alacran Reef, Yucatan Bank	......	......
38 Ag.	23 10 00	88 35 00	20	North part of Yucatan Bank	......	......
39 Ag.	....	....	14	Sixteen miles north of Jolbos Islands, southwest part of Yucatan Bank.	......	......
40 Ag.	23 26 00	84 02 00	1,323	Northwest of Cuba	77	40
41 Ag.	23 42 00	83 13 00	860	......do	73	39½
42 Ag.	23 53 00	83 04 30	620	......do	......	39½

*7 and 8 Ag.

†In 600 fathoms.

Dredgings made by the Blake, etc.—Continued.

Serial number.	Latitude N.	Longitude W.	Depth.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
	° ′ ″	° ′ ″	*Fathoms.*		°	°
43 Ag.	24 08 00	82 51 00	330	South of Dry Tortugas	......	45
44 Ag.	25 33 00	84 35 00	539	Northwest of Dry Tortugas	74½	39[illegible]
45 Ag.	25 33 00	84 21 00	101	...do	75	61[illegible]
46 Ag.	25 43 00	84 47 30	888	...do	......	39[illegible]
47 Ag.	28 42 00	88 40 00	321	Off mouth of the Mississippi	74½	46[illegible]
48 Ag.	28 47 30	88 41 30	533	...do	66	41[illegible]
49 Ag.	28 51 30	89 01 30	118	...do	......	......
50 Ag.	26 31 00	85 53 00	*119	......	......	......
51 Ag.	23 11 00	82 21 00	243–450	Off Havana	......	......
52 Ag.	23 09 00	82 23 00	158	...do	......	......
53 Ag.	......	......	242	...do	......	......
54 Ag.	......	......	175	...do	......	......
55 Ag.	23 09 00	82 21 00	242	...do	......	......
56 Ag.	23 09 00	82 21 30	175	...do	......	......
57 Ag.	23 09 15	82 21 00	177	...do	......	......
58 Ag.	23 09.30	82 11 30	242	...do	......	......
59 Ag.	......	......	158	...do	......	......
60 Ag.	......	......	480	...do	......	......
61 Ag.	23 09 00	82 01 00	243	...do	......	......
62 Ag.	......	......	80	...do	......	......
63 Ag.	......	......	177	...do	......	......
64 Ag.	......	......	122–240	...do	......	......
65 Ag.	......	......	127	...do	......	......
66 Ag.	......	......	80–100	...do	......	......
67 Ag.	......	......	128–240	...do	......	......
68 Ag.	......	......	243–458	...do	......	......
69 Ag.	......	......	100	...do	......	......
70 Ag.	......	......	111	Off Sand Key	......	......
71 Ag.	......	......	458	Off Havana	......	......
72 Ag.	......	......	50	Off Sand Key	......	......
73 Ag.	23 25 00	83 11 00	220	North of Bahia Honda, Cuba	......	......
74 Ag.	23 25 00	83 11 00	287	...do	......	......
75 Ag.	......	......	292	Off Havana	......	......
76 Ag.	......	......	154	...do	......	......
77 Ag.	......	......	240	...do	......	......
78 Ag.	......	......	129	...do	......	......
79 Ag.	......	......	175	...do	......	......

NOTE.—Stations 50 to 79 were occupied by Lieut. Commander Sigsbee while in search of Pentacrinus.
*The position or depth must be wrong, as there are 1,700 fathoms there; perhaps 28° 31′.

No dredgings appear to have been taken to which the numbers 80 to 99 in this series were originally given, but on the original chart of Sigsbee's cruise seven dredging stations are marked, which are not contained in Professor Agassiz's list in the bulletin. To these, numbers from 80 to 86 Ag. have been assigned.

Serial number.	Latitude N.	Longitude W.	Depth.	Kind of bottom.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
	° ′ ″	° ′ ″	*Faths.*			°	°
80 Ag.	22 39 00	84 59 00	1,222	lt. br. M. and S.	Northwest of Cuba	......	......
81 Ag.	22 11 30	88 11 00	20	S. and Sh	South part of Campeche Bank	......	......
82 Ag.	23 48 00	86 10 30	1,501	lt. br. M	Northeast of Campeche Bank	......	......
83 Ag.	23 52 00	86 31 30	603–9	lt. br. M.?	...do	......	......
84 Ag.	23 20 00	89 12 30	84	lt. br. M	North edge of Campeche Bank	......	......
85 Ag.	23 18 30	89 13 00	82	Co. M. and S.	...do	......	......
86 Ag.	23 16 00	89 16 00	91	Co. M. and S.	...do	......	......

During the season of 1878–'79, the dredgings, from December to March, were in charge of Prof. Alexander Agassiz, upon the *Blake*, commanded by Commander J. R. Bartlett, U. S. Navy. The cruise extended from Key West to Havana, from Havana to Jamaica through the Old Bahama Channel and Windward Passage, from Jamaica to St. Thomas, along the south coast of Hayti and Porto Rico. From St. Thomas the *Blake* visited Santa Cruz, Saba Bank, Montserrat, St. Kitts, Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, the Grenadines, Grenada, extended the dredgings as far as the 100-fathom line off Trinidad, returned to St. Vincent, and finished the dredging operations at Barbados. These positions were also published in the Bulletin of the Museum of Comparative Zoology, September, 1879, and are distinguished in the same manner as the preceding ones. The serial numbers, temperatures, and localities are taken from the Bulletin, while the depths, latitudes, and longitudes, nature of bottom, original numbers of casts, and letters designating lines are mainly taken from "Hydrographic Notice No. 9 of 1882," published by the U. S. Hydrographic Office, with the exception of about a dozen hauls, to which no latitudes or longitudes are affixed.

Dredgings made by the Blake in 1878–'79.

Serial number.	Line.	Date.	Number of cast.	Latitude N.	Longitude W.	Depth.	Nature of bottom.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
		1878.		° ′ ″	° ′ ″	Fath.			°	°
100 Ag.	......	Dec. —	....	....	....	250–400	....	Off Morro Light, Havana	.....	.....
101 Ag.	......	Dec. —	....	....	....	175-250	....	......do	.....	.....
102 Ag.	A	Dec. 16	1	22 18 05	77 47 30	128½	Coral sand	Cayo Cruz to Lobos Light	78½	69
103 Ag.	A	Dec. 16	2	22 18 19	77 44 45	438	White coral, mud	Old Bahama Channel	79	49½
104 Ag.	A	Dec. 16	3	22 20 00	77 42 30	500	Broken shell	......do	76½	45¾
105 Ag.	A	Dec. 16	4	22 21 55	77 40 35	450½	Coral, sand	......do	77¾	48¾
106 Ag.	A	Dec. 16	5	22 23 45	77 38 20	269½	Fine white sand	......do	.....	.....
107 Ag.	......	....	....	....	....	....	....	......do	.....	.....
108 Ag.	B	Dec. 17	1	21 43 45	76 35 55	994	Light-brown mud	Off Neuvitas	78	39
109 Ag.	B	Dec. 18	2	21 01 40	74 45 00	1,554	Soft gray globe, ooze	Off Cayo de Moa	76	38¾
110 Ag.	B	Dec. 18	3	20 29 30	74 21 00	1,205	Dark-brown mud, black specks	Off Cape Maysi	78	38½
111 Ag.	B	Dec. 19	4	19 05 55	74 49 05	1,200	Soft gray globigerina, ooze	....	80	39½
112 Ag.	B	Dec. 19	5	18 38 00	75 09 30	1,050	Brown mud	West of Navassa Bank	82	39½
113 Ag.	B	Dec. 20	6	17 50 30	76 40 50	633	......do	Off east end Jamaica	82	43
114 Ag.	B	Dec. 20	7	17 54 05	76 42 20	459	......do	Off Port Royal, Jamaica	.....	.....
115 Ag. } 116 Ag. }	B	Dec. 20	8	17 55 00	76 41 25	228	......do	......do	.....	.....
117 Ag.	B′	Dec. 28	1	17 47 10	67 03 20	874	Gray gritty ooze	Southwest of Porto Rico	82½	40
		1879.								
118 Ag.	C	Jan. 2	1	18 11 15	64 55 45	238	Coral sand	Between St. Thomas and Santa Cruz	.....	.....
119 Ag.	C	Jan. 2	2	18 07 15	64 55 30	1,105	Gray ooze	......do	80½	39
120 Ag.	C	Jan. 2	3	18 02 00	64 54 35	1,952	......do	......do	80¾	38¾
121 Ag.	C	Jan. 2	4	17 56 55	64 54 15	2,393	......do	......do	80	39½
122 Ag.	C	Jan. 3	5	17 52 15	64 53 45	2,412	Light-brown mud	......do	77½	38¾
123 Ag.	C	Jan. 3	6	17 49 15	64 53 35	1,450	Fine light sand, black specks	......do	80½	38¾
124 Ag.	C	Jan. 3	7	17 47 30	64 53 45	580	Fine white sand	Off Santa Cruz	81	42¾
125 Ag.	C	Jan. 3	....	....	....	300	....	Near Ham's Bluff, Santa Cruz	.....	.....
126 Ag.	C	Jan. 4	8	17 46 20	64 53 25	226	White sand, black specks	Off Santa Cruz	79	50½
127 Ag.	C	Jan. 4	9	17 46 10	64 53 15	38	Sand, black specks, shell	......do	80¾	76¾
128 Ag.	C	Jan. 4	10	17 42 50	64 53 55	180	Gray ooze	Off Frederickstadt, Santa Cruz	81	60¼
129 Ag.	C	Jan. 4	11	17 42 35	64 54 20	314	Ooze	......do	85	4[illegible]
130 Ag.	C	Jan. 4	12	17 43 00	64 55 10	451	Gray ooze	......do	84	44½
131 Ag.	C	Jan. 5	13	17 38 45	64 54 50	18	Coarse coral, sand, shell	Off Ham's Bluff, Santa Cruz	79	77
131 Ag.	C	Jan. 5	....	....	....	580	....	......do	81	42¾
132 Ag.	C	Jan. 5	15	17 37 55	64 54 20	117	Rock, broken shells	Off Frederickstadt, Santa Cruz	77	65
133 Ag.	C	Jan. 5	16	17 38 40	64 55 10	44	Coral, rock, broken shells	......do	.....	.....
134 Ag.	C	Jan. 5	17	17 37 15	64 48 20	248	Coral, sand, broken shells	......do	81	54½
135 Ag.	C	Jan. 6	18	17 41 25	64 55 55	450	Fine sand, ooze	......do	81	42½
136 Ag.	C	Jan. 6	19	17 43 10	64 55 50	504	Fine sand, gray ooze	......do	80	42½

137 Ag.	C	Jan.	6	20	17 45 15	64 55 20	625	Gray ooze	do	79½	41¼
138 Ag.	C	Jan.	7	21	17 50 45	64 53 40	2,376	Light-brown ooze	Off Santa Cruz	76½	38½
139 Ag.	C	Jan.	7	22	17 46 45	64 48 50	218	Coarse sand	Off Mount Eagle, Santa Cruz	78½	51
140 Ag.	C	Jan.	8	25	18 12 40	64 23 00	1,097	Brown ooze, sand	Off Virgin Gorda	80	38½
141 Ag.	C	Jan.	8	26	18 18 45	64 26 05	861	Broken shell, ooze	do	78½	40¼
142 Ag.	C	Jan.	8	27	18 21 45	64 37 50	27	Sand, shell	Flannegan Passage	78½	77¾
143 Ag.	C	Jan.	13	10	17 30 00	63 42 35	150	Ooze, sand	Off Saba Bank	79	63¾
144 Ag.	C	Jan.	13	13	17 27 50	63 36 10	21	Broken shell, sand	On Saba Bank	....	....
145 Ag.	E	Jan.	14	1	17 21 22	62 56 26	270	Fine sand, black specks	Off St. Kitts	79½	51
146 Ag.	E	Jan.	14	2	17 22 36	62 54 12	245	Fine gray sand, ooze	do	79½	52
147 Ag.	E	Jan.	14	3	17 19 27	62 50 30	250	do	do	79½	52½
148 Ag.	E	Jan.	14	4	17 17 12	62 46 43	208	Fine gray sand, black specks	do	79½	55¼
149 Ag.	E	Jan.	15	5	17 16 40	62 43 48	61	Fine sand, broken shell, black specks	do	79	76
150 Ag.	E	Jan.	15	6	17 11 22	62 46 00	373½	Fine sand, black specks	Between St. Kitts and Nevis	81½	45
151 Ag.	E	Jan.	15	7	17 08 21	62 42 00	356		Off Nevis	....	....
152 Ag.	E	Jan.	15	8	17 12 08	62 41 10	122	Gray sand, black specks	Off St. Kitts	79½	67½
153 Ag.	E	Jan.	16	10	16 43 45	62 16 12	303	Sand, broken shell, black specks	Off Montserrat	79½	48¼
154 Ag.	E	Jan.	16	11	16 41 10	62 14 50	298	Lava sand	do	80	49½
155 Ag. }	E	Jan.	16	12	16 41 54	62 13 24	88	....	do	80	69
156 Ag. }											
157 Ag.	E	....		....	....	....	120	....	do	....	....
158 Ag.	E	....		....	....	....	148	Stony bottom	do	....	....
159 Ag.	F	Jan.	18	1	15 59 10	61 44 15	196	Rock	Off Guadeloupe	80½	53¾
160 Ag.	F	Jan.	19	3	15 59 55	61 46 20	393	Lava sand	do	80½	43½
161 Ag.	F	Jan.	19	4	16 02 15	61 49 15	583	Lava sand, shell	do	81½	41
162 Ag.	F	Jan.	19	5	16 02 40	61 50 28	734	Lava sand	do	81	40
163 Ag. {	F	Jan.	20	6	16 03 10	61 52 20	769	Ooze, sand	do	80	39¾
{		Jan.	20	7	16 04 10	61 55 45	878	do	do	....	....
164 Ag.	F	Jan.	21	8	15 55 55	61 41 35	151	Lava sand	do	80	....
165 Ag.	F	Jan.	21	9	15 54 35	61 40 45	277	Gray ooze	do	80	48
166 Ag.	F	Jan.	21	12	15 55 50	61 37 05	150	....	do	80	59¾
167 Ag.	F	Jan.	21	13	16 09 40	61 29 25	175	Sand, black specks, shell	do	80	55
168 Ag.	F	Jan.	21	....	....	....	....	Lost trawl	do	....	....
169 Ag.	F	Jan.	22	14	16 09 55	61 28 08	101	Sand, shell	do	79½	67
170 Ag.	F	Jan.	22	15	15 57 25	61 43 40	309	Lava sand	do	80	46½
171 Ag.	F	Jan.	22	16	15 58 20	61 43 12	183	Lava sand, ooze	do	80	55½
172 Ag.	F	Jan.	22	17	15 58 10	61 42 55	62	Sand, broken coral	do	80	74½
173 Ag.	F	....		....	....	....	734	Fine grayish-brown ooze	do	81	40
174 Ag.	F	....		....	....	....	878	....	do	80	39¾
175 Ag.	G	Jan.	24	1	15 32 18	61 32 00	608	Sand, brown ooze	Off Dominica	80	40½
176 Ag.	G	Jan.	24	2	15 32 18	61 30 55	391	Dark-brown ooze, sand	do	80	43½
177 Ag.	G	Jan.	24	3	15 32 18	61 30 10	118	Sand, broken shell	do	80	65
178 Ag.	G	Jan.	25	4	15 34 10	61 29 35	130	Yellow sand	do	80	61½
179 Ag.	G	Jan.	25	5	15 30 50	61 32 55	824	Sand, brown ooze	do	79½	40
180 Ag.	G	Jan.	25	6	15 29 18	61 34 40	982	do	do	80½	39¾
181 Ag.	G	....		....	....	....	118	....	do	80	65
182 Ag.	G	Jan.	26	7	15 26 36	61 36 45	1,151	Sand, brown ooze	do	81	39½
183 Ag.	G	Jan.	27	8	15 24 05	61 27 10	252	Dark-brown mud, fine sand	do	79	49½
184 Ag.	G	Jan.	27	9	15 24 35	61 26 45	94	Fine sand, mud	do	79	69½
185 Ag.	G	Jan.	27	10	15 24 55	61 27 10	333	do	do	80	44
186 Ag.	G	Jan.	27	11	15 21 40	61 25 20	98	do	do	80	66
187 Ag.	G	Jan.	28	12	15 14 10	61 24 20	410	do	do	79½	43

Dredgings made by the Blake, etc.—Continued.

Serial number.	Line.	Date.	Number of cast.	Latitude N.	Longitude W.	Depth.	Nature of bottom.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
		1879.		° ′ ″	° ′ ″	*Fath.*			°	°
188 Ag.	G	Jan. 28	13	15 16 15	61 24 40	372	Fine sand, mud	Off Dominica	80	43
189 Ag.	G	Jan. 29	14	15 18 05	61 24 23	84	......do	......do	79	69½
190 Ag.	G	Jan. 29	15	15 18 12	61 26 32	542	Fine dark sand, black specks	......do	79½	42
191 Ag.	G	Jan. 29	16	15 16 50	61 23 30	109	Fine dark sand	......do	79	64
192 Ag.	G	Jan. 30	17	15 17 20	61 24 22	138	Fine sand, mud	......do	75	63¾
193 Ag.	H	Feb. 5	1	14 43 48	61 11 25	169	Shell, sand, dark mud	Off Martinique	79½	51
194 Ag.	H	Feb. 5	2	14 43 18	61 12 25	441	Fine yellow sand	......do	80	41½
195 Ag.	H	Feb. 5	3	14 42 35	61 13 15	501½	Fine sand, ooze, black specks	......do	80	41
196 Ag.	H	Feb. 6	4	14 38 50	61 14 20	1,030	Fine gray sand, ooze	......do	80	39
197 Ag.	H	Feb. 6	5	14 37 00	61 15 58	1,224	Light-brown ooze	......do	80	39
198 Ag. } 199 Ag. }	H	Feb. 6	6	14 30 40	61 06 50	137	Rocky	......do	79½	52½
200 Ag.	H	Feb. 7	7	14 31 55	61 07 28	472	Sand	......do	80	41½
201 Ag.	H	Feb. 9	8	14 34 40	61 08 25	565	Dark-gray ooze	......do	80	40½
202 Ag.	H	Feb. 9	9	14 29 45	61 05 56	190	Sand, shell	......do	78	48½
203 Ag.	H	Feb. 10	10	14 28 50	61 05 40	96	Sand, broken shell	......do	79	61
204 Ag.	H	Feb. 10	11	14 24 55	61 00 05	476	Fine sand, broken shell	......do	.....	42½
205 Ag.	H	Feb. 10	12	14 25 15	60 56 35	332	......do	......do	80	45½
206 Ag.	H	Feb. 10	13	14 26 18	60 55.00	170	Fine sand	......do	79	49
207 Ag.	H	Feb. 11	14	14 19 34	60 58 25	826	Sand, ooze, broken shell	......do	80	39¾
208 Ag.	H	Feb. 11	15	14 25 15	60 54 50	213	Hard	......do	80	50⅓
209 Ag.	H	Feb. 11	16	14 26 15	60 58 10	189	......do	......do	80	49¾
210 Ag.	H	Feb. 12	17	14 29 10	61 05 47	191	Rough	......do	.....	.....
211 Ag.	H	Feb. 12	18	14 28 40	61 06 08	357	Fine sand	......do	.....	.....
212 Ag.	H	Feb. 12	19	14 32 38	61 06 40	317	Sand, ooze	......do	80	45½
213 Ag.	H	....	...	....	....	357	....	......do	.....	.....
214 Ag.	H	Feb. 12	20	14 30 43	61 08 40	892	Sand, ooze	......do	79½	39½
215 Ag.	I	Feb. 15	1	13 51 30	61 03 45	226	Sand, rock	Off St. Lucia	79	51
216 Ag.	I	Feb. 15	2	13 51 45	61 03 30	153	Fine sand	......do	79½	54½
217 Ag.	I	Feb. 15	3	13 51 40	61 05 37	397	Ooze	......do	80	43½
218 Ag.	I	Feb. 15	4	13 49 12	61 04 40	164	Gray sand	......do	80	56
219 Ag.	I	Feb. 15	5	13 49 50	61 03 50	151	......do	......do	79	57
220 Ag.	I	Feb. 16	6	13 50 15	61 03 45	116	Rock	......do	79	58½
221 Ag.	I	Feb. 16	7	13 54 55	61 06 05	423	Sand, ooze	......do	80	42¾
222 Ag.	I	Feb. 16	8	13 58 37	61 04 45	422	......do	......do	80	42½
223 Ag.	J	Feb. 18	1	13 08 24	61 13 50	146	Fine black sand	Off St. Vincent	79	56
224 Ag.	J	Feb. 18	2	13 06 36	61 12 45	114	Coral	......do	.....	57
225 Ag.	J	Feb. 18	3	13 04 30	61 12 55	458	Fine sand	......do	79½	41½

226 Ag.	J	Feb. 19	4	13 09 05	61 16 20	424	Fine dark sand	......do	79¼	42¼
227 Ag.	J	Feb. 19	5	13 10 10	61 18 15	572	Sand, ooze	......do	80	40½
228 Ag.	J	Feb. 19	6	13 11 20	61 19 48	785	......do	......do	81	39½
229 Ag.	J	Feb. 20	7	13 13 50	61 20 40	1,004	......do	......do	79¼	39¼
230 Ag.	J	Feb. 20	8	13 13 20	61 18 45	464	Fine sand	......do	81	41½
231 Ag.	J	Feb. 20	9	13 12 10	61 17 18	95	Sand, broken shell	......do	80	61½
232 Ag.	J	Feb. 21	10	13 06 45	61 06 55	87	Coral	......do	80	62
233 Ag.	J	Feb. 21	11	13 07 05	61 06 15	174	......do	......do	80	49½
234 Ag.	K	Feb. 21	1	13 01 00	61 18 00	300	Fine sand, black specks	Off Bequia	80½	47
235 Ag.	K	Feb. 21	2	12 57 10	61 25 25	1,507	Light-brown ooze	......do	79	39
236 Ag.	K	Feb. 22	3	12 52 30	61 36 00	1,591	......do	......do	79	39
237 Ag.	K	Feb. 22	4	12 48 30	61 28 30	1,290	Gray ooze	Off Grenadines	......	38½
238 Ag.	K	Feb. 23	5	12 46 10	61 23 35	126	Coral sand	......do	79½	56
239 Ag.	K	Feb. 23	6	12 46 20	61 25 00	338	Fine sand, ooze	......do	80	45½
240 Ag.	K	Feb. 23	7	12 32 45	61 29 15	164	Coral, broken shell	......do	79¾	52¾
241 Ag.	K	Feb. 24	8	12 28 22	61 32 18	163	Sand, coral	......do	80	53
242 Ag.	K	Feb. 24	9	12 23 35	61 35 25	842	Fine sand, ooze	......do	80	39½
243 Ag.	K	Feb. 24	10	12 20 35	61 35 50	171	Fine gray sand	......do	79½	51½
244 Ag.	K	Feb. 24	11	12 12 05	61 45 15	792	Gray ooze	Off Grenada	72	39
245 Ag.	K	Feb. 25	12	12 07 55	61 50 45	1,010	......do	......do	77	39
246 Ag.	K	Feb. 25	13	12 05 45	61 45 40	154	Dark gray ooze	......do	79¾	56
247 Ag.	K	Feb. 25	14	12 05 25	61 47 15	170	Gray ooze	......do	80	53½
248 Ag.	K	Feb. 25	15	12 02 35	61 47 15	159	Fine gray ooze	......do	80	53½
249 Ag.	K	Feb. 27	16	11 48 15	61 48 45	262	Coarse sand	......do	80	47
250 Ag.	K	Feb. 27	17	11 43 15	61 53 00	421	Coral sand, ooze	......do	80¼	41½
251 Ag.	K	Feb. 27	18	11 35 30	62 03 05	381	......do	......do	80¼	42
252 Ag.	K	Feb. 27	19	11 30 05	62 03 45	306	Gray ooze	......do	80	44½
253 Ag.	K	Feb. 27	20	11 25 00	62 04 15	96	Coral, broken shell	......do	79½	58½
254 Ag.	K	Feb. 27	22	11 27 00	62 11 00	164	Sand, shell	......do	78½	57
255 Ag.	K	Feb. 27	24	11 32 30	62 11 00	344	Brown ooze	......do	78	43½
256 Ag.	K	Feb. 28	28	12 07 15	61 47 10	370	Sand, ooze	......do	80	44½
257 Ag.	K	Feb. 28	29	12 09 40	61 46 45	552	Fine sand, ooze	......do	80	40½
258 Ag. } 259 Ag. }	K	Feb. 28	31	12 03 15	61 46 25	159	Sand, ooze	......do	80	53½
260 Ag.	K	Feb. 28	30	12 03 30	61 47 10	291	......do	......do	79½	47
261 Ag.	K	......	......	......	......	340	......	......do	......	......
262 Ag.	K	Mar. 1	32	12 01 45	61 47 25	92	Fine sand	......do	80	62
263 Ag.	K	......	......	......	......	159	......	......do	80	53½
264 Ag.	K	Mar. 1	33	12 03 15	61 48 30	416	Gray ooze	......do	80	42½
265 Ag.	K	Mar. 2	34	12 03 55	61 49 40	576	......do	......do	79½	39¾
266 Ag.	K	Mar. 2	35	12 05 20	61 49 40	461	Coarse sand, ooze	......do	80½	41½
267 Ag.	K	Mar. 2	36	12 04 50	61 51 25	627	Gray and brown ooze	......do	81	39½
268 Ag.	K	Mar. 2	37	12 07 15	61 50 50	955	Gray ooze	......do	80	39½
269 Ag.	K	Mar. 3	38	13 07 55	61 05 36	124	Coral	Off St. Vincent	80	57½
270 Ag.	K	Mar. 3	39	13 06 18	61 09 30	74	......do	......do	80½	66
271 Ag.	K	Mar. 3	......	13 05 00	61 13 00	458	Sand	Off Bequia	79½	41½
272 Ag.	L	Mar. 5	1	13 04 12	59 36 45	76	Coral, broken shell	Off Barbados	79	64¾
273 Ag.	L	Mar. 5	2	13 03 05	59 36 18	103	......do	......do	79½	59½
274 Ag.	L	Mar. 5	3	13 00 50	59 36 20	209	Fine sand	......do	79½	53½
275 Ag.	L	Mar. 5	4	12 58 33	59 36 45	218	Fine brown sand	......do	80	52½
276 Ag.	L	Mar. 5	5	13 03 50	59 37 05	94	Coral, broken shell	......do	79½	61
277 Ag.	L	Mar. 5	6	13 03 55	59 38 25	106	Coral	......do	80	58

Dredgings made by the Blake, etc.—Continued.

Serial number.	Line.	Date.	Number of cast.	Latitude N.	Longitude W.	Depth.	Nature of bottom.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
		1879.		° ′ ″	° ′ ″	*Fath.*			°	°
278 Ag.	L	Mar. 6	7	13 04 50	59 37 40	69	Coral, shell	Off Barbados	78	68
279 Ag.	L	Mar. 6	8	13 01 00	59 30 42	118	Coral, broken shell	......do	79¾	58½
280 Ag.	L	Mar. 6	9	12 57 40	59 36 50	221	Sand	......do	80	50½
281 Ag.	L	Mar. 6	10	12 54 48	59 36 30	288	Broken shell	......do	80	46½
282 Ag.	L	Mar. 7	11	13 05 20	59 40 00	154	Sand, shell	......do	81	56
283 Ag.	L	Mar. 7	12	13 05 05	59 40 50	236	Hard bottom	......do	80	49
284 Ag.	L	Mar. 7	13	13 07 10	59 43 50	347	Sand	......do	80	44½
285 Ag.	L	Mar. 7	14	13 05 12	59 37 18	13	Coral	......do	......	......
286 Ag.	L	Mar. 8	15	13 10 58	59 38 25	6¾	......do	......do	......	......
287 Ag.	L	Mar. 8	16	13 11 25	59 38 20	7	Coral, sand, broken shell	......do	......	......
288 Ag.	L	Mar. 8	17	13 11 25	59 45 35	390	Hard	......do	80	44½
289 Ag.	L	Mar. 8	18	13 11 25	59 48 15	713	Brown ooze	......do	80½	40
290 Ag.	L	Mar. 9	19	13 11 54	59 38 45	73	Coral, sand, shell	......do	80	70¾
291 Ag.	L	Mar. 9	20	13 12 00	59 41 00	210	Coarse sand	......do	79¾	49¾
292 Ag.	L	Mar. 9	21	13 13 55	59 38 50	56	Coral, sand, broken shell	......do	80	74½
293 Ag.	L	Mar. 9	22	13 14 23	59 39 10	81	......do	......do	80	64½
294 Ag.	L	Mar. 9	23	13 14 18	59 40 10	136	Hard	......do	80½	54½
295 Ag.	L	Mar. 9	24	13 14 18	59 41 12	180	......do	......do	80	50¾
296 Ag.	L	Mar. 10	25	13 05 24	59 38 45	85	......do	......do	78	61½
297 Ag.	L	Mar. 10	26	13 02 36	59 37 45	123	Rock	......do	80¼	56½
298 Ag.	L	Mar. 10	27	13 03 28	59 37 40	120	......do	......do	80¼	61
299 Ag.	L	Mar. 10	28	13 05 00	59 39 40	140	Coral, broken shell	......do	80½	56½
300 Ag.	L	Mar. 10	29	13 06 [illegible]	59 39 20	82	......	......do	80½	60

The following stations were occupied by Commander J. R. Bartlett on the *Blake*, from February to May, 1880. They are all, except the first three, in the western Caribbean, between Cuba, Jamaica, and Honduras:

Station.	Latitude N.	Longitude W.	Depth.	Nature of bottom.	Locality.	Temperatures. Surface.	Temperatures. Bottom.
	° ′ ″	° ′ ″	*Fath.*			°	°
I	....	....	145	....	9 miles E. ½ N. of Mathewtown, Gt. Inagua Island.	....	64½
IV	20 11 00	73 33 00	766	Hard coral sand, sponge.	Off east end of Cuba	.....	40
IV*	20 24 15	73 56 50	772	Coral sand, stones, shell.	......do..........................	......	39½
V	....	....	288	Sand mud, black specks.	3.3 miles SE. by E. ½ E. from Santiago de Cuba Light.	......	55½
VI	17 51 50	76 45 00	250	Mud	Off Port Royal, Jamaica	80	56½
VII	17 28 30	77 30 00	610	Coral sand.........	South of Jamaica	......	41
VIII	17 45 00	77 58 40	322	....do	......do.........................	......	52
IX	18 12 00	78 20 00	254	Mud,............	West of Jamaica...............	....	.....
X	18 13 20	78 36 40	103	Coral	......do.	......	......
XI	17 30 00	79 14 00	555	Coral sand, ooze..	West of Pedro Bank	......	41
XIII	....	....	272	Coral	1 mile west of Georgetown, Grand Cayman Island.	......	56½
XIV	....	....	608	Coral sand.........	Off Grand Cayman Island	......	41
XV	18 51 00	83 07 00	903	Coral sand, ooze, pteropods.	East of Misteriosa Bank	......	41
XVII	18 22 20	87 21 30	41	Coral	South of Chinchorro Bank	......	79
XVIII	18 20 30	87 16 40	600	Coral sand, ooze ..	......do..........................	......	40½
XX	16 42 00	83 01 00	961	Coral sand, gray ooze.	Northeast of Honduras.........	......	39½
XXI	19 48 00	77 17 00	33	Coral	East of Cape Cruz, Cuba	......	......
XXII	19 48 47	77 23 00	250	Mud...............	......do..........................	......	......
XXIV	....	....	206	Coral sand........	5 miles east of Cape Cruz, S. side Cuba.	......	......
XXVI	....	....	297	....do	1 mile N. of W. end Cayman Brac Island.	......	......
XXIX	21 23 19	82 54 42	300	....do	South of Isle of Pines	......	55
XXX	21 26 30	86 28 40	51	....	East of Cape Catoche, Yucatan.	......	69
....	....	....	100	....	Off entrance Port Royal, Jamaica.	......	......

The following stations were occupied by the *Blake* during the dredging cruise of the summer of 1880:

Stations 301 to 308 are on the lines run off the northeastern extremity of George's Bank.
Station 309 is intermediate between the northeastern extremity of George's Bank and the next line run off Newport, which includes stations 310 to 312.
Stations 313 to 318 are in a line normal to the coast in about latitude 32° north.
Stations 319 to 323 are in a line parallel to the coast in the so-called axis of the Gulf Stream.
Stations 324 to 329, south off Cape Hatteras.
Stations 330 to 333, north off Cape Hatteras.
Stations 334 to 339, east off Cape May.
Stations 340 to 347, normal to coast southeast off Montauk Point.

Dredgings by the Blake in 1880.

Serial Number.	Line.	Date.	Number of cast.	Latitude N.	Longitude W.	Depth.	Nature of bottom.	Temperatures. Surface.	Temperatures. Bottom.
		1880.		° ′ ″	° ′ ″	*Fath.*		°	°
301 Ag.	A	June 28	3	41 26 55	66 03 00	71	Yellow sand, black specks	55	42½
302 Ag.	A	June 28	4	41 30 00	66 00 00	73	Yellow sand, black specks, shells.	53	42½
303 Ag.	A	June 28	6	41 34 30	65 54 30	306	Gray sand, black specks, mud	61	40½
304 Ag.	A	June 28	8	41 35 00	65 57 30	139	No specimen	62	44
305 Ag.	A	June 28	9	41 33 15	65 51 25	810	Dark-gray mud, sand, stones	56½	39
306 Ag.	A	June 29	12	41 32 50	65 55 00	524	......do	59	39½
307 Ag.	A	June 29	16	41 29 45	65 47 10	980	Dark-gray mud	68	38
308 Ag.	A	June 29	19	41 24 45	65 35 30	1,242	......do	65	38
309 Ag.	A	June 30	22	40 11 40	68 22 00	304	Dark-gray mud, sand	66	40½
310 Ag.	B	July 1	1	39 59 00	70 18 45	260	Green mud	69½	42
311 Ag.	B	July 1	3	39 59 20	70 11 30	143	Green sand, black specks	70½	45½
312 Ag.	B	July 1	6	39 50 30	70 11 00	466	Dark-green mud, green sand	71½	40
313 Ag.	C	July 12	3	32 31 50	78 45 00	75	Fine gray sand, black specks	82	61½
314 Ag.	C	July 12	4	32 24 00	78 44 00	142	Green sand, black specks	81	56½
315 Ag.	C	July 12	6	32 18 20	78 43 00	225	Green sand, black specks, broken shell.	80½	48
316 Ag.	C	July 12	9	32 07 00	78 37 30	229	Pebbles	82½	48
317 Ag.	C	July 12	11	31 57 00	78 18 35	334	Hard	85	45
318 Ag.	C	July 12	14	31 48 50	77 51 50	337	Coral, shell	84½	47
319 Ag.	C	July 13	20	32 25 00	77 42 30	262	Coral sand	84	45½
320 Ag.	C	July 13	21	32 33 15	77 30 10	257	Gray sand, black specks, shells	84½	51
321 Ag.	C	July 13	23	32 43 25	77 20 30	233	Globigerina, ooze	84	53½
322 Ag.	C	July 14	29	33 10 00	76 32 15	362	Coral, sand, globigerina, ooze	......	46½
323 Ag.	C	July 14	31	33 19 00	76 12 30	457	Globigerina, ooze	83	40
324 Ag.	C	July 14	33	33 27 20	75 53 30	1,386	......do	84	......
325 Ag.	D	July 14	1	33 35 20	76 00 00	647	......do	84½	30
326 Ag.	D	July 14	2	33 42 15	76 00 50	464	......do	84½	39½
327 Ag.	D	July 15	9	34 00 30	76 10 30	178	......do	84	49½
328 Ag.	E	July 15	1	34 28 45	75 22 50	1,632	......do	84½	37
329 Ag.	E	July 15	4	34 49 40	75 14 40	603	......do	84½	39½
330 Ag.	E	July 16	13	35 41 03	74 31 00	1,047	Globigerina, ooze, clay	85	38½
331 Ag.	E	July 16	17	35 44 40	74 40 20	898	Globigerina, ooze	81	39
332 Ag.	E	July 17	21	35 45 30	74 48 00	263	......do	79½	41½
333 Ag.	E	July 17	23	35 45 25	74 50 30	65	Clay	79	......
334 Ag.	F	July 18	1	38 20 30	73 26 40	395	Globigerina, ooze, clay	78½	41
335 Ag.	F	July 18	4	38 22 05	73 33 40	89	Gray sand, black specks	77½	56½
336 Ag.	F	July 18	5	38 21 50	73 32 00	197	Fine gray sand, mud	77½	45
337 Ag.	F	July 18	6	38 20 08	73 23 20	740	Globigerina, ooze	79	39½
338 Ag.	F	July 18	8	38 18 40	73 18 10	922	......do	79	39
339 Ag.	F	July 18	10	38 16 45	73 10 30	1,186	......do	78	39
340 Ag.	G	July 20	2	39 25 30	70 58 40	1,394	......do	76½	38
341 Ag.	G	July 20	5	39 38 20	70 56 00	1,241	......do	76	38
342 Ag.	G	July 20	6	39 43 00	70 55 25	1,002	Blue clay	76½	39
343 Ag.	G	July 20	8	39 45 40	70 55 00	732	Green sand	75½	39½
344 Ag.	G	July 21	12	40 01 00	70 58 00	129	......do	74½	51
345 Ag.	G	July 21	13	40 10 15	71 04 30	71	Green mud, broken shell, sand	73	51
346 Ag.	G	July 21	14	40 25 35	71 10 30	43½	Green mud	75½	49
347 Ag.	G	July 21	15	40 59 00	71 22 30	24	Coarse black sand, yellow specks.	72½	60

DREDGING STATIONS OF THE CHALLENGER IN THE ATLANTIC OCEAN, 1872 TO 1876.

The British steamer *Challenger* left England for her scientific trip around the world in December, 1872, and returned to England in May, 1876. She was under the command of Captain Nares, and the scientific operations were under the charge of Dr. (afterward Sir) Wyville Thompson.

The serial numbers in the following table are those of the stations at which serial temperatures, trawlings, and dredgings were obtained, not those of the soundings, which had a separate numbering, running up to 504. This table includes only the stations in the Atlantic, and of these only those at which dredgings and trawlings were made are given, except from No. 22 to No. 59 (including all stations in North American waters). For these all stations, which includes also *all* the soundings made, are given, and they are placed upon the accompanying charts. In the ninth column, D. signifies dredging; T. trawling.

Dredging stations of Challenger, 1872 to 1876.

Serial Number.	Date.	Latitude.	Longitude.	Depth.	Nature of bottom.	Temperatures. Surface.	Temperatures. Bottom.	Instrument used.	Locality.
		North. ° ′ ″	*West.* ° ′ ″	*Fath.*		°	°		
	1872.								
I	Dec. 30	41 58 00	9 42 00	1,125	Blue mud........	......	......	D.	Cape Finisterre to Gibraltar.
	1873.								
Ic	Jan. 1	40 23 00	9 43 00	950	Hard ground....	57	.....	D.	Do.
I d	Jan. 2	39 55 00	10 05 00	1,975	Blue mud........	57	.....	D.	Do.
II	Jan. 13	38 10 00	9 14 00	470	Green mud.......	57	.....	D.	Do.
II a	Jan. 13	38 05 00	9 30 00	1,270	Blue mud	57	......	D.	Do.
II k	Jan. 15	36 58 50	9 14 20	525	....do............	60	54	D.	Do.
III	Jan. 15	37 02 00	9 14 00	900	....do............	60	.....	D.	Do.
IV	Jan. 16	36 25 00	8 12 00	600	do............	60	.....	D&T.	Do.
V	Jan. 28	35 47 00	8 23 00	1,090	Globigerina, ooze	61	38.5	T.	Gibraltar to Maderia.
VI	Jan. 30	36 23 00	11 18 00	1,525	....do............	58	36	T.	Do.
VII	Jan. 31	35 20 00	13 04 00	2,125	....do	60	37	T.	Do.
VII f	Feb. 2	32 27 00	16 40 30	1,500	Volcanic mud	63	.....	T.	Do.
VII p	Feb. 10	28 35 00	16 05 00	78	Volcanic sand...	64	.....	D.	Canary Islands.
VIII	Feb. 12	28 03 15	17 27 00	620	Volcanic mud ...	64.5	.....	D.	Do.
1	Feb. 15	27 24 00	16 55 00	1,890	Globigerina, ooze	64.5	36.8	D.	Teneriffe to Sombrero Island.
2	Feb. 17	25 52 00	19 22 00	1,945	....do............	67	36.8	D.	Do.
3	Feb. 18	25 45 00	20 14 00	1,525	Hard ground....	65	37	D.	Do.
5	Feb. 21	24 20 00	24 28 00	2,740	Red clay.........	68	37	D.	Do.
8	Feb. 25	23 12 00	32 56 00	2,700	....do	67	37	D.	Do.
9	Feb. 26	23 23 00	35 11 00	3,150	....do............	69	36.8	D.	Do.
11	Mar. 1	22 45 00	40 37 00	2,575	Globigerina, ooze	72.2	36.5	D.	Do.
12	Mar. 3	21 57 00	43 29 00	2,025	....do............	73	36.9	D.	Do.
13	Mar. 4	21 38 00	44 39 00	1,900	....do............	72	36.8	D.	Do.
14	Mar. 5	21 01 00	46 29 00	1,950	....do............	74	36.8	T.	Do.
16	Mar. 7	20 39 00	50 33 00	2,435	....do............	74	36.2	D.	Do.
18	Mar. 10	19 41 00	55 13 00	2,650	Red clay.........	74	36	D.	Do.
20	Mar. 12	18 56 00	59 35 00	2,975	....do............	75	36	D.	Do.
22	Mar. 14	18 40 00	62 56 00	1,420	Pteropod, ooze ..	76	38.4	T.	Do.
23	Mar. 15	18 24 00	63 28 00	450	....do............	76	......	D.	Off Sombrero.
23a	Mar. 15	18 26 00	63 31 15	460	....do............	76	......	D.	Do.
23b	Mar. 15	18 28 00	63 35 00	590	....do............	76	......	D.	Do.
24	Mar. 25	18 38 30	65 05 30	390	....do............	76	......	D.	St. Thomas to Bermuda.
24a	Mar. 25	18 43 30	65 05 00	625	....do............	76	......	D.	Do.
25	Mar. 26	19 41 00	65 07 00	3,875	Red clay	76	......	D.	Do.
26	Mar. 27	21 26 00	65 16 00	2,800	....do............	76	......	......	Do.
27	Mar. 28	22 49 00	65 10 00	2,960	....do............	75.5	36.2	......	Do.

Dredging stations of Challenger, etc.—Continued.

Serial Number.	Date.	Latitude.	Longitude.	Depth.	Nature of bottom.	Temperatures. Surface.		Instrument used.	Locality.
	1873.	*North.* ° ′ ″	*West.* ° ′ ″	*Fath.*		°	°		
28	Mar. 29	24 39 00	65 25 00	2,850	Red clay	75	36.3	D.	St. Thomas to Bermuda.
29	Mar. 31	27 49 00	64 59 00	2,700	....do	72	36.4	D.	Do.
30	Apr. 1	29 05 00	65 01 00	2,600	...do	72	36.5	.....	Do.
31	Apr. 3	31 24 00	65 00 00	2,475	Globigerina, ooze	69.5	36.5	.....	Do.
32	Apr. 3	31 49 00	64 55 00	2,250	.. do	68	36.7	.....	Do.
32a	Apr. 3	32 01 00	64 51 00	1,820	...do	68	.....	.....	Do.
32b	Apr. 3	32 10 00	64 52 00	950	Coral, mud	68	.....	.....	Do.
32c	Apr. 4	32 17 30	64 39 05	780	....do	67	.....	.....	Off Bermuda.
32d	Apr. 4	32 19 00	64 40 00	380	....do	67	.....	.....	Do.
32e	Apr. 4	32 19 30	64 40 35	120	....do	67.5	.....	D.	Do.
32f	Apr. 4	32 20 40	64 38 15	125	Hard ground	67.5	.....	.....	Do.
32g	Apr. 4	32 21 25	64 37 15	265	.. do	68	.....	D.	Do.
33	Apr. 4	32 21 30	64 35 55	435	Coral, mud	68	.....	D.	Do.
33a	Apr. 21	32 31 10	64 42 55	175	Sand	67.2	.....	.....	Do.
33b	Apr. 21	32 32 30	64 46 00	640	Mud	67.2	.....	.....	Do.
34	Apr. 21	32 33 55	64 52 18	1,370	do	67.2	.....	.....	Do.
35a	Apr. 22	32 39 00	65 06 00	2,450	Globigerina, ooze	67.8	36.5	.....	Do.
35b	Apr. 22	32 26 00	65 09 00	2,100	....do	68	36.5	.....	Do.
35c	Apr. 22	32 15 00	65 08 00	1,950	....do	68	.....	.....	Do.
36	Apr. 22	32 07 25	65 04 00	30	Coral	67.5	.....	D.	Do.
37	Apr. 24	32 18 00	65 38 08	2,650	Globigerina, ooze	68	36.5	D.	Between Bermuda and Halifax.
38	Apr. 25	33 03 00	66 32 00	2,600	....do	70	36.5	.....	Do.
39	Apr. 27	34 03 00	67 32 00	2,850	Red clay	65	36.5	.....	Do.
40	Apr. 28	34 51 00	68 30 00	2,675	Blue mud	69.5	.....	D.	Do.
41	Apr. 29	36 05 00	69 54 00	(2,500)	....	65	.....	.....	Do.
42	Apr. 30	35 58 00	70 35 00	2,425	Blue mud	65	36.8	.....	Do
43	May 1	36 23 00	71 46 00	(2,600)	....	75	36.8	.....	Do.
44	May 2	37 25 00	71 40 00	1,700	Blue mud	56.5	36.2	D.	Do.
45	May 3	38 34 00	72 10 00	1,240	....do	49.5	37.2	D.	Do.
46	May 6	40 17 00	66 48 00	1,350	....do	40	37.2	D.	Do.
47	May 7	41 14 00	65 45 00	1,340	....do	42	.....	D.	Do.
48	May 8	43 04 00	64 05 00	51	Rock	38	.....	D.	Do.
49	May 20	43 03 00	63 39 00	85	Gravel, stones...	40.5	35	D.	Do.
50	May 21	42 08 00	63 39 00	1,250	Blue mud	45	38	D.	Do.
51	May 22	41 19 00	63 12 00	2,020	....do	59	36	.....	Do.
52	May 23	39 44 00	63 22 00	2,800	....do	67.2	36.2	.....	Do.
52a	May 24	38 16 00	63 17 00	....	....	73	.....	.....	Do.
53	May 26	36 30 00	63 40 00	2,650	Red clay	73	36.3	.....	Do.
54	May 27	34 51 00	63 59 00	2,650	do	70.5	.....	T.	Do.
55	May 28	33 20 00	64 37 00	2,500	Globigerina, ooze	70.5	.....	.....	Do.
55a	May 28	32 46 00	64 39 00	1,775	....do	70.5	36.2	.....	Do.
55b	May 29	32 07 35	64 53 45	1,325	Coral, mud	72	.....	D.	Off Bermuda.
56	May 29	32 08 45	64 59 35	1,075	....do	72.5	38.2	D.	Do.
56a	May 29	32 10 45	64 58 20	506	....	72.5	.....	D.	Do.
57	May 30	32 11 07	65 03 20	690	....	72.5	.....	.....	Do.
57a	May 30	32 09 30	65 07 35	1,250	Coral, mud	73	.....	D.	Do.
57b	May 30	32 09 45	65 10 50	1,575	....do	73	.....	T.	Do.
58	June 13	32 37 00	64 21 00	1,500	Globigerina, ooze	73.5	37.2	.....	Bermuda to Azores.
59	June 14	32 54 00	63 22 00	2,360	....do	74	36.3	.....	Do.
60	June 16	34 28 00	58 56 00	2,575	Red clay	71.5	36.2	T.	Do.
61	June 17	34 54 38	56 38 00	2,850	Red mud	71	36.2	T.	Do.
63	June 19	35 29 00	50 53 00	2,750	Red clay	71	.....	T.	Do.
64	June 20	35 35 00	50 27 00	(2,700)	....do	75	.....	D.	Do.
68	June 24	38 03 19	39 19 00	2,175	Globigerina, ooze	70	36.2	T.	Do.
69	June 25	38 23 00	37 21 00	2,200	....do	71	36.2	T.	Do.
70	June 26	38 25 00	35 50 00	1,675	....do	70	.....	T.	Do.
71	June 27	38 18 00	34 48 00	1,675	....do	71	36.8	T.	Do.
73	June 30	38 30 00	31 14 00	1,000	Pteropod, ooze..	60	39.4	D.	Do.
75	July 2	38 38 00	28 28 30	450	Volcanic mud...	70	.....	D.	Off Azores.
76	July 3	38 11 00	27 09 00	900	Pteropod, ooze..	70	40	D.	Do.
78	July 10	37 26 00	25 13 00	1,000	Volcanic mud...	71	.....	D.	Do.
79	July 11	36 21 00	23 31 00	2,025	Globigerina, ooze	71.5	35.9	D.	Azores to Maderia.
83	July 15	33 13 00	18 13 00	1,650	....do	71	37	D.	Do.
85	July 19	28 42 00	18 06 00	1,125	Volcanic mud...	69.2	.....	D.	Maderia to Cape de Verdes.
87	July 21	25 49 00	20 12 00	1,675	Rock	72	.....	D.	Do.
89	July 23	22 18 00	22 02 00	2,400	Globigerina, ooze	73.5	36.6	T.	Do.
92	July 26	17 54 00	24 41 00	1,975	... do	74.7	.....	D.	Do.
98	Aug. 14	9 21 00	18 28 00	1,750	....do	78.2	36.7	D.	Cape de Verdes to St. Paul's Rocks.
101	Aug. 19	5 48 00	14 20 00	2,500	Blue mud	79.2	36.4	T.	Do.
104	Aug. 23	2 25 00	20 01 00	2,500	Globigerina, ooze	78	36.6	T.	Do.

Dredging stations of Challenger, etc.—Continued.

Serial Number.	Date.	Latitude.	Longitude.	Depth.	Nature of bottom.	Temperatures. Surface.	Temperatures. Bottom.	Instrument used.	Locality.
	1873.	*North.* ° ′ ″	*West.* ° ′ ″	*Fath.*		°	°		
106	Aug. 25	1 47 00	24 26 00	1,850	Globigerina, ooze	78.8	36.6	T.	Cape de Verdes to St. Paul's Rocks.
107	Aug. 26	1 22 00	26 36 00	1,500	....do............	78.8	37.9	T.	Do.
109	Aug. 28	0 55 38	29 22 35	104	Hard ground....	77.7	.....	D.	Do.
		South.							
120	Sept. 9	8 37 00	34 28 00	675	Red mud	78	.....	T.	Between Pernambuco and Bahia.
121	Sept. 9	8 28 00	34 31 00	500	....do............	78	.....	T.	Do.
122	Sept. 10	9 05 00	34 50 00	350	....do............	77.5	.....	T.	Do.
122a	Sept. 10	9 10 00	34 52 00	120	....do............	77.5	.....	T.	Do.
122b	Sept. 10	9 09 00	34 53 00	32	....do............	77.5	.....	T.	Do.
122c	Sept. 10	9 10 00	34 49 00	400	....do............	77.5	.....	T.	Do.
124	Sept. 11	10 11 00	35 22 00	1,600	....do............	77.5	.....	T.	Do.
126	Sept. 12	10 46 00	36 08 00	770	....do............	77	.....	T.	Do.
126a	Sept. 12	10 45 00	36 09 00	700	....do............	77	.....	T.	Do.
129	Sept. 30	20 13 00	35 19 00	2,150	....do............	74	34.2	D.	Bahia to Tristan da Cunha.
130	Oct. 3	26 15 00	32 56 00	2,350	Red clay	69	34.7	T.	Do.
131	Oct. 6	29 35 00	28 09 00	2,275	Globigerina, ooze	65	34.6	T.	Do.
133	Oct. 11	35 41 00	20 55 00	1,900	....do............	58	35.4	T.	Do.
134	Oct. 14	36 12 00	12 16 00	2,025	....do............	63.5	36	D.	Off Tristan da Cunha.
135a	Oct. 16	37 16 50	12 45 15	75	Hard ground, shells, gravel.	54	.....	D.	Do.
135c	Oct. 17	37 25 30	12 28 30	110	....	54	.....	D.	Do.
135d	Oct. 17	37 25 00	12 30 30	72	....	54	.....	D.	Do.
135e	Oct. 18	37 21 00	12 22 30	1,000	Hard ground, shells, gravel.	53.5	.....	D.	Do.
135f	Oct. 18	37 14 45	12 20 15	1,100	Hard ground ...	53.5	.....	D.	Do.
135g	Oct. 18	37 10 50	12 18 30	550	....do............	54	.....	D.	Do.
136	Oct. 20	36 43 00	7 13 00	2,100	....	54	35.2	D.	Tristan da Cunha to south of Cape of Good Hope.
			East.						
137	Oct. 23	35 59 00	1 34 00	2,550	Red clay	56.1	34.5	D.	Do.
141	Dec. 17	34 41 00	18 36 00	98	Green sand......	66.5	40.5	D.	Do.
142	Dec. 18	35 04 00	18 37 00	150	....do............	65.5	47	D.	Do.
143	Dec. 19	36 48 00	19 24 00	1,900	Globigerina, ooze	73	35.6	D.	Do.
	1876.		*West.*						
313	Jan. 20	52 20 00	67 39 00	55	Sand	48.2	47.8	T.	Straits of Magellan to Falkland Islands.
314	Jan. 21	51 35 00	65 39 00	70	....do............	48	46	T.	Do.
314a	Jan. 22	51 24 00	61 46 00	110	Hard ground....	49	41.8	T.	Do.
315	Jan. 26	51 40 00	57 50 00	12	Sand, gravel....	50	.....	D.	Do.
316	Feb. 3	51 32 00	58 06 00	4	Mud	51.2	.....	D.	Falkland Islands to Rio de la Plata.
317	Feb. 8	48 37 00	55 17 00	1,035	Hard ground, gravel.	46.7	35.7	T.	Do.
318	Feb. 11	42 32 00	56 29 00	2,040	Blue mud........	57.5	33.7	T.	Do.
320	Feb. 14	37 17 00	53 52 00	600	Green sand......	67.5	37.2	T.	Do.
321	Feb. 25	35 02 00	55 15 00	13	Mud	73.5	.....	T.	Do.
322	Feb. 26	35 20 00	53 42 00	21	Sand, shells	71.5	.....	T.	Do.
323	Feb. 28	35 39 00	50 47 00	1,900	Blue mud	73.5	33.1	T.	Rio de la Plata to Tristan da Cunha.
324	Feb. 29	36 09 00	48 22 00	2,800	....do............	71.5	32.6	T.	Do.
325	Mar. 2	36 44 00	46 16 00	2,650	....do............	70.8	32.7	T.	Do.
331	Mar. 9	37 47 00	30 20 00	1,715	Globigerina, ooze	64.5	35.4	T.	Do.
332	Mar. 10	37 29 00	27 31 00	2,200	....do............	64	34	T.	Do.
333	Mar. 13	35 36 00	21 12 00	2,025	....do............	67	35.3	T.	Do.
334	Mar. 14	35 45 00	18 31 00	1,915	....do............	68.5	35.8	T.	Do.
335	Mar. 16	32 24 00	13 05 00	1,425	Pteropod. ooze..	73.5	37	D.	Tristan da Cunha to Ascension Islands.
337	Mar. 19	24 38 00	13 36 00	1,240	..do............	77	37.2	D.	Do.
338	Mar. 21	21 15 00	14 02 00	1,990	Globigerina, ooze	76.5	36.2	D.	Do.
343	Mar. 27	8 03 00	14 27 00	425	Volcanic sand...	80.8	40.3	D.	Do.
344	Apr. 3	7 54 20	14 28 20	420	....do............	82	.....	D.	Ascension towards Cape de Verdes.
346	Apr. 6	2 42 00	14 41 00	2,350	Globigerina, ooze	82.7	34	D.	Do.
		North.							
348	Apr. 9	3 10 00	14 51 00	(2,450)	....	84	.....	D.	Do.

DEEP-SEA DREDGINGS OF LE TRAVAILLEUR.

Abstract of deep-sea dredgings in the Bay of Biscay, the Atlantic Ocean, and the Mediterranean, by the French dispatch boat Le Travailleur.

[Under the command of M. E. F. Richards, Lieutenant de Vaisseau, by a commission of naturalists, of which M. Milne Edwards was president.]

BAY OF BISCAY IN 1880.

Dates.	Number of dredging.	Positions. Latitude.	Positions. Longitude.	Soundings.	Character of bottom.
		North. ° ′ ″	*West.* ° ′ ″	*Faths.*	
July 17	1	43 38 00	1 55 15	230	Soft gray mud.
Do	2	43 36 00	1 54 45	557	Soft yellowish mud.
Do	3	43 35 25	1 53 40	364	Mud.
July 19	4	43 33 10	2 10 35	181	Mud.
Do	5	43 33 30	2 11 45	177	Yellowish muddy sand.
Do	6	43 36 55	2 13 05	313	Gray mud.
Do	7	43 37 55	2 14 45	205	Rock.
Do	8	43 38 15	2 15 00	338	Gray mud.
Do	9	43 39 55	2 16 45	539	Mud.
Do	10	43 40 35	2 15 05	517	Two kinds of mud, upper layer yellowish.
Do	11	43 41 45	2 14 30	913	Soft mud.
Do	12	43 33 30	2 25 00	252	Mud.
July 20	13	43 37 05	2 49 10	67	Mud and gravel.
Do	14	43 36 45	3 02 50	384	Sand and mud.
Do	15	43 41 15	3 02 45	1,340	Mud.
Do	16	43 42 30	3 01 15	1,450	Mud.
Do	17	43 39 30	3 17 20	538	Mud.
July 22	18	43 47 00	3 41 45	1,042	No bottom.
Do	19	43 44 30	3 38 20	1,235	Mixed sand and mud.
Do	20	43 46 10	3 35 55	1,481	Mud.
July 23	21	43 38 00	4 09 35	658	Mud.
Do	22	43 38 25	4 08 25	740	Mud.
Do	23	43 35 30	4 01 45	605	Mud.
Do	24	43 32 40	4 10 45	80	Sand, gravel, shell.
Do	25	43 35 10	3 44 15	171	Sand, gravel, shell.
Do	26	43 35 30	4 28 35	361	Mud.
Do	27	43 37 25	4 31 45	104	Speckled sand.
Do	28	43 39 30	4 34 45	110	Sand.
Do	29	43 40 15	4 37 50	127	Rock.
Do	30	43 39 45	4 46 35	91	Black sand.
Do	31	43 39 45	4 50 55	91	Speckled sand shell.
Do	32	43 45 00	5 02 25	91	Black sand.
July 24	33	43 49 30	5 11 40	84	Speckled sand, gravel.
Do	34	43 54 30	5 20 35	87	Black sand, gravel.
Do	35	43 57 30	5 27 15	96	Black sand, gravel.
Do	36	43 38 30	5 21 15	77	Black sand.
Do	37	43 38 30	5 05 05	217	Sand, gravel.
Do	38	43 41 30	4 23 45	817	Sand, eight different layers.
Do	39	43 36 40	4 02 15	651	Mud.
July 26	40	43 39 50	3 32 15	1,044	Mud.
Do	41	43 39 05	3 27 45	1,072	Mud.
Do	42	43 36 45	3 29 45	744	Mud.
Do	43	43 35 00	3 27 20	68	Rock, gravel.
Do	44	43 34 30	3 23 05	111	Mixed sand and mud.
July 27	45	43 34 05	3 16 45	81	Mixed gray sand and mud.
Do	46	43 33 25	3 11 00	68	Broken shells.
Do	47	43 37 20	3 09 15	664	Mud.
Do	48	43 36 30	3 15 55	344	Mud.
Do	49	43 38 00	3 04 55	601	Mud.
Do	50	43 38 00	2 54 55	592	Mud.
Do	51	43 33 20	2 55 00	171	Mixed sand and mud.
Do	52	43 34 15	3 00 00	113	Speckled sand, gravel.
Do	53	43 31 10	2 55 40	361	Mud.
Do	54	43 34 20	2 54 15	183	Sand.
Do	55	43 35 40	2 46 30	591	Mud.
Do	56	43 36 45	2 45 15	525	Mud.
Do	57	43 39 25	2 45 10	541	Mud.
Do	58	43 40 00	2 39 15	1,105	No bottom.
July 28	59	43 40 35	2 14 35	656	Mud.
Do	60	43 40 55	2 11 35	500	Mud.
Do	61	43 41 20	2 02 35	96	Rock.
Do	62	43 41 20	2 01 35	115	Mud.
Do	63	43 46 00	2 01 45	91	Sand.
Do	64	43 45 30	2 07 15	410	Mud.
Do	65	43 46 00	2 06 45	334	Shell and coral.
Do	66	43 46 50	2 06 30	445	Soft mud.
Do	67	43 38 45	2 08 25	634	Mud.

Abstract of deep-sea dredgings in the Bay of Biscay, etc.—Continued.

BAY OF BISCAY IN 1880—Continued.

Dates.	Number of dredging.	Positions. Latitude.	Positions. Longitude.	Soundings.	Character of bottom.
		North. ° ′ ″	*West.* ° ′ ″	*Faths.*	
July 29	68	43 32 35	2 09 30	167	Mud.
Do	69	43 36 20	2 17 00	308	Mud.
July 30	70	43 37 45	2 30 00	930	Mud.
Do	71	43 37 30	2 06 20	625	Mud.
Do	72	43 33 45	1 59 15	349	Mud.
Do	73	43 32 40	1 52 50	77	Fine sand.
Do	74	43 35 00	1 52 55	93	Sand.
Do	75	43 36 30	1 53 35	231	Mud.
Do	76	43 37 30	1 53 45	419	Mud.
Do	77	43 37 50	1 51 55	419	Mud.
Do	78	43 38 00	1 47 30	155	Mud.
Do	79	43 40 15	1 50 55	77	Sand.
Do	80	43 41 25	2 02 10	91	Sand.
July 31	81	43 42 25	1 53 00	77	Mud.
Do	82	43 41 15	1 47 00	78	Mud.
Do	83	43 40 30	1 45 15	73	Mud.
Do	84	43 39 00	1 45 10	74	Mud.
Do	85	43 37 40	1 45 35	204	Mud.
Do	86	43 35 40	1 43 55	336	Mud.
Do	87	43 33 55	1 44 05	71	Mud.
Do	88	43 33 30	1 42 05	66	Sand.
Do	89	43 36 00	1 42 05	73	Sand.
Do	90	43 37 15	1 42 05	74	Mixed sand and mud.
Do	91	43 38 25	1 42 00	239	Soft mud.
Do	92	43 39 20	1 41 40	135	Mud.
Do	93	43 40 10	1 40 55	79	Mixed sand and mud.
Do	94	43 39 30	1 38 25	314	Mixed sand and mud.
Do	95	43 38 20	1 38 30	74	Mud.
Do	96	43 38 15	1 40 05	149	Mud.
Do	97	43 39 05	1 40 25	151	Rock.
Do	98	43 40 25	1 39 55	79	Sand, rock.
Do	99	43 40 30	1 38 30	179	Gray sand, rock.
Do	100	43 40 35	1 38 10	238	Mud.
Do	101	43 40 30	1 35 10	179	Soft green mud.
Do	102	43 36 50	1 57 45	612	Mud.
Do	103	43 35 40	1 55 30	514	Mud.

IN THE ATLANTIC IN 1881.

Dates.	Number of dredging.	Latitude.	Longitude.	Soundings.	Character of bottom.
FIRST SERIES.					
June 13	1	43 00 40	0 37 25	1,103	Sand and rock.
June 14	2	41 43 00	0 19 25	584	Sand, pebbles.
June 15	3	39 47 50	9 51 45	1,808	Gray mud.
June 16	4	38 08 50	9 43 15	1,360	Gray mud.
Do	5	38 05 00	9 41 45	1,781	Gray mud.
June 17	6	36 55 20	9 21 45	1,020	Gray mud.
June 18	7	36 38 20	7 03 41	291	Soft mud.
July 31	30	35 24 45	7 58 52	656	Soft mud.
Do	31	36 27 15	8 12 41	756	Soft mud.
Do	31	36 27 15	8 12 41	1,148	Soft mud.
Aug. 1	32	37 15 20	9 24 55	618	Soft mud.
Do	32	37 15 20	9 24 55	563	Soft mud.
Aug. 5	33	38 15 20	9 17 45	1,014	Soft mud.
Do	33	38 15 20	9 17 45	1,013	Soft mud.
Aug. 6	34	38 18 00	9 24 15	669	Soft mud.
Do	35	38 18 30	9 26 25	747	Soft mud.
Aug. 7	36	39 33 00	9 51 15	1,416	Soft mud.
Do	36	39 31 00	9 58 45	1,455	Soft mud.
Aug. 14	37	44 10 15	8 17 45	219	Gravel, sand, and shell.
Do	38	44 11 00	8 13 45	1,048	Mud.
Aug. 15	39	44 05 00	7 06 25	670	Black sand, coral.
Do	39	44 04 45	7 03 15	521	Black sand, coral.
Do	a39	44 05 00	7 09 15	547	Gravel, coral.
Do	b39	44 05 45	7 12 15	567	Black sand, coral.
Do	40	44 05 00	7 14 45	214	Black sand.
Aug. 16	41	44 02 15	7 07 15	598	Sand and mud.
Do	42	44 01 20	7 04 45	490	Mud and coral.
Do	43	44 00 50	6 58 00	402	Mixed sand and mud.
Do	44	44 00 10	6 48 00	954	Mud.
Aug. 17	45	44 48 30	4 40 15	2,756	Mud with foraminifera.

Abstract of deep-sea dredgings in the Bay of Biscay, etc.—Continued.

IN THE MEDITERRANEAN IN 1881.

Dates.	Number of dredging.	Positions.		Soundings.	Character of bottom.
		Latitude.	Longitude.		
FIRST SERIES.		*North.* ° ′ ″	*West.* ° ′ ″	*Faths.*	
June 22	8	36 31 45	2 11 35	167	Granulated mud.
Do	9	36 31 55	2 07 55	481	Gray and yellow mud.
Do	9	36 31 55	2 06 55	552	Gray and yellow mud.
June 23	10	37 27 55	0 13 35	1,392	Granulated mud.
			East.		
June 24	11	38 03 00	0 07 30	87	Yellow mud.
June 25	12	39 34 15	1 39 25	831	Fine yellow mud.
June 27	13	42 01 30	4 42 00	1,293	Granulated mud.
SECOND SERIES.					
July 4	1	43 02 57	5 18 45	303	Mud.
Do	2	42 57 15	5 19 12	589	Mud.
July 5	3	42 52 40	5 18 45	634	Mud.
Do	4	42 50 25	5 17 40	1,105	Mud.
Do	4	42 52 33	5 20 45	1,018	Mud.
Do	5	42 54 04	5 26 27	1,020	Mud.
July 6	6	42 59 20	5 41 05	295	Mud.
Do	6	42 59 50	5 41 30	367	Mud.
Do	7	43 00 20	5 46 27	411	Mud.
Do	8	43 01 00	5 48 35	168	Mud with a few rocks.
Do	9	43 00 35	5 42 15	248	Coral.
July 7	10	43 23 05	6 58 35	328	Mud.
Do	11	43 34 34	7 12 38	412	Mud.
Do	12	43 37 05	7 11 32	473	Sticky mud.
July 9	13	43 40 20	7 17 21	372	Mud.
Do	13	43 41 32	7 17 12	202	Mud.
Do	14	43 41 38	7 17 51	156	Mud.
Do	*a*14	43 41 21	7 19 05	35	Mud.
July 11	15	43 40 36	7 20 23	22	Coral.
Do	15	43 40 36	7 20 23	55	Mud.
Do	*a*15	43 41 16	7 17 49	102	Black mud.
Do	16	43 24 35	7 22 15	1,131	Black mud.
July 12	17	43 15 00	7 21 15	1,454	Black mud.
Do	17	43 00 15	7 32 45	1,451	Black mud.
July 13	18	41 52 40	8 22 55	1,348	Mud.
Do	18	41 52 40	8 22 55	846	Mud.
Do	19	41 52 45	8 29 10	205	Coral.
July 15	20	41 52 35	8 35 50	14	Coral.
Do	20	41 53 50	8 35 55	25	Coral.
Do	20	41 52 52	8 31 40	38	Coral.
Do	21	41 49 52	8 34 35	397	Gray and yellow mud.
Do	22	41 49 20	8 35 05	495	Gray and yellow mud.
Do	23	41 42 35	8 29 25	153	Mud.
July 16	24	41 22 15	9 07 15	42	Gravel, coral.
Do	24	41 22 15	9 07 15	30	Gravel, coral.
Do	24	41 22 15	9 07 15	36	Gravel, coral.
Do	24	41 22 15	9 07 15	41	Gravel, coral.
July 18	25	42 59 45	5 13 55	689	Mud.
Do	25	41 01 10	5 13 55	555	Mud.
Do	25	43 03 50	5 13 55	231	Mud.
Do	25	43 02 55	5 13 55	208	Mud.
Do	25	43 02 30	5 13 55	354	Mud.
			West.		
July 25	26	35 45 30	1 08 10	492	Soft mud.
July 26	27	35 30 00	2 58 15	60	Mixed sand and mud.
Do	27	35 32 00	3 13 05	238	Mixed sand and mud.
Do	*a*27	35 31 45	3 11 25	288	Mud.
July 27	28	35 21 30	4 28 35	176	Mud.
Do	28	35 21 20	4 32 45	203	Mud.
Do	28	35 23 00	4 34 00	236	Mud.
Do	29	35 24 20	4 39 15	230	Mud.

DREDGINGS OF THE TRAVAILLEUR IN 1882.

The *Travailleur* in 1882 continued the series of dredgings commenced in 1880 and 1881, and extended them from Cape Penas, on the north coast of Spain, along the coast of Portugal, the Gulf of Cadiz, and the coast of Morocco to the Canary Islands, through the strait of Bocayna (between Fuerteventura and Lanzarote), to Madeira, Lisbon, and back to Rochefort. Twenty-one hauls of the dredge were made, in from 100 to 3,700 meters (55 to 2,023 fathoms) of water. M. Alphonse Milne-Edwards was in principal charge of the natural history observations. A general report of the expedition was published in the Revue Maritime et Coloniale, February, 1883 (Tome LXXVI, page 454), and the details of position, etc., in the Annales Hydrographiques, vol. 5, p. 4, 1883.

The number of the Annales Hydrographiques containing these positions was found to be wanting in all the accessible libraries in the United States, and although ordered from France, failed to arrive in time to allow the positions to be included in this paper.

DREDGINGS OF THE FRENCH STEAMER TALISMAN, 1883.

The *Talisman* continued the researches carried on by the *Travailleur* in 1880–'82, and extended from the coast of Portugal along the west coast of Africa, touching at the Canaries, to about 17° N. latitude; thence westward to the Cape de Verde Islands; thence northwestwardly to latitude 31° 34′, longitude 41° 15′; thence northeasterly to the Azores, and thence back to France.

Dredgings by the French steamer Talisman, 1883.

Serial number.	Date.	North latitude.	West longitude, Greenwich.	West longitude, Paris.	Depth.	Depth.	Kind of bottom.	Temperatures.				Locality.
								Surface.	Bottom.	Surface.	Bottom.	
		° ′	° ′	° ′	*Fathoms.*	*Meters.*		° F.	° F.	° C.	° C.	
1	June 4	41 30	9 37	11 57	1,051	1,923	Mud	62.6	41.0	17.0	5.0	Coast of Portugal.
2	June 6	36 53	8 32	10 52	54	99	Mud, shells	63.5	59.9	17.5	15.5	Bay of Cadiz.
3	June 6	36 53	8 28	10 48	58	106	....do	63.5	61.7	17.5	16.5	Do.
4	June 6	36 53	8 24	10 44	64	118	....do	63.5	59.9	17.5	15.5	Do.
5	June 9	36 26	6 27	8 47	33	60	....do	......	......	......	......	Do.
6	June 9	36 21	6 41	9 01	69	126	....do	......	......	......	......	South of Bay of Cadiz.
7	June 9	36 19	6 44	9 04	95	174	Mud	......	......	......	......	Do.
8	June 10	35 35	6 40	9 00	295	540	....do	......	......	......	......	Cape Spartel.
9	June 10	35 31	6 43	9 03	340	622	....do	......	......	......	......	Do.
10	June 10	35 26	6 49	9 09	392	717	....do	69.4	53.6	20.8	12.0	Do.
11	June 10	35 21	7 05	9 25	593	1,084	Mud, corals	69.4	50.9	20.8	10.5	Do.
12	June 11	35 11	7 11	9 31	524	958	Mud	71.6	50.0	22.0	10.0	Coast of Morocco, from Cape Spartel to Cape Blanco.
13	June 11	35 07	7 18	9 38	765	1,216	Mud, corals	71.6	50.0	22.0	10.0	Do.
14	June 12	34 20	8 08	10 28	1,373	2,516	Mud	69.8	39.2	21.0	4.0	Do.
15	June 12	33 57	8 27	10 47	779	1,425	....do	68.9	45.5	20.5	7.5	Do.
16	June 13	34 01	8 32	10 52	1,198	2,190	....do	71.6	40.1	22.0	4.5	Do.
17	June 14	33 33	8 59	11 19	301	550	....do	66.2	55.4	19.0	13.0	Do.
18	June 14	33 33	8 59	11 19	301	550	...do	66.2	55.4	19.0	13.0	Do.
19	June 14	33 42	9 01	11 21	503	920	Mud, sponges	70.7	50.0	21.5	10.0	Do.
20	June 14	33 43	9 02	11 22	604	1,105	....do	70.7	43.7	21.5	6.5	Do.
21	June 14	33 46	9 02	11 22	721	1,319	Mud	67.1	46.4	19.5	8.0	Do.
22	June 14	33 47	9 03	11 23	894	1,635	....do	67.1	43.7	19.5	6.5	Do.
23	June 15	33 16	8 53	11 13	66	120	Rocks, shells	......	......	......	......	Do.
24	June 15	33 14	8 54	11 14	66	120	Shells, sand	......	......	......	......	Do.
25	June 15	33 14	9 18	11 38	224	410	Sand, mud	......	......	......	......	Coast of Morocco, from Cape Blanco to Mogador.
26	June 15	33 08	9 23	11 43	395	723	Mud	......	......	......	......	Do.
27	June 15	33 10	9 29	11 49	766	1,400	....do	......	......	......	......	Do.
28	June 15	33 12	9 33	11 53	1,094	2,000	....do	......	......	......	......	Do.
29	June 16	32 46	9 56	12 16	1,422	2,600	....do	68.9	38.3	20.5	3.5	Do.
30	June 16	32 44	9 56	12 16	1,312	2,400	....do	76.1	38.3	24.5	3.5	Do.
31	June 16	32 40	9 50	12 10	1,048	1,917	....do	......	......	......	......	Do.
32	June 16	32 38	9 49	12 09	797	1,435	....do	......	......	......	......	Do.
33	June 17	32 34	9 49	12 09	869	1,590	Greasy mud	......	......	......	......	Do.
34	June 17	32 31	9 48	12 08	738	1,350	Reddish mud	......	......	......	......	Do.
35	June 17	32 29	9 47	12 07	456	834	Mud	68.0	51.8	20.0	11.0	Do.
36	June 17	32 27	9 55	12 15	614	1,123	Red mud	......	......	......	......	Do.
36	June 18	32 04	10 23	12 43	1,151	2,105	Mud	......	......	......	......	Do.

Dredgings by the French steamer Talisman, 1883—Continued.

Serial number.	Date.	North latitude.	West longitude, Greenwich.	West longitude, Paris.	Depth.	Depth.	Kind of bottom.	Temperatures. Surface.	Bottom.	Surface.	Bottom.	Locality.
		° ′	° ′	° ′	*Fathoms.*	*Meters.*		° *F.*	° *F.*	° *C.*	° *C.*	
36	June 18	31 59	10 09	12 29	573	1,048	Mud	......	......	......	......	Coast of Morocco, from Cape Blanco to Mogador.
37	June 21	31 34	10 21	12 41	499	912	Red mud	......	......	......	......	Do.
38	June 21	31 31	10 27	12 47	574	1,050	...do	......	......	......	......	Do.
39	June 22	30 42	11 19	13 39	1,371	2,525	Red and yellow mud	......	......	......	......	Mogador to Canaries.
40	June 22	30 41	11 17	13 37	1,512	2,765	Red mud	......	......	......	......	Do.
41	June 23	30 09	11 41	14 01	1,209	2,210	Mud	71.6	39.2	22.0	4.0	Do.
42	June 23	30 08	11 42	14 02	1,203	2,200	Greasy mud	......	......	......	......	Do.
43	June 23	30 08	11 45	14 05	1,203	2,200	...do	70.7	39.2	21.5	4.0	Do.
44	June 24	30 03	11 42	14 02	1,210	2,212	Gray mud, broken shells	65.7	41.0	18.7	5.0	Do.
45	June 24	30 01	11 46	14 06	1,157	2,115	...do	......	......	......	......	Do.
46	June 25	29 58	11 41	14 01	1,151	2,104	...do	......	......	......	......	Do.
47	June 25	29 52	11 44	14 04	1,135	2,075	...do	67.1	41.0	19.5	5.0	Do.
48	June 25	29 52	11 47	14 07	1,139	2,083	...do	......	......	......	......	Do.
49	June 26	29 08	12 26	14 46	676	1,235	Soft yellow mud	68.5	47.3	20.3	8.5	Do.
50	June 26	29 03	12 28	14 48	667	1,220	Yellow mud	71.6	46.4	22.0	8.0	Do.
51	June 26	29 02	12 29	14 49	636	1,163	Mud	70.7	47.7	21.5	8.7	Do.
52	June 26	29 01	12 31	14 51	645	1,180	...do	70.7	47.3	21.5	8.5	Do.
53	June 27	28 37	13 02	15 22	473	865	Yellow mud	69.8	44.6	21.0	7.0	Do.
54	June 27	28 35	13 10	15 30	533	975	...do	70.2	45.0	21.2	7.2	Do.
55	June 27	28 35	13 16	15 36	677	1,238	...do	72.5	45.0	22.5	7.2	Do.
56	June 27	28 33	13 19	15 39	518	946	Sand, black specks, rocks	......	......	......	......	Do.
57	June 27	28 35	13 19	15 39	497	905	Pebbles and rocks	72.5	46.4	22.5	8.0	Do.
58	June 28	28 48	13 46	16 06	19–142	30–259	Sand, shells, pebbles	......	......	......	......	Canary Islands.
59	....	28 49	13 53	16 13	88	162	Sand and rocks	......	......	......	......	Do.
60	....	28 48	14 01	16 21	495–678	906–1,240	Muddy sand, rocks	......	......	......	......	Do.
61	July 7	27 35	14 15	16 35	1,094–1,102	2,000–2,015	Yellow mud	73.4	38.3	23.0	3.5	From Canaries to mouth of Senegal, near coast of Africa.
62	July 7	27 32	14 09	16 29	1,101	2,013	...do	73.0	39.2	22.8	4.0	Do.
63	July 7	27 31	14 08	16 28	1,080	1,975	...do	73.0	39.4	22.8	4.1	Do.
64	July 7	27 31	14 07	16 27	1,049	1,918	...do	73.0	39.4	22.8	4.1	Do.
65	July 8	26 20	14 53	17 13	421	782	Sand, shells, corals	......	......	......	......	Do.
66	July 8	26 18	14 52	17 12	350	640	Sand, corals	70.7	49.1	21.5	9.5	Do.
67	July 8	26 17	14 51	17 11	194	355	Sand, shells, corals	......	......	......	......	Do.
68	July 8	26 16	14 51	17 11	136	250	...do	......	......	......	......	Do.
69	July 8	26 13	14 50	17 10	96	175	...do	......	......	......	......	Do.
70	July 8	26 07	14 48	17 08	71	130	...do	......	......	......	......	Do.
71	July 8	26 04	14 45	17 05	56	102	...do	......	......	......	......	Do.
72	July 9	25 41	15 56	18 16	224	410	Muddy sand, corals	......	......	......	......	Do.
73	July 9	25 39	15 58	18 18	382	698	Muddy sand, corals, shells	......	......	......	......	Do.

74	July 9	25 39	15 58	18 18	350	640	...do	.....	.....	.....	.....	Do.
75	July 9	25 39	16 02	18 22	482	882	...do	.....	.....	.....	.....	Do.
76	July 9	25 39	16 06	18 26	785	1,435	...do	.....	.....	.....	.....	Do.
77	July 9	25 38	16 09	18 29	617	1,128	Gray mud	.....	.....	.....	.....	Do.
77	July 9	25 38	16 11	18 31	650	1,193	...do	70.7	44.2	21.5	6.8	Do.
78	July 10	25 02	16 51	19 11	1,271	2,325	Yellow mud	72.5	38.3	22.5	3.5	Do.
78	July 10	25 01	16 53	19 13	1,377	2,518	Gray mud	72.5	37.8	22.5	3.2	Do.
79	July 10	25 01	16 55	19 15	1,443	2,638	Yellow mud	70.2	37.0	21.2	2.8	Do.
80	July 10	25 00	17 00	19 20	1,484	2,713	...do	69.8	36.5	21.0	2.5	Do.
81	July 11	23 57	17 12	19 32	766	1,400	...do	68.9	41.4	20.5	5.2	Do.
81	July 11	23 55	17 15	19 35	785	1,435	Gray mud	68.9	41.7	20.5	5.4	Do.
82	July 11	23 53	17 16	19 36	674	1,232	...do	69.8	42.4	21.0	5.8	Do.
83	July 11	23 52	17 17	19 37	684	1,250	...do	71.6	42.8	22.0	6.0	Do.
84	July 11	23 50	17 17	19 37	623	1,139	...do	72.5	43.2	22.5	6.2	Do.
85	July 12	23 00	17 30	19 50	510	932	Greenish muddy sand	70.7	44.6	21.5	7.0	Do.
86	July 12	22 57	17 31	19 51	508	930	Green, muddy sand	70.7	44.2	21.5	6.8	Do.
86	July 12	22 55	17 29	19 49	508	930	...do	70.2	44.6	21.2	7.0	Do.
87	July 12	22 54	17 26	19 46	470	860	...do	68.9	45.5	20.5	7.5	Do.
88	July 12	22 52	17 23	19 43	454	830	...do	68.9	45.5	20.5	7.5	Do.
89	July 12	22 49	17 21	19 41	438	800	...do	68.9	46.4	20.5	8.0	Do.
90	July 13	22 03	17 33	19 53	554	1,013	Greenish, muddy sand	69.8	44.6	21.0	7.0	Do.
90	July 13	21 59	17 36	19 56	609	1,113	...do	69.8	42.8	21.0	6.0	Do.
91	July 13	21 58	17 32	19 52	486	888	...do	69.8	44.6	21.0	7.0	Do.
92	July 13	21 53	17 30	19 50	358	655	...do	71.6	48.2	22.0	9.0	Do.
93	July 13	21 51	17 28	19 48	96	175	...do	71.6	59.0	22.0	15.0	Do.
94	July 13	21 51	17 28	19 48	129	235	...do	.....	.....	.....	.....	Do.
95	July 13	21 47	17 27	19 47	76	140	...do	.....	.....	.....	.....	Do.
96	July 14	20 44	18 07	20 27	817	1,495	...do	68.9	40.1	20.5	4.5	Do.
96	July 14	20 41	18 08	20 28	702	1,283	...do	69.8	41.9	21.0	5.5	Do.
97	July 14	20 39	18 09	20 29	596	1,090	...do	70.7	42.8	21.5	6.0	Do.
98	July 14	20 38	18 19	20 39	673	1,230	...do	.....	.....	.....	.....	Do.
98	July 14	20 32	18 20	20 40	634	1,160	...do	.....	.....	.....	.....	Do.
99	July 15	19 19	18 02	20 22	1,276	2,333	Greenish, greasy mud	71.2	37.4	21.8	3.0	Do.
99	July 15	19 16	18 00	20 20	1,269	2,320	...do	71.2	37.0	21.8	2.8	Do.
100	July 15	19 12	17 57	20 17	1,271	2,324	...do	70.7	38.1	21.5	3.4	Do.
101	July 15	19 12	17 57	20 17	1,271	2,324	...do	.....	.....	.....	.....	Do.
101	July 16	18 25	17 59	20 19	1,467	2,683	Gray mud	73.4	37.0	23.0	2.8	Do.
102	July 17	17 15	17 07	19 27	858	1,570	Slaty clay	.....	.....	.....	.....	Do.
103	July 17	17 12	17 07	19 27	881	1,617	Greenish mud	.....	.....	.....	.....	Do.
104	July 17	17 16	16 59	19 19	848	1,550	...do	.....	.....	.....	.....	Do.
105	July 18	16 38	18 24	20 44	1,750	3,200	Gray mud	.....	.....	.....	.....	Between coast of Africa and Cape Verde Islands.
106	July 19	15 48	20 23	22 43	1,999	3,655	...do	73.4	36.1	23.0	2.3	Do.
107	July 23	Environs of La Praya			123	225	Sand, rocks	.....	.....	.....	.....	Among the Cape Verde Islands.
108	July 23	Environs of La Praya			57	105	Rocks	.....	.....	.....	.....	Do.
109	July 23	Environs of La Praya			67–155	123–283	Sand, rocks	.....	.....	.....	.....	Do.
110	July 23	Environs of La Praya			44	80	...do	.....	.....	.....	.....	Do.
111	July 24	16 13	24 37	26 57	2,026	3,705	Greasy mud	.....	.....	.....	.....	Between Santiago and St. Vincent.
112	July 26	Roads of Porto Grande			14– 19	25– 35	Mud and corallines	.....	.....	.....	.....	Among the Cape Verde Islands.
113	July 27	Between Branco and Razo			44– 60	80–110	Sand, rocks	.....	.....	.....	.....	Do.
114	July 28	Roads of Porto Grande			16– 41	30– 75	Sand, shells	.....	.....	.....	.....	Do.
115	July 29	Roads of Porto Grande			41– 49	75– 90	...do	.....	.....	.....	.....	Do.

Dredgings by the French steamer Talisman, 1883—Continued.

Serial number.	Date.	North latitude.	West longitude, Greenwich.	West longitude, Paris.	Depth.	Depth.	Kind of bottom.	Temperatures. Surface.	Temperatures. Bottom.	Temperatures. Surface.	Temperatures. Bottom.	Locality.
		° ′	° ′	° ′	*Fathoms.*	*Meters.*		° F.	° F.	° C.	° C.	
116	July 29	16 53	25 10	27 30	224–252	410–460	Sand, gravel	......	......	......	......	Among the Cape Verde Islands.
117	July 29	16 52	25 10	27 30	219	400	....do	......	......	......	......	Do.
117	July 29	16 53	25 06	27 26	317	580	....do	......	......	......	......	Do.
118	July 30	16 55	25 07	27 27	190	347	Sand, rocks	......	......	......	......	Do.
118	July 30	16 51	25 09	27 29	221	405	Rocks	75.2	52.7	24.0	11.5	Do.
119	July 30	16 52	25 10	27 30	261	550	Sand	......	......	......	......	Do.
119	July 30	16 52	25 12	27 32	416	760	Sand, gravel	75.2	50.0	24.0	10.0	Do.
120	July 30	16 53	25 12	27 32	338	618	Muddy sand	......	......	......	......	Do.
121	July 30	16 51	25 10	27 30	346	633	....do	......	......	......	......	Do.
121	July 30	16 52	25 12	27 32	327	598	Sand, rocks	74.3	50.0	23.5	10.0	Do.
122	July 30	18 37	25 10	27 30	2,469	4,115	Yellow mud	74.3	37.2	23.5	2.9	North of Cape Verde Islands.
123	Aug. 7	30 17	40 47	43 07	1,930	3,530	Powdered pumice	76.1	37.4	24.5	3.0	In Sargasso Sea.
124	Aug. 8	31 34	41 15	43 35	1,709	3,125	....do	73.4	34.7	23.0	1.5	Do.
125	Aug. 9	33 19	35 44	38 04	1,877	3,432	....do	77.4	35.8	25.2	2.1	Do.
126	Aug. 10	34 46	33 51	36 11	1,736	3,175	....do	76.3	38.1	24.6	3.4	Southwest of Azores.
127	Aug. 11	36 11	32 01	34 21	1,201	2,195	Sand, rocks, hard ground	74.3	39.2	23.5	4.0	Do.
127	Aug. 11	36 12	31 54	34 14	1,527	2,792	....do	75.2	28.3	24.0	3.5	Do.
128	Aug. 11	36 12	31 54	34 14	1,527	2,792	....do	......	......	......	......	Do.
128	Aug. 11	36 13	31 47	34 07	1,597	2,921	....do	75.2	38.8	24.0	3.8	Do.
129	Aug. 11	36 14	31 40	34 00	1,574	2,878	....do	76.3	38.3	24.6	3.5	Do.
130	Aug. 12	37 35	29 26	31 46	789	1,442	Gray mud	72.5	44.6	22.5	7.0	Do.
131	Aug. 12	37 35	29 26	31 46	787	1,440	....do	......	......	......	......	Do.
132	Aug. 13	38 23	28 50	31 10	306	560	Sand, gravel	73.4	54.5	23.0	12.5	Azore Islands.
133	Aug. 13	38 25	28 44	31 04	344	629	Sand, rocks	......	......	......	......	Do.
134	Aug. 13	38 25	28 44	31 04	344	629	Sand, gravel	......	......	......	......	Do.
135	Aug. 13	Between Fayal and Pico			44– 63	80–115	....do	......	......	......	......	Do.
136	Aug. 13	Between Fayal and Pico			44–104	80–190	....do	......	......	......	......	Do.
137	Aug. 15	38 37	28 21	30 41	688	1,258	Gray mud	73.4	52.7	23.0	11.5	Do.
138	Aug. 15	38 38	28 20	30 40	668	1,221	....do	73.0	52.7	22.8	11.5	Do.
139	Aug. 15	38 38	28 21	30 41	687	1,257	....do	72.5	52.7	22.5	11.5	Do.
140	Aug. 15	38 39	28 21	30 41	686	1,255	....do	......	......	......	......	Do.
141	Aug. 16	38 07	27 12	29 32	538	983	Sand, shells, Globigerina	72.5	48.2	22.5	9.0	Do.
142	Aug. 16	38 00	27 13	29 33	1,214	2,220	Soft, gray mud	......	......	......	......	Do.
142	Aug. 16	38 00	27 05	29 25	1,179	2,155	....do	73.4	39.2	23.0	4.0	Do.
143	Aug. 16	37 55	27 02	29 22	1,222	2,235	....do	......	......	......	......	Do.
144	Aug. 22	38 38	25 06	27 26	1,638	2,995	Soft, white mud	73.4	38.1	23.0	3.4	North of St. Michael.
145	Aug. 23	40 35	23 34	25 54	2,414	4,415	....do	......	......	......	......	From Azores to France.
146	Aug. 24	42 15	21 17	23 37	2,174	3,975	....do	69.8	37.4	21.0	3.0	Do.
147	Aug. 24	42 19	21 16	23 36	2,220	4,060	....do	70.7	37.4	21.5	3.0	Do.

148	Aug. 24	42 23	21 15	23 35	2,193	4,010	....do	......	......	......	......	Do.
149	Aug. 25	43 15	19 20	21 40	2,278	4,165	....do	71.6	37.2	22.0	2.9	Do.
150	Aug. 26	44 20	17 11	19 31	2,327	4,255	....do	07.1	37.4	19.5	3.0	Do.
151	Aug. 27	44 41	13 31	15 51	2,078	3,800	....do	69.8	37.4	21.0	3.0	Do.
152	Aug. 27	44 29	13 32	15 52	2,721	4,975	Whitish mud	70.7	36.9	21.5	2.7	Do.
152	Aug. 27	44 21	13 33	15 53	2,737	5,005	....do	......	......	......	......	Do.
153	Aug. 29	46 09	6 56	9 16	2,618	4,787	Yellowish, gray mud	68.9	37.0	20.5	2.8	Do.
154	Aug. 29	46 06	6 50	9 10	2,619	4,789	A thin lower bed of whitish tint	......	......	......	......	Do.
155	Aug. 30	46 04	4 26	6 46	1,250	2,285	Mud, clay	......	......	......	......	Bay of Biscay.
156	Aug. 30	45 59	4 09	6 29	809	1,480	Coral	......	......	......	......	Do.

DREDGING STATIONS OF THE ITALIAN STEAMER WASHINGTON IN THE MEDITERRANEAN, 1881.

The *Washington* was under the command of Commander G. B. Magnaghi, of the Italian navy, and the dredgings were under the direction of Prof. Enrico Hillyer Giglioli. The report from which these positions are taken was published in the Report of the Third International Geographical Congress ("Terzo Congresso Geografico Internazionale") held in Venice in 1881, published in Rome 1882.

Dredgings by the Italian steamer Washington, 1881.

Number of station.	Number of dredging.	Date.	Latitude north.	Longitude east, Greenwich.	Depth.	Depth.	Nature of bottom.	Locality.
		1881.	° ′ ″	° ′ ″	*Fathoms.*	*Meters.*		
1	1	Aug. 2	41 08 45	8 34 21	437	800	Mud	North of Sardinia.
2	2	Aug. 3	41 02 48	8 32 20	246	450	Very fine mud	Do.
2	3	Aug. 3	to	to	86	157	Mud	Northwest of Sardinia.
2	4	Aug. 3	41 05 01	8 32 23	202–230	370–420	Madrepores	Do.
3	5	Aug. 4	41 10 27	8 15 41	92–155	168–284	...do	Do.
4	6	Aug. 4	41 15 09	8 10 41	1,176	2,150	Mud (?)	Do.
5	7	Aug. 8	41 10 00	8 12 00	128–303	235–555	Madrepores	Do.
6	8	Aug. 8	41 13 10	8 12 24	1,094	2,000	Dredge lost	Do.
7	9	Aug. 8	41 14 38	8 18 05	1,173	2,145	Fine tenacious yellow mud.	Do.
8	10	Aug. 9	41 24 42	7 43 28	1,531	2,800	Tenacious mud	Do.
9	....	Aug. 9	....	....	1,553	2,840	Grayish-yellow mud.	Do.
10	11	Aug. 10	41 23 38	7 08 54	1,588	2,904	Mud	Do.
11	12	Aug. 10	41 18 42	6 54 02	1,534	2,805	Tenacious mud	Do.
12	13	Aug. 11	39 51 40	6 44 40	1,590	2,908	Dredge empty	West of Sardinia.
13	14	Aug. 13	39 15 37	9 26 37	278	508	Mud	Southwest of Sardinia.
13	15	Aug. 13	39 03 46	9 27 47	359	656	...do	Do.
14	16	Aug. 13	39 01 28	9 30 19	422–470	772–860	...do	Do.
15	17	Aug. 14	38 38 04	9 45 56	875	1,600	Yellow mud	Do.
16	18	Aug. 14	38 50 26 to	9 39 15 to	221	404	Sandy mud	Do.
16	19	Aug. 14	38 50 15	9 42 50	450	822	Yellowish mud	Do.
17	20	Aug. 15	39 23 07	9 40 53	225	412	Dredge empty	East of Sardinia.
17	21	Aug. 15	39 21 50	9 40 08	615	1,125	Mud	Do.
18	22	Aug. 15	39 20 58	9 37 02	208	381	Mud; dredge lost	Do.
19	23	Aug. 16	39 40 40	9 54 12	849	1,553	Yellow mud	Do.
20	24	Aug. 16	39 43 28	9 59 22	341–477	623–856	...do	Do.
21	25	Aug. 16	39 49 40	9 49 08	33	60	Sand; algæ	Do.
22	26	Aug. 16	39 58 32	9 48 08	216	395	Mud	Do.
23	27	Aug. 17	40 32 16	10 12 36	281–514	514–940	Rocky	Do.
24	28	Aug. 17	40 37 08	10 40 05	979	1,790	Tenacious mud	Between Sardinia and Naples.
25	29	Aug. 18	40 44 40	11 22 00	1,142–1,307	2,183–2,390	....	Do.
26	30	Aug. 18	40 44 20	11 33 22	1,229	2,247	Mud	Do.
27	31	Aug. 19	40 29 00	12 34 00	1,703	3,115	...do	Do.
28	....	Aug. 19	40 10 13	12 26 00	1,985	3,630	....	Do.
29	32	Aug. 26	40 37 32	14 09 52	223–235	407–430	Mud	South of Naples.
29	33	Aug. 26	....	....	87–197	159–360	...do	Do.
30	34	Aug. 26	40 26 52	14 07 15	685	1,070	....	Do.
31	35	Aug. 27	39 20 28	13 10 38	1,982	3,624	Mud	Between Naples and Sicily.
32	36	Aug. 28	38 05 00	11 59 40	219	400	Sand and yellow mud.	West of Sicily.
33	37	Aug. 28	37 55 50	11 53 15	450	823	....	Do.
33	38	Aug. 28	37 52 55	11 56 40	437	800	Mud	Do.
34	..							
35	..							
36	..	Aug. 29	36 55 00	11 15 00	(*)	(†)	Banks producing precious coral.	Between Sicily and Africa.
37	..	to	to	to				
38	..	Sept. 2	37 15 00	12 44 00	(*)	(†)		
39	..							
40	..							

* About 110 fathoms.
† About 200 meters.

ZOOLOGICAL STATIONS OF THE NORWEGIAN NORTH-ATLANTIC EXPEDITIONS, 1876–1878.

These expeditions were made by the steamer *Vöringen* and the zoological and physical researches were under the charge of Dr. Danielssen, Profs. Mohn and G. O. Sars, Herr Friele, etc. The first expedition, in 1876, extended along the western coast of Norway to the Färöe Islands and Iceland; the second, in 1877, from Bergen to outside the Loffoden Islands, and from Tromsöe to Jan Mayen; the third, in 1878, to Vardö, thence westward to Beeren Island, and afterwards to Spitzbergen in 80° N. latitude. All the *dredging* stations are given in this list.

Dredgings of Norwegian North-Atlantic expeditions, 1876–1878.

Serial number.	Date.	Latitude.	Longitude.	Depth.	Nature of bottom.	Bottom temperatures. Fahr.	Bottom temperatures. Cent.	Apparatus used.
	1876.	*North.* ° ′	*East.* ° ′	*Faths.*		°	°	
1	June 3	61 13	6 36	650	Sandy clay	43.9	6.6	D.
2	June 3	61 10	6 32	672	....do	44.1	6.7	T.
4	June 8	61 05	5 14	566	Sandy clay, pebbles	43.9	6.6	T.
8	June 9	61 00	4 49	200	Clay, sand, stones	43.9	6.6	D.
9	June 20	61 30	3 37	206	Clay	42.6	5.9	T.
10	June 21	61 41	3 19	220	Ooze, clay	42.8	6.0	T.
18	June 21	62 44	1 48	412	Clay	30.2	—1.0	D., T.
23	June 23	62 52	5 50	......	......	......	......	T.
25	June 28	63 10	5 25	98	Sandy clay	44.4	6.9	D., T.
26	June 28	63 10	5 16	237	... do	44.8	7.1	D.
31	June 29	63 10	5 00	417	....do	30.2	—1.0	D., T.
33	June 30	63 05	3 00	525	Clay	30.0	—1.1	D., T.
34	July 1	63 05	0 53	587	....do	30.2	—1.0	T.
			West.					
35	July 5	63 17	1 27	1,081	Biloculina clay	30.2	—1.0	D.
40	July 18	63 22	5 20	1,215	....do	29.8	—1.2	D., T
48	Aug. 6	64 36	10 22	299	Dark gray clay	31.5	—0 3	Tan.
51	Aug. 7	65 53	7 18	1,163	Biloculina clay	30.0	—1.1	D.
52	Aug. 8	65 47	3 07	1,861	....do	29.8	—1.2	T.
			East.					
53	Aug. 10	65 13	0 33	1,539	....do	29.7	—1.3	D., T.
54	Aug. 12	64 47	4 24	601	....do	29.8	—1.2	D., T.
79	Aug. 21	64 48	6 32	155	Sandy clay	44.4	6.9	D.
87	Aug. 22	64 02	5 35	498	Clay	30.0	—1.1	D.
92	Aug. 22	64 00	6 42	178	Sandy clay	45.0	7.2	T.
93	Aug. 24	62 41	7 08	158	Soft clay	43.5	6.4	T.
	1877.	(Romsdalfjord.)						
96	June 16	66 08	3 00	805	Biloculina clay	30.0	—1.1	D.
101	June 17	65 36	8 32	223	Sandy clay	42.8	6.0	D.
124	June 19	66 41	6 59	350	Coarse clay	30.4	—0.9	D., T.
137	June 21	67 24	8 58	452	Clay	30.2	—1.0	D., T.
147	June 22	66 49	12 08	142	Gray clay	43.2	6.2	D.
149	June 23	67 52	13 58	135	Clay	40.8	4.9	D., T.
		(Vestfjord.)						
164	June 29	68 21	10 40	457	Sandy clay	30.7	—0.7	D., T.
173*b*	July 3	69 18	14 32	300	Clay, stones	40.3	4.6	D.
175	July 2	69 17	14 35	415	Clay, pebbles	37.4	3.0	D.
177	July 3	69 25	13 49	1,443	Biloculina clay	29.8	—1.2	D., T.
183	July 5	69 59	6 15	1,710	....do	29.7	—1.3	D., T.
190	July 7	69 41	15 51	870	Sandy clay	29.8	—1.2	T.
192	July 7	69 46	16 15	649	....do	30.7	—0.7	D.
195	July 16	70 55	18 38	107	Stones, clay	41.2	5.1	D.
200	July 17	71 25	15 41	620	Clay	30.2	—1.0	D., T.
205	July 18	70 51	13 03	1,287	Biloculina clay	29.8	—1.2	D.
213	July 26	70 23	2 30	1,760	... do	29.8	—1.2	D.
			West.					
223	Aug. 1	70 54	8 24	70	Dark gray, sandy clay	30.9	—0.6	D.
		(*Jan Mayen I'd.*)						
224	Aug. 1	70 51	8 20	95	....do	30.9	—0.6	D.
225	Aug. 2	70 58	8 04	195	....do	30.9	—0.6	D.
237	Aug. 3	70 41	10 10	263	Brown clay, stones	31.5	—0.3	D.
240	Aug. 4	69 02	11 26	1,004	Biloculina clay	30.0	—1.1	D.

Dredgings of Norwegian North-Atlantic expeditions, 1876-1878—Continued.

Serial number.	Date.	Latitude.	Longitude.	Depth.	Nature of bottom.	Bottom temperatures. Fahr.	Bottom temperatures. Cent.	Apparatus used.
		North. ° ′	*East.* ° ′	*Faths.*		°	°	
	1877.							
248	Aug. 8	67 56	4 11	778	Biloculina clay	29.5	—1.4	D.
251	Aug. 9	68 00	9 44	634	Clay	29.7	—1.3	D.
252	Aug. 11	(Vestfjord.)		......	....do	......	......	D.
253	Aug. 15	(Skjerstadfjord.)		263	....do	37.8	3.2	D.
253*b*	Aug. 17	(Saltstrommen.)		90	Stones	......	......	D.
	1878.							
255	June 19	68 12	15 40	341	Clay	43.7	6.5	D.
		(Vestfjord.)						
257	June 21	70 04	23 02	160	....do	39.0	3.9	D.
		(Altenfjord.)						
258	June 21	70 13	23 03	230	....do	39.2	4.0	T.
		(Altenfjord.)						
260	June 24	70 55	26 11	127	....do	38.3	3.5	D., T.
		(Porsangerfjord.)						
261	June 25	70 47	28 30	127	....do	37.0	2.8	D., T.
		(Tanafjord.)						
262	June 27	70 36	32 35	148	....do	35.4	1.9	D., T.
267	June 27	71 42	37 01	148	Clay, stones	29.5	—1.4	D.
270	June 27	72 27	35 01	136	Clay	32.0	0.0	D.
273	July 1	73 25	31 30	197	....do	36.0	2.2	D.
275	July 2	74 08	31 12	147	....do	31.3	—0.4	T.
280	July 4	74 10	18 51	35	Stones	34.0	1.1	D.
		(Beeren Island.)						
283	July 5	73 47	14 21	767	Clay	29.5	—1.4	D.
286	July 6	72 57	14 32	447	....do	30.6	—0.8	T.
290	July 7	72 27	20 51	191	Sandy clay	38.3	3.5	T.
295	July 14	71 59	11 40	1,110	Biloculina clay	29.7	—1.3	T.
297	July 16	72 36	5 12	1,280	....do	29.5	—1.4	T.
303	July 19	75 12	3 02	1,200	....do	29.1	—1.6	T.
312	July 22	74 54	14 53	658	Clay	29.8	—1.2	T.
315	July 22	74 53	15 55	180	Clay, sand	36.5	2.5	T.
322	July 23	74 57	19 52	21	Hard	32.4	0.2	D.
323	July 30	72 53	21 51	223	Clay	34.7	1.5	T.
326	Aug. 3	75 31	17 50	123	....do	34.9	1.6	T.
333	Aug. 4	76 06	13 10	748	Biloculina clay	29.7	—1.3	T.
336	Aug. 5	76 19	15 42	70	Clay, hard bottom	32.7	0.4	D.
338	Aug. 6	76 19	18 01	146	Hard	30.0	—1.1	D.
343	Aug. 7	76 34	12 51	743	Clay	29.8	—1.2	T.
			West.					
350	Aug. 8	76 26	0 29	1,686	Biloculina clay	29.3	—1.5	T.
			East.					
353	Aug. 10	77 58	5 10	1,333	....do	29.5	—1.4	T.
357	Aug. 12	78 03	11 18	125	Clay	35.4	1.9	D.
359	Aug. 12	78 02	9 25	416	....do	33.4	0.8	D.
362	Aug. 14	79 59	5 40	459	....do	30.2	—1.0	T.
363	Aug. 14	80 03	8 28	260	....do	34.0	1.1	T.
366	Aug. 17	79 35	11 17	61	....do	28.2	—2.1	T.
368	Aug. 17	Magdalena Bay.		37	....do	31.6	—0.2	T.
370	Aug. 18	78 48	8 37	109	....do	34.0	1.1	T.
372	Aug. 19	78 09	14 07	129	....do	34.2	1.2	T.
		(Isfjord.)						
374	Aug. 22	78 16	15 33	60	....do	33.3	0.7	T.
		(Advent Bay)						

ZOOLOGICAL STATIONS OF THE SWEDISH ARCTIC EXPEDITIONS OF 1875, 1876, AND 1878–'79.

The dredgings of 1875 were made by A. E. Nordenskiöld and Dr. Hjalmar Théel in the sloop *Proeven*, those of 1876 by Nordenskiöld in the steamer *Ymer*, those of 1878–'79 by Nordenskiöld in the *Vega*.

The numbers assigned to the stations are arranged geographically, instead of according to the dates at which they were made.

The numbers 98, 103, and 104 refer to collections not made by the *Vega* expedition but brought in by the Tschuktsches, who found them thrown on the shores in the spring and summer months of 1879.

Zoological stations of Swedish Arctic expeditions of 1875, 1876, and 1878–'79.

Serial number.	Date.	Latitude north.	Longitude, Greenwich, east.	Depth.	Kind of bottom.	Temperatures, Fahr. Surface.	Temperatures, Fahr. Bottom.	Temperatures, Cent. Surface.	Temperatures, Cent. Bottom.	Apparatus used.
		° ′	° ′	Fath.		°	°	°	°	
1	Aug. 2, 1875	69 55	60 30	10	Sand and shells	42.3	....	5.7	....	D.
2	Aug. 3, 1875	70 00	60 35	120	Mud	39.0	28.6	3.9	—1.9	D.
3	Aug. 6-7, 1876	70 45	61 00	90	Brown soft mud	40.3	....	4.6	....	D. and Tan.
4	Aug. 8, 1878	70 14	61 21	116	Fine soft mud	39.9	....	4.4	....	D. and Tan.
5	....do	70 23	61 42	100	Fine mud, poor in life	41.7	....	5.4	....	Tan.
6	Aug. 7, 1876	70 30	62 00	60	Mud	42.3	....	5.7	....	D. and Tan.
7	Aug. 8, 1876	70 25	62 30	55	...do	35.2	....	1.8	....	D. and Tan.
8	..do	70 20	62 40	50	Brown mud	35.6	....	2.0	....	D. and Tan.
9	Aug. 9, 1876	70 12	63 07	150	Mud	36.0	....	2.2	....	D. and Tan.
10	Aug. 4, 1875	71 05	63 20	90	...do	39.6	28.9	4.2	—1.7	D.
11	....do	71 00	63 25	70	...do	39.2	....	4.0	....	D.
12	Aug. 2, 1878	71 03	63 46	70	Fine mud, poor in life	39.6	30.6	4.2	—0.8	D. and Tan.
13	Aug. 9, 1876	70 10	64 40	28	Mud	34.3	....	1.3	....	D. and Tan.
14	Aug. 2, 1878	71 21	64 53	60	Greenish-gray mud	38.5	28.4	3.6	—2.0	D. and Tan.
15	Aug. 10, 1876	70 10	65 30	7	Mud	33.8	....	1.0	....	D. and Tan.
16	Aug. 11, 1876	70 12	65 45	8	Slightly muddy sand	32.7	....	0.4	....	D.
17	Aug. 12, 1876	70 15	66 00	9	Very hard, muddy sand	32.2	....	0.1	....	D.
18	....do	70 20	66 00	9	Hard sand	33.8	....	1.0	....	D.
19	Aug. 5, 1876	70 55	64 40	11	Sand	43.2	30.9	6.2	—0.6	D.
20	Aug. 6, 1876	71 00	65 50	12	...do	42.1	....	5.6	....	D.
21	....do	71 10	65 30	10	...do	43.3	....	6.3	....	D.
22	....do	71 15	66 05	8	..do	44.6	....	7.0	....	D.
23	Aug. 7, 1876	71 55	67 00	32	Dark-blue mud	43.0	....	6.1	....	D. and Tan.
24	Aug. 2, 1876	72 05	66 10	85	Fine, soft, grayish-brown mud	38.3	27.9	3.5	—2.3	D. and Tan.
25	Aug. 7, 1875	72 05	67 30	36	Mud	42.6	....	5.9	....	D. and Tan.
26	....do	72 10	67 55	21	...do	41.7	....	5.4	....	Tangles.
27	Aug. 3, 1878	72 42	68 02	15	Fine, gray, sandy mud	37.4	34.5	3.0	1.4	D. and Tan.
28	Aug. 9, 1875	72 37	68 30	3	Sand	40.6	....	4.8	....	D.
29	Aug. 3, 1878	73 00	68 15	8	Brown, muddy sand	36.5	28.4	2.5	—2.0	D. and Tan.
30	Aug. 9, 1875	73 15	69 10	9	Slightly muddy sand	46.0	30.2	7.8	—1.0	D.
31	Aug. 3, 1878	73 28	68 32	10	Grayish-brown muddy sand	33.8	28.8	1.0	—1.8	D. and Tan.
32	Aug. 10, 1875	73 45	69 10	10	Sand	46.0	30.2	7.8	—1.0	D.
33	Aug. 6, 1878	73 35	72 00	12	Gray sand	....	....	....	....	D.
34	Sept. 3, 1876	74 45	71 06	16	Dark-brown, somewhat muddy sand	37.6	....	3.1	....	Tangles.
35	....do	74 30	73 25	17	Sandy mud	36.9	....	2.7	....	Tangles.
36	....do	74 12	75 45	18	Muddy sand	37.0	....	2.8	....	Tangles.
37	Sept. 2, 1876	73 37	80 35	23	Mud	44.4	....	6.9	....	Tangles.
38	Aug. 11, 1875	75 00	75 20	22	Muddy sand	37.8	28.9	3.2	—1.7	D.
39	....do	75 35	77 30	20	...do	36.5	....	2.5	....	D.

Zoölogical stations of Swedish Arctic expeditions, etc.—Continued.

Serial number.	Date.	Latitude north.	Longitude, Greenwich, east.	Depth.	Kind of bottom.	Temperatures, Fahr.		Temperatures, Cent.		Apparatus used.
						Surface.	Bottom.	Surface.	Bottom.	
		° ′	° ′	*Fath.*		°	°	°	°	
40	Aug. 12, 1875	75 40	78 40	26	Muddy sand	32.9	28.9	0.5	−1.7	D. and Tan.
41	Aug. 14, 1875	74 30	80 30	20	Mud, with ferruginous concrotions	34.5	....	1.4	....	D. and Tan.
42	Sept. 2, 1875	73 15	57 18	50	Mud	39.2	....	4.0	....	Tangles.
43	July 31, 1876	73 10	57 45	150	....do	34.5	....	1.4	....	D. and Tan.
44	Aug. 31, 1875	73 30	57 55	60	....do	....	28.9	....	−1.7	D. and Tan.
45	Aug. 20, 1875	Udde Bay on the east coast of Nova Zembla.		5	Lithothamnion bottom	38.5	....	3.6	....	D.
46	Sept. 7, 1876	73 28	58 00	50–125	Stony and muddy	37.4	....	3.0	....	D. and Tan.
47	....do	73 30	58 20	80	Stones	36.0	....	2.2	....	Tangles.
48	Sept. 6, 1876	73 38	59 08	100	Sand	36.0	....	2.2	....	D. and Tan.
49	Sept. 5–6, '76	73 38	63 45	80	Sand and broken shells	34.5	....	1.4	....	D. and Tan.
50	Sept. 5, 1876	74 30	65 35	35	Unknown	32.4	....	0.2	....	Tangles.
51	Sept. 4, 1876	74 43	65 35	80	Mud	32.2	....	0.1	....	Tangles.
52	Aug. 24, 1875	75 30	64 10	60	Mud?	36.7	28.8	2.6	−1.8	D.
53	....do	75 43	65 20	40–50	....do	37.0	....	2.8	....	Tangles.
54	Sept. 4, 1876	75 15	66 50	130	..do	32.2	....	0.1	....	D. and Tan.
55	....do	75 12	67 20	125	Brownish, sandy mud	33.6	29.5	0.9	−1.4	D. and Tan.
56	Aug. 9, 1878	73 30 Dickson's Harbor.	80 58	5	Fine, very soft, light-brown mud	48.7	48.2	9.3	9.0	D.
57	Aug. 10, 1878	73 52	82 12	20	Gray mud	47.7	....	8.7	....	D. and Tan.
58	....do	74 08	82 12	19	....do	46.4	30.2	8.0	−1.0	D. and Tan.
59	....do	74 18	83 08	24	Mud	46.4	29.5	8.0	−1.4	Tangles.
60	Aug. 11, 1878	74 52	85 08	6	Sand	46.8	33.8	8.2	1.0	D.
61	Aug. 12, 1878	76 08	90 25	15	Stones	34.2	30.0	1.2	−1.1	Tangles.
62	Aug. 13, 1878	76 18	92 20	40	Brown mud, with many large stones	33.3	29.5	0.7	−1.4	D. and Tan.
63	....do	76 18	94 03	3–10	Stones	35.6	....	2.0	....	D.
64	Aug. 14-16, '78	76 18 Aktinia Bay.	95 30	5–10	...do	33.6	29.5	0.9	−1.4	D.
65	Aug. 19-20, '78	77 36 Off Cape Tscheljuskin.	103 25	5–10	Mud, with stones	31.8	....	−0.1	....	D.
66	Aug. 20, 1878	77 40	105 10	70	Gray mud	32.0	29.8	0.0	−1.2	Tangles.
67	Aug. 21, 1878	77 28	108 28	50	....	32.9	29.5	0.5	−1.4	Tangles.
68	....do	77 15	111 45	22	Gray mud	32.4	29.5	0.2	−1.4	Tangles.
69	Aug. 22, 1878	76 55	115 18	32	Mud	31.8	....	−0.1	....	Tangles.
70	...do	76 52	116 00	36	Fine, gray mud	30.9	29.5	−0.6	−1.4	Tr.
71	Aug. 23, 1878	76 40	115 30	35	Mud	30.9	34.9	−0.6	1.6	Tr.
72	Aug. 24, 1878	75 00	113 30	15	Mud, with stones	39.2	30.6	4.0	−0.8	Tr. and Tan.

73	....do	74 45	113 10	5	Solid rock	40.1	....	4.5	....	D.
		Preobrascheni I'd.				41.0	36.7	5.0	2.6	Tr.
74	Aug. 25, 1878	73 41	114 58	6	Mud?	36.7	30.2	2.6	—1.0	Tangles.
75	Aug. 26, 1878	73 45	119 00	8	Solid rock	34.2	....	1.2	....	Tr.
76	....do	73 45	121 20	4	Hard sand	36.7	....	2.6	....	Tr.
77	Aug. 27, 1878	73 50	126 07	7-8	....do	39.9	38.8	4.4	3.8	Tr.
78	Aug. 28, 1878	74 09	130 20	15	Mud?	34.5	....	1.4	....	Tr.
79	....do	73 53	134 25	9	Greasy, gray mud					
80	Aug. 29, 1878	74 04 Due west of Stolbovoi Island.	135 38	16	Brown mud	34.2	31.3	1.2	—0.4	Tangles.
81	....do	73 53 Betw'n Stolbovoi and Blischni I'ds	138 00	12	Soft, gray mud	34.5	31.3	1.4	—0.4	Tr.
82	....do	73 40 West of Blischni Island.	140 16	4	Fine, gray mud	36.7	36.7	2.6	2.6	D. and Tan
						33.4	32.0	0.8	0.0	Tr.
83	Aug. 31, 1878	73 02	142 36	9	....do	36.7	31.3	2.6	—0.4	D. and Tr.
84	....do	73 05	144 20	8	....do	33.1	30.9	0.6	—0.6	Tr.
85	Sept. 1, 1878	72 20	153 30	10	Gray mud, very tough and solid	35.2	30.2	1.8	—1.0	Tangles.
86	Sept. 2, 1878	71 39	157 15	10	Brown mud	30.2	30.2	—1.0	—1.0	D. and Tan.
87	Sept. 3,4, 1878	70 28	164 10	9	Sand	30.4	29.7	—0.9	—1.3	Tr.
88	Sept. 5,6, 1878	70 14	170 17	12	Mud, with stones	29.7	30.4	—1.3	—0.9	Tr.
89	Sept. 6,7, 1878	69 56	174 26	16	Gray mud	30.2	....	—1.0	....	D.
90	Sept. 8, 1878	69 27	177 14	4-5	Fine sand, with stones	30.2	....	—1.0	....	Tr. and Tan'
91	Sept. 7,8, 1878	69 32	177 41	12	Sand and mud, with stones	29.5	29.8	—1.4	—1.2	D.
92	Sept. 9, 1878	69 22	177 28	4	Muddy sand	29.5	29.8	—1.4	—1.2	D.
93	Sept. 10, 1878	69 26	178 00	10	Sand, with small stones					
			West.			29.8	29.7	—1.2	—1.3	D.
94	Sept. 12-18, '78	68 55	179 25	3-6	Stones	30.2	29.8	—1.0	—1.2	D.
95	Sept. 20, 1878	68 12	176 32	6	Hard sand	32.0	....	0.0	....	D.
96	Sept. 24, 1878	67 58	176 10	5	....do	30.6	....	—0.8	....	D.
97	Sept. 25, 1878	67 53	176 06	4-6	Hard, gray sand					
98	Apr.-June, '79	Koljutschin Island				30.6	29.7	—0.8	—1.6	D.
99a	Oct. 3, 1878	67 07	173 24	4-5	Hard, brown sand	....	....	....	....	D.
99b	July 7,8, 1879	67 07	173 24	2-3	Sand, with stones	....	....	....	....	D.
99c	June, July, '79	67 07	173 24	9-15	Muddy sand, with stones	32.4	....	0.2	....	Tr. and Tan.
100	July 19, 1879	66 58	171 35	21	Slightly muddy sand	34.2	....	1.2	....	Tr. and Tan.
101	...do	66 25	170 35	25	Hard sand	30.6	....	—0.8	....	Tr. and Tan.
102	July 20, 1879	66 10	169 45	....	Sand, with many dead shells					
103	Apr.-July, '79	Tjapka Tchätscha.	North coast of Tschuktscha peninsula.	....	....	....	....	....	....	
104	May, 1879									

DREDGING STATIONS OF THE DANISH ARCTIC EXPEDITION, 1882–'83.

The Danish Arctic expedition of 1882–'83 in the steamer *Dijmphna*, commanded by Lieutenant Hovgaard, was partially at the expense of the Danish Government, but mainly at that of the brothers Gamél. The naturalist in charge was Th. Holm. The zoological and botanical results were published in 1887 at Copenhagen in an octavo volume, containing papers by Holm, Jensen, Deichmann Branth, Wille and Kolderup Rosenvinge, on the botany, and by Lütken, Hansen, Levinsen, Bergh, Jungersen, Traustedt, Collin, and Holm on the zoology.

The dredgings were on the southern coast of Nova Zembla and in the Kara Sea.

No. 1 in the Kostin Schar on the southwest coast of Nova Zembla.
No. 2 in the Nicholskoï Schar on the southwest coast of Nova Zembla.
No. 3 in the Olenjo Sund on the southwest coast of Nova Zembla.
Nos. 4–6 in the Petuschowski Schar in the southwest coast of Nova Zembla.
No. 7 in the Kara Sea, off Cape Yarasol.
Nos. 8–10 in the Jugor Schar at its outlet into the Kara Sea.
Nos. 11–188 in the Kara Sea.
Nos. 189–90 in the Kara Strait, between Nova Zembla and Waigatsch Island.

Dredging stations of the Danish Arctic expedition, 1882–'83.

Serial number.	Date.	Latitude north.	Longitude east, Greenwich.	Depth.	Kind of bottom.	Higher algæ found.
	1882.	° ′	° ′	*Fath.*		
1	Aug. 12	71 24	52 49	5	Sand and stones	A.
2	Aug. 18	70 31	57 28	12	Blue clay, with stones	A.
3	Aug. 23	70 30	57 02	12	Sand and stones	A.
4	Aug. 28	70 34	56 18	5	......do	A.
5	Aug. 29	70 34	56 18	5	......do	A.
6	Sept. 1	70 34	56 18	5	......do	A.
7	Sept. 9	69 52	60 40	10-12	Blue clay, with brown mud, stony	A.
8	Sept. 12	69 49	60 32	6	Sand and blue clay	A.
9	Sept. 13	69 49	60 32	6	......do	A.
10	Sept. 15	69 48	60 33	6	Blue clay	
11	Sept. 26	70 15	64 25	65	Blue clay, with brown mud	
12	Sept. 27	70 17	64 20	70	......do	
13	Sept. 28	70 12	64 37	67	......do	
14	Sept. 29	70 10	64 41	65	......do	
15	Sept. 30	70 11	64 30	67	......do	
16	Oct. 2	70 12	64 23	69	Dark-brown clay	
17	Oct. 3	70 14	64 22	69	......do	
18	Oct. 4	70 16	64 23	66	......do	
19	Oct. 5	70 19	64 26	60	......do	
20	Oct. 6	70 20	64 31	58	......do	
21	Oct. 7	70 21	64 22	65	......do	A.
22	Oct. 9	70 23	64 03	79	......do	A
23	Oct. 10	70 22	63 56	81	Blue clay, with brown mud	
24	Oct. 11	70 20	63 44	97	......do	
25	Oct. 12	70 19	63 40	98	......do	
26	Oct. 14	70 17	63 37	104	Dark-brown clay	
27	Oct. 16	70 21	63 55	78	......do	
28	Oct. 17	70 16	64 11	75	......do	
29	Oct. 19	70 07	64 22	70	Blue clay, with brown mud	A.
30	Oct. 20	70 07	64 27	67	......do	
31	Oct. 21	70 08	64 42	67	......do	
32	Oct. 23	70 07	64 52	61	......do	
33	Oct. 24	70 03	64 53	61	Stiff gray clay, with a little brown mud	
34	Oct. 25	70 03	64 47	58	Blue clay, with brown mud	
35	Oct. 27	70 04	64 51	60	......do	
36	Oct. 31	70 12	64 12	75	......do	
37	Nov. 2	70 18	64 00	76	......do	
38	Nov. 8	70 17	64 26	62	Dark-brown clay	

Dredging stations of the Danish Arctic expedition, 1882-'83—Continued.

Serial number.	Date.	Latitude north.	Longitude east, Greenwich.	Depth.	Kind of bottom.	Higher algæ found.
	1882.	° ′	° ′	*Fath.*		
39	Nov. 16	70 23	64 13	75	Blue clay, with brown mud	
40	Nov. 21	70 19	64 05	72	......do	
41	Nov. 25	70 16	64 04	80	Stiff brownish-gray clay	
42	Dec. 1	70 15	63 52	80	Dark-brown clay	
43	Dec. 12	70 28	64 35	68	Blue clay, with brown mud	A.
44	Dec. 15	70 33	64 37	48	......do	
45	Dec. 16	70 36	64 43	23	......do	
46	Dec. 22	70 38	64 40	23	......do	
	1883.					
47	Jan. 4	70 58	65 05	20	......do	
48	Jan. 6	70 57	65 02	20	......do	
49	Jan. 9	70 58	65 09	20	......do	
50	Jan. 12	70 59	64 41	40	......do	
51	Jan. 16	70 54	63 57	68	......do	
52	Jan. 19	70 55	64 16	50	......do	
53	Jan. 23	70 58	64 04	67	......do	
54	Jan. 26	70 58	64 00	68	......do	
55	Jan. 29	71 05	64 31	55	......do	
56	Jan. 31	71 02	64 23	55	......do	
57	Feb. 1	71 02	64 16	55	......do	
58	Feb. 3	71 04	64 07	58	......do	A.
59	Feb. 6	71 05	64 05	58	......do	
60	Feb. 9	71 05	63 50	59	......do	
61	Feb. 12	71 05	64 17	58	......do	
62	Feb. 13	71 06	64 21	54	......do	
63	Feb. 14	71 04	64 36	53	......do	A.
64	Feb. 15	71 04	64 38	53	......do	
65	Feb. 17	71 07	64 25	55	......do	A.
66	Feb. 21	71 08	64 31	51	......do	
67	Feb. 22	71 09	64 39	51	......do	
68	Feb. 23	71 11	64 42	51	......do	
69	Feb. 24	71 14	64 43	60	......do	
70	Feb. 26	71 17	64 47	66	......do	
71	Feb. 28	71 21	64 48	80	Blue clay, with ferruginous concretions	
72	Mar. 1	71 20	64 53	66	Blue clay, with ferruginous concretions, and small stones.	
73	Mar. 3	71 28	65 04	78	......do	
74	Mar. 5	71 38	65 17	85	Blue clay, with brown mud	
75	Mar. 6	71 40	65 07	84	Blue clay, with small stones	A.
76	Mar. 7	71 39	65 02	83	Blue clay, with brown mud	
77	Mar. 8	71 36	64 59	79	......do	
78	Mar. 9	71 33	64 56	75	Blue clay, with ferruginous concretions	
79	Mar. 10	71 34	64 53	77	......do	
80	Mar. 12	71 41	64 37	67	Blue clay, with brown mud	
81	Mar. 13	71 41	64 45	73	......do	
82	Mar. 15	71 41	64 47	72	......do	
83	Mar. 16	71 40	64 47	71	......do	
84	Mar. 17	71 40	64 43	71	Blue clay, with small stones, and ferruginous concretions.	
85	Mar. 19	71 36	64 32	60	Blue clay, with brown mud and ferruginous concretions.	
86	Mar. 21	71 34	64 30	60	Blue clay, with brown mud	
87	Mar. 24	71 32	64 24	55	Blue clay, with ferruginous concretions	
88	Mar. 27	71 32	64 26	55	......do	A.
89	Mar. 28	71 33	64 27	55	......do	
90	Mar. 29	71 35	64 32	59	......do	A.
91	Mar. 30	71 34	64 37	60	......do	
92	Mar. 31	71 32	64 36	63	Blue clay, with brown mud	
93	Apr. 2	71 30	64 33	56	Blue clay, with ferruginous concretions and small stones.	
94	Apr. 3	71 28	64 33	56	Blue clay, with brown mud and small stones	
95	Apr. 6	71 31	64 34	57	Blue clay, with brown mud and ferruginous concretions.	
96	Apr. 7	71 33	64 33	58	......do	A.
97	Apr. 9	71 34	64 33	57	......do	
98	Apr. 10	71 36	64 33	60	......do	A.
99	Apr. 11	71 37	64 38	70	Blue clay, small stones	
100	Apr. 12	71 40	64 43	68	Blue clay, with brown mud and ferruginous concretions.	
101	Apr. 13	71 44	65 03	81	Blue clay, with brown mud, and large stones	
102	Apr. 14	71 44	65 06	82	Blue clay, with brown mud, and ferruginous concretions.	
103	Apr. 16	71 45	65 20	88	Light-brown clay, with brown mud, and ferruginous concretions.	
104	Apr. 17	71 44	65 22	89	......do	

Dredging stations of the Danish Arctic expedition, 1882–'83—Continued.

Serial number.	Date.	Latitude north.	Longitude east, Greenwich.	Depth.	Kind of bottom.	Higher algæ found.
	1883.	° ′	° ′	*Fath.*		
105	Apr. 18	71 45	65 12	90	Light-brown clay, with brown mud	
106	Apr. 19	71 46	65 14	89	do	
107	Apr. 21	71 44	65 11	91	do	
108	Apr. 23	71 43	65 04	80	Light-brown clay, with brown mud, and ferruginous concretions.	
109	Apr. 24	71 39	64 56	73	do	
110	Apr. 25	71 38	64 58	79	Dark-brown clay, with brown mud, stones, and ferruginous concretions.	
111	Apr. 26	71 37	64 56	74	Grayish-brown clay, with ferruginous concretions	
112	Apr. 27	71 37	64 54	74	Grayish-brown clay	
113	Apr. 28	71 36	64 49	70	Grayish-brown clay, with brown mud	
114	Apr. 30	71 38	64 37	65	Grayish-brown clay, with small stones, and ferruginous concretions.	
115	May 1	71 34	64 22	50	do	
116	May 2	71 33	64 17	50	Blue clay, with brown mud, and ferruginous concretions.	
117	May 4	71 32	64 17	50	do	
118	May 5	71 34	64 18	44	do	
119	May 7	71 35	64 12	49	do	
120	May 8	71 32	64 18	53	do	
121	May 9	71 32	64 19	51	do	
122	May 10	71 31	64 22	53	do	A.
123	May 11	71 28	64 17	56	Blue clay, with brown mud	A.
124	May 12	71 27	64 20	53	do	
125	May 15	71 25	64 22	50	Blue clay, with ferruginous concretions	
126	May 16	71 24	64 21	55	Blue clay, with brown mud	
127	May 17	71 22	64 20	68	Blue clay, with brown mud, and ferruginous concretions.	
128	May 18	71 21	64 23	69	do	
129	May 21	71 21	64 18	68	do	
130	May 22	71 22	64 17	56	do	
131	May 24	71 25	64 18	55	do	
132	May 26	71 18	64 01	55	Blue clay, with brown mud	
133	May 28	71 21	64 07	55	do	
134	May 30	71 22	64 02	55	Blue clay, with brown mud, and ferruginous concretions.	
135	June 1	71 20	64 05	56	Blue clay, some small stones	
136	June 4	71 18	64 16	57	Blue clay, with brown mud, and ferruginous concretions.	
137	June 6	71 17	64 16	60	do	
138	June 8	71 16	64 16	59	Blue clay, with brown mud	
139	June 9	71 15	64 16	64	Blue clay, with sandy clay, and a few small stones	
140	June 11	71 12	64 20	56	Blue clay, with brown mud, and ferruginous concretions.	
141	June 12	71 13	64 22	59	Blue clay, with brown mud	
142	June 14	71 10	64 11	73	Blue clay, with brown mud, and a few ferruginous concretions.	
143	June 15	71 09	64 06	58	do	
144	June 16	71 10	64 02	75	do	
145	June 18	71 18	63 42	70	do	
146	June 19	71 20	63 39	69	Blue clay, with brown mud	
147	June 20	71 21	63 43	65	Blue clay, with brown mud, and ferruginous concretions, and small stones.	
148	June 21	71 20	63 49	85	Blue clay, with brown mud	
149	June 23	71 18	63 48	82	do	
150	June 25	71 15	63 44	91	do	
151	June 26	71 14	63 44	93½	Blue clay, with brown mud, and sandy clay	
152	June 27	71 13	63 43	83	Blue clay, with brown mud, and ferruginous concretions.	A.
153	June 28	71 12	63 43	85	Blue clay, with brown mud	
154	June 29	71 12	63 43	95	do	
155	June 30	71 11	63 42	78½	Blue clay, with brown mud, ferruginous concretions, and stones.	
156	July 1	71 10	63 37	67½	Blue clay, with brown mud, and ferruginous concretions.	
157	July 2	71 09	63 33	70	do	
158	July 3	71 07	63 24	70	Blue clay, with brown mud	
159	July 4	71 06	63 22	73	do	
160	July 5	71 04	63 13	72	do	
161	July 6	71 05	63 10	72	do	
162	July 7	71 06	63 07	79½	Blue clay, with brown mud, and ferruginous concretions.	
163	July 9	71 05	62 55	80	Blue clay, with brown mud	
164	July 12	71 02	62 46	80	do	
165	July 14	71 05	62 38	75	Blue clay, with brown mud, and stones	
166	July 16	71 04	62 40	76½	do	
167	July 18	71 04	62 37	75	do	

Dredging stations of the Danish Arctic expedition, 1882-'83—Continued.

Serial number.	Date.	Latitude north.	Longitude east, Greenwich.	Depth.	Kind of bottom.	Higher algæ found.
	1883.	° '	° '	*Fath.*		
168	July 20	71 06	62 42	75	Blue clay, with brown mud	
169	July 22	71 05	62 47	73	Blue clay, with brown mud, and stones	
170	July 24	71 04	62 40	74	Blue clay, with brown mud	
171	Aug. 2	71 14	62 37	70	......do	A.
172	Aug. 4	71 18	62 10	58	Blue clay, with brown mud, and stones	
173	Aug. 7	71 16	61 37	46	......do	A.
174	Aug. 8	71 13	61 28	48½	......do	
175	Aug. 10	71 10	61 22	52	......do	
176	Aug. 13	71 11	61 12	53	......do	
177	Aug. 16	70 59	60 30	68½	Blue clay and brown mud, with many sandy worm-tubes.	A.
178	Aug. 17	70 52	60 00	92	Blue clay, with light-brown mud, and small stones	A.
179	Aug. 20	70 54	59 51	93	Blue clay, and small stones	A.
180	Aug. 22	70 56	59 40	97	......do	A.
181	Aug. 22	70 56	59 36	100	......do	A.
182	Aug. 24	70 57	59 35	100	Blue clay and brown mud, with small stones	
183	Aug. 30	71 04	59 40	98	Blue clay and small stones	
184	Sept. 3	71 17	59 43	74	Blue clay, with brown mud, sand-tubes, and small stones.	A.
185	Sept. 4	71 10	59 24	100	Blue clay, with brown mud	A.
186	Sept. 5	71 08	59 15	106	Blue clay and brown mud, with very numerous sand-tubes.	
187	Sept. 8	71 18	59 44		Blue clay and many sand tubes	A.
188	Sept. 9	71 26	59 58	63	Blue clay and many sand-tubes, with some mud and stones.	A.
189	Sept. 21	70 26	57 53	30	Sandy clay, and stony	A.
190	Sept. 22	70 20	57 47	50	......do	A.

DREDGING AND SOUNDING STATIONS OF THE LIGHTNING, 1868.

The dredgings made by the British surveying steamer *Lightning* in 1868 were undertaken at the request of the Royal Society, and, with the exception of the dredgings of Count Pourtales in 1867 and 1868, were almost the first deliberate attempts to investigate the deep-sea fauna. The region explored was between the north of Scotland and the Färöe Islands and extending thence to a distance of about 250 miles northwest of Scotland. The series of temperatures obtained on this expedition, showing the great difference of temperature existing to the northeast and southwest of a submarine barrier (discovered by a subsequent expedition) were the first contributions of importance to our knowledge of the laws governing deep-sea temperatures. The scientific observations were under the charge of Dr. W. B. Carpenter and Prof. Wyville Thomson, and the preliminary report by Dr. Carpenter was published in No. 107 of the Proceedings of the Royal Society, 1868.

Dredging and sounding stations of the Lightning, 1868.

WARM AREA.

Serial number.	North latitude.	West longitude.	Depth.	Temperatures	
				Surface.	Bottom.
	° ′	° ′	*Fathoms.*	°	°
1	59 20	7 05	†500	54.5	49
2	60 32	9 10	164	54	48.5
3	60 31	9 18	229	54	48
4*	60 44	8 45	72	54	49
5*	61 01	7 48	62	53	50
12*	59 36	7 20	530	52.5	47.3
13*	59 05	7 29	189	52	49.3
14	59 59	9 15	650	53	46
15	60 38	11 07	570	52	47
16*	61 02	12 04	650	....	....
17	59 49	12 36	620	52	46

COLD AREA.

Serial number.	North latitude.	West longitude.	Depth.	Surface.	Bottom.
6*	60 45	4 49	510	52	33.7
7*	60 07	5 21	500	51	32.2
8	60 10	5 59	550	53	32
9*	60 24	6 38	170	52	41.7
10*	60 28	6 55	500	51	33
11	60 30	7 16	†450	50	33.2

* Dredgings. † At least.

DREDGING STATIONS OF THE PORCUPINE, 1869.

The dredgings of the British steamer *Porcupine* in 1869 were in continuation of those of the *Lightning* in 1868, and were, like them, undertaken at the request of the Royal Society. They extended west of Ireland and Scotland, as far west as the Rockall Bank, and as far north as the Färöe Islands, and reached a depth of 2,435 fathoms, a much greater one than ever before attained. Dr. Carpenter's report on them is contained in No. 121 of the Proceedings of the Royal Society, Vol. 17, p. 397.

Dredging stations of the Porcupine, 1869.

Serial number.	Date.	Latitude.	Longitude.	Depth.	Kind of bottom.	Temperatures, Fahrenheit.		Temperatures, centigrade.	
						Surface.	Bottom.	Surface.	Bottom.
		North. ° ′	*West.* ° ′	*Fath.*		°	°	°	°
1	May 18	51 51	11 50	370		54.2	49.0	12.3	9.4
2		51 22	12 25	808	Soft mud	54.2	41.4	12.3	5.2
3		51 38	12 50	722		54.5	43.0	12.5	6.1
4		51 56	13 30	251		53.5	49.5	12.0	9.7
5		52 07	12 52	364		54.0	48.8	12.2	9.3
6		52 25	11 40	90		54.0	50.0	12.2	10.0
7		52 14	11 48	159		53.2	50.4	11.8	10.2
8		53 16	11 51	106		54.2	51.2	12.3	10.7
9		53 16	12 42	165		53.5	49.7	12.0	9.8
10		53 23	13 29	85		54.6	49.5	12.5	9.7
11		53 24	15 24	1,630					
12		53 41	14 17	670		52.2	42.6	11.2	5.9
13		53 42	13 55	208		53.6	49.6	12.0	9.8
14		53 40	13 15	173		53.2	49.6	11.8	9.8
15		54 05	12 17	422		52.2	47.0	11.2	8.3
16		54 10	11 50	816		53.0	39.5	11.7	4.2
17		54 28	11 44	1,230		53.2	37.8	11.8	3.2
18	June 7 to July 9	54 15	11 09	183		53.2	49.5	11.8	9.7
19	...do....	54 53	10 56	1,360		54.8	37.4	12.6	3.0
20	...do....	55 11	11 31	1,443		55.5	37.0	13.0	2.8
21	...do....	55 40	12 46	1,476		56.2	36.9	13.4	2.7
22	...do....	56 08	13 34	1,263		56.7	37.3	13.8	2.9
23	...do....	56 07	14 19	630		57.3	43.5	14.1	6.4
23*a*	...do....	56 13	14 18	420		56.8	46.4	13.7	8.0
24	...do....	56 26	14 28	109		57.7	46.4	14.3	8.0
25	...do....	56 41	13 39	164		56.8	46.5	13.7	8.1
26	...do....	56 58	13 17	345		57.4	46.7	14.1	8.2
27	...do....	Rockall Bank.		54		55.6	48.3	13.1	9.1
28	...do....	56 44	12 52	1,215		57.6	37.1	14.2	2.8
29	...do....	56 34	12 22	1,264		56.9	36.9	13.8	2.7
30	...do....	56 24	11 49	1,380		56.0	37.1	13.3	2.8
31	...do....	56 15	11 25	1,360		56.9	37.2	13.8	2.9
32		56 05	10 23	1,320		55.9	37.4	13.3	3.0
33	July 20	50 38	9 27	74	Mud, gravel, dead shells	65.2	49.6	18.4	9.8
34	...do....	49 51	10 12	75	....do	66.0	49.6	18.9	9.8
35	July 21	49 07	10 57	96	Gravel, dead shells	63.4	51.3	17.4	10.7
36	...do....	48 50	11 09	725	Muddy sand	64.0	43.9	17.7	6.1
37	July 22	47 38	12 08	2,435	Gray, ooze	65.6	36.5	18.6	2.5
38	July 23	47 30	11 33	2,090	....do	64.2	36.3	17.9	2.4
39	July 26	49 01	11 56	557	Ooze, sand, dead shells	63.0	47.0	17.2	8.3
40	...do....	49 01	12 05	517	....do	63.4	47.7	17.4	8.7
41	...do....	49 04	12 22	584	....do	63.4	46.5	17.4	8.1
42	July 27	49 12	12 52	862	....do	62.6	39.7	17.0	4.3
43	July 28	50 01	12 26	1,207	Ooze	61.7	37.7	16.5	3.2
44	July 29	50 20	11 34	865		61.2	39.4	16.2	4.1
45	July 30	51 01	11 21	458		60.6	48.1	15.9	8.9
46	Aug. 17	59 23	7 04	374		53.9	46.1	12.1	7.7
47	August	59 34	7 18	542		54.0	43.8	12.2	6.5
48	...do....	59 32	6 59	510					
49	...do....	59 43	7 40	475		53.6	45.4	12.0	7.4
50	...do....	59 54	7 52	355		52.6	46.2	11.4	7.9
51	...do....	60 06	8 14	440		51.6	42.0	10.9	5.5
52	...do....	60 25	8 10	384		52.1	30.6	11.2	— 0.8
53	...do....	60 25	7 26	490		52.1	30.0	11.2	— 1.1
54	...do....	59 56	6 27	363		52.5	31.4	11.4	— 0.3
55	...do....	60 04	6 19	605		52.6	29.8	11.4	— 1.2
56	...do....	60 02	6 11	480		52.6	30.7	11.4	— 0.7
57	...do....	60 14	6 17	632		52.0	30.5	11.1	— 0.8
58	...do....	60 21	6 51	540		51.4	30.8	10.6	— 0.6
59	Aug. 20	60 21	5 41	580		52.7	29.7	11.5	— 1.3
60	...do....	61 03	5 58	167		49.5	44.3	9.7	6.9
61	Aug. 24	62 01	5 19	114		50.4	45.0	10.2	7.2
62	...do....	61 50	4 38	125		49.6	44.6	9.8	7.0
63	...do....	61 57	4 02	317		49.0	30.3	9.4	— 0.9
64	Aug. 25	61 21	3 44	640		49.7	30.0	9.3	— 1.1
65	Aug. 26	61 10	2 21	345		52.0	30.0	11.1	— 1.1
66	...do....	61 15	1 44	267		52.4	45.7	11.3	7.6
67	Aug. 27	60 32	0 29	64		51.9	49.1	11.0	9.5

Dredging stations of the Porcupine, 1869—Continued.

Serial number.	Date.	Latitude.	Longitude.	Depth.	Kind of bottom.	Temperatures Fahrenheit.		Temperatures centigrade.	
						Surface.	Bottom.	Surface.	Bottom.
		North. ° ′	*East.* ° ′	*Fath.*		°	°	°	°
68	August .	60 23	0 33	75	....	52.5	44.0	11.4	6.7
69	...do	60 01	0 18	67	....	53.5	43.8	12.0	6.5
			West.						
70	Aug. 28	60 04	0 21	66	....	53.4	45.1	11.9	7.3
71	Sept. 1	60 17	2 53	103	....	53.0	48.6	11.6	9.2
72	...do	60 20	3 05	76	....	52.3	48.8	11.3	9.4
73	...do	60 29	3 06	84	....	52.7	48.8	11.5	9.4
74	...do	60 39	3 09	203	....	52.6	47.6	11.4	8.7
75	...do	60 45	3 06	250	....	51.5	41.9	10.8	5.5
76	Sept. 2	60 36	3 58	344	....	50.3	29.7	10.1	—1.1
77	...do	60 34	4 40	560	....	50.9	29.8	10.5	—1.2
78	Septemb'r	60 14	4 30	290	....	52.2	41.5	11.2	5.3
79	...do	59 44	4 44	76	....	52.1	48.9	11.2	9.4
80	...do	59 49	4 42	92	....	53.2	49.4	11.8	9.6
81	...do	59 54	5 01	142	....	53.3	49.1	11.8	9.5
82	...do	60 00	5 13	312	....	52.3	41.4	11.2	5.2
83	...do	60 06	5 08	362	....	53.1	37.5	11.7	3.0
84	Sept. 4	59 34	6 34	155	....	54.3	49.1	11.4	9.5
85	...do	59 40	6 34	190	....	53.9	48.6	12.1	9.3
86	...do	59 48	6 31	445	....	53.6	30.1	12.0	—1.0
87	Sept. 6	59 35	9 11	767	....	52.5	41.4	11.4	5.2
88	...do	59 26	8 23	705	....	53.5	42.6	12.0	5.9
89	Sept. 7	59 38	7 46	445	....	53.1	45.5	11.7	7.5
90	....	59 41	7 34	458	....	53.1	45.2	11.7	7.3
VI	....	60 45	4 49	510	....	52.0	31.7	11.1	—0.2
VII	....	60 07	5 21	500	....	51.0	30.2	10.6	—1.0
VIII	....	60 10	5 59	550	....	53.0	29.8	11.7	—1.2
X	....	60 28	6 55	500	....	51.0	30.8	10.6	—0.7
XI	....	60 30	7 16	450	....	50.0	31.2	10.0	—0.4
XII	....	59 36	7 20	530	....	52.5	44.8	11.4	7.1
XIV	....	59 59	9 15	650	....	53.0	42.5	11.7	5.8
XV	....	60 38	11 07	570	....	52.0	43.5	11.1	6.4
XVII	....	59 49	12 36	620	....	52.0	43.5	11.1	6.4

DREDGING AND SOUNDING STATIONS OF THE PORCUPINE, 1870.

The dredgings of the *Porcupine* in 1870, like those of 1869 and those of the *Lightning* in 1868, were undertaken at the request of the Royal Society to extend the examination of the deep-sea bottom to the south of Europe and the Mediterranean. Two cruises were made, the first under the scientific direction of Mr. Gwyn Jeffreys, accompanied by Mr. Josua Lindahl and Mr. W. L. Carpenter, extending from Falmouth to Gibraltar, and the second under W. B. Carpenter, assisted by Mr. Lindahl and Mr. P. H. Carpenter, exploring the western basin of the Mediterranean between Gibraltar and Malta, in order to determine its physical and biological relations to the Atlantic, with special reference to the Gibraltar current. The temperature observations made on this second cruise, showing an almost absolute uniformity of temperature from the depth of about 100 fathoms (or that of the Straits of Gibraltar) to the greatest depths reached (1,743 fathoms), shed a most important light upon the phenomena of ocean basins inclosed by shallow barriers, such as the Mediterranean, the Caribbean Sea, Gulf of Mexico, and Sooloo Sea, as contrasted with those of the open ocean. Thus, on this season's work, the six temperatures taken below 1,000 fathoms in the Mediterranean (ranging from 1,328 to 1,743 fathoms) were all between

54.7° and 56°, and one at 112 fathoms giving 55.5°, whilst in the Atlantic, almost in the same latitude, depths of 1,095 and 1,065 fathoms gave 39.7° and one of 128 fathoms, a little farther north, 52.5°. The report on the expedition, by Mr. J. Gwyn Jeffreys and Dr. W. B. Carpenter, forms No. 125 of the Proceedings of the Royal Society, December 8, 1870. There appear to be some discrepancies between the numbers assigned to the stations in the Mediterranean in the detailed description of the dredgings and those given in the list of stations and on the charts, but as the latter two series agree the others are probably erroneous. Care, therefore should be taken in making use of the lists of animals dredged to see that they really belong to the station ascribed to them in the body of the text. The explorations of the first cruise (No. 1 to 38) extended from July 7 to August 5, 1870, and those of the second cruise from August 15 to October 1.

Dredging and sounding stations of the Porcupine, 1870.

Station No.	Latitude.	Longitude.	Depth.	Temperatures.		Locality.
				Surface.	Bottom.	
	North. ° ′	*West.* ° ′	*Fathoms.*	°	°	
1	48 38	10 15	567	....	....	South of Ireland.
2	48 37	10 09	305	61.5	48.5	Do.
3	48 31	10 03	690	....	....	Do.
4	48 32	9 59	717	61.5	45.3	Do.
5	48 29	9 45	100	62.3	51.5	Do.
6	48 26	9 44	358	62.0	50.3	Do.
7	48 18	9 11	93	61.0	51.3	Do.
8	48 13	9 11	257	60.7	50.0	Do.
9	48 06	9 18	539	64.0	48.0	Do.
10	42 44	9 23	81	60.5	53.5	Between Cape Finisterre and Vigo.
11	42 32	9 24	332	60.5	51.5	Do.
12	42 20	9 17	128	61.5	52.5	Do.
13	40 16	9 37	220	64.5	52.0	Between Oporto and Lisbon.
14	40 06	9 44	469	65.3	51.5	Do.
15	40 02	9 49	722	67.5	49.7	Do.
16	39 55	9 56	994	69.5	40.3	Do.
17	39 42	9 43	1,095	68.0	39.7	Do.
17*a*	39 39	9 39	740	67.5	49.3	Do.
18	39 29	9 44	1,065	65.0	39.7	Do.
19	39 27	9 30	248	64.7	51.7	Do.
21	38 19	9 30	620	67.3	50.5	Southwest of Lisbon.
22	38 15	9 33	718	66.3	52.0	Do.
23	37 20	9 30	802	66.5	49.3	Northwest of Cape St. Vincent.
24	37 19	9 13	292	67.5	52.7	Do.
25	37 11	9 07	374	69.7	53.5	Do.
26	36 44	8 08	364	71.7	52.7	Between Cape St. Vincent and Cadiz.
27	36 37	7 33	322	73.0	51.3	Do.
28	36 29	7 16	304	71.5	53.3	Do.
29	36 20	6 47	227	73.3	55.0	Southwest of Cadiz.
30	36 15	6 52	386	73.0	52.7	Do.
31	35 56	7 06	477	71.3	50.5	Off Straits of Gibraltar.
32	35 41	7 08	651	71.5	50.0	Do.
33	35 33	6 54	554	72.0	49.7	Do.
34	35 44	6 53	414	71.7	50.0	Do.
35	35 39	6 38	335	73.5	51.5	Do.
36	35 35	6 26	128	75.0	55.0	Do.
37	35 50	6 00	190	72.0	53.7	In Straits of Gibraltar.
38	35 58	5 26	503	71.7	54.0	Do.
39	35 59	5 27	517	*66.0	55.5	Do.
40	36 00	4 40	586	74.5	55.0	Between Gibraltar and Oran.
41	35 57	4 12	730	74.5	55.0	Do.
42	35 45	3 57	790	74.0	54.0	Do.
43	35 24	3 54	102	74.7	55.0	Do.
44	35 42	3 01	455	70.0	55.0	Do.
45	35 36	2 29	207	72.7	54.7	Do.
46	35 39	1 56	493	73.5	55.5	Do.
47	37 25	1 10	845	69.5	54.7	South of Cartagena.
48	37 11	0 31	1,328	73.5	54.7	Do.

* These temperatures are the averages of the day.

Dredging and sounding stations of the Porcupine, 1870—Continued.

Station No.	Latitude.	Longitude.	Depth.	Temperatures.		Locality.
				Surface.	Bottom.	
	North. ° ′	*West.* ° ′	*Fathoms.*	°	°	
49	36 29	0 31	1,412	71.5	54.7	Between Cartagena and Oran.
50	....	....	51	*74.4	....	Coast of Algiers.
50*a*	....	....	152			
50*b*	....	....	510			
		East.				
51	36 55	1 10	1,415	75.0	54.7	Off coast of Algiers.
52	....	....	660	*76.2	....	Coast of Algiers.
52*a*	....	....	590			
53	36 53	5 55	112	77.0	55.5	Do.
54	37 41	6 27	1,508	76.0	55.0	Off coast of Algiers.
55	37 30	6 51	1,456	76.5	55.0	Do.
56	37 03	11 36	390	78.0	56.5	Between Cape Bon and Pantellaria.
57	36 06	13 10	224	*76.8	....	South of Sicily.
58	36 43	13 36	266	75.5	56.5	Do.
59	36 32	14 12	445	76.5	56.5	Do.
60	36 31	15 46	1,743	74.0	56.0	Southeast of Sicily.
61	38 26	15 32	392	72.5	55.7	Northeast of Sicily.
62	38 38	15 21	730	72.5	55.3	Do.
63	....	....	181	68.0	54.7	Straits of Gibraltar.
64	....	....	460	65.6	54.7	Do.
65	....	....	198	63.0	54.5	Off Straits of Gibraltar.
66	....	....	147	69.0	....	Do.
67	....	....	188	73.0	55.3	Do.

* These temperatures are the averages of the day.

DREDGINGS OF THE SHEARWATER, 1871.

In 1871 the steamer *Shearwater* made some dredgings on the coral banks between Sicily and Cape Bon, in depths of not more than about 200 fathoms. Dredging was not the main object of the expedition and no record exists, so far as is known, of the precise localities.

SOUNDING AND DREDGING STATIONS OF THE VALOROUS, 1875.

The *Valorous* was a war-steamer sent as a store-ship with the British North-Polar Expedition of 1875 (the *Alert* and *Discovery*). As it was to return directly from Disco, Greenland, the Royal Society requested the Government to permit Mr. J. Gwyn Jeffreys and an assistant, Mr. Herbert P. Carpenter, to make the voyage, so as to undertake natural history observations both at Disco and on the *return* voyage. The reports on the dredgings, etc., between Davis's Straits and England by Mr. Jeffreys, Dr. William B. Carpenter, Rev. A. F. Norman, Dr. W. C. McIntosh, Professor Allman, Professor Duncan, Prof. George Dickie, and Mr. R. Etheridge were published in No. 173 of the Proceedings of the Royal Society, 1876. The first dredging was made about July 22 and the last on August 23, 1875. In the following table the letter D. indicates a dredging, S. T. a serial temperature. At the other stations soundings only were made.

Sounding and dredging stations of the Valorous, 1875.

Serial No.	Latitude N.	Longitude W.	Depth.	Bottom temperature.	Kind of observation.	Nature of bottom.	Locality.
	° ′	° ′	*Fath.*	°			
1	70 30	54 41	175	....	D.	Sand, mud	North of Disco Island.
2	70 27	65 00	85	....	D.	Gravel, stone	Do.
3	69 31	56 01	100	....	D.	Mud	West of Disco Island.
4	67 56	55 27	20	....	D.	Broken barnacles, shells	In Davis's Straits.
5	66 55	55 30	57	....	D.	Rock, sand, shells	Do.
6	64 05	56 47	410	34.6	D., S. T.	Sand, mud	Do.
7	63 00	56 43	1,100	36.4	D., S. T.	Clay, mud	Do.
8	62 06	55 56	1,350	34.6	....	Mud (blue clay under)..	Do.
9	59 10	50 25	1,750	34.0	D.	......do	Do.
10	58 14	46 29	1,660	34.3	S. T.	Fine sand	SW. of Cape Farewell.
11	57 50	44 52	1,860	33.4	....	Globigerina ooze........	South of Cape Farewell.
12	56 11	37 41	1,450	36.3	D., S. T.	Globigerina ooze, stone .	In Atlantic Ocean.
13	56 01	34 42	690	38.2	D.	Globigerina ooze........	Do.
14	55 58	31 41	1,230	36.8	....	Mud	Do.
15	55 58	28 42	1,485	36.5	S. T.	Clay, blue mud	Do.
16	55 10	25 58	1,785	36.7	D.	Globigerina ooze (blue mud under).	Do.

DREDGING STATIONS OF THE KNIGHT ERRANT, 1880.

The dredgings of the British steamer *Knight Errant* were made in the Färöe Channel between the Färöe Islands and the north of Scotland, covering a part of the same ground that was explored by the *Lightning* in 1868, and defining the position of the submarine barrier by which the so-called warm and cold areas of the Färöe Channel are divided from each other. The report of the expedition was published in the Proceedings of the Royal Society of Edinburgh, Vol. XI, pp. 638–720, read May 15, 1882. The dredgings were under the scientific charge of Mr. John Murray, of the *Challenger* expedition.

Dredging stations of the Knight Errant.

Serial No.	Date.	Latitude N.	Longitude W.	Depth.	Kind of bottom.	Temperatures. Surface.	Temperatures. Bottom.
		° ′	° ′	*Fath.*		°	°
1	July 27	60 04	7 37	305	Mud	54.8	46.5
2	July 28	60 29	8 19	375	....do..................	53.0	31.0
3	Aug. 3	59 12	5 57	53		....	....
4	Aug. 10	59 33	7 14	555	Mud	57.0	45.0
5	Aug. 11	59 26	7 19	515	Ooze	56.6	44.0
6	....do...	59 37	7 19	530	....do..................	57.0	....
7	....do...	59 37	7 19	530	....do..................	57.0	....
8	Aug. 17	60 03	5 51	540	....do..................	56.5	28.0

DREDGING STATIONS OF THE TRITON, 1882.

The dredgings of the British surveying steamer *Triton* in 1882 were, like those of the *Knight Errant* in 1880, directed towards the further exploration of the Färöe Channel, and covered nearly the same ground. They were also under the scientific charge of Mr. John Murray, and Mr. J. Gwyn Jeffrey's report on the mollusca obtained was published in the Proceedings of the Zoological Society of London, June 19, 1883, from which these positions have been taken.

Dredging stations of the Triton, 1882.

Serial No.	Latitude N.	Longitude W.	Depth.	Temperature of bottom.	Remarks.	Area.
	° ′ ″	° ′ ″	*Fathoms.*	° °		
1	59 51 30	6 21 00	240	47.5–47.6	On the ridge	
2	59 37 30	6 21 00	530	46.2	West of ridge	Warm.
3	60 39 30	9 06 00	87	49.5	Färöe banks	
*4	60 22 40	8 21 00	327–430	31.5–32.0	East of ridge	Cold.
†5	60 11 45	8 15 00	433	43.5	West of ridge	Warm.
6	60 09 00	7 16 30	406	29.5–30.0	East of ridge	Cold.
7	60 19 00	7 10 00	585	29.9–30.5	......do	Do.
8	60 18 00	6 15 00	640	30.0	......do	Do.
9	60 05 00	6 21 00	608	30.0	......do	Do.
10	59 40 00	7 21 00	516	46.0–46.5	West of ridge	Warm.
11	59 39 30	7 13 00	555	45.5	......do	Do.
12	60 31 00	7 34 00	580	31.0	East of ridge	Cold.
13	59 51 02	8 18 00	570	45.7	West of ridge	Warm.

* Partly on the ridge.
† The trawl had been carried right over the ridge and came up in the cold area.

DREDGINGS OF THE SWEDISH FRIGATE JOSEPHINE, 1869.

These dredgings extended from the coast of Portugal to the Azores, and thence across the Atlantic to America. They were under the charge of Messrs. Smith and Ljungmans. I have been unable to meet with any details as to the precise positions or character of the dredgings.

CLASSIFIED LIST OF ALL DREDGINGS OF OVER 60 FATHOMS MADE BY U. S. FISH COMMISSION NORTH OF BAHAMAS.

Dredgings made in the Gulf of Maine are not given, nor those made *inside* the Banks situated off the coast of Nova Scotia.

The others are designated as follows:

S.—Off Savannah to Bahamas. N. Lat. 27° 30′ to 34° 00′.
H.—Off Cape Hatteras. N. Lat. 34° 00′ to 36° 30′.
C.—Off Chesapeake Bay. N. Lat. 36° 30′ to 38° 00′.
D.—Off Delaware Bay. N. Lat. 38° 00′ to 39° 00′.
M.—South of Block Island, Martha's Vineyard, and Nantucket.
G.—South to east of St. George's Bank.
N.—South and southeast of Newfoundland and on the Flemish Cap.

60 to 100 fathoms:

H.—2008, 2267, 2268, 2298, 2595, 2600, 2602, 2603.
C.—2005, 2011, 2012, 2265, 2421, 2422, 2424.
M.—865, 866, 867, 872, 874, 920, 921, 922, 941, 950, 1091, 1109, 1117, 1118, 2031, 2032, 2057, 2085, 2086, 2087, 2177, 2197, 2198, 2199, 2243, 2244, 2247, 2248.
G.—83 B., 84 B., 2065, 2066, 2079, 2524, 2525.
N.—2432, 2692, 2693, 2694, 2698, 2699, 2700, 2701.

100 fathoms:

H.—2266, 2425, 2426, 2592, 2601.
C.—2004.
D.—1046, 2746.

100 fathoms—continued.

M.—871, 873, 875, 876, 877, 923, 949, 1027, 1035, 1036, 1040, 1107, 1108, 1110, 1111, 1119, 1151, 1152, 2053, 2054, 2055, 2056, 2091, 2245, 2246, 2505, 2512, 2522, 2558, 2559, 2560.

G.—2060, 2061, 2064, 2067, 2069, 2070, 2071, 2523, 2526, 2527.

N.—2477, 2481, 2695, 2696, 2704.

150 fathoms:

H.—2109, 2310, 2593, 2594, 2613, 2614.

C.—897, 2020, 2170, 2264, 2423.

D.—1043, 1047.

M.—868, 870, 878, 924, 940, 942, 943, 944, 1034, 1038, 1039, 1097, 1098, 1115, 1116, 1150, 2026, 2088, 2089, 2090, 2184, 2185, 2200, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2555, 2557, 2582, 2583.

G.—96 B., 97 B., 2062, 2063, 2068.

N.—2431, 2472, 2474, 2479, 2488, 2703.

200 fathoms:

C.—2021.

D.—1044, 2745.

M.—869, 926, 945, 951, 1025, 1026, 1032, 1033, 1092, 1113, 1114, 1120, 1121, 1137, 1138, 1153, 1154, 2027, 2028, 2092, 2183, 2548, 2556, 2590, 2591.

N.—2430, 2469, 2470, 2471, 2473, 2475, 2476, 2478, 2480, 2483, 2484, 2485, 2486, 2697, 2702.

250 fathoms:

S.—2624, 2625, 2665, 2666, 2667, 2673.

D.—2232.

M.—878, 879, 895, 925, 939, 1112, 2024, 2025, 2178, 2188, 2262, 2589, 2686.

300 fathoms:

S.—2668, 2670, 2671, 2672, 2674, 2675.

H.—2299, 2306.

C.—898.

D.—1045.

M.—881, 938, 947, 996, 997, 998, 999, 1031, 1094, 1095, 1096, 1125, 1139, 1142, 2176, 2586.

N.—2482.

350 fathoms:

S.—2626, 2655, 2664, 2669.

M.—1030, 1093, 1122, 2186, 2687.

400 fathoms:

S.—2627, 2661, 2662, 2663, 2676.

C.—2014, 2023, 2171, 2263.

D.—1048, 1049.

M.—893, 894, 952, 994, 995, 1028, 1140, 1141, 2033, 2045, 2046, 2047, 2187, 2212, 2213, 2547, 2554, 2581, 2587.

G.—85 B.

500 fathoms:

S.—2628, 2657, 2658, 2659, 2660, 2677.

H.—2009, 2110.

C.—2001, 2006, 2022.

M.—891, 892, 1029, 1143, 1144, 2048, 2175, 2179, 2180, 2201, 2202, 2214, 2237, 2546, 2561, 2584, 2585, 2588, 2689.

G.—2072.

N.—2427, 2429.

600 fathoms:

S.—2656.

C.—2002, 2003, 2019, 2172.

600 fathoms—continued.
D.—2233, 2744.
M.—937, 1124, 1155, 2030, 2189, 2215, 2236, 2549, 2553, 2680, 2688, 2690, 2722.
G.—2073.

700 fathoms:
S.—2654, 2678.
H.—2300.
C.—2729, 2730.
M.—936, 953, 954, 2181, 2203, 2204, 2235, 2552, 2749.
G.—2528, 2529, 2532.

800 fathoms:
S.—2679.
H.—2115.
C.—2018, 2731, 2734, 2735, 2739.
D.—2721.
M.—935, 1123, 2551, 2691.
G.—2533.
N.—2428.

900 fathoms:
H.—2010, 2111, 2116.
C.—2013, 2728, 2733, 2738, 2741, 2742.
M.—2182, 2217, 2218, 2219, 2238, 2683.
G.—2072, 2075, 2076, 2531, 2709.

Dredgings in 1,000 fathoms or more are not distinguished geographically, but are all between N. lat. 36° 06′ and 41° 43′ and W. long. 65° 22′ and 74° 33′.

1,000 fathoms:
2049, 2050, 2083, 2093, 2094, 2104, 2191, 2206, 2210, 2216, 2231, 2530, 2681, 2682, 2708, 2710, 2740.

1,100 fathoms:
2044, 2051, 2052, 2103, 2192, 2193, 2194, 2195, 2205, 2207, 2209, 2211, 2220, 2550, 2684, 2685, 2707, 2743.

1,200 fathoms:
2029, 2102, 2190, 2196, 2208, 2230, 2534, 2535, 2706, 2727, 2732, 2748.

1,300 fathoms:
2034, 2074, 2077, 2084, 2095, 2705, 2726, 2747.

1,400 fathoms:
2035, 2105, 2229, 2562, 2563, 2564, 2571, 2725.

1,500 fathoms:
2043, 2096, 2106, 2221, 2222, 2711, 2719, 2720.

1,600 fathoms:
2041, 2042, 2100, 2101, 2173, 2174, 2228, 2716, 2717, 2718, 2723, 2724.

1,800 fathoms:
2036, 2037, 2568, 2569, 2570, 2572, 2573, 2574, 2575, 2712, 2713, 2714, 2715.

2,000 fathoms:
2038, 2097, 2226, 2565.

2,200 fathoms:
2040, 2098, 2227.

2,400 fathoms:
2039.

2,600 fathoms:
2223, 2224, 2225, 2566, 2567.

2,949 fathoms:
2099.

SERIES OF TEMPERATURES TAKEN BY THE SPEEDWELL IN 1877, 1878, AND 1879.

[A + above the temperature indicates that it is that of the bottom, when that precise depth is not in the table; a Δ before the temperature indicates that the precise depth at which it was taken will be found in column A.]

Date.	Serial number.	Latitude.	Longitude.	Depth in fathoms.	Temperatures.																				A.
					Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	30 fathoms.	35 fathoms.	40 fathoms.	45 fathoms.	50 fathoms.	55 fathoms.	60 fathoms.	70 fathoms.	80 fathoms.	90 fathoms.	100 fathoms.	110 fathoms.	120 fathoms.		
1877.		° ′	° ′		°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
Aug. 6	9	......	......	25	69	63.5	......	......	57¾	55¾	52.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
6	10	......	......	20.5	69.5	64.5	60¾	59⅓	54	+50.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
6	11	42 26	70 37	45	70	64.5	......	......	......	......	55.5	......	......	......	48.5	......	......	......	......	......	......	......	......	......	......	......
28	59	......	......	25	68.5	65¾	......	......	......	Δ 47	43.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	21
29	63	......	......	26	67⅛	66⅞	67	......	......	......	+34¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
29	64	......	......	40	......	......	......	60¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
29	66	......	......	41	68.5	68	......	......	......	36.5	......	......	......	+33.5	......	......	......	......	......	......	......	......	......	......	......	......
Sept. 1	69	42 46	62 43	620	......	65⅓	......	......	......	52	......	......	......	......	......	......	......	......	......	......	......	......	......	......	+37	......
1878.																										
July 23	130	......	......	49	68	63	......	47	......	......	......	......	......	......	......	(?)	......	......	......	......	......	......	......	......	......	......
23	131	......	......	45	68	62	60.5	46.5	43	41	......	......	......	......	38	......	......	......	......	......	......	......	......	......	......	......
23	132	......	......	45	70	63	Δ 47.5	45¾	43	41	......	......	......	......	38	......	......	......	......	......	......	......	......	......	......	7½
26	135	42 33½	70 38½	25	70	58.5	49.5	......	44.5	Δ 41.5	40.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	19
26	135a	......	......	25*	72	......	......	......	42.5	41	40	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
29	137	42 33½	70 23½	53	70	65	57.5	51¼	51½	45	46	42.5	40	40	38¾	......	+38.5	......	......	......	......	......	......	......	......	......
Aug. 1	141	......	......	8½	63	57.5	53.5	+44.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1	145	......	......	8	63.5	56.5	Δ54	+51	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	4
3	147	42 33	70 41½	16	67.5	56.5	......	45.5	+42¾	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
3	149	......	......	19½	66	61¼	......	......	43	+42	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
3	150	......	......	7½	70	61	Δ 56.5	+51.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	4
8	157a	......	......	17	......	62	52	48	......	+44.5	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
15	154	42 35	70 31	38	69¼	64.5	57¼	......	42¾	Δ 45	44¼	42¼	......	+41.5	......	......	......	......	......	......	......	......	......	......	......	19.5

*Estimated.

SERIES OF TEMPERATURES TAKEN BY THE SPEEDWELL IN 1877, 1878, AND 1879—Continued.

Date.	Serial number.	Latitude.	Longitude.	Depth in fathoms.	Temperatures.																					A.
					Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	30 fathoms.	35 fathoms.	40 fathoms.	45 fathoms.	50 fathoms.	55 fathoms.	60 fathoms.	70 fathoms.	80 fathoms.	90 fathoms.	100 fathoms.	110 fathoms.	120 fathoms.		
		° ′	° ′		°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
1878. Aug. 15	157			40	73							35.5	41¾	42.5												
16	160	42 36	70 27	54	71.5								41¼		40		+39.5 (?)									
16	161			54*		64		50	47¼	44.5	44.5	44														
16	163			73	70.5	65.5		58	56.5																	
19	165	42 44½	70 38	35	71	64¾						45.5	41.5													
24	170	42 33	69 59	90																Δ39.5	40					75
24	173			115*	68.5	65.5	60¼		55¾		50¾		46½			41¼				Δ39.5				+39.5		75
27	174	42 37	69 40½	140	65.5																			40¾	+39	
27	176 & 177	42 38½	69 41½	175																		40¾			+38.5	
29	179			7	67	59	Δ54	+47																		3
29	181	42 24	70 36	45	73.5	64¼	60	57	52.5	53¾	50.5	45	44	42.5	41.5											
29	184			45	75	65.5				53.5				42¾	42¼											
31	185	42 33	69 55	110	68.5	64¼																40.5	39			
31	186			110*	73.5			61¼		59		50¾	46¼	44.5		41¼		40¼	39¾	39¾	39¾					
31	189			85		65.5									43.5					Δ39.5	+40					75
Sept. 2	195	42 27	70 19	29 to 33	72.5	63¾	62		55		51.5	+45.5														
9	200			10	64.5	60	58	56.5																		
9	201			8.5	63.5	61	58.5	+54																		
1879. Aug. 4	279	42 09½	70 15	13 to 13.5	74	63		Δ44	Δ44.2																	6.5 & 12
4	280	42 09½	70 16½	12.5 to 13.5	71			Δ52	+44																	6.5
4	281	42 12	70 16½	14		62.3		Δ57.5	+44																	7
4	282	42 13	70 13½	13.5	72.2	61.2		Δ45.5	43																	7
4	283	42 09½	70 22	31	70.7	65			41			+38.5														

6	285	42 12	70 25	35.5	69	68				Δ40			+39													18
6	286	42 16½	70 23	37	71	67				Δ39.9				+39.2												19
6	287	42 17½	70 25½	47¼	68	67.2					38.7					+38.8										......
6	288	42 20	70 27	33	72	67.3				Δ43.8			+38.8													16
6	289	42 19	70 25	45	69.8	68.5						Δ39			38											27
25	307	42 06½	70 18	31	65	61½			43.5			+43.5														......
25	308	42 08½	70 18	26	64	61.2			Δ47.2		+41															13
25	309	42 08½	70 17	27	66	60.8			Δ54.5		+40.8															14
29	312	41 59½	70 09	15	65	62		Δ60	50																	8
29	313	41 58	70 09	15	64	61		Δ60	50.5																	8
30	317	42 02	70 14	25	59	60			Δ59.1		44.8															13
30	318	42 01½	70 15	28	61	61.2			Δ52.5			+44.2														14
30	319	42 02¼	70 15	26.5	60	60.5			Δ52.5		44.8															13
30	320	42 02½	70 15	29	63.5	61			Δ53.1			+44.5														14.5
30	321	42 03	70 15	29.5	65	61			51			+44.5														......
Sept. 1	322	42 12½	70 01	67	66	60			Δ44			Δ41				41			+40.5							12 & 34
1	323	42 13½	70 01½	60	67.5	58			50			42			41.5			40.5								......
1	324	42 12¾	70 03	45	67	61				Δ42					40.8											22
1	325	42 14½	70 00½	83	67	60								Δ41						+40.0						42
1	326	42 14½	70 02	75	70	59.8				51									+40.5							......
6	330	42 09½	70 13	26	68	60			Δ51		+42															13
6	331	42 09¼	70 14	28	67	60.5			Δ54			+41.8														14
6	332	41 09	70 15	28	70	61			Δ51			+42														14
6	333	42 08½	70 16¼	27	71	61			Δ53			+42.8														14
6	334	42 08¼	70 18	27	74	61.2			Δ53			+42														14
9	335	41 58¾	70 31½	7	62	61.2	60.2	+55																		......
9	336	41 58	70 33½	11½	69	61.2	50	+50																		......
9	337	41 57¾	70 30½	16	70	62		52.8	+47.2																	......

* Estimated.

SERIES OF TEMPERATURES TAKEN BY THE SPEEDWELL IN 1877, 1878, AND 1879—Concluded.

Date.	Serial number.	Latitude.	Longitude.	Depth in fathoms.	Temperatures.																				A.
					Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	30 fathoms.	35 fathoms.	40 fathoms.	45 fathoms.	50 fathoms.	55 fathoms.	60 fathoms.	70 fathoms.	80 fathoms.	90 fathoms.	100 fathoms.	110 fathoms.	120 fathoms.		
		° ′	° ′	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	
1879. Sept. 9	338	41 57½	70 28	18	71	62.5	62.5	54.8		+49.4																
9	339	41 54	70 28	15.5	75	63	63.5	55	+47.5																	
9	340	41 51	70 27½	14	66.5	63	63.8		+49.2																	
9	341	41 51½	70 21½	15.5	65.5	63.1	63	60.5	+48																	
10	342	42 16	69 56	94	63.5	58.5										43.8					+40.5					
10	343	42 17	69 51	116	63	57					46					45								+41.8		
10	344	42 19	69 47½	130	64	57.5					45.4					43.2										
13	346	42 16	70 38	22	66.2	61.9		57			+44.8															
13	347	42 12½	70 33½	20	65	61.2	61.5	52		46.2																
13	348	42 09½	70 32½	16½	66	62.5	61.3		+46.2																	
13	349	42 10½	70 29	26	65	61.3		59	53.9		+43.8															
13	350	42 08½	70 25	31	72.5	61.2		52.2		46.8		+43.1														
13	351	42 05½	70 22	30	67	62.5		53.8		48		42.8														
15	352	41 54¾	70 07½	10½	61.5	64	63.8	+62.6																		
15	353	41 53	70 10	14	61	63.3		51.5	+49.5																	
26	373	42 07	69 59	42	58	54				53				+44												
26	374	42 04	69 54	46	64	54.5			48.5						+43											
26	375	42 04½	69 53¾	46	59	54		51							+45.5											
26	376	42 04½	69 54	46	59	54		51							+45.5											
26	377	42 04	69 44½	94	58	57										42.8					+41.5					

TEMPERATURE OBSERVATIONS BY THE SPEEDWELL, SEPTEMBER 25 AND 29, 1879.

Date.	Serial number.	Locality.	Depth in fathoms.	Temperatures. Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	30 fathoms.	35 fathoms.	40 fathoms.	45 fathoms.	50 fathoms.
				°	°	°	°	°	°	°	°	°	°	°	°
1879. Sept. 25	1	Long Point WNW. ¾ mile	17	......	55.5	......	50.75	......	+47.8	......	......	......	......	......	......
25	2	Wood End Light NW. ¼ mile	21	......	55	......	......	......	+47	......	......	......	......	......	......
29	3	Wood End Light NE. ¾ mile	22	......	59	......	56.5	......	+45	......	......	......	......	......	......
29	4	Wood End Light N. 80° E. 2 miles	24½	......	57.5	......	......	46.5	......	+44.2	......	......	......	......	......
29	5	Wood End Light N. 55° E. 3¼ miles	21	......	57.2	56.5	46.5	......	+45	......	......	......	......	......	......
29	6	Wood End Light N. 48° E. 5¼ miles	21	......	57.5	56.2	51	......	45.2	......	......	......	......	......	......
29	7	Wood End Light N. 45° E. 7¼ miles	19½	......	58.5	57.5	53.1	......	+46.1	......	......	......	......	......	......
29	8	Wood End Light N. 50° E. 7¾ miles	19½	......	58.5	57.5	56	......	+46	......	......	......	......	......	......
29	9	Wood End Light N. 66° E. 6¾ miles	21	......	59.2	57	54.1	......	......	+44.8	......	......	......	......	......
29	10	Wood End Light N. 85° E. 6 miles	26	69.5	58	57	55.1	......	......	+44	......	......	......	......	......
29	11	Wood End Light S. 75° E. 5¾ miles	30	69.5	58.5	57	55.8	......	46	......	44	......	......	......	......
29	12	Race Point Light S. 71° E. 3¼ miles	33	66	67.8	56.2	55.8	......	48	......	......	+44	......	......	......
29	13	Race Point Light S. 45° E. 4½ miles	34	66	59.2	56	54.5	......	51.1	......	......	+44.2	......	......	......
29	14	Race Point Light S. 32° E. 6 miles	11	67	58	57	+51.5	......	......	......	......	......	......	......	......
29	15	Race Point Light S. 13° E. 5¼ miles	23	63.5	57.2	56	54.5	......	......	+52.5	......	......	......	......	......
29	16	Race Point Light S. 10° W. 6 miles	19	62.5	58	56	54	......	+49	......	......	......	......	......	......
29	17	Race Point Light S. 30° W. 6½ miles	26	63	57	56.2	54.5	......	......	+46.5	......	......	......	......	......
29	18	Race Point Light S. 51° W. 8¼ miles	28	62.5	57	56.5	55	......	......	......	+45	......	......	......	......
29	19	Race Point Light S. 58° W. 9¾ miles	49	62.8	57.8	57.2	54.5	......	48	......	44	......	......	......	+43.2

TEMPERATURE OBSERVATIONS BY THE SPEEDWELL SEPTEMBER 25 AND 29, 1879—Continued.

Date.	Serial number.	Locality.	Depth in fathoms.	Temperatures.											
				Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	30 fathoms.	35 fathoms.	40 fathoms.	45 fathoms.	50 fathoms.
				°	°	°	°	°	°	°	°	°	°	°	°
1879. Sept. 29	20	Race Point Light S. 70° W. 9½ miles	32	62.5	57	55.2	51.5	......	47	......	+44	......	......	......	......
29	21	Race Point Light S. 66° W. 5½ miles	21	64	57	55.2	51	......	+45	......	......	......	......	......	......
29	22	Race Point Light S. 42° W. 5½ miles	28	62.8	56.5	56.2	46.1	......	......	......	+46	......	......	......	......
29	23	Race Point Light S. 18° W. 2¼ miles	33	......	57.5	57	56	......	45	......	......	+44	......	......	......
29	24	Race Point Light S. 83° E. 2 miles	30	61	58	58	57	......	45	......	44	......	......	......	......
29	25	Race Point Light N. 16° E. 2¼ miles	27	61	58	59	56.8	......	......	......	+44.9	......	......	......	......

A series of temperature observations was made by the Speedwell, off Provincetown, on September 25 and 29, 1879. These had separate numbers from No. 1 to No. 25, and no dredgings or natural-history observations were made. Their localities, etc., and the serial temperatures taken on those days are therefore placed at the end of the tables of serial temperatures taken in the course of dredging expeditions.

II.—*Serial temperatures, U. S. Fish Commission steamer Albatross, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding*, 1883.

Serial number.	Date.	Locality. Latitude N.			Longitude W.			Depth.	Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	40 fathoms.	60 fathoms.	100 fathoms.	200 fathoms.	300 fathoms.	400 fathoms.	500 fathoms.	600 fathoms.	700 fathoms.	800 fathoms.	900 fathoms.	1,000 fathoms.	1,100 fathoms.	1,200 fathoms.	1,300 fathoms.	1,400 fathoms.	1,500 fathoms.	1,600 fathoms.	Bottom.
	1883.	°	′	″	°	′	″	*Fathoms.*																										
2008	Apr. 27	35	09	40	75	04	36	92	67	72	75	75	74																					74½
....	Apr. 27	35	09	58	74	59	18	69	76	76	76	76	76	76		76	69																	
2009	Apr. 28	35	29	35	74	46	45	531	64	69	69	71	70½	69		65	59																	
....	Apr. 28	35	31	00	74	45	30	724	66	62									42½	40½	40													
2010	Apr. 28	35	30	00	74	44	45	890	65	61	61	69	79	69																				
....	Apr. 30	36	46	15	74	27	50	670	79	46	45	44	42	42		45	42	52		41		39½	39	39										
2016	May 5	37	31	00	74	52	36	19	48½	47	45½	45½	45½																					45½
....	May 5	37	29	40	74	53	00	17	49	47	46½	45½	45½																					45½
2018	May 7	37	12	22	74	20	04	788	62	54	52¼	51¼	52½	53		52	50	50¾																39
2019	May 7	37	13	52	74	23	52	600	56½	52¾	51¼	51¼	51½	51½		52	52½																	39
2020	May 21	37	37	50	74	15	30	143	56	54				52½																				
2021	May 21	37	36	00	74	15	00	179	58	54	52½	53	57	54		51½																		45
2022	May 21	37	32	00	74	13	20	487	59	52	52½	52	52	52½		53½	53																	40
2023	May 21	37	48	00	74	01	30	377	62	56	55	55	54½	55		54	54	54																
2025	May 25	40	02	00	70	27	00	239	57	49	48½	48	46	44½		42½	42½	48½																40½
2027	May 25	39	58	25	70	37	00	198	56	52								48																43
2028	May 25	39	57	50	70	32	00	209	56	52						49																		41
2029	May 25	39	42	00	70	47	00	1,168	57	53	52	52	52	51		50½	50½	50	46¾	40½	40	39½												38½
2032	May 26	39	29	00	72	19	40	74	55	50	49	48½	43	39½		46½	43½																	47½
2033	May 26	39	32	30	72	18	35	379	62	49½	49	48½	46½	43½		39½	40½	50	42	41½														41
2035	July 17	39	26	16	70	02	37	1,362	73	71	71	69½	52½	48	44	46		44½	41	40½	39½	40	40	39½	40	39	40							
2036	July 18	38	52	40	69	24	40	1,735	82	76	74	72	68	65	62½	60					48	48	40	39½		38½		38½	40½	40½	38½		38	38
2037	July 18	38	53	00	69	23	30	1,731	79	76	74	73	66	63	62	61																		38
2038	July 26	38	30	50	69	08	25	2,033	77	76½	77	77	71	66	62½	58																		
....	July 27	37	58	30	69	01	20	2,451	78	82					72			53			54													36½
2039	July 28	38	19	26	68	20	20	2,369	77½	81	81	81	81	81	77	68	60	50½	55	43	40½		40	39	39	39	39							
2040	July 29	38	35	13	68	16	00	2,226	76	76	75½	75½	76	75½	68	56½																		
2042	July 30	39	33	00	68	26	45	1,555	74	71		71½				57½																		38½
....	July 31	40	01	50	68	50	30	608	72	72	70	68	55	65	58	44	43½	45	43½	40	40													40
....	Aug. 30	41	58	00	67	57	45	43	58	58½	58	57	57	56	56																			50
2063	Aug. 31	42	23	00	66	23	00	141	60	57½	57½																							46
....	Aug. 31	42	23	30	66	21	15	115	57	54	53	53	53	49½	53	51½	44	42½																42½
2070	Sept. 1	41	55	30	65	47	10	113	61	57		55	54½	53																				42½
....	Sept. 1	41	56	40	65	50	10	102	58	55	55	55	55	54	52½	53	41½																	43
2072	Sept. 2	41	53	00	65	35	00	858	70	56	56																							39
....	Sept. 3	41	40	30	65	35	00	855	58	58			59	54½	48½																			39
2079	Sept. 4	41	13	00	66	19	50	75	60	67½	67½																							45
....	Sept. 20	40	06	50	70	34	15	65	71	67	58																							50
....	Sept. 20	40	01	50	70	39	20	111	70	68	68	63	69½	69½	61	47	52																	49

II.—*Serial temperature, U. S. Fish Commission steamer Albatross, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding*, 1883—Continued.

Serial number.	Date.	Locality. Latitude N.			Longitude W.			Depth.	Air.	Surface.	5 fathoms.	10 fathoms.	15 fathoms.	20 fathoms.	25 fathoms.	40 fathoms.	60 fathoms.	100 fathoms.	200 fathoms.	300 fathoms.	400 fathoms.	500 fathoms.	600 fathoms.	700 fathoms.	800 fathoms.	900 fathoms.	1,000 fathoms.	1,100 fathoms.	1,200 fathoms.	1,300 fathoms.	1,400 fathoms.	1,500 fathoms.	1,600 fathoms.	Bottom.
	1883.	°	′	″	°	′	″	*Fathoms.*																										
2093	Sept. 21	39	42	50	71	01	20	1,000	75	69	68	68	68																					39
2094	Sept. 21	39	44	30	71	04	00	1,022	70	68	68	67½	67½	67	47½	51	52½																	38½
2095	Sept. 30	39	29	00	70	58	40	1,342	71½	69½	67																							
2096	Sept. 30	39	22	20	70	52	20	1,451	70	69	67½	68	68	67	66	56½	65½	53½	47	40½	40	40	39½	39½	38½	39	38½							37½
2097	Oct. 1	37	56	20	70	57	30	1,917	73	72½	68																							
2098	Oct. 1	37	40	30	70	37	30	2,221	73	72½	72																							
2101	Oct. 3	39	18	30	68	24	00	1,686	61	67	69	68																						37
2102	Nov. 5	38	44	00	72	38	00	1,209	64	62½	62	61½	61½																					39
2104	Nov. 5	38	48	00	72	40	30	991	60	61	62	62	62	62	62	59	55	53½	43½	40½	40	40	39½	39		39								41½
.....	Nov. 6	37	34	48	73	03	15	1,542	62	62	62	62	62	62	62½	54	39½	51½	43½	41	39½	39½	39	39	39	38½								37
2108	Nov. 9	35	16	00	75	02	30	48	76	78½	77	78	78	77	75	68½																		66
.....	Nov. 9	35	16	20	75	04	00	34	75	77																								74
.....	Nov. 9	35	14	30	75	00	30	102	74	76																								52
.....	Nov. 11	35	44	30	74	28	45	1,066	76	76½	77	77	77	77	77	68½	69	40	45	41	40	40	39											
.....	Nov. 12	36	16	15	74	51	20	40	65	68																								56

Table of serial temperatures, 1884.

Serial number.	Date.	Position. Latitude N. ° ′ ″	Position. Longitude W. ° ′ ″	Depth.	Temperature. Air.	Temperature. Surface.	Temperature at— 25 fathoms.	50 fathoms.	100 fathoms.	200 fathoms.	300 fathoms.	400 fathoms.	500 fathoms.	600 fathoms.	700 fathoms.	800 fathoms.	900 fathoms.	1,000 fathoms.	1,100 fathoms.	1,200 fathoms.	1,300 fathoms.	Bottom.
	1884.			*Fathoms.*																		
Hyd. 46	Jan. 24	17 51 00	65 08 25	2,423	80	77	77	77	77	60	51	.....	.....	.....		.....	.....	.....	.....	.....	.....	39.1
Hyd. 47	Jan. 24	17 46 30	65 10 25	1,482	78	77	77	78	67	.....	.....	45	.....	.....	40	.....	40	.....	.....	.....	.....	38.8
Hyd. 57	Jan. 25	17 49 05	65 29 00	2,186	77	77	77	77	67	59	.....	.....	43	.....	.....	.....	40	.....	.....	.....	.....	38.8
Hyd. 62	Jan. 25	17 32 40	65 52 20	2,017	77	77	77.5	78	66.3	58.5	48	.....	44	.....	.....	.....	40	40	.....	.....	40	.....
Hyd. 64	Jan. 26	16 59 00	65 19 20	2,543	76	77	77.5	77	65.3	.....	62.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.8
Hyd. 66	Jan. 26	16 28 00	64 42 30	2,192	78	77	77.8	76	65	55	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.8
Hyd. 71	Jan. 27	15 44 10	63 42 10	950	76	77	78	77.3	67	54.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.5
Hyd. 80	Jan. 28	13 56 35	63 02 00	684	75	77	77	72.5	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.3
Hyd. 82	Jan. 28	13 29 00	62 42 40	1,051	80	77	.....	.....	.....	.....	41.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.5
Hyd. 84	Jan. 28	13 23 00	62 34 15	1,686	77	78	76	68	61.3	50	45	43	.....	40.5	40	40	.....	39.5	.....	.....	.....	39.3
2119	Jan. 29	11 48 30	62 17 30	1,140	75	77	75	68.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.3
Hyd. 116	Feb. 5	14 21 44	63 58 45	1,615	78	77	77.5	72	62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.8
Hyd. 120	Feb. 6	16 01 00	65 56 20	2,492	76	77	77.5	.....	64.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.5
Hyd. 121	Feb. 6	16 36 20	66 41 00	2,501	76	77	77	77	67	55	47.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 123	Feb. 7	15 40 00	67 36 40	2,616	76	77	77.3	77.3	67	55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 124	Feb. 7	15 02 00	67 13 20	2,747	80	77	77.8	78	66.5	53	.....	.....	.....	.....	40.5	39.8	39.5	.....	.....	.....	.....	.....
Hyd. 127	Feb. 8	13 25 04	66 25 00	2,844	77	77	77.8	77.8	55.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.5
Hyd. 128	Feb. 8	12 54 40	66 11 10	2,768	81	78	77.5	.....	61.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40.8
Hyd. 133	Feb. 9	11 33 20	66 19 00	553	77	75	70.5	65	58	48.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
Hyd. 134	Feb. 9	11 18 50	66 24 20	656	79	76	71.8	65	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49.3
Hyd. 135	Feb. 9	11 05 00	66 30 00	239	78	76	71	64.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 139	Feb. 9	11 01 00	67 14 15	605	75	75	.....	.....	.....	.....	.....	.....	40.5	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 145	Feb. 10	11 52 00	68 35 46	630	78	76	76	68.5	59.8	49.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 150	Feb. 18	11 56 00	68 56 00	733	77	76	76	66	63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 151	Feb. 18	11 50 45	68 56 30	739	77	76	75	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45.2
Hyd. 152	Feb. 18	11 40 25	68 57 30	321	76	75	.....	.....	.....	50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.3
2126	Feb. 19	13 17 45	70 01 00	1,701	78	77	76	66.5	65.5	.....	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 162	Feb. 19	13 40 20	70 10 45	2,694	75	76	76	69	62	53	46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 165	Feb. 20	15 55 00	71 03 00	2,209	76	77	76	74	67.5	.....	47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40.1
Hyd. 166	Feb. 20	16 42 00	71 18 30	2,028	76	77	.....	.....	66	.....	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 170	Feb. 21	17 48 00	72 12 20	2,424	77	77	77.5	77	69	.....	51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 171	Feb. 21	18 01 30	72 23 00	1,929	81	79	77	76	67	.....	51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 172	Feb. 21	18 07 00	72 29 00	1,538	80	79	77.5	77	67	.....	50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 179	Feb. 22	17 36 30	72 59 00	2,423	78	77	.....	77	70.5	.....	51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 180	Feb. 22	17 45 30	75 01 00	2,391	79	77	.....	.....	.....	.....	51.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 188	Feb. 23	17 51 40	74 36 30	894	75	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table of serial temperatures, 1884—Continued.

Serial number.	Date.	Position. Latitude N.	Position. Longitude W.	Depth.	Temperature. Air.	Temperature. Surface.	Temperature at— 25 fathoms.	50 fathoms.	100 fathoms.	200 fathoms.	300 fathoms.	400 fathoms.	500 fathoms.	600 fathoms.	700 fathoms.	800 fathoms.	900 fathoms.	1,000 fathoms.	1,100 fathoms.	1,200 fathoms.	1,300 fathoms.	Bottom.
	1884.	° ′ ″	° ′ ″	Fathoms.																		
Hyd. 190	Feb. 23	17 33 30	74 45 00	955	78	77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 197	Feb. 24	18 45 00	71 32 40	1,347	78	77	77.5	76	72	.....	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 198	Feb. 21	18 50 00	74 12 00	1,537	84	79	78	77	68.5	.....	58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 199	Feb. 24	18 56 00	73 51 00	1,974	80	79	78	77.4	68.2	.....	51.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 205	Feb. 25	19 40 00	74 42 00	1,923	77	77	78	74.6	66.7	.....	54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2127	Feb. 25	19 45 00	75 04 00	1,639	78	77	77.6	76	69	61	54.2	47.5	43.5	40	39	.....	39.7	.....	.....	.....	.....	39.7
Hyd. 206	Feb. 25	19 43 21	75 15 20	1,745	76	77	77	76	71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.9
Hyd. 215	Feb. 28	18 54 30	74 16 20	1,456	77	78	78.4	78	74.4	.....	51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 216	Feb. 28	18 32 30	75 06 00	870	78	78	.....	78.4	.....	.....	52.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 217	Feb. 28	18 34 00	74 21 00	1,015	79	78	77.8	77.6	68.7	.....	49.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 346	Mar. 23	9 46 00	76 18 30	255	81	82	.....	72.2	62.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41.8
Hyd. 353	Mar. 24	9 44 40	77 56 00	550	79	79	76	72.2	61.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 354	Mar. 24	9 47 00	78 09 30	630	79	78	78.7	72.5	61.4	51.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 355	Mar. 24	9 48 09	78 24 00	1,017	79	79	.....	72.1	61.4	52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 363	Mar. 25	9 45 15	79 34 00	370	80	79	.....	75	56.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39.3
Hyd. 371	Apr. 3	11 20 00	80 42 10	1,832	80	79	78	74	63.8	51.6	46.6	44.8	40.4	40.5	39.5	39.6	39.5	39.2	.....	.....	.....	40.2
2151	Apr. 10	15 28 39	80 36 00	653	79	78	78.8	77.8	67.9	55.3	47.8	42.7	41.4	.....	.....	.....	.....	.....	.....	.....	.....	39.7
Hyd. 419	Apr. 14	23 48 14	84 03 55	1,356	79	79	78.6	77.9	67.9	57.1	51.4	41.6	.....	40.9	40.1	40	.....	39.8	.....	.....	.....	38.6
2172	July 20	38 01 15	73 44 00	568	76	76	58.8	55.4	51	45.1	40.7	40	.....	.....	.....	.....	.....	.....	.....	.....	.....	37
2173	July 21	37 57 00	72 34 00	1,600	70	68	53	51.7	51.7	51.7	39.7	39.7	39.5	38.7	38.7	38.7	38.1	38.1	.....	.....	.....	40.7
2175	July 22	39 33 00	72 18 30	452	69	68	50.5	51.3	50.6	44.1	40.6	40.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.6
Hyd. 533	July 23	39 23 45	71 43 00	932	70	69	57	52.8	50.7	44.2	40.7	40.2	40	39.6	38.7	38.7	38.6	.....	.....	.....	.....	49.3
Hyd. 544	Aug. 3	39 55 00	71 07 00	221	71	68	61.3	51.8	51.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hyd. 545	Aug. 4	39 47 00	70 16 30	784	74	72	61.1	52.6	52.2	45.9	40.9	39.6	39.3	39.2	.....	.....	.....	.....	.....	.....	.....	52.3
2197	Aug. 6	39 56 20	69 43 30	84	77	74	49.8	52.8	52.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.6
Hyd. 549	Aug. 20	39 34 00	71 34 30	925	75	74	66.2	54.8	51.2	43.8	40.6	40.1	40.6	39.2	38.5	39	.....	.....	.....	.....	.....	38.3
Hyd. 552	Aug. 23	39 40 05	69 23 00	1,098	75	74	63.2	55.9	52.5	44.3	40.7	39.3	40.6	39.2	39.1	38.6	.....	38.8	.....	.....	.....	36.3
Hyd. 553	Sept. 7	37 41 00	69 15 16	2,704	79	81	82	79.8	72.7	57.3	44	45.6	40.5	39.6	39.6	39.5	39	38.6	.....	.....	.....	36.8
2224	Sept. 8	36 16 50	68 21 00	2,574	79	80	79.8	77.1	67.1	64.8	64.6	63.8	52.5	44.9	41	40.2	39.5	39.5	.....	.....	.....	36.7
2225	Sept. 9	36 05 30	69 51 45	2,512	77	81	78.3	71.9	67.6	64.3	64.8	60	51.1	44.7	41.4	40.2	39.6	39.2	.....	.....	.....	36.8
2227	Sept. 10	36 55 23	71 55 00	2,109	81	82	82.2	77.1	71.4	65.2	62.8	57.7	52.7	42.5	40.4	39.3	39.2	39.1	.....	.....	.....	36.8
Hyd. 554	Sept. 11	37 22 53	73 06 30	1,606	78	78	76	63.2	63.8	48	46.3	39.7	39.4	39.3	39.1	38.8	.....	38.7	.....	.....	.....	39.7
Hyd. 556	Sept. 12	39 40 09	73 03 00	474	70	74	61.8	52.9	49.3	43.5	40.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38.7
Hyd. 557	Sept. 13	39 08 30	72 12 30	851	66	72	.....	66.8	53.5	43.1	40.6	39.7	39.2	39.1	38.7	.....	.....	.....	.....	.....	.....	

Record of serial temperatures taken by the U. S. Fish Commission steamer Albatross during the year 1885.

Serial number.	Date.	Position.		Depth.	Character of bottom.	Temperature (degrees).															
		Latitude N.	Longitude W.			Air.	Surface.	25 fathoms.	50 fathoms.	100 fathoms.	200 fathoms.	300 fathoms.	400 fathoms.	500 fathoms.	600 fathoms.	700 fathoms.	800 fathoms.	900 fathoms.	1,000 fathoms.	Bottom.
	1885.	° ′ ″	° ′ ″	*Fath.*																
2393	Mar. 13	28 43 00	87 14 30	525	gy. M	70	64	65.2	64.0	57.9	.....	45.7	43.0	.....	.....	.....	.....	.....	.....	41.0
Hyd. 699	Apr. 1	31 54 45	79 17 00	86	gy. M. brk. Sh	66	69	*69.9	†68.4	‡66.3	§63.3	‖60.8	.....	.....	.....	.....	.....	.....	.....	60.3
Hyd. 702	Apr. 3	36 30 00	73 14 00	2,340	bu. Oz	69	72	.....	.....	.....	¶59.6	.....	.....	41.3	.....	.....	.....	.....	.....	36.8
Hyd. 703	Apr. 4	36 45 00	73 28 00	1,646	bu. Oz	68	66	.....	.....	.....	¶43.0	.....	.....	39.6	.....	.....	.....	.....	.....	37.2
Hyd. 704	Apr. 4	36 57 30	73 47 00	1,436	bu. Oz	61	55	50.8	49.9	52.2	43.0	.....	39.5	.....	38.4	38.6	52.2	38.1	40.6	37.5
Hyd. 705	Apr. 4	37 01 08	74 10 00	1,208	bu. Oz	50	52	50.1	44.0	51.8	44.0	.....	39.7	39.3	40.8	.....	.....	.....	.....	38.7
Hyd. 712	Apr. 5	37 04 30	74 32 00	98	bk. S	43	49	50.8	48.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2542	Aug. 7	40 60 15	70 42 20	129	S. brk. Sh	73	76	59.8	56.3	49.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	47.2
Hyd. 819	Aug. 9	39 49 00	70 42 00	452	gy M	71	77	59.5	57.0	49.8	44.0	40.5	.....	.....	.....	.....	.....	.....	.....	39.6
Hyd. 854	Aug. 10	39 41 00	71 42 00	*378	gn. S	76	77	62.5	45.8	49.0	42.1	40.1	.....	.....	.....	.....	.....	.....	.....	39.6
2564	Aug. 11	39 22 00	71 23 30	1,396	gy. Oz	79	78	61.6	58.1	51.3	48 8	40.3	40.0	39.4	39.0	39.2	38.8	38.5	41.3	37.3
2565	Aug. 28	38 19 20	69 02 30	2,069	br. & gy. Oz	72	77	76.8	53.7	53.1	54 2	49.9	40.1	39.4	38.7	39.0	38.6	38.8	38.6	36.2
2566	Aug. 29	37 23 00	68 09 00	2,620	gy. Oz	75	80	81.2	79.2	66.6	64.6	63.0	59.1	53.7	45.3	40.7	40.2	39.5	39.3	36.4
2571	Sept. 1	40 09 30	67 09 00	1,356	gy. Glob. Oz	75	72	65.7	60.2	54.8	45.7	41.8	40.0	39.7	38.8	39.8	.....	.....	.....	37.8
2573	Sept. 2	40 34 18	66 09 00	1,742	gy. M. S	71	71	68.3	61.0	52.8	49.4	42.0	40.2	39.7	39.1	39.4	38.6	38.8	38.1	37.3
2575	Sept. 3	41 07 00	65 26 30	1,710	gy. Oz	64	71	71.2	59.1	52.8	47.0	41.3	40.2	39.8	39.3	38.7	38.8	38.4	38.0	37.1
2628	Oct. 21	32 24 00	76 55 30	528	yl. M	70	77	79.9	77.6	59.0	48.0	45.5	40.2	.....	.....	.....	.....	.....	.....	38.5

* 5 fathoms. † 10 fathoms. ‡ 15 fathoms. § 25 fathoms. ‖ 50 fathoms. ¶ 250 fathoms.

Record of speed of five trawlings and soundings, July, 1883, U. S. Fish Commission steamer Albatross, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding.

TRAWL—GOING DOWN.

Fathoms.	Number of station.				
	2038.	2039.	2040.	2041.	2042.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Surface to 100	4 00	5 15	7 20	3 55	4 00
100 to 200	5 00	4 05	4 10	4 30	4 00
200 to 300	5 00	3 50	8 15	4 00	3 45
300 to 400	4 00	4 00	4 25	4 30	5 80
400 to 500	4 40	5 30	9 05	4 30	3 55
500 to 600	4 00	4 45	4 15	4 46	3 30
600 to 700	4 00	3 53	4 00	4 45	3 30
700 to 800	5 20	4 02	3 30	4 47	5 00
800 to 900	4 45	4 15	4 00	4 45	4 00
900 to 1,000	4 10	4 00	3 40	4 47	4 30
1,000 to 1,100	4 05	7 35	4 20	4 47	4 00
1,100 to 1,200	4 50	6 15	3 40	5 05	4 00
1,200 to 1,300	9 20	7 25	4 15	4 20	4 10
1,300 to 1,400	6 00	5 00	4 15	4 20	4 10
1,400 to 1,500	5 50	5 00	3 40	4 20	4 00
1,500 to 1,600	4 30	4 30	4 40	4 30	4 20
1,600 to 1,700	4 30	4 30	4 35	4 40	4 10
1,700 to 1,800	6 00	4 00	7 40	4 25	4 15
1,800 to 1,900	5 15	8 00	6 20	4 20	3 50
1,900 to 2,000	4 15	11 45	5 25	4 10	3 40
2,000 to 2,100	5 05	7 45	5 00	4 10	3 45
2,100 to 2,200	5 00	7 50	5 10	4 10	....
2,200 to 2,300	4 35	7 00	7 00	*2 00	....
2,300 to 2,400	4 20	5 00	6 15	....	....
2,400 to 2,500	4 00	5 00	7 00	....	....
2,500 to 2,600	9 30	6 45	6 45	....	....
2,600 to 2,700	5 30	4 50	4 00	....	....
2,700 to 2,800	....	5 00	3 30	....	....
2,800 to 2,900	....	9 55	4 00	....	....
2,900 to 3,000	....	5 00	3 40	....	....
3,000 to 3,100	....	4 20	....	....	....
3,100 to 3,200	....	6 15	....	....	....
Total time	2 17 30	3 02 15	2 28 40	1 40 32	1 26 00
Average speed per 100 fathoms	5 05	5 42	4 57	4 28	4 06
Depth in fathoms	2,033	2,369	2,226	1,608	1,555

*To 2,250 fathoms.

TRAWL—COMING UP.

Fathoms.	2038.	2039.	2040.	2041.	2042.
100 to surface	4 30	5 15	6 00	4 40	3 25
200 to 100	4 00	3 45	3 00	4 40	3 25
300 to 200	4 00	4 00	3 31	4 40	3 25
400 to 300	5 55	5 30	3 31	4 40	3 25
500 to 400	4 00	4 00	3 31	4 40	3 25
600 to 500	4 00	3 30	3 31	4 40	3 25
700 to 600	2 40	4 00	3 31	4 40	3 20
800 to 700	4 15	3 45	3 31	5 46	3 20
900 to 800	3 30	4 00	3 31	4 30	8 20
1,000 to 900	3 00	4 00	3 31	4 26	3 46
1,100 to 1,000	3 00	3 45	3 32	4 55	5 00
1,200 to 1,100	4 00	4 30	4 35	5 10	4 00
1,300 to 1,200	3 30	4 15	4 00	6 15	5 00
1,400 to 1,300	3 30	4 55	4 00	7 00	5 45
1,500 to 1,400	4 00	4 25	4 00	7 00	5 45
1,600 to 1,500	4 15	3 55	4 00	10 00	5 46
1,700 to 1,600	9 00	3 30	3 25	6 45	6 05
1,800 to 1,700	5 00	4 00	3 40	6 48	7 48
1,900 to 1,800	4 45	4 00	4 15	6 48	7 48
2,000 to 1,900	5 00	4 00	10 05	6 48	7 47
2,100 to 2,000	4 30	4 00	5 45	6 48	7 47
2,200 to 2,100	4 30	4 00	5 25	6 45	....
2,300 to 2,200	4 30	4 00	5 50	5 45	....
2,400 to 2,300	5 00	4 00	5 30	....	....
2,500 to 2,400	4 00	5 00	6 10	....	....
2,600 to 2,500	5 00	4 30	12 30	....	....
2,700 to 2,600	6 00	4 40	6 45	....	....
2,800 to 2,700	....	4 25	6 45	....	....
2,900 to 2,800	....	5 20	8 30	....	....
3,000 to 2,900	....	5 10	7 00	....	....
3,100 to 3,000	....	6 15	....	....	....
3,200 to 3,100	....	10 15	....	....	....
Total time	2 00 20	2 24 15	2 32 50	2 14 10	1 40 45
Trawl on bottom	1 14 30	1 47 30	2 37 20	1 51 25	1 26 50
Average speed per 100 fathoms	4 27	4 30	5 05	5 44	4 48

Record of speed of five trawlings and soundings, July, 1883, etc.—Continued.

SOUNDING—GOING DOWN.

Fathoms.	Number of station.				
	2038.	2039.	2040.	2041.	2042.
	h. m. s.	*h. m. s.*	*h. m. s.*	*h. m. s.*	*h. m. s.*
Surface to 100	1 02	0 57	1 30	1 20	1 00
100 to 200	0 56	0 55	1 30	1 20	0 55
200 to 300	0 57	1 00	1 30	1 20	4 00
300 to 400	1 00	0 46	1 30	1 20	6 30
400 to 500	1 02	0 58	1 30	1 20	1 25
500 to 600	1 02	1 02	1 30	1 15	1 03
600 to 700	1 07	1 00	1 30	1 25	1 17
700 to 800	1 09	1 02	1 30	1 18	1 15
800 to 900	1 08	1 00	1 30	1 22	1 25
900 to 1,000	1 16	1 07	1 30	1 17	1 20
1,000 to 1,100	1 14	1 06	1 30	1 23	1 25
1,100 to 1,200	1 17	1 04	1 30	1 21	1 25
1,200 to 1,300	1 07	1 08	1 30	1 19	1 30
1,300 to 1,400	1 17	1 10	1 30	1 20	1 25
1,400 to 1,500	1 16	1 11	1 30	1 20	*1 00
1,500 to 1,600	1 15	1 14	1 30	†0 24	....
1,600 to 1,700	1 22	1 05	1 00	....	....
1,700 to 1,800	1 28	1 12	1 45	....	....
1,800 to 1,900	2 40	1 18	1 20	....	....
1,900 to 2,000	‡3 33	1 15	1 30	....	....
2,000 to 2,100	....	1 15	1 20	....	....
2,100 to 2,200	....	1 20	§0 20	....	....
2,200 to 2,300	....	‖1 00	....	....	....
Total time	27 08	24 05	31 15	19 30	26 55
Average speed per 100 fathoms	1 21	1 01	1 21	1 13	1 43
Depth in fathoms	2,033	2,369	2,226	1,608	1,555

* To 1,480 turns. ‡ To 1,912 turns. ‖ To 2,276 turns.
† To 1,530 turns. § To 2,125 turns.

SOUNDING—COMING UP.

Fathoms.	2038.	2039.	2040.	2041.	2042.
100 to surface	1 00	1 00	1 05	1 25	1 00
200 to 100	1 27	1 00	1 30	1 25	0 57
300 to 200	0 37	1 00	1 30	1 25	0 58
400 to 300	0 37	1 00	1 30	1 25	1 00
500 to 400	0 35	1 00	1 30	1 25	1 00
600 to 500	0 50	1 00	1 30	1 25	1 00
700 to 600	0 38	1 00	1 30	1 20	1 00
800 to 700	0 32	0 57	1 30	1 20	1 05
900 to 800	0 40	0 50	1 30	1 25	1 07
1,000 to 900	0 47	0 51	1 30	1 30	1 05
1,100 to 1,000	0 46	0 52	1 45	1 25	1 10
1,200 to 1,100	0 45	1 05	1 45	1 26	1 15
1,300 to 1,200	0 47	1 05	1 45	1 25	1 14
1,400 to 1,300	0 51	1 05	1 45	1 25	1 13
1,500 to 1,400	0 52	1 10	2 00	1 30	1 00
1,600 to 1,500	0 57	1 16	1 05	1 00	....
1,700 to 1,600	0 55	1 10	1 40	....	....
1,800 to 1,700	1 00	1 27	1 30	....	....
1,900 to 1,800	1 20	1 30	1 30	....	....
2,000 to 1,900	0 40	1 33	1 30	....	....
2,100 to 2,000	....	2 15	1 30	....	....
2,200 to 2,100	....	2 25	0 30	....	....
2,300 to 2,200	....	2 00	....	....	....
Total time	12 36	28 30	32 50	21 15	16 04
Average speed per 100 fathoms	0 56	1 12	1 28	1 19	1 02

The "Total time" is not the sum of the partial times, but the whole time employed for the trawling or sounding, including preparation for it.

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NEW YORK, *December* 20, 1887.


No. 1.
CHART SHOWING THE POSITIONS OF THE DREDGINGS MADE BY THE U.S. FISH COMMISSION IN THE GULF OF MAINE, MASSACHUSETTS AND CAPE COD BAYS AND IN VINEYARD AND NANTUCKET SOUNDS AND ADJACENT WATERS
FROM 1871 TO 1887
Prepared by Sanderson Smith
The Dredgings marked Bl. were made in 1873 on the steamer Bluelight.
Those marked B. were made from 1872 to 1874 on Coast Survey steamer Blake.
Lists of the Stations embraced within this chart were published either in the U.S. Fish Commission report for 1879, or in the Bulletin U.S. Fish Commission Volume II. 1882.
NOTE.
Of the following locations only the first of each series is marked on the Map, the others are in close proximity to it.
102, 105, 107, 108, 119, 193, 198, 205 Bl.
103, 106, 117, 147, 194, 195, 207 Bl.
196, 202 Bl.
104, 148, 210 Bl.
122, 192, 197 Bl.
126, 172 Bl.
128, 169, 170 Bl.
131, 188, 189 Bl.
146, 177 Bl.
149, 185, 186 Bl.
167, 175, 190 Bl.
164, 208 Bl.
168, 171, 173, 174, 203 Bl.
178, 179, 206 Bl.
111, 109, 110, 113-116, 120, 121, 123-125, 129, 130, 135, 136, 139, 140, 144, 145, 153, 156, 159-163 Bl. are in Bluelight Cove.
181, 182, 183 Bl. are indeterminable.
All the above are in Casco Bay.
141-146, 150-153, 159, 179, 180, 200-202, & 231 are in Gloucester Harbor.
617 & 1205 are off E. Chop, Marthas Vineyard.
688 & 1099-1101 & 1187-90 & 1195-1201 are off Falmouth.
601-3, 613 & 649-60 & 663-5 are in Tarpaulin Cove, Naushon I.
612, 1126-8, 1134-6, 1166-70, 1178-80, 1192-4, 1202-4 are off Menemsha Bight, Martha's Vineyard.
705, 864, 931 are of Robinsons hole, Naushon I.
699, 929-30 are off Quicks Hole, Vineyard Sound
620-3-1228-35 & 1240 are S. off Cuttyhunk
NOTE.
The following positions are too indefinite to be placed on chart.
745-8 N.E. of Nantucket I.
679-81 W. side of " "
732-4 & 736-7 S.W. of Martha's Vineyard
1006-13 near Gay Head " "
614-16 Vineyard Sound
642-5, 648 Buzzards Bay.
683-7 in " "
668 off S.E part of Martha's Vineyard.
742, 1000-1005 are impossible to locate.
JEFFREY'S BANK
PLATT'S BANK
CASHE'S LEDGE
JEFFREY'S LEDGE
STELLWAGEN BANK
MASSACHUSETTS BAY
CAPE COD BAY
CAPE COD
NANTUCKET SOUND
NANTUCKET SHOALS
BUZZARD'S BAY
VINEYARD SOUND
MARTHA'S VINEYARD
NANTUCKET I.
100 fathom curve
10 fathom curve
Portland
Bath
Rockland
Monhegan I.
Metinic I.
Matinicus I.
Matinicus Rock
Portsmouth
Newburyport
Ipswich
Rockport
Gloucester
Salem
Lynn
Nahant
Boston
Scituate
Duxbury
Plymouth
Sandwich
Barnstable
Yarmouth
Provincetown
Wellfleet
Chatham
Wareham
New Bedford
Falmouth
Vineyard Haven
Edgartown
Gay Head
No Man's Land
Dredgings of 1871 not shown in main chart.
NOTE.
1-5, 10-20 are in Woods Hole Harbor.
53, 56-63, 83 are N.W. of Gay Head.


No. 2.
CHART SHOWING THE POSITIONS
OF THE
DREDGINGS MADE BY THE U.S.FISH COMMISSION
IN
LONG ISLAND, VINEYARD AND NANTUCKET SOUNDS
AND ADJACENT WATERS
FROM 1871 TO 1887.
Prepared by Sanderson Smith.
NOTE
Dredgings Numbered 401–10 414–16, 420–34, 439–44, 460–4, 462–6, 508–14, 542–8. are in Fisher's Island Sound.
For list of positions for which there is no room on this chart and indefinite positions on it, see note on chart No. 1.
The Dredgings marked Bl. were made in 1873 on the steamer Bluelight.
Those marked B. were made from 1872 to 1874 on Coast Survey steamer Blake.
That marked 347 Ag. was made by Prof. Agassiz on Coast Survey steamer.
Lists of the Stations embraced within this Chart were published either in the U.S.Fish Commission report for 1879. or in the Bulletin U.S.Fish Comm. Vol. II. 1882.
LONG ISLAND SOUND
LONG ISLAND
NARRAGANSETT BAY
BUZZARD'S BAY
VINEYARD SOUND
NANTUCKET SOUND
MARTHA'S VINEYARD
NANTUCKET I.
NANTUCKET SHOALS
CAPE COD
BLOCK I.
GARDINER'S BAY
New Haven
Saybrook
New London
Noank
Newport
Pt. Judith
Montauk Pt.
Greenport
Shelter Island
Gardiner's I.
Sag Harbor
Amagansett
E. Hampton
Bridgehampton
S. Hampton
River Head
Shinnecock Bay
Moriches Bay
New Bedford
N. Falmouth
Falmouth
Woods Hole
Cuttyhunk
Gay Head
No Mans Land
Vineyard Haven
Edgartown
C. Poge
W. Chop
E. Chop
Muskeget I.
Tuckernuck I.
Nantucket
Great Pt.
Sankaty Head
Chatham
Monomoy
Pollock Rip
Barnstable
Yarmouth
Old South Shoal
Davis South Shoal
Fishing Rips
Phelps' Bank
10 fathom curve
20 fathom curve
72° 30'
72° 00'
71° 30'
71° 00'
70° 30'
70° 00'
69° 30'
41° 30'
41° 00'

Gorham


MAINE
Portland
Boston
Eastport
GULF OF MAINE
BAY OF FUNDY
NOVA SCOTIA
New York
LONG ISLAND SOUND
Long Island
New Haven
Sandy Hook
Philadelphia
Baltimore
WASHINGTON
DELAWARE BAY
Cape May
Cape Henlopen
Cape Charles
Cape Henry
Cape Cod
Nantucket
Block Id.
Newport
Woods Holl
Montauk
GEORGES BANK
See sub map below
PAMPLICO SOUND
New Berne
Wilmington
Cape Fear
Cape Lookout
Charleston
Cape Romain
Savannah
Jacksonville
St Augustine
C. Canaveral
100 fathom curve
1000 fathom curve
SUB CHART
Scale enlarged 3 times.


No. 3.
CHART SHOWING THE POSITIONS
OF THE
DREDGINGS MADE BY THE U. S. FISH COMMISSION
IN THE ATLANTIC OCEAN
FROM 1871 TO NOVEMBER 1887.
INCLUDING ALSO THE
DEEP SEA DREDGINGS OF THE U. S. COAST SURVEY
AND THE
BRITISH STEAMER CHALLENGER
IN THE REGION MAPPED.
PREPARED BY SANDERSON SMITH.
About 2800 hauls of the Dredge have been made by the U. S. Fish Commission, of which about 150 were in the Gulf of Mexico and the Caribbean Sea.
All Dredgings over 100 fathoms are shown and about one third of the rest.
The Numbers designate the Dredging Stations as entered on the records of the U. S. Fish Commission, except those marked *Ag.* made by Prof Agassiz on Coast Survey steamers and those marked *Ch.* made by British steamer Challenger.
The Dredging Stations marked *Bl.* were made in 1873 by the U. S. Fish Comm. on the steamer Bluelight.
Those marked *B.* were made from 1872 to 1874 by the U. S. Fish Comm. on Coast Survey str. Blake.
Positions of the CHALLENGER in American Waters not included in the general Charts.
NOVA SCOTIA
CAPE BRETON ID.
NEWFOUNDLAND
Cape North
Cape Canso
Cape Sable
Sable I.
Miquelon I.
St. Pierre I.
Fogo Id.
C. Bonavista
TRINITY BAY
PLACENTIA BAY
St. Johns
Cape Race
LA HAVE BANK
MISAINE BANK
BANQUEREAU
SABLE ISLAND BANK
ST. PETERS BANK
GREEN BANK
GRAND BANK OF NEWFOUNDLAND
FLEMISH CAP
100 fathom curve
1000 fathom curve
BERMUDA IS.

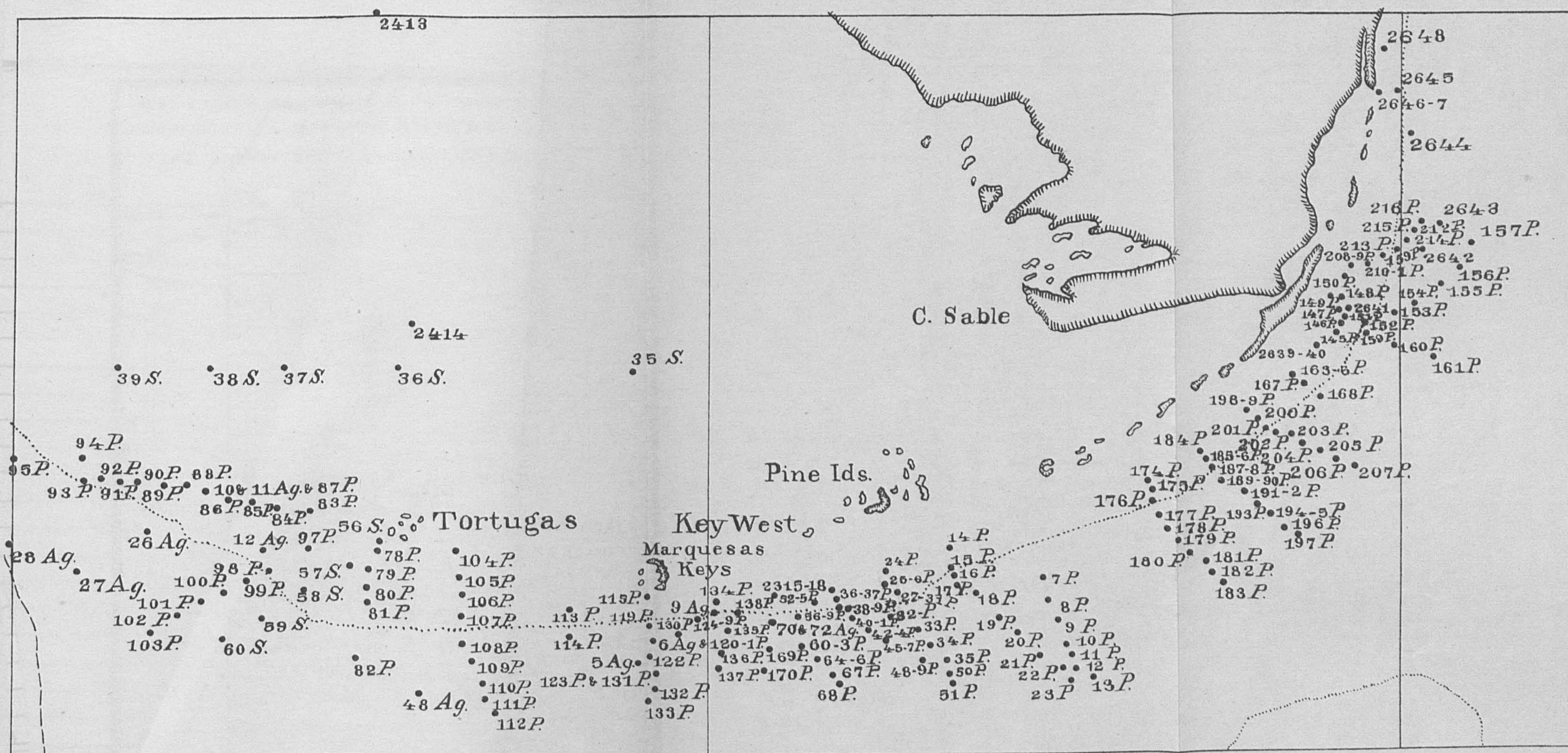
4


No. 4.
CHART SHOWING POSITIONS
OF ALL THE
DREDGINGS MADE BY THE U. S. FISH COMMISSION
AND THE
U. S. COAST SURVEY
IN THE
GULF OF MEXICO AND ADJACENT PARTS OF THE
ATLANTIC OCEAN AND CARIBBEAN SEA,
FROM 1867 TO NOVEMBER 1887.
PREPARED BY SANDERSON SMITH.
The Dredgings of the U. S. Fish Commission are indicated by numbers only.
Of the dredgings made on Coast Survey vessels, those by L. F. Pourtales from 1867 to 1872 are marked thus (5 P.). Those by Prof. Alexander Agassiz from 1877 to 1879, thus (10 Ag.). Those by Dr. Wm. Stimpson in 1872 thus (20 S.). Those by Capt. Bartlett in 1879 and 80 thus (XXX).
100 Fathom Line
1000 Fathom Line
* 2152-69, 2319-50, 2633-37, 2-4 P., 139 P., 13 Ag. 15-16 Ag., 51-69 Ag., 71 Ag. 75 Ag.-79 Ag. & 100-1 Ag. are just off Havana. 7 & 8 Ag. cannot be precisely placed. 1 P. is near 138 P. 69-77 P. are near 9 & 70 Ag. 116-8 P. are near 115 P. 142 P. is near 198-9 P. 143 P. is near 163-6 P. 144 P. is near 145 P. 158 P. is near 146 P. 5-6 P., 171-3 P. cannot be definitely placed. 30-2 S. are near 169 P. 33-4 S. are near 135 P.
UNITED STATES
GULF OF MEXICO
ATLANTIC OCEAN
CARIBBEAN SEA
CUBA
YUCATAN
BANK OF CAMPECHE OR YUCATAN
GREAT BAHAMA BANK
LIT. BAHAMA BANK
CAY SAL BANK
TONGUE OF OCEAN
EXUMA SOUND
CAICOS BANK
Mobile
Pensacola
Apalachicola
C. San Blas
Cedar Keys
Jacksonville
St. Augustine
C. Canaveral
Tampa Bay
Charlotte Harbor
C. Sable
Key West
Tortugas
Pine Ids.
Lake Ponchartrain
New Orleans
Delta of the Mississippi
HAVANA
Bahia Honda
Matanzas
Cardenas
Batabano
Cienfuegos
C. San Antonio
C. Corrientes
Isle of Pines
Gulf of Cazones
Cay Sal
Anguilla Id.
N. Bemini
S. Bemini
Great Bahama
Great Abaco
Andros Id.
Nassau
New Providence I.
Eleuthera Id.
Cat Id.
San Salvador or Watlings Id.
Conception Id.
Rum Cay
Gt. Exuma Id.
Long Id.
Samana or Atwood Cay
Crooked Id.
Fortune I.
Acklin Id.
Plana Cays
Mariguana Id.
Lit. Inagua Id.
Gt. Inagua Id.
Tork Ids.
Mouchoir Carre Bank
C. Catoche
Pt. Palmas
Arrowsmith Bank
92°00'
90°00'
88°00'
86°00'
84°00'
82°00'
80°00'
78°00'
76°00'
74°00'
72°00'
32°00'
30°00'
28°00'
26°00'
24°00'
22°00'

CHART SHOWING THE POSITIONS
OF ALL THE
DREDGINGS MADE BY THE U. S. FISH COMMISSION,
U. S. COAST SURVEY
AND THE
BRITISH STEAMER CHALLENGER
IN THE
CARIBBEAN SEA
AND ADJACENT PARTS OF THE ATLANTIC OCEAN
FROM 1867 TO NOVEMBER 1887.
PREPARED BY SANDERSON SMITH.
The Dredgings of the U.S. Fish Commission are indicated by numbers only.
Of the Dredgings made on Coast Survey vessels, those by Prof. Alexander Agassiz from 1877 to 1879 are marked thus (10 Ag.), those by Capt. Bartlett in 1879 and 80 thus (XX B.). The Dredgings made by the British Steamer Challenger are marked thus (20 Ch.).
100 Fathom Line
1000 Fathom Line
No. 5.
C A R I B B E A N S E A
BAY OF HONDURAS
PACIFIC OCEAN
Yucatan
Cozumel
British Honduras
Belize
Lighthouse Reef
Glover Reef
Chinchorro Bank
Honduras
Ruatan I.
Bonacca I.
Utila I.
Truxillo
Swan I.
C. Gracias a Dios
Mosquito Coast
Nicaragua
Lake Nicaragua
Graytown
Costa Rica
Chiriqui Lagoon
Aspinwall
Panama
Old Providence
St. Andrews I.
Cuba
Manzanilla
Santiago de Cuba
C. Cruz
C. Maysi
Cayman Brac
Little Cayman
Grand Cayman
Misteriosa Bank
Rosalind Bank
Serranilla Bank
Pedro Bank
Jamaica
Falmouth
Savanna la Mar
Port Royal
Morant Pt.
Morant Cays
Albatross Bank
Tortuga
Cape Haytian
Hayti or San Domingo
Samana Bay
Gonave
Port au Prince
San Domingo
C. Tiburon
Aux Cayes
Mona Passage
Mona I.
Puerto Rico
San Juan
Mayaguez
Culebra
St. Thomas
St. John
Tortola
Anegada
Virgin Gorda
Santa Cruz
Saba Bank
Las Monges
Oruba
Curacao
Buen Ayre
Los Roques
Orchilla
Blanquilla
Margarita
Tortuga
Peninsula de Paraguana
Gulf of Venezuela or Maracaybo
Maracaybo
Laguna de Maracaybo
La Hacha
Sta. Marta
Mouths of the R. Magdalena
Cartagena
Puerto Cabello
La Guayra
Caracas
Cumana
TEMPERATURE
SECTIONS
SECTION ACROSS THE GULF OF MEXICO FROM LOGGERHEAD KEY, DRY TORTUGAS, TO E. COAST OF MEXICO.
VERTICAL SCALE 100 TIMES THE HORIZONTAL.
TYPICAL SECTIONS OFF E. COAST.
VERTICAL SCALE 50 TIMES HORIZONTAL
CHART OF THE GULF OF MEXICO AND PART OF THE CARIBBEAN SEA.
GULF OF MEXICO
SIGSBEE DEEP
YUCATAN
FLORIDA
BARTLETT DEEP

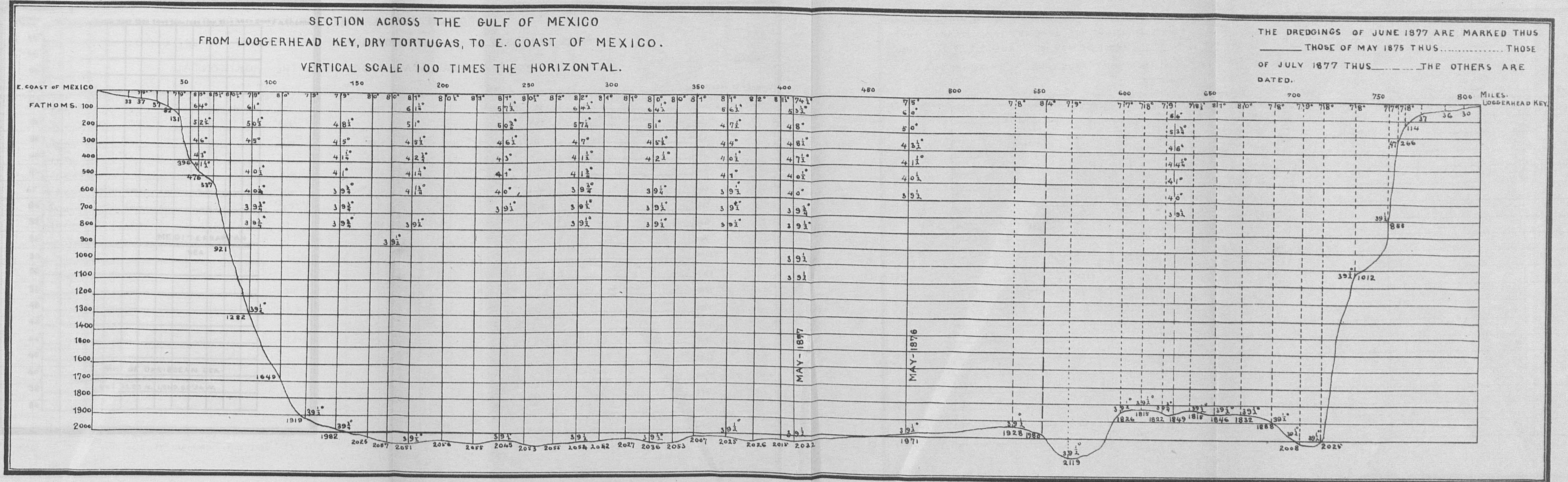

Cuba
Manzanilla
Santiago de Cuba
C. Maysi
C. Cruz
XXVI Cayman Brac
Little Cayman
XIV
XIII Grand Cayman
Tortuga
Cape Haytian
Hayti
or
San Domingo
SAMANA BAY
Gonave
Port au Prince
San Domingo
C. Tiburon
Aux Cayes
MONA PASSAGE
Mona I.
San Juan
Puerto Rico
Mayaguez
St. Thomas
Tortola
Anegada
Virgin Gorda
St. John
Culebra
Bieque
Santa Cruz
Sombrero I.
Anguilla
St. Martin
St. Bartholomew
Barbuda
Saba
SABA BANK
St. Eustatius
St. Christopher
Nevis
Antigua
Montserrat
Grande Terre
Desirade
Guadeloupe
Marie Galante
Aves I.
Dominica
Martinique
St. Lucia
St. Vincent
Barbados
Grenadines
Grenada
Tobago
WINDWARD ISLANDS
Falmouth
Savanna la Mar
Jamaica
Port Royal
Morant Pt.
Morant Cays
ALBATROSS BANK
PEDRO BANK
ROSALIND BANK
SERRANILLA BANK
C A R I B B E A N S E A
TEMPERATURE
SECTIONS
SECTION ACROSS THE GULF OF MEXICO
FROM LOGGERHEAD KEY, DRY TORTUGAS, TO E. COAST OF MEXICO.
VERTICAL SCALE 100 TIMES THE HORIZONTAL.
TYPICAL SECTIONS off E. COAST.
VERTICAL SCALE 50 TIMES HORIZONTAL
Old Providence
St. Andrews I.
CHART OF THE
GULF OF MEXICO
AND PART OF
THE
CARIBBEAN SEA.
G U L F
O F
M E X I C O
SIGSBEE DEEP
YUCATAN
BARTLETT DEEP
FLORIDA
Los Monges
Oruba
Curacao
Buen Ayre
Is. de Aves
Los Roques
Orchilla
Blanquilla
Peninsula de Paraguana
GULF OF VENEZUELA OR MARACAYBO
Coro
La Hacha
MOUTHS OF THE R. MAGDALENA
Sta Marta
Cartagena
Maracaybo
LAGUNA DE MARACAYBO
Puerto Cabello
La Guayra
Caracas
Tortuga
Margarita
GULF CARIACO
Cumana
Port of Spain
TRINIDAD
Gulf of Paria
DELTA OF THE ORINOCO
CHIRIQUI LAGOON
Aspinwall
Panama
Panama
80 00
78 00
76 00
74 00
72 00
70 00
68 00
66 00
64 00
62 00
60 00
20°00
18°00
16°00
14°00
12°00
10°00

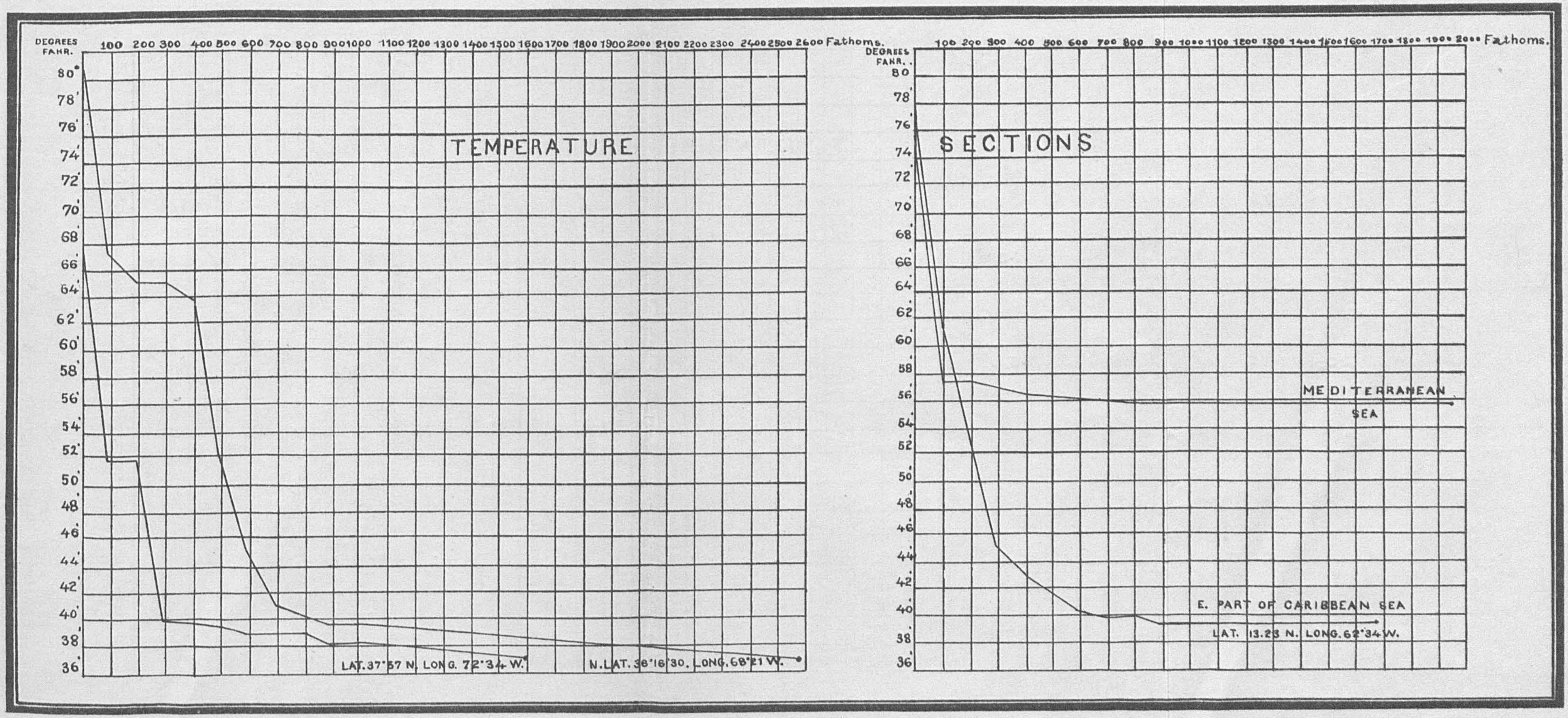
1-

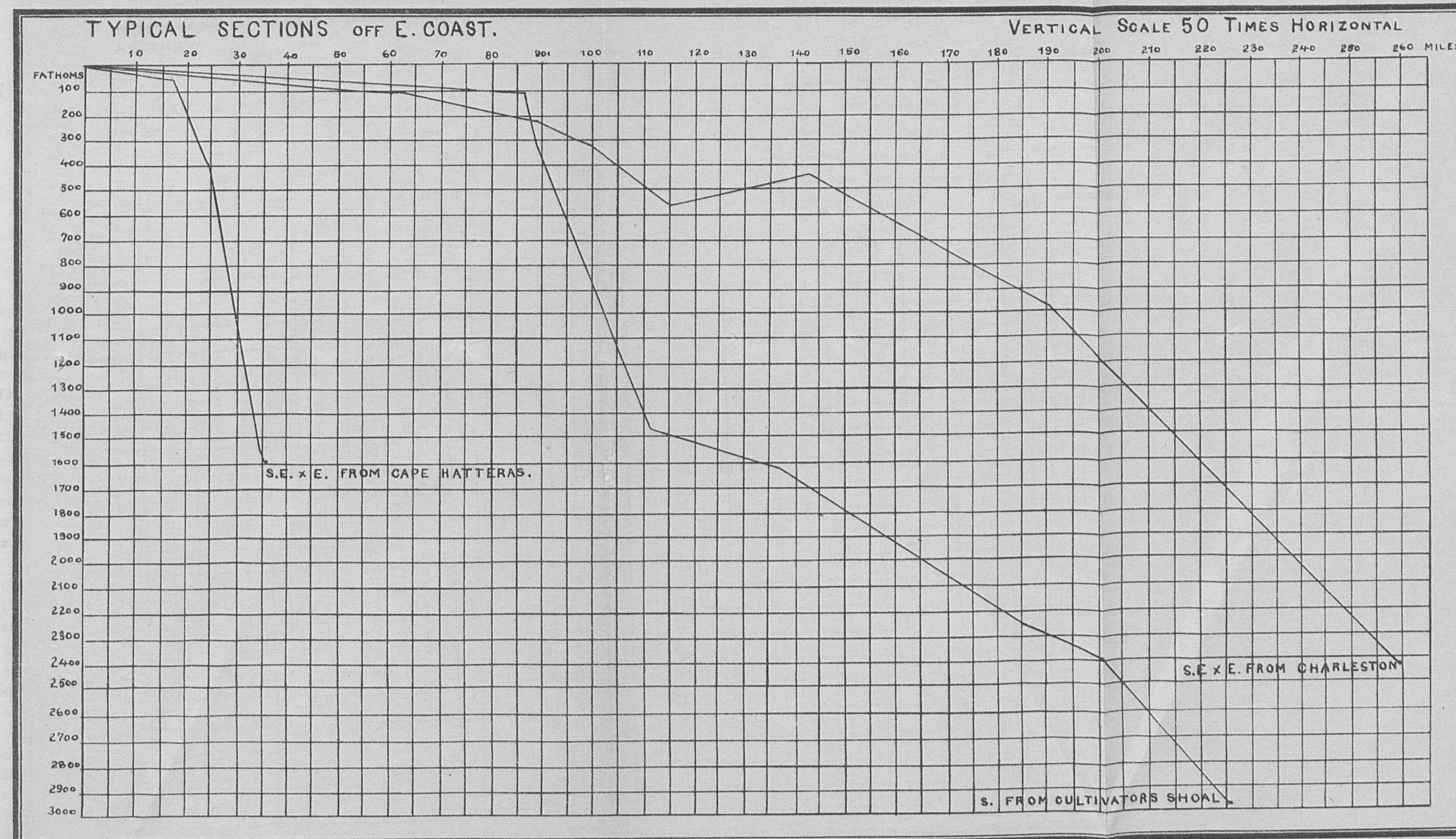


2413
2414
39 S.
38 S.
37 S.
36 S.
35 S.
Tortugas
Key West
Marquesas Keys
Pine Ids.
C. Sable
2648
2645
2646-7
2644
2643
28 Ag.
27 Ag.
26 Ag.
12 Ag.
48 Ag.
5 Ag.
9 Ag.

2-


SECTION ACROSS THE GULF OF MEXICO
FROM LOGGERHEAD KEY, DRY TORTUGAS, TO E. COAST OF MEXICO.
VERTICAL SCALE 100 TIMES THE HORIZONTAL.
THE DREDGINGS OF JUNE 1877 ARE MARKED THUS ______ THOSE OF MAY 1875 THUS .... THOSE OF JULY 1877 THUS _ _ _ _ THE OTHERS ARE DATED.
E. COAST OF MEXICO
FATHOMS.
MILES.
LOGGERHEAD KEY.
MAY-1877
MAY-1876


TEMPERATURE
SECTIONS
DEGREES FAHR.
Fathoms.
LAT. 37°57 N, LONG. 72°34 W.
N. LAT. 38°16'30. LONG. 68°21 W.
MEDITERRANEAN
SEA
E. PART OF CARIBBEAN SEA
LAT. 13.23 N. LONG. 62°34 W.


TYPICAL SECTIONS OFF E. COAST.
VERTICAL SCALE 50 TIMES HORIZONTAL
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 MILES
FATHOMS
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000
S.E. x E. FROM CAPE HATTERAS.
S.E x E. FROM CHARLESTON
S. FROM CULTIVATORS SHOAL

XXX.—CHEMICAL COMPOSITION OF FISH PRODUCTS, WITH SOME REMARKS ON THEIR NUTRITIVE VALUE.*

By Prof. P. Kostytscheff,
Of the Agricultural Station in St. Petersburg.

The number of investigations on the chemical composition of the various substances used as food by man is not great. Owing to the experiments on the feeding of domestic animals, we have, for instance, hundreds of analyses of the various kinds of hay, while the available analyses of the different kinds of bread will hardly count by dozens. Of the alimentary substances used to prepare food for man, only those have been frequently investigated which at the same time find application in technical industries, such as the potato, the grains of cereals, etc.; and it is to be noticed that such investigations were called forth not by the requirements of hygiene but of technology. The reason is evident enough. Every manufacturer is deeply interested in the amount of profit he can obtain, whereas but few persons will take as great an interest in the life of people unknown to them.

Nevertheless, there can be no doubt as to the great importance of chemical investigations concerning the composition of the materials from which the food of man is derived. Aside from the physiological interest attaching to the problem, it must be taken into consideration that the results of such investigations, if held together with the necessary statistical data, will throw much light on the economical conditions of the national life, and may sometimes illustrate such points as would otherwise escape attention.

I have thought it might not be superfluous to say these few words as introduction to the following, because my investigations concerning the composition of the flesh and some other products of fish will afford me an opportunity to call attention to the importance of fish as food in our national life in general, and, in connection with the available statistical data, will allow me to show how much other food would have to be provided and what means would have to be used if, for some reason or other, the yield of the fisheries was considerably reduced.

[* Translated from the Russian Journal of Rural Economy and Forestry, Vol. CXLIV, Part II.]

The present article is therefore subdivided into two parts. In the first part I shall try to present the results of all investigations made up to the present time on the chemical composition of the flesh of fish. In the second part I intend as far as possible to show, with the aid of certain statistical data, what importance fish has as a food-substance in our domestic economy.

I.—RESULTS OF INVESTIGATIONS.

Investigations on the chemical composition of the flesh of fish can properly be said to have begun only with the year 1854. Before this date only two such analyses were made, and they were very incomplete, so that it is impossible to obtain from their results a correct idea of the composition of the flesh of fish.*

Last year Dr. Popòf analyzed the flesh of some Russian fishes.† Being evidently unacquainted with the work of Mr. Almen, to be referred to hereafter, he proceeded in his analyses in the same manner as did Payen and König. His results are as follows:

Name of fish.	Percentage of—			
	Water.	Fat.	Protein.	Ash.
Salt smelt (*Salmo eperlanus*)	42.58	8.28	29.98	18.93
Fresh smelt	79.01	4.31	13.86	2.97
Fresh "Vobla" (a fish found in the Volga, of the size of a crucian)	75.76	5.88	17.29	1.60
Smoked bream (*Cyprinus vimba*)	37.25	15.22	36.92	10.82
Salt-dried pike-perch	20.55	1.92	60.33	17.62
Salt-dried spirling	72.45	6.78	16.14	3.51
Roe of fresh "Vobla"	72.18	6.85	19.78	0.91
Roe of smoked bream	33.17	16.30	42.80	7.58

In the spring of the present year I made analyses of thirty species of fishes and fish products from Russian waters.‡ I determined in my analyses all the substances enumerated in the table, closely following the directions given by Hoppe-Seyler in his hand-book of physiological chemical analysis. Besides the substances indicated in the table, I also determined the amount of common salt in salt fish, and in certain (salted and preserved) fishes the amounts of phosphoric acid and iron.

*The author here recapitulates the analysis of fish reported previous to the year 1883, when the following analyses by himself were performed. It is deemed unnecessary to repeat his recapitulations here, the more so as the same data with others are to be included in a detailed discussion of the subject by Prof. W. O. Atwater in connection with a report of his to be published by the Commission. A series of analyses by Popòf are, however, included, as they have not become current in the literature of the subject.—EDITOR.

† Determination of the proportion of nutritive matter contained in the most common species of fish. Dissertation for the degree of doctor of medicine. St. Petersburg, 1882; in Russian. [The analyses are stated by Professor Kostytscheff to have been made in the usual way, from which it is to be inferred that the protein was estimated by multiplying the nitrogen by 6.25.—EDITOR.]

‡ Owing to an offer made by Mr. N. M. Solsky, director of the Museum of Rural Economy, and late general commissioner to the International Exhibition of Fisheries at London.

The results of my analyses will be found in the following tables:*

TABLE I.—*Percentage of substances found in certain fishes.*

Name of fish.	Water.	Extraneous substances.	Gelatin	Albuminous matter.	Fat.	Ash.	Common salt.
FRESH FISH.							
Coregonus Baerii (Russ. Sig.)	79.13	2.93	3.70	11.69	1.53	1.22	....
Pike-perch	79.87	3.28	3.55	12.10	0.20	1.60	....
Common codfish	81.02	3.45	4.24	10.11	0.07	1.11	....
Carp (Russ., "Sazàn")	79.89	3.92	2.84	10.79	1.42	1.14	....
Pike	80.70	3.14	3.32	11.23	0.33	1.18	....
Crucian (carp)	80.82	4.56	3.63	9.44	0.48	1.07	....
Haddock (Russ., "Navàga")	81.35	4.99	2.40	9.03	0.59	1.58	....
Smelt	78.38	4.14	2.83	10.00	3.08	1.57	....
Salmon	62.02	2.70	5.08	12.98	14.82	1.30	....
Salmon trout	75.35	3.11	1.71	16.01	2.40	1.33	....
Sturgeon (Russ., "Ositòr")	76.02	3.05	1.58	13.04	5.15	1.16	....
Sterlet	76.81	1.69	1.74	13.21	5.59	0.26	....
Sprat	76.11	2.54	1.20	13.46	4.89	1.71	....
Liver of eel-pout	45.58	2.55	1.01	5.26	44.89	0.61	....
PRESERVED FISH AND FISH PRODUCTS.							
Dried smelt; the whole fish, with the bones	47.12	3.56	2.27	20.55	8.03	18.47	13.14
Pickled anchovy; whole fish, with bones	60.72	3.73	3.06	3.79	17.14	11.56	9.90
Salmon (Russ., "Siomga")	53.48	3.96	5.08	15.64	12.19	11.65	11.21
Salt turbot	54.65	5.57	1.09	16.83	6.82	15.04	13.77
Salt sturgeon (Russ., "Beluga")	61.85	1.83	2.05	14.82	8.93	10.52	10.03
Pickled lamprey; whole fish, without head and tail	44.62	2.70	4.05	27.57	16.57	4.49	3.33
Smoked shield-fish	54.89	6.42	6.14	18.48	5.08	9.20	7.99
Smoked herring (Russ., "Shemaia")	43.53	6.37	3.47	18.99	16.21	11.43	9.86
Smoked Astrakhan herring	59.56	3.78	4.87	13.41	8.86	9.52	8.98
Roe of *Coregonus Baerii*	66.05	2.16	1.10	14.37	8.07	7.20	6.16
Fresh roe of sturgeon	56.97	1.62	0.78	25.47	12.85	2.31	0.35
Dried "Vobla" (kind of crucian?)	27.96	9.44	8.23	30.18	9.88	14.31	8.92
Dried cod	25.23	5.21	13.23	50.44	0.69	5.20	1.20
"Balyk"* of whitefish	57.55	3.99	4.59	14.91	13.07	5.78	4.13
"Balyk" of sturgeon †	36.67	8.34	2.63	31.08	14.35	6.93	3.53
"Viaziga" (*i. e.*, the spinal cartilage of sturgeon)	50.99	5.21	40.04	0.18	0.06	3.52	....

* "Balyk" is the Russian term for the flesh of fish dried in the sun.

† The "balyk" investigated by me was too dry; fresh "balyk" ought to contain at least 48 to 50 per cent. of water, with corresponding amounts of other constituent parts.

TABLE II.—*Proportions of phosphoric acid and iron contained in certain fish products.*

	Percentage of—	
	Phos. acid.	Iron.
Flesh of *Coregonus Baerii* (Russ. "Sig.")	0.4711	0.0031
Flesh of pike-perch	0.2602	0.0025
Flesh of fresh cod	0.3731	0.0018
Flesh of pike	0.3980	0.0034
Flesh of haddock (Russ. "Navaga")	0.4833	0.0041
Flesh of salmon	0.3822	0.0035
Flesh of salmon-trout	0.3998	0.0010
Flesh of sturgeon	0.2993	0.0027
Flesh of sterlet	0.3104	0.0025
Dried smelt (*Salmo eperlanus*)	1.3701	0.1341
Flesh of salt turbot	0.4007	0.0041
Flesh of Astrakhan herring	0.2733	0.0020
Roe of sturgeon	1.0340	0.0047

* Where nothing is specified, the substance analyzed is the flesh alone.

[At the International Fisheries Exhibition in London in 1883 there were displayed in the Russian exhibit two printed charts of analyses of the fishes of Russia by Pro-

By comparing these results in their different bearings we are led to the following conclusions, which are not without interest:

(1) The greater the proportion of water contained in the flesh of a fish the smaller is the proportion of fat, as is also the case with the mammalia.

This will readily appear from the tables given above. It will be seen, for instance, that all our most common fishes—the perch, pike, pike-perch, etc., and also the cod—contain in their flesh about 80 per cent. of water, while the proportion of fat amounts to a little over 1 per cent. or less than 1 per cent.* On the other hand, such fishes as the salmon, sturgeon, eel, etc., which contain much fat, have a far smaller proportion of water. The greatest proportion of fat was found in the liver of the eel-pout, which also contains the smallest proportion of water. One and the same fish, if it has mo e fat, will have less water, as will be seen from the following examples:

	Water.	Fat.
Salmon (according to Almen)	70.33	10.12
Salmon (according to my analysis)	62.02	14.82
Eel (according to Payen)	62.08	23.86
Eel (according to Almen)	52.78	32.88

(2) In general it may be said that the more expensive a fresh fish is the more it contains of nutritious matter. In this respect it will be instructive to compare, on the one hand, the figures showing the propor-

fessor Kostytschelf. Aside from one evident misprint, the figures are the same as here given, except that in the shield-fish (*Pelecus vulgaris*) the percentage of fat is 5.87 instead of 5.08, and in the balyk of whitefish (*Coregonus leucichthys*) the fat is 13.17 instead of 13.07 per cent. The names are somewhat different, and the Latin names are added. As they are (it is to be presumed) the author's translation into English, the names are inserted here, by the aid of Professor Atwater, to supplement the names as here translated from Professor Kostytschef's article.

Fresh fishes.—Flesh of Sig, *Coregonus Baerii*; Pike-perch, *Lucioperca sandra*; Codfish, *Gadus morrhua*; Carp, *Cyprinus carpio*; Pike, *Esox lucius*; Crucian carp, *Carassius vulgaris*; *Gadus navaga*; Smelt, *Osmerus eperlanus*; Salmon, *Salmo salar*; Salmon-trout, *Salmo trutta*; Sturgeon, *Acipenser güldenstaedtii*; Sterlet, *Acipenser ruthenus*; *Clupea harengus* var. *membras*; liver of Burbot, eel-pout, *Lota vulgaris*.

Preserved fishes.—Salted and dried entire *Osmerus spirinchus*; marinated entire *Maletta vulgaris*; salted salmon, flesh of *Salmo salar* ("Semga"); salted flesh of the halibut, *Hippoglossus maximus*; salted flesh of the great sturgeon, *Acipenser huso*; marinated entire river lamprey, *Petromyzon fluviatilis*; salted and smoked flesh of *Pelecus vulgaris*; salted and smoked flesh of *Alburnus chalcoides*; salted flesh of caspian shad, *Alosa caspica*; salted caviare of *Coregonus* species; fresh caviare of sturgeon; salted and dried flesh of *Leuciscus rutilus* var. *caspica*; dried flesh of codfish, *Gadus morrhua*; salted and dried backs of *Coregonus leucichthys* ("Balyk"); salted and dried backs of sturgeon ("Balyk"); dried cartilaginous dorsal chords ("Vezeega").

The *Osmerus spirinchus* here is the smelt of the tables; the *Pelecus vulgaris* the shield-fish; the *Alburnus calcoides*, smoked herring; the *Alosa caspica* the Astrakhan herring; the salted caviare, the roe of *Coregonus Baerii*; the *Leuciscus rutilus*, the vobla, and the *Coregonus leucichthys* the whitefish.—EDITOR.]

*[The original has "or *not* less than 1 per cent.;" probably a misprint.]

tions of fat and albumen in the flesh of the salmon, salmon-trout, sturgeon, and sterlet with the corresponding figures for the pike-perch, pike, perch, cod, etc., on the other. Among the cheap fishes only one presents an exception, namely, the sprat. Its flesh has precisely the same composition as that of the sturgeon and sterlet. It will be noticed that, of all fresh fish-products, fresh (granulated) caviare or roe of sturgeon contains the greatest proportion of nutritious matter.

(3) As regards digestibility, certain kindred species of fish appear to present a remarkable diversity; for instance, salmon and salmon-trout. The flesh of salmon is much fatter than that of "*siomga*,"* which, however, contains more albuminous matter; and compared with other fishes it has much soluble albumen, as far as could be judged from the size of the coagulated albumen without weighing it. Hence, a weak stomach will stand salmon-trout more readily than salmon.

(4) Some fish products used as food apparently contain scarcely any nutritive matter; for instance, "*viaziga*," which is almost exclusively composed of water and gelatin-forming substances. The liver of the eel-pout contains mainly fat (nearly 45 per cent.), with a small quantity of albuminous matter.

(5) The investigation concerning the proportions of phosphoric acid and sesquioxide of iron contained in the flesh of fish did not result in any definite indications of particular interest, excepting, perhaps, the fact that granulated caviare is distinguished by a large proportion of phosphoric acid. The high figures resulting in the case of dried smelt are due to the circumstance that the whole fish, with its bones, was subjected to analysis, and that the ashes were not free of extraneous matter adhering to the smelt from the drying process.

I restrict myself to the present few remarks and the incomplete grouping together of figures, leaving it to the reader to evolve from the tables those more minute indications and results that may be of interest to him.

II.—IMPORTANCE OF FISH AS A FOOD-SUPPLY.

It is well known that in general our waters are comparatively rich in fish, and that a very large quantity of fish is caught there every year. In a recently published pamphlet by O. A. Grimm,† the amount of fresh fish caught every year in Russia is estimated at 40,000,000 puds.‡ Whoever will take the trouble to examine closely the statistical data presented in this work will find that such data are very incomplete, and that this figure of 40,000,000 puds is far below the actual number.

But even this incomplete estimate will allow us to deduce some very instructive conclusions concerning the importance of fish as food in our

[*It would seem as if this ought to be "salmon-trout" and not "*siomga*."]

† Fishing and Hunting in Russian Waters. (International Fisheries Exhibition.) St. Petersburg, 1883. (English.)

‡ 1 pud = 40 Russian pounds = about 36 English pounds.

national life. To do this, let us determine the quantity of nutritive matter derived from the fish caught and prepared in various manners in Russia. In doing this we may restrict ourselves to the consideration of the albuminous matter as the most important constituent of animal food.

Let us first select for our calculation those more important species of fish about which Mr. Grimm's pamphlet gives definite data, and for which we have also analyses:

	Puds.
1. Pike-perch, amount sent out from Astrakhan, not less than	2,000,000
2. Salmon, caught in various places, not less than	60,000
3. Smelt and spirling	1,000,000
4. Salt-dried "vòbla"	3,000,000
5. Bream, shield-fish, etc	3,500,000
6. Astrakhan herring	7,000,000
7. Sturgeon, sturgeon caviare, and "balỳk"	1,500,000

It will be seen from Mr. Grimm's figures that this whole amount of fish, which is mostly in a preserved condition, corresponds to 25,000,000 puds of fresh fish. Consequently, the quantity of all other kinds of fish caught every year amounts to not less than 15,000,000 puds.

Assuming that in the fishes mentioned above two-thirds of the weight is flesh and one-third makes up the weight of bones, skin, etc., it will be found, with the aid of the analyses given before, that the amount of dry albumen obtained from these fishes is not less than 2,330,000 puds. Assuming further that in the remaining 15,000,000 puds of fish the skin, scales, bones, etc., amounts to one-third and the flesh to two-thirds of the total weight, and supposing all these fishes to be such as contain the least amount (10 per cent.) of albuminous matter, the amount of dry albumen obtained will be at least 1,000,000 puds.

We thus find that we annually derive from our fisheries 3,330,000 puds of albuminous matter. This estimate is certainly below the actual amount; first, because many fishes contain more than two-thirds of flesh; second, because the annual yield of the fisheries in Russia is no doubt greater than 40,000,000 puds. At first sight this figure of 3,330,000 puds of albuminous matter may not appear very great. To realize better its true signification let us try to calculate what resources would be required to obtain the same amount of animal albuminous substances from cattle.

Let us suppose that, to replace fish as food, we keep black cattle of such kind that, on an average, every head when fully grown weighs 20 puds. Such an animal will contain 45.9 per cent. of flesh without bones, or 9.18 puds; and this flesh will contain 1.61 puds of albuminous matter. Now, to obtain from such black cattle 3,330,000 puds of albuminous matter annually it will be necessary to kill not less than 2,000,000 head of cattle a year.

Let us further assume that our cattle will be ready for slaughter when four years old; it will be seen that the supply of cattle in Russia would have to be increased by 8,000,000 head of cattle for slaughter and not less than 2,500,000 cows for breeding. Consequently, even under the most fortunate (but impossible) circumstances, such as the absence of special cattle diseases, sterility of cows, etc., the number of black cattle in Russia would have to be increased by at least 10,500,000 in order to supply those 3,330,000 puds of albumen, and it would require not less than 25,000,000 *desiatin** of meadows and pastures of good quality to keep and feed these cattle.

How enormous these figures are will be seen from the fact that the number of milch cows in European Russia (not including Poland and Finland) is estimated by various authors at from five to ten millions, and the area of pasturage at 55,000,000 *desiatin.*

We have, however, neglected in our calculation to take into account the milk provided by the cows. Supposing that, on an average, every cow gives 60 pails, or 180 pounds, of milk, this milk represents 1.44 pud of albuminous matter (the average proportion of albumen in milk being 3.2 per cent.). Every cow thus furnishes nearly as much albuminous matter per year as is contained in the flesh of the full-grown animal.

Taking into account the milk, our figures will therefore have to be reduced by one-half. But even then they are exceedingly high, amounting to 6,000,000 head of cattle that would require over 12,000,000 *desiatin* of meadows and pastures. Approximately, we may adopt as our final result that, in order to substitute the albuminous matter of the milk and flesh of our domestic animals for that obtained from our fisheries, we would have to raise by 10 per cent. the productivity of our cattle-breeding industry and the supply of food for the same.

These figures define (with the degree of approximation attainable with the available statistical data) the position and rank the fisheries take in the animal food-supply of the population of Russia. It would of course be possible to replace it by the products of cattle-breeding, but only with the same prices for food. But the prices for the products derived from cattle are far higher than those for the corresponding nutritive products of fish (taken on an average, of course): 1 pud of albuminous matter of fish is worth less than 20 roubles [1 rouble=58.2 cents], whereas the same amount derived from the flesh of cattle will be worth not less than 40 to 50 roubles; the latter food is therefore accessible to a smaller number of people.

It is true, however, that to replace fish by vegetable food would require very much smaller resources. To produce 3,330,000 puds of albuminous matter requires, for instance, only 600,000 *desiatin* of rye, assuming a yield of 55 puds per *desiatina* exclusive of seed, or not over 900,000 *desiatin* in the case of triennial farming and neglecting the meadows necessary for obtaining manure.

* 1 *desiatin* = about 2.7 acres.

XXXI.—CASES OF POISONING CAUSED BY SPOILED CODFISH, AND THE UNNECESSARY PROHIBITION OF THE SALE OF REDDENED CODFISH.*

By Dr. E. Mauriac.

By a circular dated December 31, 1885, the minister of commerce instructed the prefects to prohibit the sale of red codfish throughout the entire French territory. The prohibitory orders of the prefects, issued in accordance with this circular, threatened venders of reddened codfish with articles 423, 471, and 477 of the penal code, and the law of March 27, 1851, relative to the suppression of frauds in the sale of goods, *i. e.*, they may be punished by imprisonment, fines, seizure of their goods, and the publication of the judgment by means of placards; moreover, dealers are made responsible for any cases of sickness which may be caused by the use of red cod. This prohibitory measure, which was taken in consequence of several cases of poisoning caused by spoiled codfish, has raised energetic protests in all the ports where fishing fleets are fitted out, and especially in Bordeaux, which is the most important center of the codfish trade.

At the urgent request of interested parties, indorsed by the deputies and senators from the sea-board departments, the new minister of commerce, Mr. Lockroy, has withdrawn the circular of his predecessor, until fuller information on the subject could be obtained; but this withdrawal is only temporary and not final, as some papers have erroneously stated.

We have therefore deemed it useful to make an exhaustive study of this whole question, and to submit the results to the Bordeaux Society of Medicine and Surgery and to the central Council of Public Hygiene of the Gironde.

Our work is divided into five parts:

(1) In the first we give a brief historic review of all the cases of poisoning caused by spoiled codfish, which, as far as our knowledge goes, have been noticed in the annals of science. We give at the same time a sketch of the symptoms which have been found to accompany these cases of poisoning.

*"*Des accidents toxiques occasionnés par la morue avariée, et de l'interdiction de la mise en vente des morues rouges.*" From the *Journal de Médecine de Bordeaux*, vol. xv, 1886, p. 425. Translated from the French by Herman Jacobson.

(2) In the second we endeavor to ascertain the physical characters of the codfish which have produced these cases of poisoning, with the aid of all the information contained in the reports of the physicians who have treated these cases.

(3) In the third we give the results of recent investigations relative to the nature of the red color of the codfish; and we show that not only is the red in the codfish not poisonous, but that it is not even the determining cause of the putrid change of the codfish. We endeavor, moreover, to ascertain under what special conditions this abnormal color develops, and we show the means by which it may be caused to disappear, or by which its development may be prevented.

(4) In the fourth we show that all the cases of poisoning which have been observed must be attributed solely to the eating of spoiled codfish, whose flesh had already become more or less putrid. We also give the results of investigations relative to the specific poisonous matter contained in spoiled codfish. We compare the phenomena produced by eating spoiled codfish with those produced by other spoiled articles of animal food, and show the difference between these phenomena.

(5) In the fifth we enter into some technical details regarding the cod fisheries, and regarding the curing and preserving of cod; we show the important place which this fish holds among the articles of human food; and we point out the evil effect which the ministerial circular of December 31, 1885, is liable to produce on national and local commerce, without yielding any benefit for hygiene and the health of the people.

I.—REVIEW OF CASES OF POISONING, IN CHRONOLOGICAL ORDER.

(1) *Case on a gun-boat in* 1866, *reported by Dr. Maréchal, chief physician of the navy.*

"In 1866 there suddenly appeared on the 5th of June, in the port of Toulon, a sickness which fortunately was not very serious, but which, when night set in, had attacked about one hundred and thirty men belonging to the navy. All awoke with violent colic, followed soon by liquid, copious, and frequent operations, sometimes by vomiting, and more or less pronounced headache; nearly all the patients had a cold skin, and occasionally they were slightly feverish. In nearly all cases a very marked prostration was noticed, accompanied by profuse perspiration, and an evident tendency to a syncopal condition.

"I at once began to search for the cause of these phenomena. The kitchen utensils were in perfect condition, but the crew had on that day had codfish for their meals. I had the codfish brought to me, and tasted it raw, after I had already eaten it cooked at the same meal as the crew and without producing in me the slightest inconvenience.

"The appearance of the phenomena was as follows: After a period varying between half an hour and one hundred and fifteen hours, and averaging from five to fifteen hours, the symptoms began to appear.

The first were digestive troubles, consisting at first in a feeling of dryness in the mouth and throat, which most of the patients considered as an excessive thirst, while some considered it as the sharp after-taste of their dinner, which they hoped to overcome by drinking copiously. But soon, no matter whether they drank anything or not, they had a feeling of heaviness in the stomach, and a disagreeable bloated feeling, which very soon, however, turned to a severe stomach-ache. In the evening more than half the men were on their feet again, and on the following day most of them did not feel any traces of this slight indisposition."

(2) *Case reported by Dr. Hermann, of St. Petersburg, in* 1878.

In 1878, 108 persons at St. Petersburg were poisoned by eating the salt and dried cod called "stock-fisch," which forms a common article of food in Russia. Dr. Hermann treated four of the worst cases. One of them, forty-four years of age, died after twenty-four hours; and the autopsy showed a hemorrhagic injection of the ileum and the larger intestines. The symptoms in all cases were faintness, stupor, violent colic, diarrhea, vomiting, cramps in the lower extremities; pulse weak, a little quicker than usual; stomach elastic, no sensation of pain when pressed.

In most cases convalescence was reached on the third day; in one case the diarrhea lasted longer than two days. The codfish which had produced these cases had a bad taste and odor; and a sample examined under the microscope showed that the muscular tissue had become granulous and brittle; while the streaks of the muscular fiber were no longer apparent. The codfish had a deep yellow color.

(3) *Case in a regiment of the Foreign Legion, at Sidi-Bel-Abbès, in* 1878.

Dr. Schaumont has published in the Recueil de mémoires de Chirurgie et de Pharmacie militaires (vol. for 1878, p. 504), a report on a case of poisoning of the same kind, showing extremely grave symptoms.

The case occurred in the night of April 19, 1878, in a company of the Foreign Legion stationed at Sidi-Bel-Abbès, province of Oran, Algiers. At 9 p. m. the physician was informed that 20 men had been taken with violent colic, diarrhea, and vomiting. At 11 p. m. the number of patients had increased to 64, and the condition of those who had been taken first became more and more serious. An hour later the number of patients had reached 80. In all, 122 men were sick, 17 of whom had to be sent to the hospital.

"All complained at first of vertigo, headache, and nausea; the face became livid; then followed cramps in the stomach, and vomiting of food matter, and finally frequent and violent attacks of diarrhea. At last the lower extremities began to grow cold, and cramps were felt in the calves."

Dr. Schaumont and Dr. Péborde gave to the sick a draught composed of six drops of ether and eight drops of tincture of opium dissolved in a little water, and followed this up by some tea. In the morning there was a very noticeable improvement in all the patients. On the 21st only 36 were sick; on the 22d, 27; on the 23d, 16; the 24th, 15; the 25th, 14; the 26th, 7; and on the 27th, 4, who were all convalescent on May 1.

After having administered the most urgent remedies, Dr. Schaumont inquired what had occurred on the 19th, and learned that the men had gone to target practice in the afternoon. None of them had experienced the least inconvenience before dinner, although the heat on that day was excessive.

In the evening they had taken their principal meal, composed of codfish, potatoes fried in lard, and wine. In the morning of April 20 several dishes containing some of the food which had not been touched since the evening were taken to the pharmacy of the military hospital to be subjected to an analysis, as well as samples of the wine, lard, and codfish from the stores of the commissary of the Foreign Legion. It was found that neither the wine nor the lard (which was white and free from bad odor) contained any poisonous matter. The potatoes were in perfectly good condition. No copper utensil had been used in cooking any of the victuals. But when the dishes were opened an exceedingly strong and very disagreeable odor was noticed at once, reminding one of putrefying matter.

The sample of codfish from the commissary was examined next. By its external appearance it might deceive an unskilled eye. When subjected to a careful examination, and broken into two parts its entire length, it showed towards the middle a grayish portion, measuring almost six centimeters [2⅓ inches] in diameter, and completely decayed. When opened it exhaled a sickening odor. No poisonous substance was discovered in this analysis. It was, therefore, an evident case of spoiled codfish.

From the above facts Dr. Schaumont arrived at the conclusion that the cases of sickness which occurred in the night of April 19 were caused by accidental poisoning by putrid codfish, which opinion was confirmed by the circumstance that none of the officers, who had a mess of their own and had not partaken of codfish, were in the least indisposed.

(4) *Case reported by Dr. Bertherand, of Algiers.*

While on a tour of inspection of the military grocery stores, Dr. Bertherand ate codfish with a white sauce, which produced colic and diarrhea. The symptoms consisted in "violent pain in the stomach, incessant bilious vomiting, frequent attacks of diarrhea, accompanied by a very painful tenesmus; general collapse, excessive thirst, dysphagy, acrid taste, a burning sensation along the entire esophagus, general cramps, and very cold extremities."

The examination of this codfish showed that it had a faint putrid odor, and that all along the backbone, on the surface and even in the thick part of the flesh round the backbone, there was a very pronounced vermilion color.

Several other persons who had partaken of codfish having a similar red color, and a certain putrid odor, experienced similar attacks of sickness.

(5) *Case reported by Dr. Heckel, of Marseilles, in* 1878.

In 1878 Dr. Heckel visted a family of fifteen persons, who had all been poisoned by a spoiled codfish which had the red color above referred to. The symptoms were similar to those already described, and all the persons suffering from these attacks were quickly cured.

(6) *Case on the flag-ship of the practice fleet in December*, 1880.

This case, witnessed by Dr. Bérenger-Féraud, director of the naval health service at L'Orient, was briefly as follows:

On December 10, 1880, the practice fleet, commanded by Vice-Admiral Garnault, was engaged in gun exercises out at sea between Fréjus and Toulon. After this very tiring exercise, the crew partook of codfish at 10 a. m. At 8 p. m. a sailor from the admiral's ship, the *Colbert*, became indisposed, experiencing violent colic, accompanied by vomiting. Soon after, and during the course of the night, 35 others from the same vessel were taken sick. On the following day and the day after, 16 more were similarly affected, and in all 52 men were taken sick out of a force of 710 men, composing the crew of the *Colbert.*

The symptoms were exactly like those already mentioned, but were not quite so serious, "because convalescence or a perfect cure was effected after a few hours. Even the person who suffered from the most violent attacks was only excused from service for two days.

"On board the five other ironclads and the two transports where codfish from the commissary at Toulon had likewise been used, there were 50 cases of sickness like the one described, but none of them was serious. In all about 100 persons were affected, and none of these suffered more than one to two days."

(7) *Case in the fleet at L'Orient, on October* 3, 1884.

This case, observed and carefully described by Dr. Bérenger-Féraud, is of the greatest importance, and we believe that it really has been the determining cause of the recent ministerial circular prohibiting the sale of red codfish. It is, therefore, proper that we should give it somewhat more in detail.

The first report on this case was published by Dr. Bérenger-Féraud in the Archives de Médecine navale (vol. for 1884–'85) under the title, "Étude d'un empoisonnement multiple survenu á L'Orient par l'usage de morue altérée. (Study on cases of poisoning at L'Orient by spoiled codfish).

In a more recent treatise, published in the Annales d'Hygiène publique et de Médecine légale (October, November, and December, 1885) under the title Recherches sur les accidents que provoque la morue altérée (Investigation of cases of poisoning caused by spoiled codfish) Dr. Bérenger-Féraud, has grouped together all similar cases which have come to his knowledge, and has produced a remarkable monograph, showing the question as it stands at present in all its features.

The number of cases which he describes is 7, and they are not all of equal importance. We reproduce the description of the last, in point of time, as given by Dr. Bérenger-Féraud.

On October 3, 1884, a number of cases of sickness, occasioned by eating codfish from the naval commissary at L'Orient, occurred among the crew of the fleet stationed at that port. Of 387 men composing the crew of the frigate *Vengeance*, 175 were taken sick; 114 of these within twelve hours after partaking of codfish at the noonday meal.

At the same time similar cases occurred on board the *Aubette* and among the marines; but none of these were as serious as the first mentioned. On board the *Aubette* there were only 19 cases of sickness out of a total number of 978 men, and among the marines only 17 were sick out of a total of 746 men; the largest proportion of sick (45 per cent.) was on board the *Vengeance;* and to these Dr. Bérenger-Fèraud gave his special attention.

We should state right in the beginning that most careful investigations very clearly determined the causes of the sickness, as neither the utensils in which the food had been cooked nor the water, bread, coffee, wine, or the oil used in the preparation of the codfish showed the slightest traces of poisonous matter.

In most cases the following symptoms were observed soon after the persons had been taken sick: Stomach-ache, nausea, vomiting, attacks of diarrhea, sometimes accompanied by the passage of blood, and coldness in the lower extremities. Cramps in the lower extremities were not observed in all cases. All these symptoms were of a very pronounced bilious character. The first period of the sickness, lasting from two to ten hours, generally was followed by a period of reaction, accompanied by great lassitude. Convalescence was very rapid, and even those who suffered from the most serious attacks did not have to stay in the hospital more than eight to ten days. In fact, in all these cases of poisoning the first symptoms were very alarming, but the consequences were not serious. A commission of competent men, appointed by the vice-admiral commanding at L'Orient, made a careful examination of the codfish furnished by the naval commissary at L'Orient on October 3, and found that some of it was perfectly sound, while some was spoiled.

According to the report of this commission, the change in the codfish, which were found to be spoiled and which had caused the cases of sickness, "consisted in an abnormal coloring of the muscular tissue of the fish. This color varied from a tender rose color to an orange-red, and seemed to follow certain portions of the flesh, leaving others close by entirely sound. This change was noticed in the two muscular bands lying along the backbone and in the neighborhood of the head. The more intense the color, the more deeply did it penetrate into the tissues. In codfish which had some pale rosy spots it went only to the depth of half a millimeter [one-fiftieth inch], while in some which had an orange-red color it went to the depth of 3 or 4 millimeters, and even half a centimeter [.12 to .20 inch]. In these last-mentioned fish the spoiled portions exhaled a putrid odor, and at the same time the muscular fiber crumbled to pieces, having lost all consistence."

The above are the symptoms of cases of poisoning by spoiled codfish, observed and described by Dr. Bérenger-Féraud.

In spite of the most exhaustive bibliographic researches made by us in regard to this subject, we have not been able to find in the numerous medical publications consulted by us any other cases, and, as far as our knowledge goes, we have not learned that any cases of this kind have ever occurred at Bordeaux. Our city, however, is the principal port of importation of codfish, and an enormous quantity of this fish is consumed in Bordeaux.

Cases of poisoning by codfish are therefore extremely rare, considering the vast quantity of codfish consumed throughout the world. Such cases have only been observed among troops or on board a fleet, where it is well known the food is not always of the first quality, and where the culinary arrangements often leave much to be desired.

II.—Characteristics of the codfish producing cases of poisoning.

In endeavoring to ascertain the characteristics of the codfish which have produced cases of poisoning like those described, we find that in 4 out of the 7 cases the codfish did not show any red color (on the gunboat, on the practice fleet, case reported by Dr. Hermann, and the case which occurred in the Foreign Legion at Sidi-Bel-Abbès.)

In the St. Petersburg case—the only one where the symptoms were violent enough to cause death—the codfish had a deep-yellow color, a bad flavor, and a bad odor; its flesh crumbled to pieces; in short, it showed unmistakable signs of putrefaction.*

The same, or very nearly the same, physical characteristics were observed in the case which occurred in the Foreign Legion at Sidi-Bel-

*It seems proper to state here that the only case of death resulting from spoiled codfish was one caused by the cod caught and prepared by the Norwegians, and termed "stock-fisch." But "stock-fisch" never turns red. The mode of curing it is entirely different from that followed in France. The "stock-fisch" is cod dried, hardened, and rolled out into sticks, which are left to dry in the open air for two or three months. The French fishermen never cure codfish in this way.

Abbès. When the lids were removed from the dishes which contained the codfish an exceedingly strong and disagreeable odor arose at once, in every respect like the odor from putrid animal matter. The codfish taken from the commissary might deceive an unskilled eye; but when subjected to a careful examination, and broken in two along its entire length, it showed towards the middle a grayish part, measuring hardly 6 centimeters in diameter, and completely decayed. This part when broken open exhaled a sickening odor.

In the first four cases of poisoning, therefore, which are the most important on account of the larger number of individuals attacked (460), no red codfish was the cause. On the contrary, this red color was noticed only in the three other cases, in which the total number of individuals attacked was only 227 (case of Dr. Bertherand, in Algiers; case of Dr. Heckel, in Marseilles; case on the fleet at Lorient).

The codfish described by Dr. Bertherand had along the backbone a very pronounced vermilion color; but it had at the same time a faint putrid odor. The codfish which Dr. Heckel examined at Marseilles in 1878, and by which fifteen persons were poisoned, had likewise a red color.

As regards the codfish which caused the more recent cases of poisoning on board the fleet at L'Orient, they showed an abnormal color, from a tender rose-color to a deep red-orange, and this color was found principally in certain parts of the fish (the two muscular bands lying alongside of the backbone), leaving here and there portions which were entirely sound. Especially in those codfish which had an orange-red color the spoiled portions exhaled a putrid odor; the muscular fiber crumbled to pieces, and had lost all consistence.

It will be seen that in the three cases where the red color was noticed there was observed at the same time a putrid odor and a crumbling of the muscular fiber—plain indications that the flesh of the codfish had become decayed.

It appears from the brief examination of the physical character of poisonous codfish that in two-thirds of the cases observed there was no red color, while the putrid odor and the crumbling of the flesh were observed in all cases.

There is, therefore, no reason to assume that the red color of codfish is an indication of their being poisonous, because on the one hand the most numerous and most serious cases of sickness have been caused by codfish which did not have its red color, and because, on the other hand, in cases of sickness caused by red codfish there was at the same time noticed a putrid odor and the crumbling of the flesh—the only indications (we must repeat it) common to all cases, and the only ones which can be considered in the etiology of cases of poisoning of this kind. In short, these codfish did not cause cases of poisoning because they were red, but because they were more or less decayed or putrified.

Although there is no absolute identity of symptoms between the cases of poisoning caused by spoiled codfish and cases of poisoning produced by other spoiled fish, or by fresh or preserved meats which have begun to decay, there is good reason to believe that all these cases must be attributed to special poisonous substances produced by the putrefaction of animal matter.

III—NATURE OF THE RED SUBSTANCE IN CODFISH, ITS CHARACTER, DEVELOPMENT, AND PREVENTION.

Since it has been deemed proper to prohibit the sale of red codfish, it is evident that in the opinion of the ministry which has taken this measure, the red codfish is the principal indication that the flesh has undergone a hurtful change. But what proofs are there, and what experiments can be cited, to show that the red color of the codfish possesses any poisonous qualities? We shall endeavor to answer these questions.

In the first place, what constitutes the red color of the codfish? The few authors who have studied this subject do not agree among themselves. It seems, however, pretty well established that this red color is produced by the development of a fungus, whose name varies according to the different authors who have described it. Thus, Mr. Fonssagrives calls it the *Penicillium roseum;* Mr. Heckel, the *Coniothecium sanguineum;* and Mr. Mégnin, the *Coniothecium bertherandi.* In an article published in the Madrid Imparcial, March 20, 1886, and cited by Prof. Alex. Layet, it is stated that some years ago (in 1878) attention was called at Gloucester and some other places in the United States to the red color of the fresh and dried codfish, which appeared during the summer months. Prof. W. G. Farlow was commissioned to investigate the causes of this coloration, and it is stated in the Imparcial that Professor Farlow found that it was caused by an alga of the family of the *Nosto chaccæ*, namely, the *Clathrocystis roseo-persicina.** Mr. Carles, who has recently published the results of his researches in the Bulletin des travaux de la Société de Pharmacie de Bordeaux (February, 1886), thinks that the red color of the codfish is caused by the evolution of various parasites of a very primitive organization, belonging to the micrococci.

This is also, we believe, the opinion of Mr. Gayon, professor of chemistry at the faculty of sciences at Bordeaux and chief chemist of the custom-house, who for about two years, in conjunction with Mr. Carles, has been engaged in the cultivation of these small organisms. He writes the following:

"When one examines under the microscope the red spots of a codfish one sees among the loose muscular fibers and the sea-salt crystals numerous organisms of various kinds, young and live specimens of the micrococcus. The red color is attenuated through their enlargement.

"If the surface of a red spot is dissolved in some drops of boiling water, and if the liquid obtained is carefully stirred in codfish broth or

* See F. C. Report for 1878, p. 969, and F. C. Bulletin for 1887, p. 95.

poured on moist pieces of muscle of codfish, it will be found that after having been kept in a stove heated to from 30° to 35° C. [89° to 95° F.] red color develops and gradually covers all the parts exposed to the air. The microbes causing this coloration are, therefore, aërobies (produced by the action of the atmosphere).

"By successive experiments, and by varying the physical and chemical conditions, Messrs. Carles and Gayon succeeded in eliminating a large number of live organisms; and when they closed their investigations there were only two kinds left, a bacillaria and a micrococcus, which, when mixed, invariably produced the red color, although it could not be determined which part each took in this process. It is remarkable that these infinitesimal organisms can live on sea-salt; they even develop on salt crystals which are merely moist, but not on all kinds of salt."

On the other hand it appears from recent investigations made in the hygienic laboratory of the medical school of Bordeaux, by Drs. Layet, Artigalas, and Ferré, that "in examining the red matter of the codfish under the microscope we find, after it has been dissolved in water or glycerine, that it is composed of (1) crystals of sea-salt; (2) lanceolate lamellæ; (3) a granular substance; (4) muscular elements; and (5) special elements, resembling in shape the elements called sarcines, found not only in decaying but also in sound substances. They represent quarters of a sphere joined by a common diameter. Taken by themselves, each one of these elements is transparent and colorless, but when grouped in masses, forming several layers, it can easily be seen that the center has a rosy color. The coloration, therefore, seems to be due to the greater or less quantity of these elements. One of the gentlemen who made these experiments was of opinion that the red color was produced exclusively by the sarcinoid elements.

The three gentlemen arrived at the following conclusions as the result of their microscopical examination:

(1) There are, on the surface of the codfish showing a red color and in the interstices between the bundles of the surface muscles, special organisms of a vegetable nature which constitute the coloring elements.

(2) These elements are found in masses, together with a granular substance composed of single or double grains, zooids, and detritus.

(3) These colored masses are particularly dense round the salt crystals, appear to penetrate with them into the interstices between the bundles of muscles, and to reach small cavities when these open on their level.

It was important to know whether these small cavities were found in the sound codfish, without red color. This could easily be ascertained. Cuts made in a sound codfish showed these cavities formed of radiating lamella, more or less filled with detritus. They are, as in the red codfish, found in the first central muscular layer, in the shape of grains producing a screeching noise when rubbed on a plate of glass.

This kind of corrosion of the muscular fibers must, therefore, be attributed to an entirely different cause than the development of the red color. It is probably a normal production in the codfish during the salting process.

In the red codfish no other change is noticed in the muscular tissue, except the formation of small cavities which are found in the salt, white, sound codfish; but the red color penetrates into the flesh, continues to develop, and gains in intensity.

In an additional note, Dr. Layet states that the small organism composing the red part of the codfish is not a fungus, but rather an alga, belonging to the family of the *Bacteriaceæ*.

We shall not say any more regarding the composition and nature of the red of the codfish, as we desire that our article shall keep the character of a practical hygienic treatise. Whatever may be its nature, the red is evidently a parasitic growth in the flesh of the codfish. So far as our knowledge goes, there is not a single proof of the poisonous character of this parasite, while proofs of the contrary abound.

We first give the opinion of Dr. Dumas, of Cette, vice-president of the hygienic council of Hérault, as given in the treatise of Mr. Bérenger-Féraud. Dr. Dumas says: "This fungus is not poisonous in itself, which fact has been sufficiently proved by direct experiments made by the codfish dealers of Cette, who, as well as their employès, have many a time eaten rose-colored and red codfish, which was otherwise perfectly good, without being in the slightest inconvenienced thereby."

Mr. Bérenger-Féraud adds that the employès of the commissary's department at L'Orient have frequently made the same experiment with exactly the same result. He does not believe in the poisonous character of the red of the codfish, and bases his opinion on the circumstance that he has many a time seen people eat rose-colored and even red codfish which had no putrid odor without causing any indisposition, and on the fact that Mr. Degorce, principal pharmacist of the navy at L'Orient, has frequently found this same fungus in otherwise perfectly sound codfish, and that fish containing these fungi have repeatedly been eaten without causing any disturbance of the digestion, so that it can certainly not be termed a poisonous fungus. Mr. Mégnin is, as far as we know, the first who has given red codfish to live animals (dogs and rabbits). The result of his experiments was entirely negative, as these animals showed no symptoms of indisposition. He, therefore, reached the conclusion that this fungus is not poisonous.

Dr. Carles, of the School of Medicine of Bordeaux, also maintains that the red of the codfish is not injurious to health. He calls to mind the fact that the city of Bordeaux, which for the last two years has been right between two dangerous cholera centers, has remained entirely free from any case of sickness resembling cholera, in spite of the enormous quantities of red codfish from the suburban drying establishments which were consumed in the city every day.

Professor Layet, in his recent "*Note sur le rouge de la morue*" (notes on the red of the codfish), states that "the red in itself cannot be considered as the cause of poisoning by spoiled codfish, but that the poisonous character depends entirely on the state of putrid decay of the fish." For more than a week he fed two cats exclusively on red codfish, and these animals were not in the least inconvenienced thereby.

We have fed two hunting dogs of medium size on a codfish which was strongly tainted with red, and neither of these dogs experienced any disagreeable consequences. The codfish was given to them mixed with bread soaked in tepid water. It should be stated, however, that this fish when split open along its entire length did not emit any putrid odor, and that its flesh had preserved its normal consistence.

We ourselves have repeatedly eaten red codfish without being inconvenienced, and we know many places in the southwest of France where the codfish sold by the small dealers frequently has a red color.

If one considers, on the other hand, that the greater portion of the codfish received in our colonies, in the Antilles, in Réunion, and in eastern countries has always more or less of a red color, produced by the influence of the great heat, and that the people of these countries have been in the habit of eating such codfish every day, from time immemorial, without experiencing any injurious consequences, we are forced to the conclusion that the red color of the codfish has nothing to do with the poisonous nature of the decaying flesh.

But, it will be said, if red codfish are not injurious to health, why has their sale been prohibited, as a hygienic measure? Here the question becomes somewhat complicated.

Mr. Bérenger-Féraud says in his treatise: "If the red is not poisonous in itself, it seems certain that, when closely examined, it acts in a powerful manner in producing or aiding the decay of the codfish, and the decay always began, as far as the codfish served to the garrison at L'Orient is concerned, coincident with the appearance of the reddish color. In those parts which first turned red, and in their immediate surroundings, the flesh was first noticed to become soft, moist, and crumbling, and finally the putrid odor first began to show itself in these parts."

Further on the same author states: "In my opinion, therefore, the codfish sometimes undergoes a change whose first indication is the growth of the red cryptogam referred to. It is true that this cryptogam, in itself, has not the property to render the flesh poisonous, but it will, under certain special conditions—for instance, when the weather has for some time been moist and hot—favor a putrid decay of a greater or less portion of the codfish."

According to Dr. Bérenger-Féraud, therefore, the red, although not poisonous in itself, is one of the determining causes of the putrid decay of the codfish. It probably (the author is not absolutely sure) hastens the putrid decay of the flesh; and this is the only effect of the kind which it produces.

This opinion appears to us to be based on an inaccurate interpretation of the facts. We agree that this is only a supposition, but the authoritative character attaching to it from the high standing of the author has caused it to be accepted as true in government circles. The minister reasoned in the following manner: Because the red color of the codfish causes and aids its putrid decay, we shall prohibit the sale of red codfish, and thus cause all danger of poisoning to disappear on the well-known principle that when the cause is removed the effect will cease. This mode of reasoning would be correct if the basis on which it rests were sound, but so far the relation supposed to exist between the red color of the codfish and its poisonous putridity has not been sufficiently proved.

If the opinion of Mr. Bérenger-Féraud is well founded, the degree of poison in the flesh of a codfish should be in the direct ratio of the extent and intensity of the red color. But the very contrary is the case, because in by far the larger number of cases of poisoning by spoiled codfish and in the most serious cases there was no red color. In a second category of facts, it is true, the codfish which had been eaten were red, but we believe to have shown sufficiently that these fish did not produce cases of sickness, because they had this abnormal color, but because they were at the same time spoiled and partly putrid.

In short, the more or less advanced stage of putrid decomposition of codfish, no matter whether they are red, gray, yellow, or white, is, in our opinion, the sole cause of the poisonous character of their flesh.

In order to maintain authoritatively, as Mr. Bérenger-Féraud has done, that the red color—although inoffensive in itself—favors the putrid decomposition, and should be considered as the first cause of the poisonous nature of the flesh, it ought to have been proved, in the first place, that all the codfish which produced cases of poisoning were more or less impregnated with the fungus referred to above. But this proof has not been furnished. On the contrary, it has been clearly shown that this cryptogamic vegetation has been observed only on a small number of the codfish which produced cases of sickness; from which we think we can draw the conclusion that the presence of the red color on these fish is simply a coincidence and a sort of unimportant phenomenon.

Although the red color is found both in sound and spoiled codfish, it is none the less true that, from a commercial point of view, to which we shall soon have occasion to return, codfish which have that color are slightly depreciated in value in our French markets, where whiteness of the flesh is the principal recommendation of a codfish. It seems that this was not always so, for we read in a popular almanac for the year 1838 that red codfish was at that time considered the best; a proof that the popular taste changes in course of time, and that red codfish are not a new thing. In hot countries, especially in the Antilles and in Réunion, consumers even to this day give the preference to red codfish, which they term "*saumonée*" (salmonified).

Endeavors have been made to find what might be the cause of the red color in codfish. It has been noticed more frequently during the last twenty years. Sometimes it is found in all the codfish of one consignment, and sometimes there is not one which has a red color. It seems that moist heat favors its development. It has been observed that entire cargoes of codfish which had kept white during the voyage from Newfoundland to Bordeaux rapidly turned red only a few days after their arrival at the latter port.

According to Dr. Dumas some dealers have observed "that the rose color shows itself most frequently when Mediterranean salt has been used in salting codfish, while the salt from the west of France produces the contrary effect, and they think that this result is due to the presence in the salt from the west of France of a larger quantity of small earthy particles. These particles, although rendering the salt less pure, would therefore have at least this advantage, that they prevented the codfish from turning red. But as this salt gives to the codfish a yellowish color, which is not very agreeable to the eye, most people prefer to use the Mediterranean salt."

This opinion regarding the special influence of the Mediterranean salt on the development of the red color is not shared by all dealers; but it is nevertheless interesting to note, because it raises the question as to the influence of the salting on the production of parasitic germs in albuminous matter.

According to Dr. Layet there are facts, proved by actual practical observation, which seem to show this influence of the different methods of salting on these small organisms in other substances than the red of the codfish, as for instance, the appearance of red color in the Norwegian sardines; and there are likewise facts, proved by experiments, which clearly establish the influence of sea-salt on the development of microbic germs. Miguel has clearly shown that, according to the quantity of salt added to the liquids which serve as elements of cultivation for *schizomycetes*, these show themselves in greater or less quantity; a certain quantity favors their development, while a different quantity almost entirely prevents it.

We have already given the opinion of Professor Farlow regarding the red color of the codfish. According to the Spanish journal which has published Professor Farlow's opinion, he examined the Cadiz salts, which showed a slight rose-colored tinge, and arrived at the conclusion "that the Cadiz salt, as it comes into the hands of fishermen, is already impregnated with a considerable quantity of the *clathrocystis*," and that this plant develops on the codfish whenever the temperature is sufficiently high (above 65° F.)

Let us now hear what Mr. Carles has to say on the subject:

"It is a very delicate matter to show precisely whence come the germs of this red coloring, especially in the absence of samples of the different substances with which the codfish has come in contact from the time it is caught till its arrival in the port of destination. But everything leads us to suppose that the origin of the trouble is in the salt; and if the germs develop on salt fish with an intensity which varies in different years—*i. e.*, according to the temperature, the condition of the atmosphere, etc.—the codfish must, in order to become a fertile soil for the parasite, have commenced to spoil on the surface."

In short, it may be said that all the naturalists who have occupied themselves with this question and the codfish dealers agree in considering the salt as one of the principal causes of this cryptogamic vegetation. But so far this is only a supposition, which, in spite of its great probability, needs to be confirmed by experimental investigations conducted on scientific principles. We know that Messrs. Layet, Artigalas, and Ferré, of Bordeaux, and Dr. Heckel, of Marseilles, have undertaken this task, and we shall probably soon learn the results of their investigations.

Several means have been proposed to prevent the development of red in the codfish, but so far none has proved sufficiently practical to be employed. Salicylic acid, borate of soda, sulphite of soda, a freezing process, etc., all have been mentioned. By a ministerial circular of February 7, 1881, the application of salicylic acid to articles of food was prohibited. This method, therefore, could not be employed. As regards borate of soda, by which it has been proposed to replace the salt, and the freezing process, it must be said that these methods are too expensive to be employed to any extent.

As far as we are concerned, and until something better is found, we freely give the preference to the means indicated by Mr. Carles, which, if they do not altogether kill the germs, at least prevent their spread. These means are the following:

(1) Careful washing of the fresh codfish, so as to remove all impurities from the intestines.

(2) Using salt obtained from mines, which is free from all germs, and contains fewer deliquescent magnesian salts.

(3) Washing and disinfection of the vessels by fumigation with sulphurous gases.

(4) Disinfection, by the same means, of the material, the ground, and the walls of the drying-houses.

(5) Removing at once from the drying-houses all organic detritus produced by the washing of the fish and their immediate disinfection by sulphates of iron or copper.

(6) A final washing of the fish in water from which all organic products and deliquescent salts have been carefully removed.

This question of the influence of the salt on the production of the red color in codfish naturally leads us to speak of the codfish termed "soft-salted;" that is, insufficiently salted. It is certain that these codfish spoil more easily than others, and may therefore cause cases of poisoning similar to those which have been described. Otherwise they are much less subject to being infected by red color than those which have been well-salted. When fresh—and even when dried—they exhale, according to the statements of dealers whom we have consulted, a very strong odor of garlic; their flesh is soft, and an impression made with the finger will remain. When cooked they exhale a putrid odor, characteristic of their decay, which generally prevents people from eating them.

There are "soft-salted" codfish which accidentally have been badly salted at the fishing stations. Their number, however, is small; but there are large quantities of badly salted codfish simply owing to the fact that the fishermen, with the view to making greater gains, have been too saving with their salt. Insufficiently salted codfish keep a much larger quantity of water in their flesh than well salted ones, and consequently weigh heavier when they reach the French ports, where they are sold by weight.

This method of insufficiently salting codfish can not be censured too severely, and dealers can not be too careful in this respect, as both from a hygienic and from a commercial point of view the consequences may be most deplorable.

IV.—NATURE OF THE POISONOUS SUBSTANCE CONTAINED IN PUTREFIED CODFISH.

The cases of poisoning observed, which we have described in the first part of this treatise, prove beyond a doubt that spoiled codfish contains a poisonous substance which, when eaten, is liable to cause in human beings more or less serious cases of sickness resembling cholera in its symptoms. We deem it proper to enter somewhat into detail regarding the nature of this poison; and it may be stated here that there are weighty reasons for supposing that the poisonous substance of putrefied codfish is a cadaveric alkaloid or ptomaine.

This last-mentioned word was introduced to science in 1872 by Professor Selmi, of Bologna, who first of all toxicologists called attention to the existence of small quantities of poisonous alkaloids which could be extracted from human bodies, which had not been poisoned, after having lain in the ground for some time. He proposed for these poisonous substances the name *ptomaine* (from the Greek word πτῶμα, cadaver), and pointed out the possibility of confounding these substances with vegetable alkaloids. In 1870 Selmi's attention was for the first time directed to the existence of these alkaloids. He produced, according to the method of Stas, from the entrails of a man who was supposed to have been poisoned an alkaloid which he could not identify with any of the poisonous alkaloids hitherto known. But it was only in 1874, and later, in 1878, that Selmi again took up this question and made experiments on a large scale on human bodies which had been buried for several months. By these experiments Selmi established, beyond the shadow of a doubt, the fact that poisonous alkaloids will develop in the course of putrefaction.

This study of the ptomaines from a toxicological point of view has been continued in France by Messrs. Brouardel and Boutmy. In 1881 Messrs. A. Gauthier and Etard, taking up Selmi's work, isolated the products from a large number of putrefying fish from the volatile bases belonging to the pyritic series, which were the first of these interesting compounds to be analyzed. The physiological action of these alkaloids varies greatly; some are only poisonous for animals, while others produce symptoms similar to those produced by strychnine, morphine, and veratrine.

Our knowledge of these substances, some of which are extremely poisonous, is still very rudimentary. A large number, however, of new and well-established facts have increased our knowledge since 1850, when Stas, in connection with the celebrated Bocarmé affair, discovered a method of separating the alkaloids, which bears his name. But, on the other hand, many new alkaloids have been discovered since that time whose poisonous character has hardly been demonstrated, or which as yet has not been shown at all. Mr. Duvillier, professor of chemistry in the medical school of Algiers, has discovered a large number of these cadaveric alkaloids in the flesh of spoiled codfish, which Dr. Bertherand had submitted to him for analysis in 1878. This chemist by following the Stas method succeeded in obtaining the characteristic reaction of ptomaines (precipitate of Prussian blue by prussiate of potash and perchlorate of iron).

Mr. Degorce, principal pharmacist of the navy, did not obtain the same result in his examination of spoiled codfish from the port of L'Orient. He says in his report to Mr. Bérenger-Féraud: "50 grams of codfish, taken from those parts of the fish which were rose-colored, were treated according to the Stas method, and did not show any traces of organic alkaloids or ptomaines." This negative result is not surprising. It is, on the contrary, only another proof that the poisonous substance of spoiled codfish is not found in its red portions; and it is more than probable that, if this chemist had sought for ptomaines, not in the red portions, but in the positively putrid flesh of the codfish, he would have found them.

Other experiments have confirmed the presence of ptomaines in putrefied codfish. Brieger discovered, besides the alkaloids which are generally found in spoiled articles of animal food, a particular ptomaine, which he has called *gadinine*. Mr. Brieger has made experiments on ptomaines developed in digested fibrine, in spoiled milk, putrefied fish, spoiled cheese and gelatine, and putrefied yeast. According to him, putrefied milk produces a poisonous base *neurine*, and a non-poisonous base *neuridine*. The poisonous quality of *neurine* is ten times stronger than that of choline. *Neurine* is the characteristic alkaloid of putrefied meat. In the long run, these alkaloids are destroyed by the process of putrefaction. Decayed fish produces *neuridine*, *diamine-ethylene*, *muscarine*, similar to that of mushrooms, and a new base, *gadinine* and *rimethylamine.* Most of these ptomaines have been reproduced by synthesis.

Professor V. K. Anrep, of Kharkov, Russia, had occasion to observe several cases of poisoning by salt sturgeon, five of which were fatal, and found on investigating the nature of the poison that it was a ptomaine. He examined matter drawn from the gastro-intestinal canal of one of the victims (blood, liver, brain, and milt of the sturgeon), and likewise the urine of one of the persons who had died, and he found in both cases a substance identical in its physical and chemical properties as well as in its physiological action on animals. This ptomaine appeared in the shape of a solid amorphous substance, having strongly pronounced alkaline properties, and of an exceedingly strong, poisonous character. Not very soluble in water it produces salts of a very great solubility. Its principal characteristic is its great firmness.

When given to animals (dogs, rabbits, frogs) it very soon produced the same symptoms which had been observed in human beings. In human beings the eating of poisonous fish invariably produced in a few hours (never more than twenty-four) great lassitude, a sensation of cold with violent pain in the stomach, vomiting, dryness of the mouth and tongue, excessive thirst, a weakened sight, ptosis, and dilation of the pupil of the eye, cold extremities, difficult respiration, præcordial anxiety, a slow pulse, considerable prostration, and gradual diminution of the temperature of the body. In fatal cases the cardiac and respiratory functions do not recover their normal condition and the sight becomes very weak. These symptoms are followed by cyanosis of the face, paralysis of the bladder and intestines, and great difficulty in speaking or even uttering sounds. Death occurs on the second day, or sometimes on the third or fourth.

Bocklisch found that codfish and perch undergoing a process of putrid fermentation yielded different products. He also made an investigation regarding herring, which frequently, when decayed, cause cases of poisoning. He succeeded in extracting from the brine of herring the following bases: *trimethylamine*, *dimethylamine*, and *methylamine.* In the flesh of a decayed herring he found *cadaverine* (discovered also by Brieger), *diamine-ethylene*, *gadinine* (discovered by Brieger), and *putrescine,* as well as *methylamine* and *trimethylamine.*

This question, which is still but little known and has not been sufficiently studied—that is, the question of poisons produced in decaying organic matter—has been treated from a more general point of view by Mr. Netter in an excellent treatise published by him in 1884 in the Archives générales de Médecine. The author attributes to these poisons, the study of which has hardly been begun, the cases of poisoning known as *bolutism* and *allantiasis*, which sometimes occur after partaking of certain articles of food, especially preserved meats and spoiled sausage. The following are, according to Mr. Netter, the symptoms of *bolutism:*

"Two stages may be distinguished; one of irritation and one of paralysis. Eighteen hours after the food has been partaken of the patient complains of an uncomfortable feeling, general lassitude and pain and a heavy feeling in the epigastrium. He has no appetite; but instead nàusea, attacks of retching and vomiting. There is pain in the abdomen, which is frequently swollen and extended. Sometimes diarrhea sets in at the very beginning, but it is soon followed by constipation, which generally is very severe. There is an extraordinary dryness in the mouth and throat, which frequently rises to a burning sensation. Only in rare cases these symptoms are accompanied by chills. The head aches.

"On the second or third day the paralytic stage commences. At first this shows itself by attacks of vertigo, an uncertain step in walking, and heavy respiration. The sight becomes dim and the pupil of the eye is dilated. On the third or fourth day the upper eyelid falls down, the pupil is immovable and insensible. Then follow attacks of choking and cough, reminding one of croup. From the fourth to the tenth day dysphagy becomes more pronounced, and it now becomes impossible to swallow anything. All secretions are suppressed, with the exception of the urinary secretion; constipation becomes settled, the faintness of sight becomes amaurosis, and the hoarseness becomes speechlessness; the sense of touch is entirely lost. The patient can no longer move the tongue. The paralysis of the members becomes complete; the skin is cold, the pulse slow and feeble, and the beating of the heart can no longer be noticed. One fainting spell follows another, and respiration ceases. Finally the patient dies with every indication of complete and utter exhaustion. Sometimes death is accompanied by convulsions.

"This is the course in fatal cases. Death, which follows in one-third of all the cases, occurs during the first ten days. At the autopsy nothing can be discovered but a congestion of most of the viscera. Rigidity sets in slowly, and putrefaction likewise makes its appearance very slowly."

These morbid phenomena of *bolutism* differ far too much from those of poisoning by spoiled codfish to allow us to draw the conclusion with Bérenger-Féraud that they both are produced by the same cause, by a poisonous substance having varying effects, according to its different degree of strength. It seems much more natural to suppose that the putrefaction of animal matter produces different poisonous substances, according to the nature of the matter in which they are developed.

This appears very clearly from all the recent researches and from the different symptoms which have been observed both in cases of accidental poisoning by decayed food substances of animal origin and in physiological experiments.

Mr. Bérenger-Féraud himself recognizes the decided difference of the symptoms of the two cases. "In cases of poisoning by spoiled codfish," he states, "we notice immediate attacks resembling that of cholera, and after this first stage has been passed the condition of the patient improves very regularly and rapidly. In *bolutism*, on the other hand, there are two stages, one of irritation and the other of paralysis, and after a short and deceptive period of improvement the special symptoms begin to show themselves—paralysis of the limbs, eyelids, etc.; symptoms which have never been known to follow the eating of spoiled codfish." It is truly astonishing that the author, after making the above statement, nevertheless arrives at the conclusion that there is a complete etiological identity between the two cases.

For our part we can not share this view; and we find a new proof of the decided difference between the two poisonous substances by examining the different symptoms by which these two cases of poisoning are followed.

Poisoning by spoiled codfish, which we propose to designate by *gadinism*, in order to distinguish it from other cases of poisoning of the same kind, has only resulted in death in a single case (in St. Petersburg) among 700 persons who had been poisoned. *Bolutism*, on the other hand, very frequently causes the death of the victims, as will be seen from the following facts from Mr. Netter's treatise already referred to:

In 1799, on a farm in Suabia, 5 persons were taken sick from eating spoiled meat-balls, and 4 of them died. In 1808, Jaeger observed 25 cases, in 11 of which death followed. In 1820, Kerner observed 76 cases, of which 37 were fatal; and in 1822, 155 cases, in 86 of which death ocurred.

The objection might be raised against these statistics that they are of ancient date, of foreign origin, and that the study of these cases doubtless left much to be desired. But the opinion which we have advanced regarding the probability of the existence of different poisonous substances in decayed articles of food of animal origin is not merely based on a comparison of the symptoms of *bolutism* described by Mr. Netter and the symptoms observed in cases of poisoning by spoiled codfish and on the different course of the illness following these two kinds of poisoning; it is also based on the comparative examination of a certain number of more recent cases of poisoning by animal substances of the most varied character, in which the symptoms showed essentially different characteristics.

It is impossible to give in this place a detailed account of all these cases without exceeding the limits allowed for this article. We shall content ourselves to enumerate them and to indicate the sources from which they have been taken, so that our readers, if they desire it, may study these sources, and ascertain the truth of our assertions:

(1) Cases of poisoning produced by the eating of mussels, communicated by Dr. E. Monod at the session Society of Public Hygiene of Bordeaux, December 5, 1883 (Revue sanitaire de Bordeaux, January 25, 1884).

(2) Case of poisoning by eating Portuguese oysters during the month of August, observed by Dr. Méran (Revue sanitaire de Bordeaux, January 25, 1884).

(3) Case of poisoning from eating the roe of flounder, reported by Dr. Rondot (Revue sanitaire de Bordeaux, January 25, 1884).

(4) Case of poisoning from eating preserved turkey which had become spoiled, communicated by Mr. Darnet, a pharmacist of Soulac at the session of the Society of Public Hygiene of Bordeaux, December 5, 1883 (Revue sanitaire de Bordeaux, January 10, 1884).

(5) Poisoning by the flesh of a goose, reported by Brouardel in Hoffman's Traité de Médecine légale.

(6) Poisoning by the spoiled flesh of a turkey, communicated to the Academy of Medicine of Dublin at the session of January 18, 1884. (Revue sanitaire de Bordeaux, March 10, 1884). In this connection the author recalls other cases of poisoning by spoiled meat, observed by Van der Corput, Klein, and Ch. Cameron.

(7) Case of poisoning by small mussels; reported by Dr. J. Turle in the Sanitary Record, January 15, 1884. This was a case of the death of a person who had eaten about a handful of these small shell-fish, bought in the Finchley market. Four hours after eating them he was taken with violent attacks of colic, followed by utter prostration, and death after thirty hours.

(8) Poisoning by eating snails; reported by Dr. Dumas, of Cette, in 1873. Several persons who had partaken of snails were taken with intestinal troubles, nervous symptoms, vertigo, headache, delirium, etc. (Revue sanitaire de Bordeaux, March 10, 1884).

(9) Poisoning by spoiled meat. This case occurred at the Bordeaux fair in October, 1884, in a family of strolling actors, three of whom died (Revue sanitaire de Bordeaux, October 10, 1884).

(10) Poisoning by spoiled English preserved beef, March 26, 1881, on board the English pleasure yacht *Amy*, in the harbor of Villefranche This was observed and described by Bérenger-Féraud in his treatise Sur les accidents que provoque la morue altérée (cases of sickness caused by spoiled codfish).

(11) Poisoning by cheese, in Michigan (Revue sanitaire de Bordeaux, January 25, 1885).

(12) Poisoning by meat from a sick calf (Echo vétérinaire belge; Art médical de Bruselles, June, 1885, and Revue sanitaire de Bordeaux, September 25, 1885). In this last-mentioned case 10 persons were poisoned, and 1 died. The man who died, and a woman, showed typhoid symptoms. The others, whose cases were not so severe, were attacked by headache, violent diarrhea, and intense colic for two days. The patients, moreover, suffered from a very painful dysury, and the urine, which flowed out drop by drop, was as black as ink.

(13) Numerous cases of poisoning by mussels; communicated to the Berlin Society of Medicine by Dr. Virchow, at its session of November 18, 1885.

The cases occurred in one of the docks of Wilhelmshafen on the North Sea. After two vessels had entered the dock, and after the water had been let out, it was noticed that these vessels were covered with an innumerable quantity of mussels. The workmen gathered them, had them cooked, and partook of them with their families. After a few hours 19 persons (13 men, 5 women, and 1 child) were taken seriously ill. Four died; the first, three-quarters of an hour after having eaten the mussels; the three others several hours later. We should state that these two vessels were not covered with copper.

The symptoms observed after eating only from five to six mussels were in all cases the same. The teeth of the patients seemed blunted; they experienced an itching sensation in the hands and feet, but no headache. An excitement like the one produced by alcohol soon gave way to a feeling of depression; the pulse varied between 80 and 90; the temperature of the body did not increase; the pupil of the eye became dilated, but the vision did not become dim; convulsive movements of the hands were noticed, great feebleness in the lower extremities; no diarrhea. During the last stage there were general chills, anxiety, a feeling of oppression, and finally the patients died, without having lost consciousness for a single moment.

At the autopsy the intestines showed symptoms of inflammation of the bowels, which confirms the opinion of Orfila as to the irritating action of the poisonous substance.

Professor Virchow gave some of these mussels to dogs, cats, rabbits, and frogs; and all these animals died after having eaten a very small quantity. Thus, the largest dog had only eaten from six to seven mussels. A cat licked a very small quantity of the liquor from the mussels left in a dish and was taken violently sick. The poison must, therefore, have been very strong. Dr. Schmidtmann, the physician of Wilhelmshafen, who observed all these cases of poisoning, believes that it was ptomaine. Virchow is inclined to consider it as a chemical poison. In either case it must be admitted that the mussels produced this poison.

In the Japan seas there is a species of fish which for several months during the year becomes poisonous, while during the remaining portion of the year it may be eaten with impunity. Does not this fact agree with the supposition of a kind of virulence showing itself at the time of reproduction, and might not this virulence be the result of the development of a normal or accidental ptomaine, resembling the substance described by Balbaud (in Études sur l'empoisonnement par les moules, Paris, 1870), and termed by him *molluscine* (?)

It is probable, however, that mussels may also become poisonous by the beginning of the putrefying process, which would agree with the circumstance that these cases of poisoning are more frequent during the hot season. However this may be, the variety of symptoms observed in most of the cases justifies the opinion that spoiled articles of food of animal origin contain ptomaine or different chemical poisons. The clinical observation therefore agrees entirely with the chemical observation, which has already isolated and characterized several of these poisonous substances. Much remains, doubtless, to be done, both from a chemical point of view and from that of physiological experimenting, in order to throw full light on this but little explored field of the toxicology of cadaveric alkaloids; but the results which have been reached thus far justify the hope that science will finally succeed in solving all the knotty problems of this question.

We will close this chapter by the report of a personal experience regarding the eating of putrefied codfish: During the first days of April two reliable codfish dealers of our city furnished me, at my request, with a number of dried codfish which had been more or less tainted with red; and three of the oldest and most decayed codfish which could be found among the refuse of their drying-houses.

These three codfish, three years old, and destined to be sold as grease, showed all the signs of putrefaction—a putrid odor, and flesh which throughout was of a brownish color, and easily crumbled to pieces. The outside showed many red spots scattered irregularly over the entire body.

I gave these three old codfish, raw, and without being prepared in any way whatever, to three dogs of the physiological laboratory of the Faculty of Medicine, which Professor Oré kindly placed at my disposal. None of these three dogs were inconvenienced thereby. They neither vomited, nor had they attacks of diarrhea, or any other symptoms of sickness; and still the codfish of which they had eaten was old and thoroughly decayed.

May we conclude from this experiment that the eating of such codfish would not produce cases of sickness in a human being? I do not believe it. Dogs are in the habit of eating all sorts of impure matter, and putrefied substances, without suffering any bad consequences.

The same would hardly be the case with man, whose stomach is of a much more delicate organization; and one should be careful not to draw any conclusion as regards man, as to the harmless character of spoiled articles of food, from cases in which dogs ate such articles with impunity. To make the experiment complete, I should also have eaten of the spoiled codfish, but I freely confess that I did not have the courage to let my scientific devotion go so far. I contented myself by eating red, but otherwise sound, codfish at two consecutive meals; and I can state that I digested it perfectly without the least trouble, like all the members of my family who partook of it with me.

It may, therefore, be considered as settled that the red codfish has no hurtful quality, and that dogs could eat, without being in the slightest inconvenienced, raw codfish, three years old, intended to be used for grease, and showing every sign of putrefaction. Should we admit that the poisonous products of putrefied codfish do not act on dogs, or that these products, poisonous at a certain given time, are finally destroyed by the process of putrefaction? These questions can only be solved by new researches, and by much more numerous experiments.

V.—COMMERCIAL ASPECTS OF THIS QUESTION.

The cod fisheries are carried on on the coasts of Iceland and Newfoundland from April till the middle of September, and more than 12,000 of the best class of fishermen and sailors are engaged in these fisheries.

The codfish are not caught in the same manner near Iceland as near Newfoundland. In Iceland fishing is going on while the vessel is moving, drawing the fishing-lines after it. The fishermen constantly raise these lines, and the codfish pass direct from the sea into the vessel which is to take them to France. When they reach the deck of the vessel the head is cut off and the abdominal viscera are removed, among which is the roe, which is to be used as bait in the sardine fisheries, and the liver, from which oil is to be extracted. Then the fish are cut open and a portion of the backbone is removed; whereupon they are washed, salted, and piled up in the hold of the vessel.

Near Newfoundland the fisheries are carried on in a different way. Lines with hooks are immersed in the water and left there from one tide to the other. At each tide small boats are sent out from the vessel to raise the lines. The codfish are at first received in these small boats, or dories, which convey them to the vessel. There is therefore a double handling, which does not take place in the Iceland fisheries. As regards the methods of preparing the codfish, they are the same in both countries. We should also bear in mind the fact that the temperature of Iceland is much colder than that of Newfoundland.

These details are of importance regarding the question before us, for they may have to be taken into account in explaining the fact, which has been duly observed, that the codfish caught near Iceland turn red more rarely than those caught near Newfoundland.

In 1885 the average quantity of codfish taken by each fishing vessel near Newfoundland was from 3,500 to 5,000 quintals. A boat manned by 24 men can take at each tide about 5,000 codfish. The largest fishing vessels can carry as many as 180,000 codfish.

It is probable that if Dr. Bertherand, of Algiers, had been acquainted with the above-mentioned fact when he read his treatise on the poisonous fungus at the meeting of the scientific societies held in Paris in April, 1884, he would not have proposed as a remedy for preventing the growth of this fungus, to arrange in the fishing vessels tanks in which live codfish could be conveyed to France. Without mentioning other impossibilities we must say that no vessel would be large enough to hold tanks for 180,000 live codfish, many of which are 3 feet long. It is true that the fish might be distributed among a number of vessels, but what an enormous fleet would be required to convey to France in tanks the 1,200,000 quintals of codfish which represent the annual yield of these fisheries. All the vessels of the French merchant marine would not suffice, not to speak of the enormous expense which this mode of transportation would involve.

We stated that the cod fisheries take place from April till the middle of September. The first vessels conveying fresh codfish from Iceland and the Newfoundland banks arrive in France about the end of May or the beginning of June, and from that time on ships continue to arrive every week in July, August, September, October, and November. A considerable quantity of codfish, therefore, arrives in our ports during the heat of summer. It is no rare case to see entire cargoes turn red from the influence of the heat, either during the voyage or when the fish are landed in the port of destination. But at that time the red spots are merely found on the surface.

As soon as the codfish are landed they are taken to the drying-houses. There they are piled up in enormous heaps in closed but well-ventilated rooms. They remain in this condition a longer or shorter period, according to the needs of the trade. They are termed "green codfish." Some are shipped in this condition, but by far the larger quantity is delivered to the dealers as "dried codfish."

According to the needs of the trade, the green are transformed into dried codfish in the following manner. They are brushed violently with a broom-corn brush, and washed in several waters, so as to get them as clean as possible. This operation frequently causes the red color to disappear. After they have been thus washed, they are hung in the open air to dry. In summer two "suns" suffice to dry them completely, but in winter and in wet weather they have frequently to hang much longer. The codfish hung to dry is carried to the warehouse every evening, and is not allowed to stay in the open air a single night. We have seen 30,000 codfish hung up to dry in a single drying-house at Bégles. This operation, of course, necessitates the employment of a very large number of persons.

The dried codfish generally leaves the drying-houses in good condition, but it passes through several hands before it reaches the retail dealers, and with these latter it is not always kept under conditions favorable to its preservation.

The following figures, derived from a reliable source, give an exact idea of the importance of the French codfish trade:

The whole of France receives every year from the Iceland and Newfoundland fisheries codfish valued at from 30,000,000 to 35,000,000 francs (about $6,000,000). The share of Bordeaux alone in 1885 was 14,000,000 francs (about $2,700,000). The average annual quantity received is 600,000 quintals.

In 1885 the Bordeaux merchants exported to Spain and Italy 150,000 quintals, Spain taking three-fourths of this quantity.

Some years ago (hardly six) France exported no codfish to Spain, Norway furnishing that country with all the codfish consumed. It seems that considerable difficulty was experienced in opening the Spanish market for French codfish, but at present the Norwegians again take courage, and, since the ministerial circular prohibiting the sale of red codfish in France, again ship large quantities of codfish to Spain.

The Spanish dealers say: "Don't buy any more French codfish, because they have turned red; and that this color is a proof of their bad quality is clearly shown by the recent circular of the French ministry prohibiting the sale of red codfish." A Bilboa paper has even gone so far as to insinuate that it is more than probable that it was the French codfish which last year carried the cholera into Spain, and that if these fish had been carefully examined specimens of Dr. Koch's bacillus would probably have been found.

All this evidently is not strictly scientific, but it will be seen how much in such matters the hygienic consideration influences the commercial side of the question; and it will be understood what great damage may be inflicted on commerce by an erroneous scientific opinion when it has been pronounced in an official way, especially in the shape of a prohibitory measure.

We have stated that the new minister of commerce, Mr. Lockroy, has suppressed the circular of his predecessor until the entire question in all its bearings has been made the subject of exhaustive investigations. We hope that soon sufficient light will have been thrown upon this question to cause the minister to revoke definitively the prohibitory measure referred to, and to proclaim positively in a new circular the absolutely harmless character of red codfish from a hygienic point of view. Such a declaration seems to be the only means of conquering the very considerable prejudice which has been created against these fish by the prohibitory ministerial circular of December 31, 1885.

VI.—CONCLUSIONS.

From all that has been said above we feel justified in drawing the following conclusions:

(1) Cases of poisoning from eating spoiled codfish are extremely rare, considering the enormous quantity of these fish consumed throughout the entire world.

(2) The exceptional cases which have been observed must be attributed to the eating of spoiled codfish which had already commenced to putrefy, which can always be recognized by the following two certain indications: A putrid odor, and the easy crumbling of the flesh. Every codfish showing these two indications should be condemned at once.

(3) The red color which often appears on these fish, both when "green" and when "dry," under certain conditions of temperature and the place where they are kept, is no indication of their injurious character; because, on the one hand, it is a well-established fact that from time immemorial people have eaten red codfish without experiencing any bad consequences; and because, on the other hand, animals (dogs and cats) have for several days in succession been fed on raw codfish, having a deep red color, without causing any sickness whatever. One may therefore eat without fear any codfish which has preserved its

normal odor, and the firm consistence of its flesh, no matter whether its color is more or less rosy or red.

(4) The red of the codfish is produced by a cryptogamic vegetation, the nature of which has not yet been fully determined. Some think it is a fungus, others an alga.

(5) This cryptogamic vegetation which develops both on spoiled and on sound codfish, seems to be aided in a special manner by the salting process; but it has nothing whatever to do with putrefaction.

(6) Only those codfish whose flesh is more or less putrefied contain a poisonous substance, which in man may produce symptoms similar to those of cholera.

(7) This poisonous substance has been isolated and characterized by several experimenters as a kind of ptomaine, or an alkaloid produced by putrefaction.

(8) Protection against all danger of such poisoning is easy, simply by not eating any codfish which has at all begun to putrefy. As regards sound codfish, they should invariably, before being eaten, be carefully cleaned, soaked in water, which should be changed several times for twelve hours, and above everything else should be well cooked. Thorough cooking of all articles of food of animal origin is in fact the best means of destroying all hurtful parasites and minute organisms which they may contain.

(9) In peremptorily prohibiting the sale of red codfish, which is absolutely harmless unless it is at the same time spoiled (a measure which can not be justified by any reasons, and which has done considerable injury to an important branch of our commerce), a product which has lost nothing of its alimentary value, and which is of great and every-day importance to the laboring classes, has been unjustly depreciated and condemned.

(10) We therefore consider it our duty to advise that, as soon as possible and in the most positive manner, this prohibitory measure be revoked, because it is based on a manifestly erroneous interpretation of facts.

BORDEAUX, FRANCE, *April* 25, 1886.

XXXII.—NOTES ON THE NORWEGIAN FISHERIES OF 1885.

[Abstract from a Compilation of A. N. Kiær.*]

Cod fisheries.—The yield of the cod fisheries in 1885 was larger than in any of the four preceding years; while it was considerably less than in 1880, which was the most productive year since 1866, when somewhat complete statistics of these fisheries were first taken. The amount of cod taken in 1885 was above the average, while the value was somewhat below it, owing to a decided fall in prices. A comparison of the results of 1884† and 1885 may easily be made by referring to the following table:

Year.	No. of fish.	Liver.	Roe.	Value.	Average price per 100 round fish.
		Hectoliters.	*Hectoliters.*		
1884	50,435,500	99,636	47,765	$4,163,732.68	$8.25
1885	58,798,000	117,989	53,065	2,951,275.23	5.02

The amounts for 1885 are owing partly to the Lofoden fisheries and partly to the spring fisheries in Finmark, which gave a regular and average yield. The Lofoden fisheries, which had such poor yields in 1883 and 1884, improved very much, and in the Lofoden district proper during the fishing season 26,530,000 codfish were taken. If to this are added the number of fish caught after April 14 and those caught near Væröe and Röst and near the outer group of islands (in all 7,480,000 fish, 500,000 of which were caught in the Lofoden district proper after April 14), the total yield of these fisheries is brought up to 34,010,000, while in 1884 it was only 23,354,000.

* From the *Norges Officielle Statistik*, 3d series, No. 29, Christiania, Norway, 1886. Compiled by A. N. Kiær. Mr. H. Jacobson has assisted in the translation and Mr. H. P. Jerrell in preparing and reducing the tables.

Throughout this article reductions are made to dollars and pounds, by considering the crown as worth $0.268, and the kilogram equal to 2.2046 pounds. The hectoliter contains nearly 26¼ gallons, wine measure, or about 2⅞ bushels.

† For the statistics for 1884, with comparative tables covering the five preceding years and other details, see the U. S. Fish Commission Report for 1885, p. 313.

The Romsdal fisheries in 1885 yielded the following quantities:

	Number.
Söndmöre	2,011,500
Romsdal	265,500
Nordmöre	1,306,800
Total	3,583,800

These figures are below those of 1884 in each instance, and considerably less than the average for several years back.

In the Tromsöe district the cod fisheries have been on the increase during the last few years, giving in 1885 1,433,800 fish as against 1,241-800 in 1884. On the other hand, the Fosen (or South Trondhjem) fisheries were not so productive as in former years, falling from an average of about 1,000,000, and from 1,766,000 in 1884 to 689,400 in 1885. The Namdalen fisheries yielded 618,400 in 1885, against 424,000 in 1884.

The quality of the fish was about the same in 1885 as in 1884. They were fat and plump, but the Lofoden fish were very small. But the fish were not so fat nor did they contain so much liver as in average years, when one hectoliter of liver may generally be obtained from 350 fish, while in 1885 it took 506 fish to yield one hectoliter.

The average prices paid at the fishing stations were much below those of 1884, especially in the case of round fish and roe. The inspector of the Lofoden fisheries said in his report that with reference to roe the fall in price could be attributed only to accidental circumstances. Regarding the price of the fish, however, he thought the cause a different one. In 1880 and 1881 the price was lower in the Lofodens than in 1885, but he considered it doubtful whether it would again rise as rapidly, as the competition in the codfish trade is considerable, owing to the increase in the French cod fisheries near Iceland and Newfoundland.

Fat-herring fisheries.—The yield of these fisheries in 1885 was nearly twice as great as in 1884; but the value was not much greater, owing to the low prices. The principal fat-herring fisheries were, as usual, carried on in the Nordland district, where the quantity caught was 498,570 hectoliters, or nearly five-sixths of the entire quantity. A comparison of 1884 and 1885 is afforded by the following table:

Year.	Quantity.	Value.	Average price per hectoliter.
	Hectoliters.		
1884	344,090	$685,076.34	$1.99
1885	619,347	801,823.84	1.29

Spring-herring fisheries.—The following table shows the yield, value, and average price for 1884 and 1885:

Year.	Quantity.	Value.	Average price per hectoliter.
	Hectoliters.		
1884	261,981	$387,390.95	$1.48
1885	209,246	203,048.86	.97

Sprat and other small herring fisheries.—The following table affords a comparison between the quantities taken, the values, and the average prices for 1884 and 1885:

Year.	Quantity.	Value.	Average price per hectoliter.
	Hectoliters.		
1884	157,471	$78,605.74	$0.50
1885	121,267	57,586.77	.47

Mackerel fisheries.—The comparison of the mackerel fisheries for 1884 and 1885 is shown by the following table:

Year.	Number.	Value.	Average price per 100 fish.
1884	5,348,700	$197,094.43	$3.69
1885	6,111,969	209,562.60	3.43

Summer fisheries for ling, coal-fish, torsk, etc.—The total quantity of these fish taken could not be ascertained; but their value in 1885 was $653,593.57, while in 1884 it was $776,960.41, thus showing a considerable decrease in value.

Salmon-trout and sea-trout fisheries.—These fisheries yielded much better results in 1885 than in 1884, though that year was better than any of the five preceding years. The yield was particularly good in the districts of South Trondhjem, Lister, Mandal, and Stavanger. A comparison of the years 1884 and 1885 is shown in the following table:

Year.	Quantity.	Value.	Average price per pound.
	Pounds.		
1884	1,082,789	$132,707.97	$0.12
1885	1,287,006	158,056.22	.12

Lobster fisheries.—The number of lobsters taken was smaller than usual, while, owing to the high prices, the value was about the average. A comparison for the two years is as follows:

Year.	Number.	Value.	Average price per 100.
1884	1,099,828	$111,922.15	$10.18
1885	1,007,871	106,661.05	10.58

Oyster fisheries.—The comparative total statistics of these fisheries for 1884 and 1885 are shown in the following table:

Year.	Quantity.	Value.	Average price per hectoliter.
	Hectoliters.		
1884	230	$1,991.78	$8.66
1885	153	1,299.27	8.49

The total value of the Norwegian coast fisheries in 1885 was $5,142,907.41, as against $6,535,488.45 for 1884, showing a considerable falling off for 1885. This small total value, which was less than for any of at least the six preceding years, was due principally to the low prices of the products of the cod fisheries. A comparative table showing the value of the coast fisheries according to the kinds of fish caught is as follows:

Fisheries.	1884.		1885.	
	Total value.	Per cent.	Total value.	Per cent.
Cod fisheries	$4,163,732.68	63.7	$2,951,275.23	57.4
Fat-herring fisheries	685,070.34	10.4	801,823.84	15.6
Spring-herring fisheries	387,396.95	5.9	203,048.86	3.9
Sprat, etc., fisheries	78,605.74	1.2	57,586.77	1.1
Mackerel fisheries	197,094.43	3.0	209,562.60	4.1
Summer fisheries	776,960.41	11.8	653,593.57	12.7
Salmon-trout, etc., fisheries	132,707.97	2.3	158,050.22	3.1
Lobster fisheries	111,922.15	1.7	106,661.05	2.1
Oyster fisheries	1,991.78	.....	1,299.27	....
Total	6,535,488.45	100	5,142,907.41	100

Storeggen Bank fisheries.—The results of the fisheries, which were especially for ling and torsk, were not very favorable in 1885, owing chiefly to the stormy weather.

The fisheries on the banks near Stordy Bet were comparatively more successful, being carried on simultaneously with the Storeggen fisheries.

The following table gives the statistics for 1885, and affords a partial comparison with the figures for 1884:

Year.	Storeggen.			Stordy bet.				Total value.
	Vessels.	Men.	Value.	Steamer.	Boats.	Vessels.	Value.	
1884	25	308	$28,056.38	....	....	....	....	....
1885	26	310	20,038.30	1	20	90	$48,240	$68,278.30

Shark fisheries in Finmark.—These employed 14 boats, 25 vessels, and 174 men. The total value of the livers obtained (4,078 hectoliters) was $13,742.77. The quantity obtained was less than for several years and the low prices of the oil caused the value of these fisheries to decline.

Other Polar Sea fisheries.—These fisheries employed 45 vessels, with a tonnage of 1,933, and 453 men. They yielded 10,654 seals, 721 walruses, 177 white-fish, 12 bottle-noses, 623 hectoliters of sharks' livers, and 40 hectoliters of whale fat. The total value in 1885 was $54,603.66, against $80,145.40 in 1884. Besides the above, a vessel from Vardöe brought 204 seals and 6 walruses, valued at $1,447.20.

Whale fisheries in Finmark.—These fisheries yielded 1,269 whales, valued at $320,883.64. This result is a great increase over 1884 and the catch for many years previously.

Seal fisheries.—These fisheries near Jan-Mayen and in the sea between Iceland and Greenland employed 18 steamers, with a tonnage of 4,527, and 993 men, 148 of whom were hunters. They yielded 58,028 seal skins and 10,625 hectoliters of fat and oil, having a total value of $174,200.

Bottle-nose fisheries.—These employed 20 vessels (5 being steamers), with a tonnage of 2,255, and yielded about 800 bottle-noses, producing about 7 800 barrels of oil, valued at $83,616.

Total value of Norwegian salt water fisheries in 1885.

Coast fisheries	$5,142,907.41
Bank fisheries	68,278.36
Shark fisheries	13,742.77
Other Polar Sea fisheries	54,603.66
Whale fisheries	320,883.64
Seal fisheries	174,200.00
Bottle-nose fisheries	83,616.00
Total	5,858,231.84

The following twelve tables give more full details in regard to the coast fisheries in 1885:

TABLE I.—*Number of fishermen engaged in the cod, fat-herring, and mackerel fisheries in* 1885.

District.	Cod fisheries.	Fat-herring fisheries.	Mackerel fisheries.	Total.
Smaalenene			132	132
Akershus			125	125
Buskerud			30	30
Jarlsberg and Laurvig			937	937
Bratsberg			79	79
Nedenæs			232	232
Lister and Mandal			1,286	1,286
Stavanger	475	114	1,302	1,891
South Bergenhus	650	2,130	24	2,804
North Bergenhus	60	1,494		1,554
Romsdal	15,626	2,830		18,456
South Trondhjem	3,162	5,161		8,323
North Trondhjem	2,029	2,090		4,119
Nordland	34,810	16,002		50,812
Tromsöe	2,381	3,187		5,568
Finmark	17,311			17,311
Total	76,504	33,008	4,147	113,659

TABLE II.—*Value of the coast fisheries in 1885.**

District.	Cod.	Fat herring.	Sprat and other small herring.	Spring herring.	Mackerel.
Smaalenene	....	....	$1,404	$29,507	$4,744
Akershus	....	....	2,900	134	1,454
Buskerud	....	....	1,769	....	003
Jarlsberg and Laurvig	....	....	947	19,106	48,529
Bratsberg	....	....	....	5,215	3,175
Nedenæs	....	....	....	12,917	8,280
Lister and Mandal	....	....	509	....	87,735
Stavanger	$1,415	$5,186	8,746	89,908	54,853
South Bergenhus	1,029	21,606	16,213	32,605	187
North Bergenhus	500	5,065	6,626	2,037	....
Romsdal	223,066	25,063	9,700	11,560	....
South Trondhjem	39,057	37,438	5,628	....	....
North Trondhjem	35,417	32,374	858	....	....
Nordland	1,896,559	635,792	1,745	....	....
Tromsöe	72,961	39,300	482	....	....
Finmark	681,271	....	....	....	....
Total	2, 1,275	801,824	57,587	203,049	209,563

District.	Summer fisheries for ling, coal-fish, etc.	Salmon trout and sea-trout.	Lobsters.	Oysters.	Total.
Smaalenene	$4,837	$1,544	$5,070	$214	$47,320
Akershus	1,745	1,616	80	9	7,998
Buskerud	5,146	2,624	51	40	10,236
Jarlsberg and Laurvig	19,307	4,615	9,301	454	102,259
Bratsberg	6,046	2,352	3,537	....	20,325
Nedenæs	6,579	4,326	12,543	....	44,645
Lister and Mandal	9,097	22,238	29,756	....	150,235
Stavanger	7,697	21,445	26,287	....	215,600
South Bergenhus	29,010	16,453	14,126	....	131,229
North Bergenhus	8,001	12,213	4,198	111	38,751
Romsdal	21,663	8,966	1,700	129	301,847
South Trondhjem	21,799	38,085	....	288	142,295
North Trondhjem	16,880	14,387	....	54	99,970
Nordland	139,433	3,839	....	....	2,677,368
Tromsöe	74,847	2,304	....	....	189,894
Finmark	280,607	1,049	....	....	962,927
Total	653,594	158,056	106,661	1,299	5,142,908

* The figures in this table are given in even dollars.

TABLE III.—*Details of the cod fisheries in 1885, showing the number of fishermen and boats.*

District.	Total number of fishermen.	Fishermen using—			
		Nets only.	Night-lines only.	Lines only.	Two or more of these.
Stavanger	475	....	....	....	475
South Bergenhus	650	....	....	650	....
North Bergenhus	60	....	......	......	60
Romsdal	15,626	1,723	2,946	1,562	9,395
South Trondhjem	3,162	661	......	1,272	1,229
North Trondhjem	2,029	302	30	313	1,384
Nordland	34,810	12,072	19,442	1,590	1,706
Tromsöe	2,381	50	1,305	75	951
Finmark	17,311	25	3,566	3,693	10,027
Total	76,504	14,833	27,289	9,065	25,317

TABLE III.—*Details of the cod fisheries in* 1885, *etc.*—Continued.

District.	Total number of boats.	Boats equipped with—			
		Nets only.	Night-lines only.	Lines only.	Two or more of these.
Stavanger	125				125
South Bergenhus	250			250	
North Bergenhus	10				10
Romsdal	2,686	233	516	289	1,648
South Trondhjem	787	150		382	255
North Trondhjem	514	57	15	93	349
Nordland	8,157	2,000	5,250	501	406
Tromsöe	828	16	452	33	327
Finmark	4,959	8	1,122	869	2,960
Total	18,316	2,464	7,355	2,417	6,080

TABLE IV.—*Quantity of codfish caught in* 1885.

District.	Number of cod taken.	Liver.	Roe.	Number of fish-heads sold.
		Hectoliters.	*Hectoliters.*	
Stavanger	22,000	37	29	22,000
South Bergenhus	15,000	25	20	7,500
North Bergenhus	6,500	18	15	6,500
Romsdal	3,583,800	5,961	5,373	2,291,800
South Trondhjem	689,400	1,360	1,440	470,000
North Trondhjem	620,400	954	745	300,000
Nordland	34,888,400	62,555	44,118	22,399,000
Tromsöe	1,433,800	2,860	932	115,000
Finmark	17,529,700	44,219	393	13,790,800
Total	58,798,000	117,989	53,065	39,402,600

TABLE V.—*Value of the cod fisheries in* 1885 *and the average prices paid.*

District.	Value of the different products.				
	Fish without liver and roe.	Liver.	Roe.	Fish-heads sold.	Total value.
Stavanger	$1,179.20	$90.16	$77.72	$58.06	$1,415.04
South Bergenhus	837.50	107.20	64.32	20.10	1,029.12
North Bergenhus	349.74	77.18	55.48	17.42	499.82
Romsdal	175,152.74	24,258.83	17,244.46	6,410.02	223,066.05
South Trondhjem	28,291.15	5,252.80	4,631.04	881.72	39,056.71
North Trondhjem	28,834.11	4,055.38	1,964.98	562.80	35,417.27
Nordland	1,426,171.65	294,952.23	155,649.30	19,786.17	1,896,559.35
Tromsöe	58,763.83	10,318.00	3,747.71	131.32	72,960.86
Finmark	530,684.22	138,945.41	1,140.07	10,501.31	681,271.01
Total	2,250,264.14	478,066.19	184,575.68	38,369.82	2,951,276.23

TABLE V.—*Value of the cod fisheries in 1885, etc.*—Continued.

District.	Average prices.				Estimated price per 100 with liver, roe, and heads.
	Without liver and roe, per 100.	Liver, per hectoliter.	Roe, per hectoliter.	Fish-heads, per 100.	
Stavanger	$5.36	$2.68	$2.68	$0.27	$6.43
South Bergenhus	5.58	4.20	3.22	.27	6.88
North Bergenhus	5.38	4.29	3.70	.27	7.69
Romsdal	4.89	4.07	3.21	.28	6.22
South Trondhjem	4.10	3.86	3.22	.19	5.67
North Trondhjem	4.56	4.25	2.64	.19	5.63
Nordland	4.09	4.71	3.53	.09	5.44
Tromsöe	4.10	3.61	4.02	.12	5.99
Finmark	3.03	3.14	2.90	.08	3.89
General average	3.83	4.05	3.48	0.10	5.02

TABLE VI.—*Details of the fat-herring fisheries in 1885.*

District.	Total number of fishermen.	Fishermen using nets.	Fishermen using seines.	Net-boats used.	Seines used.
Stavanger	114	14	100	1	5
South Bergenhus	2,130	25	2,105	10	146
North Bergenhus	1,494	400	1,094	50	87
Romsdal	2,830	672	2,158	399	140
South Trondhjem	5,161	1,164	3,997	556	248
North Trondhjem	2,090	245	1,845	110	107
Nordland	16,002	8,600	7,402	3,046	435
Tromsöe	3,187	2,675	512	1,026	50
Total	33,008	13,795	19,213	5,198	1,218

District.	Total quantity caught.	Caught with nets.	Caught with seines.	Value.	Average price per hectoliter.
	Hectoliters.	*Hectoliters.*	*Hectoliters.*		
Stavanger	1,350	1,050	300	$5,185.80	$3.81
South Bergenhus	6,708	232	6,476	21,605.62	3.22
North Bergenhus	3,840	300	3,540	5,065.20	1.32
Romsdal	29,370	2,178	27,192	25,063.36	.85
South Trondhjem	15,109	2,760	12,349	37,437.99	2.48
North Trondhjem	18,300	1,400	16,900	32,374.40	1.77
Nordland	498,570	95,610	402,960	635,791.95	1.28
Tromsöe	46,100	16,800	29,300	39,299.52	.85
Total	619,347	120,330	499,017	801,823.84	1.29

TABLE VII.—*Details of the mackerel fisheries in* 1885

District.	Total number of fishermen.	Fishermen using drift-nets.	Boats having drift-nets.	Total number of fish caught.	Fish caught with drift-nets.	Value of fish caught.	Average price per 100.
Smaalenene	132	132	44	88,500	77,000	$4,743.60	$5.36
Akershus	125	....	....	28,100	....	1,453.90	5.18
Buskerud	30	....	....	19,500	....	603.00	3.11
Jarlsberg and Laurvig	937	937	254	1,211,760	1,171,260	48,520.44	4.00
Bratsberg	79	71	24	80,750	72,500	3,174.46	3.93
Nedenæs	232	204	76	188,025	176,425	8,279.59	4.40
Lister and Mandal	1,280	1,270	346	2,826,330	2,813,030	87,735.16	3.10
Stavanger	1,302	1,152	300	1,663,995	1,644,860	54,855.85	3.30
South Bergenhus	24	24	8	5,000	5,000	187.00	3.75
Total	4,147	3,790	1,052	6,111,909	5,960,084	209,562.00	3.43

TABLE VIII.—*Details of the sprat and other small-herring fisheries in* 1885.

District.	Quantity.	Value.	Average price per hecto-liter.
	Hectoliters.		
Smaalenene	2, 280	$1, 403. 78	$0. 62
Akershus	888	2, 960. 33	3. 33
Buskerud	1, 100	1, 768. 80	1. 61
Jarlsberg and Laurvig	1, 095	946. 58	. 87
Lister and Mandal	800	500. 20	. 64
Stavanger	20, 778	8, 746. 18	. 42
South Bergenhus	46, 170	16, 212. 66	. 35
North Bergenhus	10, 468	6, 626. 03	. 63
Romsdal	19, 963	9, 700. 53	. 49
South Trondhjem	11, 000	5, 628. 00	. 51
North Trondhjem	1, 100	857. 60	. 78
Nordland	4, 925	1, 744. 68	. 35
Tromsöo	700	482. 40	. 69
Total	121, 267	57, 586. 77	. 47

TABLE IX.—*Details of the spring-herring fisheries in* 1885.

District.	Quantity.	Value.	Average price per hecto-liter.
	Hectoliters.		
Smaalenene	60, 060	$29, 506. 80	$0. 49
Akershus	50	134. 00	2. 68
Jarlsberg and Laurvig	20, 810	19, 105. 72	. 92
Bratsberg	3, 100	5, 215. 28	1. 68
Nedenæs	11, 760	12, 917. 60	1. 10
Stavanger	67, 650	89, 967. 60	1. 33
South Bergenhus	34, 050	32, 604. 88	. 96
North Bergenhus	891	2, 036. 80	2. 29
Romsdal	10, 825	11, 560. 18	1. 07
Total	209, 246	203, 048. 86	. 97

TABLE X.—*Details of the salmon-trout and sea-trout fisheries in* 1885.

District.	Quantity.	Value.	Average price per pound.
	Pounds.		
Smaalenene	7, 910	$1, 543. 95	$0. 20
Akershus	8, 827	1, 615. 77	. 18
Buskerud	15, 388	2, 624. 52	. 17
Jarlsberg and Laurvig	26, 640	4, 615. 50	. 17
Bratsberg	12, 787	2, 351. 70	. 18
Nedenæs	32, 518	4, 325. 52	. 13
Lister and Mandal	177, 779	22, 238. 87	. 13
Stavanger	166, 337	21, 444. 82	. 13
South Bergenhus	133, 224	16, 453. 06	. 12
North Bergenhus	92, 853	12, 212. 76	. 13
Romsdal	82, 613	8, 966. 94	. 11
South Trondhjem	321, 856	38, 084. 68	. 12
North Trondhjem	123, 250	14, 386. 78	. 12
Nordland	38, 257	3, 839. 37	. 10
Tromsöo	32, 902	2, 304. 26	. 07
Finmark	13, 856	1, 049. 22	. 08
Total	1, 287, 006	158, 050. 22	. 12

TABLE XI.—*Details of the lobster fisheries in* 1885.

District	Quantity.	Value.	Average price per 100.
	Number.		
Smaalenene	61,000	$5,078.60	$8.33
Akershus	1,000	80.40	8.04
Buskerud	500	53.60	10.72
Jarlsberg and Laurvig	99,890	9,300.67	9.31
Bratsberg	33,000	3,537.60	10.72
Nedenæs	128,547	12,548.21	9.76
Lister and Mandal	233,770	29,756.04	12.73
Stavenger	232,305	26,286.78	11.32
South Bergenhus	155,049	14,126.28	9.11
North Bergenhus	46,950	4,197.68	8.94
Romsdal	15,860	1,700.19	10.72
Total	1,007,871	106,661.05	10.58

TABLE XII.—*Details of the oyster fisheries in* 1885.

District.	Quantity.	Value.	Average price per hectoliter.
	Hectoliters.		
Smaalenene	20	$214.40	$10.72
Akershus	1	8.58	8.58
Buskerud	5	40.20	8.04
Jarlsberg and Laurvig	39	454.26	11.65
North Bergenhus	24	111.49	4.64
Romsdal	11	128.64	11.70
South Trondhjem	45	288.10	6.40
North Trondhjem	8	53.60	6.70
Total	153	1,299.27	8.49

CHRISTIANIA, NORWAY, *October* 23, 1886.

INDEX.

NOTE.—This index contains general references to the entire volume; more detailed indexes to nine papers will be found at the pages indicated.

A.

B.