U. S. COMMISSION OF FISH AND FISHERIES.

GEORGE M. BOWERS, Commissioner.

PART XXVIII.

REPORT

OF

THE COMMISSIONER

FOR

THE YEAR ENDING JUNE 30, 1902.

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Report of the United States Commissioner of Fisheries

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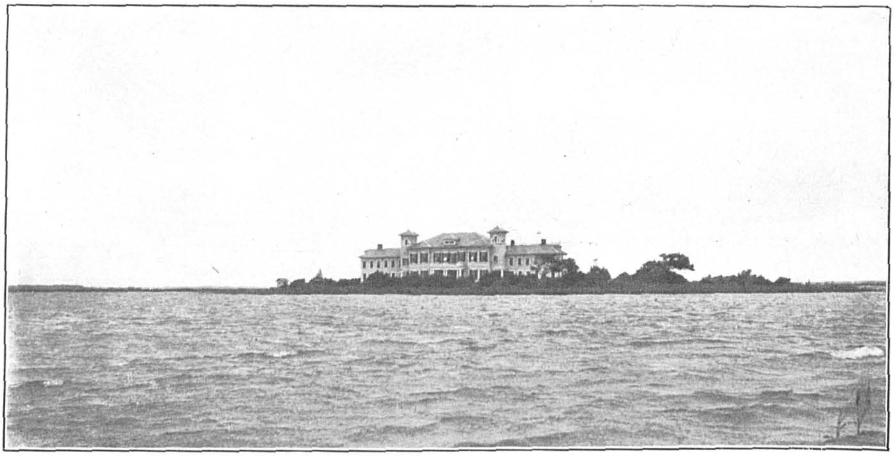
CONTENTS.

LIST OF ILLUSTRATIONS.



PIVERS ISLAND AND LABORATORY.

BEAUFORT LABORATORY—EXTERIOR VIEW.

REPORT

OF THE

UNITED STATES COMMISSIONER OF FISH AND FISHERIES

FOR THE

FISCAL YEAR ENDING JUNE 30, 1902.

I have the honor to submit a report covering the fish-cultural work and scientific and statistical investigations of the United States Commission of Fish and Fisheries for the fiscal year ending June 30, 1902, together with the detailed reports of the assistants in charge of its different divisions.

PROPAGATION OF FOOD-FISHES.

Natural conditions governing the collection of eggs were generally very favorable at all points where operations were carried on, and increased appropriations made it possible to take advantage of these conditions. The Commission was therefore enabled to keep up its record and show an increased output of nearly all of the species handled, and in the aggregate there were distributed over 1,495,500,000 fish and eggs, or 321,700,000 more than last year. Of these, 99 per cent were in the interests of the commercial fisheries and 1 per cent, or 14,900,000, were game fishes. Popular interest in the Commission and wider knowledge of its functions are shown by the increasing number of applications for fish to stock interior waters, 3,814 having been received, or 25 per cent more than the previous year.

The propagation of quinnat salmon was carried on in California, Oregon, and Washington, at 12 stations, including several collecting camps, and the season's work was considered very satisfactory. The runs of fish in the various streams were in most cases good, and over 56,000,000 eggs were collected. 29,300,000 fry and fingerlings were hatched and planted and 17,480,000 eggs were transferred to the California State Commission. As far as possible fry were held and fed during the winter and planted when about 2½ inches long, but lack of room and other facilities prevented pursuing this policy to its full extent. A few silver-salmon eggs were taken on a tributary of Rogue River, Oregon, and steelhead-trout eggs were obtained at the same point and at the Baker Lake Station in Washington. The collection of steelhead eggs was hampered by unfavorable weather and scarcity of fish. At Baker Lake 3,694,000 blueback-salmon eggs were taken and hatched with a small percentage of loss, and the fry were planted in the lake.

Over 41,000,000 lake-trout eggs were obtained from commercial fishermen in Lake Superior and Lake Michigan; of these, 5,000,000 were assigned to various State commissions and other applicants, and the remainder hatched by the Commission, the fry—except some 700,000—being planted in the Great Lakes.

In Lake Erie the number of white-fish eggs secured from fishermen exceeded any previous record, the hatchery at Put-in Bay at one time being so crowded that they were retained in temporary devices. The facilities for holding the white-fish in pens were increased, but, owing to unpropitious weather, not many eggs were obtained from fish thus held at Lake Erie points, though at the collecting stations on the Detroit River the results were very successful. The total take of white-fish eggs amounted to 701,900,000, of which 111,000,000 were assigned to State commissions and others and the balance hatched at different stations of the Commission, whence the fry were planted in the lakes. The quality of the fry was unusually good.

Although April was cold and unfavorable, 437,000,000 pike-perch eggs were taken in Lake Erie, but the weather conditions were such that the percentage of fry was comparatively small. At Swanton, Vt., 113,000,000 eggs of this species were also obtained. No lake herring were taken, as the work was interrupted by ice before any spawning fish were found.

On the New England coast 338,120,000 cod eggs were collected and hatched at Woods Hole and Gloucester, Mass. Those from the brood fish taken off Nantucket Shoals and held at Woods Hole were of exceptionally good quality. Cod were scarce on the Maine coast, and the number of eggs from this source was not large. From Plymouth fishermen, however, the supply was good.

The flat-fish work was more successful than in the preceding year, both in the collection of eggs, which amounted to 194,000,000, and in the hatching of fry.

The collection of lobster eggs was also more satisfactory, though some of the territory in Massachusetts formerly depended on was abandoned. In Maine, however, egg-bearing lobsters were abundant. Eggs from all sources numbered 103,898,000, which, except for 5,000,000 devoted to experiments in hatching and rearing, were hatched at the New England stations and yielded 81,000,000 fry.

The runs of shad in the rivers where the Commission operates were small, owing to the late spring, and consequently the take of eggs shows a falling off, the station on the Potomac being the only one where there was an increase, while on the Delaware, where the collections have usually been large, there was a great decrease. 141,239,000 eggs were secured from all points and 107,000,000 fry were hatched and planted. Considerable consignments were sent to rivers north and south, where the shad runs have been diminishing in recent years.

The propagation of the trouts, basses, and other fish appropriate for interior waters has been satisfactorily continued, and these species supplied to applicants in all parts of the country. The collections of wild fishes from overflowed lands along the Mississippi River continued throughout the summer, and large numbers of bass and other native fishes were saved and distributed. On the Illinois River this work was curtailed by the excessive heat, which caused the death of many fishes in the shallow ponds.

In continuation of the policy of acclimatizing certain species in sections of the country to which they are not indigenous, steelhead and grayling eggs were brought from the West to be hatched at eastern stations, and white-fish, lake-trout, and brook-trout eggs were sent to the Pacific coast, where they were hatched and planted. Landlocked salmon eggs from Maine were sent to various places as far west as Utah.

Twenty-nine species of fish and one crustacean have been handled during the fiscal year, and in the following tables and in the reports of station superintendents are shown the results attained in hatching the eggs and the disposition of the product.

Distribution and assignments of fish and eggs among the States and Territories.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Alabama	Shad		450,000	
	Rainbow trout			3,400
	Brook trout			200
	Cat-fish			1,300
	Black bass			9,000
	Crappie			500
	Rock bass			300
	Bream			7,000
Arizona	Rainbow trout			1,400
	Black bass			550
	Strawberry bass			400
	Sun-fish			500
Arkansas	Rainbow trout			2,700
	Black bass			2,225
	Crappie			200
	Rock bass			100
	Sun-fish			500
California	Quinnat salmon	17,480,410	2,115,550	
Colorado	Landlocked salmon	5,000		
	Steelhead trout	10,000		
	Loch Leven trout		3,000	
	Rainbow trout		160,000	5,200
	Black-spotted trout	20,000		765,000
	Brook trout		745,000	85,500
	Grayling		100,000	
	Black bass			75
Connecticut	Shad		6,000,000	
	Atlantic salmon	200,000		
	Landlocked salmon	25,000		
	Rainbow trout		2,000	3,200
	Brook trout		55,000	4,000
	Lake trout	250,000	20,000	
	Black bass			150
	Crappie			100
	Rock bass			200
	Lobster		1,151,000	
Delaware	Shad		7,092,000	
	Rainbow trout			1,800

Distribution and assignments of fish and eggs among the States and Territories—Cont'd.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
District of Columbia	Shad		800,000	2,000,000
	Cat-fish			30,000
	Black bass			100
Florida	Shad		6,010,000	
	Cat-fish			300
	Black bass			1,650
	Bream			310
Georgia	Shad		2,550,000	
	Rainbow trout			16,700
	Cat-fish			4,250
	Black bass			8,684
	Rock bass			500
	Bream			7,059
Idaho	Black-spotted trout	75,000	100,000	38,000
	Brook trout			11,500
Illinois	Rainbow trout			500
	Black bass			6,700
	Crappie			1,990
	Rock bass			400
	Warmouth bass			100
	Sun-fish			300
Indiana	Rainbow trout		4,500	
	Brook trout		45,000	
	Pike perch		16,000,000	
	Black bass			18,600
	Crappie			945
	Rock bass			900
Indian Territory	Rainbow trout			1,000
	Black bass			1,675
	Crappie			500
	Rock bass			200
	Strawberry bass			350
Iowa	Quinnat salmon		4,000	
	Rainbow trout		215,000	54,475
	Brook trout		10,000	4,500
	Lake trout		30,000	
	Grayling		50,000	
	Cat-fish			58,120
	Pike perch			500
	Pickerel			805
	Yellow perch			1,100
	Buffalo-fish			200,000
	Black bass			19,630
	Crappie			702,620
	Rock bass			200
	Sun-fish			603,890
Kansas	Black bass			12,675
	Crappie			2,960
	Rock bass			1,500
Kentucky	Black bass			13,885
	Crappie			1,395
	Rock bass			700
Louisiana	Black bass			2,275
	Crappie			1,425
	Strawberry bass			600
Maine	Atlantic salmon		48,715	282,000
	Landlocked salmon	20,000	519,785	74,582
	Steelhead trout		12,046	84
	Rainbow trout			1,406
	Brook trout	370,000	1,080,863	643
	Scotch sea trout		7,694	6,837
	Grayling		36,333	
	Lobster		37,100,000	
Maryland	Shad		21,897,000	
	Rainbow trout	50,000		15,650
	Brook trout			8,350
	Pike perch		1,800,000	
	Black bass			250
Massachusetts	Shad		6,400,000	
	Landlocked salmon	40,000		500
	Rainbow trout	50,000		2,000
	Brook trout	50,000	75,000	14,500
	Lake trout		20,000	
	Scotch sea trout	10,000		
	Black bass			675
	Rock bass			600
	Cod		212,001,000	
	Flat-fish		168,133,000	
	Lobster		38,107,000	
Michigan	Steelhead trout		160,000	
	Loch Leven trout		75,000	
	Rainbow trout		68,500	

Distribution and assignments of fish and eggs among the States and Territories—Cont'd.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Michigan	Brook trout	25,000	911,000	
	Lake trout	1,000,000	15,295,000	
	Grayling	100,000	200,000	
	White-fish		245,300,000	
	Pike perch	50,000,000	1,500,000	
	Black bass			8,850
Minnesota	Steelhead trout		66,900	25,000
	Rainbow trout		32,000	
	Brook trout		107,230	1,900
	Lake trout		1,964,000	
	Grayling	10,000	124,000	
	Black bass			3,500
	Crappie			500
Mississippi	Rainbow trout			500
	Black bass			16,125
	Crappie			4,650
	Rock bass			6,890
	Bream			500
Missouri	Rainbow trout	21,090	24,275	30,678
	Brook trout	20,000		
	Grayling	50,000		
	Pike perch	10,000,000		
	Black bass			2,189
	Crappie			250
	Rock bass			2,800
	Strawberry bass			351
Montana	Steelhead trout			10,000
	Black-spotted trout			258,500
	Brook trout			15,000
	Grayling		525,000	9,925
	Black bass			1,800
Nebraska	Rainbow trout	50,000		
	Brook trout	50,000		
	Black bass			1,240
	Rock bass			1,000
	Crappie			300
Nevada	Brook trout	5,000		
New Hampshire	Atlantic salmon	100,000		
	Landlocked salmon			8,759
	Rainbow trout	25,000	7,000	900
	Brook trout		330,000	31,241
	Lake trout	500,000	120,000	
	Golden trout		69,950	
	Pike perch		3,000,000	
	Black bass			50
	Lobster		2,200,000	
New Jersey	Shad		7,597,000	
	Landlocked salmon	10,000		
	Rainbow trout			1,450
	Brook trout	20,000		
	Crappie			400
New Mexico	Rainbow trout			6,600
	Black-spotted trout			10,000
	Black bass			1,700
	Rock bass			1,200
	Strawberry bass			200
	Sun-fish			600
New York	Shad		2,123,000	
	Atlantic salmon		4,050	
	Landlocked salmon	45,000	3,870	
	Steelhead trout			1,319
	Rainbow trout		38,360	1,000
	Brook trout		744,350	3,500
	Lake trout	2,710,000	3,138,630	
	Grayling	70,000		
	White-fish	8,100,000	34,900,000	
	Pike perch		8,200,000	
	Black bass			200
	Rock bass			200
North Carolina	Shad		22,909,500	
	Rainbow trout	25,000		23,875
	Brook trout			500
	Black bass			300
	Crappie			100
	Rock bass			1,700
North Dakota	Rainbow trout			3,000
	Brook trout			1,000
	Cat-fish			2,000
	Pike perch			75
	Yellow perch			600
	Black bass			8,681
	Crappie			300
	Rock bass			200
	Sun-fish			250

Distribution and assignments of fish and eggs among the States and Territories—Cont'd.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Ohio	Rainbow trout		13,000	
	Brook trout		85,000	
	Lake trout		3,500	
	White-fish		200,500,000	
	Pike perch		125,500,000	
	Black bass			5,080
	Crappie			330
	Rock bass			700
Oklahoma	Rainbow trout			3,000
	Black bass			5,600
	Rock bass			1,100
	Strawberry bass			1,450
Oregon	Quinnat salmon	1,866,000	14,401,619	
	Silver salmon		424,530	
	Steelhead trout		20,250	
	Rainbow trout			18,745
	Black-spotted trout			15,000
	Brook trout		138,979	74,876
	Lake trout		45,498	
Pennsylvania	Shad		598,000	
	Rainbow trout			61,000
	Brook trout			17,900
	White-fish	48,160,000		
	Pike perch		1,800,000	
	Black bass			2,925
	Crappie			3,940
	Rock bass			2,350
Rhode Island	Shad		3,000,000	
	Landlocked salmon			1,000
	Rainbow trout		2,000	500
	Brook trout		20,000	
	Black bass			625
	Lobster		2,462,000	
South Carolina	Shad		5,138,000	
	Atlantic salmon		4,000	
	Rainbow trout			2,500
	Lake trout		20,000	
	Pike perch		1,900,000	
	Black bass			3,625
	Rock bass			400
South Dakota	Loch Leven trout		13,760	5,000
	Rainbow trout		41,500	11,000
	Black-spotted trout			342,000
	Brook trout		209,000	56,650
	Black bass			10,316
	Crappie			2,200
Tennessee	Rainbow trout			76,184
	Brook trout			75
	Black bass			5,895
	Crappie			500
	Rock bass			2,525
Texas	Rainbow trout			3,000
	Black bass			80,060
	Crappie			4,425
	Rock bass			5,155
	Strawberry bass			200
	Bream			2,830
Utah	Landlocked salmon	10,000		
	Rainbow trout	26,700		
	Black-spotted trout			10,000
	Brook trout	50,000		
	Grayling	100,000		
Vermont	Landlocked salmon	35,000		13,724
	Steelhead trout		10,000	36,283
	Rainbow trout		2,000	1,341
	Brook trout	50,000	436,000	15,629
	Lake trout	250,000	190,000	3,012
	Grayling		20,000	
	Pike perch		17,399,000	
	Black bass			100
Virginia	Shad		12,411,500	
	Rainbow trout		148,700	126,692
	Brook trout		8,000	26
	Black bass			100
	Crappie			2,750
	Rock bass			5,050
Washington	Quinnat salmon		12,816,129	
	Blueback salmon		3,371,000	
	Steelhead trout		110,000	
	Black-spotted trout			30,000
	Brook trout	20,000	20,000	44,250
	Lake trout		24,950	
	White-fish		730,000	

Distribution and assignments of fish and eggs among the States and Territories—Cont'd.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
West Virginia	Rainbow trout			7,100
	Brook trout	100,000		2,000
	Black bass			1,657
	Crappie			1,640
	Rock bass			300
Wisconsin	Steelhead trout		10,000	5,000
	Rainbow trout		26,000	4,000
	Black-spotted trout	25,000		
	Brook trout		164,000	38,600
	Lake trout		790,000	
	Grayling	200,000	75,000	
	White-fish	55,000,000	1,800,000	
	Black bass			2,540
Wyoming	Steelhead trout	33,000		
	Rainbow trout	50,000		
	Black-spotted trout	150,000		20,000
	Brook trout	135,000	48,000	10,000
	Lake trout	500,000		
	Grayling	125,000		8,000
	Black bass			200
	Crappie			200
Foreign countries:				
Canada	Lake trout		360,000	
England	Landlocked salmon	10,000		
	Rainbow trout	25,000		
	Lake trout	25,000		
Ireland	Rainbow trout	25,000		
Mexico	....do	25,000		
Germany	Steelhead trout	25,000		
	Rainbow trout	25,000		
Japan	Brook trout	25,000		
Belgium	Black-spotted trout	10,000		
	Total	198,672,200	1,290,000,926	6,870,248

Fish and eggs furnished for distribution during the fiscal year ending June 30, 1902.

Source of supply.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Green Lake, Me	Landlocked salmon	45,000		
	Brook trout	370,000	1,081,388	
Craig Brook, Me.[a]	Atlantic salmon	300,000	48,715	282,300
	Landlocked salmon	155,000	90,000	20,758
	Steelhead trout		12,046	84
	Scotch sea trout	10,000	7,694	6,837
	Brook trout		5,475	1,143
	Rainbow trout			4,406
	Grayling		36,333	
Grand Lake Stream, Me	Landlocked salmon		429,785	53,825
Nashua, N. H	Landlocked salmon			11,262
	Brook trout	100,000	470,000	62,741
	Rainbow trout		8,000	
	Lake trout		160,000	
	Golden trout		70,000	
St. Johnsbury, Vt.[b]	Landlocked salmon			12,728
	Brook trout	120,000	471,000	5,634
	Rainbow trout		5,000	1,341
	Steelhead trout		10,000	36,285
	Lake trout		190,900	3,028
	Grayling		20,000	
Gloucester, Mass.[c]	Cod		83,191,000	
	Lobster		74,340,000	
Woods Hole, Mass.[d]	Cod		128,810,000	
	Flat-fish		168,133,000	
	Lobster		6,680,000	

[a] Besides the above there were transferred from Craig Brook Station to other stations 10,000 Atlantic-salmon eggs, 65,000 landlocked-salmon eggs, and to Charleston (S. C.) Exposition 5,000 Atlantic-salmon eggs, 5,000 landlocked-salmon eggs, and to the Washington (D. C.) Aquarium 528 adult fish of various species; also 100,000 landlocked-salmon fry were transferred to Green Lake Station to be reared.

[b] In addition to the above, there were transferred from St. Johnsbury Station to other stations of the U. S. Fish Commission 10,000 brook-trout eggs and 100,000 brook-trout fry.

[c] In addition to the above there were transferred from Gloucester Station to Woods Hole Station for scientific purposes 2,000,000 lobster eggs and 180,000 lobster fry.

[d] In addition to the above there were transferred to Gloucester Station, for hatching, 6,348,000 cod eggs, and there were delivered to Mr. Geo. H. Sherwood, for scientific investigation, 4,689,000 lobster eggs and 5,750,000 lobster fry.

Fish and eggs furnished for distribution during fiscal year ending June 30, 1902—Cont'd.

Source of supply.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Cape Vincent, N. Y	Brook trout		749,350	
	Rainbow trout		38,360	
	Lake trout		3,088,880	
	Pike perch		10,000,000	
	White-fish		34,300,000	
	Steelhead trout			1,319
Swanton (substation)	Pike perch		20,575,000	
Steamer Fish Hawk [a]	Shad		25,997,000	
Battery Station, Md. [b]	Shad		14,943,000	
Fish Lakes, D. C. [c]	Black bass			4,464
	Crappie			13,903
	Shad			2,000,000
	Cat-fish			30,000
Central Station, D. C	Brook trout		8,000	
	Rainbow trout		4,200	
	Lake trout		53,200	
	Pike perch		1,800,000	
	White-fish		600,000	
	Atlantic salmon		4,050	
	Landlocked salmon		3,870	
	Shad		1,850,000	
Bryan Point, Md. [d]	Shad		34,994,000	
Wytheville, Va. [e]	Rainbow trout	175,000	145,000	208,460
	Brook trout			13,124
	Black bass			3,815
	Rock bass			8,700
Erwin, Tenn	Rainbow trout			133,925
	Brook trout			12,075
	Black bass			1,050
Cold Springs, Ga	Black bass			13,310
	Bream			17,350
	Speckled cat-fish			5,850
Edenton, N. C	Shad		24,662,000	
Charleston (S. C.) Exposition	Shad		2,700,000	
	Pike perch		2,000,000	
	Lake trout		20,000	
	Atlantic salmon		4,700	
Put-in Bay, Ohio [f]	Pike perch	60,000,000	143,000,000	
	White-fish	56,260,000	200,500,000	
Northville, Mich. [g]	Brook trout		1,031,000	
	Rainbow trout		86,000	
	Loch Leven trout		75,000	
	Lake trout	2,535,000	6,025,000	
	Steelhead trout		140,000	
	Grayling		200,000	
Alpena Substation	Lake trout		2,530,000	
	White-fish		42,500,000	
Sault Ste. Marie Substation	Lake trout	1,000,000	2,700,000	
	White-fish		40,000,000	
Detroit Substation [h]	White-fish	55,000,000	135,000,000	
Duluth, Minn. [i]	Brook trout		92,230	
	Rainbow trout		32,000	
	Steelhead trout		96,900	30,000
	Grayling		199,000	
	Lake trout	1,700,000	7,150,000	
	White-fish		29,800,000	

[a] In addition to the above there were transferred from steamer *Fish Hawk* to Central Station 621,000 shad eggs.

[b] In addition to the above there were transferred from Battery Station to Central Station 267,000 shad eggs, and to Charleston (S. C.) Exposition 2,134,000 shad eggs.

[c] In addition to the above there were transferred from Fish Lakes to Erwin Station 3,550 crappie for breeding purposes, and to the aquarium at Central Station and to Buffalo and Charleston expositions 249 black bass and 15 crappie.

[d] In addition to the above there were transferred from Bryan Point to Central Station 2,421,000 shad eggs, and to the Charleston (S. C.) Exposition 2,007,000 shad eggs.

[e] In addition to the above there were transferred from Wytheville Station to other stations of the U. S. Commission of Fish and Fisheries 60,000 rainbow-trout eggs and 300 rock bass, and to Charleston (S. C.) Exposition 10,000 rainbow-trout eggs, and to Norfolk (Va.) School 1,000 rainbow-trout eggs.

[f] In addition to the above there were transferred from Put-in Bay Station to other stations of the U. S. Commission of Fish and Fisheries 2,000,000 pike-perch eggs and 32,212,000 white-fish eggs, and to the Charleston (S. C.) Exposition 4,000,000 pike-perch eggs.

[g] In addition to the above there were transferred from the Northville Station to other stations of the U. S. Commission of Fish and Fisheries 6,653,000 lake-trout eggs and to the Fish and Game Association, Philadelphia, Pa., 5,000 lake trout eggs.

[h] In addition to the above there were transferred from the Detroit Substation to other stations of the U. S. Commission of Fish and Fisheries 146,480,000 white-fish eggs, and to Fish and Game Association, Philadelphia, Pa., 320,000 white-fish eggs.

[i] In addition to the above there were transferred from Duluth Station to other stations of the U. S. Commission of Fish and Fisheries 6,121,000 lake-trout eggs.

Fish and eggs furnished for distribution during fiscal year ending June 30, 1902—Cont'd.

Source of supply.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Quincy, Ill[a]	Black bass			51,500
	Crappie			2,170
	Warmouth bass			100
	Sun-fish			300
Manchester, Iowa[b]	Brook trout	50,000	189,000	49,200
	Rainbow trout	175,000	241,000	69,000
	Lake trout		44,000	
	Grayling		50,000	
	Quinnat salmon		4,000	
	Black bass			105,976
	Rock bass			14,450
	Crappie			724,680
	Sun-fish			604,340
	Cat-fish			60,320
	Yellow perch			1,700
	Bream			600
	Pickerel			805
	Pike perch			575
	Buffalo-fish			200,000
Neosho, Mo.[c]	Rainbow trout	47,790	25,000	44,088
	Black bass			9,514
	Rock bass			18,400
	Strawberry bass			3,251
	Sun-fish			1,800
San Marcos, Tex	Black bass			81,260
	Rock bass			4,556
	Crappie			4,555
	Bream			2,830
	Strawberry bass			200
Leadville, Colo.[d]	Brook trout	125,000	745,000	127,500
	Black-spotted trout	145,000		847,000
	Rainbow trout		160,000	5,200
	Loch Leven trout		3,000	
	Grayling		100,000	
Spearfish, S. Dak.[e]	Brook trout	155,000	269,000	73,500
	Black-spotted trout			382,000
	Rainbow trout		41,500	10,000
	Loch Leven trout		14,000	5,000
Bozeman, Mont.[f]	Black-spotted trout	135,000	100,000	262,500
	Brook trout			24,000
	Steelhead trout			10,000
	Grayling	655,000	525,000	18,000
Baird, Cal.[g]	Quinnat salmon	5,706,410	2,115,560	
Battle Creek, Cal	Quinnat salmon	9,354,000		
Mill Creek, Cal	Quinnat salmon	2,420,000		
Clackamas, Oreg	Quinnat salmon		8,515,698	
	Brook trout		157,989	69,901
	Rainbow trout			18,845
	Lake trout		70,498	
	White-fish		750,000	
Rogue River, Oreg.[h]	Quinnat salmon	1,866,000	3,071,363	
	Silver salmon		424,530	
	Steelhead trout	68,000	20,250	
Little White Salmon, Wash	Quinnat salmon		15,587,687	
Baker Lake, Wash	Blueback salmon		3,371,000	
	Quinnat salmon		50,000	
	Steelhead trout		110,000	

[a] In addition to the above there were transferred from Quincy Station to Buffalo Exposition 158 adult miscellaneous fishes.

[b] In addition to the above there were transferred from Manchester Station to other stations of the U. S. Commission of Fish and Fisheries 350,000 rainbow-trout eggs; to the Buffalo Exposition, 300 quinnat salmon; to Interstate Fish and Game Association, Chicago, Ill., 25 adult grayling, and to the Buffalo Exposition, 102 miscellaneous fishes.

[c] In addition to the above there were transferred from Neosho Station to other stations of the U. S. Commission of Fish and Fisheries 255,100 rainbow-trout eggs, and to universities for experimental purposes 1,525 rainbow-trout eggs.

[d] In addition to the above there were transferred from Leadville Station to other stations of the U. S. Commission of Fish and Fisheries 550,000 brook-trout eggs, and to the Pan-American Exposition, Buffalo, N. Y., 30,000 black-spotted-trout eggs.

[e] In addition to the above there were transferred from Spearfish Station to other stations of the U. S. Commission of Fish and Fisheries 200,000 brook-trout eggs.

[f] In addition to the above there were transferred from Bozeman Station to other stations of the U. S. Commission of Fish and Fisheries 800,000 grayling eggs.

[g] In addition to the above there were transferred from Baird Station to other stations of the U. S. Commission of Fish and Fisheries 20,000 quinnat-salmon eggs, and to the Pan-American Exposition, Buffalo, N. Y., 30,000 quinnat-salmon eggs.

[h] In addition to the above there were transferred from Rogue River Station to other stations of the U. S. Commission of Fish and Fisheries 413,000 steelhead-trout eggs.

Summary of distribution.

Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.	Total.
Shad	....	104,986,000	2,000,000	106,986,000
Quinnat salmon	19,346,410	29,337,308	....	48,683,718
Atlantic salmon	300,000	56,765	282,000	638,765
Landlocked salmon	200,000	523,655	98,565	822,220
Silver salmon	....	424,530	....	424,530
Blueback salmon	....	3,371,000	....	3,371,000
Steelhead trout	68,000	389,196	77,686	534,882
Loch Leven trout	....	91,760	5,000	96,760
Rainbow trout	397,790	784,835	492,496	1,675,121
Black-spotted trout	280,000	100,000	1,488,500	1,868,500
Brook trout	920,000	5,222,422	437,340	6,579,762
Lake trout	5,235,000	22,022,478	3,012	27,260,490
Scotch sea trout	10,000	7,694	6,837	24,531
Golden trout	....	69,950	....	69,950
Grayling	655,000	1,130,333	17,925	1,803,258
White-fish	111,260,000	483,230,000	....	594,490,000
Pike perch	60,000,000	177,099,000	575	237,099,575
Pickerel	....	....	805	805
Cat-fish	....	....	95,970	95,970
Yellow perch	....	....	1,700	1,700
Buffalo-fish	....	....	200,000	200,000
Black bass	....	....	262,157	262,157
Crappie	....	....	735,120	735,120
Strawberry bass	....	....	3,551	3,551
Rock bass	....	....	37,170	37,170
Warmouth bass	....	....	100	100
Sun-fish and bream	....	....	623,739	623,739
Cod	....	212,001,000	....	212,001,000
Flat-fish	....	168,133,000	....	168,133,000
Lobster	....	81,020,000	....	81,020,000
Totals and grand total	198,672,200	1,290,000,926	6,870,248	1,495,543,374

RAILROAD TRANSPORTATION.

The cars of the Commission while distributing fishes during the fiscal year have traveled 95,259 miles, and detached messengers 199,944 miles. The work of distribution has been greatly facilitated by the free transportation furnished through the courtesy of the following railroads:

Statement of free transportation furnished by certain railroads.

Name of railroad.	Cars.	Messengers.
Astoria and Columbia River R. R	....	236
Atchison, Topeka and Santa Fe Rwy	....	348
Atlantic Coast Line R. R	....	456
Baltimore and Ohio R. R	....	19
Bangor and Aroostook R. R	1,194	608
Boston and Maine R. R	....	7,379
Burlington, Cedar Rapids and Northern Rwy	1,684	1,282
Central Vermont Rwy	....	502
Chicago and Northwestern Rwy	177	1,531
Chicago, Burlington and Quincy R. R	3,892	2,809
Chicago, Rock Island and Pacific Rwy	....	62
Chicago, Rock Island and Texas Rwy	....	183
Colorado and Southern Rwy	74	3,036
Colorado Midland Rwy	139	1,034
Cooperstown and Charlotte Valley R. R	....	50
Crystal River R. R	....	154
Delaware, Lackawanna and Western R. R	....	242
Denver and Rio Grande R. R	552	8,718
Detroit and Mackinac Rwy	756	252
Elgin, Joliet and Eastern Rwy	....	20
El Paso and Northeastern R. R	....	330
Florida East Coast Rwy	....	250
Fort Worth and Denver City Rwy	....	2,312
Grand Trunk Rwy. System	....	197
Great Northern Rwy. Line	1,378	....
Gulf, Colorado and Santa Fe Rwy	....	6,445
Houston and Texas Central R. R	....	922
Houston, East and West Texas Rwy	....	556
Illinois Central R. R	....	497
International and Great Northern R. R	....	8,714
Jacksonville and St. Louis Rwy	....	54
Lake Erie and Western R. R	....	8
Linville River R. R	....	13
Maine Central R. R	512	4,327
Michigan Central R. R	1,592	198
Mobile and Ohio R. R	1,721	104
Monson R. R	....	12
Montana R. R	188	188
Montpelier and Wells River R. R	....	192
New York Central and Hudson River R. R	....	149

Statement of free transportation furnished by certain railroads—Continued.

Name of railroad.	Cars.	Messengers.	Name of railroad.	Cars.	Messengers.
Norfolk and Western Rwy	754	621	Seaboard Air Line Rwy	1,690	....
Northern Pacific Rwy	2,419	663	Southern Rwy	616	809
Oregon R. R. and Navigation Co	....	714	Southern Indiana Rwy	121	74
Oregon Short Line R. R	434	....	Southern Pacific Co	....	1,025
Pennsylvania R. R. System	608	....	Texas and Pacific Rwy	882	2,344
Pennsylvania Lines, west of Pittsburg	522	....	Texas Central R. R	....	100
Pere Marquette R. R	592	1,507	Union Pacific R. R	....	118
Plant System	4,225	825	United Verde and Pacific Rwy	....	26
Queen and Crescent Route	408	....	Vandalia Line	450	....
Rio Grande Southern R. R	....	340	Virginia-Carolina Rwy	52	....
Rio Grande Western Rwy	911	....	Wabash R. R	....	1,607
Rutland R. R	....	1,005	Washington and Columbia River Rwy	30	....
St. Louis and San Francisco R. R	1,043	1,509	Washington County R. R	....	204
St. Louis Southwestern Rwy	....	633			
San Antonio and Aransas Pass Rwy	....	427	Total	29,616	68,940

BIOLOGICAL INQUIRIES.

The experiments which have been carried on for several years at Lynnhaven, Va., to perfect a method by which oysters can be fattened and improved in flavor and food value are meeting with encouraging success. Means have been found to supply proper food in sufficient quantity and in a systematic manner, and it is believed in another season it can be demonstrated that oysters can be fattened foi market by simple economical means. This will make the industry far more profitable than the present method of allowing the oysters to grow under natural conditions, which is always uncertain and often will not give the best results.

Successful results are hoped for from the experimental work carried on in Florida in raising sponges from cuttings. It is desired to discover methods which will be available for the practical sponge-grower and which will permit the cultivation of sponges systematically and assure the grower of regular marketable crops. As Florida can now supply only about half the demand of this country, and as the natural sponge-grounds are rapidly becoming depleted, the undertaking is watched with interest by prominent dealers.

A systematic investigation of the carp in the Great Lakes, where this species is very abundant, was undertaken on account of the disfavor in which it is held by many persons. Attention was given to the food and feeding of the carp, its relation to other fishes, and its food and market value. It is probable that the prejudice against this fish comes from a misapprehension and may be removed with a fuller knowledge of the facts. Much information on the subject has been obtained, and the inquiries will be continued another season.

The supposed destruction of fish and apparatus by sea lions has caused apprehension to the fishery interests of the Pacific coast, and in some localities systematic efforts have been made to kill off the herds. A diversity of opinion has existed as to the advisability of this course, for while the fishermen claim that great damage was done, this was hardly substantiated by reliable data, and the extermination of the herds met with opposition in many quarters. The Commission was finally asked by the California authorities to make an investigation of the food and feeding habits of the sea lions with a view to determining the point at issue. This was accordingly undertaken by an agent of this office, assisted by a representative from both the California board of fish commissioners and the California Academy of Sciences, and was carried on during July and August. As thorough an inquiry as practicable was made, from which it appears that the sea lions did not do much damage except at the mouth of the Columbia River, but further study of some aspects of the case will be necessary before a definite conclusion can be reached.

At the request of oyster-growers of Tuckerton, N. J., a representative of the Commission was detailed to investigate the destruction of oyster beds in that vicinity by drum-fish. These fish feed on the seed oysters, which are the thin-shelled eastern forms, and cause enormous losses, many extensive beds being practically depleted. In one case, where some 20,000 bushels of oysters had been planted, an examination showed that over 80 per cent had been destroyed. Various expedients have been tried or suggested without much success, and it would seem that it will be necessary to use heavy-shelled oysters, which are strong enough to resist the drum-fish, for seed, rather than the thin-shelled ones. The former, however, at this particular locality do not attain so satisfactory a growth.

The biological survey of the Great Lakes has been continued, the work still being confined to Lake Erie with headquarters at the station of the Commission at Put-in Bay. Special attention was given to the white-fish, wall-eyed pike, carp, and sturgeon.

The investigations of the fisheries of the Territory of Hawaii, called for by act of Congress, were partially completed during the summer of 1901, most of the islands being visited, the fishery methods and laws studied, a statistical canvass made, and a large and interesting collection of fishes obtained. A preliminary report was made to the President in July, 1902, and by him submitted to Congress. As stated elsewhere, the investigation of the deeper waters around the islands is now being continued by means of the steamer *Albatross*.

Among other investigations may be mentioned the continuation of the biological study of the quinnat salmon in California, a further inquiry as to the results of introducing new species into certain lakes in Idaho and Utah, an inquiry into the geographical distribution of trout and salmon in the waters of Maine, and biological investigations of certain waters of New York and New Jersey.

The subject of the diseases of fishes has received considerable attention, the time of one assistant being entirely devoted thereto. Mortality from causes little understood in the Government hatcheries and private establishments has always been a source of embarrassment and loss. These studies have been made at a number of places and under various conditions, and it is hoped they will result in rendering it possible to stamp out disease, or, better still, prevent its appearance.

The laboratories at Woods Hole and Beaufort, which have been open as usual during the season, have been utilized by a number of trained investigators, who are attracted by the facilities offered for biological research. The investigations carried on have direct bearing on the various problems related to the fisheries and are exceedingly valuable to the Commission in the performance of its functions.

In the laboratory at Washington studies have been made of various collections of fishes and of particular species, reports prepared, and much work of a miscellaneous character accomplished.

STATISTICAL INQUIRIES.

The principal statistical canvass undertaken was that of the Middle Atlantic States, and at the close of the fiscal year it was still in progress. Besides this, the lobster fishery and several inquiries relating to minor or local fisheries were covered.

At Boston and Gloucester, during the calendar year 1901, there were landed 151,165,191 pounds of fishery products, valued at $4,245,951. These figures are somewhat less than in the preceding year, both in quantity and value, both ports participating in the decrease.

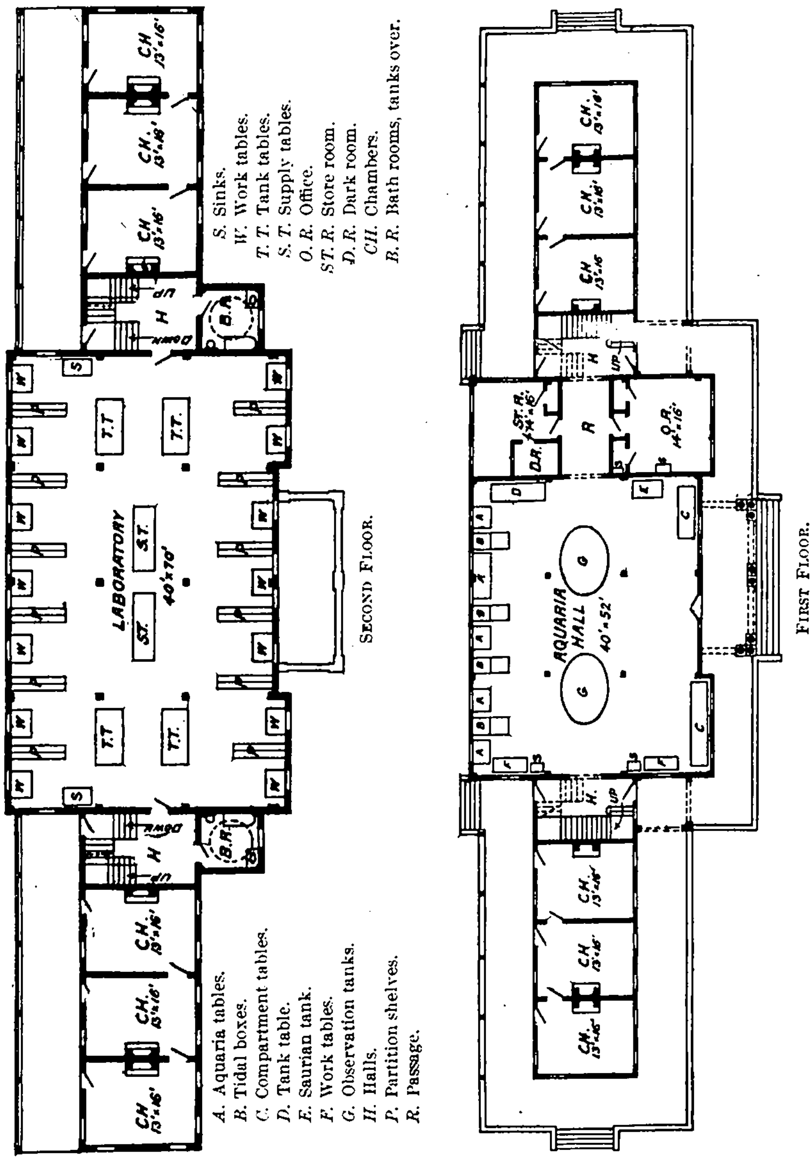
An inquiry prosecuted in the State of Utah developed that a considerable fishing industry, amounting to over 1,000,000 pounds and nearly $50,000, is carried on in that State, the principal part of the catch being taken from Utah Lake and consisting mainly of carp, trout, and black bass. It is not possible to show the entire quantity taken, for here, as in other interior waters, much of the fishing is by sportsmen or for the personal use of the fishermen and is not reported.

In the season of 1901 a canvass of the lobster fishery of the Atlantic coast States was made, and interesting comparisons of the value of the industry for the preceding ten years will be found on pp. 156–158. This inquiry, which covered the calendar year 1900, showed a total investment of $1,668,000 and that 4,348 persons were employed. While lobster fishing is carried on to some extent from New York and New Jersey, it is chiefly confined to the New England States, Maine having far the largest interest, followed by Massachusetts. The total yield was 15,767,700 pounds, having a first value of $1,390,500.

In the report of the Division of Statistics, on pp. 154–155, will be found notes on salmon fishing with hand apparatus in several localities on the Pacific coast. This method of capture has achieved some commercial importance during the last few years, besides being in vogue with anglers. There are also given in the report the results of some inquiries respecting the trade in fur-seal skins in London.

NEW STATIONS.

Work was begun on the biological station near Beaufort, N. C., the latter part of July, 1901, and it is now practically completed and in operation. It was desired to afford this establishment every facility

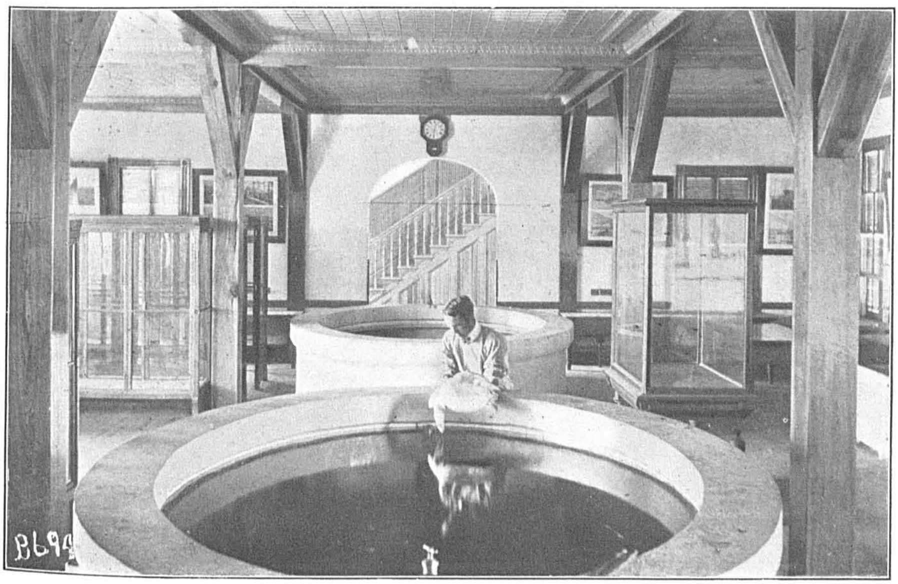


FLOOR PLANS OF BEAUFORT LABORATORY.

for carrying on marine biological research, for which it is admirably located, and its appointments and equipment, while plain, are substantial and as complete as possible.

The main building is a 2-story frame structure 70 by 42 feet, with

LABORATORY INTERIOR, BEAUFORT.



OBSERVATION TANK, BEAUFORT LABORATORY.

two wings each $51\frac{2}{3}$ by $17\frac{2}{3}$ feet, and contains a laboratory, aquarium, office, 12 bedrooms, commodious halls, 2 bathrooms, and storerooms. In front is a portico with a balcony, and around the sides is a veranda. In the center of the large aquaria hall are two oval tanks, 12 by 8 feet and 3 feet deep, constructed of white cedar and finished with cement. Along the north wall, in front of each window, are placed large aquaria with tidal boxes between. The room also contains a tank-table and saurian tank, three compartment hatching-tables, work-tables, and sinks. Along the north and south walls of the laboratory are compartments divided by partition shelves, each compartment being provided with a table for microscopes. Four large tank-tables, two at either end of the room, are arranged for the experimental work of the laboratory, while two long tables in the center contain lockers and shelves for the supplies. At each end are sinks. All other available space is used for show-cases.

Sixty-five feet north of the main building is the mess-house, a $1\frac{1}{2}$-story frame structure, 36 by 33 feet, containing a dining-room, three bedrooms, kitchen, and bath. Near by is the power-house, 36 by 33 feet, in which are the boiler, pumps, dynamo, etc. All these buildings are lighted with electricity and have slate roofs. There are also a boat-house, fuel-shed, outbuildings, and a landing-pier 80 feet long. Fresh water is obtained from an artesian well 200 feet deep and a brick cistern with a capacity of 10,000 gallons. Salt and fresh water tanks are placed in towers on the wings of the main building, from which the water is distributed by pipe lines as needed.

Under the authority of an act of Congress approved June 6, 1900, correspondence was begun with a view to the selection of a site for a fish-cultural station in West Virginia, and during the fall of 1900 and the succeeding year a number of localities in different parts of the State were examined by the Commissioner personally and by agents of the Commission. A site about two-thirds of a mile from White Sulphur Springs, Greenbrier County, was finally decided upon as combining the desired requisites for both trout and bass culture. Here was found a spring flowing 1,800 gallons per minute, with a temperature of 53° in August. Below the spring several small runs, with temperatures of 65° to 70°, can be utilized, which will augment the supply by about 5,000 gallons per minute. Land was available where buildings can be advantageously erected and well adapted to the construction of ponds below the spring, and railroad facilities are good. Accordingly a tract of 25 acres was purchased June 26, 1902, and the preparation of plans was at once begun.

An item in the urgent deficiency bill approved February 14, 1902, so amended an item in the sundry civil bill approved March 3, 1901, providing for the establishment of a fish-cultural station at Tupelo, Miss., as to allow the purchase of land. The wording of the act limited the location of the station to the town of Tupelo, and a site comprising 28 acres was selected on its southeast border, where it would appear that a water supply can be obtained by artesian wells. Steps have been taken to acquire the property.

An act of Congress approved February 4, 1901, provided for a lobster hatchery on the Maine coast, and after an examination of different localities by the Commissioner and representatives of the Commission conversant with the needs of such an establishment, McKown Point, on the southwest side of Boothbay Harbor, was chosen. This is about 3½ miles by land and about a mile by water from the town of Boothbay Harbor, Lincoln County, where there are daily boat connections with Bath and other important towns. The site selected has an area of 9 acres. It is on a rocky point with deep water close to the shore, thus insuring a good water supply by pumping even at low tide; boat landings can be advantageously constructed, and the ground lies well for a convenient arrangement of the hatchery and other buildings. Moreover, Boothbay Harbor is an excellent center for obtaining egg lobsters in quantities for artificial propagation, which is a matter of importance.

STEAMER ALBATROSS.

The salmon investigations conducted with this vessel during the summer of 1901 were carried on in southeast Alaska, and it was intended to complete the survey begun in 1897. Smallpox broke out among the crew, compelling the return of the ship earlier than was intended, but though an examination of all the new canneries in this part of the Territory was interfered with, the stream and lake work was practically completed. The vessel reached Seattle early in September. A report covering the salmon investigation for 1900 and 1901 will soon be issued, which, taken in connection with that of 1897, it is believed will give a comprehensive account of the commercial aspects of the salmon interests of Alaska.

During September and October an examination was made along the coasts of Washington, Oregon, and California, looking to the movements of salmon at sea and the results of the introduction of eastern lobsters and crabs. At the end of October the *Albatross* was in San Francisco for the purpose of refitting and making minor repairs preparatory to her next duty.

In continuation of the investigation of the Hawaiian fisheries, begun in 1901 by direction of Congress, it was decided to send the *Albatross* to those islands to study the conditions in the surrounding waters. An arrangement was made with Dr. David Starr Jordan to have general supervision of the expedition, and Dr. Charles H. Gilbert was put in immediate charge of the scientific work. The investigation was to embrace dredging and collecting in channels and on the banks about the islands, and a thorough examination of the surroundings of Kauai, the oldest of the group, of outlying reefs about the islands northwest of Kauai, and of the different fishing-banks. It is believed information of both commercial and scientific importance will be gained. The vessel sailed from San Francisco March 11, arriving at Honolulu March 24, where the investigation was at once begun and is now in progress.

On October 26, 1901, by order of the Secretary of the Navy, Commander Jefferson F. Moser, U. S. Navy, was detached from the command of the *Albatross* and was succeeded by Commander Chauncey Thomas, U. S. Navy. Commander Moser's services with this Commission covered a period of over four years and were efficient and valuable. His detachment was viewed with regret.

STEAMER FISH HAWK.

On July 3, 1901, this vessel left Gloucester City, N. J., for Woods Hole, Mass., where she was detailed for duty in connection with the laboratory until September, when she was sent to Baltimore to undergo considerable repairs. It having been determined to use her in connection with the sponge investigations on the Florida coast, she sailed from Baltimore October 8, 1901, arriving at Cedar Keys, where it was decided to establish headquarters, on the 21st. The work outlined for the vessel was to determine and plot the area of the different sponge-grounds; to investigate the nature of the bottom and depth of water as affecting the growth, distribution, and abundance of marketable sponges; and to examine biologically certain areas, making as complete collections of specimens as possible. A survey covering all the sponge-grounds on the west coast of Florida, north of Tampa Bay, was continued till January 29, 1902, during which lines of soundings and dredgings, about 5 miles distant from each other, were made from shoal water out to a depth of about 10 fathoms. On completing this work the vessel proceeded to Key West, Fla., and made a series of dredgings for the purpose of determining the nature of the marine fauna in this region as bearing on the advisability of establishing a biological station at Key West, and also to ascertain the condition of the sponge-grounds in this region. During the season collections of live fishes were made for the aquarium at the Charleston Exposition. The results of these operations, though considerably retarded by bad weather, are regarded as successful, and will be enlarged on when the complete reports of the condition and resources of the Florida sponge-grounds are published.

From March 17 to April 10 the *Fish Hawk* was at Charleston, S. C., moored at the Exposition grounds, where she formed an attractive feature of the exhibit of the Commission by illustrating the methods of carrying on deep-sea investigations, with the appropriate apparatus. After some repairs at Baltimore the vessel proceeded to Gloucester City, N. J., and on April 29 the usual spring shad-hatching on the Delaware was taken up and continued until the close of the fiscal year. The fish-cultural work is referred to elsewhere.

EXPOSITIONS.

At the close of the Pan-American Exposition at Buffalo, November 1, 1901, it was desired by those interested to have the Government exhibits sent to the South Carolina Interstate and West Indian Exposition, which was to open at Charleston, S. C., December 1. Congress at that time had provided no funds for the purpose, but with the approval of the President the heads of the Executive Departments directed that such parts of their respective exhibits as might be desired should be sent to Charleston for display there, provided that all the expenses should be borne by the exposition authorities. Accordingly, the Commission sent its entire exhibit directly from Buffalo to Charleston, where it was installed in a building constructed for the purpose, with an amount of space equal to that in Buffalo, except that the aquarium was much smaller.

By an act approved January 21, 1902, Congress appropriated $90,000 to defray the expense of the Government exhibit. At the close of the exposition, on the 31st of May, 1902, the material was returned to Washington.

The board of directors of the Pan-American Exposition awarded commemorative diplomas to the Commission for its exhibits as follows: The collective exhibit; the aquarium; the hatching and transporting apparatus; fishing apparatus and accessories; scientific researches; products of fisheries; sponges; collection of pearls and pearl-bearing shells; reports and bulletins. The Interstate and West Indian Exposition awarded a diploma and gold medal.

By an act approved March 3, 1901, Congress appropriated $5,250,000 for the Louisiana Purchase Exposition to be held in St. Louis in 1903. The act directed the appointment by the President of a national commission and also that the Executive Departments and bureaus, including this Commission, should take part. The Government exhibit, as usual, is to be under the direct control of a board of management consisting of a representative from each establishment participating. Mr. W. de C. Ravenel, who has represented the Commission at all the recent expositions, was designated to act in a similar capacity at St. Louis. The opening of the exposition has been deferred till 1904.

Invitations to participate in the below-mentioned expositions were received, but could not be accepted in the absence of specific authority from Congress:

International Exposition of Hygiene, Maritime Security, and Fishing, Ostend, August–September, 1901; organized under the auspices of the Communal Administration.

International Exhibition of Fisheries, St. Petersburg, February–March, 1902; organized by the Imperial Society of Fisheries and Fish-Culture.

International Fishery Exhibition, Vienna, September 6–21, 1902, on the occasion of the eighth Austrian Fishery Conference.

Exposition of Hydro-biology, Fish-culture, and Fishing, Moscow, March, 1903; organized by the Ichthyological Section of the Imperial Society of Acclimatation of Russia.

MISCELLANEOUS.

At Neosho, Mo., it was found advisable to obtain an addition of 3½ acres of land in order to control the water supply from Spring Branch and to extend the pond system. This purchase was made by deed dated June 6, 1901.

Two small tracts of land were also purchased at San Marcos in order to straighten the boundary lines of the property and to obtain additional area for new ponds with land and water rights adjacent to the San Marcos River. These purchases were deeded October 2, 1901, and March 27, 1902.

The increasing work involved in the collection and distribution of adult fishes in the Mississippi River and its tributaries in connection with the operations of the Manchester, Iowa, Station has rendered the use of a steamer specially constructed for the purpose very desirable, as by this means the work can be conducted more efficiently and economically. Accordingly, under authority of an act of Congress approved March 3, 1901, a contract was entered into with Kahlke Brothers, of Rock Island, Ill., to build a two-decked, stern-wheeled river steamboat 76 feet long, 20 feet beam, with 3 feet depth of hold. On the main deck are light galvanized-iron retaining-tanks, 4 feet by 2½ feet by 2 feet, for carrying fish, with pump, air-compressor, and necessary machinery for a complete circulating apparatus; on the deck above are the pilot-house and a deck-house containing four double bunks. The boat is propelled by a pair of lever engines, with a boiler 40 inches in diameter and 16 feet long. The vessel will be completed and ready for use during the coming season.

Besides the usual repairs to the steam launches and smaller vessels, to keep them in good condition, the *Shearwater* and *Senator* have been thoroughly overhauled, the hulls of both being practically rebuilt, as they were in bad condition and showed serious signs of decay.

CHANGES IN PERSONNEL.

On February 14, 1902, Mr. W. de C. Ravenel, who had been assistant in charge of the Division of Fish-culture since 1895, severed his connection with the Commission to accept an administrative position with the United States National Museum. Mr. Ravenel, entering the service in 1884 as superintendent of the St. Jerome, Md., Station, had risen through different grades, and his record has always been distinguished for efficiency and business ability. He has taken a prominent part in the exposition work of the Commission, and has been its representative on the Government Boards of Managers at all the expositions held in this country, except at Cincinnati and Chicago. At the latter exposition he was chief special agent.

PUBLICATIONS.

During the year there have been added to the library 115 books and 185 pamphlets and unbound volumes. The bound report for 1900 has been issued together with the following pamphlets:

The Mollusca of Porto Rico, by W. H. Dall and C. T. Simpson. Bulletin for 1900, vol. 1, pp. 351–524, plates 53 to 58.

The Brachyura and Macrura of Porto Rico, by Mary J. Rathbun. Bulletin for 1900, vol. 2, pp. 1 to 127+*129 to *137, plates 1 and 2.

The Anomuran collections made by the *Fish Hawk* expedition to Porto Rico, by J. E. Benedict. Bulletin for 1900, vol. 2, pp. 129–148, plates 3–6.

Stomatopoda of Porto Rico, by R. P. Bigelow. Bulletin for 1900, vol. 2, pp. 149–160.

Report on Porto Rican Isopoda, by H. F. Moore. Bulletin for 1900, vol. 2, pp. 161–176, plates 7–11.

The Cirripedia collected near Porto Rico by the *Fish Hawk* expedition in 1898–99, by M. A. Bigelow. Bulletin for 1900, vol. 2, pp. 177–180.

The Polychætous Annelids of Porto Rico, by A. L. Treadwell. Bulletin for 1900, vol. 2, pp. 181–210.

Descriptions of two new leeches from Porto Rico, by J. Percy Moore. Bulletin for 1900, vol. 2, pp. 211–222, plates 12–13.

The Nemerteans of Porto Rico, by W. R. Coe. Bulletin for 1900, vol. 2, pp. 223–229.

The Echinoderms of Porto Rico, by H. L. Clark. Bulletin for 1900, vol. 2, pp. 231–263, plates 14–17.

The Alcyonaria of Porto Rico, by C. W. Hargitt and C. G. Rogers. Bulletin for 1900, vol. 2, pp. 265–287, plates I–IV.

The stony corals of Porto Rican waters, by T. Wayland Vaughan. Bulletin for 1900, vol. 2, pp. 289–320, plates I–XXXVIII.

Actinaria from the vicinity of Porto Rico, by J. E. Duerden. Bulletin for 1900, vol. 2, pp. 321–374, plates I–XII.

The sponges collected in Porto Rico in 1899 by the U. S. Fish Commission steamer *Fish Hawk*, by H. V. Wilson. Bulletin for 1900, vol. 2, pp. 375–411.

Dredging and other records of the U. S. Fish Commission steamer *Albatross*, with bibliography relative to the work of the vessel, compiled by C. H. Townsend. Report for 1900, pp. 387–562, plates I–VII.

The French sardine industry, by H. M. Smith. Bulletin for 1901, pp. 1–26, plates 1–8.

Biological notes, No. 2, from the biological laboratory at Woods Hole. Bulletin for 1901, pp. 27–33.

Description of a new oceanic fish found off southern New England, by Carl H. Eigenmann. Bulletin for 1901, pp. 35–36.

The egg and development of the conger eel, by Carl H. Eigenmann. Bulletin for 1901, pp. 37–44.

Investigations into the history of the young squeteague, by Carl H. Eigenmann. Bulletin for 1901, pp. 45–51.

A new isopod parasitic on the hermit crab, by Millet T. Thompson. Bulletin for 1901, pp. 53–56, plates 9–10.

The plants of western Lake Erie, with observations on their distribution, by A. J. Pieters. Bulletin for 1901, pp. 57–79, plates 11–20.

The Leptocephalus of the American eel and other American Leptocephali, by C. H. Eigenmann and C. H. Kennedy. Bulletin for 1901, pp. 81–92.

Report of the Commissioner for the fiscal year ending June 30, 1901, by George M. Bowers. Report for 1901, pp. 1–170.

Publications of the United States Commission of Fish and Fisheries available for distribution on December 1, 1901. Report for 1901, pp. 177–192.

Notes on the fishes and mollusks of Lake Chautauqua, N. Y., by B. W. Evermann and E. L. Goldsborough. Report for 1901, pp. 169–175.

The Foraminifera of Porto Rico, by James M. Flint, medical director, U. S. Navy. Bulletin for 1900, vol. 2, pp. 413–416.

Description of a new species of blenny from Japan, by Hugh M. Smith. Bulletin for 1901, pp. 93, 94.

List of species known to occur in the Great Lakes or their connecting waters, by Barton Warren Evermann. Bulletin for 1901, pp. 95, 96.

Notes on the tagging of four thousand adult cod at Woods Hole, Mass., by Hugh M. Smith. Report for 1901, pp. 193–208.

Notes on the silversides of the genus *Menidia* of the east coast of the United States, by W. C. Kendall. Report for 1901, pp. 241–267.

Notes on the Scotch methods of smoking haddocks, by Hugh M. Smith. Report for 1901, pp. 269–271.

Notes on the fishes of Lake Ontario. An annotated list of the fishes known to occur in Lake Champlain and its tributary waters. An annotated list of the fishes known to occur in the St. Lawrence River. By B. W. Evermann and W. C. Kendall. Report for 1901, pp. 209–240.

A report on fishes collected in Mexico and Central America, by B. W. Evermann and E. L. Goldsborough. Bulletin for 1901, pp. 137–159.

The organic constituents of the scales of fish, by E. H. Green and R. W. Tower. Bulletin for 1901, pp. 97–102.

The reactions of copepods to various stimuli and the bearing of this on daily depth migrations, by G. H. Parker. Bulletin for 1901, pp. 103–123.

The gas in the swim-bladder of fishes. Biliary calculi in the squeteague, by R. W. Tower. Bulletin for 1901, pp. 126–135, plate 21.

Description of new species of shad (*Alosa ohiensis*), with notes on other food-fishes of the Ohio River, by Barton Warren Evermann. Report for 1901, pp. 273–288.

There have been distributed during the year 1,815 bound and 19,210 pamphlet publications of the Commission.

The Museum of Comparative Zoology, Cambridge, Mass., has published under the general title, "Reports on the scientific results of the expedition to the tropical Pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer *Albatross*, from August, 1899, to March, 1900, Commander Jefferson F. Moser, U. S. N., commanding":

I. Preliminary report and list of stations, by Alexander Agassiz; with remarks on deep-sea deposits, by Sir John Murray. (Vol. XXVI, No. 1.)

II. Some species of Partula from Tahiti: A study in variation; by Alfred Goldsborough Mayer. (Vol. XXVI, No. 2.)

III. Medusæ, by Alexander Agassiz and Alfred Goldsborough Mayer. (Vol. XXVI, No. 3.)

APPROPRIATIONS.

The appropriations available for conducting the Commission during the fiscal year 1902 were as follows:

Salaries	$234,120
Miscellaneous expenses:	
Administration	12,500
Propagation of food-fishes	175,000
Inquiry respecting food-fishes	22,500
Statistical inquiry	7,500
Maintenance of vessels	35,000
For improvement and enlargement of stations at—	
Green Lake, Me	4,000
Woods Hole, Mass	2,000
For purchase of additional land and improvements at—	
San Marcos, Tex	8,000
Neosho, Mo	7,500
For the construction of a steamboat for use on the Mississippi River	5,000
For the establishment of a lobster hatchery on the coast of Maine	10,000
For the establishment of a fish-cultural station at Tupelo, Miss	20,000

A report of the expenditure of these appropriations will be made to Congress in accordance with law.

GEORGE M. BOWERS,
Commissioner.

REPORT ON THE PROPAGATION AND DISTRIBUTION OF FOOD-FISHES.

By JOHN W. TITCOMB, *Assistant in Charge.*

PROPAGATION OF FOOD-FISHES.

The work of the division was under the direction of Mr. W. de C. Ravenel until February 15, 1902, when he resigned to accept the position of administrative assistant in the National Museum. The vacancy was filled by the promotion of Mr. John W. Titcomb from the superintendency of the St. Johnsbury, Vt., Station.

In addition to the usual work of the division, which consists of the general direction of fish-cultural work, including the propagation and distribution of fish from the various stations, Mr. Ravenel was representative of the Commission at the Pan-American Exposition and also at the Charleston Exposition, and continued the duties of representative after assuming his new position in the National Museum.

There has been no change in the policy of the Commission in respect to the division of fish-culture, and the work is conducted on the same general lines as in the past, the results exceeding those of any previous year. The total number of fish and eggs distributed was 1,495,543,374, or an increase of 321,709,912 over the output of the preceding year. Of these 1,480,642,960 were for the development of the commercial fisheries of the country, and 14,900,414 may be regarded as strictly game fishes. The number of applications received during the year was 3,814, an increase of 762 over the previous year, or 25 per cent. This is in addition to the large number of fishes distributed and planted by the Commission from the various stations, principally commercial fishes. This increase in the output of the stations is attributable to several causes, largely to the increased appropriation provided for by Congress and also to the fact that the general conditions for collecting eggs at most of the stations were unusually favorable during the spawning seasons. The results reflect great credit upon the esprit de corps of the superintendents and other employees in the field.

The following is a list, in systematic order, of the fishes propagated and distributed by the Commission, with the scientific name and the common name or names. The fishes artificially propagated are designated *; those simply collected and distributed are indicated thus §; the introduced species are shown by §§; and the species propagated as food for other fishes are represented by an exclamation mark.

List of fishes propagated and distributed by the Fish Commission.

Siluridæ, The Cat-Fishes.

* § *Ictalurus punctatus* (Rafinesque). Spotted Cat; Blue Cat; Channel Cat.
* § *Ameiurus nebulosus* (Le Sueur). Horned Pout; Bullhead; Yellow Cat.

Catostomidæ, The Suckers and Buffalo-fishes.

§ *Ictiobus bubalus* (Rafinesque). Small-mouthed Buffalo-fish.

Cyprinidæ, The Minnows and Carps.

! §§ *Cyprinus carpio* Linnæus. Carp. (Cultivated varieties, German Carp, Leather Carp, Mirror Carp, etc.)

Clupeidæ, The Shads and Herrings.

* *Alosa sapidissima* (Wilson). Shad.

Salmonidæ, The Salmons, Trouts, White-fishes, etc.

* *Coregonus clupeiformis* (Mitchill). White-fish.
* *Argyrosomus artedi* (Le Sueur). Lake Herring; Cisco.
* *Oncorhynchus tschawytscha* (Walbaum). Quinnat Salmon; Chinook Salmon; Tyee Salmon; King Salmon.
* *Oncorhynchus kisutch* (Walbaum). Silver Salmon; Coho.
* *Oncorhynchus nerka* (Walbaum). Blueback Salmon; Red-fish; Sockeye.
* *Salmo gairdneri* Richardson. Steelhead; Hardhead; Salmon Trout.
* *Salmo salar* Linnæus. Atlantic Salmon.
* *Salmo sebago* Girard. Landlocked Salmon.
* *Salmo lewisi* Girard. Yellowstone Lake Trout; Cut-throat Trout; Black-spotted Trout.
* *Salmo pleuriticus* Cope. Colorado River Trout; Black-spotted Trout.
* *Salmo macdonaldi* Jordan & Evermann. Yellow-finned Trout.
* §§ *Salmo trutta* Linnæus. Sea Trout; Salmon Trout.
* §§ *Salmo trutta levenensis* (Walker). Loch Leven Trout.
* §§ *Salmo fario* Linnæus. European Brown Trout; Von Behr Trout.
* *Cristivomer namaycush* (Walbaum). Lake Trout; Mackinaw Trout; Longe; Togue.
* *Salvelinus fontinalis* (Mitchill). Brook Trout; Speckled Trout.
* *Salvelinus agassizii* (Garman). Dublin Pond Trout.
* *Salvelinus aureolus* Bean. Golden Trout; Sunapee Lake Trout.

Thymallidæ, The Graylings.

* *Thymallus montanus* Milner. Montana Grayling.

Esocidæ, The Pikes.

§ *Esox lucius* Linnæus. Common Pike; Pickerel.
§ *Esox vermiculatus* Le Sueur. Little Pickerel; Grass Pike.

Centrarchidæ, The Basses, Sun-fishes, and Crappies.

* § *Pomoxis annularis* Rafinesque. Crappie.
* § *Pomoxis sparoides* (Lacépède). Strawberry Bass; Calico Bass.
* § *Ambloplites rupestris* (Rafinesque). Rock Bass; Red-eye; Goggle-eye.
* § *Chænobryttus gulosus* (Cuvier & Valenciennes). Warmouth; Goggle-eye.
§ *Micropterus dolomieu* Lacépède. Small-mouthed Black Bass.
* § *Micropterus salmoides* (Lacépède). Large-mouthed Black Bass; Straw Bass.
* § *Lepomis pallidus* (Mitchill). Bluegill.

Percidæ, The Perches.

* § *Stizostedion vitreum* (Mitchill). Pike Perch; Wall-eyed Pike; Yellow Pike; Blue Pike.
* § *Perca flavescens* (Mitchill). Yellow Perch.

Gadidæ, The Cods.

* *Gadus callarias* Linnæus. Cod.

Pleuronectidæ, The Flounders.

* *Pseudopleuronectes americanus* (Walbaum). Winter Flounder.

INSPECTIONS.

During the month of November Mr. Ravenel visited Detroit and Northville to confer with the superintendent of the Northville Station and the State fish and game warden of Michigan, and to arrange for the collection of lake-trout eggs in the Michigan waters of the Great Lakes. He also visited Put-in Bay Station, inspected the improvements recently made, and found the station in very good condition. Various recommendations were made for further improvements—first, for the dredging out of the channel and a place for anchoring the penning crates. The station very much needs a residence for the superintendent. The only available house is over 2 miles from the hatchery.

In order to familiarize himself with the work of the various stations over which he had recently assumed charge, Mr. Titcomb began a series of inspections in March, and before the close of the year had visited the following stations in the order named:

Wytheville, Va., Station.
Erwin, Tenn., Station.
Bullochville, Ga., Station.
Neosho, Mo., Station.
San Marcos, Tex., Station.
Bryan Point, Md., Station.
Edenton, N. C., Station.
Gloucester, Mass., Station.
Swanton, Vt., Substation.
Nashua, N. H., Station.
Battery Station, Havre de Grace, Md.
Steamer *Fish Hawk*, Delaware River.
Cape Vincent, N. Y., Station.
St. Johnsbury, Vt., Station.

All of these stations were found to be in good condition, but each one seemed to have more or less need for improvement in order to keep the work up to its fullest capacity. At the Wytheville Station the buildings and ponds were found to be in very good repair. An ice-house is needed, as it is possible to collect at the station all the ice necessary for fish-cultural work if storage room is provided for it. The superintendent was instructed to introduce a power chopper for preparing fish food. A bad feature about this station is the fact that the spring is gradually failing in the amount of water flowing from it.

The Erwin Station is very attractive in appearance, and everything being new was in good repair with a few exceptions. The superintendent's residence is small and cheaply constructed; it should be enlarged and the chimney rebuilt. Arrangements were made for the construction of five new ponds for the propagation of bass and other pond fishes and for inclosing the station with a hog-proof wire fence.

The station at Bullochville, Ga., was found to be in first-class condition, both as to buildings and ponds. One of the main sources of water supply is not on the station property. It would be a great improvement to the station if an additional purchase of land could be made, to include the source of water supply and straighten the boundary lines.

At Neosho the buildings had been recently repaired under a special appropriation and the ponds were in course of construction and repair. The station is very inadequately supplied with water, and an additional supply can be obtained only at large expense.

The station at San Marcos, Tex., and everything connected with its conduct, was very satisfactory. The demands upon this station are increasing annually, owing to the opening up of new territory and the remarkable results attained from the fishes already distributed. These conditions make it desirable to acquire additional land for pond culture.

The shad stations at Bryan Point and Havre de Grace, Md., were visited during the period of active operations, and everything was found to be working most satisfactorily. The *Fish Hawk*, engaged in shad work on the Delaware River, was also visited before the close of the egg-collecting season.

The shad station at Edenton has in connection with it three marsh ponds for the propagation of black bass and crappie, but it is questionable whether the station will ever be of value for other work than the propagation of shad. It is a well-built and well-equipped station, in fact, the most complete shad station of the Commission. It would be economy, however, to have in connection with it a boathouse to shelter the launches and other boats and to give additional storage room.

When the station at Gloucester, Mass., was visited everything was in readiness for the lobster work. Arrangements were made for the construction of a breakwater in which to keep the fish-cars for retaining live cod and lobsters. The capacity of the station for fish-cultural work should be increased by an addition to the hatchery.

At Swanton the work of collecting pike-perch eggs on Missisquoi River was placed in charge of Supt. Livingston Stone, of Cape Vincent Station, and arrangements made for its conduct during the season.

At the Nashua Station the chief problem was the shortage of the water supply during the summer season, and methods for increasing the supply were fully discussed with the superintendent. In the hatchery there had been an unusual mortality among the brook-trout fry, undoubtedly due to the lack of sufficient flow of water upon the eggs during the period of incubation.

At the time the Cape Vincent Station was visited no fish-cultural work was going on, the product of the station having been previously distributed. This station is entirely dependent upon the collections of eggs from other stations for its source of supply. The capacious hatchery building is capable of turning out a great many young fish and is well supplied with the necessary apparatus and equipment. Arrangements were made for obtaining water from the city works upon a more economical basis. The heating apparatus at this station is not satisfactory, owing to the inordinate amount of coal consumed by it. A new and more economical heating plant should be installed. Extensive repairs upon the wharf will soon be necessary.

The St. Johnsbury Station is still inadequately supplied with water, the special appropriation for necessary improvements being kept unimpaired until satisfactory arrangements can be made for its economical expenditure.

The traveling expenses incurred were much less than the saving at one station, resulting from the changes made as a result of the inspection.

METHODS OF FISH-CULTURE.

Few improvements in the methods of fish-culture can be recorded for the year. The most notable one may be the method of taking salmon eggs at the Baird, Cal., Station and substations, whereby from 10 to 15 per cent more eggs are obtainable from the same number of fish than heretofore. This is accomplished by cutting the salmon open after the usual stripping and washing the bloody eggs thus obtained in a normal salt solution before fertilizing them, as explained in detail under the summarized report of Baird Station. This improved method will be adopted at the other salmon stations the coming year.

At Put-in Bay, Ohio, Superintendent Downing has devised a new hatching-jar along the same general lines as the Stranahan jar, except that it is of a different shape and of greater capacity. It has been adopted for Put-in Bay Station.

In pond culture, by which is meant the propagation of the basses and other fishes, the eggs of which are handled and hatched in ponds by the natural process, little definite progress has been made. The general feeling among fish-culturists in charge of pond stations is that the ponds for the propagation of bass and other fish should be made much larger than at present—in fact, as large as possible and still have them entirely under control so that the fish can be removed as wanted.

The following stations and auxiliary stations were operated during the year, and the work at each is reviewed in detail in the abstracts of the reports from the various superintendents:

Green Lake, Maine.
Craig Brook, Maine.
Grand Lake Stream, Maine.
St. Johnsbury, Vermont.
Nashua, New Hampshire.
Woods Hole, Massachusetts.
Gloucester, Massachusetts.
Cape Vincent, New York.
Swanton, Vermont.
Steamer *Fish Hawk* (Delaware River).
Battery Station, Maryland.
Bryan Point, Maryland.
Fish Lakes, Washington, D. C.
Central Station, Washington, D. C.
Wytheville, Virginia.
Edenton, North Carolina.
Erwin, Tennessee.
Cold Springs, Georgia.
Put-in Bay, Ohio.
Northville, Michigan.
Detroit, Michigan.
Alpena, Michigan.
Sault Ste. Marie, Michigan.
Duluth, Minnesota.
Quincy, Illinois.
Manchester, Iowa.
Bellevue, Iowa.
San Marcos, Texas.
Neosho, Missouri.
Leadville, Colorado.
Spearfish, South Dakota.
Bozeman, Montana.
Baird, California.
Battle Creek, California.
Mill Creek, California.
Rogue River, Oregon.
Clackamas, Oregon.
Little White Salmon River, Washington.
Baker Lake, Washington.

GREEN LAKE STATION, MAINE (E. E. RACE, SUPERINTENDENT).

The work at the Green Lake Station has been confined entirely to the propagation of the brook trout and landlocked salmon. During the summer months, in addition to the usual fish-cultural work, investigations were made with the view to establishing new field stations for the collection of eggs, and as a result operations were inaugurated at Alligator Lake, in Hancock County, and Sourdnahunk Lake, in Piscataquis County. The field stations operated in previous years at Green Lake, Pattens Pond, and Branch Pond were also reopened and operated.

At Alligator Lake a log camp was constructed for the shelter of the fishermen, and a temporary hatchery for eying eggs was erected and equipped with the necessary apparatus for conducting operations. At this point it was thought that brook trout could be captured on the bars and landlocked salmon at the outlet of the lake, but although the water and weather were both favorable, and the station in the hands of experienced fishermen, no salmon and only 52 brook trout were captured. From the trout 21,000 eggs were obtained, 7,000 of them being transported direct to Green Lake Station within 24 hours after being taken from the fish. The remaining 14,000 were laid down in the temporary hatchery to be eyed, but after holding them from 15 to 20 days in a temperature of 38° F., it was found that the expense of developing them at the point of collection would be very large; they were therefore transferred to Green Lake Station before the eye-spots appeared, but all died en route.

Sourdnahunk Lake is 55 miles northwest of Patten, in an unbroken wilderness, and is probably at the highest elevation of any lake of equal size in the State. It is 4 miles long by 1¼ miles wide, and is the breeding-ground for nearly the entire west branch of the Penobscot River. No fish are found in the lake except brook trout and shiners. The adult trout averaged a trifle less than a pound in weight, the largest weighing 2 pounds. Owing to the expense of transporting suitable material from Patten, nets were used for the leads of the traps and sides of the confining pens, but these were destroyed by a moose swimming around in the lake about the time the fishing season began. Temporary pens were built of poles and the fish were captured by means of seines. All the fish that could be safely held in these pens were caught before any of them had commenced working on the spawning-grounds, as many as 800 being taken at one haul of the seine. The total number recorded as captured was 4,275 males and 5,725 females; 4,047 females were stripped and yielded 1,470,000 eggs. As the lake froze over two weeks earlier than was expected, the rest of the females were liberated by cutting holes through the ice and removing the stakes in the pens. The eggs were eyed in troughs set up in a small tent, the troughs being not more than 6 inches above the ground; but notwithstanding the fact that two fires were kept night and day, the water temperature dropped to the freezing-point several times, and 190,000 were lost by freezing to the bottoms of the hatching-troughs. On February 19 the eggs were packed out, but on account of the deep snow between Sourdnahunk Lake and Patten they were on the road three days, and 10,250 died en route. Of the 1,280,000 which reached Patten in good condition, 320,000 were shipped to the Maine Fish Commission and 50,000 to the Parmachenee Club, Camp

Caribou, Maine. The others were transferred to Green Lake to be hatched, and the losses on the eggs and fry were very small.

Operations at Green Lake for collecting landlocked-salmon and brook-trout eggs were inaugurated as in previous years, but owing to the fact that the water in the lake was 14 inches lower than during any fishing season in the past seven years no fish were captured in the trap at Great Brook near the spawning-house, it being impossible for them to get over the bars at the mouth of the brook. This is the first season since the establishment of the hatchery that the fish were unable to ascend Great Brook during the spawning season. A large pound net was operated on what is known as the middle ground, between the hatchery wharf and the outlet of the lake, but owing to unprecedentedly low water no fish were captured in it. A pound net set southeast of the bar at Great Brook in 10 feet of water captured 2 brook trout and 164 salmon, half of each species being females. From these fish 2,000 trout and 194,000 salmon eggs were taken. The female salmon caught late in the season were all small, and averaged a trifle over 2,365 eggs to the fish. Some eggs were from immature salmon, apparently 4 or 5 years old, and, as a result, 25,000 died within a few days after being laid down in the troughs.

At Patten Pond, owing to the low water, only 56 brook trout and 2 male salmon were captured. The trout yielded 35,000 eggs, which were transferred to Green Lake Station in good condition.

In September the collecting station at Branch Pond (Winkempaugh Brook) was repaired and put in shape for the season's work. The water at this point was higher and general conditions more favorable for the capture of fish than at any of the other field stations. However, the lake froze over ten days earlier than the previous year, which prevented the capture of the usual number of salmon. On October 14 the only rain of any importance during the fishing season raised the water in the brook from 8 to 10 inches, and as a result 110 brook trout (25 males and 85 females) and 35 salmon (22 males and 13 females) were captured. The total take of fish at this point for the season was 142 trout and 50 salmon. Owing to the scarcity of male brook trout, 16 were captured at Harriman's Pond and transferred to this station, but after using all the male fish available there were still 25 large females unstripped, and as it was impossible to obtain milt for fertilizing their eggs, they were liberated. The total collections at Branch Pond amounted to 56,000 salmon eggs and 85,000 brook-trout eggs.

The landlocked-salmon eggs secured at all points numbered 250,000, and 45,000 of these were shipped to applicants in Massachusetts, Vermont, New York, Utah, and Colorado. The remainder were hatched for rearing and distribution as yearlings in the fall. The stock set aside for this purpose was materially increased during the spring by the transfer of 100,000 young salmon from the Craig Brook Station, the loss on these in transit between the stations amounting to 1,551.

In addition to the 1,613,000 brook-trout eggs collected at the field stations, 200,000 were purchased from George F. Lane, Silver Lake, Mass. These reached the station in excellent condition, only 1,370 having died en route, and the resulting fry were strong and active, the total losses on eggs and fry not exceeding 4 per cent. All but 15,000 of this stock, which are being held for brood fish, were distributed in May and June with the fry derived from the collecting stations, the total output aggregating 1,081,388. This work was all done by the regular employees of the station, and was completed by June 20.

The following shows the field stations operated in connection with Green Lake Station, and the number of fish and eggs obtained at each:

Stations.	Species.	Males.	Females.	Total.	Number of eggs.
Branch Pond	Brook trout	41	101	142	85,000
Do.	Landlocked salmon	28	22	50	56,000
Patten's Pond	Brook trout	29	27	56	35,000
Do.	Landlocked salmon	2	....	2	....
Sourdnahunk Lake	Brook trout	4,275	5,725	10,000	1,470,000
Alligator Lake	....do	20	32	52	21,000
Green Lake	....do	1	1	2	2,000
Do.	Landlocked salmon	82	82	164	194,000
Harriman's Pond	Brook trout	16	....	16	....
Total		4,494	5,990	10,484	1,863,000

At the close of the year the stock of fish on hand consisted of 264,088 landlocked salmon fry and 129,514 brook-trout fry.

A special appropriation for general repairs and improvements having been provided, the western wing of the dam at Rocky Pond, 53 feet long, was removed and replaced by a new wing 189 feet long, and surmounted with 4-foot flush boards. Two hundred and fifty feet of the main supply flume was replaced and 5,000 feet of it repaired. For the purpose of housing the steamer *Senator* and other boats during the winter, a boat-house 57 feet long by 22 feet wide, with a roller railway 384 feet long leading to it, was constructed near the station wharf. The hull of the steamer *Senator* was replanked, calked, and otherwise repaired. Sixteen hatching-troughs were constructed for increasing propagation facilities in the hatchery; the bridges between the hatchery and Rocky Pond were repaired, and much work was done in grading around the north and south reservoirs, hatchery buildings, and rearing-ponds. The coal shed at the outlet of Green Lake, together with 7 or 8 tons of soft coal, was burned on October 17, it presumably having been struck by lightning.

Craig Brook Station, Maine (C. G. Atkins, Superintendent).

The work at the Craig Brook Station and its two auxiliaries, Mattagamon and Grand Lake Stream, has been applied to the propagation of the Atlantic salmon, landlocked salmon, quinnat salmon, steelhead trout, brook trout, rainbow trout, Scotch sea trout, and grayling.

The work at the Mattagamon auxiliary was wholly tentative, aiming at the capture of wild Atlantic salmon near their natural spawning-beds for the collection of spawn, as a substitute for the present system of obtaining spawn from salmon purchased from fishermen about the mouth of the river and impounded during the summer in a stream near Craig Brook. At the beginning of the year a weir of novel form was in operation and an inclosure ready to capture all salmon seeking to ascend the East Branch, but on account of the very low water the salmon failed almost wholly to surmount the dams in its lower course, and scarcely any reached the East Branch. In consequence of their failure the station was abandoned in August.

At the beginning of the year the stock of Atlantic salmon consisted of 238 adults in the Dead Brook inclosure, 300,295 fry, and 411 fish 2 years old. Of the 2-year-old fish 16 were distributed in August, and the remainder were carried through the year with a loss of 19. The fry were reared to fingerlings, and as a result 282,400 were distributed in October and 351 kept to the end of the year. From the 238 adult salmon 832,300 eggs were obtained, of which 315,000 were distributed in the winter and 397,499 hatched in March and April. Of the fry thus obtained 48,715 were liberated in June, and 326,186 remained on hand at the close of the year in course of rearing. Preparations have been made for enlarging the Atlantic salmon operations the coming year by the collection in May and June of 614 adult salmon, of which 589 remained alive at the close of the year.

The stock of landlocked salmon on hand at the opening of the year consisted of 4 broods, of which 24,229 were fry and 1,796 were from 1 to 3 years old. The fry were all fed until November, when 20,758 of them were distributed. Of the balance 2,407 remained on hand at the end of the year. At the Grand Lake Stream auxiliary 72,312 landlocked-salmon fry were on hand at the beginning of the year. These were a part of those reserved for the preservation of the species in the waters where the eggs were collected, and 53,825 were reared and liberated in Grand Lake Stream and vicinity in October. During October and November the run of wild salmon from Grand Lake down into the stream for spawning purposes was unusually heavy, and the weir intercepted 3,210, of which 1,464 were males and 1,746 females. The eggs obtained from the latter amounted to 1,448,274, the largest number collected at this point since 1884. Of these, 225,000 eggs were distributed, and there were hatched from those retained at Grand Lake Stream 505,513 fry and at Craig Brook 282,482. Of the fry at Grand Lake Stream 429,785 were liberated in the lake and stream in June and the remainder, 68,949, were held for feeding. From Craig Brook 100,000 of the fry were transferred to the Green Lake Station in May, 90,000 were distributed in June, and on June 30 there were 67,546 on hand.

Of the 2,137 fingerling brook trout on hand at the beginning of the year 1,243 were distributed as yearlings. From the few adult brook trout on hand 8,500 eggs were collected, and the fry from these eggs, amounting to 5,475, were distributed in local waters.

Forty-one quinnat salmon hatched in 1897 are kept in a deep pond for experimental purposes.

Of steelhead trout several old broods have been kept for experiment, and two of the broods, numbering 1,019, are still retained. One brood afforded 8,500 eggs. From these and from a lot received from Rogue River there were hatched 33,994 fry. These suffered from an obscure disease, and only 12,046 were left for distribution.

In October there were distributed 3,350 rainbow trout hatched in 1901 and 1,056 hatched in 1900, leaving only a lot of 33 fish hatched in 1899.

The Scotch sea trout, like other species, has deteriorated under domestication, the vitality of the eggs and fry growing constantly less. In October 6,937 yearlings were distributed, and in November 68,950 eggs were taken from the brood stock. Of these 10,000 were distributed in the egg stage; the remainder were hatched, and as a result 7,694 fry were distributed in June. The adult stock on hand is 459. The results from the introduction of this species are not encouraging, and their propagation will be discontinued.

From 100,000 grayling eggs shipped from Montana in May, 86,615 fry were hatched, and 36,333 fry were distributed in local waters. An attempt was made to feed the balance, but about June 3 a sudden and heavy mortality attacked them, and by the end of the month only 1,775 remained. This remnant has, as observed at other stations, grown very rapidly.

The fish food consisted of hogs plucks, purchased at an abattoir near Boston. The total consumption was 5,346 plucks, weighing 23,790 pounds and costing $310.04, including transportation.

From the entire stock of fry of all species in the spring of 1901 84.4 per cent were reared to fingerlings and distributed in October and November. The Atlantic salmon did a trifle better than this, and the landlocked salmon best of all, 94.4 per cent having been reared to the fingerling stage. The aggregate production of the station for the year, including auxiliary stations, is as follows: Eggs collected, 2,516,524; eggs distributed, 550,000; fish hatched, 1,321,490; fish distributed, 1,099,929.

The stock on hand at the close of the year was as follows:

Kind.	Calendar year in which fish were hatched.					
	1902.	1901.	1900.	1899.	1898 or earlier.	Wild fish inclosed.
Atlantic salmon	326,186	351		376		589
Landlocked salmon	[a] 67,546	2,407	39	955	707	
Do	[b] 68,949					
Quinnat salmon					41	
Steelhead trout				906	113	
Rainbow trout				83		
Scotch sea trout		279		47	133	
Grayling	1,775					
Total	464,456	3,037	39	2,317	994	589

[a] At Craig Brook.

[b] At Grand Lake Stream.

ST. JOHNSBURY STATION, VERMONT.

Mr. John W. Titcomb, the superintendent of this station, having been appointed in charge of the Division of Fish-culture of the U. S. Fish Commission, at Washington, D. C., he was succeeded on February 15 by Mr. E. N. Carter.

During the summer preparations were made for the collection of brook-trout eggs in the waters controlled by the Laurentian Club in Canada, in Lake Mitchell at Sharon, Vt.; Darlings Pond, Groton, Vt., and Noyes Lake, Chittenden, Vt. At Darlings Pond, where the run of fish has heretofore been very large, the opposite conditions prevailed. The collecting season was unusually dry throughout New England and also in the Province of Quebec, where, in the Laurentian Mountains, the lumbermen reported the water in the streams as lower than it had been since 1847. Owing to the excessive drought the trout did not run as early as usual, and in many instances the eggs were inferior in quality. In the Province of Quebec 6,000 trout were handled in one stream, but the ovaries of the females seemed diseased and the few eggs secured were of inferior quality. In the Laurentian Mountains most of the fish spawned around the shores of the lakes late in the season after the ice had formed on the surface, and there were very few places where the fish ascended the streams to spawn.

At Lake Mitchell the first eggs were secured October 9 and the last on November 16. Of the 324,129 collected, 150,300 were shipped on assignments and the remaining 173,829 were transferred to the St. Johnsbury Station to be hatched.

At Darlings Pond the spawning season extended from September 30 to November 11, and resulted in the collection of 156,000 eggs, 15,000 of which were shipped on assignments. The remainder were hatched at St. Johnsbury.

From Noyes Lake 53,930 eyed eggs were secured, and after shipping 25,000 to fill assignments, the remaining 28,930 were transferred to St. Johnsbury and hatched, producing 22,661 fry. The work at this point began late in the season—October 18—and lasted only five days.

In addition to the eggs secured at the different field stations 250,000 domesticated-trout eggs were purchased of commercial fish-culturists; a consignment of 40,000 was received from Carolina, R. I., in exchange for 35,000 wild-trout eggs, and 39,500 were obtained by the same method from East Freetown, Mass. An assignment of 8,000 domesticated-trout eggs was donated by Mr. L. B. Handy, of South Wareham, Mass., to be used for experimental purposes. All of these eggs were hatched at the St. Johnsbury Station, and the fry were distributed with those derived from the field station in May and June, only 5,802 being retained for rearing.

While the results from the domesticated-trout eggs do not compare favorably with those from the eggs of the wild brook trout, very good results obtain by stipulating that the domesticated eggs must be the product of fish at least 2½ years old.

The rainbow trout on hand began spawning early in April and eggs were obtained from them at intervals to the end of the month. Only 17,845 were secured, and these were very inferior in quality. The fry were retained for rearing. The propagation of the rainbow trout at the St. Johnsbury Station has never been very successful, owing to the extremely cold water. A shipment of 50,000 eggs was also received from the Manchester Station, but they proved to be very poor and only a few fry were hatched from them.

During the winter and spring 200,000 lake-trout eggs were received from Duluth, Minn; 25,000 landlocked-salmon eggs from East Orland, Me.; 50,000 grayling eggs from Bozeman, Mont., and 50,000 steelhead-trout eggs from the station at Rogue River, Oregon. These hatched with good results, and all of the fry were distributed, with the exception of the landlocked salmon and a few of the grayling, which were retained for rearing.

The results of the fish-cultural work at St. Johnsbury for the past five years have proved extremely satisfactory, as demonstrated by the large catches of lake trout from Big Averill Pond, Averill, Vt., which never contained any of that species until they were introduced by the Commission in 1897. From Little Averill Pond, Averill, Vt., in which salmon never existed until introduced from the St. Johnsbury Station, large quantities of salmon have been taken. From Caspian Lake, at Greensboro, Vt., it is estimated that 6 tons of fish were taken with hook and line between May 1 and September 1, 1901, and a proportionate amount for the months of May and June, 1902. Ever since the establishment of the St. Johnsbury Station this lake has been annually stocked with lake trout, landlocked salmon, and brook trout. The species mostly caught are the lake trout and landlocked salmon, speckled trout not having produced very satisfactory results. The introduction of the steelhead trout in Vermont waters has also been very successful.

The introduction of the lake trout in Big Averill Pond afforded an opportunity of ascertaining the actual growth of the fish from the fry stage. The plant of 1897 afforded good fishing for anglers during the season of 1901, the largest fish taken that year weighing 3¾ pounds. The next in size weighed 2¾ pounds, the next 1½ pounds, and the smallest specimens ranged from 9 to 10 inches in length. Many fish of the sizes mentioned were taken, and there was very little variation from the weights given above, indicating that the fry planted in 1897 had attained in 1901 a weight of 3¾ pounds, and that the other sizes were the results of plants in the succeeding years, those from 9 to 10 inches long being a year and a half old from the time the eggs were taken.

During May and June, 1902, the anglers reported an average of about 200 pounds a day from this lake, and the largest fish, which undoubtedly resulted from the plant in 1897, weighed 5½ pounds.

The stock on hand at the close of the year is shown by the following table:

Species.	Calendar year in which fish were hatched.					
	1902.	1901.	1900.	1899.	1898.	1897 or before.
Steelhead trout	20,500					
Rainbow trout	5,734					90
Hybrid of brook and lake trout					4	
Grayling	1,000			14		
Brook trout	5,802					
Landlocked salmon	17,786					
Total	50,822			14	4	90

NASHUA STATION, NEW HAMPSHIRE (W. F. HUBBARD, SUPERINTENDENT).

Besides the brood stock of fish on hand at the beginning of the year, there were 63,810 brook-trout fry which were reared to yearlings before being distributed, the product of the same amounting to 62,500 yearlings. There were also on hand at this time 46,100 landlocked-salmon fry hatched from eggs belonging to the New Hampshire Fish Commission on shares. The product of these fish amounted to 22,400 yearlings, one-half of which were turned over to the New Hampshire Commission and the balance distributed in the usual manner.

During the summer a disease known as pop-eye attacked the 55 adult rainbow trout retained as a brood stock. The eyes protruded from the head, and little bubbles, some of them as large as peas, appeared on the gill-covers, fins, and other parts of the body. When the disease made its appearance the fish were being held in one of the rearing-ponds 100 by 8 feet in dimensions and with plank sides and bottom. In order to cure the affection, the fish were transferred to a larger pond, 150 by 100 feet in area, with natural earth embankments, and as a consequence only two of them died. When removed from this pond, in November, they were found to be in good condition and produced eggs during the following spawning season.

In the course of the summer the superintendent visited various places in the State with the view to finding suitable locations for field stations, and as a result a station for the collection of brook-trout eggs was, in September, established at the Balsams, 12 miles east of Colebrook, the nearest railroad station. Another station was established at Lake Sunapee for the collection of eggs of the brook trout, golden trout, and landlocked salmon.

At the Balsams the fish were caught by means of a trap, in a brook tributary to the pond, and held in pens. The eggs were transferred daily by wagon 12 miles to the State hatchery at Colebrook, where they were eyed, and in December shipped to the Nashua Station.

At Lake Sunapee the brook trout were captured in traps and also, along with the landlocked salmon and golden trout, in fine-meshed gill nets. The eggs at Lake Sunapee were placed in hatching-troughs at the lake, where they were kept for four or five days, or until enough had been collected to warrant making a shipment, when they were placed in 2-quart glass preserve jars, filled three-fourths full of eggs and brimful of water. The jars were then sealed and packed in a box with hay and ice, and in this condition were shipped to Nashua. The eggs were about eight hours in the jars in transit and the jars were not opened during that period, but all eggs shipped in this manner were received at Nashua in good condition and with very small loss.

The brook trout at the station began spawning October 24 and continued until the middle of January, when 1,959 females, nearly all of which were 2½ years old, had been stripped and 1,009,470 eggs secured, or an average of about 512 per fish. The eggs began hatching early in February, the period of incubation being 104 days.

There was an unusual mortality among the brook-trout fry about the time they began to feed, and the cause of this mortality is attributed to the fact that the station was inadequately supplied with water during the early stages of incubation. In order to determine whether the same mortality would occur among fry hatched under favorable conditions, but reared at the Nashua Station, 100,000 brook-trout fry were transferred from the St. Johnsbury Station to Nashua and were successfully reared.

The following table shows the number of eggs and fry received at the station during the year:

Species.	Source of supply.	Eggs.	Fry.
Brook trout	Taken at station	1,009,470	
Do	Taken at Lake Sunapee	70,500	
Do	Taken at the Balsams	176,720	
Golden trout	Taken at Lake Sunapee	123,800	
Landlocked salmon	do	23,000	
Do	Craig Brook Station	10,000	
Rainbow trout	Taken at station	25,500	
Lake trout	Duluth Station	200,000	
Brook trout	St. Johnsbury Station		100,000
Total		1,638,990	100,000

The distributions of fish from the station were all made by the regular station force, and the following table shows the number of fish and eggs shipped from the station during the year:

Species.	Eggs.	Fry.	Yearlings.	Two years or over.
Brook trout	100,000	470,000	62,500	294
Golden trout		70,000	15	
Rainbow trout		8,000		
Lake trout		160,000		
Landlocked salmon			11,200	74
Grayling				8
Total	100,000	708,000	73,715	376

The stock of fish on hand at the close of the year is shown by the following table:.

Species.	Calendar year in which fish were hatched.				
	1902.	1901.	1900.	1899.	1898.
Brook trout	131,087		4,429		85
Steelhead trout				5	
Rainbow trout	5,705				51
Lake trout	23,510				
Landlocked salmon	21,636				
Grayling			35		
Aureolus	7,051	754			
Hybrids	1,989				
Total	190,978	754	4,464	5	136

Woods Hole Station, Mass. (E. F. Locke, Superintendent).

The collection of brood cod off Nantucket Shoals was commenced by the schooner *Grampus* on October 2 and closed on November 3, when 3,179 had been captured and conveyed alive to Woods Hole Station. These fish varied in weight from 3 to 10 pounds, the average being between 6 and 7 pounds, and from them 118,745,000 eggs were taken, which were all of good quality, with the exception of a few of the last lots secured. Of the brood fish 2,106 were released alive, the remainder dying from natural causes. Some of the smaller fish were barren and yielded no eggs.

On November 29 the *Phalarope* reached Plymouth, Mass., and the auxiliary station at that point was opened on December 2. The first eggs were taken on December 3, and collections were obtained up to February 28, when 125,559,000 had been secured. Of these 38,621,000 were shipped to the Gloucester Station and the remainder, 86,938,000, to Woods Hole.

The total number of cod eggs received at Woods Hole amounted to 205,683,000, from which 128,810,000 fry were hatched and planted.

During the month of January arrangements were made for the collection of flat-fish eggs, and on February 5 the boats, nets, and other equipment were sent to Waquoit Bay, but owing to the ice in the bay it was impossible to set the nets until February 15, and it was only done then by breaking up quantities of ice. Nets were also set in the harbor near the station, and from these two fields 553 females were secured, of which 105 died and 123 failed to deposit eggs. The product of the egg-bearing fish amounted to 194,059,000 eggs, of which 144,800,000 were secured from the fish taken at Waquoit Bay. The average yield of eggs this season was larger than that of last year, the average from the fish captured at Woods Hole being 808,000 per fish and from those taken at Waquoit Bay 548,000 per fish.

About the middle of April arrangements were made for collecting egg-bearing lobsters at Scituate, Mass., and from the fishermen at Buzzards Bay and Vineyard Sound. At Plymouth only a few men were fishing and this territory was abandoned. Later in the season a man was employed at Noank, Conn., to collect egg-bearing lobsters from the fishermen there and at Stonington. The work heretofore done at Newport was discontinued because the commissioners of inland fisheries for the State of Rhode Island were engaged in collecting at that point, and arrangements were made to receive such eggs as the State commission did not have use for. The receipts from these sources were less than one-fourth of the number received last year, but the receipts from Buzzards Bay and Vineyard Sound showed a slight increase over the collections of the previous year, and the collections from Connecticut waters showed a gain of over 900 per cent. The total number of eggs received during the season was 20,480,000, a slight increase over the previous year. Of these 5,176,000 were delivered to Mr. G. H. Sherwood, an assistant in the Division of Scientific Inquiry, for experimental purposes, and from the remainder 12,857,000 fry were hatched. Of the fry 6,177,000 were delivered to Mr. Sherwood for rearing purposes, 2,462,000 were shipped to the Rhode Island Fish Commission, at Wickford, R. I., and the remainder were planted in the waters of Connecticut and Massachusetts.

During the year several collections of live fishes were made for the Pan-American Exposition and also for the aquarium at Central Station, Washington, D. C.

The usual repairs necessary at such a station were made during the season, as well as the necessary repairs to the vessels.

Gloucester Station, Massachusetts (C. G. Corliss, Superintendent).

During the summer months the station employees were occupied in overhauling and fitting up the cod-hatching apparatus, making repairs to the equipment and buildings, and also assisting in the construction of the new coal-house. The old coal-house, being past repairs, was torn down and a new one, 29 feet by 14 feet, with a capacity of 45 tons, erected in its place. After the cod season closed a woodshed 12 feet by 9 feet was built adjoining the coal-house, and all the station buildings were painted.

Early in November preparations were made for collecting cod eggs at Kittery Point, Me., and on November 15 Capt. E. E. Hahn, of the schooner *Grampus*, and a force of 7 spawn-takers reported there and at once began operations. The first eggs were taken and shipped to the station November 17. Eggs were collected daily until November 24, when bad weather put a stop to egg-collecting until December 6. Throughout December, January, and February the Ipswich Bay fishing was very poor and irregular. Cod were scarce and many of the boats were laid up for a week or two at a time, it often being difficult to find boats for the spawn-takers. The results of the collections were very disappointing, especially as the weather throughout the winter was exceptionally mild and favorable for fishing. The last eggs were taken March 20, and a few days later Captain Hahn and the *Grampus* force proceeded to Woods Hole to fit up the vessel for collecting egg lobsters on the Maine coast. During the entire season 132,437,000 cod eggs were received at the station, of which 87,468,000 were collected at Kittery Point, Me.; 38,621,000 were received from the collecting station at Plymouth, Mass., and 6,348,000 from the Woods Hole Station. As a result of these collections 83,191,000 fry were hatched and distributed on the natural spawning-grounds from Ipswich Bay to Massachusetts Bay.

In the meantime preparations were being completed for collecting lobster eggs. Early in April collecting stations were established at Kittery Point, Me.; Boston, Mass., and Beverly, Mass., and the customary arrangements were made with fishermen and dealers for saving their egg lobsters. Collections were also made on the Maine coast from Wood Island to Eastport by the schooner *Grampus*, assisted by a steam smack which was chartered for the purpose. Active operations began April 18, when the first shipment of egg lobsters was received from Boston. The collections in April were unusually large, and in May were greatly increased, the collections at all the stations showing a substantial increase over those of the previous season. During June the collections in Massachusetts dropped off considerably, while at Kittery Point and along the Maine coast egg lobsters continued to be found in fair quantities up to the latter part of the month. The collecting stations at Boston and Kittery Point were closed on July 10, but the *Grampus* continued making collections up to July 18. The shipments of egg lobsters from the several collecting fields arrived at the station in excellent condition, with the exception of a few lots late in the season, the eggs on these being so far advanced that some of them were affected by the heat. The collections from all sources aggregated 5,901 lobsters, which yielded 83,418,000 eggs. Of the fry hatched from these 37,100,000 were distributed in Maine waters, 2,200,000 off the coast of New Hampshire, and the balance, except 180,000 sent to Woods Hole for experimental purposes, were planted at various points along the Massachusetts coast from Rockport to Boston.

CAPE VINCENT STATION, NEW YORK (LIVINGSTON STONE, SUPERINTENDENT).

During the year eggs of the white-fish, lake trout, brook trout, and pike perch were handled.

In November 3,771,000 green eggs of the lake trout were received from the Duluth Station which turned out very well, 2,347,600 fry being hatched from them and distributed. Later 4,088,000 green eggs of this species were sent from Charlevoix, Mich., but these turned out very badly, producing only 741,280 healthy fry.

In December 31,212,000 white-fish eggs were received from the Put-in Bay, Ohio, Station, and 10,003,000 from Detroit, Mich. Both lots turned out well, yielding, respectively, 27,346,000 and 6,954,000 strong, healthy fry.

During the months of January and February 816,250 brook trout eggs were received from commercial fish-culturists in Massachusetts, the product of which, as distributed, amounted to 749,350 fry.

In February 50,000 rainbow-trout eggs were received from Manchester, Iowa, resulting in 38,360 fry at the time of distribution.

In March an auxiliary station at Swanton, Vt., was established for the collection of pike-perch eggs. The superintendent assumed general charge of operations at this point, and was in the field in northern Vermont from March 27 to May 24. The run of pike perch up the Missisquoi River began unusually early, and trial hauls of the seine were first made on March 17. The first ripe eggs were taken April 7. The spawning season lasted fifteen days, during which time 113,550,000 eggs were taken, including the eggs contributed free of cost by the commercial fishermen on Lake Champlain. Most of the brood fish from which eggs were secured were captured by operating a seine on the Missisquoi River, and the green eggs collected from the fish thus taken turned out about 65 per cent of eyed eggs. The total number of good eyed eggs, measured just before the hatching began, was 48,000,000, of which 32,000,000 were turned over to the State of Vermont, 11,925,000 were taken to the Cape Vincent Station, and the remainder, a little over 4,000,000, were distributed in the waters of Vermont and New Hampshire.

In the course of this work it was found that the use of muck is not essential for separating pike-perch eggs, the finely pulverized silt forming the upper layer of the river bed answering the purpose fully as well. It was also found that pike-perch eggs conveyed to the hatchery in the milt in which they were fertilized and put into jars immediately after being washed proved to be better than eggs treated in any other way.

Thirteen hundred steelhead-trout fry were liberated in the St. Lawrence River during the summer, the remarkable feature about this event being the fact that the fry were the product of eggs that had been taken from fish that had been hatched at the station four years earlier and had spent their entire life inside the hatchery building. The fry seemed strong and healthy. Several of the parents of these fish were subsequently liberated in the St. Lawrence River, together with some of the quinnat salmon, which had also matured in the hatchery building. Those of both varieties remaining in the hatchery were sent in September to the Pan-American Exposition at Buffalo.

During the year some minor repairs were made.

STEAMER FISH HAWK (JAMES A. SMITH, IN CHARGE).

The vessel arrived off Gloucester City, N. J., in the Delaware River, on April 29, and the hatching apparatus was immediately erected and spawn-takers from the vessel's crew detailed to attend the fishing shores at Howells Cove, Bennetts, and Cramer Hill.

Having received information that the Pennsylvania Fish Commission would not operate the hatchery at Bristol, three spawn-takers were detailed to attend the fishery at Riverton, N. J., 9 miles above Camden. The first eggs were taken on May 1, but owing probably to the prolonged season of cool weather and the consequent low-water temperatures very little spawn was secured until May 14. Contrary to past experience, the majority of the spawning fish were found in the upper river above Philadelphia, and the fisheries below that point yielded very few eggs. Howells Cove, which has each season yielded the greatest amount of spawn, the take there last year amounting to nearly 50,000,000 eggs, produced this season only 6,500,000.

The collecting season ended on June 9, the total take of eggs aggregating 36,977,000. Of these 621,000 impregnated eggs were shipped to Central Station, Washington, D. C., and 25,997,000 fry were hatched; 4,835,000 of the fry were distributed on the spawning-grounds at Howells Cove and at the mouth of Timber Creek, New Jersey. The balance were planted by the regular car messengers in the waters of Connecticut, Massachusetts, New Jersey, Rhode Island, and Florida.

BATTERY STATION, MARYLAND (GEORGE H. H. MOORE, IN CHARGE.)

The station was opened March 24 by J. J. Glennan, who, with a small force of men, prepared the buildings and apparatus for active operations. The superintendent assumed charge of operations on April 21, and the first shad eggs were received April 22. The total collections of eggs for the season, which ended June 5, amounted to 20,707,000. Of these, 2,134,000 were shipped to the Exposition at Charleston, S. C., which were subsequently hatched and distributed from that point. The balance, with the exception of 267,000 sent to Central Station, were hatched and produced 14,943,000 fry.

As at the other shad stations, ripe fish were scarce, and it is a notable circumstance, as reported by old and experienced fishermen, that while the proportion of roe or egg-bearing fish was greater than usual, the percentage of ripe fish was smaller than ever before noted by them.

A supply of herring roe was canned and shipped to the stations at Wytheville, Va., and Erwin, Tenn., to be used as food for trout fry.

A few cases of shad roe were canned with a view to testing its edible qualities. From those who have tested it many favorable reports have been received, and it is the consensus of opinion that it would be difficult to distinguish it from the fresh roe. The method pursued in its preparation and preservation is simple. After being washed a set or pair of roe are put in a 2-pound tin can, which is then capped, exhausted, tipped, and subjected to 15 pounds steam pressure for about an hour. To prepare for the table it is removed from the can and cooked the same as the fresh roe. The milt has also been successfully canned, and it is quite as palatable as the fresh product.

The following table shows the details of operations:

Operations at Battery Station in 1902.

Date.	Number of eggs when received.	Number of eggs 12 hours after received.	Number of eggs 24 hours after received.	Number of eggs 36 hours after received or number purchased.	Fry hatched and planted.	Number of eggs shipped.	Mean water temperature
April 22	589,000	577,000	560,000	249,000	149,000	....	57
23	1,355,000	1,322,000	1,283,000	596,000	235,000	....	60.50
24	1,681,000	1,640,000	1,495,000	822,000	618,000	....	60.25
25	185,000	180,000	151,000	83,000	70,000	....	59.50
27	974,000	914,000	887,000	488,000	363,000	....	60
28	1,713,000	1,617,000	1,495,000	657,000	489,000	....	61
29	8,008,000	2,895,000	2,721,000	1,430,000	1,347,000	....	60.75
30	871,000	830,000	756,000	416,000	319,000	....	62.25
May 1	1,856,000	1,762,000	1,711,000	941,000	709,000	....	62
2	861,000	839,000	829,000	181,000	125,000	....	62.75
3	215,000	197,000	191,000	105,000	84,000	....	63.25
4	1,402,000	1,343,000	1,207,000	609,000	499,000	....	63.25
5	1,741,000	1,696,000	1,647,000	906,000	819,000	....	63.75
6	2,754,000	2,685,000	2,607,000	1,434,000	1,228,000	....	65.50
7	1,691,000	1,649,000	1,601,000	881,000	840,000	....	66.75
8	3,231,000	3,173,000	3,081,000	1,695,000	1,417,000	....	67
9	815,000	793,000	726,000	621,000	280,000	229,000	65.50
10	366,000	350,000	336,000	292,000	56,000	222,000	62.25
11	1,179,000	1,122,000	1,089,000	1,053,000	248,000	671,000	60.75
12	1,022,000	980,000	932,000	751,000	570,000		61.25
13	777,000	725,000	670,000	577,000	411,000	....	62.25
14	782,000	768,000	724,000	624,000	515,000	....	61.50
15	1,374,000	1,336,000	1,216,000	1,076,000	841,000	....	61.75
16	1,020,000	982,000	871,000	748,000	145,000	530,000	62.75
17	492,000	465,000	385,000	247,000	143,000	91,000	64.25
18	689,000	651,000	599,000	520,000	92,000	391,000	66.75
19	1,498,000	1,402,000	881,000	605,000	605,000	....	68.75
20	837,000	789,000	597,000	460,000	450,000	....	69.50
21	593,000	549,000	497,000	295,000	286,000	....	69.50
22	902,000	836,000	634,000	471,000	402,000	....	70.25
23	126,000	109,000	87,000	78,000	77,000	....	72
24	128,000	124,000	91,000	79,000	79,000	....	73.50
25	70,000	70,000	57,000	30,000	28,000	....	73.25
26	184,000	162,000	98,000	60,000	57,000	....	73.25
27	189,000	189,000	180,000	128,000	119,000	....	68.75
29	49,000	49,000	49,000	20,000	20,000	....	63.25
30	82,000	82,000	36,000	34,000	34,000	....	65.75
31	14,000	14,000	10,000	....	....	....	66.50
June 2	271,000	226,000	194,000	146,000	15,000	131,000	71
3	280,000	272,000	140,000	140,000	....	136,000	73.75
4	176,000	102,000	66,000	66,000	66,000	....	75
5	112,000	100,000	93,000	93,000	93,000	....	73.50
Total	37,649,000	36,067,000	32,980,000	20,707,000	14,943,000	2,401,000	

Bryan Point Station, Maryland (L. G. Harron, in Charge).

The old pump-house being badly out of repair and disadvantageously located with reference to the new hatchery, a new and substantial pump-house was erected near the east end of the hatchery and the suction pipe extended from the pumps to the river on the bracing under the new wharf to a point where the water is 10 feet deep at low tide. This change in the location effected the saving of 248 feet in the length of the discharge pipe from the pumps to the supply tank, with a resultant saving in fuel whenever the pumps were operated. The boiler and pumps were removed to the new pump-house, and the old pump-house was fitted up as quarters for four of the spawn-takers; 354 feet of 3-inch discharge pipe was removed from underground, and 106 feet of the same relaid; 240 feet of 3-inch suction pipe was also laid, and the necessary steam-pipes connected. A suitable coal-bin was constructed adjoining the pump-house.

The launch *Blue Wing*, which had been ordered from Woods Hole, Mass., arrived at Washington on March 23 and was taken to Bryan Point the following day. Some necessary repairs were made on her stern post and her hull above the water line, and all her house work and decks were thoroughly cleaned and painted, after which she was in good condition for the season's work.

The station was opened March 24. Sixteen tents were set up and the necessary equipment installed therein for quartering spawn-takers. The hatchery and other buildings were painted with a coat of indurine, and by April 15 all necessary repairs were completed preparatory to active operations in collecting shad eggs.

Small lots of eggs were taken on April 15, 16, and 17, which were placed in jars, but they died and no record was kept of them. On April 18th 60,000 good eggs were received, and on April 20th 791,000 eggs were taken and fishing began in earnest, the entire force of spawn-takers being set to work. The collecting of eggs was pushed vigorously with a full force until May 9, when operations were discontinued. The total collection of eggs for the season was 45,971,000, of which 2,421,000 were shipped to Central Station, Washington, D. C., and 2,007,000 were shipped to the Fish Commission exhibit at Charleston, S. C. Of the 41,543,000 eggs remaining, 84 per cent, or 34,994,000, were hatched at Bryan Point. Of the fry resulting 9,018,000 were delivered to the Fish Commission cars at Alexandria, Va., for distribution in southern waters, and 25,976,000 were planted on the principal spawning-grounds in the Potomac River.

The following table shows the daily collection of eggs, the number of fry planted, and maximum and minimum water temperatures:

Date.	Eggs received.	Eggs hatched	Eggs shipped.	Fry shipped.	Fry planted.	Temperature of water.	
						Max.	Min.
1902.						°F.	°F.
April 18	60,000					53	52
19	81,000					53	52
20	791,000					55	52
21	1,599,000					56	54
22	2,748,000					60	53
23	2,529,000					63	57
24	3,706,000					63	60
25	1,788,000		999,000			62	60
26						64	60
27	668,000					63	61
28	3,490,000	686,000				63	60
29	4,929,000	3,139,000	1,005,000		686,000	63	61
30	5,857,000	4,444,000			3,139,000	65	62
May 1	7,271,000	1,648,000			4,444,000	66	62
2	2,663,000				1,648,000	66	63
3	791,000					68	64
4	1,002,000	5,535,000				67	65
5	1,581,000	6,149,000			2,525,000	69	65
6	1,896,000	6,378,000	1,002,000	3,010,000	3,146,000	70	67
7	947,000			3,003,000	6,378,000	70	68
8	1,201,000	3,005,000	1,005,000			71	68
9	873,000	1,328,000				68	67
10		1,733,000		3,005,000	1,328,000	67	66
11						68	65
12		949,000	417,000		1,733,000	68	65
13					949,000	68	63
Total	45,971,000	34,994,000	4,428,000	9,018,000	25,976,000		

FISH LAKES, WASHINGTON, D. C. (C. K. GREEN, SUPERINTENDENT).

The station being located within the parking system of the District, much attention is given to the ornamentation and care of the grounds during the summer. During the summer months the work consists chiefly in keeping down the extensive growth of aquatic grasses in the various ponds and giving them a tidy appearance. The adult bass and crappie are fed regularly, the food consisting of carp bred for the purpose, which are taken from the ponds by means of nets, dressed, and cut in pieces as large as a hickory nut for the adults and from one-fourth to one-half this size for the yearlings. In the fall of the year, when the breeding-ponds are drawn, a supply of young carp is secured and introduced into the stock ponds, and in this way the adult fish are furnished with a food supply throughout the winter.

During the year the cottage was thoroughly renovated and put in a sanitary condition as a residence for the superintendent. The work of collecting young fish for distribution was begun September 16 and continued until October 21, the total number furnished consisting of 4,688 large-mouthed black bass, 17,468 crappie, and 30,000 cat-fish. On October 18 the shad which had been introduced as fry the previous May to the number of 2,000,000 were liberated in the Potomac River by raising the gates leading from the pond to the river. Several specimens examined when liberated showed that the fish had grown to an average length of 3¼ inches.

The usual attention was paid to the cultivation of ornamental fishes, such as gold-fish, golden tench, green tench, and golden ide, which are raised for stocking the aquaria at the Zoological Park and Central Station and for the District parks. Large numbers of carp were also reared for fish food. Many predatory animals, birds, and snakes were killed during the year.

The crappie began spawning April 17, in a water temperature of 61°, and continued until May 15, the height of the season being about May 2, when the temperature of the water ranged from 68° to 75°. The first eggs cast hatched in five days, the water temperature during the time ranging from 53° to 66°, but as the weather became warmer the period of incubation was reduced to three days.

The large-mouthed black bass began spawning April 20, in a water temperature of 64°, and ceased spawning about May 20, although four nests were discovered between June 2 and June 13. The height of the spawning season was about April 23, when the water temperature averaged about 71°. The first fry made their appearance April 24.

CENTRAL STATION, WASHINGTON, D. C. (J. E. BROWN, IN CHARGE).

The work at Central Station has been conducted on the same lines as for the past few years. The station is used as a clearing-house for much of the product of the Fish Lakes Station and for shipments of fish and eggs sent here from other stations. During fall and winter various species of fish are hatched for the purpose of illustrating the methods of fish-culture. This branch of the work has always formed an attractive and very interesting exhibit.

Following is a record of the fish and eggs received at the station during the year, eggs hatched, and fish distributed:

Species.	Fish received.	Eggs received.	Eggs shipped.	Eggs hatched.	Fry shipped.	Fish shipped.
Black bass	787					787
Rock bass	2,300					2,300
Rainbow trout	1,746	9,823		7,120	4,200	1,741
Lake trout		253,925	160,000	58,512	53,200	
Brook trout		9,729		9,117	8,000	
White-fish		3,099,000	2,138,000	628,000	600,000	
Atlantic salmon		10,000	5,000	4,620	4,050	
Landlocked salmon		5,000		4,411	3,870	
Pike perch		2,000,000		1,800,000	1,800,000	
Shad		2,892,000	400,000	2,050,000	1,850,000	
Total	4,833	8,279,477	2,703,000	4,561,780	4,323,320	4,828

CENTRAL STATION AQUARIUM (L. G. HARRON, SUPERINTENDENT).

In addition to his regular duties in charge of the aquarium at Central Station, the superintendent was detailed to the station at Woods Hole, Mass., from July 8 to August 15, for the purpose of superintending the arrangement and stocking of the aquarium there. In February he was detailed to superintend the installation of a live-fish exhibit at the Sportsmen's Show in Boston, and from March 24 until May 14 he was detailed in charge of the shad hatchery at Bryan Point.

During the summer the aquaria were kept well stocked with the various species of fresh-water fishes found in the Potomac River and five species of ornamental fishes, some of which have been kept in the aquarium for years. In the fall, as soon as the water temperature was sufficiently cool to maintain them, various species of *Salmonidæ* were introduced into the aquarium and carried through the winter. An assignment of trout, salmon, and grayling, representing nine species, was received from the aquarium at Buffalo, at the close of the exposition, and held until December, when the stock was drawn upon to stock the Fish Commission exhibit at the Charleston Exposition.

A live-fish exhibit of marine species was maintained in the aquarium from September until May 15, when the salt-water exhibit was given up entirely, and the closed circulating system connected with this exhibit was used for supplying the fresh-water aquaria, which were cleaned out and completely stocked with fresh-water fishes. The adoption of closed circulation for supplying fresh water is an experiment to test the feasibility of using the system of closed circulation for this purpose at the St. Louis Exposition in order to insure having perfectly clear water in the aquaria at all times. At the close of the year this system was in successful operation, and the exhibit showed great improvement over its appearance when the filthy water of the Potomac was supplied to the aquarium from the city water mains.

Very few improvements have been made to the aquarium in the past few years, and in comparison with the elaborate aquarial displays at the World's Fair in Chicago and the Pan-American Exposition at Buffalo the Central Station aquarium is a very small affair. It should be greatly enlarged and the salt-water tank supplemented with an additional one, so that during the year, while the stock of marine species is in the aquarium, the salt water can be entirely renewed every few months. A refrigerating system is also recommended, in order that the various species of the *Salmonidæ* may be carried in the fresh-water aquaria during the summer months.

The following is a list of the marine and fresh-water species exhibited at Central Station during the year:

Salt-water species.—Jumping mullet, croaker, hog-choker, red drum, sea-robin, toad-fish, sea trout, moon-fish, pompano, swell-fish, spot, pin-fish, spade-fish, blue-fish, yellow-tail, king-fish, striped bass, tautog, flounder, white perch, tongue sole, crevalle, sea bass, blenny, pig-fish, file-fish, scup, rudder-fish, cunner, bur-fish, tom-cod, remora, mummichog, star-fish, chætodon, conger eel, blue crab, hermit crab, lobster, sea-anemone.

Fresh-water species.—Rainbow trout, steelhead trout, brook trout, albino brook trout, lake trout, Scotch sea trout, golden trout, Atlantic salmon, landlocked salmon, grayling, black bass, rock bass, white perch, yellow perch, sand-perch, crappie, blue sun-fish, long-eared sun-fish, banded sun-fish, common sun-fish, spotted cat-fish, channel cat-fish, yellow cat-fish, golden ide, golden tench, green tench, gold-fish, gar-pike, dog-fish, paradise fish, German carp, dace, red sucker, chub sucker, common eel, snapping turtle, diamond-back terrapin, common terrapin, salamander, alligator.

The following shows the maximum and minimum temperatures of salt and fresh water in the tanks during the year:

Month.	Fresh water.		Salt water.		Month.	Fresh water.		Salt water.	
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.
	°F.	°F.	°F.	°F.		°F.	°F.	°F.	°F.
July	84	79			January	35	33	58	55
August	82	78			February	36	33	58	54
September	78	68	72	58	March	51	36	65	61
October	68	55	69	54	April	61	47	72	50
November	55	38	61	51	May	72	61	75	58
December	41	34	58	53	June	78	68		

WYTHEVILLE STATION, VIRGINIA (GEORGE A. SEAGLE, SUPERINTENDENT).

Fish-cultural operations have been confined chiefly to the propagation and distribution of rainbow trout, brook trout, black bass, and rock bass. The number of fish on hand at the beginning of the year is shown by the following table:

Species.	Calendar year in which fish were hatched.				
	1901.	1900.	1899.	1898.	1897, or before.
Rainbow trout	318,000	5,080	598	339	1,872
Brook trout	19,400				
Large-mouthed black bass		112			53
Small-mouthed black bass					11
Rock bass			39	80	180
Carp					20
Gold-fish					15
Total	337,400	5,192	637	419	2,151

The distribution of the stock of young was begun October 5 and continued until December 13, the output amounting to 208,100 yearling and 385 adult rainbow trout, 13,124 brook trout, 3,815 black bass, 8,700 rock bass. In addition to the above the following fish were received from other stations and distributed: 3,450 brook trout, 2,142 black bass, 9,650 rock bass, 7,310 crappie.

The spawning season of the rainbow trout began November 6 and closed February 10. During this period of ninety-seven days 1,099,000 eggs were collected, of which number 802,000, or 73 per cent, were fertilized and brought to the eyed stage, 246,000 were shipped on assignment, and 556,000 were hatched at the station. The fry resulting from them were strong and vigorous, and when four months old 145,000 were distributed to various applicants by the station employees, and at the close of the year there remained on hand 200,000 fingerlings to be reared for the fall distribution.

In January 304,000 eyed brook-trout eggs were received from one of the commercial hatcheries at Plymouth, Mass., in good condition and hatched out well. Owing to an unusual period of muddy water during the hatching stage, there was a loss of 18,000 alevins, caused by smothering, and the mortality among the young fish during the sac stage was considerable, presumably from the same cause. The fry began feeding when about four weeks old and have grown rapidly. At the close of the year there were 105,000 fingerling fish on hand, the largest weighing 134 ounces to the thousand. The brook and rainbow trout fry were fed on canned herring roe for the first six weeks, when the food was gradually changed to a mixed diet of liver and mush.

Early in the spring the brood stock, consisting of 53 large-mouthed and 11 small-mouthed black bass, were transferred to the breeding ponds. Large beds of creek gravel were provided for their nests, and a light paling fence was built around the nesting-ground to keep the brood fish within its limits. The fish commenced nesting early in May, and by the middle of the month several large schools of young were observed. When the fish were from one-half to five-eighths of an inch in length, which is about the time of the breaking up of the schools, a few thousand were netted from the ponds and placed in rearing-troughs for the purpose of making some experiments in artificial feeding. These fish were first given minute insects collected from the warm, shallow parts of the pond. Only enough of this natural food was given to keep them alive, and while their appetites were only partly satisfied in this way, prepared artificial food was offered them. Ground fish, crawfish, beef heart, and herring roe were all tried, but the experiment was not sufficiently successful to warrant continuing it for more than a few days. If crawfish could have been secured in sufficient quantities, it is believed that better results would have followed, as the fish preferred it to the other food. As soon as it became evident that the experiment would not be successful the fish were released in rearing-ponds, together with several thousand more which had been captured from time to time.

About two weeks later, when the fish were nearly an inch in length, the experiment was repeated by transferring 1,500 bass from the ponds to a trough. This time the fish were easily trained to take artificial food. They were first given chopped or ground fish, and afterwards prepared beef heart. After the first two or three days they devoured this food ravenously until about the tenth day, at which time they began to die, and although eating well and apparently in the best of health, the death rate steadily increased from day to day, until the loss reached over 100 per day. On the fourteenth day the remaining fish in the trough, about 900, were released in the rearing-ponds. The cause of the mortality is not known, but sufficient success followed the feeding of artificial food to warrant taking up the experiments another season, in the hope that the cause of the mortality would be ascertained.

The brood stock of rock bass were transferred to their summer ponds about the middle of April, and nesting began the latter part of the same month. By the middle of May the ponds were well stocked with young fish, and at the close of the year there is every prospect of a large crop.

The following improvements at the station were made during the fiscal year: The superintendent's residence was painted, a water tank for supplying the transportation cars with water at the railway siding was erected, and pipe connections made with it and with a Rife hydraulic ram for supplying the tank with water. A cooling tank for mush and two tanks for culling fish were also constructed, besides several other minor improvements.

EDENTON STATION, NORTH CAROLINA (S. G. WORTH, SUPERINTENDENT).

This is one of the new stations, all constructions having been made since 1899. It is in first-class condition as a shad-hatching station, the third successive season of operations having this year been concluded.

Within the year two tidal ponds were constructed, which will demonstrate the value of this class of ponds for producing black bass and crappie for stocking interior waters. The bottoms of these ponds are from 3 to 5 feet below the surface of Pembroke Creek, wire screens in the gateways permitting such change of water as the irregular wind tides send in or draw out. The ponds can be emptied when desired at the rate of 1,200 gallons per minute by means of a centrifugal steam pump economically operated.

The shad-hatching season of the present year was marked by its short duration, being practically confined to twenty-two days between April 14 and May 8. Adult shad were less abundant than usual by one-half. It is believed by the station superintendent that this scarcity was caused by the destruction of the young in the prolonged and violent hurricane which beat directly upon the Atlantic coast August 18–21,

1899. The young which should have arrived at maturity and reentered the sounds and rivers in 1902 were then but a few inches long and were outside the inlets and subject to the breakers.

The spring was very late, both air and water being far below the normal temperature.

A feature unobserved before in this region was the deposition of eggs by the shad 20 miles or more down the sound to the eastward of Edenton Bay. The superintendent attributes this new condition to the excessive rainfall of the previous year, which freshened the waters of Albemarle Sound throughout its length, consequently when the shad reached the fisheries where the spawn-takers were located they were largely spawned out or were carrying overripe eggs owing to low temperatures. A large percentage of loss followed in the process of hatching the eggs.

The whole number of eggs brought to the station was 37,987,000, and from these there was a production of 24,662,000 young fish, the liberation of which is shown in the table of distribution.

ERWIN STATION, TENNESSEE (ALEX. JONES, SUPERINTENDENT).

The fingerling fish on hand at the beginning of the year were distributed as yearlings during the fall and winter, 49,670 being supplied to applicants in eastern Tennessee and western North Carolina by the regular employees of the station. The remainder were shipped by the Fish Commission cars to more distant points. The total product of the station for the season amounted to 133,925 yearling rainbow trout, 12,075 yearling brook trout, 1,050 black bass.

The brood rainbow trout began spawning on November 12 and continued to February 7, the total collections of eggs being 329,100. There were also received from Wytheville Station 50,000 rainbow-trout eggs, and from Neosho 171,740 rainbow-trout eggs. This stock of eggs produced 280,000 fry.

The purchase of 200,000 brook-trout eggs was made from a commercial hatchery in Massachusetts and produced 164,180 fry.

The rainbow trout were transferred from the hatchery to outside ponds as soon as they began to feed nicely, and they grew rapidly with little or no mortality until the approach of warm weather in April. At this time they were attacked by a peculiar disease, and until the warm weather was over there was an unusual mortality among them. This disease is not fully understood, and no remedy has yet been found for it. The first symptoms may be described as follows: Contraction of the stomach, general weakness, rising to the surface with spasmodic contortions, and inability to take food, although inclined to do so. Microscopical examinations failed to reveal any signs of affection of the stomach, throat, or gills, although the latter were at times greatly inflamed. The disease attacks the fish whether in the hatchery or outdoors, in deep or shallow ponds, and with or without shade, but the trouble is most apparent during and immediately following very hot weather. It abates during cool days, even though the variation in temperature may not be more than four to six degrees.

The young fish at this station are fed on beef liver and canned herring roe, the beef to the brook trout and the roe to the rainbow trout. The brook trout do not seem to be able to masticate the roe, but the rainbows are especially fond of it, and it has proved a very economical and nutritious food for them for a period of about six weeks, after which time it has been found best to change their food to liver.

Predatory birds and animals are exceedingly numerous and destructive in the summer months, and great numbers are annually destroyed.

The following table shows the stock of fish on hand at the close of the year:

Species.	Calendar year in which fish were hatched.				
	1902.	1901.	1900.	1899.	1898.
Rainbow trout	150,000	1,911	....	....	1,315
Brook trout	66,000	....	....	....	....
Rock bass	2,000	....	....	....	....
Black bass	....	75	....	....	54
Crappie	....	696	....	....	25
Total	218,000	2,682	....	....	1,394

By an act of Congress $5,000 became available in March for the completion of the station, new ponds, and other improvements, and work was immediately commenced on the construction of three ponds ranging in size from 1 to 2 acres, and these have been completed. Another pond 1 acre in area, which had already been partially constructed, was completed. Various repairs and improvements were made about the station buildings, roadways were constructed from the hatchery to the main highway, and 50 shade trees were set out. Contracts have been made for a substantial fence around the station property, and at the close of the year it is in course of construction.

COLD SPRINGS STATION, GEORGIA (J. J. STRANAHAN, SUPERINTENDENT).

Within the year the construction work under the special appropriation was of minor importance, but with it the station was practically completed. There was erected near the station residence a woodhouse 16 by 20 feet, a cabin was built for one of the laborers, and three bridges were constructed across Cold Springs Creek. The drives, walks, lawns, and embankments to the ponds were graded, and the lawns and pond embankments seeded down. All rubbish and underbrush were removed, so that the station presents a neat and attractive appearance. The fish-cultural work was confined to the propagation of the large-mouthed black bass, bream, crappie, and speckled cat-fish.

The spawning season of the black bass extended over 110 days, and this year the season began a full month earlier than in former years, notwithstanding the fact that the temperature of the water was cooler for the month preceding and during the spawning time than in any year since the establishment of the station. With a few exceptions the bass finished spawning two months earlier than usual. But few eggs were deposited by them in any of the ponds as compared with former years, although the output of young fish was much greater, owing to improved facilities, a larger stock of brood fish, and an earlier distribution.

Pond culture at this station is still in the experimental stage, as the conditions here are not the same as those existing at other stations. The chief difficulty presenting itself is that of fish food. Very little aquatic or plant life is found in the waters under natural conditions, and it is difficult to make the introduced plants thrive and thereby increase the amount of natural food by the development of aquatic life which would naturally follow. The output of black bass fingerlings has, however, been much greater than in previous years, and it is expected that the product of the station can be annually increased for several years to come.

The young bass removed to the fry ponds were fed on chopped fish raised at the station, and no mortality resulted from what appeared to be convulsive fits, which caused an alarming mortality last year when the young fish were fed upon salt-water mullet preserved by some apparently injurious chemical. By careful sorting cannibalism was reduced to a minimum throughout the season. The product of the station in fingerling fish is recorded as follows: Black bass, 13,310; bream, 17,350; speckled cat-fish, 5,850. At the close of the year the stock of young fish on hand available for distribution as fingerlings is estimated as 5,000 bream, 40,000 cat-fish, and 10,000 black bass. There are also on hand a few hundred calico bass.

Put-in Bay Station, Ohio (S. W. Downing, Superintendent).

In addition to various minor repairs at the station the wharf was rebuilt to the water's edge and covered with 2-inch oak plank; the channel and harbor were also improved by dredging the channel to a depth of 9½ feet and widening it 25 feet. This enlargement gives ample room for the crates used for holding the white-fish penned during the spawning season.

In the fall the work of collecting eggs of the white-fish was pushed at all the fields customarily operated from the Put-in Bay Station. On October 20 a crew of men was set to work at Monroe Piers, Michigan, and two additional rafts of 5 crates each were constructed, making a total of 30 crates available. On this shore the prevailing winds were unfavorable throughout the season, and but 6,627 fish were received at the crates, a few more than one-half the number penned at this point the previous year. Part of these were penned in October, and the temperature of the water during the latter part of the month was so high that a large number of the fish were returned to the fishermen before spawning commenced. As a further result of the warm weather quite a number of the females became plugged, causing the yield of eggs from the number of fish penned to run below the average.

At Put-in Bay the first fish were received at the crates on October 22 and by the 30th of October 1,403 fish had been received. Owing to the warm weather nearly all the fish taken at this time had to be returned to the fishermen, and penning was discontinued until November 5, when it was commenced again and continued until December 1. The total number collected and penned after November 5 was 5,963 fish, nearly one-fourth of which had been returned to the fishermen before the spawning season commenced. The final results of the work at this point, however, were very satisfactory. At the Port Clinton field men were set at work on November 6 and at the Kelley Island and North Bass fields on November 11. Although the weather was rough and unpleasant through the greater part of the season, there were but few days on which the fishermen did not visit their nets, and the number of eggs secured was beyond all expectations, more than 100,000,000 in excess of any previous season's collection being taken.

The number of eggs received from the different fields and from the crates was 335,860,000, as follows:

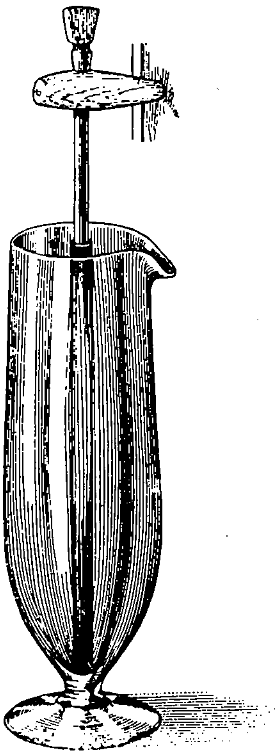
Locality.	Field.	Crates.
Monroe, Mich	6,265,000	52,547,000
Put-in Bay	29,998,000	55,422,000
North Bass	47,516,000	
Kelley Island	42,240,000	
Port Clinton	101,872,000	
Total	228,291,000	107,569,000

The increased collections were particularly noticeable at the Port Clinton and Kelley Island fields, the first yielding nearly twenty-five times as many eggs as last year, and more than twice the number taken in any season since 1895, when 92,000,000 were secured. At the Kelley Island field the yield was more than four times greater than ever before, and at North Bass it was twice as large as the greatest take of any previous season. At Put-in Bay the yield was four times greater than last year.

The first eggs were received from the fields on November 12 and the last December 2; the first collections from the crates arrived on November 13 and the last December 7. A shipment of 48,160,000 eggs was made to the Pennsylvania fish-hatchery at Erie, Pa., and 31,212,000 were transferred to Cape Vincent; 256,488,000 were retained at the station until eyed, when 8,100,000 were shipped to the New York Fish Commission and 1,000,000 to the Central Station at Washington, the balance being retained for hatching.

During the early stages of development every jar in the hatchery was filled, the surplus of eggs being cared for in floating boxes placed in the fry tanks until arrangements had been made with Col. Horace Park, superintendent of the Sandusky, Ohio, hatchery, for the loan of 100 jars of the Chase pattern. The borrowed jars were operated by tapping the fry tanks and using wooden faucets, the jars standing upon the floor, and in this way the surplus eggs were cared for until the natural losses and the shipments to other stations made room for all the eggs in the regular batteries.

The eggs commenced hatching on March 25 and were all out by April 15, the period of incubation being 128 days. Eighty-two per cent of the eggs retained were hatched, giving a total of 200,500,000 fry, which were liberated in the waters of Lake Erie.


The Downing jar.

Preparations were made for the collection of lake-herring eggs and a force of men sent to Ashtabula, Ohio, where large catches of herring had been reported, but up to very late in the season very few female fish were taken and none of these were spawning. On December 6 the weather turned so cold as to make large fields of ice, and as there seemed to be no prospects of continuing the work the men were ordered home and the efforts to secure herring eggs were discontinued.

On April 2 men were placed in the Toledo, Ohio, and Monroe, Mich., fields for the collection of pike-perch eggs, and on April 6 pike-perch work was also taken up at Port Clinton, Ohio. Although the weather turned cold, the spawn-takers were very successful in securing eggs, the total collections amounting to 437,200,000, the greatest number with one exception ever secured in one season at Put-in Bay Station. The first eggs were received April 4 and the last April 19, the total yield from the various fields being as follows: Toledo field, 246,850,000; Port Clinton field, 126,800,000; Monroe field, 63,550,000.

Of these eggs 66,000,000 were shipped to State fish commissions and on other assignments, leaving a balance of 371,200,000 on hand to be hatched at the station. Of those retained 48 per cent hatched, and the resulting 143,000,000 fry were disposed of as shown by the tables of distribution. The loss on the eggs was much greater this season than last, being 52 per cent as against a record of 34 per cent the previous year. As the same spawn-takers were employed this year, and the methods were the same as last year, the only possible way to account for the greater loss is the difference in the temperature of air and water, the weather remaining cold and disagreeable throughout the entire period of incubation, thus causing the eggs to develop very slowly. Hatching began May 3 and closed on May 12.

The superintendent was given authority to make some experiments with the view to making improvements in the form of hatching jar, having in mind convenience in manipulation and general results. Accordingly, a jar was designed somewhat after the pattern of the Chase jar, except that it has a glass instead of a metal spout and is made smaller at the top than at the bilge, thus concentrating the current of water and giving a good motion to the eggs at the top as well as at the bottom. The new jar was received January 18 and a poor lot of eggs placed in it. It was found that these eggs cleaned up faster in the new jar than in any of the older forms, that about a quart more eggs could be worked in it than in either of the other jars, and that it required but two-thirds the volume of water required in the older forms. From an economic standpoint and for convenience in handling it is claimed by the superintendent to be far the best jar used at the station.

Northville Station and Substations in Michigan (Frank N. Clark, Supt.).

In the output of eggs and fry the past year's operations at the stations in Michigan have been the most successful of any since the commencement of the work. There are two regular stations in the State, one at Northville and the other at Alpena, and in addition to these the hatcheries at Detroit and Sault Ste. Marie, belonging to the Michigan Fish Commission, have been operated the greater part of the year, Northville Station being the headquarters.

At the beginning of the year there were no fish or eggs in the Northville hatchery, and the number of fish in the ponds was very small. For the first two or three months, therefore, the force were engaged in preparing for the reception of eggs, maintaining the buildings, ponds, and grounds, and in construction work.

Three old wooden ponds were torn out, and in their place two cement ponds 50 feet long, 8 feet wide at the surface, and 6½ feet wide at bottom were constructed, the cement being 5 inches thick on the sides and 4 inches on the bottom. These ponds are supplied with water from a spring under the hatchery, which flows about 135 gallons per minute, the temperature being 48° F. They were constructed for experimental work in connection with the bacterial disease that has caused great mortality amongst the brook trout in past years. Fish not affected by the disease were brought from the Au Sable River and introduced into the ponds.

The experimental work is being conducted under the direction of Mr. M. C. Marsh, and further mention of it is contained in the report of the Division of Scientific Inquiry.

Six old ponds with plank sides were also torn out with the intention of replacing them with one large pond, which will cover more surface than the old ones.

About October 20 preparations for the collection of lake-trout eggs were commenced. After the superintendent had visited various points with the view of establishing field stations it was decided to confine operations to Beaver Island and Manistique, on Lake Michigan, and arrangements were completed for the conduct of work after the close season, which began October 30, on practically the same lines as in previous years, the fishermen agreeing to bear all expenses of catching the fish, and to receive the fish so caught in compensation for their services after the eggs had been taken by representatives of the Commission.

At the Beaver Island group the tugs fished on the shoals within a radius of 33 miles from the harbor of St. James, which is about 36 miles from the mainland, without telegraphic communication, and in rough weather without a regular boat service. The most important of the fishing-grounds were Boulder Reef, Skillagillee, West Shoals, Trout Island Reef, and The Hat, the largest number of eggs being obtained at Boulder Reef. All spawning fish were captured in from 3 to 26 fathoms of water, the early run being principally in water from 9 to 18 fathoms deep, and the last run, which were larger trout, in from 18 to 26 fathoms of water. The first fish were captured November 3, and the last on November 30. The collections were not notably large until November 13, but from that time on to the close of operations the work was highly successful, the best results being secured from November 18 to 26, inclusive. In all, 13,670 trout, weighing 103,716 pounds, or an average of nearly 7¾ pounds each, were captured, and from them 14,804,000 eggs were taken.

At Manistique all eggs were taken between November 5 and 27, the season being a trifle later than usual owing to warm weather. At this point 11,937 trout, weighing 72,796 pounds, were captured, which produced 10,508,000 eggs.

Of the 25,312,000 lake-trout eggs obtained at these two points 14,304,000 were shipped to Northville. The remainder were transferred to the Alpena, Sault Ste. Marie, and Cape Vincent stations. After the eggs sent to Northville were eyed, 5,305,000 were distributed to various points and the hatching period of the balance extended from February 17 to March 25. All of the fry, with the exception of 700,000 distributed in inland waters, were deposited in the Great Lakes and were in excellent condition when planted.

Brook-trout eggs to the number of 1,074,000 were purchased from commercial hatcheries in Massachusetts, and in addition to these 41,807 were taken from the adult fish in the ponds at Northville, making a total of 1,115,807 brook-trout eggs. Of these 1,055,000, or a little over 93 per cent, hatched, the first fry making their appearance on

January 28. The hatching season closed on March 5, and the distribution of fry was made during March and April by the Fish Commission cars and was very successful.

From the brood stock of Loch Leven trout 78,000 eggs were taken, the first on October 28 and the last December 12, the 117 females stripped averaging 667 eggs to the fish. These eggs were of extra fine quality, and from them 75,000 fry were hatched and planted, a trifle over 96 per cent. They were the first eggs in the house to hatch, beginning January 4 and continuing until February 25. The distribution of the fry was made between March 12 and 18.

From the Neosho and Manchester stations 105,012 rainbow eggs were received, from which 86,000 fry, or about 82 per cent, were hatched and planted. This low percentage was due to the fact that some of the eggs were not in good condition when received. The first eggs hatched February 19 and the last March 12, and by April 17 the distribution of the fry had been completed.

From a stock of 3-year-old steelhead trout, which had been hatched and reared at the station, 114,600 eggs of fine quality were obtained, the first on March 19 and the last on April 10, the females averaging 850 eggs each. In addition to the above 50,000 steelhead eggs were received on April 8 in good condition from the Clackamas, Oreg., Station, making a total of 164,600. They commenced hatching on April 23 and closed on May 6, when 140,000 fry, or 85 per cent, were hatched and distributed shortly afterwards in good condition.

One of the finest consignments ever received at the Northville Station arrived from the Bozeman, Mont., Station on May 16, the case containing 209,078 grayling eggs. These were placed in spring water, and in a few days practically all hatched, and shortly afterwards the resultant fry were planted in excellent condition.

At the Alpena Station hatching operations began on November 20, when 35,000,000 green white-fish eggs were received from the Detroit hatchery, and on December 6 a second shipment of 16,000,000 arrived. From the 51,000,000 eggs thus received 42,500,000 fry, or nearly 84 per cent, hatched. The eggs began hatching April 6 and finished April 18. The distribution of the fry was commenced April 11 and was completed April 22, all of the plants being made in Lake Huron, with the exception of 500,000, which were sent to Turtle Lake.

In addition to the white-fish eggs sent to the Alpena Station, 3,581,000 lake-trout eggs were transferred there from Northville and Manistique at various times in the course of the season, and it became necessary to construct additional hatching-troughs to accommodate them. In the month of April 2,530,000 lake-trout fry were distributed, most of them being planted in Lake Huron not far from the Alpena Station. At this point during the past fiscal year a greater number of fry, both of lake trout and white-fish, have been turned out than ever before, the fry being of the most excellent quality.

At the Detroit Station the work has been confined entirely to white-fish operations, the eggs being collected from the field stations on Belle Isle and Grassy Island, the former located in the Detroit River opposite the upper end of the city of Detroit, and the latter about 8 miles down the river below the city. Fishing was conducted by means of seines, the work being done by the Wolverine Fishing Company, which received the fish in payment for its services after the agents of the Commission had taken the eggs. The fishing season extended from October 16 to December 3, during which time 2,875 hauls of the seine were made and 41,242 fish captured—an average of between 14 and 15 per haul. Of these 2,270 were undersized and were immediately returned to the river. The remaining 38,972 were retained in crates and pounds. The crates used in this work were constructed of slats, to allow free circulation of water, and were 12 feet long, 4 feet wide, and 5 feet deep. The pounds, which were irregular in size and shape, were made by driving boards into the bottom of the river, with a space between each for the free circulation of water. The best day's fishing was on November 18, when 2,568 fish were caught. Of the fish held, 22,245 were males and 16,727 females. Of the latter, 12,529 were stripped, yielding 366,040,000 eggs, or an average of 29,215 per fish. The balance of the females were either spent, plugged, or hard when the season closed.

Following is a summary of the daily take of eggs:

Date.	Belle Isle.		Grassy Island.		Total.
	Females stripped.	Eggs obtained.	Females stripped.	Eggs obtained.	
1901.					
Nov. 10	1	25,000	1	40,000	65,000
11	2	55,000	....	....	55,000
12	6	400,000	7	400,000	800,000
14	28	1,520,000	31	1,520,000	3,040,000
15	31	1,440,000	33	1,720,000	3,160,000
16	42	1,560,000	23	1,080,000	2,640,000
17	36	1,520,000	53	2,600,000	4,120,000
18	85	3,040,000	68	2,760,000	5,800,000
19	100	3,320,000	229	8,680,000	12,000,000
20	55	1,920,000	260	9,000,000	10,920,000
21	152	5,120,000	353	11,840,000	16,960,000
22	271	10,000,000	486	15,400,000	25,400,000
23	220	7,280,000	354	12,840,000	20,120,000
24	554	17,680,000	388	11,840,000	29,520,000
25	808	23,560,000	829	22,000,000	45,560,000
26	224	6,320,000	652	18,440,000	24,760,000
27	260	8,280,000	576	14,000,000	22,280,000
28	143	3,760,000	475	12,680,000	16,440,000
29	1,085	30,520,000	906	22,400,000	52,920,000
30	300	9,080,000	644	16,520,000	25,600,000
Dec. 1	111	3,040,000	211	5,600,000	8,640,000
2	52	1,120,000	263	6,240,000	7,360,000
3	156	4,120,000	200	4,800,000	8,920,000
4	140	3,760,000	88	1,800,000	5,560,000
5	....	....	71	1,800,000	1,800,000
6	183	5,200,000	....	....	5,200,000
7	....	....	110	2,480,000	2,480,000
9	115	2,640,000	....	....	2,640,000
11	58	1,280,000	....	....	1,280,000
Total	5,218	157,560,000	7,311	208,480,000	366,040,000

All of the eggs were forwarded to the Detroit hatchery by means of tug and wagon, it being necessary to hold over night those taken at Grassy Island, but this was done without detriment. The number of eggs shipped was 201,800,000, leaving 164,240,000 in the hatchery. As the total number hatched was 135,000,000, it would appear that the percentage was a little above 82, but in reality it was about 85 per cent when allowance is made for the fact that a part of the eggs shipped were eyed eggs. The season was rather earlier than usual, the hatching period extending from March 23 to April 16, and the distribution was made between March 30 and April 17 by means of a tug and two of the Fish Commission cars. The cars carried 27,000,000 fry in five loads, three of 5,000,000 each to Charlevoix and two of 6,000,000 each to Mackinac City, for planting in Lake Michigan. The balance were deposited in the Detroit River and Lake St. Clair.

Not only did the number of white-fish greatly exceed that of any previous year, but the quality of the fry also greatly surpassed that of any of the earlier efforts. This may have been due in part to the favorable weather conditions, improved facilities, and expert manipulation, but undoubtedly credit should be given to the liberal plants made in the past in the Great Lakes.

To relieve the overcrowded condition of the Northville and Detroit stations, and also to comply with the Milliken act of the State legislature, which provides that the fry from 75 per cent of the eggs collected shall be deposited in State waters, the Sault Ste. Marie hatchery was used, and from the 16th to the 23d of November 5,000,000 lake-trout eggs were sent there from Manistique. Of the 3,700,000 fry which hatched from these eggs, 1,000,000 were turned over to the Michigan Fish Commission and 2,700,000 distributed. The eggs began hatching April 20 and it was not until May 10 that all had hatched, the cold weather greatly retarding development, although it apparently made the fry extremely hardy. The first plant was made on May 19, and the last of the fry were liberated May 31, the work being done by messenger and tug.

A shipment of 30,000,000 white-fish eggs was received at the Sault Ste. Marie Station from Detroit on November 29th, 6,080,000 on December 28, and 10,000,000 on February 25, or a total of 46,080,000. The first shipment was made when the eggs were green and the last two shipments after the eggs were eyed. The product of the eggs resulted in 40,000,000 fry, or about 86 per cent, the first hatching on April 10 and the last on April 29. With the exception of 2,000,000, which were shipped by baggage car to Manistique, the distributions were all made by boat. The first plant was made on April 15, and the work of distribution was completed on May 1. A large proportion of the fry were planted in Lake Superior near Whitefish Point and in Lake Huron off Detour.

The Commission is indebted to A. Booth & Co. for the free transportation of fry to Whitefish Point, Lake Superior.

The following table shows the number of eggs collected, number of eyed eggs shipped, and fry distributed:

Species.	Eggs collected.	Eggs shipped.	Fry distributed.
White-fish	366,040,000	104,720,000	217,500,000
Lake trout	25,312,000	8,128,000	13,255,000
Brook trout	1,134,260	....	1,055,000
Steelhead trout	164,600	....	140,000
Rainbow trout	105,012	....	86,000
Loch Leven trout	78,000	....	75,000
Grayling	209,078	....	200,000
Total	393,042,950	112,848,000	232,311,000

DULUTH STATION, MINNESOTA (S. P. WIRES, SUPERINTENDENT).

During the year a concrete sidewalk was constructed along two sides of the station grounds abutting the highway, and extensive improvements were made on the hatchery building, gravity flume, and steam plant. A large number of shade trees were also set out.

Of the 34,290 young steelhead trout on hand at the beginning of the year 30,000 survived and were distributed as fingerlings.

In August and September arrangements were made for the collection of lake-trout eggs at the usual points on Lake Superior, namely, at Grand Portage, Minn.; Port Arthur and Rossport, Ontario; Isle Royale, Manitou Island, Keystone, Ontonagon, and Marquette, Mich. The spawning season opened September 15 and closed October 31, resulting in a total collection of 15,771,000 eggs. Of these 3,771,000 green eggs were transferred to Cape Vincent, and 25,000 to the Pan-American Exposition, at Buffalo. Subsequent shipments of eyed eggs were also made to the number of 2,325,000.

The following table shows the number of eggs of various species received from other stations of the Commission and the disposition of same:

Species.	Eggs received from other stations.	Eggs collected.	Eggs shipped.	Fry distributed.	Fingerlings distributed.
White-fish	36,000,000	....	....	29,800,000	....
Lake trout	....	15,771,000	6,121,000	7,150,000	....
Grayling	200,000	....	....	199,000	....
Brook trout	100,000	....	....	92,230	....
Steelhead trout	100,000	....	....	96,900	30,000
Rainbow trout	50,000	....	....	32,000	....
Total	36,450,000	15,771,000	6,121,000	37,370,130	30,000

All eggs and fry were handled throughout the season with very light losses, and the fry resulting from the eggs received from other stations, and also the lake trout carried through the season, were all distributed in good condition in April, May, and June.

QUINCY STATION, ILLINOIS (S. P. BARTLETT, SUPERINTENDENT).

Throughout the navigable portion of the Illinois River, or about 250 miles, the banks in most places are low and any considerable rise of water overflows them, producing ponds and lakes varying in width from a few feet to 8 or 10 miles, in which the native fishes find desirable spawning-grounds. With the receding waters many of the adult fish and millions of fry become landlocked. Here they grow rapidly until, with the contraction of the water areas and the increasing demands for food, the waters become overstocked and the fish die in countless thousands from starvation or perish by the drying up of the ponds during the season of summer drought, when the temperature of both air and water become abnormally high. The work of the Quincy Station consists in the collection of the fishes from these overflowed ponds and lakes and the return of them to the Illinois River, or their distribution to applicants throughout the country.

At the beginning of the year there were large numbers of fish in the ponds and the best of prospects for a good collection. The weather was hot, causing the moss to grow rapidly, but the evaporation was correspondingly great, so that little difficulty was experienced in cleaning out the moss to facilitate the use of small-meshed seines. The work of collecting continued good until July 22, when the water in the lakes and ponds, which were 10 to 12 inches deep, showed a temperature of 120 degrees, and the fish, large and small, came to the surface dead. Up to this time operations had been confined mostly to one lake, although the moss had been removed from others preparatory to working them. After July 22 operations were necessarily confined to the seining of the deeper ponds, but as the moss could not be removed the results were not so satisfactory as when collecting from the shallower waters. Operations extended over the entire navigable portion of the Illinois River. Great care was exercised in handling the fish on account of the usual high temperature of the water and the distance the fish must be carried from the river to the large towing live-boxes.

It is necessary to observe caution in rounding a haul to land the seine, because if the seine is hauled in rapidly to the shore the floundering of the larger fishes and the rolling of the moss will cause great injury to the fingerlings. Where possible the seine is brought together in deep water and a few feet at a time worked over, the fish being carefully placed in tubs and from them into the smaller live-boxes until ready to haul over to the river, where they are placed in the large live towing-cars. They are then taken to the pumping station, placed in tubs until the temperature is gradually reduced, after which they are put in the retaining-troughs and held until the following day. Those showing signs of injury are removed and those selected for distribution are placed in the retaining-ponds. Early in the season it is difficult to induce the very small fry to take food, but as they grow older little trouble is experienced in that respect. Fish that have been kept a week or more in the retaining-ponds are in prime condition to bear transportation, but if sent to the distribution cars direct from the field where collected great mortality results.

The season of 1901 was an unusually disastrous one, all kinds of fishes perishing in the shallow overflowed ponds, owing to the high temperature, when in ordinary seasons they live and flounder around until all the water is gone and they are absolutely left on the bare mud. The total distributions of fish thus collected for the year were as follows: Black bass fingerlings, 50,900; adult black bass, 600; adult crappie, 2,170; adult warmouth bass, 100; adult sun-fish, 300; also 158 adult assorted fish.

At the close of the year the water in the river was 13¼ feet higher than the normal level, and too high throughout the month of June for the collecting of fish.

MANCHESTER STATION, IOWA (R. S. JOHNSON, SUPERINTENDENT).

During the year various improvements and repairs were made to the buildings, grounds, and waterways, the most important being the construction of three new ponds. These ponds were 15 feet wide at the top by 10 feet wide at the bottom, and 291 feet, 254 feet, and 140 feet in length, respectively.

Congress having made a special appropriation of $5,000 therefor, a stern-wheel steamboat was constructed by Kahlke Brothers, of Rock Island, Ill., under the supervision of the superintendent. Other particulars in regard to this boat will be found elsewhere. On the morning of May 18 a violent rainstorm and cloud-burst broke over the station, flooding the southeast section of the reservation, destroying the wagon bridge and road from the main-entrance gate, and doing much other damage to the grounds. The upper spring reservoir was completely choked with mud, cutting off the water supply temporarily from the hatchery building and ponds. This resulted in the loss of about 75,000 of the 328,000 fry which were being held in the hatchery troughs. The property damage resulting from the flood was repaired by the station employees, assisted by temporary labor.

The output of fish and eggs during the year has been most gratifying, exceeding the work of all previous years.

The 60,000 brook-trout fry on hand at the opening of the year were reared to the fingerling stage, and in the fall 49,200 were distributed, 2,275 being held for brood stock. The loss incurred in rearing amounted to 8,525. The brood stock of brook trout, consisting of 1,209 two and three year old fish, were kept in one of the stock ponds in an apparently healthy condition until October, when they were transferred to the 80-foot ponds with plank sides, in readiness for the spawning season. Soon after the transfer was made the same peculiar disease which has attacked the brook trout at this station for the past four years caused a heavy mortality. Efforts were made to check the disease, but without success, until the fish were again transferred to the earth ponds. Experiments conducted at this station prove that it is impossible to hold adult brook trout in the 80-foot wood-lined ponds, while there seems to be no difficulty in holding the same fish in the larger ponds with natural earth embankments.

From 257 ripe female brook trout 214,000 eggs were secured, or an average of 833 per fish. Of this lot of eggs 50,000 were shipped to applicants and 100,000 were hatched, but the fry were a very inferior lot and only 65,000 were distributed. The poor quality of the fry is attributed to the diseased condition of the parent fish. From the Spearfish and Leadville stations 250,000 brook-trout eggs were received, and 285,000 fry were hatched from the eggs received from all sources. Of these, 189,000 were distributed during the spring and 96,000 were held for fall distribution.

The 75,000 rainbow-trout fry on hand July 1 were carried until fall, when 69,000 were distributed and 3,000 held for brood stock. The spawning season of the rainbow trout extended from December 10 to March 21. The brood stock of rainbows consisted of 3,980 three and five year old fish, which were in excellent condition, having been held in the large stock ponds the greater part of the year. Out of this lot 1,296 ripe females yielded 1,247,400 eggs, or an average of 963 per fish. Of the total number of eggs secured 1,007,190, or 80 per cent, were eyed. Of this number 525,000 were shipped on assignment and 482,190 hatched. Of the fry thus obtained, 241,000 were distributed and 128,000 are being held for the fall distribution.

At the beginning of the year there were on hand 10 adult Loch Leven trout. During the month of November 8 ripe females produced 8,000 eggs. From this lot of eggs 6,000 fry were hatched, 3,500 of which are on hand at the close of the year.

There were also received from other stations in good condition 10,000 quinnat-salmon eggs, 10,000 landlocked-salmon eggs, 50,000 lake-trout eggs, 50,000 steelhead-trout eggs, and 100,000 grayling eggs, which produced strong, healthy fry, and these fry were distributed on assignments.

The food used for the brook and rainbow trout fry that were reared to fingerlings consisted of beef livers and mill shorts, boiled in varying proportions, according to the age of the fish. Live food collected from streams in the vicinity of the station was also used to some extent.

During the month of September the rock-bass ponds were drawn, and the young fish, numbering 14,450, were transferred to troughs in the hatchery, where they were held without loss until distributed. The stock of adult rock bass on hand at the beginning of the year numbered 235, but this number was increased by the addition of 45 adults collected from streams near the station. These fish were seen spawning in May, and the first fry were discovered on June 20. The indications are that the crop of young from this brood stock will be large.

The work of fitting up the Bellevue collecting station and overhauling the equipment preparatory to the season's work was begun May 27 and completed June 15. Active fishing operations commenced on July 1, under the direction of Mr. H. Crasser, assisted by the launch *Water Witch* and a temporary crew of six men. Fishing continued until October 12, an extra launch and an additional crew of five men being employed during the month of August. As a result of this work 100,976 black bass, 24,680 crappie, 16,820 cat-fish, 1,700 perch, 4,340 sun-fish, 600 bream, 305 pickerel, 75 pike perch, and 26 carp were collected in the lakes and bayous formed by the overflows of the Mississippi River. These fish were distributed by means of the U. S. Fish Commission cars to various applicants and planted in public waters throughout the United States.

While making the collections of young black bass and crappie large numbers of the more common varieties of fish were seined from the warm shallow lakes and liberated in the Mississippi River between Dubuque, Iowa, and Savanna, Ill. On account of the large number of fish handled and the necessity of transferring them quickly, it was not practicable to count them, but it is estimated that there were transferred in this way 5,000 black bass, 700,000 crappie, 600,000 sun-fish, 500 pickerel, 43,500 cat-fish, 35,000 carp, 500 pike, and 200,000 buffalo, a total of 1,584,500. This is regarded as a conservative estimate, and it is believed to fall short of the actual number transferred.

The fish on hand at the close of the year were as follows:

Species.	Calendar year in which fish were hatched.				
	1901.	1900.	1899.	1898.	1897.
Brook trout	56,000	2,275			110
Rainbow trout	128,000	2,935			2,975
Loch Leven trout	3,500	300			4
Quinnat salmon	5,300				
Grayling	25,000				94
Rock bass					220
Landlocked salmon	6,600				
Lake trout	4,700				
Steelhead trout	49,000				
Total	278,100	5,510			3,403

SAN MARCOS STATION, TEXAS (J. L. LEARY, SUPERINTENDENT).

An appropriation of $8,000 for enlarging and improving the station having been secured, two tracts of land (one cutting into the southwest corner of the grounds and the other extending about 300 feet along the river front) were purchased at an expenditure of $3,200. This property rounds out and adds greatly to the appearance of the station and makes it possible to conduct operations on a much larger scale.

Four ponds, covering about 3 acres, were constructed at an expense of $2,252, and a pumping plant of 1,000 gallons capacity was installed. The latter consists of a 10-horsepower gasoline engine of the Springfield type and a No. 6 centrifugal pump, with 6-inch suction and

8-inch discharge. The entire cost of installing it, including the construction of a substantial engine-house and pump-pit, ámounted to $1,125. While in operation the pump requires very little attention, and the cost of running it for a period of 8 hours is only $1.40. The plant has already proved invaluable, the station having been entirely dependent upon it at one period during the severe drought which has continued almost without intermission for two years. A building on one of the acquired pieces of land was removed to the southwest end of the reservation and fitted up as a residence for the foreman. Wire fencing was constructed around the orchard and superintendent's dwelling and a large number of shade trees set out.

The four new breeding-ponds for the large-mouthed black bass necessitated the collection of additional brood fish from the San Marcos River, the stock being increased during the winter to 360, not including 90 eighteen-months-old fish which have been reared under domestication. The spawning season of the black bass began over a week later than in past seasons, not a nest being observed until February 18, whereas the first nesting has usually occurred from February 8 to 10. The first fry made their appearance on March 10, but the weather at this time was very cold, the water temperature being 58°, and nearly all of this school died. During the year 103,580 large-mouthed black bass were transferred from the breeding-ponds and 81,260 distributed.

The 70 adult crappie on hand were placed in a breeding-pond prepared for them, together with the necessary number of carp for keeping the water roily. During the year 6,490 were removed from the ponds and 4,455 distributed. This fish is considered as invaluable for the muddy lakes and streams of Texas, being a prolific breeder, rapid in growth, and a fine table fish. Its propagation has hardly advanced beyond the experimental stage, however. The breeding season opens in March, continues well into the summer, and young fish have frequently been observed spawning during the fall months.

Early in the spring 38 bream were placed in one of the breeding-ponds and commenced nesting late in April. The spawning season of this species extends through the summer into early fall. During the year 3,410 young fish were taken from the pond and 2,830 distributed.

The rock bass is the most desirable pond fish cultivated at the station for ponds of an acre or less in area. These fish begin to spawn early in March and the spawning season continues until July. During the year 9,360 were transferred from the ponds and 4,555 distributed. The brood stock on hand at the close of the year consisted of 5 adult fish brought from Neosho in the winter of 1898 and 25 two-year-old fish. These were placed in two ponds previous to the spawning season and from them a good crop of young fish is expected for distribution the coming season.

Of the 10 calico bass received from Neosho in the winter of 1898, 6 remain, and these, with 17 two-year-old fish, were placed in two ponds previous to the spawning season, which began March 10. The product from this brood stock during the year amounted to 1,450 young fish. At the close of the year the ponds had not been drawn, but the young fish seen in them appeared to be about one-third larger than rock bass of the same age.

The question of fish food is an important one in the conduct of a pond station. As most of the streams in the vicinity from which supplies of food have been obtained in previous years had dried up, it was difficult to secure natural food in abundance and cannibalism among the young was much more prevalent as a result. Carp and mud shad have been propagated for a supply of fish food. The carp are placed in the ponds with the bass, where the young make excellent food for the fry. River shrimp have been planted in the ponds in large numbers, but as they have no protection are soon devoured. They make very excellent food for all kinds of fry in the ponds. Crawfish, also a valuable food supply, have been scarcer than for the past four years. Bullfrogs breed in the ponds, but were not so plentiful as in former seasons. Their young make fine food for the adult bass.

Blind cave salamanders and shrimp continued to come up with the waters of the artesian well.

It becomes necessary in the protection of the fish to kill many wild ducks, other water fowl, and snakes, as they are very destructive to the young fish.

With very few exceptions the railroads of the State have given free transportation for messengers with cans of fish and messengers returning with empty cans, thus contributing very largely to the success of the station.

NEOSHO STATION, MISSOURI (H. D. DEAN, SUPERINTENDENT).

The construction work begun last year was continued throughout the year. The hatchery was reconstructed and changed from a low one-story to a two-story building, the office was enlarged, and a hot-water furnace was installed for heating the building. The hatching-room is now 28 by 36 feet, with space for 20 hatching-troughs and a capacity for 1,000,000 trout eggs. A room of the same size on the second floor is used for storage and workshop. Some necessary repairs were made on the residence and a new pond, 12,000 square feet in area, was constructed. Two of the old ponds were enlarged, deepened, and repiled with 1½-inch cypress, and a drainage sewer 800 feet in length was constructed. Over 200 feet of retaining wall and gutter were constructed to protect the embankments on the north side of the station property, a cement concrete walk was built from the hatchery to connect with the walk on the south side of the driveway, and considerable grading was done around the ponds and grounds. This construction interfered somewhat with fish-cultural work, as some of the ponds were undergoing repairs during the spawning season.

Of the 51,500 young rainbow trout on hand at the beginning of the year 44,088 were distributed in the fall and 2,000 were held for rearing. The adult rainbow trout were placed in the rearing-ponds early in December, and from them 487,011 eyed eggs were obtained. Of these, 91,296 eyed eggs were the product of 376 two-year-old female trout, being 63½ per cent of the total number of green eggs taken from these young fish, and a much better percentage than usual for fish of this age. Of the eggs thus obtained 304,415 were shipped on assignment, 25,000 were distributed as fry when 3 months old, and 77,000 remained on hand at the close of the year.

Shipments of eggs from other stations to be hatched and the product reared for the aquarium at the Louisiana Purchase Exposition were received as follows: Quinnat salmon eggs, 10,000, which were hatched, and the product at the close of the year amounted to 6,900 young fish; landlocked salmon, 5,000, which nearly all died in hatching, only about 200 remaining at the close of the year; steelhead, 10,000, which hatched well and grew nicely, the product on hand at the close of the year being 6,400; grayling, 25,000, large numbers of which died in process of hatching, though 8,000 remained at the close of the year and were in fine condition.

In addition to the propagation of the *Salmonidæ* above referred to, the various fishes propagated in ponds were handled at the station, and while the work during the year was not entirely successful, 32,965 yearlings were distributed, as follows: 18,400 rock bass, 3,251 strawberry bass, 9,514 black bass, and 1,800 sun-fish.

LEADVILLE STATION, COLORADO (E. A. TULIAN, SUPERINTENDENT).

At the beginning of the year there were on hand 260,800 brook-trout fingerlings, of which 30,000 were planted during the month of July, 9,000 in August, 53,000 in September, and 35,500 in October, the losses during this time amounting to about 51 per cent.

The usual arrangements were made for the collection of brook-trout eggs in the fall from lakes belonging to private individuals, and the results of the work are embodied in the following statement:

Source of supply.	Spawning season.	Eggs collected.	Percentage of loss.	Fry hatched.	Eggs shipped.
Station brood fish	Oct. 3 to Dec. 6	235,300	31	....	162,540
Uneva Lake	Oct. 23 to Nov. 27	261,700	13.5	226,500	....
Smith's ponds	Oct. 21 to Dec. 5	197,300	12.3	128,300	....
Wellington Lake	Nov. 1 to Nov. 28	1,303,400	15.9	944,200	153,400
Young's ponds	Oct. 19 to Nov. 23	1,013,700	21.9	680,800	111,700
Musgrove's ponds	Oct. 14 to Nov. 26	569,300	22.8	257,100	183,200
Derry's ponds	Oct. 28 to Dec. 7	225,300	19.2	182,000	....
Black Lake	Oct. 28 to Nov. 2	443,800	9	378,700	25,000
Total	....	4,249,800	20.7	2,797,600	635,840

Reference was made in last year's report to the improvement in the percentage of eggs which produced fry owing to the fact that the practice of stripping young fish had been discontinued. This year the lines were drawn somewhat closer, and when in doubt as to whether a fish was spawning for the first time or not it was put aside without taking the eggs. As a result the loss on each lot of eggs was from 20 to 50 per cent less than on lots taken from the same places last year. Undoubtedly a very much larger percentage of eggs would produce strong, healthy fry were it possible to secure the eggs from wild fish without confining them for a considerable period, during which time it is necessary to handle them over and over again; but the conditions under which the collection of eggs is made in Colorado are such that there is no other practicable way, and most of the wild fish must be caught early in the season and penned until ripe.

After the eggs were eyed 675,000 were shipped on assignments, and in every instance the assignments reached their destination in good condition. One case of 25,000 eggs was sent to Tokyo, Japan, with a loss of 12 per cent en route and a subsequent loss of 2,000 during the period of incubation.

Although the total number of eggs taken was somewhat less than the number taken last year, the percentage of fry hatched was greater than last year, and the number of fish available for distribution proportionally greater. On May 20, when all the brook-trout eggs had been hatched, there were on hand 2,664,440 fry, of which 1,087,115 belonged to the Commission and 1,577,325 to the parties who had furnished the eggs. Between this time and the end of the fiscal year there was a loss of 6½ per cent of the fry belonging to the Commission; 745,000 were planted, and there remained on hand 271,000.

Of the 68 adult Loch Leven trout on hand at the beginning of the year 33 died, and during the months of November and December 30,600 eggs were obtained from the remainder, from which 18,500 fry were hatched; 3,000 of the fry were distributed in June, and the balance on hand at the close of the year amounted to 2,450. The eggs were of inferior quality, as the parent fish were past their prime. The introduction of the Loch Leven trout has not proved very successful, and its propagation will be discontinued.

Of 1,525 two-year-old rainbow trout on hand July 1, 1901, 675 died and 200 were shipped on assignment, leaving 650 on hand at the close of the year. There were also 6,790 fry in the rearing-ponds, of which 5,000 were shipped and 1,790 died. During the months of February and March, 109,800 eggs were collected from Ridgway's ponds, 50,000 were acquired from the station at Manchester, Iowa, and 100,000 were purchased from J. P. Morrill, Verdi, Nev. These eggs produced 227,075 fry, of which 160,000 were distributed during the month of June, 41,550 were returned to the owner of the ponds, the balance being lost.

In February 25,000 lake-trout eggs were received from the Duluth Station, and hatched with a loss of 900. The fry from these eggs did not do well, 16,600 of the young dying before the close of the year.

Out of 76 three-year-old grayling in stock at the beginning of the year, only 15 remained at the close of the year. The domestication of the grayling has not proved a success, the few fish on hand having been carried for experimental purposes. On the 21st of May 131,200 eyed grayling eggs were received from the Bozeman Station, 120,000 of which hatched, and during the month of June a distribution of 100,000 fry was made in Colorado waters.

On the 23d of May 35,000 steelhead eggs were received from the collecting station at Medford, Ore., from which 34,090 fry were hatched, and 33,900 healthy and rapidly growing fish remained on hand at the end of the year.

On the 26th of February 10,000 landlocked-salmon eggs were received from Craig Brook Station, from which 9,800 fry hatched, and at the close of the year 9,450 remained on hand.

At the beginning of the year there were on the hatching-trays 1,317,800 black-spotted trout eggs, to which may be added the collections during the month of July, amounting to 863,900. Of the 2,181,700 collected, 175,000 eyed eggs were shipped elsewhere and the balance hatched, with a loss of 17.6 per cent. The distribution of these fish was made during the fall, when 847,000 were planted for the Commission and 560,000 for the owner of Grand Mesa Lakes, the point of collection. During the month of June, 3,016,700 eggs were collected at Grand Mesa Lakes, and the loss to June 30 was 106,000, or 3½ per cent, leaving on hand at the close of the year 2,910,700.

For two months during August, September, and October the superintendent was detailed to collect statistics and methods of the fisheries in Utah and Colorado. During this time the station was in charge of W. K. Hancock, fish-culturist.

No material improvements were made at the station during the year in the way of new constructions, although, so far as the funds would permit, the property was kept in good repair. A new tin roof was laid on the kitchen, coal-shed, and storeroom of the messhouse. A small room was built in the workshop, with an inside lining of tin, in which to store seines and nets. The grounds were inclosed by a Page woven-wire fence along the south side and the greater part of the west side, and the balance of the west side was inclosed with a barbed-wire fence.

The stock of fish on hand at the close of the year is shown by the following table:

Species.	Calendar year in which fish were hatched.				
	1902.	1901.	1900.	1899.	1898.
Brook trout	271,000				26
Loch Leven trout	2,450	1,000			35
Rainbow trout			650		
Grayling					15
Lake trout	7,500				
Landlocked salmon	9,450				
Steelhead trout	33,900				
Black-spotted trout					8
Total	324,300	1,000	650		84

SPEARFISH STATION, SOUTH DAKOTA (D. C. BOOTH, SUPERINTENDENT).

During the year the station grounds were materially improved by the construction of a stone bulkhead 82 feet long, 4 feet wide, and 6 feet high across the canyon outlet, and a channel, in places 6 feet deep and 8 feet wide, was cut through the upper grounds to connect with the storm channel constructed last year. Although still incomplete, the channel is sufficiently large to care for sudden accumulations of water from the canyon during ordinary rains, and has during the past year carried off the surface water, thus preventing the pollution of the water supply to the hatchery, and as a consequence the percentage of eggs hatched was higher than heretofore. During the summer much trouble was experienced owing to a decrease in the volume of the spring-water supply, which is the main source of supply for the hatchery and ponds. From time to time, as the regular force could be spared from the fish-cultural work, and with some temporary assistance, the sources of the springs rising on the reservation in the canyon were developed with gratifying results, and it is believed that by continuing this work the present volume of water can be doubled. A driveway was laid to grade through the station grounds, and, together with other completed portions of the grounds, sown to grass. Shrubs of various kinds were planted, and 47 shade trees were set out.

The fish on hand at the beginning of the year in course of rearing were distributed as fingerlings and yearlings during the summer and fall, with the exception of a lot of rainbows which were retained to rear for a brood stock. The output amounted to 73,500 brook trout, 5,000 Loch Leven trout, and 10,000 rainbow trout.

On the 1st of July there were on hand 1,200,000 black-spotted trout eggs at the collecting station in the Yellowstone Park. As soon as the eggs were properly eyed they were packed in refrigerator cases in lots of about 250,000 each and transported 74 miles by wagon to Cinnabar, Mont., thence by rail to Spearfish, where they were hatched, and during the fall and winter 382,000 fry were distributed to applicants or planted in the waters of the Black Hills. The substation in the Yellowstone National Park was again opened in the early part of June, 5 men being detailed for the collection of eggs at that point. At the close of the year there were in the troughs 1,934,000 eggs.

During the fall the brood stock of brook trout at the station was largely increased by seining the creeks in the vicinity of the station, and resulted in a larger collection of eggs from this source than in previous years. During the early fall arrangements were made with persons in the vicinity of the station who had a supply of stock fish to collect and hatch the eggs at the station on shares. The first eggs were taken October 26 and the spawning season continued until January 14, when the last eggs were taken from the brood fish at the station. The total number of brook-trout eggs collected from all sources amounted to 1,065,000, of which 112,000 green eggs were given to the owners of stock fish, 113,477 were lost during incubation, 355,000 eyed eggs were shipped to other stations, and the balance produced 496,523 fry. Of the fry, 50,023 were lost in the hatchery, 77,500 were given to the owners of stock fish, 269,000 were distributed as fry during May and June, and at the close of the year 100,000 fry remained on hand in course of rearing for distribution as fingerlings and yearlings.

The Loch Leven trout at the station began spawning October 23 and finished November 29, when 16,375 eggs had been collected. The product of these eggs amounted to 14,000 fry, which were distributed during May and June.

On February 10th 50,000 rainbow-trout eggs were received from the Manchester Station in good condition. The 41,500 fry from these eggs were distributed to various applicants and planted in streams on the Rosebud Reservation and in Spearfish Creek.

Between March 20th and May 31st 3,670 adult rainbow trout were seined in the Laramie River and Sodergreen Lake, about 20 miles south of Laramie City, Wyo. Only 183, or 5 per cent, of these fish produced any eggs, the total collection amounting to 170,000, which, after being eyed at the hatchery of the Wyoming Fish Commission, were divided equally between the Laramie State hatchery and the Spearfish Station, the latter receiving 75,000, the product of which at the close of the year amounted to 60,000 fry.

At the close of the year the stock of fish on hand was as follows:

Species.	Eggs.	Calendar year in which fish were hatched.				
		1902.	1901.	1900.	1899.	1898.
Brook trout		100,000		690		1,000
Loch Leven trout				2,239		104
Rainbow trout		60,000	5,000			
Black-spotted trout	1,934,000				390	54
Total	1,934,000	160,000	5,000	2,929	390	1,158

Bozeman Station, Montana (James A. Henshall, Superintendent).

The work at this station was confined to the propagation of brook trout, black-spotted trout, steelhead trout, rainbow trout, Montana grayling, and the collection of eggs at auxiliary stations.

The work at the auxiliary station for the collection of black-spotted trout eggs at Henry Lake, Idaho, was in charge of Mr. W. F. Jarvis, who took the first eggs April 4 and the last May 24. From 700 females there were obtained 871,500 eggs, an average of 1,200 per fish. Ripe males were very scarce during the season, and the loss of nearly a half million eggs is to be attributed to this cause. Besides the eggs transferred to the Bozeman Station, 235,000 were shipped to other stations and applicants, one assignment going to Belgium. The temperature of the water in the hatchery during the season varied from 40° to 54° F., the water in the spring pool being much influenced by the air temperature.

The auxiliary station at Red Rock Lake, Montana, for the collection of grayling eggs, was in charge of Mr. G. H. Tolbert. The first eggs were taken on April 21 and the last on May 31. Ripe fish of both sexes were very plentiful, and the number of eggs collected could have been greatly augmented had the station been equipped with more hatching-jars, in which the eggs are eyed. The collection amounted to 4,463,000 eggs, which were eyed in 21 jars. In addition to the eggs shipped to Bozeman Station there were shipped to other stations and applicants 1,455,000. More than 2,000,000 were hatched and the fry planted in streams contiguous to the substation. The temperature of the water in the hatchery varied from 49° to 53° during the season.

Mr. Tolbert reports that the streams are swarming with yearling grayling from the plant of last season, which indicates that grayling fry thrive well when planted early.

The number of eggs collected at Bozeman Station and received from the auxiliary stations during the year numbered 1,429,000, as follows: Black-spotted trout, 615,000; steelhead trout, 83,000; rainbow trout, 2,000; brook trout, 129,000; grayling, 600,000.

The number of eggs received from other stations during the year was 282,700, as follows: Brook trout, 197,000; rainbow trout, 47,000; lake trout, 38,700.

During the year 2,946,000 fry and fingerlings were distributed in Montana, Idaho, Oregon, and Washington, as follows: Black-spotted trout, 262,000; brook trout, 24,000; steelhead trout, 10,000; grayling, 2,650,000.

The water in the hatchery at the Bozeman Station is uniformly 45° during the winter and 44° during the summer months, when the snow is melting in the mountains. During the past fall the wall of the warm spring was raised and extended, giving a fall of 18 inches to the creek-water ditch. As the water of this spring is 77° during the entire year, it keeps the water in the ditch from freezing in the winter, thus insuring a constant supply of creek water the year round. After the fry are hatched in the spring water it is shut off and the creek water is utilized for the fry. As it never rises above 65° in summer, contains a great deal of natural food, is more highly aerated, and is clear and pure after the spring rise, or from the middle of June, it is preferable to the spring water for the fry.

The different species of trout sent out from the station have done exceedingly well wherever planted. The steelhead trout and brook trout have shown a growth quite remarkable, in some instances weighing 3 pounds at little more than 2 years of age where the supply of natural food was abundant. There was sent to the station a black-spotted trout 2¼ years old that weighed 3 pounds dressed. It had been placed, with others of the same hatching, in a carp pond near Toston, Mont., which may go to show the value of young carp as trout food.

During the past year there has been no evidence of disease among the fry at this station. A few of the black-spotted male trout were injured by fighting and some by jumping against the supply pipes during the spawning season, resulting eventually in their loss. The same causes also account for a slight loss of steelhead trout; otherwise all stock fish have done very well. They are fed on mush made of 1 part beef or sheep liver and 3 parts of mill shorts from which the bran has been taken. This food is well assimilated and taken with avidity.

At the close of the fiscal year the following fish were on hand:

Species.	Calendar year in which fish were hatched.			
	1902.	1899.	1898.	1897.
Brook trout	249,000		278	268
Black-spotted trout	225,000		2,326	
Steelhead trout	21,000		1,580	
Rainbow trout	37,000	1,574		
Lake trout	18,000	40		
Grayling	25,000			
Total	575,000	1,614	4,184	268

BAIRD STATION, CALIFORNIA (G. H. LAMBSON, SUPERINTENDENT).

The work at this station is confined to the propagation of the quinnat salmon. At the beginning of the year the various racks were in place and some salmon had collected in the fishing pool; the current wheel used to supply the hatchery with water was in running order, and all hatching equipment had been cleaned and painted. During the month of July the spawning-house, fish-pens, whim, and seine reel were made ready for active operations. Twice during the season the current wheel broke down. The first time it was repaired by the station employees, but the second time it was necessary to replace the countershaft. On each occurrence the steam pump was operated during the time the current wheel was out of service and thus kept the hatchery supplied with water.

Fishing began on August 16, when 4 ripe females were obtained. The following day 37,200 eggs were taken from 7 females. Fishing and spawning operations continued until September 25, when the season's operations with the summer run of salmon closed. The fall run of fish began October 25, with a catch of 8 ripe females, and the following day 66,400 eggs were obtained from 10 females. Fishing and spawning operations continued until November 25.

From the summer run 7,375,520 eggs were taken from 1,203 females, or an average of 6,130 per fish. The fall run yielded 1,557,770 eggs from 233 females, or an average of 6,690 per fish. Of the total collections, amounting to 8,933,290 eggs, 5,706,410 were shipped to the California Fish Commission at its Sisson and Eel River stations, 30,000 were shipped to the Pan-American Exposition at Buffalo, N. Y., and 10,000 to each of the stations of the Commission at Neosho, Mo., and Manchester, Iowa. From the balance of the eggs collected 2,115,560 healthy fry were planted in the McCloud River. The fry from the summer run, 811,900 in number, were planted just as the umbilical sac was absorbed, all the trough room being required for the eggs from the fall run. The fry from the fall-run fish were held in the troughs until April and when planted averaged about 2½ inches in length. A lot of 100,000 fry from the fall run were reared in an earthen pond, and at the end of the season, when the plants were made, averaged slightly larger than those retained in the hatching-troughs.

The method of stripping and fertilizing the eggs was the same process used during the past five years, with the exception that after the regular spawning all females were killed and opened to secure the balance of the eggs in them which could not be extruded in the regular way. These eggs were washed in a normal salt solution and then fertilized. As a result about 12 per cent more eggs were secured than if the usual methods had been pursued.

The food for rearing the fry consisted of liver, liver and mush mixed, and canned salmon. Heretofore much difficulty has been experienced from feeding the canned salmon, as it dissolved in the water so quickly that the fish could not find particles large enough to eat and the water became so milky as to obscure the fish from view. It also fouled the troughs, covering the sides and bottom with a greasy scum, and collected on the gills of the young fish. During the past season these difficulties were obviated by submitting the canned salmon to pressure in a press made for the purpose, somewhat similar to a hand cider-press. The moisture was pressed from the salmon until it could be squeezed in the hand like damp earth, and in this condition it held together well in the water and did not foul the troughs much more than liver or liver and mush. For experimental purposes eight troughs of fry of about the same age were set aside, four troughs being fed on nothing but canned salmon and the other four on liver at first and then a mush of liver and shorts. When the fry were planted there was no apparent difference in the size or condition of the two lots, the fry fed on the canned salmon appearing as strong and healthy as any in the hatchery. The first cost of the canned salmon is about the same as that of the liver and mush, but it is always available when once canned and the labor necessary to secure and prepare the liver and mush is avoided.

On October 5 the foreman's cottage was reported on fire, and although all the employees were at hand ready to do what was possible to extinguish the flames the building was entirely consumed within half an hour, the foreman losing nearly all of his personal effects.

During the summer there were many fires on the hills and around the reservation. In September the fires entered the southern part of the reservation, endangering the woods back of the superintendent's residence. The spread of the flames was prevented by back-firing.

On January 16 Colchoolooloo, one of the oldest and most influential Indians on the reservation, died in his hut. He was a consistent friend of the white people, and in former years saved the superintendent from being killed by the Indians. His influence was always exerted toward keeping his people sober and industrious. He was buried on the reservation upon a hill, where he had selected a site for his grave.

From October 18 to December 18 the superintendent was absent from the station, detailed to act as messenger in the transportation of a shipment of salmon eggs from San Francisco to New Zealand.

On April 24 a quinnat salmon was noticed spawning in the river opposite the hatchery. It had about finished spawning, only 10 or 15 eggs being secured. It is not known whether this fish was a straggler from the fall and winter run or an early comer in the spring run.

BATTLE CREEK SUBSTATION, CALIFORNIA (OPERATED FROM BAIRD STATION).

In order to determine the extent of the spring and summer run of salmon the racks had been put in place during the month of April. A large run of fish came into the seining-pool during the late spring and early summer, but owing to the extreme heat they died without ripening. The experiment proved that there is a large summer run of fish in the creek, but it also proves that it is impossible to secure eggs from this run at the Battle Creek Station. A new stone-ballasted crib pier was constructed at the mouth of the ditch and the water turned in by the aid of a wing dam. All hatching-troughs and equipment were cleaned and asphalted and the general repairs about the station completed.

The first fishing occurred October 22, when 13 ripe females were caught, and the following day from 41 ripe fish 238,700 eggs were taken. Fishing and spawning operations continued until December 1, when portions of the racks were washed out and the balance of the salmon on hand escaped. The total number of eggs collected amounted to 10,059,000, of which 705,000 were lost during incubation, and 9,354,000 were shipped to the Sisson Station of the California Fish Commission. The fry resulting from the eggs shipped to the Sisson Station were all planted in the Sacramento River and tributaries.

The ordinary method of stripping the fish and fertilizing the eggs was pursued the same as at Baird, and after each stripping all the female fish were cut open to secure the balance of the eggs in them. The eggs were washed in a normal salt solution and then fertilized. By this method 1,512,630 eggs were obtained, or 15 per cent of the total take. The entire loss of eggs from all causes was 0.07 per cent. The method of handling the eggs was different from that followed at the Baird and Mill Creek stations in that after the second day they were left undisturbed until they emerged from the tender period or when the blastopore was fully closed, while at Baird and Mill Creek the eggs were picked daily. The results from this experiment were not definite or satisfactory, as the eggs proved to be better than those at Baird Station and not as good as those at the Mill Creek Station.

On November 28 a very heavy rainstorm occurred and by night the creek was raised over 7 feet. A large amount of drift came downstream and lodged against the racks and the entire force were engaged in removing it in order to save the racks. This work proved unavailing, and just as the men were ordered to desist C. H. Storrs, a temporary laborer, was caught by a log and killed. The coroner's jury returned a verdict of accidental death and exonerated the Commission from all blame. The work of clearing the racks in times of freshet is hazardous, but this is the first fatal accident that has occurred at any of the California stations, although there have been several narrow escapes.

Toward the close of the year racks were put across the mouth of the creek to turn the salmon into the river and force them up the McCloud, where they can be retained until ripe. The results of this experiment can not be foretold at the close of the year.

MILL CREEK SUBSTATION, CALIFORNIA (OPERATED FROM BAIRD STATION).

This is a new station situated on Mill Creek, a stream which has its source in the foothills of the Sierra Mountains in the northeastern part of Tehama County, and emptying into the Sacramento River from the east about a mile above the town of Tehama.

Investigations made toward the close of the previous year demonstrated that there was a large run of salmon in this creek, and in order to take and eye the eggs a hatching-shed 80 feet long by 40 feet wide, with 10-foot studding and open on all four sides, was erected. A water supply of 1,000 gallons per minute was obtained by tapping a mill-race and thence conducting the water to a settling tank in the hatchery through 78 rods of ditch and 57 rods of flume. The water thus used is returned to the mill-race, and is furnished free of charge. In the hatching-shed 80 troughs, 15½ feet long, 11½ inches wide inside measure, and 6¾ inches deep, were erected. When fully equipped the hatchery will have a capacity of 10,000,000 eggs. A small tool-house and storehouse were also constructed.

The site having been selected before the close of the last year, the racks were all in place at the beginning of the year. The upper rack, 75 feet long, is composed of three stone-ballasted piers, upon which rest three double stringers. The racks are 14 in number, made in sections 5½ feet wide and 9 feet deep, with a space of 2¼ inches between the slats. These racks rest upon stringers at the top and on the mud sill, which is placed across the stream at the bottom. The lower rack is constructed in the same way except that it is 85 feet long and has three V-shaped openings or traps, the angle of the V being upstream.

The salmon of the summer run which were intercepted by the racks all died before becoming ripe enough to spawn, death being due to the extremely warm weather. The fall run was not large because the creek was very low, while at the same time the Sacramento was several feet above the low-water mark. The run began during the last week in October, and fishing commenced October 30 and continued at intervals until the close of the season on December 2, when 2,561,000 eggs had been secured from 451 female salmon. The loss during incubation was 141,000 eggs, or 0.055 per cent. All of the eggs were shipped to the California Fish Commission—1,000,000 to the Price Creek hatchery and the remainder to Sisson. The method of fertilization was the same as at Baird and Battle Creek.

As it has been found impossible to secure eggs from the summer run of fish at the Mill Creek Station, during the spring temporary racks were constructed across the mouth of the creek in order to turn the salmon back into the Sacramento River with the hopes that a large proportion of them would continue up the river and on to Baird Station, where the water is colder and the eggs can be taken. A large run of salmon passed up the river during May and June, and the fish were continually fighting the racks, but all were compelled to return to the river.

Clackamas Station, Oregon (J. N. Wisner, in Charge).

Mr. E. N. Carter, who was in charge of the station for the first six months of the year, having been relieved, Mr. J. N. Wisner, field superintendent, was placed in charge for the balance of the year, and on February 15 Mr. Carter was transferred to St. Johnsbury, Vt.

The initial work of the year consisted in the care of the few fish on hand at the end of June, cleaning up of the station buildings, and the construction of a fence around the premises. On July 24 the construction of the rack across the Clackamas River a short distance below the station was undertaken and the work completed early in August. Owing to the fact that about 2,000 cords of wood were being floated down the river, it was necessary to construct a boom above the rack on either side of the river to a point in the rack where a gate was made to allow of its passage. This gate was constructed of 1-inch boards, 4 inches wide, placed with their edges to the current and hinged to an iron rod below the surface. After the rack had been completed the employees were set to work on the bed of the river, which was cleared of bowlders and snags and put in condition for fishing. Live pens were made for retaining the salmon, and other work preparatory to the fishing season was done.

Fishing with gill nets began on the evening of September 22, and on the following morning 43,000 eggs were taken from eight ripe females. The run of fish gradually increased until October 15, when 194 were taken, 94 being females, and from these 412,000 eggs were secured, making the largest single day's work of the season. By November 8th 10,018,000 eggs had been collected, and as the capacity of the station was taxed to its utmost it was necessary to discontinue collections. The rack was at once opened, that the remaining salmon might have free passage to the upper waters for spawning. A large portion of the rack was saved and stored for future use. The total loss of eggs was 1,347,850, or about 13 per cent of the entire collection.

The females were spawned in the same manner as that practiced throughout the Columbia River territory, except that after the greater portion of the eggs had been removed an incision was made in the belly of the fish, the eggs shaken free from the enfolding sac, and then pressed from the vent. In this manner the egg take was added to materially, but the eggs thus taken were not of the best quality. On November 10, after a period of incubation of fifty days, the eggs began hatching, and owing to lack of space it became necessary to plant the greater portion of the fry as soon as they hatched.

With the view to affording them as much protection as possible, a series of dams was thrown across the small branch leading from the hatchery to the Clackamas, it having first been cleaned, and into the small ponds thus made throughout its length the fry were liberated. By January 1 over 6,000,000 fry had been planted, and the balance, 2,412,000, were held in troughs and outside tanks to be reared for a time upon artificial food. In each tank 36,000 fry were placed and in each trough 18,000, but on January 9 it was necessary to thin them out by distribution, leaving 15,000 in each tank and 5,000 in each trough. The fry loss for the year amounted to 128,866, or 1.48 per cent of those hatched.

During September and October 220,000 eyed quinnat-salmon eggs were received from the Oregon Fish Commission. Of these, 10,000 were loaned to the Portland Carnival in connection with its exhibit and 175,472 fry hatched from the remainder were planted in the Clackamas River.

In February 900,000 white-fish eggs were received from the Northville, Mich., Station, and after being successfully hatched the resulting fry, numbering 750,000, were planted in Lake Sequalitchew, Washington.

In July and August the rainbow and brook-trout fry carried over from the previous year were planted under the direction of the Oregon Fish and Game Association.

In one of the rearing-tanks 20 quinnat salmon had been held until 18 months old, and on June 26, 1902, copper tags were placed upon them and they were liberated in the Clackamas River.

At the request of the committee in charge a model salmon hatching-house was installed as an exhibit at a carnival held in Portland, Oreg. All the equipment used was made one-third the regular size and was furnished by the committee. The Commission loaned cans, packing, and such other articles as could be spared. The installation of this exhibit was under the direction of the superintendent until completed, and it proved to be very interesting and instructive to the visitors at the carnival.

On the 25th of February 100,000 brook-trout eggs were received from the Leadville, Colo., Station, and early in March another shipment of the same number came from the same place. These eggs were received in fine condition, hatched well, and the resulting fry, after being fed for a short time, were planted in waters of Oregon and Washington.

On March 16 a shipment of lake-trout eggs was received from the Duluth, Minn., Station in good condition, and began hatching March 23. The loss of fry was heavy, but was due to the fact that one of the screens clogged up, forming a current, which destroyed a large number. The fry were planted in Lake Sequalitchew, Pierce County, Wash., and in waters in Oregon.

During May 10,000 cut-throat trout eggs were received from Verdi, Nev., and the fry hatched from them were planted in waters in Clackamas County, Oreg.

On May 23 the first shipment of steelhead eggs, numbering 40,000, was received from the Rogue River Station, and on June 3 a second lot of 30,000 arrived in good condition. The eggs hatched well, and at the close of the year the fry were doing nicely.

The food used consisted at first of pure liver and later of liver mixed with Germea. This was prepared by stirring the Germea into very hot water, to which a little salt had been added, and then grinding the mixture with the liver to thoroughly combine the ingredients.

Rogue River Station, Oregon.

This station was operated as a substation of Clackamas. The construction of the rack across the river to stop the ascent of the quinnat salmon was commenced on July 5 and completed within five days, the expense of building it being much less than usual, as most of the material in the last year's rack was again utilized. For the remainder of the month and during the early part of August the time of the men was taken up in general repairs to the equipment preparatory to the opening of the salmon work, and in making various improvements, the most important being the construction of a large water-wheel capable of lifting 100 gallons of water per minute, and the erection of 28 hatching-troughs. A strong boom was also anchored in the river above the wheel to protect it from driftwood, and a large supply tank was built. The money for making these improvements was furnished by Hon. R. D. Hume.

The fishing season opened August 20, when 2 ripe females were stripped, and from that time to the end of October eggs were obtained daily, the total collections aggregating 5,601,000. The entire number of ripe females stripped was 1,515, and the largest take of eggs was on October 21, when 385,000 were secured. The last eggs were taken on November 5, and on the 26th of that month one-third of the season's take was shipped to Hon. R. D. Hume, Wedderburn, Oreg., to be hatched and liberated by him in the Rogue River at that point. The balance of the eggs hatched at the station with a loss of 11.10 per cent, and on December 14 the first plant of fry was made. Early in the winter an effort was made to feed a lot of 100,000 in the rearing-tanks, but by January 26 the weather became so cold that it was impossible to keep the water running and the fry were liberated. Plants of fry were made from time to time during the winter, though as many as could be accommodated were retained for rearing to the fingerling stage, the last of them being released on May 22. The food given these fish consisted entirely of canned salmon, and they seemed to thrive on it until they were about 2 months old, after which time they began dying in large numbers and were immediately distributed.

The Elk Creek Substation was again operated for the collection of eggs of the steelhead and silver salmon. A dam 125 feet long and 10 to 15 feet wide was constructed in the creek about a mile from the hatchery, the old location 10 miles above the station having been abandoned, as it was found that a large number of the fish spawned before reaching that point. The dam was very solidly built of logs and rocks, with false and solid aprons alternating. The false aprons were filled with rock to give the necessary weight, and around one end of the dam a 4-foot channel was blasted and a trap placed in it. Toward the center of the dam were bowlders, around which the fish jumped, and it was found that by putting a slide upon some of these the fish would fall into it and be carried into the trap on the opposite end of the dam. Only one trap was in operation at the opening of the season, but later the number was increased to three. A series of substantial live-pens was constructed above the dam.

Between the 18th of November and 6th of December 500,000 silver salmon eggs were taken from 268 females. These hatched with a loss of 63,000 eggs, and in April 424,530 fry were deposited in the Rogue River at Trail, Oreg.

The steelhead work opened February 18, but the conditions early in the season were all unfavorable. There was a scarcity of males, and in many instances it was necessary to impregnate the eggs of several females with the milt of a not fully matured male. The weather was also cold and rainy and the water higher than normal. At the close of the season—May 11—the total collections amounted to 617,000. The number of ripe females used was 290. As soon as the eggs had developed sufficiently 481,000 were shipped on assignment, one case of 25,000 being forwarded to an applicant in Germany. The loss on the 126,000 eggs retained for hatching was very heavy, only 20,250 fry resulting from them. These were released in the Rogue River on May 29. The method of taking and fertilizing the eggs was the same as in previous years, and the heavy mortality during incubation is attributed to the unfavorable conditions existing during the collecting season.

LITTLE WHITE SALMON STATION, WASHINGTON.

Although a substation of Clackamas, this station is more important than the head station in all branches of the work. From it are operated the substations on the Big White Salmon River, and also on Eagle and Tanner creeks.

The station was opened July 9, when the usual preparations for active work were commenced. The hatchery and troughs were put in good condition, a combined wood-shed and storeroom was erected, and four skiffs for use at the station and substations were built. All of the buildings were whitewashed and the outside of the window frames given a coat of paint. The dam in the supply creek was partly torn out and widened, with the view to giving an easier outlet during winter freshets. The mess-house, which had been almost against the hatching-house, was moved to a distance of 30 yards from the latter to lessen the danger of fire. A new flume was built from the source of the water supply to the filter, and thence to the upper hatching-house; it was then laid along this building to the lower house, and from there to the outside troughs. A scow was made for use in bringing in supplies and for the distribution of fish and eggs.

On August 5 the upper rack was completed, and the work of putting in the other racks was at once pushed to completion. The racks were constructed in the usual temporary manner of tripods with one long and two short legs, weighted, and tied with stringers, upon which the pickets of 2 by 2 material were nailed in a vertical (angular) position.

The fish were captured by means of the regular downstream traps, and after being caught they were held in retention pens until the following day, when they were spawned.

The spawning was done by the use of a spawning-box to hold the fish, which were stunned before being put into the box. The eggs were pressed from the fish by one man into a pan held by another, and the milt was immediately applied. The mixture of milt and eggs was stirred with the fingers, and then the spawn-taker added water until the eggs were barely immersed. After this the pan was set aside for 1½ minutes before being taken up and washed. The eggs were then carried to the station in buckets, 15,000 to the bucket, and there they were measured and placed in hatching baskets. After the eggs had been cleaned and picked for a period of 4 or 5 days, they were covered and allowed to remain in perfect quiet until 30 days old, when they were thoroughly washed and picked over. After this picking they were kept perfectly clean until hatched. Feeding was begun before the yolk-sac was absorbed. At first, with the view to accustoming the fry to food, only pure and very finely ground liver was given, but later on, as soon as they began taking food well, they were fed a mixture of liver and mill-feed.

It was necessary to plant many of the fry as soon as they were hatched, on account of lack of water and space, but as many as possible were held and fed until late in the spring, the final distribution taking place during April. The total collections during the season amounted to 14,166,132 eggs, on which there was a loss of 2,537,200.

In addition to the eggs taken at this station, 573,000 were received from the Big White Salmon substation and 598,868 from the Eagle Creek substation, making the total of eggs handled 15,338,000, from which were hatched 12,800,800 fry. The fry loss amounted to 719,995, and the total number available for distribution amounted to 12,080,805, which were scattered along in waters tributary to and in the Columbia River from a point 30 miles up the Des Chutes River to the Sandy River.

Big White Salmon Station.

When this station was visited it was found that the White Salmon Boom and Improvement Company had thrown a wing dam across the mouth of the river and had cut a channel across the bar in order to get logs out on a lower stage of water than had been the former practice. This change necessitated new plans for capturing the fish in the river, as it gave the fish a new lead from the Columbia and threw the current from the eastern to the western side of the river.

On September 5 the run of logs was finished and Mr. G. H. Tolbert was placed in charge of the substation with a crew of 2 men. As there are no buildings at this point, the necessary camp equipment was transferred from the Little White Salmon Station, also a complete equipment of tools. Camp was pitched within 300 yards of the mouth of the river, and the fishing-ground was located 500 yards from its mouth. Fishing was conducted by racking the stream and by downstream traps. Old troughs were freighted from the Little White Salmon Station and set up on Olsen Creek, a small stream 1 mile below the mouth of the Big White Salmon River. Here a fine water supply was available, which was not only clear at all times but never varied in temperature.

Later in the season it developed that there was not sufficient room for the fry being collected, and 100 new troughs were made for this station and set up out of doors. They were supplied with water from a 500-foot flume temporarily but substantially built, as it was necessary to carry the flume in one place 20 feet from the ground, exposed to high winds.

The first females were taken September 14, when 29,500 eggs were secured. The fish were captured during the greater part of the season in the downstream trap, but owing to high water it was necessary at times to seine them. The same manner of handling the fish was in vogue as at the Little White Salmon. During the season 872 females were taken, from which were secured 3,415,000 eggs, showing the average production per fish to have been 3,916. From the eggs taken at this station, and from the 741,932 taken at Tanner Creek and shipped to this point, there were hatched 3,075,000 fry, which were distributed with a loss of 330,500. Considering the fact that there were no buildings at the station and that it was but the second year of operation, and also that it was impossible to start the work until late in the season, the results are considered very good.

At Eagle Creek the eggs collected were eyed in troughs set up temporarily and supplied with water by a flume from the creek. Owing to the rough bottom of the creek it was impossible to follow any definite method of fishing, but so far as possible the fish were caught in downstream traps. The traps could hardly deserve the name, being nothing more than slats and slabs placed wherever practicable between the bowlders. Besides these traps, seines and dip nets were used.

The total number of eggs collected amounted to 715,000, which were secured from 146 females, an average of 4,897 per fish. Of these, 90,132 were lost during the period of incubation, 598,868 eyed eggs were shipped to the Little White Salmon Station, and 26,000 eggs were left at the point of collection and planted in Tanner Creek.

The station was cared for throughout the season by two men, and, considering the fact that it was operated for the first time, the work is thought to have been very successful.

At Tanner Creek troughs, lumber, tools, tent, and a complete outfit were set up which had been sent over by boat from the Little White Salmon Station.

The fish were caught by means of racks and downstream traps, and troughs were set up beside the creek in a most temporary manner, with a flume 700 feet in length leading to it from the creek as a water supply.

The first eggs were taken September 12, when 6,000 were obtained from 2 females, and from this date the collecting season continued with an average daily take of 33,516 for twenty-four days. The total take for the season amounted to 804,400, which were secured from 234 females. The loss of eggs during the eying period was 43,468. Of the 786,932 eggs eyed 45,000 hatched before it was possible to get them away from the station, and 741,932 were shipped to Big White Salmon Station to be hatched in the new troughs set up at that place.

The work at this point, as at the Big White Salmon and Eagle Creek, was all done out of doors. The crew of two men lived in a tent, cooked for themselves, and did all the work. The hatching troughs were set up in the open air with no shelter except boards laid across the top of them as covers.

BAKER LAKE STATION, WASHINGTON (H. H. BUCK, SUPERINTENDENT).

The opening of the fiscal year found the racks in place on the river above the lake, as work on them had been diligently prosecuted throughout the preceding month. Seven racks were built, but there were still some sloughs and low places which it was impracticable to close entirely at high stages of the water. Notwithstanding the fact that the racks stood and were carefully attended, it was found, as the season advanced, that the fish ascended the river. This makes six years that the problem of blocking the salmon from the upper river has been tried without success. Some other method of capturing the fish must be devised.

During the summer 100 new egg baskets were made of wire with 5½ meshes to the inch, and these proved more satisfactory for hatching blueback-salmon eggs than the former size of 5 meshes to the inch.

The spawning season of the blueback salmon opened September 5 and lasted until October 26. Low water, which had prevailed throughout the summer, continued, and the run of fish in the lake was the smallest that has been noted. In all, 3,694,000 blueback eggs and 50,000 quinnat-salmon eggs were secured, which hatched with a normal loss of 8.7 per cent. These were all planted as fry in the waters of Baker Lake between February 22 and June 4.

Silver salmon, as usual, spawned in large numbers in the sloughs at the head of the lake, but no attempt was made to collect eggs from this species because it is not thought best to allow them to dispute the limited area of Baker Lake with the more valuable bluebacks, and there are no facilities for transporting the eggs from the hatchery to other points for distribution.

Early in December the auxiliary station at Birdsview was opened under the direction of Mr. Henry O'Malley, and preparations were made to collect eggs of the steelhead trout from Phinney and Grandy creeks. The heavy winter rains made the maintenance of the racks difficult on Phinney Creek and they were twice washed out. The temporary hatchery erected at this point last year was used as a base of operations, but the greater number of eggs were secured on Grandy Creek, and considerable inconvenience and a heavy loss of eggs resulted in transporting them over the 5 miles of rough country which separates the creeks. It is recommended that the temporary hatchery be removed to Grandy Creek. In all, 408,000 eggs were collected and hatched, with a loss of 18 per cent. Of the resulting fry, 110,000 were planted in the tributaries of the Skagit River during the last days of June and 223,815 were on hand at the close of the year.

Details of distribution.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Shad:			
Cahaba River, Centervile, Ala	....	450,000	....
Connecticut Fish Commission, Stratford, Conn	....	3,000,000	....
Hadlyme, Conn	....	3,000,000	....
Brandywine Creek, Wilmington, Del	....	2,257,000	....
Nanticoke River, Seaford, Del	....	2,755,000	....
Leipsic Creek, Clayton, Del	....	83,200	....
Leipsic Creek, Cheswold, Del	....	124,800	....
St. Johns Creek, Dover, Del	....	332,800	....
Murdock Creek, Felton, Del	....	416,000	....
Mispillion Creek, Milford, Del	....	416,000	....
Murderkill Creek, Ellendale, Del	....	124,800	....
Indian River, Millsboro, Del	....	582,400	....
Potomac River, opposite Fish Lakes, D. C	....	....	2,000,000
above Georgetown, D. C	....	450,000	....
Bathing Beach, D. C	....	350,000	....
Suwannee River, Suwannee, Fla	....	240,000	....
Bramford, Fla	....	240,000	....
Ichetucknee River, Ichetucknee, Fla	....	240,000	....
Santa Fe River, High Springs, Fla	....	270,000	....
Withlacoochee River, Istachatta, Fla	....	300,000	....
Anclote River, Tarpon Springs, Fla	....	520,000	....
Aucilla River, Aucilla, Fla	....	525,000	....
Ocklocknee River, Ocklocknee, Fla	....	525,000	....
Little River, Quincy, Fla	....	525,000	....
Apalachicola River, River Junction, Fla	....	525,000	....
St. Johns River, East Palatka, Fla	....	450,000	....
Tomoke River, Ormond, Fla	....	225,000	....
Spruce Creek, Spruce Creek, Fla	....	225,000	....
Peace Creek, Wauchula, Fla	....	600,000	....
Lake Tohope Kaliga, Kissimmee, Fla	....	600,000	....
Ogeehee River, Midville, Ga	....	450,000	....
Savannah River, Augusta, Ga	....	1,650,000	....
Ocmulgee River, Macon, Ga	....	450,000	....
Potomac River off Pamunkey Creek, Md	....	2,049,000	....
Piscataway Creek, Md	....	8,245,000	....
Bryan Point, Md	....	5,423,000	....
Point of Rocks, Md	....	600,000	....
Swan Creek, Swan Creek, Md	....	2,140,000	....
Bush River, Bush River, Md	....	688,000	....
Elk River, Elkton, Md	....	319,000	....
Susquehanna River, Port Deposit, Md	....	600,000	....
Havre de Grace, Md	....	214,000	....
Gunpowder River, Gunpowder, Md	....	939,000	....
North East River, Charlestown, Md	....	230,000	....
Patuxent River, Laurel, Md	....	450,000	....
Wankinko River, Wareham, Mass	....	400,000	....
Assawomsett Pond, Middleboro, Mass	....	3,000,000	....
Furnace Pond, South Hanson, Mass	....	3,000,000	....
Delaware River, Howells Cove, N. J	....	4,435,000	....
off mouth of Timber Creek, N. J	....	400,000	....
Lambertville, N. J	....	450,000	....
Scudders Falls, N. J	....	450,000	....
Washingtons Crossing, N. J	....	450,000	....
Trenton, N. J	....	512,000	....
Navesink River, Redbank, N. J	....	450,000	....
Salem Creek, Salem, N. J	....	450,000	....
Hudson River, Catskill, N. Y	....	2,123,000	....
Cape Fear River, Wilmington, N. C	....	956,500	....
Neuse River, Newberne, N. C	....	750,000	....
Kinston, N. C	....	750,000	....
Trent River, Pollocksville, N. C	....	270,000	....
Six Runs River, Clinton, N. C	....	1,000,000	....
New River, Jacksonville, N. C	....	300,000	....
Chowan River, Hornblower Point, N. C	....	2,103,000	....
Eden House, N. C	....	2,802,000	....
Reedy Point, N. C	....	1,245,000	....
Pasquotank River, Elizabeth City, N. C	....	1,448,000	....
Tar River, Washington, N. C	....	728,000	....
Salmon Creek, Avoca, N. C	....	3,409,000	....
Perquimans River, Hertford, N. C	....	1,012,000	....
Roanoke River, Plymouth, N. C	....	2,623,000	....
Neuse River, Goldsboro, N. C	....	380,000	....
Edenton Bay, Edenton, N. C	....	1,269,000	....
Lake Waccamaw, Lake Waccamaw, N. C	....	400,000	....
Chowan River, Holleys Haul, N. C	....	1,464,000	....
Susquehanna River, Fites Eddy, Pa	....	235,000	....
Columbia, Pa	....	363,000	....
Runnins River, Providence, R. I	....	1,200,000	....
Shad Factory Creek, Providence, R. I	....	1,800,000	....
Cooper River, Monks Corners, S. C	....	300,000	....
Ashepoo River, Ashepoo, S. C	....	900,000	....

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Shad—Continued.			
Big Pedee, Pedee, S. C		1,625,000	
Sampit River, Georgetown, S. C		413,000	
Black River, Harpers, S. C		410,000	
Edisto River, Jacksonboro, S. C		1,000,000	
Salkehatchie River, Yemassee, S. C		500,000	
Nottaway River, Courtland, Va		750,000	
Blackwater River, Franklin, Va		446,000	
Nansemond River, Suffolk, Va		956,500	
Potomac River, Occoquan Bay, Va		686,000	
off Occoquan Creek, Va		2,000,000	
Little Hunting Creek, Va		1,090,000	
Pohick Creek, Va		4,835,000	
Doves Creek, Va		1,648,000	
Total		104,986,000	2,000,000
Quinnat salmon:			
McCloud River, Baird, Cal		2,115,560	
California Fish Commission, Sisson, Cal	14,472,380		
Eel River, Cal	2,008,030		
Price Creek Hatchery, Cal	1,000,000		
Lake Okoboji, Spirit Lake, Iowa		4,000	
Spring Branch, Clackamas, Oreg		4,462,342	
Clackamas River, Clackamas, Oreg		4,043,356	
Columbia River, Viento, Oreg		1,757,000	
Cascade Locks, Oreg		192,000	
Hood River, Oreg		108,000	
Hood River, Hood River, Oreg		153,558	
Columbia River, mouth of Lindsey Creek, Oreg		80,000	
Osterguarde Creek, Oreg		80,000	
Shell Rock, Oreg		60,000	
The Dalles, Oreg		12,000	
Memaloose Island, Oreg		55,100	
Eagle Rock, Oreg		36,000	
Wasco County, Oreg		36,000	
Seufert's cannery, Oreg		12,500	
Rogue River, Rogue River, Oreg		920,000	
Trail, Oreg		2,151,363	
Tanner Creek, Bonneville, Oreg		45,000	
Five Mile Creek, Wasco County, Oreg		23,400	
Lindsey Creek, Wasco County, Oreg		30,000	
Five Mile Creek, Seufert's Cannery, Oreg		25,000	
Des Chutes River, Free Bridge, Oreg		11,000	
Sandy River, Multonomah County, Oreg		15,000	
Mill Creek, The Dalles, Oreg		7,000	
Currens Creek, Currens Creek, Oreg		21,000	
Eagle Creek, Wasco County, Oreg		15,000	
Tanner Creek, Wasco County, Oreg		20,000	
Herman Creek, Wasco County, Oreg		20,000	
Willamette River, Portland, Oreg		10,000	
R. B. Hume, Wedderburn, Oreg	1,866,000		
Little White Salmon River, Skamania County, Wash		7,650,305	
Big White Salmon River, Skamania County, Wash		234,000	
Columbia River, mouth of Dog Creek, Wash		432,000	
Cooks Landing, Wash		244,000	
Underwoods, Wash		72,000	
Skamania County, Wash		2,024,390	
Thirteen Mile Point, Wash		450,000	
Eagle Rock, Wash		160,000	
Klickitat County, Wash		62,558	
Huntsucker Point, Wash		61,600	
Dog Creek, Skamania County, Wash		37,000	
Rock Creek, Skamania County, Wash		89,000	
Olsen Creek, Skamania County, Wash		1,159,276	
Wind River, Skamania County, Wash		36,000	
Hamilton Creek, Skamania County, Wash		15,000	
Klickitat River, Klickitat County, Wash		39,000	
Baker Lake, Baker Lake, Wash		50,000	
Total	19,346,410	29,337,308	
Atlantic salmon:			
Connecticut Fish Commission, Windsor Locks, Conn	200,000		
East Branch of Mattawamkeag River, Oakfield, Me		48,715	70,650
East Branch of Penobscot River, Grindstone, Me			87,768
Pleasant River, Brownville, Me			118,582
Phillips Lake, Bangor, Me			5,000
New Hampshire Fish Commission, Concord, N. H	100,000		
Salmon River, Altmar, N. Y		4,050	
Saxton Millpond, Spartanburg, S. C		4,000	
Total	300,000	56,765	282,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Landlocked salmon:			
Gus. Cushman, Telluride, Colo	5,000		
Connecticut Fish Commission, Windsor Locks, Conn	25,000		
Sysladobsis Lake, Grand Lake Stream, Me			8,000
Grand Lake Stream, Grand Lake Stream, Me		282,057	30,880
Grand Lake, Grand Lake Stream, Me		147,728	14,945
Phillips Lake, Dedham, Me			4,999
Toddy Pond, Orland, Me			10,723
Williams Pond, Bucksport, Me			4,999
Moosehead Pond, Moosehead, Me			45
Second Debsconeag Lake, Norcross, Me		35,000	
Herd Pond, Norcross, Me		35,000	
Nickerson Lake, Houlton, Me		20,000	
Parmachenee Club, Camp Caribou, Me	20,000		
City Reservoir, Worcester, Mass			500
Massachusetts Fish Commission, Wilkinsonville, Mass	10,000		
G. H. Richards, Wenaumet, Mass	5,000		
E. C. Wood, Plymouth, Mass	5,000		
Massachusetts Fish Commission, Paris, Mass	20,000		
Lake Winnepesaukee, Laconia, N. H			1,000
Crystal Lake, Grafton, N. H			1,000
Penacook Lake, Concord, N. H			1,000
Granite Lake, Keene, N. H			1,000
Lake Winnepecket, Warner, N. H			1,600
Tewksbury Pond, Canaan, N. H			800
Lake Tarleton, Pike Station, N. H			1,800
Dan Hole Pond, Moultonville, N. H			500
Sunapee Lake, Lake Station, N. H			59
A. M. Bigelow, Branchville, N. J	10,000		
New York Fish Commission, Caledonia, N. Y	20,000		
James Annin, jr., Caledonia, N. Y	10,000		
Wilmurt Club, Northville, N. Y	5,000		
W. M. Keil, Tuxedo Park, N. Y	10,000		
Otsego Lake, Cooperstown, N. Y		3,870	
Harris Pond and Mill River, Woonsocket, R. I			1,000
Utah Fish Commission, Murray, Utah	10,000		
Clyde River, Derby, Vt			1,000
Caspian Lake, Greensboro, Vt			4,688
Little Averill Pond, Averill, Vt			3,797
Long Pond, Westmore, Vt			2,240
Willoughby Lake, Westmore, Vt			400
Lake Dunmore, Salisbury, Vt			1,599
Vermont Fish Commission, Roxbury, Vt	35,000		
J. B. Fielding, North Wales, England	10,000		
Total	200,000	523,655	98,565
Silver salmon:			
Rogue River, Trail, Oreg		90,000	
Rogue River, Rogue River, Oreg		334,530	
Total		424,530	
Blueback salmon:			
Baker Lake, Baker Lake, Wash		3,371,000	
Steelhead trout:			
Alex. Von Boxel, Cimarron, Colo	10,000		
Lake Cobbosseecontee, Monmouth, Me		12,046	84
Big Sturgeon River, Indian River, Mich		20,000	
Thunder Bay River, Turtle Lake, Mich		40,000	
Baldwin and Sanborn creeks, Baldwin, Mich		30,000	
Spring Fork and Sweetwater creeks, Wingleton, Mich		10,000	
Greens and Floodwood creeks, Leota, Mich		20,000	
North Branch Pere Marquette River, Branch, Mich		10,000	
Little Au Sable River, Fountain, Mich		10,000	
Tobins Harbor, Tobins Harbor, Mich		20,000	
Lester River, Duluth, Minn			5,000
Fischer Creek, Duluth, Minn			5,000
Lake and Stream, St. Paul, Minn			5,000
Pickwick Creek, Pickwick, Minn			10,000
Lake Reno, Deerwood, Minn		20,000	
Island Lake, Cromwell, Minn		20,000	
Lester, French and Sucker rivers, Duluth, Minn		20,000	
West Branch of Lester River, Duluth, Minn		6,900	
Bridge Creek, Gallatin Co., Mont			10,000
St. Lawrence River, Cape Vincent, N. Y			1,319
Rogue River, Trail, Oreg		20,250	
Willoughby Lake, Westmore, Vt			28,358
Bean Pond, Wheelock and Snyder, Vt			145
Crystal Lake, Barton, Vt		10,000	6,930
Fairlie Lake, Fairlie, Vt			850

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Steelhead trout—Continued.			
Skagit River, Phinney Creek, Wash		85,000	
Quartz Creek, Wash		25,000	
Fischer Creek, Orienta, Wis			5,000
Christie Lake, Spooner, Wis		10,000	
S. E. Land, Centennial, Wyo	33,000		
S. Jaffe, Osnabruck, Germany	25,000		
Total	68,000	389,196	77,686
Loch Leven trout:			
Trout Lake, Idaho Springs, Colo		3,000	
Orchard Hill Brook, Plymouth, Mich		10,000	
Van Etten Creek, Au Sable, Mich		35,000	
Intermediate Lake, Bellaire, Mich		15,000	
Lake Hamlin, Ludington, Mich		15,000	
Spearfish Creek, Elmore, S. Dak			5,000
Box Elder Creek, Benchmark, S. Dak		4,760	
Spearfish Creek, Spearfish, S. Dak		4,000	
Trout Ponds, Roubaix, S. Dak		5,000	
Total		91,760	5,000
Rainbow trout:			
Black Water Creek, Jasper, Ala			950
Big Cove Creek Mill Pond, Gadsden, Ala			450
Big Spring, Huntsville, Ala			1,000
Applicants in Alabama			1,000
Oak Creek, Jerome, Ariz			450
Oak Creek, Flagstaff, Ariz			500
Clear Creek, Jerome, Ariz			450
Big Creek, Rich Mountain, Ark			2,000
Fish Lake, Pine Bluff, Ark			500
Spring Brook, Rogers, Ark			200
Eagle River and Lake, Berrys Station, Colo			5,000
Artificial Lake, Salida, Colo		10,000	
Fryingpan River, Thomasville, Colo		45,000	
Platte River, between Grant and Cliff, Colo		45,000	
Eagle River, Berrys Station, Colo		50,000	
Trout Lake, Grover, Colo		10,000	
Applicant at Sterling, Colo			200
Copeland Pond, Seymour, Conn			1,000
Connecticut Fish Commission, Windsor Locks, Conn			1,700
Applicants at Windsor Locks, Conn			500
Beaver Pond, Pine Orchard, Conn		2,000	
Pembleton Creek, Ellendale, Del			800
E. G. Shortlidge (State waters), Wilmington, Del			1,000
Spring Lake, Cedartown, Ga			1,000
Cherry Log and Rock creeks, Ellijay, Ga			1,000
Tallulah River, Tallulah Falls, Ga			3,000
Wolf Creek, Turnerville, Ga			1,000
Anderson Creek, Turnerville, Ga			1,000
Deep Creek, Turnerville, Ga			1,000
Big Spring, Calhoun, Ga			200
Fish Ponds, Calhoun, Ga			2,500
Ivy Creek, Clarksville, Ga			1,000
Santee Creek, Clarkesville, Ga			1,000
Amys Creek, Clarkesville, Ga			1,000
Crystal Lake, Dalton, Ga			300
Pacolet Lake, New Holland, Ga			500
Lookout Creek, Rising Fawn, Ga			1,000
Fish Lake, Toccoa, Ga			1,000
Applicant at Dalton, Ga			200
Bee Creek, Olney, Ill			500
Spring Brook, Bristol, Ind		2,500	
Trout Pond, Rolling Prairie, Ind		2,000	
Early Lake, Durant, Ind. T			1,000
Crystal Lake, Dewitt, Iowa			6,000
Snymagill Creek, McGregor, Iowa			10,000
Spring Creek, McGregor, Iowa			2,000
Maquoketa River, Forestville, Iowa		50,000	5,000
Mill Creek, Bellevue, Iowa			4,975
Lime Creek, Mason City, Iowa			5,300
Upper Iowa River, Decorah, Iowa		25,000	5,300
Big Cedar River, Osage, Iowa			5,300
Turkey River, Cresco, Iowa			5,300
Wapsipinicon River, McIntire, Iowa			5,300
Ionia, Iowa		25,000	
Upper Iowa River, Chester, Iowa		25,000	
Turkey River, Fort Atkinson, Iowa		25,000	
Red Cedar River, Charles City, Iowa		25,000	
Des Moines River, Estherville, Iowa		30,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Rainbow trout—Continued.			
Maquoketa River, Manchester, Iowa		5,000	
Spring Branch, Manchester, Iowa		5,000	
Canaan Lake, Camden, Me			500
Lake Penneesswassee, Norway, Me			406
Phillips Lake, Bangor, Me			500
Twinings Branch, Belair, Md			1,000
Texas Branch, Texas, Md			500
Turkey and Painter branches, Parkton, Md			500
Spring Branch, Garrett County, Md			2,000
Muddy Creek, Garrett County, Md			400
Fishing Creek, Frederick, Md			1,000
Bennetts Creek, Frederick, Md			1,000
Mine Branch, Minefield, Md			950
Branch of Youghiogheny River, Mountain Lake Park, Md			1,000
North Blade Pond, Swanton, Md			1,000
Brownings Dam, Oakland, Md			1,300
White Oak Run, Oakland Md			1,500
Marsh Run, Oakland, Md			500
Trout Lake, Oakland, Md			1,000
Lake Jorosa, Glyndon, Md			1,000
North Branch and Paint creeks, Hyattsville, Md			1,000
Maryland Fish Commission, Druid Hill Park, Baltimore, Md	50,000		
Lake Quinsigamond, Worcester, Mass			1,000
Pine Grove Pond, Williamsburg, Mass			500
Massachusetts Fish Commission, Hadley, Mass	25,000		
Wilkinsonville, Mass	25,000		
Hicks Brook, Millbury, Mass			500
West Creek, Hastings, Mich		5,000	
St. Marys Rapids, Sault Ste. Marie, Mich		17,500	
West Branch of Cedar River, Harrison, Mich		6,000	
Perch Creek, Sidnaw, Mich		5,000	
Tributaries of Paint Creek, Oxford, Mich		5,000	
Black River, Onaway, Mich		5,000	
Tittibawassee River, West Branch, Mich		10,000	
Huron River, Milford, Mich		10,000	
Pigeon River, Rondo, Mich		5,000	
Lester River, Duluth, Minn		20,000	
Branch of Lester River, Duluth, Minn		12,000	
Fish Pond, Gloster, Miss			500
Brazil Creek, Bourbon, Mo			6,200
Flat Creek, McDowell, Mo			1,000
Lake of the Woods, Fulton, Mo			1,000
Spring Lake, Republic, Mo			1,000
Ash Cave Lake, Dixon, Mo			500
Distillers Pond, Southwest City, Mo			2,300
Galloway Cave Pond, Galloway, Mo			4,000
Bryant Creek, Mansfield, Mo			1,900
Spring River, Verona, Mo			1,900
Bennetts Mill Creek, Lebanon, Mo			4,400
Baker Lake, Dixon, Mo			2,500
Hahatonka Lake, Hahatonka, Mo			1,800
Fish Pond, Carthage, Mo			1,000
Kansas City, Mo			500
Exeter, Mo			500
Hickory Creek, McMahons, Mo			178
Bennetts Mill Spring, Bennetts Mill, Mo		12,675	
Schlichts Springs, Crocker, Mo		5,700	
Blue Lodge Spring, Bourbon, Mo		5,900	
R. D. Kellogg, Lebanon, Mo	9,450		
John A. Williams, Verona, Mo	11,640		
Nebraska Fish Commission, South Bend, Nebr	50,000		
Penacook Lake, Concord, N. H			400
Isinglass River, Dover, N. H			500
Webster Lake, Colebrook, N. H		8,000	
Cocheco River, Dover, N. H		4,000	
Chas. B. Clarke, Concord, N. H	25,000		
Spring Brook, Ramsey, N. J			450
Fish Pond, Gallia, N. J			500
Riegelsville, N. J			500
Pecos River, Glorieta, N. Mex			1,500
Gonzaloy Aroyd Creek, Springer, N. Mex			1,000
Alamositos Creek, Springer, N. Mex			1,000
Fish Pond, Springer, N. Mex			500
Engle, N. Mex			500
Las Vegas, N. Mex			500
Dorsey, N. Mex			500
Portales, N. Mex			600
Indian Creek, San Marcial, N. Mex			500
Wynantskill Creek, Troy, N. Y			500
Fish Pond, Hudson, N. Y			500
Batten Kill Creek, Cambridge, N. Y		10,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Jacobs Creek, Watertown, N. Y		10,360	
J. Stens Creek, Watertown, N. Y		9,000	
Jummey Creek, Watertown, N. Y		9,000	
Silver Mine Branch, Hot Springs, N. C			1,000
Spring Creek, Hot Springs, N. C			1,500
Nokomis Mill Pond, Lexington, N. C			1,000
Fish Lake, Oak Ridge, N. C			1,000
Elk River, Elk Park, N. C			1,000
Fish Pond, Spray, N. C			700
Morrisville, N. C			1,000
Cranberry and Blevins creeks, Cranberry, N. C			500
Trout Lake, Rowland, N. C			1,000
Millpond, Rowland, N. C			1,000
French Broad River, Hot Springs, N. C			500
Swannanoa River, Black Mountain, N. C			1,000
Savannah and Green creeks, Dilsboro, N. C			875
Steele Creek, Morganton, N. C			500
Craig Creek, Morganton, N. C			500
Camp Creek, Morganton, N. C			500
Rose Creek, Morganton, N. C			500
Johns Creek, Morganton, N. C			500
Upper Creek, Morganton, N. C			600
Diamond Lake, Vade Mecum, N. C			1,000
Clear Creek, Hendersonville, N. C			1,000
Devils Creek, Huntsdale, N. C			1,000
Hollow Poplar Creek, Hollow Poplar, N. C			1,000
Bolden Creek, Bolden Creek, N. C			1,000
Trout Pond, Durham, N. C			500
Mine Fork Creek, Mine Fork, N. C			1,000
Jacks Creek, Jacks Creek, N. C			1,000
Boyds Creek, Boyds Creek, N. C			1,000
Applicant at Roxboro, N. C			200
C. A. Schenck, Biltmore, N. C	25,000		
Forest River, Inester, N. Dak			3,000
Beaver and Cedar creeks, Springfield, Ohio		10,000	
Applicant at Amanda, Ohio		3,000	
Indian Creek, Woodward, Okla			1,000
North Canadian River, Oklahoma, Okla			1,500
Applicant at Mulhall, Okla			500
Necanicum River, Seaside, Oreg			18,745
Spring Lake, Chester Valley, Pa			200
Tributary of Susquehanna River, Cush Creek, Pa			500
Musqueto Creek, Williamsport, Pa			1,000
Mountain Brook, Landstreet, Pa			1,200
Windsor Furnace Creek, Hamburg, Pa			700
Dolphin Run, Johnstown, Pa			2,200
North Kill Creek, Robesonia, Pa			500
Sand Spring Run, Lehigh, Pa			500
Ash Gap Run, Lehigh, Pa			500
Pond Creek Run, Lehigh, Pa			500
Trout Creek, Lehigh, Pa			500
Stony Run, Mahanoy City, Pa			500
Messer, Nigger, Hollow, and Rattling runs, Mahanoy City, Pa.			500
Stone Creek, Huntingdon, Pa			1,500
Spruce Creek, Spruce Creek, Pa			1,000
Shermans Run, Riddlesburg, Pa			700
Clear Run, Dubois, Pa			800
Allegheny River, Coudersport, Pa			800
Hill Creek, Mansfield, Pa			600
Bailey Creek, Mansfield, Pa			600
Mill Creek, Mansfield, Pa			600
Fish Pond, Bellevernon, Pa			600
Johnson Run, Johnsonburg, Pa			800
Rabbit Run, Tamaqua, Pa			500
Cushen Creek, Grant, Pa			500
Falling Spring Creek, Chambersburg, Pa			800
Queen Run, Lock Haven, Pa			6,000
Sugar Creek, Columbia Cross Roads, Pa			1,200
Trout Stream, McElhatten, Pa			800
Rattling Run, Gordon, Pa			1,000
Locust Creek, Mahanoy City, Pa			500
Trout Stream, Mahanoy City, Pa			500
North Fork Creek, Johnstown, Pa			1,600
Trout Streams, Hutchins, Pa			800
Starrucca Creek, Starrucca, Pa			500
Reform School Pond, Morganza, Pa			400
Tributaries of Clarion River, Foxburg, Pa			1,600
Clover Creek, Altoona, Pa			1,400
Bobs Creek, Altoona, Pa			400
Tom Creek, Stroudsburg, Pa			500
Goose Pond Run, Cresco, Pa			500

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Rainbow trout—Continued.			
Stony Run, Cresco, Pa			500
Buck Hill Run, Cresco, Pa			500
Mill Creek, Cresco, Pa			500
Spruce Cabin Run, Cresco, Pa			500
Fish Pond, Norristown, Pa			500
Marsh Creek, Howard, Pa			1,600
Goldmine Creek, Tremont, Pa			500
Good Spring Creek, Tremont, Pa			500
Middle Creek, Tremont, Pa			500
Swatara Creek, Tremont, Pa			500
Rattling Run, Tremont, Pa			500
Black Creek, Tremont, Pa			500
Trout Pond, Radnor, Pa			500
Mitchell Run, Snow Shoe, Pa			800
Jonathan Run, Snow Shoe, Pa			600
Beech Creek, Snow Shoe, Pa			1,400
Lucas Run, Snow Shoe, Pa			600
Oley Creek, Upper Lehigh, Pa			1,000
McGinty Dam, Ashland, Pa			600
Spruce Creek, Pottsville, Pa			500
Spring Meadow Pond, Bedford, Pa			200
Stony Run, Tower City, Pa			500
Hunters Valley Creek, Newport, Pa			1,000
Bear Run, Bear Run, Pa			1,600
Swamp Run, Bear Run, Pa			1,600
Spring House Creek, Penllyn, Pa			500
Trout Run, York, Pa			500
Millers Run, York, Pa			1,000
Piney Creek, Martinsburg, Pa			500
Clover Creek, Martinsburg, Pa			500
Trout Pond, Martinsburg, Pa			500
Green Spring, Newville, Pa			1,200
Letort Spring, Carlisle, Pa			500
Rock Run, Ralston, Pa			600
Applicants in Pennsylvania			400
Warwick Lake, Providence, R. I			500
Trout Pond, Providence, R. I		2,000	
Drayton Swamp, Sheldon, S. C			1,000
Saxon Mill Pond, Spartanburg, S. C			500
South Pacolett River, Campobello, S. C			500
Edwards Lake, Campobello, S. C			500
Reservoir, Blunt, S. Dak			1,000
Upper Spearfish Creek, Elmore, S. Dak			5,000
Beaver Creek, Buffalo Gap, S. Dak			5,000
Spearfish Creek, Spearfish, S. Dak		26,500	
Rock Creek, Rosebud Agency, S. Dak		15,000	
Spring Lake, Paris, Tenn			300
Trout Pond, Bolivar, Tenn			1,000
Spring Lake, Chattanooga, Tenn			1,200
Fish Pond, Chattanooga, Tenn			1,200
Richmond Reservoir, Chattanooga, Tenn			1,200
Willow Lake, Murfreesboro, Tenn			300
Waterworks Reservoir, Murfreesboro, Tenn			300
Fish Pond, Santa Fe, Tenn			300
Roaring River and Tributaries, Algood, Tenn			1,400
Bear Creek, Algood, Tenn			600
Spring Creek, Algood, Tenn			700
Turtletown Creek, Ducktown, Tenn			1,000
Fish Pond, Mason, Tenn			300
Rock Creek, Rock Creek, Tenn			3,000
Fish Pond, Trenton, Tenn			300
Beaver Dam Lake, Crandull, Tenn			1,667
Trout Pond, Jonesboro, Tenn			1,000
Fish Pond, Guthrie, Tenn			300
Doak, Middle and Paint creeks, Greeneville, Tenn			1,000
Watauga River, Neva, Tenn			1,000
Sinking Creek, Newport, Tenn			500
Fish Pond, Willard, Tenn			300
Flint Springs Lake, Cleveland, Tenn			500
Silver Lake, Cleveland, Tenn			500
Spring Creek, Cookeville, Tenn			1,000
Little River, Rockford, Tenn			1,025
Trout Pond, Columbia, Tenn			300
Big Richland Creek, Waverly, Tenn			300
Blue Creek, Waverly Tenn			300
Trace Creek, Waverly, Tenn			300
Fish Pond, Lewisburg, Tenn			200
Martins Creek, Martins Creek, Tenn			1,000
Sams Creek, Flagpond, Tenn			6,000
Rice Creek, Flagpond, Tenn			2,000
Coffey Ridge Creek, Flagpond, Tenn			4,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Dicks Creek, Dicks Creek, Tenn			1,000
Dry Creek, Dry Creek, Tenn			1,000
Dickens Creek, Dickens, Tenn			1,000
Beaver Dam Creek, Crandull, Tenn			1,667
Rockyfork Creek, Rockyfork, Tenn			1,000
Spivy Creek, Indian Creek, Tenn			1,000
Unaka Springs, Tenn			500
Nolachucky River, Unaka Springs, Tenn			10,000
Fish Lake, Mason, Tenn			300
Carrs Lake, Tazewell, Tenn			1,125
Higgins Creek, Ernestville, Tenn			2,000
Bumpus Cove Creek, Bumpus Cove, Tenn			1,000
Higgins Creek, Higgins Creek, Tenn			1,000
South Indian Creek, Chestoa, Tenn			2,700
Underwood Branch, Bluff City, Tenn			1,000
Barren Fork Creek, McMinnville, Tenn			300
Watauga River, Butler, Tenn			500
Spring Branch, Erwin, Tenn			1,000
South Indian Creek, Erwin, Tenn			2,700
North Indian Creek, Erwin, Tenn			1,000
Broad Shoal Creek, Erwin, Tenn			2,700
Buffalo Creek, Buffalo, Tenn			2,700
North Indian Creek, Unicoi, Tenn			2,700
Tanks, Ennis, Tex			1,500
Waterworks Reservoirs, Ennis, Tex			1,000
Pond, Ennis, Tex			500
John Sharp, State fish commissioner, Murray, Utah	26,700		
Beaver Pond, Proctor, Vt			911
Clyde River, Newport, Vt		2,000	
Bean Pond, Wheelock & Snyder, Vt			120
Willoughby Lake, Westmore, Vt			310
Reservoir, Lynchburg, Va			500
Trout Pond, Cedar Springs, Va			800
Martin Creek, Boons Path, Va			1,000
Ice Pond, Cumberland, Va			500
Trout Pond, Burkes Garden, Va			1,000
North Fork of Catawba River, Fincastle, Va			1,200
Trout Pond, Briggs, Va			2,000
Cedar Creek, Winchester, Va			1,000
Vance Spring, Winchester, Va			500
Bobbs Run, Winchester, Va			1,000
Fish Pond, Milford, Va			500
Goose Creek, Plains, Va			600
Fish Pond, Spencer, Va			500
Wolf Creek, Vienna, Va			2,000
Fish Pond, Cumberland, Va			500
Scottsville, Va			500
Wash Creek, Lynch, Va			1,000
Mill and Cliff Creeks, Lynch, Va			1,000
Fish Pond, Ontario, Va			500
Millpond, Draper, Va			1,000
Trout Lake, Rural Retreat, Va			2,000
Northfork Creek, Northfork, Va			1,000
Fish Pond, Powhatan, Va			500
Graham Creek, Burfords, Va			1,000
North Fork of Holston River, Ceres, Va			1,000
Fish Pond, Marion, Va			600
Back Creek, Stewarts Draft, Va			2,000
Glade Creek, Blue Ridge, Va			1,000
Dry River, Harrisonburg, Va			1,000
Appomattox River, Petersburg, Va			1,000
Stony Creek, Petersburg, Va			1,000
Bailey Creek, Petersburg, Va			1,000
Lake Spring, Gap Store, Va			1,000
Paper Companies' Reservoir, Bristol, Va			500
Goose Creek, Bristol, Va			1,000
Brumbley Creek and tributaries, Abingdon, Va			3,500
Light Top and Laurel Rivers, Damascus, Va			6,666
Mill Creek, Christiansburg, Va			5,000
Trout Brook, Strasburg, Va			1,400
Berry Creek Pond, Amherst, Va			500
Reed Creek, near Wytheville, Va			6,500
South Fork of Reed Creek, Wytheville, Va			3,500
Tates Run, Wytheville, Va			1,160
Little Stony Creek, Pembroke, Va			3,000
Dry Branch, Narrows, Va			3,000
North Fork of Clinch River, Tazewell, Va			8,000
South Fork of Clinch River, Tazewell, Va			8,000
Laurel Creek, Elliston, Va			4,500
Stony Creek, Elliston, Va			1,500
Jennings Creek, Arcadia, Va			3,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Spie Creek, Catopaxi, Va			3,000
Cove Creek, Max Meadows, Va			2,500
Trout Lake, Roanoke, Va			1,600
Tinker Creek, Roanoke, Va			8,400
Fish Pond, Crockett, Va			400
South Fork of Holston River, Marion, Va			1,400
Staley Creek, Marion, Va			8,000
Berry Creek, Abingdon, Va			1,000
North Fork of Holston River, Groseclose, Va			2,000
Middle Fork of Holston River, Sevenmile Ford, Va			4,000
Trout Lake, Etter, Va			1,200
Gladstone Pond, Gladstone, Va			500
Spring Pond, Bluemont, Va			54
Harrisonburg, Va			12
Spring Stream, near Alexandria, Va			200
Swan Creek, Warminster, Va		20,000	
Buffalo Creek and Lick Run, Forest, Va		19,500	
Mill Pond, Rural Retreat, Va		20,000	
Roanoke River, Elliston, Va		25,000	
Tributaries of Difficult Run, Vienna, Va		4,200	
Trout Pond, Rural Retreat, Va		10,000	
Stoubles Creek, Blacksburg, Va		6,750	
Meadow Run, Petunia, Va		10,000	
North Fork of Roanoke River, Blacksburg, Va		3,000	
Lick Branch, Blacksburg, Va		5,250	
Stone Bridge Run, Milldale, Va		15,000	
Little Reed Island Creek, Betty Baker, Va		10,000	
Buffalo Creek, Bayard, W. Va			2,000
Fish Pond, Eglon, W. Va			500
Buffalo and Cross creeks, Wellsburg, W. Va			1,000
Trout Pond, Tunnelton, W. Va			1,500
Cheat River, Morgantown, W. Va			1,000
Evitts Run, Charlestown, W. Va			500
Trout Brook, Rowlesburg, W. Va			600
Brown Creek, Augusta, Wis			4,000
Augusta Pond, Augusta, Wis		8,000	
Coon Fork Creek, Augusta, Wis		8,000	
Pigeon Creek, Alma Center, Wis		10,000	
Wyoming Fish Commission, Wolf, Wyo	50,000		
H. S. Beattie, Mexico	25,000		
Walter Bailey, Malvern Wells, England	25,000		
Moreton Frewen, Innishannon, Ireland	25,000		
F. Bruggeman, Lemgo, Germany	25,000		
Total	397,790	748,835	492,496
Black-spotted trout:			
Chicago Lake, Idaho Springs, Colo			50,000
Millers Lake, Idaho Springs, Colo			30,000
Loch Lomond, Idaho Springs, Colo			5,000
Soda Creek, Idaho Springs, Colo			10,000
Clear Creek, Idaho Springs, Colo			10,000
Lake Creek, Leadville, Colo			35,000
Rock Creek, Leadville, Colo			20,000
Savage Lakes, Thomasville, Colo			10,000
Crystal Lake, Malta, Colo			15,000
Conejos River, Antonito, Colo			25,000
Chicago Creek, Idaho Springs, Colo			5,000
Eagle Lake, Thomasville, Colo			10,000
Fryingpan River, Thomasville, Colo			15,000
Little Thompson River, Lyons, Colo			20,000
St. Vrain River and tributaries, Lyons, Colo			65,000
Texas, Mera, and Colony lakes, Westcliffe, Colo			25,000
Clear Lake, Georgetown, Colo			5,000
Fish Lakes, Leadville, Colo			20,000
Eagle River, Berrys Ranch, Colo			25,000
Grissley Creek, Glenwood, Colo			50,000
Fryingpan River, Ivanhoe, Colo			75,000
Platte River, Baileys, Colo			75,000
Hunter and Maroon creeks, Aspen, Colo			25,000
Brush Creek, Eagle, Colo			15,000
Marshall Creek, Chester, Colo			10,000
Beaver Creek, Aberdeen, Colo			10,000
Elk Creek, Gunnison, Colo			5,000
Goose Creek, Wagon Wheel Gap, Colo			35,000
Boulder Creek, Black Hawk, Colo			45,000
Gypsum Creek, Gypsum, Colo			15,000
Fish Pond, Buffers Spur, Colo			5,000
Alex. Van Boxel, Cimarron, Colo	20,000		
Crystal Lake, Hailey, Idaho			15,000
Lake Ethel, Nampa, Idaho			10,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Black-spotted trout—Continued.			
Hayden Lake, Rathdrum, Idaho			10,000
Blue Lake, Priest River, Idaho			8,000
Trout Ponds, Henrys Lake, Idaho		100,000	
R. A. Osborn, St. Anthony, Idaho	25,000		
Walter Green, St. Anthony, Idaho	25,000		
C. A. Coffman, St. Anthony, Idaho	25,000		
Six Mile Creek Pond, Toston, Mont			10,000
Duck Creek, Bonner, Mont			10,000
Lake Alvord, Troy, Mont			9,000
Upper Dry Wolf Creek, Monarch, Mont			9,000
Twin Lakes, Columbia Falls, Mont			3,000
Pritchard Lake, Chester, Mont			4,500
Fish Pond, Chester, Mont			7,500
Spring Lake, Chester, Mont			9,000
Corrall Brook, Chester, Mont			6,000
Little Boulder Creek, Boulder, Mont			10,000
South Miners Coolee Creek, Shelby Junction, Mont			9,000
Morgan Pond, Maudlow, Mont			5,000
Gooseberry Creek, Shelby Junction, Mont			9,000
Blacktail Deer Creek, Dillon, Mont			10,000
Red Spring Creek, Harlowton, Mont			20,000
Little Belt and Highwood creeks, Belt, Mont			18,500
Belt and Deep creeks, Great Falls, Mont			9,000
Neil Creek, Great Falls, Mont			9,000
Sixteen Mile Creek, Bakers Siding, Mont			10,000
Scotts Lake, Red Rock, Mont			5,000
Sixteen Mile Creek, Broadwater County, Mont			20,000
Spring Creek, Harlowton, Mont			15,000
Rock Creek, Harlowton, Mont			10,000
Chimney Lake, Toston, Mont			1,000
Prickly Pear Creek, Helena, Mont			15,000
Birch and Little Sheep creeks, Lima, Mont			15,000
Upper Pecos River, Glorieta, N. Mex			5,000
Trout Brook, Bernalillo, N. Mex			5,000
North Powder Lake, Haines, Oreg			10,000
Trout Ponds, Norton, Oreg			5,000
Little Spearfish Creek, Spearfish Falls, S. Dak			30,000
Box Elder Creek, Nemo, S. Dak			25,000
Spring Creek, Hill City, S. Dak			10,000
East Fork Spearfish Creek, Elmore, S. Dak			20,000
Spearfish Creek, Elmore, S. Dak			47,500
Middle and East Forks of Spearfish Creek, Elmore, S. Dak			12,500
Upper and East Fork of Spearfish Creek, Elmore, S. Dak			25,000
Lower East Fork of Spearfish Creek, Elmore, S. Dak			25,000
Spearfish Creek, Spearfish, S. Dak			60,000
Crow Creeks, near Spearfish, S. Dak			30,000
Trout Ponds, Spearfish, S. Dak			15,000
Whitewood Creek, Englewood, S. Dak			10,000
B. & M. R. R. Ponds, Englewood, S. Dak			5,000
Tributary of Box Elder Creek, Rochford, S. Dak			3,500
Tributary of Spring Creek, Hill City, S. Dak			3,500
Squaw Creek, Hermosa, S. Dak			5,000
Fish Pond, Pringle, S. Dak			5,000
North Fork of Rapid Creek, Rochford, S. Dak			5,000
Jim Creek, Nemo, S. Dak			5,000
Red Butte Creek, Salt Lake City, Utah			10,000
Freeman Lake, Newport, Wash			3,000
O'Reilly River, Newport, Wash			3,000
Trout Lake, Hood River, Wash			7,000
South Fork of Stilaguamish River, Everett, Wash			10,000
Samish Lake, Samish, Wash			2,000
Local Trout Creek, Northport, Wash			5,000
A. J. McNab, Lake Nebogemain, Wis	25,000		
Streams in Big Horn Mountains, Sheridan, Wyo			20,000
Wyoming Fish Commission, Laramie, Wyo	100,000		
S. E. Land, Laramie, Wyo	50,000		
Minister of agriculture and public works, Brussels, Belgium	10,000		
Total	280,000	100,000	1,488,500
Brook trout:			
Big Spring Creek, Tuscambia, Ala			200
Lode Creek, Leadville, Colo			1,000
Fish Lake, Montevista, Colo			2,000
Cimarron River, Cimarron, Colo			2,000
Little Cimarron River, Cimarron, Colo			2,000
Van Boxel Lake, Cimarron, Colo			6,000
Cimarron Fish Lakes, Cimarron, Colo			1,000
Frying Pan River, Basalt, Colo			8,000
Cottonwood Creek, Buenavista, Colo			2,000
Clear Creek Ponds, Granite, Colo			2,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
Frying Pan River, Sloane, Colo			1,000
Thomasville, Colo		75,000	2,000
Cache la Poudre River, Fort Collins, Colo		10,000	3,000
Crystal River, Redstone, Colo			2,000
Nichols Lake, Crested Butte, Colo			2,000
Fall River, Idaho Springs, Colo		5,000	2,500
Banning Lake, Colorado Springs, Colo			1,000
Fish Lake, Colorado Springs, Colo			2,000
Taylors Lake, Aspen, Colo			10,000
Eagle River and Lake, Berrys Station, Colo		25,000	20,000
Spring Creek, Montrose, Colo		15,000	1,000
Chicago Lake, Idaho Springs, Colo			500
Chinn Lake, Idaho Springs, Colo			500
Englewood Pond, Thomasville, Colo			2,000
Animas River, Durango, Colo			2,000
Platte River, Buffalo, Colo			6,000
Arkansas River, Leadville, Colo			2,000
Sarles Lake, Rockwood, Colo		5,000	
Spring Creek, Thomasville, Colo		5,000	
Spring Lake, Thomasville, Colo		10,000	
Boulder Creek, Dillon, Colo		30,000	
Little Turkey Creek, Colorado Springs, Colo		10,000	
Gardner Lakes, Fort Collins, Colo		10,000	
Snow Mass Lake, Aspen, Colo		10,000	
Waugh Creek, Freshwater, Colo		10,000	
Fish Lakes, Leadville, Colo		5,000	
Loveland, Colo		10,000	
Trout Lake, Buenavista, Colo		5,000	
Echo Lakes, Minturn, Colo		5,000	
Lake Peterson, Boulder, Colo		5,000	
North Boulder Creek, Boulder, Colo		10,000	
Blue River, Breckinridge, Colo		10,000	
St. Vrain Creek, Lyons, Colo		50,000	
Cascade Creek, Cascade, Colo		10,000	
Edwards Lake, Crestone, Colo		10,000	
Chicago Creek, Idaho Springs, Colo		5,000	
Bear Creek, Idaho Springs, Colo		5,000	
Loch Lomond, Idaho Springs, Colo		5,000	
Silver Lake, Idaho Springs, Colo		5,000	
Vance Creek, Idaho Springs Colo		5,000	
Lake Hassell, Idaho Springs, Colo		5,000	
Platte River, Chase, Colo		10,000	
Cliff, Colo		5,000	
Baileys, Colo		10,000	
Buffalo Creek, Colo		10,000	
North Fork of South Platte River, Buffalo Creek, Colo		5,000	
Platte River, Estabrook, Colo		10,000	
Cassells, Colo		5,000	
Kline, Colo		5,000	
North Fork of South Platte, Shawnee, Colo		20,000	
Muldoon, Colo		5,000	
Buckhorn Creek, Loveland, Colo		5,000	
Tarryall Creek, Lake George, Colo		10,000	
Cimarron River, Montrose, Colo		10,000	
Naylor Club Lake, Georgetown, Colo		10,000	
Dallas and Cow creeks, Ridgway, Colo		10,000	
Smith Creek, Baileys, Colo		10,000	
Lake Lenore, Ouray, Colo		10,000	
Tusco Creek, Delnorte, Colo		10,000	
Roaring Fork Creeks, Rico, Colo		10,000	
Dolores River, Rico, Colo		20,000	
Scotch Creek, Rico, Colo		10,000	
Taylor Creek, Rico, Colo		10,000	
Elk Creek, Pine Grove, Colo		10,000	
Ground Hog Creek, Rico, Colo		5,000	
Bear Creek, Idaho Springs, Colo		5,000	
Trout Lake, Montevista, Colo		5,000	
Grand Lake, Georgetown, Colo		10,000	
Tomiche Creek, Parlins, Colo		25,000	
Uncompahgre River and tributaries, Ridgway, Colo		40,000	
Goose Creek, Wagon Wheel Gap, Colo		25,000	
Pienas Creek, Delnorte, Colo		10,000	
Crystal River, Placita, Colo		10,000	
South Platte River, Dome Rock, Colo		5,000	
Big Thompson River, Loveland, Colo		10,000	
North Fork of South Platte, Pine Grove, Colo		5,000	
Rock House Brook, Redding Ridge, Conn		15,000	
Aspetuck River, Redding Ridge, Conn		20,000	
Miames River, Greenwich, Conn		20,000	
Twin Lakes, Twin Lakes, Conn			3,000
Applicant at Seymour, Conn			1,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
Gravel Creek, Blackfoot, Idaho			2,000
Silver Creek, Hailey, Idaho			2,000
Bon Air Lakes, Spencer, Idaho			2,000
Bonanza Lake, Spirit Valley, Idaho			3,000
Thorps Lake, Rathdrum, Idaho			1,500
Lake George, Lenore, Idaho			1,000
Waterworks Lake, Bloomington, Ind		20,000	
Tributary of Galena River, Rolling Prairie, Ind		20,000	
Trout Brook, Laporte, Ind		5,000	
Snymagill Creek, McGregor, Iowa			2,000
Bloody Run, McGregor, Iowa			2,500
Maquoketa River, Manchester, Iowa		5,000	
Spring Branch, Manchester, Iowa		5,000	
Sawyer Pond, Greenville, Me		10,000	
Clearwater Lake, Farmington, Me		15,000	
Barnum Pond, Farmington, Me		10,000	
Sweet Pond, Farmington, Me		10,000	
Sand, North and Norcross Ponds, Farmington, Me		15,000	
Gull Pond, Farmington, Me		10,000	
Tufts and Dutton Ponds, Farmington, Me		15,000	
Long and Square Ponds, Springvale, Me		20,000	
Canaan Lake, Rockland, Me		25,000	
Hobbs Pond, Rockland, Me		15,000	
Meadow and Branch brooks, Rockland, Me		10,000	
Norris Pond, Blue Hill, Me		4,000	
Unity Pond, Unity, Me		15,000	
South Lake, Warren, Me		20,000	
Green Lake, Otis, Me		125,000	
Lake Cobbosseecontee, Augusta, Me		50,000	
Black Brook, Brownfield, Me		15,000	
Tripp Pond, Mechanic Falls, Me		10,000	
Sandy Pond, Thorndike, Me		15,000	
Lake Thompson, Oxford, Me		15,000	
Embden Lake, North Anson, Me		15,000	
Hancock Pond, North Anson, Me		10,000	
Sand Pond, North Anson, Me		10,000	
Spruce Pond, North Anson, Me		10,000	
China Lake, Waterville, Me		15,000	
Lake George, Skowhegan, Me		10,000	
Little Pond, Franklin, Me		10,000	
Otter Ponds, Bingham, Me		40,000	
Chase Pond, Bingham, Me		10,000	
Fish Pond, Bingham, Me		10,000	
Austin Brook, Bingham, Me		10,000	
Rowe Ponds, Bingham, Me		25,000	
Lake Sebasticook, Newport, Me		20,000	
Mooselookmeguntic Lake, Bemis, Me		15,000	
Quantabacook Pond, Belfast, Me		15,000	
First Debsconeague Pond, Old Town, Me		15,000	
First Hurd Pond, Old Town, Me		15,000	
Pond and stream, Cumberland Junction, Me		5,000	
Holeb Pond, Greenville, Me		15,000	
Spring Lake, Bigelow, Me		5,000	
Lake Anasagunticook, Canton, Me		15,000	
Sebago Lake, Sebago Lake, Me		175,000	
Nickerson Lake, Houlton, Me		15,000	
Pattens Ponds, Ellsworth, Me		25,000	
Marston Pond, Brownfield, Me		5,000	
Branch Pond, Dedham, Me		25,000	
Tunk Ponds, Sullivan, Me		25,000	
Heart Pond, East Orland, Me		1,475	
Penemagnau Creek, Calais, Me		15,000	
Billings Pond, Ellsworth, Me		15,000	
Little Houston Pond, Katahdin Iron Works, Me		14,000	
Phillips Lake, Dedham, Me		25,000	
Lake Hebron, Monson, Me		20,000	
Green Lake, Green Lake, Me		1,388	
Alamoosook Lake, Orland, Me			111
Heart Pond, Orland, Me			532
Parmachenee Club, Camp Caribou, Me	50,000		
Maine Fish Commission, Greenville, Me	320,000		
Rock Gay Creek, Cumberland, Md			1,000
Deer Creek, Belair, Md			650
Brownings Dam, Oakland, Md			1,400
McHenry Branch, Oakland, Md			300
North Branch Brook, Springfield, Mass			1,000
Reservoir, Cottage City, Mass		15,000	1,000
Stream and pond, Fall River, Mass			1,333
Lyon Brook, Fall River, Mass			1,333
Kirby Brook, Fall River, Mass			1,334
Emerson Brook, Uxbridge, Mass			8,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
City reservoir, Worcester, Mass		15,000	2,000
Knollwood Cemetery Pond, Sharon, Mass			1,000
Plymouth River, Higham, Mass			1,000
Two mountain brooks, New Lenox, Mass			1,500
Trout Brook, Springfield, Mass		20,000	
Coonemessett River, Falmouth, Mass		25,000	
Massachusetts Fish Commission, Wilkinsonville, Mass	25,000		
Massachusetts Fish Commission, Hadley, Mass	25,000		
Looking Glass River, Portland, Mich		25,000	
Spring Brook, Kalamazoo, Mich		15,000	
Portage Creek, Kalamazoo, Mich		15,000	
Murray Lake, Grand Rapids, Mich		10,000	
McKinley Creek, Clare, Mich		10,000	
Russell Creek, Clare, Mich		20,000	
Trout Creek, Clare, Mich		10,000	
Branch of Tobacco River, Clare, Mich		10,000	
Murray Lake, Mosley, Mich		10,000	
Cedar Creek, Harrison, Mich		20,000	
Joas Creek, Harrison, Mich		15,000	
Lemon Creek, Berrien Springs, Mich		20,000	
Wright Pond, Greenville, Mich		5,000	
Berridge Creek, Greenville, Mich		15,000	
Turk Lake Creek, Greenville, Mich		15,000	
Brush Creek, Alpena, Mich		15,000	
Browning Lake, Iron Mountain, Mich		15,000	
Bird Creek, Holly, Mich		15,000	
Tributaries of Flint River, Oxford, Mich		25,000	
Millikan Creek, Onaway, Mich		25,000	
Wild Cat and Little Wolf Creeks, Alpena, Mich		30,000	
Silver Creek, Alpena, Mich		20,000	
Fish Pond, Milford, Mich		5,000	
Rifle River, Ogemaw, Mich		10,000	
Au Sable River, Cheney, Mich		10,000	
Pigeon River, Sallings, Mich		10,000	
Sturgeon River, Gaylord, Mich		25,000	
Stewart River, Vanderbilt, Mich		15,000	
North Branch Au Sable River, Lovells, Mich		30,000	
Hale and Smith creeks, Hale, Mich		35,000	
Silver and Gold creeks, East Tawas, Mich		35,000	
Pine Lake, Au Sable, Mich		30,000	
Local trout streams, Farwell, Mich		10,000	
Marquette River, Nirvana, Mich		10,000	
Marquette River, Baldwin, Mich		20,000	
Dannaher River, Baldwin, Mich		10,000	
Little Manistee River, Canfield, Mich		20,000	
Bear Creek, Kaleva, Mich		10,000	
Rapid River, Rapid City, Mich		10,000	
Buckhorn Creek, Holly, Mich		1,000	
Maple River, Peelston, Mich		95,000	
Local streams, Emery Junction, Mich		150,000	
Grace Harbor, Washington Harbor, Mich		10,000	
Spring Brook trout hatchery, Kalamazoo, Mich	25,000		
Crooked Creek, Reno, Minn			1,000
McCarthy and Hall creeks, Floodwood, Minn		10,000	900
Lester, French, and Sucker rivers, Duluth, Minn		20,000	
Fischer Creek, Duluth, Minn		5,000	
Talmage Creek, Duluth, Minn		12,230	
Hanging Horn Stream, Carleton, Minn		5,000	
Lester River, Duluth, Minn		10,000	
Poplar River, Lutsen, Minn		10,000	
Rocky Run Creek, Proctor, Minn		10,000	
Spring Brooks, Northfield, Minn		25,000	
Missouri Fish Commission, St. Joseph, Mo	20,000		
Horseshoe Lake, Dillon, Mont			1,000
Judilo River, Harlowton, Mont			1,000
Reservoir, Big Timber, Mont			2,000
Artificial Lake, Butte, Mont			2,000
Spring Creek, Whitehall, Mont			3,000
Spring Creek, Harlowton, Mont			2,000
Fish Pond, Harlowton, Mont			2,000
Rock Creek, Browns, Mont			1,000
Fitzpatrick Lake, Sweet Grass, Mont			1,000
Nebraska Fish Commission, South Bend, Nebr	50,000		
J. P. Morrill, Verdi, Nev	5,000		
Thompson Brook, Exeter, N. H			2,000
Lake Winnepecket, Warner, N. H			2,000
Greenough Pond, Colebrook, N. H			2,000
Strafford Bogs, Groveton, N. H			2,000
Swift Brook, West Ossipee, N. H			2,500
Grass Brooks, Potter Place, N. H			2,000
Cole Pond and stream, Potter Place, N. H		10,000	4,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Brook trout—Continued.			
Brown Pond, Lang, N. H			2,000
Spring Brooks, Northampton, N. H			2,000
Wild Meadow Brook Pond, Grafton, N. H		20,000	3,000
Brickyard Brook, Nashua, N. H			500
Trout Brook, Nashua, N. H			500
Sunapee Lake, Newbury, N. H			3,000
Trout Brooks, Hollis, N. H			500
Trout Pond, Hudson, N. H			241
New Hampshire Fish Commission, State waters, Colebrook, N. H		30,000	3,000
Home Hill Brook, Plainfield, N. H		20,000	
Bear Camp and Swift rivers, Center Sandwich, N. H		30,000	
Isinglass River, Dover, N. H		25,000	
Town Farm and Rum Brooks, Epping, N. H		30,000	
Goffstown Reservoir, Manchester, N. H		15,000	
Bowman Brook, Manchester, N. H		20,000	
Pleasant Pond, Manchester, N. H		15,000	
Lake Massabesic, Manchester, N. H		25,000	
Mantee Brook, Manchester, N. H		20,000	
Silver Brooks, Warner, N. H		20,000	
Christine Lakes, Percy, N. H		10,000	
Indian River, Canaan, N. H		20,000	
Webster Lake, Franklin, N. H		10,000	
Nash Ponds, Groveton, N. H		10,000	
A. N. Bigelow, Branchville, N. J	20,000		
Beaver River, Beaver, N. Y			1,000
Fish Ponds, Booneville, N. Y			500
Silver Spring Creek, Booneville, N. Y			1,000
Montfredy Brook, Syracuse, N. Y		10,000	1,000
Isatsawassa Creek, Rensselaer, N. Y		20,000	
Wolf Creek, Cuba, N. Y		25,500	
Three Ponds, Saratoga Springs, N. Y		20,000	
Carpenter Brook, Halfway, N. Y		25,500	
Pleasant Lake, Pleasant Lake, N. Y		50,000	
Fish Pond, Schenectady, N. Y		10,000	
Twitchel Creek, Beaver River, N. Y		60,000	
Trout streams, Watertown, N. Y		75,000	
Duel and Black Creeks, Carthage, N. Y		75,000	
Little River, Star Lake, N. Y		75,000	
Oswegatchie River, Newton Falls, N. Y		50,350	
Smith Creek, Harrisville, N. Y		25,000	
Caldwell Clark Creek, Lake Bonaparte, N. Y		30,000	
Indian River, Natural Bridge, N. Y		20,000	
Blanchard Creek, Natural Bridge, N. Y		20,000	
B. B. Smith Creek, Natural Bridge, N. Y		10,000	
Sand Hill Creek, Natural Bridge, N. Y		5,000	
Robt. Henry Creek, Natural Bridge, N. Y		10,000	
Tidd Creek, Natural Bridge, N. Y		10,000	
Green Lake, Lake Bonaparte, N. Y		20,000	
Fish Creek, Harrisville, N. Y		20,000	
Taylor Brook, Pierpont Manor, N. Y		15,000	
Silver Lake, Big Moose, N. Y		10,000	
Preston Ponds, Tahawas, N. Y		10,000	
Tichnor and Hazzard brooks, Chenango Forks, N. Y		10,000	
Dark Hollow and Wheeler brooks, Greene, N. Y		19,000	
Thomas Brook, Whitney Point, N. Y		4,000	
Casey Brook, Norwich, N. Y		10,000	
Linville River, Montezuma, N. C			300
Applicant at Morrisville, N. C			200
Beaver Creek, Wishek, N. Dak			500
Sand Lake, Pleasant Lake, N. Dak			500
Spring Pond, Ontario, Ohio		15,000	
Tributaries of Mad River, Bellefontaine, Ohio		35,000	
Spring Lake, Wickliffe, Ohio		10,000	
Water Works Ponds, Coshocton, Ohio		2,000	
Fish Pond, Cuyahoga, Ohio		5,000	
Newark, Ohio		5,000	
Trout Lake, DeGraff, Ohio		5,000	
Applicant at West Liberty, Ohio		3,000	
Fish Pond, Bellefontaine, Ohio		5,000	
Willow Lake, La Grande, Oreg			5,000
Nenacinum River, Seaside, Oreg			39,975
Clackamas River, Stone, Oreg			29,901
Mill Creek, The Dalles, Oreg		2,500	
Upper Eight Mile Creek, Endersley, Oreg		2,500	
Fifteen Mile Creek, Dufur, Oreg		5,000	
Bear Creek, Umatilla County, Oreg		10,000	
McKai Creek, Glencoe, Oreg		5,000	
Emery Creek, Glencoe, Oreg		5,000	
Rock Creek, Bakers Ferry, Oreg		3,500	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
Clear Creek, Clear Creek, Oreg		17,500	
Clackamas River, Clackamas, Oreg		13,990	
Ten Mile Creek, Seuferts, Oreg		10,000	
La Bish Creek, Chemawa, Oreg		7,500	
Ford Creek, Chemawa, Oreg		3,500	
Panther Creek, Carlton, Oreg		5,000	
Cain Creek, Carlton, Oreg		5,000	
North Fork of Macham Creek, Wilbur, Oreg		25,000	
Scappoose Creek, Scappoose, Oreg		10,000	
Johnson Creek, Milwaukie, Oreg		2,000	
Hamilton Creek, Bonneville, Oreg		5,989	
Trout Lake, Marietta, Pa			500
Stony Fork Creek, Wellsboro, Pa			400
Steele Run, Wellsboro, Pa			200
Spring Brook, Wellsboro, Pa			200
Four Mile Run, Wellsboro, Pa			200
Stowells Creek, Wellsboro, Pa			200
Fellows Creek, Columbia Cross Roads, Pa			200
Rattlesnake Run, Wetham, Pa			1,000
Harlemans Run, Lock Haven, Pa			200
Lick Run, Lock Haven, Pa			500
Fishing Creek, Lock Haven, Pa			500
Baker Run, Lock Haven, Pa			200
McElhattan Run, Lock Haven, Pa			400
Cherry Run, Lock Haven, Pa			400
Queens Run, Lock Haven, Pa			400
Chatham Run, Lock Haven, Pa			200
Hayes Run, Lock Haven, Pa			200
Twin Run, Lock Haven, Pa			200
Cedar Run, Lock Haven, Pa			100
Bull Run, Lock Haven, Pa			200
Fish Pond, Reading, Pa			100
Daniels Brook, Ulysses, Pa			300
Lead Run, Jamison City, Pa			150
Pigeon Run, Jamison City, Pa			150
West Branch of Fishing Creek, Jamison City, Pa			350
East Branch of Fishing Creek, Jamison City, Pa			350
Meeker Run, Jamison City, Pa			150
Trout Run, Jamison City, Pa			150
Craig Run, McElhattan, Pa			200
Cedar Run, McElhattan, Pa			100
Grayham Run, McElhattan, Pa			200
Paddy Run, McElhattan, Pa			200
Spring Run, McElhattan, Pa			200
Lusk Run, McElhattan, Pa			200
Ferney Run, McElhattan, Pa			200
Sixpenny Creek, Birdsboro, Pa			200
Glade Run, Kane, Pa			200
Little Mahanoy, Ashland, Pa			200
McGinty Dam, Ashland, Pa			100
Sherman Valley Brook, Hopewell, Pa			200
Raven Run, Riddlesburg, Pa			200
Branch of Blacklick Creek, Ebensburg, Pa			200
Barren Run, Ebensburg, Pa			200
Crooked Creek, Little Marsh, Pa			200
Beaver Creek, Pottstown, Pa			200
Freeman Run, Austin, Pa			500
Trout Run, Trout Run, Pa			400
Clover Creek, Martinsburg, Pa			200
Fisher Dam, Shamrock, Pa			100
Old Log Cabin Brook, Honesdale, Pa			400
Cacoosing Creek, Sinking Spring, Pa			200
Sansom Pond, Shenandoah, Pa			100
Young Creek, Conshohocken, Pa			200
Spring Brook, Linesville, Pa			200
Alwine Run, Johnstown, Pa			200
Oven Run, Stoyestown, Pa			200
Muncy Creek, Nordmont, Pa			200
Trout Pond, Lansdowne, Pa			100
Clover Creek, Altoona, Pa			600
Bear Run, Wellsboro, Pa			200
Branch of Yellow Creek, Curry, Pa			400
Dalton Creek, Johnstown, Pa			200
Bushkill Creek, Stroudsburg, Pa			200
Spring Run, Martinsburg, Pa			200
Elk Run, Jamison City, Pa			200
Panther Run, Jamison City, Pa			150
Deserters Run, Jamison City, Pa			150
Big Run, Jamison City, Pa			200
Muncy Creek, La Porte, Pa			200

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
Chilliquakie Creek, Washingtonville, Pa			300
Cold Run, Pottstown, Pa			300
Tumbling Run, Pottstown, Pa			300
Trout Pond, Georgiaville, R. I		20,000	
Reservoir, Wagner, S. Dak			400
Pease Creek, Geddes, S. Dak			2,000
Beaver Creek, Buffalo Gap, S. Dak			3,000
Fish Pond, Spearfish, S. Dak			5,000
Spearfish Creek, Spearfish, S. Dak		52,000	12,000
McCrery Lake, Kimball, S. Dak			200
Fish Pond, Fort Meade, S. Dak		10,000	
Castle Creek, Hill City, S. Dak			5,000
Fish Pond, Wessington, S. Dak			600
Fawndale Ponds, Whitewood, S. Dak			10,000
Box Elder Creek, Black Hawk, S. Dak			4,950
Spearfish Creek, Elmore, S. Dak			10,000
Fish Pond, Deadwood, S. Dak			1,000
Willow Springs Pond, Nemo, S. Dak			1,500
Honey Peak Creek, Hill City, S. Dak			1,000
Upper Spearfish Creek, Elmore, S. Dak		20,000	
Fish Pond, Piedmont, S. Dak		5,000	
Rapid Creek, Rochford, S. Dak		10,000	
Castle Creek, Rochford, S. Dak		10,000	
Watercress Creek, Spearfish, S. Dak		15,000	
Fleurdelis Creek, Fairburn, S. Dak		15,000	
Norse Creek, Tilford, S. Dak		10,000	
Spring Creek, Spearfish, S. Dak		5,000	
Fish Ponds, Spearfish, S. Dak		10,000	
Pond and stream, Spearfish, S. Dak		5,000	
Box Elder and Jim creeks, Nemo, S. Dak		20,000	
Box Elder Creek, Nemo, S. Dak		5,000	
South Box Elder Creek, Roubaix, S. Dak		10,000	
Squaw Creek, Maurice, S. Dak		7,000	
Barren Fork Creek, McMinnville, Tenn			75
John Sharp, Utah Fish Commission, Murray, Utah	50,000		
Frog Pond, St. Johnsbury, Vt			1,500
Trout streams, Calais, Vt			1,500
Little Leach Pond, Averill, Vt			1,000
Leach Pond, Averill, Vt		20,000	898
Caspian Lake, Greensboro, Vt			500
Darling Pond, Groton, Vt		75,000	655
Trout Pond, West Hartford, Vt			1,000
Noyes Lake, Chittenden, Vt		20,000	400
Lake Mansfield, Stowe, Vt		20,000	4,500
Beaver Pond, Proctor, Vt			3,000
Cold River, Clarendon, Vt			676
Clyde River and Derby Pond, Island Pond, Vt		20,000	
Pico Lake, Rutland, Vt		50,000	
Johnsons Brook, Brattleboro, Vt		20,000	
Ayers Brook, Randolph, Vt		20,000	
Hatch and Mason ponds and brooks, Randolph, Vt		10,000	
Three trout ponds, Newbury, Vt		20,000	
Silsby Pond, Newbury, Vt		5,000	
Black Pond, Plymouth, Vt		20,000	
Meccawe Pond, Redding, Vt		15,000	
Sprague Pond, Walden, Vt		10,000	
Langdon Pond, Montpelier, Vt		15,000	
Big Fish Pond, Sutton, Vt		5,000	
May Pond, Barton, Vt		15,000	
Otter Creek, Mount Tabor, Vt		20,000	
Lake Mitchell, Norwich, Vt		35,000	
Caswell Creek, St. Johnsbury, Vt		8,000	
Beaver Meadow Brook, Pasumpsic, Vt		10,000	
Trout brooks, St. Johnsbury, Vt		3,000	
Vermont Fish Commission, Colebrook, N. H	50,000		
Dry River, Harrisonburg, Va			26
Tributaries of Difficult Run, Vienna, Va		8,000	
Lake Alfred, Blossburg, Wash			2,000
Lake Amelia, Blossburg, Wash			2,000
Lake Lewis, Blossburg, Wash			2,000
Lake Perkins, Blossburg, Wash			2,000
Harris Lake, Blossburg, Wash			2,000
Trout Lake, Hood River, Wash			2,000
Washtucna Lake, Washtucna, Wash			2,000
Wilson Creek, Wilbur, Wash			2,000
Crab Creek, Sprague, Wash			5,000
South Fork of Stilaguamish River, Everett, Wash			1,000
Skykomish River, Skykomish, Wash			2,000
Fau Lake, Deer Park, Wash			2,000
Trout pond, Fairfield, Wash			500

Detail of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Brook trout—Continued.			
Green Lake, Seattle, Wash			500
Trout pond, Seattle, Wash			2,000
North Branch of Spokane River, Milan, Wash			2,000
Fish Pond, Tacoma, Wash			250
O'Reilly River, Newport, Wash			10,000
Local Trout Creek, Northport, Wash			3,000
Star Lake, Auburn, Wash		10,000	
Lewis Gilbert, Milan, Wash	20,000		
Clover Creek, Lake View, Wash		10,000	
Cheat River, Huttonsville, W. Va			1,000
Branch of Deep Creek, Morgantown, W. Va			200
Elk and Houston rivers, Centralia, W. Va			500
F. A. Degler, Cheat Bridge, W. Va	50,000		
Sportsmen's Association of Cheat Mountain, W. Va	50,000		
Stony Creek, Marlinton, W. Va			300
Otter Creek, Augusta, Wis			1,800
Thompson Creek, Augusta, Wis			1,000
Beef River, Augusta, Wis			1,800
Brown Creek, Augusta, Wis			900
Bear Grass Creek, Augusta, Wis		8,000	
Sand Creek, Augusta, Wis		8,000	
Eagle Valley Brook, Fountain City, Wis			1,800
Spring Brook, West Salem, Wis			1,000
Mill Brook, Tomah, Wis		10,000	2,000
Squaw and Ash creeks, Sparta, Wis			2,000
Burns Creek, Bangor, Wis			1,000
Hall Creek, Alma Center, Wis			900
Storkwell Creek, Alma Center, Wis			900
Bovee Creek, Alma Center, Wis			900
Arno Creek, Alma Center, Wis			900
North Branch of Coon Creek, La Crosse, Wis		10,000	1,000
Chipmunk Creek, La Crosse, Wis			1,000
Krall Creek, La Crosse, Wis			1,000
Withee Creek, Sechlerville, Wis			800
Marine Creek, Fairchild, Wis			900
McLaren Creek, Fairchild, Wis			900
Soper and Davis creeks, Sparta, Wis			1,000
Stillwell Creek, Sparta, Wis			500
Rush Creek, Baldwin, Wis			900
Kenyon Creek, Black River Falls, Wis			625
Allen Creek, Black River Falls, Wis			625
Trout Run, Black River Falls, Wis			625
Squaw Creek, Black River Falls, Wis			625
Rock and Beaver creeks, Rice Lake, Wis			1,800
State Line Brook, Foxboro, Wis			1,350
Stony Creek, Black River Falls, Wis			900
South Branch, Alma Center, Wis			900
North Branch of Pike River, Dunbar, Wis			1,000
Balsam River, Foxboro, Wis			1,350
Trout pond, Appleton, Wis			1,000
Inlet to Elbow Lake, Wausaukee, Wis			1,000
Iron and Brule rivers, Marinette, Wis			1,000
Beaver River, Galesville, Wis			900
Billings Creek, Glendale, Wis		10,000	
White Creek, New Lisbon, Wis		10,000	
Pigeon Creek, Alma Center, Wis		10,000	
Moores Creek, Norwalk, Wis		20,000	
Spring Creek, Norwalk, Wis		10,000	
Hay Creek, Augusta, Wis		8,000	
Gates Creek, Osseo, Wis		10,000	
Flick Creek, Fairchild, Wis		10,000	
Morrill Creek, Fairchild, Wis		10,000	
Marvins Creek, Fairchild, Wis		10,000	
Beef River, Osseo, Wis		10,000	
Blacktail Creek, Hulett, Wyo			10,000
Trout ponds, Beulah, Wyo		10,000	
Glenn Creek, Yellowstone National Park, Wyo		9,000	
Willow Creek, Yellowstone National Park, Wyo		18,000	
Indian Creek, Yellowstone National Park, Wyo		11,000	
Wyoming Fish Commission, Sheridan, Wyo	135,000		
Claude M. MacDonald, Tokyo, Japan	25,000		
Total	920,000	5,222,422	437,340
Lake trout:			
Twin Lakes, Salisbury, Conn		20,000	
Connecticut Fish Commission, Windsor Locks, Conn	250,000		
Spirit Lake, Spirit Lake, Iowa		15,000	
Lake Okoboji, Spirit Lake, Iowa		15,000	
Mountain Lake, Tolland, Mass		20,000	
Lake Esau, Presque Isle, Mich		100,000	

Detail of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Lake trout—Continued.			
Arnold Lake, Harrison, Mich		100,000	
Long Lake, Howell, Mich		200,000	
Clark and Loon lakes, Watersmeet, Mich		200,000	
Chief or Trout Lake, Iron Mountain, Mich		200,000	
Lake Michigan, Charlevoix, Mich		3,100,000	
near Beaver Island, Mich		575,000	
Mackinac City, Mich		650,000	
Lake Huron, Alpena, Mich		1,000,000	
North Point, Mich		1,000,000	
Scarecrow Island, Mich		1,000,000	
Big Reef, Mich		380,000	
Detour, Mich		1,000,000	
Lake Superior, Rock Harbor, Mich		140,000	
Washington Harbor, Mich		140,000	
Marquette, Mich		1,000,000	
Todds Harbor, Mich		360,000	
Eagle Harbor, Mich		320,000	
Long Point, Mich		320,000	
Ontonagon, Mich		960,000	
Keystone, Mich		480,000	
Fish Island, Mich		120,000	
Tobins Harbor, Mich		200,000	
Whitefish Point, Mich		1,000,000	
St. Marys River, Bay Mills, Mich		400,000	
Hay Lake, Hay Lake, Mich		300,000	
Turtle Lake, Turtle Lake, Mich		50,000	
Michigan Fish Commission, Detroit, Mich	1,000,000		
Leech Lake, Walker, Minn		30,000	
Lake Pulaski, Buffalo, Minn		14,000	
Lake Superior, Poplar River, Minn		260,000	
Grand Marais, Minn		280,000	
Chicago Bay, Minn		220,000	
Grand Portage, Minn		320,000	
Two Harbors, Minn		640,000	
Duluth, Minn		200,000	
Newfound Lake, Bristol, N. H		30,000	
Squaw and Black Nit ponds, Meredith, N. H		30,000	
Spofford Lake, Chesterfield, N. H		20,000	
Lake Winnepesaukee, Weirs, N. H		20,000	
Squam Lake, Ashland, N. H		20,000	
Chas. B. Clarke, Concord, N. H	500,000		
Pleasant Lake, Pleasant Lake, N. Y		20,000	
St. Lawrence River, Cape Vincent, N. Y		46,280	
Otsego Lake, Cooperstown, N. Y		49,750	
Lake Ontario, near Cape Vincent, N. Y		766,600	
off Grenadier Island, N. Y		1,256,000	
Dutch Point, N. Y		450,000	
Tibbetts Point, N. Y		530,000	
St. Lawrence River, off Carlton Island, N. Y		20,000	
James Annin, Caledonia, N. Y	10,000		
W. H. Boardman, Fulton Chain, N. Y	200,000		
New York Fish Commission, Caledonia, N. Y	2,500,000		
Maumee River, Toledo, Ohio		3,500	
Triangle and Nash lakes, Lane and Lincoln counties, Oreg		18,000	
Hawthorne Lake, Portland, Oreg		1,000	
Meadow Lake, Yamhill County, Oreg		26,498	
Saxton Mill Pond, Spartanburg, S. C		20,000	
Sunset Lake, Orwell, Vt			3,012
Holland Pond, Holland, Vt		15,000	
Big Averill Pond, Averill, Vt		30,000	
Caspian Lake, Greensboro, Vt		49,900	
Willoughby Lake, Westmore, Vt		40,000	
Crystal Lake, Barton, Vt		36,000	
Stone Pond, Glover, Vt		20,000	
Vermont Fish Commission, Roxbury, Vt	250,000		
Lake Sequalitchew, Lake View, Wash		24,950	
Lake Superior, Madeline Island, Wis		320,000	
Ashland, Wis		470,000	
Wyoming Fish Commission, Sheridan, Wyo	500,000		
J. B. Fielding, Upper Downing, England	25,000		
Lake Superior, Ross Point, Ontario		360,000	
Total	5,235,000	22,022,478	3,012
Scotch sea trout:			
Phillips Lake, Bangor, Me			3,000
Craig Pond, East Orland, Me			3,837
Alamoosook Lake, Orland, Me		7,694	
G. H. Richards, Wenaumet, Mass	10,000		
Total	10,000	7,694	6,837

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
Golden trout:			
Round Pond, Conway, N. H		10,000	
Lake Tarleton, Pike Station, N. H		10,000	
Lake Sunapee, Sunapee Lake, N. H		49,950	
Total		69,950	
Grayling:			
South Platte River, Florissant, Colo		10,000	
Fryingpan River, Thomasville, Colo		30,000	
Platte River, between Grant and Cliff, Colo		30,000	
Eagle River, Berrys Station, Colo		30,000	
Clear Creek, Lansing, Iowa		25,000	
Village Creek, Lansing, Iowa		25,000	
Heart Pond, Orland, Me		17,822	
Craig Pond, Orland, Me		17,761	
Craig Brook, Orland, Me		750	
Spring Pond, Horricon, Mich		20,000	
Bird Creek, Holly, Mich		10,000	
Baldwin and Sanborn creeks, Baldwin, Mich		85,000	
Au Sable River and tributaries, Grayling, Mich		85,000	
Michigan Fish Commission, Paris, Mich	100,000		
Lester River, Duluth, Minn		24,000	
Minnesota Fish Commission, State Waters, Duluth, Minn		100,000	
Dr. Justus Ohage, St. Paul, Minn	10,000		
Missouri Fish Commission, St. Joseph, Mo	50,000		
Eureka Ponds, Anaconda, Mont			9,925
Prickly Pear Creeks, Helena, Mont		50,000	
Prickly Pear Creek Lake, Prickly Pear Junction, Mont		50,000	
Rock Creek, Harlowton, Mont		50,000	
Bakers Ponds, Anaconda, Mont		25,000	
Bozeman Creek, Bozeman, Mont		66,000	
Bridger Creek, Bozeman, Mont		84,000	
Stone Creek, Bozeman, Mont		50,000	
Waste Ditch, Bozeman, Mont		100,000	
Fish ponds, Bozeman, Mont		50,000	
W. M. Keil, Tuxedo, N. Y	20,000		
New York Fish Commission, Caledonia, N. Y	50,000		
John Sharp, Utah Fish Commission, Murray, Utah	100,000		
Caspian Lake, Greensboro, Vt		20,000	
Brule River, Winnie Bayou, Wis		75,000	
E. Bryant, for Wisconsin Fish Commission, Bayfield, Wis	200,000		
Fox Creek, Sheridan, Wyo			8,000
Wyoming Fish Commission, Laramie, Wyo	100,000		
S. E. Land, Laramie, Wyo	25,000		
Total	655,000	1,130,333	17,925
White-fish:			
Bates Lake, Hastings, Mich		250,000	
Dowd, Leach, and Middle lakes, Hastings, Mich		250,000	
Lake Michigan, Charlevoix, Mich		15,000,000	
Mackinac City, Mich		12,000,000	
Off Manistique, Mich		2,000,000	
Detroit River, off Belle Isle, Mich		19,500,000	
Detroit, Mich		56,000,000	
Lake St. Clair, Lake St. Clair, Mich		32,000,000	
Lake Huron, off North Point, Mich		15,000,000	
Scarecrow Island, Mich		10,450,000	
Presque Isle, Mich		8,000,000	
Sturgeon Point, Mich		4,500,000	
Detour, Mich		16,000,000	
Forester, Mich		4,050,000	
Turtle Lake, Turtle Lake, Mich		500,000	
Hay Lake, Hay Lake, Mich		5,000,000	
Soo Rapids, Sault Ste. Marie, Mich		3,000,000	
Lake Superior, Whitefish Point, Mich		15,000,000	
Marquette, Mich		6,000,000	
Ontonagon, Mich		10,600,000	
Fishermans Home, Mich		6,400,000	
Grace Harbor, Mich		4,800,000	
Otsego Lake, Cooperstown, N. Y		600,000	
Lake Ontario, Dutch Point, N. Y		26,090,000	
Lake Ontario, near Cape Vincent, N. Y		4,830,000	
St. Lawrence River, off Cape Vincent		1,080,000	
St. Lawrence River, off Carleton Island, N. Y		2,300,000	
New York Fish Commission, Caledonia, N. Y	8,100,000		
Lake Erie, off Ballast Island Shoal, Ohio		23,000,000	
Bass Island, Put-in Bay, Ohio		28,800,000	
Kelley Island, Ohio		40,000,000	
Isle St. George, Middle Ground, Ohio		20,000,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and finger-lings.	Adults and yearlings.
White-fish—Continued.			
Lake Erie, off Port Clinton, Ohio		38,200,000	
Light-House Point, Put-in Bay, Ohio		10,500,000	
North Bass Reef, Ohio		10,000,000	
Starve Island Reef, Ohio		10,000,000	
Toledo, Ohio		10,000,000	
Storm Island Reef, Put-in Bay		10,000,000	
Pennsylvania Fish Commission, Erie, Pa	48,160,000		
Lake Sequalitchew, Lake View, Wash		730,000	
Lake Superior, Ashland, Wis		1,800,000	
Wisconsin Fish Commission, Madison, Wis	55,000,000		
Total	111,260,000	483,230,000	
Pike perch:			
Simonton Lake, Elkhart, Ind		500,000	
Yellow Creek and lakes, Silver Lake, Ind		1,000,000	
Silver, Rickle, and Hulbert lakes, Silver Lake, Ind		500,000	
Kankakee River, Riverside, Ind		1,500,000	
Caldwell Lake, Claypool, Ind		400,000	
Beaver Dam Lake, Claypool, Ind		400,000	
Mud Lake, Claypool, Ind		400,000	
Carr Lake, Claypool, Ind		400,000	
Homan Lake, Claypool, Ind		400,000	
Grove Lake, Columbia City, Ind		500,000	
Mississippi River, Dubuque, Iowa			500
Spirit Wood Lake, Jamestown, N. Dak			75
Lake Maxinkuckee, Culver, Ind		10,000,000	
Potomac River, Sycamore Island, Md		540,000	
Potomac River, Anglers Club House, Md		1,260,000	
Town Line Lake, Coral, Mich		500,000	
Miner Lake, Miner Lake, Mich		1,000,000	
Michigan Fish Commission, Detroit, Mich	50,000,000		
Missouri Fish Commission, St. Joseph, Mo	10,000,000		
Walser Pond, Webster, N. H		1,000,000	
Round and Stump ponds, Nashua, N. H		1,000,000	
Massabesic Lake, Manchester, N. H		1,000,000	
St. Lawrence River, off Carlton Island, N. Y		4,860,000	
Grass Bay, N. Y		2,000,000	
Cape Vincent, N. Y		1,340,000	
Lake Erie, off Middle Bass Island Reef, Put-in Bay, Ohio		15,000,000	
Ballast Island Reef, Put-in Bay, Ohio		20,000,000	
Magara Reef, Port Clinton, Ohio		20,000,000	
North Bass Reef, Put-in Bay, Ohio		20,500,000	
Catawba Island, Ohio		20,000,000	
Locust Point Shoals		20,000,000	
Toledo, Ohio		10,000,000	
Conneautee Lake, Cambridge, Springs, Pa		500,000	
Clarion River, Foxboro, Pa		800,000	
Lake Nephawin, Canton, Pa		500,000	
St. Clair, White, and Wahlamah lakes, Gough, S. C		1,900,000	
Salem Pond, Derby, Vt		500,000	
Fairfield Pond, Sheldon, Vt		899,000	
Vermont Fish Commission, Swanton, Vt		16,000,000	
Total	60,000,000	177,099,000	575

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Cat-fish:	
Benton Pond, Seale, Ala	300
Buzzard Pond, Eufaula, Ala	300
Turner Fish Pond, Eufaula, Ala	300
Clubs Pond, Eufaula, Ala	300
Mill Pond, Columbia, Ala	100
Potomac River, Fish Lakes, D. C	30,000
Lake Ella, Umatilla, Fla	300
Brickyard Pond, Columbus, Ga	500
Ockmulgee River, Macon, Ga	1,000
Hudson Pond, Hamilton, Ga	200
Bussey Pond, Cuthbert, Ga	500
Hood Creek, Bostick, Ga	300
Fish Ponds, Atlanta, Ga	450
Bullochville, Ga	900
Greenville, Ga	200
Stinson, Ga	200
Mississippi River, Dubuque, Iowa	43,500
Maquoketa River, Manchester, Iowa	2,800
Cedar River, Cedar Rapids, Iowa	7,000
Wapsipinnicon River, Independence, Iowa	4,820
Spirit Wood Lake, Jamestown, N. Dak	2,000
Total	95,970
Pickerel:	
Maquoketa River, Manchester, Iowa	200
Wapsipinnicon River, Independence, Iowa	105
Mississippi River, Dubuque, Iowa	500
Total	805
Yellow perch:	
Maquoketa River, Manchester, Iowa	500
Cedar River, Cedar Rapids, Iowa	300
Wapsipinnicon River, Independence, Iowa	300
Spirit Wood Lake, Jamestown, N. Dak	600
Total	1,700
Buffalo-fish:	
Mississippi River, Dubuque, Iowa	200,000
Total	200,000
Black bass:	
Big Cave Creek, Gadsden, Ala	300
Betheas Lake, Faundale, Ala	100
Mill Pond, Birmingham, Ala	150
Ingrams Mill Pond, Opelika, Ala	300
Mill Pond, Attalla, Ala	100
Spring Lake, Epes, Ala	200
Mill Pond, Brantley, Ala	500
Avery Lake, Goldhill, Ala	150
Fletchers Lake, Opelika, Ala	150
Oak Lake, Hooks, Ala	50
Locust Warrior River, Warrior, Ala	800
Black Warrior River, Warrior, Ala	200
Town Creek, Town Creek, Ala	300
Mill Pond, Spruce Pine, Ala	200
Town and Short Creeks, Guntersville, Ala	200
East Sheffield Lake, Tuscumbia, Ala	200
Chambliss Mill Pond, Montgomery, Ala	300
Simmons Spring, Florence, Ala	100
Bradley Mill Pond, Millport, Ala	200
Briggs Mill Pond, Jasper, Ala	300
Blackwater Mill Pond, Jasper, Ala	150
Jones Mill Pond, Waverly, Ala	150
Oxford Lake, Anniston, Ala	200
Lake Baxter, Birmingham, Ala	200
Eufaula Fish Club Pond, Eufaula, Ala	350
Applicants in Alabama	3,150

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
Verde River, Jerome, Ariz	75
Sycamore Creek, Jerome, Ariz	225
Railroad Reservoir, Williams, Ariz	100
Reservoir, St. David, Ariz	150
Clear Lake, Pine Bluff, Ark	75
Lake Taylor, Pine Bluff, Ark	75
Ouachita River, Malvern, Ark	300
McHenry Fish Pond, Malvern, Ark	300
Artificial Lake, Eureka Springs, Ark	75
Little River, Wilton, Ark	150
Grassy Lake, Wilton, Ark	150
Fish Lake, Earle, Ark	200
Applicants in Arkansas	900
Applicant at Lamar, Colo	75
Mudge Pond, Sharon, Conn	100
Washbands Ponds, Seymour, Conn	50
Applicant at Brightwood, D. C	100
Crescent Lake, Cleremont, Fla	100
Lake Ella, Umatilla, Fla	200
Lake Helen, Lake Helen, Fla	300
Fish Lake, Clearwater, Fla	500
Applicants in Florida	550
Cumber Mill Pond, Morris Station, Ga	150
Bell Branch Pond, Haddocks, Ga	75
Artifical Lake, Box Springs, Ga	100
Swift Creek Mill Pond, Macon, Ga	200
McCalls Pond, Macon, Ga	200
Spring Branch, Upatoie, Ga	150
Mill Pond, Howard, Ga	150
Smoors, Ga	100
Savannah River, Grovetown, Ga	300
St. Elmo Lake, Columbus, Ga	100
Lake Carmichael, Gracewood, Ga	250
Augusta Game Club Pond, Augusta, Ga	250
King Lake, Box Springs, Ga	300
Caldecott Lake, Atlanta, Ga	150
Roundabout Pond, Kirkland, Ga	200
Lake Benson, White Sulphur Springs, Ga	100
Mill Pond, Greenville, Ga	200
Ruby Lake, Fort Valley, Ga	100
Fish Lake, Cussetta, Ga	500
Holly Springs Lake, Americus, Ga	150
Mill Pond, Hazlehurst, Ga	200
Lake Mohignac, Box Springs, Ga	400
Panther Creek, Reynolds, Ga	350
Coleman Lake, Coleman, Ga	489
Applicants in Georgia	3,520
Long Lake, Mitchell, Ill	400
Lonetree Lake, Lonetree, Ill	500
Cherokee Fish Lakes, East St. Louis, Ill	250
Black Walnut Lake, Goodenow, Ill	100
Spring Lake, Barrington, Ill	300
Spring Lake, Wheaton, Ill	300
Scotts Lake, Belleville, Ill	150
Fox River, Olney, Ill	500
Pine Terrace Lake, Crete, Ill	250
Ahern Lake, Columbia, Ill	100
Clear Lake, Columbia, Ill	150
Gilmore Lake, Columbia, Ill	200
Long Pond, Columbia, Ill	300
Kneipp Lake, Belleville, Ill	300
Priester Lake, Belleville, Ill	150
Artificial Lake, Olney, Ill	100
Jacks Run Lake, Freeburg, Ill	200
Burghardt Lake, Belleville, Ill	150
Kretzer Lake, Harristown, Ill	200
Soldiers Home Lake, Danville, Ill	200
Applicants in Illinois	1,900
Lake Maxinkuckee, Culver, Ind	800
Winona Lake, Winona, Ind	800
Webster Lake, North Webster, Ind	300
Lake Wawassee, Wawassee, Ind	800
Tippecanoe Lake, Leesburg, Ind	400
Fall Creek, Malot Park, Ind	150
Car Lake, Claypool, Ind	300
Homan Lake, Claypool, Ind	300
Mud Lake, Macy, Ind	150
Lake Manitou, Rochester, Ind	300

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
Gravel Lake, Adamsville, Ind	150
Black River, New Harmony, Ind	275
Indian Pond, Elnora, Ind	200
Swan and Snider Ponds, Washington, Ind	200
Kankakee River, Kouts, Ind	300
Notre Dame Lake, South Bend, Ind	250
White River, Muncie, Ind	500
Tippecanoe River, Winamac, Ind	300
Tippecanoe River, Monticello, Ind	500
Big Walnut Creek, Greencastle, Ind	300
Huff Lake, Argos, Ind	100
Fall Creek, Indianapolis, Ind	300
St. Joseph Lake, South Bend, Ind	300
Pretty Lake, Plymouth, Ind	200
Gravel Pit, Ossian, Ind	100
Indian Creek, New Albany, Ind	300
Sugar Creek, Crawfordsville, Ind	300
White River, Castleton, Ind	500
White River, Winchester, Ind	300
Wabash River, Williamsport, Ind	500
Sugar Creek, Thorntown, Ind	300
Mine Pond, Clarks, Ind	200
Blue River, Shelbyville, Ind	500
Lewis Reservoir, Lewis, Ind	650
Shriner Lake, Columbia City, Ind	300
Round Lake, Columbia City, Ind	300
Cedar Lake, Columbia City, Ind	300
Quarry Pond, Bloomington, Ind	150
Clements Mill Pond, Chrisney, Ind	83
Canning Factory Pond, Chrisney, Ind	167
Walnut Fork of Eel River, Greencastle, Ind	300
Simonton Lake, Elkhart, Ind	200
Wabash River, Gibson County, Ind	275
Applicants in Indiana	4,700
Spring Lake, Davis, Ind. T	100
Rock Creek, Davis, Ind. T	200
Mountain Stream, Talihina, Ind. T	200
Shannon Pond, Purcell, Ind. T	100
Bratcher Lake, Ardmore, Ind. T	100
Fish Lake, Ardmore, Ind. T	100
Applicants in Indian Territory	875
Fish Lake, Buffalo Center, Iowa	500
Fish Lake, Corydon, Iowa	500
Boyer River Mill Pond, Dow City, Iowa	750
Crane Creek, Riceville, Iowa	500
North Fork of Maquoketa River, Dyersville, Iowa	1,000
Maquoketa River, Manchester, Iowa	3,000
Cedar River, Cedar Rapids, Iowa	4,000
Wapsipinnicon River, Independence, Iowa	3,380
Mississippi River, Dubuque, Iowa	5,000
Little Turkey River, Waucoma, Iowa	200
Applicants in Iowa	800
Smoky Hill River, Enterprise, Kans	300
Wisner Creek, Hutchinson, Kans	400
Spring Lake, Abilene, Kans	300
Connor Creek, Connor, Kans	200
Little Arkansas River, Hutchinson, Kans	300
Spring Lake, Nashville, Kans	100
North Fork of Sappy Creek, Oberlin, Kans	50
Spring Creek, Coldwater, Kans	200
Willow Lake, Bavaria, Kans	50
Little Arkansas River, Wichita, Kans	600
Spring Creek, Grainfield, Kans	150
Lake Chanute, Olathe, Kans	150
Elkhorn Creek, Lincoln Center, Kans	300
Rock Creek, Sabetha, Kans	300
Mule Creek, Wilmore, Kans	200
Hazel Dell Lake, Garnett, Kans	75
West Park Lake, Parsons, Kans	250
Black bass—Continued.	
Wea Creek and Bull Creek, Paola, Kans	150
Rattlesnake Creek, Macksville, Kans	200
Saline River, Grinnell, Kans	300
Spring Branch, Prairie View, Kans	150
Branch of Solomon Creek, Topeka, Kans	350
Lakeview Lake, Larned, Kans	200
Fish Lake, Hilltop, Kans	600
Dennis Lake, Manhattan, Kans	200
McDowell Creek, Manhattan, Kans	300
Blue River, Manhattan, Kans	150
Baldwin Creek, Manhattan, Kans	150
King Creek, Manhattan, Kans	150
Deep Creek, Manhattan, Kans	150
Wild Cat Creek, Manhattan, Kans	300
Pfeil Creek, Manhattan, Kans	150
Mill Creek, Manhattan, Kans	150
Eureka Lake, Manhattan, Kans	150
Lowland Lake, Muscotah, Kans	200
Mulberry Creek, Dodge City, Kans	300
Playters Lake, Pittsburg, Kans	250
Spring Pond, Coldwater, Kans	150
Applicants in Kansas	4,050
Rolling Fork Creek, Lebanon, Ky	200
Spring Lake, Covington, Ky	300
Dix River, Lancaster, Ky	500
Oak View Lake, Versailles, Ky	150
Deaf Mute Institute Pond, Danville, Ky	100
Geigers Lake, Henshaw, Ky	200
Cumberland River, Pineville, Ky	400
Reservoir, Springfield, Ky	180
Clear Creek, Shelbyville, Ky	200
Kinniconick River, Vanceburg, Ky	600
Railroad Reservoir, Cumberland Falls, Ky	825
Elkhorn Creek, Georgetown, Ky	300
Little River, Hopkinsville, Ky	400
Jones Pond, Nolin, Ky	100
Lake Reba, Richmond, Ky	200
Spring Lake, Madisonville, Ky	200
Mill Creek, Fredonia, Ky	200
Willow Pond, Hodgensville, Ky	200
Livingston Creek, Fredonia, Ky	400
Waterworks Reservoir at Springfield, Ky	180
Ilsley Lake, Ilsley, Ky	100
Guiest Creek, Shelbyville, Ky	300
Clear Creek, Shelbyville, Ky	300
Bull Skin Creek, Shelbyville, Ky	150
Tyler Pond, Shelbyville, Ky	100
Wild Cherry Pond, Brent, Ky	250
Barber Pond, Hopkinsville, Ky	200
Green River, McKinney, Ky	300
Fern Lake, Middlesboro, Ky	400
Floyds Fork Creek, Fisherville, Ky	100
Washiers Pond, Hodgensville, Ky	100
Applicants in Kentucky	5,750
Sunrise Lake, Mansfield, La	150
City Park Lake, New Orleans, La	225
Chaplin Lake, Natchitoches, La	150
Lake Marie, Natchitoches, La	150
Manheim Pond, Robeline, La	75
Red Bayou, Shreveport, La	200
Youskee Lake, Shreveport, La	200
Lake Julia, Brevelle, La	100
Mill Pond, Keithville, La	75
Spring Branch, Lafayette, La	150
Magnolia Lake, Verry, La	175
Banner Pond, Kentwood, La	100
Applicants in Louisiana, La	525
Antietam Creek, Hagerstown, Md	100
Chevy Chase Lake, Chevy Chase, Md	100
Applicant at Cumberland, Md	50
Percival Pond, Orleans, Mass	75
Factory Pond, Fall River, Mass	75
Lake Acoaxet, Fall River, Mass	75
Middleboro Lakes, Rock, Mass	50

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
Roden Pond, Lynn, Mass	50
Silver Lake, Plympton, Mass	150
Crane Pond, Newburyport, Mass	150
Applicant at Hamilton, Mass	50
Boardman Lake, Traverse City, Mich	450
Gull Lake, Yorkville, Mich	1,000
Crooked Lake, Watersmeet, Mich	500
Big Platte Lake, Beulah, Mich	500
Burgess Lake, Greenville, Mich	300
Coady Lake, Coral, Mich	300
Devils Lake, Devils Lake, Mich	500
Whites Lake, Kalamazoo, Mich	300
Eagle Lake, Edwardsburg, Mich	1,000
Juno Lake, Edwardsburg, Mich	500
Christiana Lake, Edwardsburg, Mich	500
Round Lake, Hanover, Mich	300
String of Lakes, Oxford, Mich	300
Stony Lake, Oxford, Mich	300
Bald Eagle Lake, Oxford, Mich	500
Pleasant Lake, Leslie, Mich	300
Klinger Lake, White Pigeon, Mich	500
Holland Lake, Sheridan, Mich	300
Bailey Lake, Claire, Mich	500
Eagle Lake, Willmar, Minn	500
Pike Lake, Duluth, Minn	1,000
Madison Lake, Mankato, Minn	1,000
Lake Minnewaska, Glenwood, Minn	1,000
Fish Club's Lake, Holly Springs, Miss	300
Beech Spring, Topton, Miss	125
Tupelo Park Lake, Tupelo, Miss	250
Artificial Lake, Tupelo, Miss	250
Spring Branch, Myrtle, Miss	150
Arundel Lake, Meridian, Miss	300
Horseshoe Lake, Aberdeen, Miss	400
Lower Dead River, Aberdeen, Miss	250
Tibbs Lake, West Point, Miss	350
Spring Lake, Macon, Miss	200
Mill Pond, Olive Branch, Miss	150
McPherson Lake, Mhoon Valley, Miss	250
Mooreville Park Lake, Corinth, Miss	200
Tuscumbia River, Corinth, Miss	200
Alligator Lake, Columbus, Miss	100
Buttahachie River, Greenwood Springs, Miss	200
Tombigbee River, Bigbee, Miss	200
Aberdeen, Miss	200
Columbus, Miss	200
Donald Lake, Baldwyn, Miss	100
Chatauqua Lake, Crystal Springs, Miss	150
Tchula Lake, Tchula, Miss	200
Silver Creek, Yazoo City, Miss	200
Yokanookany River, McCool, Miss	100
Big Black River, Pickens, Miss	200
Applicants in Mississippi	10,900
James River, Aurora, Mo	300
James Fork of White River, Aurora, Mo	250
Duck Lake, Schell City, Mo	100
Woods Pond, Shelbina, Mo	100
Spring Lake, Schell City, Mo	100
Greenwood Lake, Greenwood, Mo	100
Clear Lake, Bois d'Arc, Mo	150
Pond and stream, Joplin, Mo	150
Cutoff Lake, Brunswick, Mo	248
Pryor Lake, Redbridge, Mo	100
Montgomery Lake, Saginaw, Mo	100
Shipman Springs, Ritchie, Mo	75
James River, Galloway, Mo	75
Herrells Branch, Neosho, Mo	16
Applicants in Missouri	325
Flat Willow, Harlowton, Mont	300
Hogue Lake, Columbia Falls, Mont	200
Lake Blaine, Kalispel, Mont	300
Boorman Lake, Kalispel, Mont	300
Echo Lake, Kalispel, Mont	300
Black bass—Continued.	
Gilkerson Lake, Harlowton, Mont	200
Applicant at Cinnabar, Mont	200
Fish Lake, Whitman, Nebr	300
Box Butte Creek, Hay Springs, Nebr	150
Lake Ericson, Greeley, Nebr	200
Red Willow Pond, Indianola, Nebr	200
Indian Creek, Benkelman, Nebr	140
Applicants in Nebraska	250
Lamprey River, New Market, N. H	50
Spring Lake, Portales, N. Mex	75
Spring River, Roswell, N. Mex	375
Ojitos Creek, Springer, N. Mex	75
Alamositos Creek, Springer, N. Mex	150
Applicants in New Mexico	1,025
Canisteo River, Addison, N. Y	100
Black Brook, St. Joseph, N. Y	50
Snyder Lake, West Sandlake, N. Y	50
French Broad River, Hot Springs, N. C	150
Spring Creek, Hot Springs, N. C	100
Ochlawakee Creek, Hendersonville, N. C	50
Spirit Wood Lake, Jamestown, N. Dak	6,525
Fish Lake, Rolla, N. Dak	806
Willow Lake, Rolla, N. Dak	500
Sanborn, N. Dak	500
Spring Lake, Edgerley, N. Dak	200
Fish Lake, Kulm, N. Dak	150
Wagner Lake, Sidney, Ohio	150
Pond and stream, Greenwich, Ohio	150
St. Joseph Lake, Carthage, Ohio	100
Waterworks Lake, Blanchester, Ohio	200
Hazledell Pond, Clinton, Ohio	100
Cliff Lake, Springfield, Ohio	185
Beaver Creek, Springfield, Ohio	375
Maumee River, Antwerp, Ohio	300
Sandy Lake, Ravenna, Ohio	500
Grand River, West Farmington, Ohio	500
Vermillion Lake, Ashland, Ohio	500
Middle Basin Pond, Coshocton, Ohio	90
Applicants in Ohio	1,930
Threemile Creek, Weatherford, Okla	200
Spring Branch, Woodward, Okla	400
Deer Creek, Deer Creek, Okla	200
Salt Lake, Yeldell, Okla	200
Yost Reservoir, Guthrie, Okla	200
Frisco River, Guymon, Okla	900
Spring Lake, Woodward, Okla	400
Sanders Pond, Okarche, Okla	100
Crutcho Creek, Oklahoma, Okla	200
North Canadian River, Oklahoma, Okla	400
Applicants in Oklahoma	2,500
West Branch Susquehanna River, Muncy, Pa	100
Allegheny River, Tidioute, Pa	300
Twolick Brook, Blairsville Junction, Pa	100
Susquehanna River, Lockhaven, Pa	500
Loyalhanna Creek, Latrobe, Pa	205
Allegheny River, Oil City, Pa	300
Lake Boquet, Latrobe, Pa	75
Oswayo Creek, Shinglehouse, Pa	100
Conococheague Creek, Chambersburg, Pa	50
Conneaut Lake, Cambridge, Pa	450
Sunnyside Pond, Volant, Pa	100
Waterworks Reservoir, Washington, Pa	225
Red Bank Creek, Maysville, Pa	300
Applicants in Pennsylvania	120
Rhode Island Fish Commission, Westerly, R. I	250
Rhode Island Fish Commission, Providence, R. I	250
Mill Pond at Tiverton, R. I	50

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
Silver Lake, Wakefield, R. I	75
Roost Pond, Beaufort, S. C	50
Drayton Swamp, Sheldon, S. C	250
Pacolet River, Converse, S. C	350
Sheldon Preserve Pond, Sheldon, S. C	100
Reedy and Saluda rivers, Greenville, S. C	150
Seneca River, Calhoun, S. C	100
Saxton Mill Pond, Spartanburg, S. C.	100
Fair Forest Creek, Spartanburg, S. C.	150
Reedy River, Greenville, S. C	450
Mill Pond, Greenville, S. C	50
Rock Quarry Pond, Edgefield, S. C.	200
Reedy River, Laurens, S. C	100
Enoree River, Fountain Inn, S. C	300
Whitney Pond, Spartanburg, S. C.	100
Applicants in South Carolina	1,175
Artesian Lake, Tyndall, S. Dak	300
Eads Lake, Tyndall, S. Dak	300
Mackintosh Lake, Tyndall, S. Dak.	300
Foot Creek, Aberdeen, S. Dak	900
James River, Huron, S. Dak	1,043
Lake Donald, Huron, S. Dak	143
Shoe Creek, Huron, S. Dak	243
Whitestone Creek, Wilmot, S. Dak.	500
Whiteclay Creek, Pine Ridge Agency, S. Dak	500
Emanuel Creek, Springfield, S. Dak	1,200
James River, Mitchell, S. Dak	500
Alexandria, S. Dak	644
Lake Tetonkaha, Volga, S. Dak	500
Turkey Creek, Volin, S. Dak	500
Frasin Lake, Mitchell, S. Dak	100
Lake Kampeska, Watertown, S. Dak	500
Antelope Creek, Rosebud, S. Dak	300
Lake Chilohwee, Canova, S. Dak	143
Applicants in South Dakota	1,700
Red River, Clarksville, Tenn	261
Horse Creek, Bethel Springs, Tenn	125
Elk Fork Creek, Sadlersville, Tenn	300
Millpond, Lawrenceburg, Tenn	100
Piney River, Nunnelly, Tenn	200
McKinstry Pond, Oakland, Tenn	125
Beaver Creek, Huntingdon, Tenn	900
Big Pigeon River, Newport, Tenn	75
Railroad Reservoir, Winfield, Tenn	825
Idaho Creek, St. Bethlehem, Tenn	183
Applicants in Tennessee	2,801
Artificial Lake, Chesterville, Tex	50
Lower State Lake, Rusk, Tex	200
Spring Creek, Hillsboro, Tex	50
Old Reservoir, Jacksonville, Tex	100
Old River Bed Pond, Marlin, Tex	1,000
Poynors Lake, Athens, Tex	50
New Years Creek, Stone, Tex	1,000
Mosque Creek, Marfa, Tex	700
Bold Spring Lake, West, Tex	200
Hurst Lake, Fort Worth, Tex	500
Alligator Lake, Fort Worth, Tex	400
Clear Fork of Trinity River, Fort Worth, Tex	370
Trinity River, Fort Worth, Tex	750
Mill Pond, Greenville, Tex	100
Trippett Lake, Fort Worth, Tex	300
Lake Watts, Waco, Tex	150
Daniel Lake, Lerens, Tex	275
Fish Pond, Laredo, Tex	400
Fish Lake, Corsicana, Tex	300
Bass Lake, Waco, Tex	75
Highland Club Lake, Dallas, Tex	400
Fish Lake, Elgin, Tex	500
Oak Lake, Waco, Tex	300
Oltorf Lake, Marlin, Tex	300
Clear Lake, Longview, Tex	500
Mound Lake, Longview, Tex	300
McKinley Lake, Longview, Tex	300
Spring Creek, Plano, Tex	500
Mitchell Lake, Nacogdoches, Tex	1,000
Tubbins Mill Pond, Nacogdoches, Tex	1,000

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
Old River Lake, Nacogdoches, Tex.	2,000
Conch Creek, Miami, Tex	400
Rock Creek, Hallettsvile, Tex	1,000
Washita River, Canadian, Tex	900
Comanche Creek, Pecos, Tex	1,000
Westude Lake, Crockett, Tex	800
Graham Lake, Overton, Tex	500
Elmendorf Lake, San Antonio, Tex.	500
Gordon Lake, Paris, Tex	1,075
Fish Lake, Brownwood, Tex	400
Sweetwater Lake, Sweetwater, Tex	200
Railroad Lake, Wills Point, Tex	500
Buffalo Bayou, Houston, Tex	200
Pecan Springs, Austin, Tex	75
Erwin Lake, Honey Grove, Tex	800
Fish Lake, Claude, Tex	1,150
Lake Nevill, Longview, Tex	100
Fish Pond, Marlin, Tex	300
Elm Creek, Ballinger, Tex	1,000
Fish Pond, Rosebud, Tex	300
West Lake, West, Tex	175
Wanoreck Lake, Rockdale, Tex	100
Brandon Canal, Altair, Tex	1,000
Walnut Spring, Austin, Tex	50
Waterworks Pond, Taylor, Tex	200
Lake Kuykendall, Taylor, Tex	200
The Lake, Elkhart, Tex	1,500
Lake Wichita, Wichita Falls, Tex	500
Crescent Lake, Wichita Falls, Tex	500
Fish Lake, Greenville, Tex	400
Sportsmens Lake, Petty, Tex	125
Willard Lake, Waco, Tex	200
Lake Park Lake, Tyler, Texas	1,000
Moores Lake, Tyler, Tex	500
Camp Creek Lake, Higgins, Tex	200
Coldwater Creek, Strafford, Tex	400
Clear Creek, Canadian, Tex	300
Lake Alford, Wills Point, Tex	350
Howell Lake, Wills Point, Tex	300
Finney Lake, Wills Point, Tex	300
Owen Lake, Wills Point, Tex	500
Montague Pond, Wills Point, Tex	150
Fish Lake, Wills Pond, Tex	300
Fish Lake, Overton, Tex	300
Lake Surprise, Overton, Tex	300
Lake Eloise, Waco, Tex	1,150
Springdale Lake, Sherman, Tex	250
Colorado and Lampasas rivers, Lampasas, Tex	1,000
Tributary of Lampasas River, Lampasas, Tex	1,000
Sulphur Fork of Lampasas River, Lampasas, Tex	200
Fish Lake, Dallas, Tex	1,000
Orphans' Home lakes, Orphans Home, Tex	800
Fish Lake, Livingstone, Tex	400
Chapman Lake, Overton, Tex	100
Parish Lake, Crockett, Tex	250
Reddin Lake, Naples, Tex	1,375
Mann Lake, West, Tex	400
Trinity Lake, Dallas, Tex	3,000
Fish Lake, Dallas, Tex	1,000
Fish Lake, Hamshire, Tex	1,000
Fish Pond, Lufkin, Tex	1,000
Watson Lake, Stone, Tex	500
McGlanthery fish tank, Corsicana, Tex	200
Fish Lake, Santa Anna, Tex	50
Johnsons Pond, West, Tex	100
Swindall tank, Terrell, Tex	100
Lake Polk, Temple, Tex	800
Gageby Creek, Canadian, Tex	400
Hackberry Creek, Canadian, Tex	400
Private lake, Canadian, Tex	150
Spring Park Lake, Palestine, Tex	500
Sour Lake, Sour Lake, Tex	2,500
Artificial Lake, Lott, Tex	100
Newtons Lake, Pilot Point, Tex	200
Wood Lake, Sherman, Tex	600
Honey Grove Lake, Honey Grove, Tex	800

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass—Continued.	
San Gabriel River, Georgetown, Tex	1,500
Palace Lake, Elkhart, Tex	250
Spring Lake, Bonham, Tex	1,900
Seven Springs, Roanoke, Tex	100
Onion Creek, Manchaca, Tex	500
Bonita Lake, Marshall, Tex	1,000
Carlisle Lake, Chapel Hill, Tex	500
Paradise Creek, Vernon, Tex	400
Railroad Lake, Coleman Junction, Tex	100
Little Conch River, San Angelo, Tex	200
Tanks, Cactus, Tex	1,000
Fish Lake, Longview, Tex	175
Two Lakes, Marlin, Tex	500
Fish Lake, Terrell, Tex	100
Bois D'Arc Creek, Wetherford, Tex	450
Fish Pond, Aldine, Tex	400
Applicants in Texas	14,540
Echo Lake, Brandon, Vt	50
Eddy Pond, Rutland, Vt	50
South River, Grottoes, Va	50
Shenandoah River, Boyce, Va	50
Spring Lake, Parkersburg, W. Va	500
Big Sandy River, Naugatuck, W. Va	250
Kanawha River, Fishing Camp, W. Va	200
Elk River, Charleston, W. Va	207
Buffalo and Cross creeks, Wellsburg, W. Va	150
Tygarts Valley River, Fairmont, W. Va	150
Spring Run, Bunker Hill, W. Va	100
Elk River, Centralia, W. Va	100
Yellow River, Necedah, Wis	1,040
Diamond Lake, Drummond, Wis	1,000
Spread Eagle Lake, Florence County, Wis	500
Dinwiddie Lake, Sheridan, Wyo	200
Total	262,157
Crappie:	
Jones Mill Pond, Waverly, Ala	300
Spring Lake, Opelika, Ala	100
Blue Creek, Johns, Ala	100
Grassy Lake, Wilton, Ark	200
Mudge Pond, Sharon, Conn	100
Lonetree Lake, Lonetree, Ill	1,000
Toledo Reservoir, Toledo, Ill	150
Soldiers' Home Lake, Danville, Ill	790
Applicant in Illinois	50
Leatherwood Creek, Bedford, Ind	50
Indian Creek, Bedford, Ind	50
Salt Creek, Bedford, Ind	50
Patoka River, Jasper, Ind	25
White River, Noblesville, Ind	175
Waterworks Lake, Bloomington, Ind	25
Calumet Lake, Jasper, Ind	150
Stevenson Pond, Bloomington, Ind	25
Pigeon Creek, Boonville, Ind	120
Indian Creek, New Albany, Ind	25
Simonton Lake, Elkhart, Ind	200
Applicants in Indiana	50
Mountain Stream, Talihina, Ind. T	500
North Fork of Maquoketa River, Dyersville, Iowa	500
Maquoketa River, Manchester, Iowa	600
Cedar River, Cedar Rapids, Iowa	700
Wapsipinnicon River, Independence, Iowa	720
Mississippi River, Dubuque, Iowa	700,000
Applicant at Leon, Iowa	100
Spring Lake, Nashville, Kans	100
Spring Lake, Syracuse, Kans	100
Little Arkansas River, Wichita, Kans	200
Bull Creek, Paola, Kans	170
Crappie—Continued.	
Little Arkansas River, Halstead, Kans	200
McDowell Creek, Manhattan, Kans	150
Eureka Lake, Manhattan, Kans	230
Wild Cat Creek, Manhattan, Kans	255
Blue River, Manhattan, Kans	55
Baldwin Creek, Manhattan, Kans	55
Kings Creek, Manhattan, Kans	55
Deep Creek, Manhattan, Kans	55
Pfeil Creek, Manhattan, Kans	55
Mill Creek, Manhattan, Kans	55
Lake Chanute, Olathe, Kans	170
Fish Lake, Hill-top, Kans	200
Applicants in Kansas	855
Karlsruhe Pond, Newport, Ky	25
Fern Lake, Middlesboro, Ky	15
Cemetery Lake, Louisville, Ky	125
Reservoir, Slaughtersville, Ky	100
Barren River, Bowling Green, Ky	100
Kinniconick River, Vanceburg, Ky	175
Lake Mingo, Nicholasville, Ky	25
Spring Lake, Madisonville, Ky	100
Ilsley Lake, Ilsley, Ky	100
Nolin River, Nolin, Ky	100
Paynes Pond, Georgetown, Ky	77
Applicants in Kentucky	453
City Park Lake, New Orleans, La	125
Chaplin Lake, Natchitoches, La	200
Manheim Pond, Robeline, La	100
Red Bayou, Shreveport, La	200
Youseeka Lake, Shreveport, La	200
Lake Julia, Brevelle, La	200
Bayou Dorchita, Haughton, La	200
Yarbrough Lake, Mansfield, La	100
Applicant at Mansfield, La	100
Eagle Lake, Willmar, Minn	250
Leech Lake, Walker, Minn	250
Little Spring Creek, Waterford, Miss	200
Chautauqua Lake, Crystal Springs, Miss	200
Lutz Lake, Canton, Miss	200
Constantine Lake, Shuqualak, Miss	100
Fords Pond, Waterford, Miss	200
Mooreville Park Lake, Corinth, Miss	200
Buttahachie River, Greenwood Springs, Miss	200
Tombigbee River, Bigbee, Miss	200
Aberdeen, Miss	200
Columbus, Miss	200
Tchula Lake, Tchula, Miss	200
Yokanookany River, McCool, Miss	200
Big Black River, Pickens, Miss	200
Silver Creek, Yazoo City, Miss	200
Applicants in Mississippi	1,950
Duck Lake, Schell City, Mo	250
Lake Ericson, Greeley, Nebr	200
Private Lake, Greeley, Nebr	100
Rancocas River, Mt. Holly, N. J	50
Opennaki Lake, Morristown, N. J	50
Spring Lake, Morristown, N. J	50
Elkwood Lake, Newark, N. J	50
Richmondtown Lake, Woodstown, N. J	50
Quick Pond, Swartswood, N. J	50
Fish Lake, Kingston, N. J	100
French Broad River, Hendersonville, N. C	100
Spirit Wood Lake, Jamestown, N. Dak	300
Springfield Lake, Akron, Ohio	100
Cliff Lake, Springfield, Ohio	90
Buck Creek, Springfield, Ohio	140
Pennypack Creek, Hatboro, Pa	200
Crystal Lake, Carbondale, Pa	100
Porters Lake, Stroudsburg, Pa	100
Deer Lake, Stroudsburg, Pa	150
Forest Lake, Stroudsburg, Pa	100
Lake Minisink, Stroudsburg, Pa	100

Details of distribution—Continued.

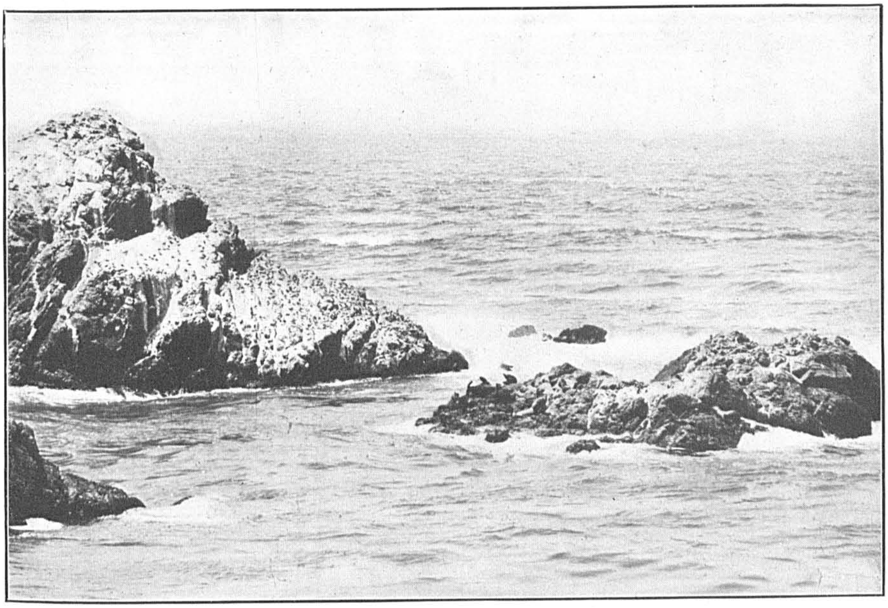
Species and disposition.	Adults and yearlings.
Crappie—Continued.	
Lake Taminent, Stroudsburg, Pa	100
Jones Lake, Montrose, Pa	390
Perkiomen Creek, Norristown, Pa	100
Schuylkill River, Norristown, Pa	100
Sugar Loaf Lake, Hazleton, Pa	250
Lake Clerno, Hoadleys, Pa	100
Juniata River, Huntingdon, Pa	400
Stone Creek, Huntingdon, Pa	200
Harveys Lake, Alderson, Pa	100
Frankstown Branch, Juniata River, Spruce Creek, Pa	150
Frankstown Branch, Juniata River, Barre, Pa	175
Aughwick Creek, Hopewell, Pa	50
Lake St. Clair, Latrobe, Pa	100
Raystown Branch of Juniata River, Hopewell, Pa	25
Raystown Branch of Juniata River, Riddlesburg, Pa	125
Raystown Branch, Juniata River, Everett, Pa	100
Raystown Branch, Juniata River, Saxton, Pa	225
Ludwig Run, Ebensburg, Pa	100
Conneaut Lake, Cambridge, Pa	100
Trough Creek, Mapleton, Pa	50
Twelve Mile Lake, Stroudsburg, Pa	100
Silver Lake, Morton, Pa	100
Applicant at Jermyn, Pa	50
Foot Creek, Aberdeen, S. Dak	700
James River, Huron, S. Dak	700
Lake Donald, Huron, S. Dak	150
Shoe Creek, Huron, S. Dak	200
James River, Mitchell, S. Dak	300
Frasin Lake, Mitchell, S. Dak	150
Beaver Creek, Huntingdon, Tenn	500
Orchard Pond, Tioga, Tex	45
Old River Bed Pond, Marlin, Tex	100
Restleys Creek, Dublin, Tex	200
Greens Creek, Clairette, Tex	100
Bosque River, Clairette, Tex	200
Four Ponds, Marfa, Tex	100
Crescent Lake, McNeil, Tex	500
Litttle Brazos River, Hearne, Tex	300
Onion Creek, Manchaca, Tex	100
Oltorf Lake, Marlin, Tex	150
San Gabriel River, Georgetown, Tex	350
Cannon Creek, Marfa, Tex	100
West Side Lake, Crockett, Tex	200
Elmendorf Lake, San Antonio, Tex	75
Waterworks Pond, Taylor, Tex	100
Washita River, Canadian, Tex	250
Dads Creek, Canadian, Tex	150
Du Tait Creek, Canadian, Tex	100
Beaver Lake, Canadian, Tex	30
North Creek, Canadian, Tex	100
White River, Canadian, Tex	50
Bear Creek, Manchaca, Tex	100
Club Lake, Austin, Tex	40
Applicants in Texas	985
Potomac River, Daysville, Va	200
Fish Pond, Winston, Va	200
Broad Run, Manassas, Va	200
Bull Run, Manassas, Va	200
Cedar Run, Manassas, Va	200
Occoquan Run, Manassas, Va	200
Fish Pond, Amherst, Va	200
Shadybrook Pond, Glencarlyn, Va	100
Piedmont Pond, Charlottesville, Va	200
Fish Pond, North Garden, Va	200
Tinker Creek, Hollins, Va	50
Fish Lake, The Plains, Va	200
North Fork Creek, North Fork, Va	200
Applicants in Virginia	400
Kanawha River, Fishing Camp, W. Va	1,000
Elk River, Charleston, W. Va	240
Sleepy River, Hancock, W. Va	200
Cold Run Creek, Hancock, W. Va	200
Dinwiddie Lake, Sheridan, Wyo	200
Total	735,120
Rock bass:	
Sandy Creek Mill Pond, Opelika, Ala	200
Applicant in Alabama	100
Applicant in Arkansas	100
Mudge Pond, Sharon, Conn	200
Reservoir, Covington, Ga	100
Applicants in Georgia	400
Vermillion River, Danville, Ill	200
Applicants in Illinois	200
Waterworks Lake, Bloomington, Ind	200
Applicants in Indiana	700
Applicant at Dewey, Ind. T	200
Applicant at Harlan, Iowa	200
Fish Lake, Hilltop, Kans	500
Fall Creek, Caldwell, Kans	200
Applicants in Kansas	800
Reservoir, Slaughtersville, Ky	150
Fern Lake, Middleboro, Ky	200
Spring Lake, Madisonville, Ky	150
Applicants in Kentucky	200
Middleboro Lakes, Rock, Mass	400
Applicant at Northampton, Mass	200
Horseshoe Lake, Macon, Miss	300
Harpers Lake, Brooksville, Miss	300
Applicants in Mississippi	6,290
Fishing Club Pond, Glasgow, Mo	500
Woods Pond, Schell City, Mo	100
Spring Lake, Schell City, Mo	500
Eden Green Ponds, Chillicothe, Mo	200
Cutoff Lake, Brunswick, Mo	200
Fish Lake, Billings, Mo	500
Applicants in Missouri	800
Nebraska Fish Commission, Soúth Bend, Nebr	1,000
Las Palomas Creek, Engle, N. Mex	400
North Spring River, Roswell, N. Mex	200
Applicants in New Mexico	600
Fish Lake, Rockville Center, N. Y	200
Rhetts Lake, Hendersonville, N. C	1,000
Mattamuskeet Lake, Elizabeth City, N. C	200
Applicants in North Carolina	500
Applicant at New Salem, N. Dak	200
Odell Lake, Lakeville, Ohio	200
Applicants in Ohio	500
Applicants in Oklahoma	1,100
Antietam Creek, Reading, Pa	200
Porters Lake, Stroudsburg, Pa	400
Aughwick Creek, Shirley, Pa	50
Harveys Lake, Alderson, Pa	400
Juniata River, Lewistown, Pa	300
Swatara Creek, Meyerstown, Pa	400
Cocalamus Creek, Mifflin, Pa	100
Ludwig Run, Ebensburg, Pa	200
Middle Creek, Fairfield, Pa	200
Applicants in Pennsylvania	100
Fish Pond, Allendale, S. C	400
Fish Lake, Carthage, Tenn	400
Duck Run, Columbia, Tenn	925
Mill Pond, Lawrenceburg, Tenn	800
Hurricane Creek, Waverly, Tenn	400
Aughtry Lake, Richland, Tex	500
Upper State Lake, Rusk, Tex	175
Bold Spring Lake, West, Tex	175
Creek, Carrizo Springs, Tex	250
Fish Lake, Waco, Tex	150
Gibson Lake, Palestine, Tex	75
Gordon Lake, Paris, Tex	500
San Gabriel River, Georgetown, Tex	1,000
West Lake, West, Tex	150
Railroad Lake, Walnut Springs, Tex	200

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Rock bass—Continued.	
Railroad Lake, Cisco, Tex	350
Trinity River, Fort Worth, Tex	400
Fish Lakes, Chico, Tex	250
San Antonio, Tex	150
Applicants in Texas	830
Fish Pond, Richmond, Va	200
Spring Lake, Luray, Va	100
Tacoma Fish Club Pond, Richmond, Va	200
Wolf Creek Mill Pond, Abingdon, Va	200
Ice Pond, Danville, Va	150
James River, Lynchburg, Va	300
City Reservoir, Charlottesville, Va	200
Dowdy Creek, Petersburg, Va	200
Appomattox River, Petersburg, Va	200
Powell Creek, Petersburg, Va	200
Taylor Mill Pond, Warsaw, Va	200
Tinker Creek, Hollins, Va	200
Davis Branch, Catron, Va	200
Piney Creek Mill Pond, Clover, Va	200
Orrix Creek Mill Pond, Evington, Va	200
Goose Creek, Edwards Ferry, Va	1,300
Applicants in Virginia	800
Kanawha River, Fishing Camp, W. Va	300
Total	37,170
Strawberry bass:	
Verde River, Jerome, Ariz	400
Fish Lake, Ardmore, Ind. T	350
Lake Macia, Natchitoches, La	100
Chaplin Lake, Natchitoches, La	200
Youseeka Lake, Shreveport, La	200
Lake Ninock, Ninock, La	100
Scoutaway River, Leasburg, Mo	200
Clear Creek, Bois D'Arc, Mo	100
Lake of the Woods, Fulton, Mo	51
North Spring River, Roswell, N. Mex	200
Yost Reservoir, Guthrie, Okla	500
Spring Lake, Guthrie, Okla	500
Sanders Pond, Okarche, Okla	300
Applicant at Mulhall, Okla	150
San Gabriel River, Georgetown, Tex	200
Total	3,551
Warmouth bass:	
Soldiers Home Lake, Danville, Ill	100
Total	100
Sun-fish:	
Verde River, Jerome, Ariz	200
Beaver Creek, Jerome, Ariz	300
Little River, Wilton, Ark	500
Soldiers Home Pond, Danville, Ill	300
Maquoketa River, Manchester, Iowa	1,400
Cedar River, Cedar Rapids, Iowa	2,400
Wapsipinnicon River, Independence, Iowa	90
Sun-fish—Continued.	
Mississippi River, Dubuque, Iowa	600,000
North Spring River, Roswell, N. Mex	600
Spirit Wood Lake, Jamestown, N. Dak	250
Total	606,040
Bream:	
Mill Pond, Alabama City, Ala	100
Oak Lake, Hooks, Ala	500
Fish Pond, Inverness, Ala	200
Mill Pond, Inverness, Ala	200
Rodgers Lake, Letohatchie, Ala	200
Craddock Lake, Dadeville, Ala	100
Bloom Pond, Eufaula, Ala	800
Dent Pond, Eufaula, Ala	700
Thompson Pond, Eufaula, Ala	200
Chambliss Mill Pond, Montgomery, Ala	200
Jones Mill Pond, Waverly, Ala	200
Briggs Mill Pond, Jasper, Ala	100
Blackwater Mill Pond, Jasper, Ala	100
Ingrams Mill Pond, Opelika, Ala	1,000
Lake View, Opelika, Ala	100
Eley Pond, Union Springs, Ala	300
Howell Pond, Union Springs, Ala	100
Buzzard Pond, Eufaula, Ala	200
Spring Lake, Union Springs, Ala	150
Applicants in Alabama	1,550
Crescent Lake, Cleremont, Fla	200
Lake Ella, Umatilla, Fla	110
Jaques Pond, Macon, Ga	100
Henderson Creek, Jasper, Ga	100
Mill Pond, Jonesboro, Ga	100
Sunnyside, Ga	50
Coleman Mill Pond, Cuthbert, Ga	300
Laza Creek, Talbotton, Ga	150
Juniper Pond, Juniper, Ga	200
Augusta Game Club Pond, Augusta, Ga	300
Spring Creek, Rome, Ga	200
Roundabout Pond, Kirkland, Ga	200
Mill Pond, Greenville, Ga	200
Kings Lake, Box Springs, Ga	300
Hills Fish Pond, Greenville, Ga	200
Brick Yard Pond, Columbus, Ga	500
Hoods Creek, Bostick, Ga	100
Hudson Pond, Hamilton, Ga	200
Crystal Lake, Cuthbert, Ga	209
Green Springs, Columbus, Ga	300
Hooks Mill Pond, Americus, Ga	500
Applicants in Georgia	2,850
Applicants in Mississippi	500
El Caney Lake, Crockett, Tex	150
Old River Bed Pond, Marlin, Tex	500
Crystal Lake, Palestine, Tex	500
Little Brazos River, Hearne, Tex	500
San Gabriel River, Georgetown, Tex	500
Waterworks Pond, Taylor, Tex	100
Trinity River, Fort Worth, Tex	500
Applicants in Texas	80
Total	17,699

Details of distribution—Continued.

Species and disposition.	Fry.	Species and disposition.	Fry.
Cod:		*Lobster*—Continued.	
Woods Hole Great Harbor, Woods Hole, Mass	1,257,000	Gulf of Maine, Me.—Continued.	
Vineyard Sound, Mass.:		Wood Island	1,000,000
Robinsons Hole	32,265,000	Mouth of Indian Harbor	250,000
Tarpaulin Cove	69,574,000	off Eastport Harbor	650,000
Nashewena Island	16,315,000	off Georges Island Harbor	500,000
Quicks Hole	5,231,000	Mickleridge Channel	1,000,000
French Watering Place	3,132,000	Rockland Bay	1,500,000
Hadley Harbor	1,036,000	off Cranberry Island Harbor	700,000
Atlantic Ocean, Gloucester, Mass	60,033,000	East End of Long Island	500,000
Rockport, Mass	23,158,000	near North Point, Isle au Haut	200,000
Total	212,001,000	Outer Bass Harbor	200,000
Flat-fish:		near Scoobic Island	200,000
Woods Hole Great Harbor, Woods Hole, Mass	113,996,000	Casco Bay, Maine:	
Eel Pond, Woods Hole, Mass	13,621,000	Diamond Cove	500,000
Waquoit Bay, Waquoit, Mass	28,557,000	west side of Cow Island	500,000
Hadley Harbor, Hadley Harbor, Mass	7,623,000	off Peaks Island	500,000
Buzzards Bay, Monument Beach, Mass	4,336,000	south shore of Great Diamond Island	2,000,000
Total	168,133,000	west side of Long Island	1,000,000
Lobster:		off Two Brothers Island	1,500,000
Fishers Island Sound, off Noank, Conn	1,151,000	off Mackies Island	1,500,000
Gulf of Maine, Maine:		off Clapboard Island	1,500,000
Goose Fair Bay	1,800,000	Biddiford Pool, Me	1,000,000
Portland Head	500,000	Fore River, Portland Harbor, Me	1,500,000
Cape Elizabeth	700,000	Atlantic Ocean, Kittery Point, Me	5,400,000
off Cape Porpoise	1,000,000	York Harbor, Me	3,000,000
Small Point	1,500,000	Gloucester, Mass	20,270,000
Sequin Island	1,000,000	Rockport, Mass	1,800,000
Cape Newagen	1,500,000	Beverly, Mass	8,800,000
Pemaquid Point	1,000,000	Boston, Mass	3,800,000
West Boothbay Bay Harbor	1,000,000	Manchester, Mass	370,000
Kennebunk Beach	500,000	Wellfleet Harbor, Wellfleet, Mass	932,000
		Scituate Harbor, mouth of Scituate Harbor, Mass	1,017,000
		Woods Hole Great Harbor, Woods Hole Harbor, Mass	1,118,000
		Atlantic Ocean, Isle of Shoals, N. H	2,200,000
		Wickford Harbor, Wickford, R. I	2,462,000
		Total	81,020,000



SEA LIONS AT CLIFF HOUSE, SAN FRANCISCO.

PUPS ABOUT FOUR WEEKS OLD.

REPORT ON THE INQUIRY RESPECTING FOOD-FISHES AND THE FISHING-GROUNDS.

By Hugh M. Smith, *Assistant in Charge*.

COASTAL AND MARINE INVESTIGATIONS AND EXPERIMENTS.

FISHES AND FISHERIES OF HAWAIIAN ISLANDS.

Reference was made in the report for the fiscal year ending June 30, 1901, to the party sent by the Commission to the Hawaiian Islands to make the investigation of the fisheries of those islands called for by the act of Congress of April 30, 1900. The investigations were carried on during the summer of 1901 and completed as far as the circumstances permitted. Most of the islands were visited; the fishery methods, appliances, laws, and customs were studied; a thorough statistical canvass of the commercial fisheries was made, and a very large and valuable collection of fishes was obtained. A preliminary report on the investigations submitted to the President in January, 1902, and by him transmitted to Congress, was printed as a special document (H. R. Doc. No. 249, Fifty-seventh Congress, first session).

It having been determined to continue the investigation of the aquatic resources of the Territory, more especially those in the deeper water, the steamer *Albatross* was detailed for the work, and Dr. D. S. Jordan, of Stanford University, was given general charge. The *Albatross* was fitted out in San Francisco, and sailed for Hawaii on March 11 with a party of naturalists, mostly from Stanford University. The vessel was engaged in this service at the close of the fiscal year.

DESTRUCTIVENESS OF SEA LIONS.

For a number of years the damage supposed to be done to fish and fishing gear by sea lions has been receiving much attention from the fishery interests of the west coast, and the systematic killing of the sea lions has been undertaken in some localities and planned in others, under either State or private auspices.[a]

The following article, from the San Francisco *Bulletin*, is a fairly conservative statement of the fishermen's views:

Fishermen of the North Pacific coast are undertaking a movement for the destruction of the sea lions, the inveterate enemies of salmon and other food-fishes, and which annually make incalculable ravages in the schools of chinooks, steelheads,

[a] According to an official communication, dated January 29, 1903, received through the Department of State from Mr. Victor E. Nelson, United States consul at Bergen, Norway, similar charges are made against the Greenland seal (*Phoca grœnlandica*). It is stated that "the cod have been driven entirely away from those parts of the coast (of Norway) where the seals appear in great masses," and the Government has included in the budget the sums of 4,000 kroner ($1,072) for killing the seals and 15,000 kroner ($4,020) for other repressive measures.

and other varieties of salmon that hover off the Washington and Oregon coast. The last Oregon legislature passed a bill offering a bounty of $2.50 for each sea lion killed in the waters of the State or within one marine league of the Oregon shore. Faulty wording of the bill renders the money set aside for the purpose unavailable, and the Fishermen's Protective Union has raised a fund by private subscription to hire men to shoot the lions at their breeding-grounds.

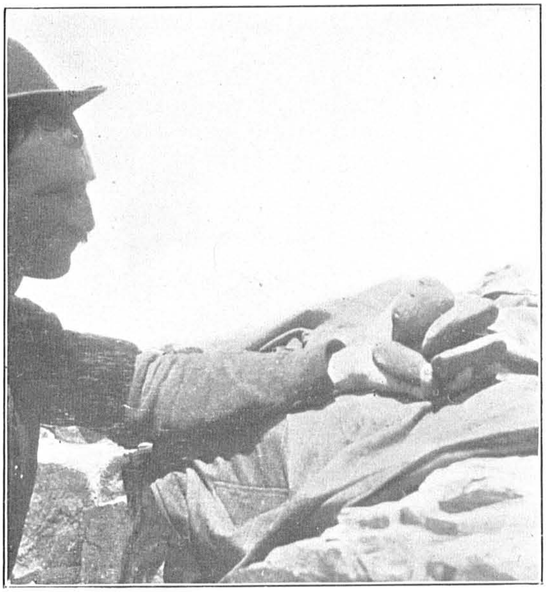
How many salmon each of these monsters kills each day is purely a matter of conjecture, but instances are known where a single sea lion has killed and eaten 18 salmon within a very few minutes, and it is certain that many hundreds of thousands of royal chinook salmon are killed every year by these pests. When fishing, the lions usually travel in groups of from six to eight, and they will follow a school of fish for days. They feast on the fish until they become quite dainty, and will take but one bite from the choicest part of the salmon, leaving the remainder of the fish to float ashore or to be devoured by the scavengers of the seas. The lions vary in size, but when fully grown average about 8 or 10 feet in length, although specimens have been seen fully 18 feet long and which would weigh 4,000 pounds.

It is during the summer months that the lions do the greatest amount of damage. They are numerous at many places along the Pacific coast, but their favorite rendezvous appears to be in the neighborhood of the mouth of the Columbia River. Thousands of them congregate at Seal Rock light-house during the breeding season. These rocks are situated well out from the beach and can be reached only during the extreme low tides of the summer months, thus rendering the retreat of the lions comparatively safe from attack except during isolated periods. After leaving the rocks at the close of the breeding season the lions are even more voracious than usual, and the schools of fish in that region of the ocean have short shrift. Numbers of the lions gather off the mouth of the Columbia River, and the sands of the jetty are black with them during the warm hours of the day. The huge mammals appear to be warned by instinct of the approach of a school of salmon, which is always the signal for a hurried putting to sea, and before the return thousands of the choicest fish in the world have been devoured or so badly mutilated that they will die.

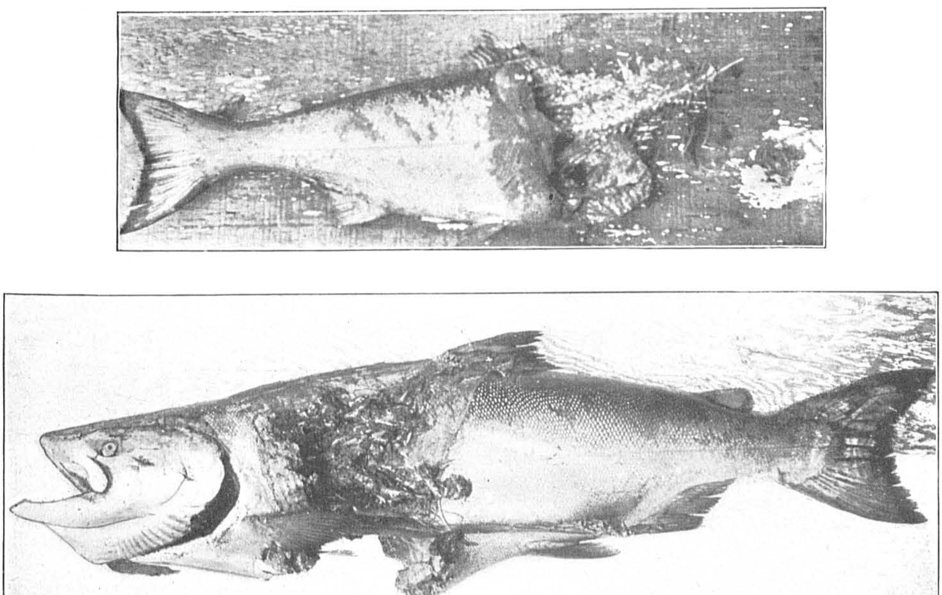
Commercially the sea lions are of little value, and not enough can be realized from their sale to make the killing of them profitable. This, coupled with the extreme difficulty of securing the carcasses of the animals, as the lions take to the water as soon as they are shot, makes the hunting of them a precarious means of livelihood and renders it absolutely necessary that a bounty be paid if the lions are to be exterminated. The hides, which weigh when green about 70 pounds, sell for half a cent a pound. The whiskers of the male sell for from 10 cents to 13 cents for the largest, which are from 10 to 12 inches in length. Those of the female are fewer in number and less valuable, but longer, some reaching 18 inches in length.

A vast amount of valuable fishing gear is destroyed each year by the lions. A big male lion, while in pursuit of a salmon, will become entangled in a gill net or trap, and before it can possibly be released will, by its desperate lashings and biting, tear the web into shreds. The amount of damage done each season would be difficult to estimate, but it is certainly enormous, and their extermination at the least would be of untold benefit to the fishing industry of the coast.

In California the State board of fish commissioners espoused the cause of the fishermen and strongly advocated a reduction of the size of the sea-lion herds on the California coast. As the sea lions can be killed most expeditiously when resorting to rookeries for breeding purposes, and as the rookeries are mostly on islands which are Government reservations under control of the Light-House Board, the California commissioners sought permission for their agents to visit these rookeries and thin out the herds. The granting of this request was opposed



STONES FOUND IN THE STOMACH OF A SEA LION, POINT ARENA, CALIFORNIA.



SPECIMENS OF SALMON FROM GILL NETS, ASTORIA, OREG., SUPPOSED TO HAVE BEEN MUTILATED BY SEA LIONS.

by representatives of the Fish Commission, the Department of Agriculture, and other branches of the Government, on account of lack of evidence showing the destructive habits of the sea lions; and the desired permission was withheld by the Secretary of the Treasury.

Dr. C. Hart Merriam, of the Department of Agriculture, contributed the following article to Science for May 17, 1901, based on the action of the California authorities:

FOOD OF SEA LIONS.

The California State board of fish commissioners during the past two years has taken steps to kill off a very large number of sea lions on the California coast, on the ground that these animals are highly destructive to the salmon fishery. The president of the board, Mr. Alexander T. Vogelsang, claims that it is not the intention of the board to exterminate the sea lions, but merely to kill "10,000 of the 30,000 that now infest our harbor entrance and contiguous territory."* The opinion of observers familiar with the sea-lion rookeries is that the number of animals has been greatly exaggerated, and that long before Mr. Vogelsang has killed the contemplated 10,000 there will not be a living sea lion left on the whole coast. Already many have been killed, and, unless public sentiment is aroused to check the movement, some of the most interesting rookeries of the State are in danger of depletion. The fish commissioners have employed men to shoot the sea lions, and are loud in their lamentations because the Government light-house reservations have not been thrown open to the slaughter.

The local fisherman, the State fish commission, and others assert without qualification that the sea lions feed extensively on salmon, and the inference from their statements is that the animals subsist chiefly, if not entirely, on fish. A few years ago, when similar complaints were made against the fur seals, I took the trouble to examine the stomach contents of a large number of these animals, and found to my surprise that the great bulk of their food consisted of squids, hundreds of whose beaks and pens were found in the stomachs, while in only a few instances were any traces of fish discovered.

In 1899 a well-known naturalist, Prof. L. L. Dyche, of the University of Kansas, spent the months of June, July, August, and September on the California coast, at a time when the sea lions were being slaughtered in the alleged interests of the fishermen. Professor Dyche became interested in the question of their food, and took the trouble to examine the stomachs of twenty-five sea lions, not one of which contained so much as a trace of fish. The region visited extends from Monterey Bay southward along the coast for about 25 miles.

Between June 25 and July 16 there were washed ashore within 3 miles of Point Pinos, at the mouth of Monterey Bay, eight sea lions which had been shot, the fishermen said, because they were feeding on salmon. Professor Dyche examined the stomachs of all of these and has given me a detailed record of the contents of each. It would take too much space to print this in full. Suffice it to state that the remains of squids and cuttlefish (*Octopus*) were found in all, and that several were filled with large pieces of giant squid. Notwithstanding the fact that at the same time and place salmon were being caught by fishermen, not a fish scale or bone was detected in any of the stomachs. Whenever possible Professor Dyche opened the stomachs in the presence of the fishermen, who invariably expressed the greatest surprise at the result.

On July 20 Professor Dyche moved his headquarters southward and established a camp about 12 miles below Monterey Bay, between Point Carmel and the light-house, near which is an extensive rookery of sea lions. Between July 20 and August 16 the stomachs of seventeen additional sea lions were examined. Eight out of the

*In a letter to Hon. Lyman J. Gage, Secretary of the Treasury, dated San Francisco, June 3, 1899.

seventeen were well filled with the flesh of the giant squid; two were gorged with large octopus, while the remaining seven contained pens and beaks of squids, the quantity varying from half a pint to about a quart.

Professor Dyche was told that there were no fish within 2 or 3 miles of the sea-lion rookeries near his camp, as the sea lions had caught or driven them away. In the face of this statement, he himself caught a dozen rock-cod one morning between shore and the seal rocks, and his boatman, George Carr, an old salmon fisherman, caught plenty of rock-cod weighing from 1 to 8 pounds each within 60 feet of the flat rock where from 1 to 300 sea lions landed each day. The water close to these rocks, where sea lions had lived for ages, proved to be the best fishing-ground in the locality. Professor Dyche states further that he landed a number of times on the rocky islands where in places the excrement from the sea lions formed a layer a foot thick. He hunted through this for fish bones and scales, without being able to discover a single one. On the other hand, the tough pens from the backs of the squids were abundant.

Professor Dyche found the fishermen loud in their denunciation of the sea lions on account of their alleged destruction of salmon, but, although he was on the fishing-grounds continuously for more than three months, the fishermen were unable to show him a single instance in which a sea lion had killed a salmon. He adds: "You can hardly imagine the surprised look on these fishermen's faces when they saw the great masses of squid meat roll out of the sea lions' stomachs when cut open."

The fact that sea lions in captivity will eat fish rather than starve has little bearing on the question, and the additional fact that salmon in nets are sometimes found bitten off or eaten is by itself no evidence at all, particularly in places where either sharks or otters occur. It is not claimed that sea lions in their native element never eat fish; at the same time the only actual evidence we have on the subject fails utterly to substantiate the allegations of the fishermen. On the contrary, all of the twenty-five stomachs of sea lions examined by Professor Dyche contained remains of squids or cuttle-fishes, and not one contained so much as the scale or bone of a fish. And is it not significant that in former years, when sea lions were much more plentiful than now, salmon also were vastly more abundant? If the fishermen will look into their own habits and customs during the past twenty-five years, it is believed that the cause of decrease of the salmon will not be difficult to find, and this without charging the decrease to the inoffensive sea lions, whose rookeries constitute one of the greatest attractions to the visitor on the California coast.

In 1901 the California board of fish commissioners again brought up the subject and asked that the United States Fish Commission investigate it. The Commissioner accordingly addressed the following letter to the chairman of the Light-House Board, under date of June 6, 1901:

Respectfully adverting to correspondence between the Light-House Board and this Commission regarding the killing of sea lions on Government reservations on the west coast under supervision of the Light-House Board, I have to advise you that this Commission has been asked by the board of fish commissioners of the State of California to make an investigation of the food and feeding habits of the sea lions on the Californian coast, and that the Commission is disposed to accede to the request of the State authorities, in order that the question at issue may be definitely settled by competent official authority.

I have therefore to request that you will cause to be issued the necessary orders to the keepers of light-house reservations, permitting a duly selected scientific assistant of this Commission, with such associates or aids as he may require, to visit the reservations and make the desired investigations, including the killing of a limited number of animals.

I need hardly assure your board that under the desired permission only the minimum number of sea lions required for the settlement of the question will be killed by the Commission's agent.

The Treasury Department made a favorable response to this request, and steps were taken to begin the inquiry at once. Mr. Cloudsley Rutter, scientific assistant of the Commission, was placed in charge of the investigation; and the California board of fish commissioners and the California Academy of Sciences were asked to nominate representatives to cooperate with Mr. Rutter. In accordance with this invitation, Mr. Robert E. Snodgrass was named by the California Fish Commission and Mr. Edwin C. Starks by the California Academy of Sciences. The instructions issued for the conduct of the investigation called for a consideration of the following subjects: The species of sea lions on the California coast, their characteristics, size, distribution, and general habits; the number and location of the rookeries, and the number of sea lions resorting to each rookery; the food and feeding habits of sea lions, in salt and fresh water, at all seasons; the times and places of the appearance of sea lions in fresh water; the damage to fishing apparatus occasioned by sea lions.

The inquiries were begun July 10 in Half-moon Bay, San Mateo County, about 18 miles south of the Golden Gate. Here Pillar Point and vicinity and the Purissima rookery were visited. This is the only rookery where accurate count of the sea lions can be made, and it was kept under observation throughout the year, semimonthly records being made. From the 13th to the 16th of July the rookery at Ano Nuevo (about midway from Half-moon Bay to Monterey Bay) was under observation, and a number of sea lions were here killed. This is the only rookery which can be visited except during the most favorable weather, and is well suited for the study of feeding and breeding habits.

After leaving Ano Nuevo the party divided, Mr. Rutter going north and Messrs. Snodgrass and Starks south. The latter visited Santa Cruz Island, where a number of specimens were obtained, and also other islands of the vicinity, all the rookeries being located with the aid of seal hunters, although most of the rookeries were deserted at that time. Early in August the rookeries near San Pedro were inspected, and later the fishing stations farther south were visited and the fishermen and seal hunters were interviewed. The inquiries were brought to a close by second visits to the Purissima and Ano Nuevo rookeries, August 26 to September 1.

Mr. Rutter spent a week at the Farallone Islands, but was unable to reach the rookeries owing to rough weather, and a later attempt was also unsuccessful. At Point Arena four sea lions were killed and examined. Some time was then spent at the mouth of the Columbia River, where sea lions were under observation from fishing scows and the jetty, and many persons interested in the fishing industry were interviewed. Rough water prevented a visit to the Tillamook rookery. After visiting various points on Puget Sound and Straits of Fuca, Mr. Rutter joined the other members of the party at San Francisco.

Following is the substance of the report submitted by Messrs. Rutter, Snodgrass, and Starks, the description of rookery sites and data on the general habits of the sea lions being omitted. It will be seen that while much has been established regarding the question at issue, further inquiries should be addressed to some aspects of the subject.

REPORT ON THE SEA LION INVESTIGATION, 1901.

The Steller sea lion (*Eumetopias stelleri*) was found at Ano Nuevo Island and northward, and the California sea lion (*Zalophus californianus*) in the Santa Barbara Channel and southward. The Steller sea lion is reported to breed on San Miguel and Santa Rosa islands, but this could not be verified, owing to the rookeries being deserted at the time of visit.

Following is a tabulated statement of the stomach contents of 42 sea lions, 18 of the species *Eumetopias stelleri* and 24 of the species *Zalophus californianus*. An examination of this table shows, among other things, the following points:

1. Of the 26 sea lions whose stomachs contained food, fish remains were found in 18 and squid or octopus in 15.

2. All of the 13 Steller sea lions whose stomachs contained food had eaten fish and 5 had eaten squid or octopus. The number of squid eaten was small, 6 being the maximum number in 1 sea lion, while the quantity of fish was large, at least 35 pounds being taken from 1 stomach.

3. Of 13 California sea lions whose stomachs contained food 5 had eaten fish and 11 had eaten squid. The quantity of fish was inconsiderable, 17 small fishes being the maximum, while the remains of 100 to 300 squid were found in each of 5 stomachs.

This study, as far as it goes, indicates that the Steller sea lion is largely a fish consumer and the California sea lion is chiefly a squid eater. It seems apparent, however, that either species feeds on whatever is most convenient.

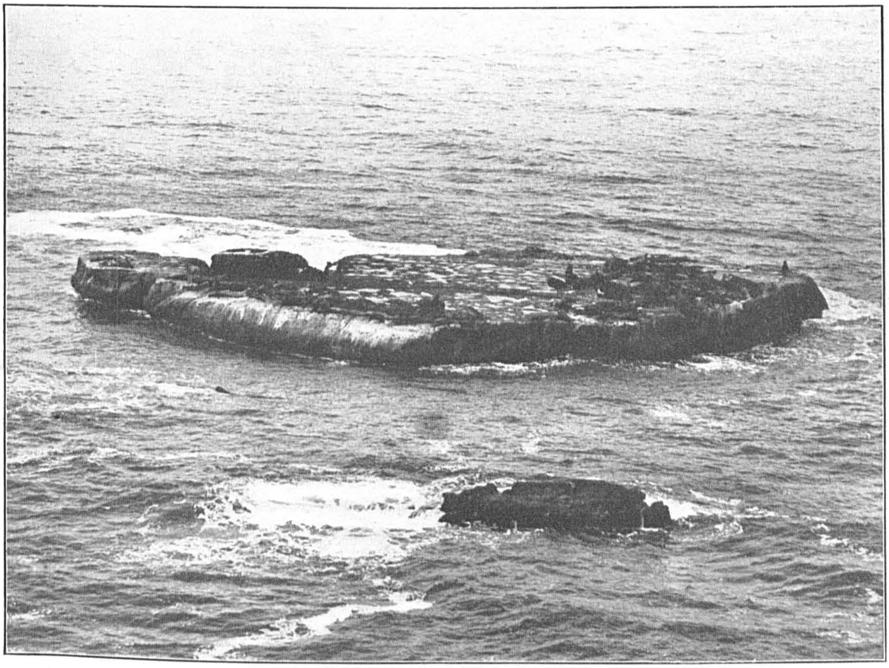
Very little positive information was obtained regarding the damage done to the fishing industry at southern points. On one trip made with the fishermen a net was found torn in one place, but there was no proof that the injury was done by sea lions. The testimony of the fishermen was so contradictory that it is of no value. One fisherman claims that in securing $3 worth of fish his net was damaged $75, while another claims that there is very little damage done by sea lions. One man holds that the sea lions are becoming more numerous and destructive every year, while another claims that they are rapidly becoming exterminated.

In former years the fishermen in the vicinity of San Francisco complained a great deal about the sea lions, but there was practically no complaint at the time of the investigation. Sea lions were scarcely ever seen in the vicinity of the salmon nets during the year 1901.

At the mouth of the Columbia River, as elsewhere, the direct evidence obtained on this point is meager. Sea lions were seen fishing in considerable numbers about the shoals near the jetty at the mouth of the river, but none was seen to catch a fish of any kind. Gulls were frequently observed hovering about a group of sea lions and acting as if picking up food. One such flock of gulls was seen coming gradually nearer the jetty from a group of sea lions about a mile away; after a time, it was shown that they were following a large piece of salmon flesh which the tide brought within 20 feet of the observer. Salmon were seen and photographed that had been mutilated (presumably by sea lions and seals) after being caught in gill nets. Such mutilated specimens were common. The fishermen stated that the seals simply pull off the gills, but the sea lions always take a bite out of the belly of the netted salmon.

A number of pound nets were visited, but no sea lions were seen in them.

A PART OF THE AÑO NUEVO ROOKERY.



PURISSIMA ROOKERY.

The following is a statement of the number of times sea lions entered various pound nets set in the mouth of the Columbia River, as reported by the owners:

Owner.	No. of traps.	No. of times entered.	Owner.	No. of traps.	No. of times entered.
C. Oleson	6	4	G. Johansen	2	1
B. Hawkins	9	3	B. Sutherland	2	6
C. Davidson	1	1	W. B. Donaldson	2	3
C. Johnson	2	4	Sam Oleson	2	3
N. Fodrop	2	2			
F. Gardner	2	4	Total	30	33

The fishermen were unanimous in their denunciation of the sea lions. A fishing company at Chinook, Wash., states that it was damaged $1,500 in 1901 by sea lions letting fish out of the nets, the damage to the nets not being included. The sea lions enter the traps in the same way that fishes do, and, after eating what they wish, break their way out through the side.

Sea lions were not found in Puget Sound in 1901, and no complaint whatever was made concerning them.

It appears from the above that the sea lions are doing very little damage anywhere, excepting at the mouth of the Columbia River. The shallow water and the large number of salmon make that point a favorite feeding ground, and there is no doubt that the sea lions are doing much damage there.

Table of stomach contents of sea lions.

Specimen No.	Rookery.	Sex.	Age.	Date.	Hour.	Food present.
	Eumetopias stelleri.					
1	Point Arena	Male	Bachelor	July 31	Noon	Yes.
2	do	Male	do	do	2 p. m.	Do.
3	do	Male	do	Aug. 1	10 a. m.	Do.
4	do	Male	do	do	do	Do.
5	Ano Nuevo	Male	do	July 15	7 a. m.	Do.
6	do	Male	Adult	July 14	5 a. m.	No.
7	do	Fem	do	do	do	Yes.
8	do	Fem	do	do	do	Do.
9	do	Fem	do	do	do	No.
10	do	Fem	do	July 15	7 a. m.	Yes.
11	do	Fem	do	do	do	Do.
12	do	Fem	do	Aug. 29	9 a. m.	Do.
13	do	Fem	do	do	3 p. m.	No.
14	do	Fem	do	Aug. 30	8 a. m.	Yes.
15	do	Fem	do	do		Do.
16	do	Fem	do	do	3 p. m.	Do.
17	do	Fem	do	do	do	No.
18	do	Fem	do	do	6 p. m.	Do.
	Zalophus californianus.					
19	China Harbor, Santa Cruz Island	Male	Bachelor	July 23	7 a. m.	Yes.
20	do	Male	do	July 24	8 a. m.	Do.
21	do	Male	do	do	do	Do.
22	do	Male	do	do	9 a. m.	Do.
23	do	Male	do	July 31	8 a. m.	No.
24	do	Male	1 year	Aug. 1	5 a. m.	Yes.
25	do	Male	Adult	July 23	8 a. m.	No.
26	do	Male	do	July 29	10 a. m.	Do.
27	do	Male	do	do	do	Do.
28	Gull Island	Fem	1 year	July 28	6 a. m.	Yes.
29	East End Cove, Santa Cruz Island	Fem	Young	Aug. 1	4 a. m.	Do.
30	China Harbor	Fem	Adult	July 23	8 a. m.	No.
31	do	Fem	do	do	do	Yes.
32	do	Fem	do	July 29	10 a. m.	Do.
33	do	Fem	do	do	do	No.
34	do	Fem	do	July 31	7 a. m.	Yes.
35	do	Fem	do	do	do	No.
36	do	Fem	do	do	10 a. m.	Do.
37	do	Fem	do	do	11 a. m.	Do.
38	East End Cove, Santa Cruz Island	Fem	do	Aug. 1	5 a. m.	Yes.
39	do	Fem	do	do	do	Do.
40	China Harbor	Fem	do	do	do	No.
41	San Clemente Island	Fem	do	Aug. 6	9 a. m.	Yes.
42	do	Fem	do	do	1 p. m.	No.

Table of stomach contents of sea lions—Continued.

Specimen No.	Kind and quantity of food.																					
												Fish bones.										
	Rock-fish.	Perch.	Clupeoid fish.	Carangoid fish.	Hake.	Large fish, 12 to 18 inches long.	Small fish.	Skate.	Shark.	Hog-fish.	Chimera.	Number of quarts.	Representing at least — fishes.	Small squid.	Giant squid.	Octopus.	Shrimp.	Crab.	Gasteropod shell.	Milk.	Stones ½ to 1 inch in diameter.	Stones 1 to 3 inches in diameter.
1								2				4	52	1	1			1				
2												2	25									
a3						16	1		6				23									8
4												3	40	1								4
5						1						¼	7	2								
6																						
7		2						4		1			7				(b)					
8	14								2				16									
9																						
10												2	15									
11	×											1	6									
12			30	1									31	6								1
13																						
14												¼	5			1						
15												2	15									
c16												¼	5									
17																						
18																						
19					2		17						19	4								14
20														200								
21														200								
22	3										1		3									
23																						
24																				×	31	
25																						
26																						
27																						
d28							7						7	8					1		15	
29														×								
e30																						
31														×								
32							×					1	5	×								
33																						
34														300								
35																						
36																						
37																						4
38														300								
39														100							4	
40																						3
41							×					1	5	×								
42																						
	17	2	30	1	2	17	25	6	8	1	1	18	286	1,122	1	1	(b)	1	1	...	50	34

× Indicates that the forms mentioned were present, but their number could not be determined.

a Several "sea pens."
b Few.
c Unrecognizable material.
d Shell apparently empty when swallowed.
e Filled with clear liquid, in which floated a light, yellow, flaky substance.

The following additional information regarding the number of sea lions on the California coast has been submitted by Mr. Rutter:

In 1902 the Ano Nuevo rookery contained 150 pups, which would indicate as many adult females. As there are more males born than females, there is no apparent reason why there should not have been as many adult males, so that the adults of the herd certainly numbered 300, not including the 1 and 2 year old individuals. The number of pups could not be determined at any of the other rookeries, and there is, therefore, no basis of estimating the number of adults at any point except at Purissima, where the adults themselves could be counted. But as Purissima was not a regular breeding rookery in 1901 and 1902, and as it is probable that many of the Ano Nuevo sea lions spent part of the year there, the Purissima counts can not be relied upon for statistical estimates. The most that can be said is that there were more sea lions at Point Arena than at Ano Nuevo Island, and that there were several times as many at the various Farallon rookeries. Probably half the sea lions of California are found at the Farallon Islands, and it seems doubtful whether the total number on the coast amounts to 5,000.

During the breeding season of 1901 there were about 400 adults at Ano Nuevo rookery. The larger males began leaving in July, and were followed by the younger males, and these by the cows and pups. The rookery was entirely deserted by the first of September, and remained so till the middle of the following May, the beginning of the next breeding season. Such was not the case with the Purissima rookery, however. This was not an important breeding place, though a few sea-lion pups were found there in 1901 and also in 1902.

The Purissima rookery is located on a single flat-topped rock lying close to a high bluff, affording an excellent opportunity for observation. Mr. James Mosconi, an employee of the Light-House Service, was engaged to make a count of the sea lions on this rookery at regular intervals, and his figures are as follows:

Date.	No.	Date.	No.	Date.	No.	Date.	No.
1901.		1901.		1902.		1902.	
July 15	225	October 15	417	January 15	16	April 15	66
July 31	312	October 31	313	January 31	42	April 30	36
August 15	578	November 15	311	February 15	0	May 15	122
August 31	558	November 30	59	February 28	68	May 31	64
September 15	302	December 15	48	March 15	7	June 15	78
September 30	370	December 31	90	March 31	29	June 30	143

THE REARING OF LOBSTERS.

Profiting by the experience gained from the previous season's observations and experiments in rearing lobsters, the Commission, during the spring and summer of 1901, made substantial progress in this important work. It having been shown that the station at Wickford, R. I., on Narragansett Bay, afforded better facilities and conditions for lobster rearing than did any of the other stations occupied in 1900, the experiments of 1901 were chiefly conducted at that place, where, as heretofore, the Commission cooperated with the Rhode Island Fish Commission, represented by Dr. A. D. Mead.

The essential factors in lobster rearing are (1) to keep the larval lobsters in motion so they will not settle to the bottom of the retaining vessel and there suffocate or devour each other, and (2) to provide them with suitable food so they will grow and molt quickly and take on the habits of the adults. The vessel in which young lobsters may be best held was devised only after much study and experimentation.

The following report of Dr. H. C. Bumpus, who directed this work, may be advantageously quoted as to methods and results:

Large salt-water ponds, small pools, artificial pools made by the building of dikes, inclosures made of wire screen and floated, and of wire screen and submerged, huge canvas boxes and cars, cars of scrim floated and anchored at the bottom, glass jars of various sizes, running water in vessels of wood, glass, porcelain, and stone, and various rotary devices, all proved efficient agents for the killing rather than for the rearing of lobster fry. After many experiments a relatively simple and inexpensive device was adopted. Several bags of scrim about 3 feet in diameter and 4 feet in depth were so suspended in the pool of the floating laboratory that the current could not change their general shape or cause them to collapse. In each bag was placed a dasher, the blades of which in rotation would constantly lift the water through the mesh at the bottom of the bag and urge it with obviously less velocity through the pores of the vertical walls. The dashers were kept in motion by means of a small gasoline engine. We found that when the mechanism was in actual operation, the current, in rising through the bottom of the bag, brought with it large numbers of pelagic animals, while the reduced current of the water passing through the greater expanse of the vertical walls was not sufficient to carry this living material out of the bags; thus the apparatus sufficed not only for keeping the fry and artificial food from the bottom, but also provided the fry with living natural food. To Mr. G. H. Sherwood is due the credit of devising and installing this aerating and feed apparatus.

In practice it was found that the eggs stripped from the abdomen of the female would hatch in these scrim inclosures under much more favorable conditions than in the McDonald jars. Indeed, I am inclined to believe that a far higher percentage of eggs would hatch in these bags than in the McDonald jars, and I am sure that the young are in a much more healthy condition than when hatched by the older method. Even a superficial examination of the young that have spent some hours in the trituration of the McDonald jars will show that a large proportion of them have the appendages broken, bent, or indented.

The number of fry that were available for the purpose of experimentation during the first season was considerably less than in 1900, and the period of experimental work was also materially reduced. Nevertheless, Dr. Mead, who had the work immediately in charge, reports that by actual count in no case was the number of lobsters that reached the fourth stage less than 16 per cent of the number of fry originally placed in the inclosure. In a few cases it was above 40 per cent, and in at least one case it was as high as 54 per cent. In previous years no experiments had yielded more than a fraction of 1 per cent. The total number of lobsters raised to the fourth stage during the season of 1901 (in the 12 cylinders) was a little more than 9,000.[a]

OYSTER-FATTENING EXPERIMENTS AT LYNNHAVEN.

For several years past the Commission has been conducting experiments in Lynnhaven, Va., under the direction of Messrs. H. F. Moore and W. W. Blackford, for the purpose of developing a method by which oysters may be fattened artificially with the same degree of certainty attained by stock-raisers in fattening cattle.

The practice of allowing oysters to fatten on the beds where they are grown is haphazard in its methods and uncertain in its results, and coves and other places where the natural food supply is sufficiently great at all times and under all conditions are too rare to be available to most oyster-growers. Ordinarily there is no difficulty in raising oysters to a marketable size within a reasonable time, but there is often considerable difficulty in producing them in a marketable condition. Frequently a grower will be unable to ship during a large part of the most profitable season because for some reason, which he can not control, the oysters will not get fat. This difficulty often happens unexpectedly, even within the most favorable localities, and causes the grower to hesitate to enter into contracts which he could profitably

[a] The results attending the experiments in lobster culture made by the U. S. Commission of Fish and Fisheries, Science, December 27, 1901.

make had he available some method of fattening his oysters as they were needed. To overcome this difficulty in a measure, it has been customary in some places to resort to "floating" or "drinking," which consists essentially of transferring the oysters to fresh or brackish water. That practice, while giving them an illusive plumpness, injures them in both flavor and nutritive value.

The experiments which have been carried on by this Commission have nothing in common with this method, but are designed actually to fatten and improve the oyster in weight, flavor, and food value. The progress of the work has been briefly noticed from time to time in the annual reports of this Commission. Each year the results have approached more nearly the desired end, and during the season 1901–2 the work has been attended with such success that it is considered desirable to give a more extended account of the plant and its operations than has been before attempted. The work, however, is still in an experimental stage, and the financial results have not yet demonstrated the practicability of the method. During the coming season it is believed that the operations can be so simplified and cheapened and the output so increased as to show pecuniary advantages.

The plant at present consists of a 2-acre pond having an average depth of 2½ feet. Originally it was a cove with a narrow mouth, giving tidal communication with the main body of Lynnhaven Bay. Across the mouth a substantial dam has been constructed of such height as to exclude all save exceptionally high tides. There is some drainage into the pond from the surrounding land, so that after it was dammed it became practically a claire according to the French method.

During the first season of its operation oysters were spread on the bottom of the pond in limited numbers, but there was practically no improvement in their condition during the season, and it was evident that the diatoms, which constitute the principal food of the oyster, would not multiply to a measurable extent under these conditions. In the meantime laboratory experiments carried on in Washington had demonstrated that the growth and multiplication of these microscopic plants, like that of other vegetable organisms, could be stimulated and increased by using certain salts in solution; in other words, by the application of fertilizers to the water in which they were growing. During the following year ordinary commercial fertilizers, such as are commonly used for potatoes and similar crops, were placed in the pond and the number of diatoms increased very considerably, and during that season about 50 or 60 per cent of the oysters in the pond became reasonably fat, some of them excessively so, but the others remained poor and lean. It was evident, as a result of the season's work, that the food supply was ample, but that for some reason it was not equally accessible to all of the oysters, and a comparison of the conditions in the pond with the open waters of the bay indicated that the cause probably lay in the absence of the currents necessary to transport the diatoms within reach of the sedentary oysters. In the open waters these currents were furnished by the tides, but in the pond there were only feeble currents produced by the winds and local differences in the temperature of the water.

To supply the necessary currents a canal faced with sheet piling was constructed along one side of the pond and communicating with it at both ends. This canal is about 150 feet long and 9 feet wide, and is provided with 16 wooden floats or trays 8 feet 8 inches square and 4 inches deep inside. Each float is capable of holding about three barrels of oysters in a single layer packed nib up, and is hung by ropes attached to small roller windlasses about 6 inches above the bottom. A current through the canal is produced by a propeller at the inlet driven by a gasoline engine connected by rubber belting. During the first year power was supplied by a windmill, but it was found that much power was lost, owing to the frequency of calms and winds too light to carry the load, and the more reliable motor was substituted.

The method of operating the claire is briefly as follows: Before the opening of the oyster season a supply of commercial fertilizer is applied in the shallow water around the edges of the pond, whence it gradually reaches the surrounding water, stimulating a vigorous growth of oyster food. Poor, unsalable oysters are then placed on the floats in the canal and, the propeller being set in motion, a current of about 1 mile per hour is maintained, carrying over the oysters a constant supply of diatoms from the rich store contained in the pond at large. It was found that by this means the oysters in the canal fattened quickly and uniformly, an extremely low proportion of blanks or watery oysters being found.

Owing to the exigencies of experimental work, the utmost capacity of the claire in fattening oysters has not yet been determined, but the fact that one lot was raised from a very poor to first-class condition in eight days indicates that it will be considerable when the proper arrangement is discovered. With the present canal capacity, which could probably be considerably increased to advantage, a maintenance of this rate would give a capacity of about 175 barrels per month, or 1,400 barrels during the season of eight months, from a 2-acre farm. During the past season two difficulties which militated against a true test of the capacities of the ponds were encountered: Occasionally a very slight marshy taste would be noticeable in the oysters, and at such times no shipments were made, for fear of injuring the demand. It has been learned that this can be overcome by the application of lime to the water at the end of the canal. The other difficulty is that in wet seasons with few high tides the water in the pond becomes too fresh and the oysters rather too insipid to bring the highest price in the market. A plan is now under consideration and will be put into operation during the ensuing season which it is thought will obviate this. Under the best conditions, oysters placed in the pond in an unmerchantable condition sold after fattening for $6 per barrel in Philadelphia. It is believed that at the close of the next oyster season definite plans of a plant and a method of operating it can be placed before the oyster-planters of the country. At present the Commission does not feel prepared definitely to recommend the method.

INQUIRY REGARDING DESTRUCTION OF OYSTERS BY DRUM-FISH.

In the latter part of June, 1902, the attention of the Commission was called to the destruction wrought by the drum-fish (*Pogonias cromis*) in the vicinity of Tuckerton, New Jersey, and Dr. H. F. Moore was at once sent to that place to make an investigation and if possible determine what measures should be taken to mitigate the losses. Oyster-growing is the main industry of Tuckerton, and most of the available oyster bottoms of Little Egg Harbor and Great Bay are taken up by persons living in that town and its vicinity. Although there is some good spawning-ground in these waters, the industry is mainly dependent on seed brought from other localities. Until within a few years, most of it was brought from Chesapeake Bay and other parts of Virginia, but recently it was discovered that seed from Long Island and Connecticut grew with remarkable rapidity when laid down in that vicinity, and it has since been heavily purchased, almost to the exclusion of other seed. It is stated that in some instances seed oysters from Great South Bay, Long Island, have increased 400 per cent in bulk within a period of six months, and to a somewhat greater extent in value.

For several years past the oystermen have sustained losses for which they could account only by attributing them to theft, but in the spring of 1901 it was discovered that the drum-fish was eating the young oysters in considerable quantities, and during the spring of 1902 the destruction became so great as to demand concerted action upon the part of the oystermen. A meeting was held at Tuckerton, at which most of the principal planters were present, and a fund was created to defray the expenses of fighting the common enemy. Special permission having been obtained from the State authorities, an attempt was made to kill the fish and drive them away by dynamite and nets. The nets used were some that had been discarded by sturgeon fishermen, and had a mesh of about 14 inches extension measure, rather too large for the drum-fish. They were set at random over the oyster beds and at first made fair catches, but their efficiency gradually decreased, owing, the oystermen supposed, to the fish being frightened away, though it seems very probable that the fish deserted the beds owing to their practical depletion and to their consequent loss of attraction to the fish which came upon them in search of food.

At the time of the visit of Dr. Moore about 100 pounds of dynamite had been exploded during four days' work, and about 1,000 fish of large size had been killed. The dynamite is not used on the oyster beds for fear of killing the oysters as well as the fish, but near the inlet, where the fish school at ebb tide. Two charges of 3 pounds each are attached, 50 feet apart, to a conductor, towed over the schools of fish, and exploded about 4 feet below the surface. On several occasions from 100 to 200 fish have been destroyed at a single explosion, and the survivors within a considerable radius of the disturbance are apparently badly frightened. As the dynamiting takes place at a considerable distance from the oyster beds and in the daytime, however, while the fish appear to feed on the beds principally at night, it is by no means certain that the effects will be very manifest in preventing the destructive inroads. The most efficient way of protecting the beds would, of course, be to inclose them completely with nets or stockades, but, owing to the large extent of the beds, to the navigable character of the water, and to the amount of material which drifts with the tide, this plan is not feasible at Tuckerton.

Some very extensive beds examined by Dr. Moore were found to be practically depleted of oysters. In one case where 15,000 or 20,000 bushels had been planted, and the owner estimated the loss at 50 per cent, an examination of areas selected at random indicated that upwards of 80 per cent of oysters had been eaten by the drum-fish, and nothing remained of them but a few ground-up fragments of shells. On these same beds native seed, owing, doubtless, to its much heavier shell, had not been destroyed. Should the present efforts of the oystermen to protect their beds prove unavailing, it seems probable that the only recourse is to abandon the use of the thin-shelled eastern seed and restrict planting to heavy-shelled varieties. If the beds can be efficiently protected each year for a period of two or three months after they are planted, it is probable that no further trouble will occur, as by that time the seed oysters will be large enough to resist the attacks of drum-fish.

TRIP TO THE TILE-FISH GROUNDS.

On July 28 the schooner *Grampus*, with a small party from the Woods Hole Station, made a short trip to the tile-fish grounds lying off No Man's Land. The grounds were reached during the night of July 28–29, and on the morning of the 29th four tubs of trawls, baited with squid, were set in water 65 to 70 fathoms deep, in latitude 40° 6′ north, longitude 70° 24′ west, 70½ miles south and one-half mile east from No Man's Land. One part of the trawl, owing to fouling, caught no fish; the other, after being on the bottom for about two hours, was hauled and found to have 62 fine fish, with an aggregate weight of about 700 pounds. The *Grampus* returned to Woods Hole on July 30, and the fish were shipped to dealers in New York, Boston, and Gloucester, who had expressed a willingness to handle them and endeavor to create a demand which would lead to the establishment of a regular fishery.

The reports as to the food value of these fish coincide with those received in previous years in being unqualifiedly favorable. The following, from Mr. William H. Jordan, collector of customs at Gloucester and one of the leading vessel-owners and fish-dealers, shows the way in which the tile-fish is regarded in the leading fishing port of the country:

> The tile-fish arrived in the best of order, having been very carefully prepared, and I distributed them among fourteen of my acquaintances. I have heard from nearly all of them, and they have expressed themselves as highly pleased with the quality of the fish, considering them delicate and of high flavor. I, myself, found the fish exceptionally good, and enjoyed my dinner from it. Certainly it would seem to me that if the people could become familiar with the tile-fish in some such manner of distribution as you have made through me, it would open up a demand for a large quantity of the fish, should they be caught.

The prospects for the inauguration of a special tile-fish fishery from Gloucester, Boston, New York, and several other ports now seems much more promising than at any previous time. The investigations of the Commission have shown a great abundance of tile-fish over a wide area adjacent to our shores and clearly indicate that a profitable industry may be developed.

THE GROWING OF SPONGES FROM CUTTINGS.

The experiments in sponge-culture begun in Florida under the direction of Dr. H. F. Moore during the preceding fiscal year have been continued during the present year, and it is believed that considerable progress has been made toward the development of a practical commercial system of sponge-culture. The constant aim has been to reduce as far as possible the niceties of experimental work to a basis adapted to the requirements of the practical sponger.

As stated in a previous report, several thousand sponges were planted in January and February, 1901, and at the end of six weeks these were found to be growing well. Examination in November, 1901, however, showed that most of the cuttings had died and that some of them had been stolen for the value of the wire to which they were attached. Most of these plants were made upon copper wire, which, while it has the power of resisting to some extent the action of salt water, is in some localities more or less subject to corrosion, and the salts produced are inimical to the sponge, causing it to die near the point of attachment and fall from its support. During the present year it has been sought to overcome this difficulty by using insulated copper wires, so that the cuttings would not be brought into contact with the bare metal. Further improvement was made in slitting the sponge cuttings and placing them astride the wire or other support to which they were attached, and then binding the surfaces of the flap in close apposition by means of a wire. In the course of a few days the two flaps grew together and the cutting became permanently attached, independently of any artificial binding. Temporary tie wires of aluminum wire were used, which, while slowly acted upon by salt water, lasted a sufficient length of time to permit the sponge to permanently heal.

During the winter months the growth of the cuttings was rather slow, so far as increase in bulk was concerned, although eyes, or oscula, were promptly put out and the circulatory system quickly reorganized and completed. During the spring when the water, especially in the more southern part of the State, was becoming warmer, there were indications of more rapid growth. About six thousand cuttings were planted in Biscayne Bay, Sugar Loaf Key, and in the vicinity of Anclote Keys, and in the latter part of April, after they had been planted for periods varying from two to five months, most of them were growing and in an apparently healthy condition.

Between the lower end of Biscayne Bay and Matecumbe Key there is a long stretch of water where sponges do not grow naturally. An investigation of this region was made to determine the reason for their absence, and an experimental plant of about a thousand cuttings was made in a small sound back of Key Largo, with a view to determining whether they could be artificially introduced there. At the end of six weeks practically all of these cuttings were dead, although others planted at about the same time in more favorable localities were alive and growing. A series of observations developed the fact that the water in this region is of a much lower salinity than in places where the sponge grows naturally, and it is probable that this is the cause of their absence naturally and of the mortality of the cuttings.

Practically nothing is known of the rate of growth of sponges under natural conditions, or of the rapidity with which they will develop from fragments and cuttings, and it will probably require several years' investigation to determine these points and to develop, if it can be developed, a system of sponge-culture which will be of value to the State of Florida. At the present time the production of sponges in this State, which is the only one in the country producing them, is about $500,000 per annum. An equal or perhaps greater value of sponges is imported from abroad, and it is hoped eventually to supply this excess of demand over production by sponges raised artificially. Many of the sponge-dealers are showing considerable interest in the experiments, and it is believed that they will promptly undertake sponge-culture if a reasonably practical method can be developed.

SURVEY OF THE FLORIDA SPONGE-GROUNDS.

The steamer *Fish Hawk*, working under the direction of this division, in October, 1901, resumed the survey of the sponge-grounds of the western coast of Florida, and in March, 1902, completed the examination of the waters lying north of Tampa Bay, comprising all those grounds designated under the names "Gulf," "Bay," "Rock Island," and "Anclote." The location of the sponge-grounds has been plotted on charts, and, for the first time, the extent, position, and relations of the grounds have been determined.

The sponge-bearing bottom stretches in a continuous but irregular band or zone, 5 to 35 miles wide, from Apalachee Bay nearly to Tampa Bay, the length, following the curvature of the coast, being about 175 miles. The grounds are widest off Withlacoochee Bay, Deadmans Bay, and Rock Island, and narrowest off Cedar Keys. Three large disconnected areas, between the shore and the sheepswool grounds, on which grass sponges grow rankly to the exclusion of most other kinds, are in or near St. Martins Bay, Deadmans Bay, and Apalachee Bay.

It is intended to continue this work by detailing the *Fish Hawk* to survey and plot the remaining sponge-grounds, of which those about the Florida keys are the most important.

RIVER AND LAKE INVESTIGATIONS.

GREAT LAKES BIOLOGICAL SURVEY.

Prof. H. S. Jennings, of the University of Michigan, directed inquiries addressed to various subjects connected with the animal and plant life of the Great Lakes, in continuation of the work begun a number of years ago. As in previous seasons, Lake Erie was the field of investigation, and the Fish Commission station at Put-in Bay was the headquarters of a party of specialists employed throughout the summer.

Among the fishes specially considered were the white-fish and wall-eyed pike, by Dr. Raymond Pearl, of the University of Michigan, the carp, by Mr. Leon J. Cole, of the same institution; and the sturgeon, by Prof. S. O. Mast, of Hope College. Mr. Pearl's inquiries had for their object (1) the determination by detailed statistical methods of the existence or nonexistence of different races of white-fish (*Coregonus clupeiformis*) in the different lakes, and (2) the demonstration by the same methods of the relation of the blue pike to the yellow pike (*Stizostedion vitreum*) of the Great Lakes. The study of the variations of the white-fish will not be completed for several seasons, owing to the wide field to be covered and the extensive series of measurements of individual specimens necessary for the purpose in view. The work on *Stizostedion* need not be resumed, as enough has been learned to show that the wall-eyed pike is a species of remarkably low variability and that there are no structural differences between the blue and the yellow varieties, this being in accord with other observations. The continuation of Mr. Mast's examination of the lake sturgeon at the spawning season resulted in the collection of additional information as to the past and present abundance of the fish in the rivers of Michigan, and furnished data of importance in the event of the Commission taking up the artificial propagation of this species in the Great Lakes.

Prof. H. B. Ward, of the University of Nebraska, was in charge of the plankton work. He completed the field tests of the efficiency of the large plankton nets. Further work with these nets should be specially directed to the comparative abundance and food relations of plankton organisms. The small minnows which abound in the plankton region and form a link between the plankton and some of the larger fishes should receive attention at the same time. Prof. Ward also continued his study of the vermine parasites of fishes, assisted by Mr. H. W. Graybill.

Dr. Charles Fordyce, of Nebraska Wesleyan University, was engaged in a study of the small crustaceans of the order Cladocera, which are an important element of the fish food of the lakes.

Prof. F. C. Newcombe, of the University of Michigan, was in general charge of the investigations of aquatic flora. Dr. Julia W. Snow, of Rockford College, continued her work on algae. Prof. R. H. Pond, of the Maryland Agricultural College, completed during the fiscal year his study of the nutrition of the larger aquatic plants. During the summer he assisted Prof. Newcombe in his study of the distribution of water plants in relation to soils in Lake Erie.

For several weeks in April and May Prof. Jacob Reighard, of the University of Michigan, was engaged in studying the breeding habits of fresh-water fishes. The forms chiefly studied were the black bass, the brook lamprey, the stone roller, and the horn dace.

During the year Prof. Reighard and Prof. Ward were engaged in discussing and preparing for publication the results of their work in determining the efficiency of plankton nets. At the same time Professor Jennings studied one of the families of rotifers (the *Rattulidæ*), and prepared a monograph of the family.

A bill "to authorize the establishment of a biological station on the Great Lakes under the control of the United States Commission of Fish and Fisheries" was introduced in the Senate on December 17, 1901, and favorably reported back by the committee on fisheries on April 1, 1902. The report of the committee embodied a communication from the Commissioner advocating the passage of the bill. The bill passed the Senate on May 16, but was not acted on by the House.

THE STATUS OF THE CARP IN THE GREAT LAKES.

With the probable exception of the Illinois River, no body of water in the United States appears to be so well-stocked with carp as Lake Erie. There is also an abundance of carp in Lake Huron, Lake St. Clair, and other Great Lakes. In view of the continued disfavor with which this fish is regarded in some quarters on account of its supposed objectionable qualities, the Commission decided to institute a systematic investigation of the species in the Great Lakes, and assigned to the work Mr. Leon J. Cole, of the University of Michigan, who began his inquiries in the latter part of June, 1901, and continued until the last of November. The points to which special attention was given were the food and feeding of the carp, the relation of the carp to other fishes, the relation of the carp to wild fowl, and the food and market value of the carp. Much information of interest and importance was obtained, but it will require another full season's inquiries in order to render the investigation approximately complete.

The carp investigation was begun in Lake St. Clair, where Mr. Cole went to investigate some statements of a fisherman which were published in the Port Huron (Mich.) *Times* of April 16, 1901. These assertions were to the effect that "the carp eats the spawn and destroys the perch, bass, and other good fish of these waters"; that "the supply (of these fish) is already much reduced," and that "in three years more there will be no fish except carp left in the lake." At New Baltimore and other places on the lake Mr. Cole found the same sentiments prevailing in regard to the carp as those expressed in the newspaper article referred to. Inquiry among the fishermen, mostly city sportsmen, showed that certain stock charges were made against the carp, and it was not usually claimed that these charges were based on direct knowledge or observation.

The sentiment against this fish in this region was due largely to a belief (1) that the carp thrashes about and stirs up the mud, so that the breeding-grounds of other fish are spoiled; (2) that the carp roots up the vegetation, destroying the wild rice, etc., and thus ruining good duck-shooting grounds; (3) that the carp eats the spawn of other fish; (4) that the carp eats the young of other fish; (5) that the carp is of no value as a food-fish; (6) that the carp is of no value as a game fish.

The fact that black bass and other fish were nesting at this time afforded opportunity to make observations on several of these points. In a small bay where carp were commonly found in the shallow water among the weeds and grasses, there were a number of bass nests. At no time was a carp seen among the bass nests, which were some distance apart and hence covered a considerable area. A fyke net was set with a view to intercept any carp that might cross the tract covered by the bass nests, but with negative results. On several nests young bass were later noticed, and Mr. Cole thinks it probable that more would have hatched if the parent fish had not been speared (in violation of law) or caught with hook and line (in conformity with law), thus leaving the eggs exposed to any fish that might come along. Nests of some of the sun-fishes were found close inshore where carp were common, and these nests contained eggs; when the parent fish were frightened way, it was noticed that swarms of minnows, which seemed to be waiting this opportunity, rushed in and began to devour the eggs.

The observations showed that the carp makes the water very roily where it splashes about and evidently tears up more or less vegetation, but there was no evidence that the flags often found floating were not torn loose by muskrats or other animals.

Considerable time was spent at Port Clinton, Ohio, as this is the principal market for carp on the lakes. The wholesale dealers here rendered every possible assistance to Mr. Cole, including all the carp needed for examination and a room in which to work. Many carp were here examined with reference to their food, and the study of various related subjects was made possible by the abundance of material. During the course of the season all important points between Buffalo and Detroit were visited, and the fishermen and dealers in each place were interviewed. Among the data thus obtained was a statement from each wholesale dealer of the quantity of carp received from Lake Erie fishermen in 1900, this representing the approximate catch of carp in the lake. The figures as tabulated give 4,595,000 pounds as the carp product in 1900, an increase of 964,000 pounds over the previous year; of this quantity about 4,069,000 pounds were landed at Monroe, Toledo, Port Clinton, and Sandusky.

Carp ponds at Monroe, near Sandusky, at Port Clinton, and on Catawba Island were visited and information regarding the feeding, etc., of carp was obtained.

In the fall of 1901 the inquiries were addressed particularly to the relation of the carp to the white-fish during the spawning season of the latter, and were conducted at the Bass Islands and Port Clinton. As a basis for the investigation, the following assertions of the fishermen of North Bass Island were taken: Carp are abundant about the Bass Islands when the white-fish are spawning; carp eat the spawn of other fish, especially white-fish; white-fish spawn has been taken from a carp's stomach; when carp are numerous on a reef, the white-fish are not there, being driven away by the carp.

At Port Clinton Mr. Cole made trips to the fishing-grounds with the fishermen and also examined the carp landed by the fishermen; and at North Bass Island examined carp brought in by fishermen using white-fish gill nets on the reefs. He reports that very few carp were caught on the white-fish grounds, and that the result of their examination was entirely negative as to any damage done by carp to white-fish. The evidence indicates that the number of carp on the white-fish spawning-grounds in fall is very small, and the carp which are there have not been found to contain white-fish spawn. The eggs of the white-fish, not being adhesive to any great degree, probably become widely scattered over the rocky reefs; and unless the carp were present in large numbers, the relative number of eggs destroyed would be small. There is no direct evidence as to the destruction of white-fish fry by carp, except that during the entire course of this investigation no young white-fish or any other kind of fish were found in carps' stomachs. Considering the shape of the carp's mouth, the lack of teeth, and other anatomical peculiarities, it seems very doubtful that the fish-eating charge against the carp could be very serious.

FISHES OF CHAUTAUQUA LAKE, NEW YORK.

In September, 1901, this lake was visited by Prof. B. W. Evermann for the purpose of determining its general biological features and the variety and abundance of its fish fauna. A report[a] on this inquiry gives an annotated list of 31 species of fishes known from the lake. Although this lake is only 8 miles from Lake Erie, it is in the Ohio River drainage basin, and its fish life partakes of the character of the latter. Among the important species are bullhead (*Ameiurus nebulosus*), rock bass, blue sun-fish, large and small mouthed black bass, and muskallunge. The last named is the leading fish, from the standpoint of both angler and commercial fishermen. Although extensively caught, its abundance appears to be maintained from year to year as a result of limited protection and artificial propagation by the State authorities. It appears from this investigation that the Chautauqua Lake muskallunge is not identical with the muskallunge of the Great Lakes (*Esox nobilior*), as has generally been held, but is a distinct species (*Esox ohiensis*) peculiar to the Ohio basin. The two gars or bill-fish (*Lepisosteus osseus* and *L. platostomus*), worthless as food and very destructive to other fish, were systematically destroyed by the State Fish Commission for several years and their numbers much reduced.

FRESH-WATER FISHES OF LONG ISLAND, NEW YORK.

During September and October, 1901, Dr. Tarleton H. Bean collected and studied the fishes of Long Island, New York, in the interests of the Commission, with headquarters on Great South Bay. Particular attention was given to the fresh-water species, which, while few in number, are of considerable interest.

The peculiar topographical features of Long Island are responsible for the scarcity of fresh-water fishes. The total number of such fishes known to occur in the streams and lakes is 27. One of these—a hybrid trout—has been artificially produced; another, the black-nosed dace, is of doubtful occurrence, and 13 others have recently been introduced. The permanent residents in fresh water, as determined by Dr. Bean, are horned pout, chub sucker, chain pickerel, killifish, pirate perch, silverside, sun-fish, yellow perch, and darter, all of which could easily have been introduced by man within the last century or two.

Mitchill, in his Report on the Fishes of New York (1814), mentions only the yellow perch, brook trout, and pickerel as occurring on Long Island. Mitchill, in 1790, transplanted yellow perch from Ronkonkoma Pond to Success Pond, Queens County, a distance of 40 miles.

FISHES OF LAKE MASHIPACONG, NEW JERSEY.

Lake Mashipacong lies in the New Jersey mountains about 10 miles south of Port Jervis, N. Y., and covers approximately 100 acres. In

[a] Notes on the Fishes and Mollusks of Lake Chautauqua, New York. Report U. S. Fish Commission for 1901.

October, 1901, Prof. B. W. Evermann made an examination of the lake with reference to its fish fauna. The maximum depth, as determined by numerous soundings, was 14.5 feet. Although fish food is abundant, the larger fishes are limited in both species and individuals.

The following fishes were found to inhabit the lake: Common bullhead (*Ameiurus nebulosus*), white sucker (*Catostomus commersonii*), chub sucker (*Erimyzon sucetta*), roach (*Abramis crysoleucas*), eel (*Anguilla chrysypa*), banded pickerel (*Esox americanus*), common eastern pickerel (*Esox reticulatus*), and blue-gill sun-fish (*Lepomis pallidus*). A few large-mouthed black bass were recently planted in the lake, and the conditions seem favorable for their rapid increase.

FRESH-WATER FISHES OF MAINE.

In accordance with a request from the Debsconeag Fish and Game Club that the waters composing the fishing privilege of the club be examined to ascertain why trout attain only a small size and if the lakes were suitable for the introduction of trout and landlocked salmon, Dr. W. C. Kendall devoted the month of August to the study of these waters.

Debsconeag lakes are a chain of five or six small lakes, which from the westward debouch into the West Branch of the Penobscot not far from Debsconeag Falls and about 20 miles from Norcross. Other waters not connected with this chain of lakes, but comprised within the Debsconeag privilege, are Hurd Pond and tributaries and Rainbow Lake, besides a number of smaller ponds and streams. These waters are not exclusively controlled by the club, being public waters, but the club has camp privileges on all of them within certain townships. The water area was found to be so extensive that only superficial examination of all of them could be made, so most of the time was devoted to First Debsconeag Lake and Hurd Pond.

Brook trout are apparently uncommon in Debsconeag lakes and Hurd Pond, but very abundant, though of small size, in Rainbow Lake; in some of the small ponds they occur in fair numbers. Togue (*Cristivomer namaycush*) are doubtless common; some of large size have been caught, but only small ones of 2 or 3 pounds were obtained during the month of August, and these only in Hurd Pond. There seems to be a scarcity of species of the minnow tribe in some of these lakes, and the fish faunas of the several bodies of water seem to differ somewhat in character; for instance, the chub (*Semotilus corporalis*), common in the Debsconeag lakes, was not found in Hurd Pond, but there its place is taken by the brook chub (*Semotilus atromaculatus*), which, so far as ascertained, did not occur in the Debsconeag waters. If the conditions prevailing in August obtain throughout the year, the scarcity and smallness of trout is probably due to paucity of food.

In order to obtain important information regarding small salmon occurring in the East Branch of the Penobscot, mention of which was made in last year's report, Dr. Kendall visited Matagamon Lake, and the East Branch was examined from the dam at the foot of the lake to Stair Falls. The small salmon were found common in the pool below the dam and at Stair Falls. Specimens were obtained by fishing with very small artificial flies, but none over 9 inches long was found. All but one of these fish were males in well-advanced breeding condition, the exception being a female with distinct eggs, but which would not have matured before another fall.

From here opportunity was taken to visit more northern Maine waters to obtain much-needed information regarding the character and distribution of the fish life of this region. Accordingly, a canoe voyage was made from Matagamon via Matagamonsis, Webster, Telos, and Chamberlain lakes to the Allagash River, thence down the stream through numerous lakes to the St. John, and from the St. John a trip was made up the St. Francis to a few miles above Beau Lake and return, thence down the St. John to Fort Kent. It was the intention to haul from here to Cross Lake, thence proceed by canoe down the Eagle lakes or east branch waters of Fish River, up Fish River to Portage Lake, and thence haul to Ashland; but owing to the uncertainty of getting through the proposed route on time, it was decided to bring the explorations to a close after making some collections in Cross Lake. Very interesting collections were made in all the lakes en route, as well as in some tributary waters, and much valuable knowledge was gained.

Some interesting facts regarding the geographical distribution of the Maine fishes were developed. The recorded range of some species was extended into the State, and others already recorded from Maine waters were found in new localities.

At least four species of fishes apparently new to science were obtained, the most interesting and important being a white-fish (*Coregonus*). Two species of white-fish were already known to occur in the State, the round white-fish (*Coregonus quadrilateralis*) and the "attahawmeg" (*C. labradoricus*). The latter is the best known and reaches the largest size. The only locality in Maine from which the round white-fish has hitherto been recorded is Clearwater Pond, at Industry. It was ascertained to be very common in northern Maine.

The little stickleback (*Gasterosteus atkinsii*), for many years known only from a few specimens from Grand Lake Stream, was found to be widely distributed over northern Maine and is not so insignificant as from its size it at first might appear. In the fall it was found to constitute the principal food of the lake trout, or "togue," sometimes to the exclusion of everything else. Many togue were caught gorged with these little fish. *Couesius plumbeus*, until recently not known from Maine waters, was found to be one of the commonest minnows. In the lakes it seems to be a deep-water form, seldom approaching the shore except at night and in breeding season, when it enters streams and shallow water to spawn. This habit and the abundance of the fish would indicate that it must be an important food for larger fishes.

Coherent reports and descriptions of a red forked-tailed trout in some of the waters of St. Francis River suggests the possibility of another char occurring in these waters.

BIOLOGY OF THE SACRAMENTO SALMON.

On the conclusion of the sea-lion investigation elsewhere alluded to, Mr. Cloudsley Rutter resumed the study of the quinnat salmon in the Sacramento basin, on which he had been engaged for a number of years.

The work began September 1 at Black Diamond, California, where by weighing and measuring many specimens of salmon recently from the sea a standard weight was established for fishes at the mouth of the river. Then 150 specimens were weighed, branded with serial numbers, and released, in the expectation that some of them would be taken again at the hatcheries and light thus be thrown on their rate of travel upstream and their loss of weight during migration. Three of the marked fish were subsequently recaptured.

During October two trips were made down the Sacramento River in a skiff for the purpose of charting the spawning-beds and noting the dates at which the beds were successively occupied. November was spent at the Mill Creek hatchery near Tehama, the principal work being the weighing and measuring of salmon in various conditions for comparison with those examined at the mouth of the river.

The run of quinnat salmon in Papermill Creek, Marin County, was investigated, as the species had never been known in that stream prior to the planting of fry there in 1897 and 1898.

The preparation of a general report on the salmon investigations and the study of material with a view to a report on the embryology of the quinnat occupied Mr. Rutter's time during the remainder of the year.

The habits of the Pacific salmons are vitally different from those of the Atlantic species, and as these have an important relation to natural reproduction, artificial propagation, and commercial fishing, the Commission deemed it desirable that the species be subjected to a careful physiological investigation. While the Atlantic salmon, *Salmo salar*, has been studied from the standpoint of physiology,* the Pacific salmons have up to this time been neglected in this respect. The Commission therefore engaged the services of Prof. Charles W. Greene, of the University of Missouri, who has devoted much attention to comparative physiology. Professor Greene began his field work early in July and continued until September, examining the salmon before they entered the rivers and after they reached their spawning-grounds,

*See Investigations on the Life History of the Salmon in Fresh Water, by D. Noel Paton, M. D. Special Report of 1898, Fishery Board for Scotland.

and at intermediate points in the Sacramento basin. Most of the time was spent at Baird hatchery, where there was an abundance of material and where the superintendent, Mr. Lambson, and the foreman, Mr. Wallich, rendered valuable assistance.

INTRODUCED FISHES IN UTAH AND IDAHO LAKES.

Continued public interest in the planting of the Great Lakes white-fish (*Coregonus clupeiformis*) in Bear Lake (Idaho and Utah), Coeur d'Alene Lake (Idaho), and Pend d'Oreille Lake (Idaho), induced the Commission to make another effort to determine the results of the plants of fry in these waters a number of years ago. Accordingly, in July, 1901, a party, consisting of Mr. S. P. Wires, superintendent of the Duluth (Minnesota) hatchery; Mr. S. L. Pritchard, of the Washington office, and Mr. Dwight E. Miller, was dispatched to these lakes with an equipment of gill nets of various sizes, seines, and other appliances. Fishing was carried on in Bear Lake (and Mud Lake connected therewith) at ten different points and during six days; in Lake Coeur d'Alene at thirteen different points and during eight days; in Pend d'Oreille Lake at nine different localities and during six days. No introduced white-fish were discovered, and no evidence of the existence of this species in any of the lakes was obtained, although three other species of introduced fishes were found.

The water of Bear Lake is reported to be very hard, unfit for domestic use, and possibly unsuited to the white-fish of the Great Lakes, although Williamson's white-fish (*Coregonus williamsoni*) is found in it. During the first week in August the surface temperature of the water in the vicinity of Fish Haven was found to be from 69° to 71°. The minimum bottom temperature determined was 50°, at a depth of 105 feet; fishing, however, was carried on in water 175 feet deep, but no temperature data were obtained therefor. Suckers (*Catostomus macrocheilus*) and chubs (*Leuciscus lineatus*) abound and are the characteristic fishes of the lake; black-spotted trout (*Salmo clarkii*) also occur. Mud Lake is reported to be little more than a marsh during July and August, although it contains some black bass, carp, and a few black-spotted trout.

The water of lakes Coeur d'Alene and Pend d'Oreille is deep and cold, resembling in every respect that of the Great Lakes; and it would seem that the white-fish whose introduction has been attempted should do well in both of them. Besides Williamson's white-fish, many fine specimens of bull trout (*Salvelinus parkei*) 11 to 12 inches long and of the black-spotted trout were found in both these lakes, and suckers (*Catostomus macrocheilus* and *C. catostomus*) are abundant. The introduced species, large-mouth black bass and yellow perch, seem to have become well established in Lake Coeur d'Alene; examples of the latter 10½ inches long were obtained.

MARINE BIOLOGICAL LABORATORIES.

WOODS HOLE, MASSACHUSETTS (HUGH M. SMITH, DIRECTOR).

During the season of 1901-2 the work at the Woods Hole laboratory was under the direction of Dr. Hugh M. Smith, assistant in charge of division. Dr. H. C. Bumpus, who had been in charge of the laboratory for a number of years, was unable to continue his relations with the Commission owing to other duties.

The usual facilities for research and collecting existed, and the rare opportunity for marine biological work here afforded was appreciated by the representatives of many institutions of learning. Two large fish-traps operated for the laboratory in Vineyard Sound and Buzzards Bay furnished much useful material. The steamer *Fish Hawk* and the schooner *Grampus* were temporarily attached to the station during the entire summer, and the steam yacht *Phalarope* and the steam launches *Blue Wing*, *Cygnet*, and *Merganser* were in constant service. The director had the efficient assistance of Prof. R. W. Tower, Mr. George H. Sherwood, and Mr. Vinal N. Edwards.

Among the biologists who occupied tables, the following carried on special investigations in behalf of the Commission:

Dr. Gary N. Calkins, of Columbia University, studied the marine protozoa found in the vicinity of the station. This group of animals has been neglected by systematists in the United States. The protozoa are numerous, and are important as being the ultimate animals on which the higher animals are dependent for food. Dr. Calkins found the water in the immediate vicinity of the station to contain many species and individuals, including a number of species not previously described. His report, published in the Fish Commission Bulletin for 1901, is an important contribution from one who is a leading authority on the subject.

Dr. George H. Parker, of Harvard University, studied and reported on the effects of light, temperature, gravity, currents, and other natural agencies on the movements of copepods. These minute crustaceans are found throughout the year in varying abundance, and constitute one of the most important foods of young and small fishes, young lobsters, and other animals. Dr. Parker's observations and experiments were directed to the determination of the physical factors controlling the appearance and disappearance of copepods in a given region at different times, and his conclusions bear on the movements and abundance of the food-fishes whose immediate or ultimate pabulum the copepods are. His paper is published in the Fish Commission Bulletin for 1901.

Prof R. W. Tower, of Brown University, conducted a number of chemical and physiological investigations addressed to the food-fishes of the region. An inquiry regarding the organic constituents of the scales of fish and their use in the manufacture of gelatin was conducted jointly by Professor Tower and Mr. E. H. Green, and a special report thereon was published in the 1901 Bulletin. Numerous gallstones were found in several of the squeteague caught in the pound nets, and the determination of the chemical constituents of the calculi formed the subject of a paper by Professor Tower and Mr. A. K. Krause, forming a part of the 1901 Bulletin, which is an important contribution to the diseases of wild fishes. A related subject which received attention was the bile pigments and bile acids of squeteague, blue-fish, and bonito.

In the course of a general study of noises produced by fishes, some important physiological observations were made on the "drumming" of the squeteague. The drumming of the drum-fishes (*Sciænidæ*), of which the squeteague is the most prominent representative at Woods Hole, has been variously explained by different writers; and in the case of the squeteague, at least, it would appear that no accurate account of the factors producing the characteristic sound has heretofore been given.

Professor Tower's observations and experiments have developed the following facts:

1. There is in the squeteague a special drumming muscle, lying between the abdominal muscles and the peritoneum, and extending the entire length of the abdomen on either side of the median line.
2. The muscle fibers are very short, and run at right angles to the long axis of the muscle.
3. The muscle is in close relation with the large swim-bladder, and by its rapid contractions produces a drumming sound, with the aid of the tense bladder which acts as a sounding-board.
4. This muscle exists only in the males, and only the males are able to drum.

In continuation of the plan of issuing from time to time systematic reports on the various groups of water animals in the Woods Hole region, studies of the following groups were carried on during the year: The crabs, by Dr. Robert P. Bigelow, of the Massachusetts Institute of Technology; the jelly-fishes and sea-anemones, by Prof. Charles W. Hargitt, of Syracuse University; the parasitic copepods of fishes, by Mr. M. T. Thompson, of Brown University, and Mr. C. B. Wilson, of the Westfield (Massachusetts) State Normal School; the isopods, by Miss Harriet Richardson, of Columbian University (Washington, D. C.); the amphipods, by Prof. S. J. Holmes, of the University of Michigan

Following is a list of those in attendance at the laboratory, arranged under the institutions with which they were connected:

U. S. Department of Agriculture: W. T. Swingle, Ph D.; Dr. Geo. T. Moore; Karl Kellerman, B. S.

Brown University. R. W. Tower, A. M.; L. W. Williams, Ph. D.; George H. Sherwood, A. M.; M. T. Thompson, A M.; A. K Krause, A. B.

Bryn Mawr College: T H. Morgan, Ph. D.

Columbia University Gary N. Calkins, Ph D.

Harvard University: George S. Amsden, A. B.; Henry B. Bigelow, A. B.; J. H. Converse; Julius M. Johnson, A. B.; Clarence H. Lander, B. S.; F. T. Lewis, M. D.; James H. McMurray; Thomas Ordway, A. B.; George H. Parker; H. W. Rand, Ph. D.; M. E. Stickney, A. M.; R. M. Strong. Ph. D.; William A. Willard, A. M.; Robert M. Yerkes, A. M.
Indiana University: W. J. Moenkhaus, Ph. D.
Johns Hopkins University: Caswell Grave, Ph. D.; Henry F. Perkins, A. B.
Massachusetts Institute of Technology: Robert P. Bigelow, Ph. D.; Erik H. Green, A. M.
College of City of New York: Francis B. Sumner, Ph. D.
Princeton University: Ulric Dahlgren, Ph. D.; C. F. Silvester.
Syracuse University: Charles W. Hargitt, Ph. D.
Yale University: W. G. Van Name, Ph. D.
Miscellaneous: John Barlow, A. M., Fairmont College, Wichita, Kans.; E. W. Barnes, Tabor College, Iowa; W. B. Bell, University of Iowa; W. A. Denny, A. M., Anderson (Ind.) High School; Otto Folin, Ph. D., McLean Hospital, Waverly, Mass.; Henry R. Linville, Ph. D., De Witt Clinton High School, New York City; Porter E. Sargent, A. M., Browne & Nichols School, Cambridge, Mass.

BEAUFORT, NORTH CAROLINA (H. V. WILSON, DIRECTOR).

The Fish Commission laboratory at this place was in operation at the beginning of the fiscal year and remained open until September 25, the same temporary quarters being occupied as in previous years. Prof. H. V. Wilson, of the University of North Carolina, continued in charge. A dwelling-house near the laboratory was rented for a dormitory and mess-house. The launch *Petrel* was attached to the station during the season and was in constant use. About 20 persons availed themselves of the privilege of working at the laboratory; these, with the institutions with which they were connected, were as follows:

Johns Hopkins University: Prof. W. K. Brooks, Dr. Caswell Grave, Messrs. R. P. Cowles, D. H. Tennent, O. C. Glaser, R. E. Coker, and J. A. E. Eyster.
Columbia University: Prof. E. B. Wilson, Messrs. H. B. and J. C. Torrey.
University of North Carolina: Prof. H. V. Wilson and Mr. C. A. Shore.
University of Missouri: Prof. George Lefevre and Dr. W. C. Curtis.
Washington and Jefferson College: Prof. Edwin Linton and Mr. C. W. Stone.
University of Alabama: Dr. J. Y. Graham.
Bryn Mawr College: Prof. T. H. Morgan.
Dartmouth College: Dr. J. H. Gerould.

Professor Brooks studied the eggs of the oyster and preserved material for further work on the same. Prof. E. B. Wilson was engaged in experimental studies of the living eggs of the sea-urchin, *Toxopneustes*, and Professor Morgan worked on the eggs and larvæ of the same species in connection with his researches on regeneration. Professor Linton began a systematic examination of the food-fishes of the Beaufort region with reference to their parasites. Professor Graham studied a trematode worm which is parasitic in the oyster.

Dr. Grave, assisted by Mr. Glaser, continued the work on the biology of the North Carolina oyster and conducted experiments with a view to develop a method by which oyster-farming may be successfully carried on in the North Carolina sounds, where, on account of the peculiarity of the bottom in many places, the ordinary methods of planting are inapplicable.

Mr. Coker investigated a barnacle (*Dichelaspis*) parasitic on the gills of the common edible crab. From a report submitted by Mr. Coker it appears that this parasite affects over 50 per cent of the male crabs and about 90 per cent of the females; that it is not found in young crabs, being thrown off by the frequent molting; that crabs whose gills are heavily burdened with the parasite have less vitality, are sluggish in their movements, and are the first to die in captivity. While the usual number of barnacles found in one crab is from 2 or 3 to 8 or 10, in some the gills are filled to overflowing and may contain 500 to 1,000 of the parasites.

The new laboratory buildings on Pivers Island were nearly completed by the end of the year, and on May 26 it was practicable to throw the laboratory proper open to investigators. Prof. H. V. Wilson, the director, having gone abroad, Dr. Caswell Grave, of Johns Hopkins University, was appointed to the position. The operations of the laboratory during the last few weeks of the fiscal year 1902 will be referred to in the report for the next year.

WORK IN FISH PATHOLOGY.

The occurrence of serious disease among fishes at the hatcheries of the Commission and elsewhere has required the almost constant attention of Mr. M. C. Marsh, the assistant assigned to this subject, and has shown the wisdom of making special provision for the study of this increasingly important branch.

A part of the summer and fall was spent by Mr. Marsh at the Northville (Michigan) station of the Commission in considering the disease affecting the brook trout. A bacterial organism was isolated from the dying fish and the disease was reproduced in healthy trout by inoculation. On the recommendation of this division, two ponds were constructed entirely of concrete and cement for the purpose of excluding disease-producing bacteria, and the ponds were stocked with healthy trout from the Au Sable River and from a private trout farm at Osceola, Wis. Mr. Marsh visited this farm to inspect the fry and yearling fish prior to securing a supply for Northville. The large spring pond constituting the main water supply was drawn down, cleaned, and thoroughly disinfected with chlorinated lime. Pathological material and cultures were brought to the Washington laboratory, and a study of the the offending organism was taken up. This germ can not be identified with any hitherto-known species, and a full description of its form and behavior is substantially completed.

At the meeting of the American Fisheries Society, held at Milwaukee, Wis., in July, Mr. Marsh brought the brook-trout disease to the attention of the assembled fish-culturists.

An investigation of the mortality among brook trout at the Paris station of the Michigan Fish Commission disclosed the same disease as at Northville, but in a milder form. Mr. Marsh visited by request the hatchery of the Pere Marquette Club at Wingleton, Mich., where brook trout were found to be slowly dying of the Northville disease, and some suggestions for the amelioration of the conditions were made.

The existence of fungous disease among fishes in the Government aquaria at the Pan-American Exposition, as noted in the report for last year, continued during the summer and required attention. Experiments with potassium permanganate and formalin confirmed the previously expressed opinion that they had no advantages over common salt as a remedy for this troublesome disease.

In March a visit of about one week was made to the Charleston Exposition to look into some cases of mortality among aquarium fishes. No serious losses were occurring, and some previous trouble was probably due to polluted water from the lagoon from which the water supply was drawn. The brook trout were slowly dying and these were infected with the Northville organism, which makes an interesting addition to the recorded distribution of this species. Local fishes taken for the exposition were not in the best condition and this accounts partly for the aquarium losses. Both salt and fresh water supplies were rather peculiar and not of the best for aquarium purposes, the river water being subject to contamination from phosphate works and the fresh artesian water containing considerable soda, like all of the artesian water of the region.

MISCELLANEOUS LABORATORY WORK, REPORTS, ETC.

FISHES FROM THE PHILIPPINE ISLANDS.

The Commission received through the Surgeon-General of the Army specimens of fishes and fish cakes from medical officers in the Philippine Islands. The fish were from Lake Buhi, in southern Luzon, and represented five or six species, several of which were previously unknown. The most interesting and important of these was an exceedingly diminutive form, caught in large numbers by the natives and used for food. In forwarding specimens of these fish, Dr. George A. Zeller wrote as follows from the military hospital at Buhi:

I inclose herewith samples of a strange article of diet greatly relished by the Bicols, among whom I have been stationed for the past eighteen months. Rice and fish are the staple articles of diet for most Filipinos and in the provinces of the Camarines there is little variation from these two. Fishes of every size and many varieties are prepared in every conceivable form, but the samples inclosed are unique in that they are found here and nowhere else. * * * Many varieties of fish abound in the lake, but by far the most numerous are these minute specimens. They are called in the native Bicol tongue *sinarapan*, and when dried in the sun on a leaf are called *badi*. They are caught by a large sheet of close web, which is dipped under wherever a school congregates. They are put into tightly woven baskets from which the water soon drains, leaving a compact mass of fish. They are not minnows or immature fish. The natives buy them eagerly; and when the little fleet of fishermen return from their morning's quest and place their baskets upon the ground on the market place, they are instantly surrounded by a crowd of waiting children, who, armed with every sort of dish, are anxious to take home the family meal. They bring three or four potatoes, tubers, a handful or two of rice, or a few copper pennies, and in exchange receive about a pint of fish. In the kitchen the fish are made up with peppers or other spiced herbs, and they do not taste bad. The soldiers have become quite fond of this food, and liberally patronize the little native restaurants where it is served.

This fish proved to be of an undescribed genus and species, and its diagnostic features were given in an article in Science (January 3, 1902), where the name *Mistichthys luzonensis* was applied to it. The maximum length of the species is only 0.6 inch and the average slightly over 0.5 inch. It is the smallest known fish and probably the smallest known vertebrate.

Through the courtesy of the Surgeon-General of the Army, the Commission was enabled to place three collecting outfits in the hands of medical officers located in various parts of the archipelago, and it is expected that additional specimens of interest will thus be obtained.

SHAD OF THE OHIO RIVER.

Prof. B. W. Evermann concluded his study of the shad of the Ohio River, referred to in the annual report for 1898, and submitted a paper thereon which was published in May, 1902. Publication of this article was delayed in the hope that opportunity might be afforded for obtaining further information on this fish, especially its migration from the Gulf of Mexico up the Mississippi and its tributaries.

This shad proves to be an indigenous species, and is not, as some have supposed, the transplanted shad from the Atlantic coast. It has appropriately been named *Alosa ohiensis*. It is an excellent food-fish, probably not inferior to the common shad, but is not highly regarded by the people of the Mississippi basin, the price received by fishermen being only 2 cents a pound. Its abundance and distribution are not yet known, and the annual catch is quite small and localized.

FISHERIES OF THE GREAT LAKES, ST. LAWRENCE RIVER, AND LAKE CHAMPLAIN.

The extensive collections of fishes from these waters obtained by the Commission during a series of years have been reported on by Prof. Barton W. Evermann and Dr. W. C. Kendall, in four annotated lists published in March and April, 1902. The number of species and subspecies known from the Great Lakes and their tributary waters is 152, of which 27 are peculiar to Great Lakes basin. From Lake Ontario 73 species are recorded, and from the St. Lawrence River 71. The fish fauna of Lake Champlain includes 54 species.

SILVERSIDES OF THE EAST COAST.

The silversides are among the most abundant of the small fishes inhabiting the salt, brackish, and fresh waters of the Eastern and Southern States. Their maximum length is but little over 6 inches, and most of them are hardly half so large; they are, therefore, only sparingly eaten by man, but they constitute one of the most important foods for many of the best food-fishes of the coast. Extensive collections of the Fish Commission, supplemented by material in the National Museum, were studied by Dr. W. C. Kendall, and a report[a] thereon was issued in April, 1902. In this paper the abundance, uses, habits, food, etc., of the silversides are considered, and a detailed description, with figure, of each species is given.

FISHES OF MEXICO.

Recent collections of fishes from various parts of Mexico, obtained by the Division of Biological Survey of the U. S. Department of Agriculture, have been referred to this Commission for identification, and have been reported on by Messrs. B. W. Evermann and E. L. Goldsborough in a paper issued May 3, 1902. These collections, supplemented by several smaller ones from various sources, comprised 56 species, of which 5 were previously undescribed.

FISHES OF LABRADOR.

At the request of Prof. Leslie A. Lee, of Bowdoin College, Maine, Dr. W. C. Kendall identified and reported on a small collection of fishes obtained on the Labrador expedition of that college in 1901. The report will form one of a series of articles on the natural history collections of that expedition. Professor Lee donated to the Commission specimens of all the desirable duplicates.

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[a] Notes on the Silversides of the genus Menidia of the East Coast of the United States, with descriptions of two new subspecies.

REPORT OF THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES.

By C. H. Townsend, *Assistant in Charge.*

The commercial fisheries of the United States employ about 200,000 persons, the amount of capital invested is $60,000,000, and the annual value of the products to the fishermen is approximately $50,000,000. The different regions in which fisheries exist are the New England, Middle Atlantic, and South Atlantic States on the Atlantic coast, the Gulf States on the Gulf of Mexico, the Pacific coast States, Alaska, the Great Lakes, and the various rivers and minor lakes.

At the commencement of the present fiscal year the statistical agents of this division were in the field engaged in investigations of the lobster, sturgeon, menhaden, and salmon fisheries of the Atlantic coast. A thorough canvass was made of the entire lobster fishery, Mr. W. A. Wilcox canvassing Massachusetts; Mr. T. M. Cogswell, Massachusetts and New Hampshire; Mr. E. S. King, Rhode Island; Mr. C. H. Stevenson, New York; Mr. W. A. Roberts, Connecticut and a portion of Rhode Island; Mr. John B. Wilson, New Jersey and Delaware; Mr. G. H. H. Moore, Maine. Mr. C. G. Atkins, superintendent of the Fish Commission station at Craig Brook, Maine, made a canvass of the salmon fishery of the Penobscot River. Mr. J. N. Cobb, who during the summer had been detailed to assist in an investigation of the fisheries of the Hawaiian Islands, was for a short time engaged in making inquiries respecting certain fisheries centered in New York City. In the autumn Mr. C. H. Stevenson made inquiries in Connecticut and Massachusetts respecting the preservation of fishery products. Mr. E. A. Tulian, superintendent of the Fish Commission station at Leadville, Colo., made a canvass of the fisheries of Utah and Colorado.

A canvass of the fisheries of the Middle Atlantic States was then begun, Mr. W. A. Wilcox taking up the work in Virginia and Mr. J. B. Wilson in New Jersey. Mr. Roberts was assigned to the canvass of Maryland and was assisted for a time by Mr. Wilson, who later took up the work in New Jersey. Mr. Cobb was assigned to New York and Mr. Stevenson to portions of Virginia and Maryland. Mr. Thomas B. Gould was temporarily employed in canvassing the fisheries of Pennsylvania and New Jersey on the Delaware River. At the close of the fiscal year the investigations of the fisheries of the Middle Atlantic States were still in progress.

Mr. Townsend, assistant in charge, after representing the Commission at a meeting of the American Fisheries Society at Milwaukee, Wis., in July, made a reconnaissance of the fisheries of the Great Lakes west of Lake Ontario. In June he accompanied the Assistant Secretary of State to The Hague in connection with the arbitration of American whaling and sealing claims against Russia.

Capt. S. J. Martin and Mr. F. F. Dimick, statistical agents of the division located at Boston and Gloucester, Mass., have continued to submit their monthly reports on the quantity and value of certain fishery products landed at those ports by American vessels.

Mr. A. B. Alexander, of the steamer *Albatross*, was employed for a short time in making inquiries relative to the increase, among commercial fishermen, of hook-and-line fishing for salmon at Monterey, Cal., and elsewhere on the Pacific coast.

The following bulletins, issued as single sheets, containing advance statistics in condensed form, were widely distributed during the year:

114. Lobster fishery of the United States, 1900.

117. Statement of the quantity and value of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year 1901.

Other bulletins, showing the quantity and value of fishery products landed at Boston and Gloucester, have been issued monthly as usual.

The publications appearing during the year which were prepared in this division were:

Records and bibliography of the steamship *Albatross*, by C. H. Townsend.
Statistics of the fisheries of the Great Lakes.
Notes on the fisheries of the Pacific coast, by W. A. Wilcox (in press).

BOSTON AND GLOUCESTER.

The local agents of the Commission at Boston and Gloucester have continued to make monthly reports on the great fisheries centering there. The total quantity of products landed by American vessels during the year 1901 was 151,165,191 pounds, worth $4,245,951. These figures as compared with those for the previous year are somewhat smaller, there being a decrease of 11,053,730 pounds and a decrease in value of $139,151. The total number of fares landed was 6,964, a decrease of 549 as compared with the year 1900.

The fish landed at Gloucester amounted to 92,173,060 pounds, valued at $2,674,551, a moderate decrease in both quantity and value from the previous year. The decrease is shown in the quantity of fresh fish landed, the amount of fish salted being somewhat larger. The fares landed at Gloucester numbered 3,561, of which 2,899 were from grounds off the New England coast and 662 from the Eastern Banks. The total of fish from grounds off the New England coast was 34,835,456 pounds, worth $1,050,211. The quantity from the Eastern Banks was much larger, amounting to 57,337,604 pounds, worth $1,624,340.

At Boston the decrease amounted to 7,828,781 pounds and $27,106 in value. The fares landed at Boston were 3,403, 170 being from the Eastern Banks and 3,233 from grounds off the New England coast. At this port the greater quantity of the fish was derived from grounds off the New England coast. The total quantity of products landed at Boston was 58,992,131 pounds, worth $1,571,400, the fresh fish amounting to 56,855,111 pounds, the salt fish being only 2,137,020 pounds. It should be noted that at Gloucester the quantity of salt fish is greatly in excess of that landed in a fresh condition.

Summary, by fishing-grounds, of certain fishery products landed at Gloucester, Mass., in 1901 by American fishing vessels.

Fishing-grounds.	No. of trips.	Cod, fresh.		Cod, salted.		Cusk, fresh.		Cusk, salted.	
		Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:									
La Have Bank	132	3,740,485	$75,619	798,450	$27,814	198,130	$2,979	....	....
Western Bank	187	9,173,636	172,777	5,501,347	185,690	36,600	571	....	....
Quereau Bank	142	2,104,738	39,834	4,856,906	152,664	8,000	121	5,000	$175
Grand Bank	73	35,620	855	12,405,293	385,245	....	....	....	....
St. Peters Bank	2	....	....	9,730	315	....	....	....	....
Bacalieu Bank	22	25,000	500	48,000	1,801	....	....	....	....
Off Newfoundland	88	12,185	274	231,742	8,426	....	....	....	....
Cape North	1	41,230	993	....	....	....	....	....	....
Cape Shore	15	89,000	2,211	....	....	116,000	1,690	....	....
Total	662	15,221,894	293,063	23,851,468	761,955	358,730	5,361	5,000	175
West of 66° W. longitude:									
Browns Bank	25	298,010	6,424	230,830	7,743	118,494	1,952	10,000	251
Georges Bank	298	1,208,656	24,856	5,502,683	200,293	27,210	550	18,000	456
Cashes Bank	43	512,630	9,954	26,710	1,025	249,960	3,783	18,980	495
Jeffreys Ledge	104	8,250	130	....	....	3,000	45	....	....
Ipswich Bay	19	32,788	659	....	....	....	....	....	....
South Channel	25	358,637	7,333	....	....	49,795	734	....	....
Nantucket Shoals	1	38,000	1,469	....	....	....	....	....	....
Off Chatham	22	....	....	....	....	....	....	....	....
Bay of Fundy	129	148,130	2,610	....	....	124,315	1,888	....	....
Block Island	7	....	....	91,110	2,958	....	....	....	....
Shore, general	2,226	1,253,079	33,656	....	....	7,114	109	....	....
Total	2,899	3,858,180	87,091	5,851,333	212,019	579,888	9,061	46,980	1,202
Grand total	3,561	19,080,074	380,154	29,702,801	973,974	938,618	14,422	51,980	1,377

Fishing-grounds.	Pollock, fresh.		Pollock, salted.		Halibut, fresh.		Halibut, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:								
La Have Bank	88,164	$578	20,000	$250	144,110	$14,225	....	....
Western Bank	56,320	428	2,622	39	67,462	5,110	960	$58
Quereau Bank	16,130	97	....	....	1,332,971	119,337	4,660	368
Grand Bank	....	....	....	....	368,633	30,052	1,650	99
St. Peters Bank	....	....	....	....	47,559	4,756	....	....
Bacalieu Bank	....	....	....	....	367,042	28,499	447,970	40,128
Off Newfoundland	....	....	....	....	1,034,527	57,043	7,350	398
Total	160,614	1,103	22,622	289	3,362,304	259,022	462,590	41,051
West of 66° W. longitude:								
Browns Bank	....	....	23,120	290	4,000	240	....	....
Georges Bank	....	....	52,000	668	274,029	26,576	....	....
Cashes Bank	3,500	21	....	....	3,000	180	....	....
Jeffreys Ledge	1,450,820	11,281	....	....	....	....	....	....
South Channel	14,000	84	....	....	....	....	....	....
Off Chatham	135,000	948	....	....	....	....	....	....
Bay of Fundy	12,000	72	....	....	....	....	....	....
Block Island	20,000	100	....	....	....	....	....	....
Shore, general	3,355,206	25,005	....	....	122	15	....	....
Total	4,990,526	37,511	75,120	958	281,151	27,011	....	....
Grand total	5,151,140	38,614	97,742	1,247	3,643,455	286,033	462,590	41,051

Fishery products landed at Gloucester, Mass., in 1901—Continued.

Fishing-grounds.	Haddock, fresh.		Haddock, salted.		Hake, fresh.		Hake, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:								
La Have Bank	1,328,271	$23,967			1,114,410	$11,216	10,000	$225
Western Bank	767,316	10,719	18,690	$370	129,455	1,373		
Quereau Bank	75,370	943			37,000	459	1,560	39
Cape North					2,000	23		
Cape Shore	81,280	1,903			51,180	611		
Total	2,252,237	37,532	18,690	370	1,334,045	13,682	11,560	264
West of 66° W. longitude:								
Browns Bank	149,160	3,201	3,000	75	196,113	2,554	8,000	181
Georges Bank	1,268,954	20,545	16,160	220	21,240	356	19,200	418
Cashes Bank	82,685	1,310			806,556	9,033	39,460	493
Jeffreys Ledge					85,000	903		
South Channel	134,180	1,706			256,108	2,686		
Bay of Fundy	1,000	8			578,000	6,067		
Block Island			8,120	162			3,560	80
Shore, general	310,675	6,787			386,035	4,838	66,700	834
Total	1,946,654	33,557	27,280	457	2,329,052	26,437	136,920	2,006
Grand total	4,198,891	71,089	45,970	827	3,663,097	40,119	148,480	2,270

Fishing-grounds.	Mackerel, fresh.		Mackerel, salted.		Other fish, fresh.		Other fish, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:								
Bacalieu Bank					250	$33		
Off Newfoundland					1,308,800	51,330	8,561,400	$138,509
Cape Shore			405,400	$20,601				
Total			405,400	20,601	1,309,050	51,363	8,561,400	138,509
West of 66° W. longitude:								
Georges Bank	34,740	$1,973	1,622,200	95,546	17,610	1,514	2,080	229
Jeffreys Ledge					10,240	1,085		
Ipswich Bay					167,040	1,856		
Off Chatham	81,000	2,803	397,000	24,817	260	31		
Bay of Fundy	118,260	5,344	2,504,600	155,306	522	42	40,000	400
Block Island			16,000	700				
Shore, general	756,440	31,354	6,435,400	260,395	413,740	5,523	2,095,240	23,983
Total	990,440	41,474	10,975,200	536,764	609,412	10,051	2,137,320	24,612
Grand total	990,440	41,474	11,380,600	557,365	1,918,462	61,414	10,698,720	163,121

Fishing-grounds.	Total, fresh.		Total, salted.		Grand total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:						
La Have Bank	6,613,570	$128,584	828,450	$28,289	7,442,020	$156,873
Western Bank	10,230,789	190,978	5,523,619	186,157	15,754,408	377,135
Quereau Bank	3,574,209	160,791	4,868,126	153,246	8,442,335	314,037
Grand Bank	404,253	30,907	12,406,943	385,344	12,811,196	416,251
St. Peters Bank	47,559	4,756	9,730	315	57,289	5,071
Bacalieu Bank	392,292	29,032	495,970	41,929	888,262	70,961
Off Newfoundland	2,355,512	108,647	8,800,492	147,333	11,156,004	255,980
Cape North	43,230	1,016			43,230	1,016
Cape Shore	337,460	6,415	405,400	20,601	742,860	27,016
Total	23,998,874	661,126	33,338,730	963,214	57,337,604	1,624,340
West of 66° W. longitude:						
Browns Bank	765,777	14,371	274,950	8,540	1,040,727	22,911
Georges Bank	2,852,439	76,370	7,232,323	297,830	10,084,762	374,200
Cashes Bank	1,658,331	24,281	85,150	2,013	1,743,481	26,294
Jeffreys Ledge	1,557,310	13,444			1,557,310	13,444
Ipswich Bay	199,828	2,515			199,828	2,515
South Channel	812,720	12,543			812,720	12,543
Nantucket Shoals	38,000	1,469			38,000	1,469
Off Chatham	216,260	3,782	397,000	24,817	613,260	28,599
Bay of Fundy	982,227	16,031	2,544,600	155,706	3,526,827	171,737
Block Island	20,000	100	118,790	3,900	138,790	4,000
Shore, general	6,482,411	107,287	8,597,340	285,212	15,079,751	392,499
Total	15,585,303	272,193	19,250,153	778,018	34,835,456	1,050,211
Grand total	39,584,177	933,319	52,588,883	1,741,232	92,173,060	2,674,551

Summary, by fishing-grounds, of certain fishery products landed at Boston, Mass., in 1901, by American fishing vessels.

Fishing-grounds.	No of trips.	Cod, fresh.		Cod, salted.		Cusk, fresh.		Haddock, fresh.	
		Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:									
La Have Bank	42	569,500	$13,985	......	......	91,500	$1,449	909,300	$21,172
Western Bank	38	770,000	19,978	......	......	63,000	1,005	103,000	2,705
Quereau Bank	13	266,000	6,280	......	......	......	......	......	......
Green Bank	1	......	......	......	......	......	......	......	......
Grand Bank	12	9,000	195	......	......	......	......	......	......
Off Newfoundland	20	......	......	6,000	$120	5,000	100	......	......
Cape Shore	44	622,500	15,430	10,000	300	45,000	780	760,000	20,838
Total	170	2,237,000	55,868	16,000	420	204,500	3,334	1,772,300	44,715
West of 66° W. longitude:									
Browns Bank	61	927,200	25,053	......	......	137,000	2,128	1,222,000	25,148
Georges Bank	263	2,359,600	65,038	......	......	68,000	1,057	4,631,500	101,160
Cashes Bank	51	464,300	11,929	......	......	206,900	3,201	344,200	9,234
Clark Bank	11	106,000	2,930	......	......	12,000	180	169,000	3,985
Fippenies Bank	9	44,000	1,375	......	......	14,000	220	46,000	1,585
Middle Bank	219	391,800	10,608	......	......	12,500	190	1,117,500	33,071
Jeffreys Ledge	233	510,200	16,554	......	......	63,700	970	1,092,900	34,093
South Channel	450	3,528,300	99,322	......	......	70,500	1,155	8,097,800	188,125
Nantucket Shoals	102	1,552,400	37,241	......	......	83,300	1,429	194,800	3,828
Off Highland Light	65	197,900	5,522	......	......	......	......	519,000	14,894
Off Chatham	84	328,300	9,168	......	......	8,000	110	839,000	22,309
Shore, general	1,685	4,245,450	124,886	......	......	209,900	3,573	4,685,350	136,088
Total	3,233	14,655,450	409,626	......	......	885,800	14,213	22,959,050	573,520
Grand total	3,403	16,892,450	465,494	16,000	420	1,090,300	17,547	24,731,350	618,235

Fishing-grounds.	Hake, fresh.		Pollock, fresh.		Halibut, fresh.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:						
La Have Bank	76,000	$946	29,000	$390	9,300	$1,088
Western Bank	101,000	1,528	28,000	374	307,800	24,699
Quereau Bank	21,000	285	......	......	207,000	17,200
Green Bank	......	......	......	......	20,000	2,000
Grand Bank	......	......	......	......	368,000	28,370
Off Newfoundland	......	......	......	......	393,000	27,500
Cape Shore	57,500	938	38,000	548	31,700	2,640
Total	255,500	3,697	95,000	1,312	1,336,800	103,497
West of 66° W. longitude:						
Browns Bank	67,700	1,189	26,500	355	11,350	1,109
Georges Bank	216,000	2,563	69,200	1,124	32,800	3,831
Cashes Bank	546,100	8,829	65,500	807	3,600	512
Clark Bank	99,000	1,435	18,000	175	2,900	447
Fippenies Bank	94,000	1,600	2,000	20	400	60
Middle Bank	540,400	6,757	107,200	1,442	......	......
Jeffreys Ledge	721,400	12,082	367,900	4,202	2,600	374
South Channel	2,430,300	39,218	350,200	5,509	23,100	3,110
Nantucket Shoals	7,000	120	97,300	1,306	3,000	890
Off Highland Light	107,000	1,408	49.100	547	200	20
Off Chatham	195,800	3,037	134,800	2,582	300	36
Shore, general	2,177,650	35,392	811,100	10,301	4,666	583
Total	7,202,350	113,630	2,098,800	28,370	84,916	10,472
Grand total	7,457,850	117,327	2,193,800	29,682	1,421,716	113,969

Fishing-grounds.	Mackerel, fresh.		Mackerel, salted.		Other fish, fresh.		Other fish, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:								
Off Newfoundland	......	......	......	......	410,000	$12,300	1,468,200	$23,005
West of 66° W. longitude:								
Georges Bank	208,250	$11,285	127,200	$7,407	337,000	33,518	......	......
Middle Bank	64,450	4,430	......	......	1,400	140	......	......
Jeffreys Ledge	......	......	......	......	4,400	508	......	......
South Channel	16,250	1,300	1,000	40	8,700	778	......	......
Nantucket Shoals	2,000	90	......	......	4,000	460	......	......
Shore, general	1,501,405	69,968	504,620	19,741	509,790	23,431	20,000	325
Total	1,792,355	87,073	632,820	27,188	865,290	58,885	20,000	325
Grand total	1,792,355	87,073	632,820	27,188	1,275,290	71,135	1,488,200	23,330

Fishing products landed at Boston, Mass., in 1901—Continued.

Fishing-grounds.	Total, fresh.		Total, salted.		Grand total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
East of 66° W. longitude:						
La Have Bank	1,684,600	$39,030			1,684,600	$39,030
Western Bank	1,372,800	50,289			1,372,800	50,289
Quereau Bank	494,000	23,765			494,000	23,765
Green Bank	20,000	2,000			20,000	2,000
Grand Bank	377,000	28,565			377,000	28,565
Off Newfoundland	808,000	39,900	1,474,200	$23,125	2,282,200	63,025
Cape Shore	1,554,700	41,174	10,000	300	1,564,700	41,474
Total	6,311,100	224,723	1,484,200	23,425	7,795,300	248,148
West of 66° W. longitude:						
Browns Bank	2,391,750	54,982			2,391,750	54,982
Georges Bank	7,922,350	219,576	127,200	7,407	8,049,550	226,983
Cashes Bank	1,630,600	34,512			1,630,600	34,512
Clark Bank	406,900	9,152			406,900	9,152
Fippenies Bank	200,400	4,860			200,400	4,860
Middle Bank	2,235,250	56,638			2,235,250	56,638
Jeffreys Ledge	2,763,100	68,783			2,763,100	68,783
South Channel	14,525,150	338,517	1,000	40	14,526,150	338,557
Nantucket Shoals	1,943,800	44,864			1,943,800	44,864
Off Highland Light	873,200	22,391			873,200	22,391
Off Chatham	1,506,200	37,242			1,506,200	37,242
Shore, general	14,145,311	404,222	524,620	20,066	14,669,931	424,288
Total	50,544,011	1,295,739	652,820	27,513	51,196,831	1,323,252
Grand total	56,855,111	1,520,462	2,137,020	50,938	58,992,131	1,571,400

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year 1901.

Months.	No. of trips.	Cod, fresh.		Cod, salted.		Cusk, fresh.		Cusk, salted.	
		Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
January	237	988,800	$28,175			99,000	$1,654		
February	283	917,100	37,396	6,000	$120	54,200	1,221		
March	342	1,738,800	49,275			57,700	1,144		
April	308	1,007,200	34,416			44,500	766		
May	288	1,561,200	31,745			195,000	2,759		
June	206	1,632,400	39,937	10,000	300	133,000	1,920		
July	246	1,257,600	32,734			24,000	360		
August	274	1,504,400	42,418			109,800	1,852		
September	265	1,608,000	46,252			28,900	446		
October	357	1,643,100	40,497			132,000	1,925		
November	313	1,387,700	35,103			87,700	1,313		
December	284	1,646,150	47,546			124,500	2,187		
Total landed at Boston	3,403	16,892,450	465,494	16,000	420	1,090,300	17,547		
January	172	443,971	11,622	622,465	21,731	29,475	372		
February	122	349,449	12,025	55,480	2,026	12,460	286		
March	246	2,332,102	50,053	233,539	8,019	3,680	92		
April	205	1,698,776	33,739	279,300	9,621	17,740	224		
May	357	1,819,231	38,687	915,342	34,231	298,269	4,593	18,980	$495
June	377	2,250,147	41,462	2,368,714	80,594	355,730	5,402		
July	445	2,367,707	43,011	5,792,307	182,311	150,610	2,255	23,000	569
August	368	2,075,340	38,957	4,759,911	165,112	8,000	260	5,000	138
September	334	1,803,920	33,637	3,899,928	129,423	5,000	83		
October	370	1,903,656	34,238	4,019,358	125,458	9,364	141	5,000	175
November	385	908,005	18,306	5,715,343	178,217	44,010	660		
December	180	1,127,770	24,417	1,041,114	37,231	4,280	54		
Total landed at Gloucester	3,561	19,080,074	380,154	29,702,801	973,974	938,618	14,422	51,980	1,377
Grand total	6,964	35,972,524	845,648	29,718,801	974,394	2,028,918	31,969	51,980	1,377
Landed at Boston in 1900	3,731	17,717,650	397,415	131,000	1,850	916,800	13,262		
Landed at Gloucester in 1900	3,782	16,333,742	293,248	29,837,821	722,366	1,101,100	12,534	131,000	2,348

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year 1901—Continued.

Months.	Haddock, fresh.		Haddock, salted.		Hake, fresh.		Hake, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
January	1,641,900	$41,315	....	....	409,800	$8,249	....	....
February	2,521,600	78,565	....	....	326,300	10,230	....	....
March	3,852,600	81,424	....	....	190,500	5,556	....	....
April	1,741,900	52,102	....	....	60,000	1,745	....	....
May	1,520,900	34,528	....	....	400,900	4,418	....	....
June	1,457,800	31,380	....	....	341,750	3,957	....	....
July	1,838,900	32,046	....	....	277,100	5,562	....	....
August	1,683,650	37,293	....	....	390,300	8,163	....	....
September	2,749,300	58,655	....	....	815,700	13,889	....	....
October	2,307,900	59,766	....	....	1,826,600	19,987	....	....
November	1,669,400	53,677	....	....	1,646,400	21,231	....	....
December	1,745,500	57,484	....	....	772,500	14,340	....	....
Total landed at Boston	24,731,350	618,235	....	....	7,457,850	117,327	....	....
January	411,615	10,179	....	....	46,360	697	....	....
February	689,232	16,795	....	....	16,515	368	1,560	$39
March	1,219,310	14,975	....	....	530	9		
April	447,590	8,700	....	....	49,780	767	....	....
May	239,715	2,305	2,000	$30	463,413	5,952	39,460	493
June	233,890	2,332	17,280	289	1,018,834	10,972	8,560	193
July	180,161	1,365	8,000	138	1,033,655	9,307	14,200	305
August	....	....	13,690	220	16,930	153	8,000	181
September	27,280	218	....	....	216,480	2,131	....	....
October	211,065	2,248	5,000	150	279,220	3,347	....	....
November	236,755	4,722	....	....	449,840	5,422	76,700	1,059
December	302,278	7,250	....	....	71,540	994	....	....
Total landed at Gloucester	4,198,891	71,089	45,970	827	3,663,097	40,119	148,480	2,270
Grand total	28,930,241	689,324	45,970	827	11,120,947	157,446	148,480	2,270
Landed at Boston in 1900	28,235,850	589,105	....	....	6,917,100	98,119	....	....
Landed at Gloucester in 1900	4,806,652	71,452	6,000	75	4,528,456	41,830	78,000	1,068

Months.	Pollock, fresh.		Pollock, salted.		Halibut, fresh.		Halibut, salted.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
January	86,000	$1,189	....	....	129,000	$11,940	....	....
February	72,100	2,084	....	....	83,300	6,095	....	....
March	42,100	1,041	....	....	74,500	5,335	....	....
April	9,500	235	....	....	112,700	7,280	....	....
May	45,800	377	....	....	215,300	13,957	....	....
June	116,800	1,044	....	....	132,900	9,430	....	....
July	119,400	1,432	....	....	198,400	16,880	....	....
August	153,200	2,587	....	....	177,200	15,943	....	....
September	296,200	3,770	....	....	39,050	3,712	....	....
October	510,200	4,548	....	....	149,766	14,476	....	....
November	326,500	3,420	....	....	40,200	3,804	....	....
December	416,000	7,955	....	....	69,400	5,117	....	....
Total landed at Boston	2,193,800	29,682	....	....	1,421,716	113,969	....	....
January	73,830	739	....	....	378,736	34,018	....	....
February	11,502	124	....	....	328,508	26,699	....	....
March	28,150	210	....	....	315,172	23,903	....	....
April	30,630	184	....	....	557,395	31,948	4,350	$218
May	99,074	838	6,000	$90	572,705	35,927	5,640	282
June	105,867	585	19,000	239	244,050	18,451	....	....
July	78,955	478	16,000	201	189,813	16,010	3,000	150
August	6,410	54	36,742	467	320,105	27,796	14,770	887
September	164,900	1,314	....	....	203,586	18,830	392,330	35,476
October	2,077,320	16,040	....	....	157,238	16,281	42,500	4,038
November	2,324,620	16,807	....	....	235,671	22,291	....	....
December	149,882	1,241	20,000	250	140,476	13,879	....	....
Total landed at Gloucester	5,151,140	38,614	97,742	1,247	3,643,455	286,033	462,590	41,051
Grand total	7,344,940	68,296	97,742	1,247	5,065,171	400,002	462,590	41,051
Landed at Boston in 1900	1,173,500	13,296	....	....	1,588,150	104,788	180,000	9,900
Landed at Gloucester in 1900	4,104,324	28,957	41,070	514	5,686,505	371,616	1,389,335	78,599

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year 1901—Continued.

Months.	Mackerel, fresh.		Mackerel, salted.		Other fish, fresh.[a]		Other fish, salted.[a]	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
January	....	....	....	....	140,000	$3,850	240,000	$3,250
February	....	....	....	....	190,000	4,850	232,200	5,205
March	....	....	....	....	80,000	3,600	....	....
May	61,530	$1,904	1,600	$64	....	....	....	....
June	456,198	12,939	331,000	12,638	....	....	....	....
July	446,850	23,539	164,420	6,115	228,400	23,979	....	....
August	295,877	18,143	112,200	6,732	262,100	23,038	....	....
September	183,200	13,430	23,600	1,639	50,200	6,616	....	....
October	348,700	17,118	....	....	137,440	2,243	....	....
November	....	....	....	....	166,600	2,711	20,000	325
December	....	....	....	....	20,550	248	996,000	14,550
Total landed at Boston	1,792,355	87,073	632,820	27,188	1,275,290	71,135	1,488,200	23,330
January	....	....	....	....	441,000	14,880	1,151,400	17,769
February	....	....	....	....	306,000	11,050	171,000	2,779
March	....	....	....	....	235,800	13,100	50,000	1,000
April	....	....	....	....	108,000	3,900	....	....
May	3,600	150	83,000	3,273	....	....	....	....
June	277,470	9,601	3,479,000	132,520	....	....	....	....
July	220,320	8,222	3,521,400	150,157	3,530	388	44,720	893
August	200,690	9,410	2,351,000	141,643	28,454	1,347	....	....
September	119,430	6,369	1,108,000	77,378	59,928	1,397	....	....
October	168,930	7,722	679,600	43,671	339,550	5,130	759,400	9,288
November	....	....	158,600	8,723	178,200	1,822	3,240,200	49,519
December	....	....	....	....	218,000	8,400	5,282,000	81,873
Total landed at Gloucester	990,440	41,474	11,380,600	557,365	1,918,462	61,414	10,698,720	163,121
Grand total	2,782,795	128,547	12,013,420	584,553	3,193,752	132,549	12,186,920	186,451
Landed at Boston in 1900	4,019,362	155,544	1,404,300	68,662	3,079,400	123,850	1,457,800	22,715
Landed at Gloucester in 1900	4,869,932	234,408	14,561,200	769,081	2,104,872	65,445	5,818,000	93,055

Months.	Total fresh.		Total salted.		Grand total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
January	3,494,500	$96,372	240,000	$3,250	3,734,500	$99,622
February	4,164,600	140,441	238,200	5,325	4,402,800	145,766
March	6,036,200	147,375	....	....	6,036,200	147,375
April	2,975,800	96,544	....	....	2,975,800	96,544
May	4,000,630	89,688	1,600	64	4,002,230	89,752
June	4,270,848	100,607	341,000	12,938	4,611,848	113,545
July	4,390,650	136,532	164,420	6,115	4,555,070	142,647
August	4,576,527	149,437	112,200	6,732	4,688,727	156,169
September	5,770,550	146,770	23,600	1,639	5,794,150	148,409
October	7,055,706	160,560	....	....	7,055,706	160,560
November	5,324,500	121,259	20,000	325	5,344,500	121,584
December	4,794,600	134,877	996,000	14,550	5,790,600	149,427
Total landed at Boston	56,855,111	1,520,462	2,137,020	50,938	58,992,131	1,571,400
January	1,824,987	72,507	1,773,865	39,500	3,598,852	112,007
February	1,713,666	67,347	228,040	4,844	1,941,706	72,191
March	4,134,744	102,342	283,539	9,019	4,418,283	111,361
April	2,909,911	79,462	283,650	9,839	3,193,561	89,301
May	3,496,007	88,452	1,070,422	38,894	4,566,429	127,346
June	4,485,988	88,805	5,892,554	213,835	10,378,542	302,640
July	4,224,751	81,036	9,422,627	334,724	13,647,378	415,760
August	2,655,929	77,977	7,189,113	308,648	9,845,042	386,625
September	2,600,524	63,979	5,400,258	242,277	8,000,782	306,256
October	5,146,343	85,147	5,510,858	182,780	10,657,201	267,927
November	4,377,101	70,030	9,190,843	237,518	13,567,944	307,548
December	2,014,226	56,235	6,343,114	119,354	8,357,340	175,589
Total landed at Gloucester	39,584,177	933,319	52,588,883	1,741,232	92,173,060	2,674,551
Grand total	96,439,288	2,453,781	54,725,903	1,792,170	151,165,191	4,245,951
Landed at Boston in 1900	63,647,812	1,495,379	3,173,100	103,127	66,820,912	1,598,506
Landed at Gloucester in 1900	43,535,583	1,119,490	51,862,426	1,667,106	95,398,009	2,786,596

[a] Includes herring from Newfoundland, 1,718,800 pounds frozen, $63,630, and 10,029,600 pounds salted, $161,514.

FISHERIES OF UTAH.

The fisheries of Utah in 1900 employed 505 persons, most of whom fished in Utah Lake. The capital invested was $52,985; $33,400 of this amount is credited to Utah County. Seines and hand lines constituted the principal forms of apparatus in use. The products amounted to 1,081,863 pounds, valued at $47,458. By far the greater part of the catch was derived from Utah Lake, in Utah County. Weber, Rich, and Garfield counties are next in regard to the quantity of fish taken. The principal species taken were, carp, 353,885 pounds, valued at $4,494; trout, 145,798 pounds, $24,678; black bass, 104,800 pounds, $11,105; suckers and mullet, 452,780 pounds, $4,833.

Mr. E. A. Tulian reports that black bass, carp, trout, and bullheads have greatly increased in Utah County since 1895. The bass, carp, and bullheads were nearly all taken in Utah Lake and its tributaries. Bass weighing 7 to 8 pounds are sometimes taken, and are said to be of excellent quality. The bullheads introduced into the lake four or five years ago are increasing and find a ready sale at good prices. The black bass and carp are also introduced species.

It appears that an important quantity of fish is taken and sold contrary to law, so that the yield of fish from the waters of Utah is larger than the present figures show.

Most persons engaged in fishing in these waters carry on the business in a desultory manner. Considerable quantities of fish are taken by farmers living in the vicinity of Utah Lake, many of them spearing carp in the winter time for their own use.

Table showing, by counties, the number of persons employed in the fisheries of Utah in 1900.

Counties.	Fishermen.	Shoresmen.	Total.
Utah	295	47	342
Garfield	24	1	25
Piute	4	....	4
Sevier	20	....	20
Salt Lake	12	25	37
Cache	20	....	20
Weber	47	2	49
Morgan	3	....	3
Rich	5	....	5
Total	430	75	505

Table showing, by counties, the apparatus and capital employed in the fisheries of Utah in 1900.

Designation.	Utah.		Garfield.		Piute.		Sevier.		Salt Lake.	
	No.	Value.	No.	Value.	No.	Val.	No.	Val.	No.	Value.
Apparatus:										
Boats	100	$2,150	15	$75	......	......	30	$150	......	......
Hand lines	70	350	16	115	15	$75	100	500	5	$25
Seines	11	825	2	30	......	......	......	......	2	100
Spears	200	200	......	......	......	......	......	......	......	......
Shore and accessory property	......	27,275	......	575	......	......	......	......	......	14,700
Cash capital	......	2,600	......	350	......	......	......	......	......	1,000
Total	......	33,400	......	1,145	......	75	......	650	......	15,825

Table showing apparatus and capital employed in the Utah fisheries in 1900—Continued.

Designation.	Cache.		Weber.		Morgan.		Rich.		Total.	
	No.	Value.	No.	Value.	No.	Val.	No.	Val.	No.	Value.
Apparatus:										
Boats	......	....	2	$50	......	$50	3	$55	150	$2,480
Hand lines	20	$100	31	155	10	......	......	......	266	1,370
Seines	......	....	8	120	......	......	2	45	25	1,120
Gill nets	......	....	......	....	......	......	1	15	1	15
Spears	......	....	......	....	......	......	......	......	200	200
Shore and accessory property	......	....	......	500	......	......	......	......	......	43,050
Cash capital	......	....	......	800	......	......	......	......	......	4,760
Total	......	100	......	1,625	......	50	......	115	......	52,985

Table showing, by counties and apparatus, the yield of the fisheries of Utah for the year 1900.

Apparatus and species.	Utah.		Garfield.		Piute.		Sevier.		Salt Lake.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Brook trout	....	......	......	......	......	......	......	......	3,000	$1,500
Bullheads	10,050	$603	......	......	......	......	......	......	......	......
Carp	194,685	2,434	......	......	......	......	......	......	4,200	85
Rainbow trout	....	......	......	......	......	......	......	......	1,800	900
Suckers and mullet	387,880	3,879	3,000	$150	......	......	......	......	5,400	108
White-fish [a]	....	......	1,000	100	......	......	......	......	......	......
Total	592,615	6,916	4,000	250	......	......	......	......	14,400	2,593
Lines:										
Black bass	92,300	9,230	......	......	......	......	......	......	12,500	1,875
Black-spotted trout	....	......	39,500	3,950	3,500	$350	2,900	$290	10,200	2,050
Trout	40,098	6,015	......	......	......	......	......	......	......	......
White-fish [a]	4,100	410	......	......	......	......	......	......	......	......
Total	136,498	15,655	39,500	3,950	3,500	350	2,900	290	22,700	3,925
Spears:										
Carp	150,000	1,875	......	......	......	......	......	......	......	......
Grand total	879,113	24,446	43,500	4,200	3,500	350	2,900	290	37,100	6,518

Apparatus and species.	Cache.		Weber.		Morgan.		Rich.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Seines:										
Brook trout	......	......	......	......	......	......	......	......	3,000	$1,500
Bullheads	......	......	......	......	......	......	......	......	10,050	603
Carp	......	......	5,000	$100	......	......	......	......	203,885	2,619
Chubs	......	......	1,500	40	......	......	......	......	1,500	40
Rainbow trout	......	......	......	......	......	......	......	......	1,800	900
Suckers and mullet	......	......	4,500	115	......	......	50,500	$558	451,280	4,810
White-fish [a]	......	......	......	......	......	......	......	......	1,000	100
Total	......	......	11,000	255	......	......	50,500	558	672,515	10,572
Gill nets:										
Suckers	......	......	......	......	......	......	1,500	23	1,500	23
Trout	......	......	......	......	......	......	100	8	100	8
Total	......	......	......	......	......	......	1,600	31	1,600	31
Lines:										
Black bass	......	......	......	......	......	......	......	......	104,800	11,105
Black-spotted trout	13,500	$3,375	27,400	5,480	3,800	$760	......	......	100,800	16,255
Trout	......	......	......	......	......	......	......	......	40,098	6,015
White-fish [a]	......	......	6,950	1,045	1,000	150	......	......	12,050	1,605
Total	13,500	3,375	34,350	6,525	4,800	910	......	......	257,748	34,980
Spears:										
Carp	......	......	......	......	......	......	......	......	150,000	1,875
Grand total	13,500	3,375	45,350	6,780	4,800	910	52,100	589	1,081,863	47,458

[a] The species called white-fish in this table is *Coregonus williamsoni*, commonly known in this region as mountain herring or Rocky Mountain white-fish.

CARP.

The wholesale trade in carp in New York City.—During the progress of the canvass of the fisheries of New York City for the year 1901 Mr. Cobb made inquiries respecting the trade in German carp. The item of carp in the fish supply of the city is quite important, amounting to 6,906,950 pounds, valued in New York at $197,451. While small quantities are received incidentally by most dealers, the handling of the greater part of the supply is done by a few firms only.

Carp in the New York markets are mainly from the Illinois River and from Lake Erie, the balance coming generally from eastern points, notably East Bay, L. I., the Delaware River, Havre de Grace, Md., and Washington, D. C. Most of the carp are received from April to September, inclusive, the remainder arriving in the winter months. Hebrew retail dealers and peddlers dispose of the greater part on the East Side, some going to Philadelphia and to points in New England. As the Hudson River contains many carp, it is probable that New York will in time be supplied with cheap fish from that source.

The following table shows the quantity and value of German carp handled in the wholesale markets of New York City during 1901:

Seasons.	Lbs.	Value to fishermen.	Value to dealers.
Jan. 1 to Mar. 1	354,950	$10,649	$17,748
Mar. 1 to Apr. 15	589,500	7,370	11,790
Apr. 15 to June 15	2,040,000	20,040	34,000
June 15 to Sept. 1	1,485,000	29,700	44,550
Sept. 1 to Dec. 1	2,032,500	51,813	71,138
Dec. 1 to Jan. 1	405,000	13,163	18,225
Total for the year	6,906,950	132,735	197,451

The above values represent the selling price in New York. The value of this quantity of carp to the fishermen was $132,735, which does not include freight or express charges.

The carp trade in general.—The carp industry of the Illinois River has been important for several years, the catch in 1901 amounting to 5,780,200[a] pounds, valued at $173,406. The catch in Lake Erie in 1900 was 4,598,090 pounds. The quantity marketed in the United States is, according to the latest statistics available, 17,160,873 pounds, valued at $407,633. As the figures for some sections of the country are over three years old, and as the consumption of carp is increasing, the quantity put on the market annually is probably over 20,000,000 pounds.

Where dealers have worked up regular markets for carp, and handled them in quantities large enough for profit at the low prices obtained, hopeful opinions will be heard; where these fish are received incidentally they can not be handled with profit, and opinions just the reverse will be expressed regarding their presence in the fish trade.

[a] Report of the Illinois Fishermen's Association for the year ending December 31, 1901.

HOOK-AND-LINE FISHING FOR PACIFIC SALMON.

Mr. A. B. Alexander, of the steamer *Albatross*, has furnished some interesting notes relative to the taking of Pacific salmon with hook and line.

Trolling for salmon in Monterey Bay has increased steadily each year since its beginning, and in 1901 there were taken by this method, approximately, 190,786 pounds of salmon, or about 10,000 fish in number, most of which was placed in cold storage and shipped to various Eastern markets. About 100 boats were engaged in the fishing.

Previous to 1893 few salmon were taken in Monterey Bay by any kind of apparatus. In that year trolling for them was found to be very successful and the discovery was quickly taken advantage of by anglers and commercial fishermen. It was not known that salmon could be taken with the hook in this bay in paying quantities, the reason being, doubtless, that the fish do not appear leaping at the surface, as is the custom when entering fresh water. Most of the fishing is done in the summer time, but a moderate number of fish can also be taken in Monterey Bay during the winter months.

The fish appear in numbers about the first week in June, when the sardines are most numerous. The salmon are also found feeding on smelts and squid. The fish are taken in two ways, by trolling with the spoon with and without bait, and with the baited hook used at a considerable depth with a heavy sinker. Previous to the arrival of the sardines and other species on which the salmon feed the fishing is done mostly by trolling with the rod and spoon, but as soon as bait is to be had this method is abandoned for the sinker and hook. As a substitute for bait the baited spoon is sometimes used, but the baited hook is preferred by the commercial fishermen.

Sportsmen who visit the bay from San Francisco and elsewhere use split bamboo rods ranging from 10 to 12 ounces. Both silk and linen lines are employed, varying in length from 150 to 200 yards. The spoons vary in size from Nos. 5 to 7. The average hook used in connection with the spoon corresponds in size to the No. 14 cod trawl hook, with a slightly longer shank. Some fishermen use the brazed treble hook, but it is not a favorite with sportsmen. All the fishing is carried on from skiffs and small rowboats.

As the numerous commercial fishermen do not often use a spoon, many more salmon are taken with baited hooks. A common bamboo pole is used by the fishermen, with a cotton line of 32 thread, from 80 to 100 feet in length. The hook is 5 inches long and shaped like a halibut hook, with a longer shank. In baiting the hook care is taken to have the shank entirely covered, leaving the barb and point bare. The sinker is quite heavy, being about 4 pounds in weight and fastened to the line 25 feet above the hook. When the salmon is hooked the pole is dropped and the line is hauled in hand over hand, great care being taken that the fish does not break away. Frequently the fishing is done without the use of the rod. When the sinker is used the trolling is done at a depth of at least 20 feet. The usual sailing speed in trolling is 4 miles an hour, and the average size of the salmon taken is a little over 20 pounds, although 50-pounders are sometimes caught. The best fishing is usually to be had during the afternoon, and 25 fish are considered a good day's catch for one hook.

Monterey is the most southerly point where salmon are taken, either commercially or for sport. Very few salmon are taken with the hook in San Francisco Bay and the Sacramento River. In the Eel River there is good salmon trolling to be had in the fall. The fish are taken in tide water chiefly by professional fishermen, using from 20 to 30 boats, but many anglers visit these waters for the sport fishing. It takes the angler an hour on an average to land one of the larger fish. Similar fishing is done by anglers in a number of the smaller coast rivers, such as the Russian and Nevarro, the Olema, and about the head of Tomales Bay. Steelhead salmon are frequently taken in these waters with artificial flies.

The Indians of Neah Bay, Washington, do considerable trolling for silver salmon and have been known to take as many as 4,000 fish in a day. The principal fishing-grounds lie off the mouth of the bay and in the vicinity of Tatoosh rock off the coast and some 2 or 3 miles farther south. The catch is usually disposed of at Port Townsend. The Indians repair to the grounds early in the morning, remaining out all day and sometimes after dark if the weather permits. The spoons employed are larger than those used elsewhere on the coast. The lines are usually of 30 thread and about 150 feet long. Pieces of salmon and small herring are used for bait. In trolling the canoe is paddled, except in very light breezes, when the sail is set.

Salmon trolling has long been practiced in Puget Sound, where sportsmen use the rod and reel.

At Killisnoo, Alaska, the king salmon take the spoon readily, the fish coming in to feed on the herring which annually visit these waters in great numbers. Spoons and lines of the same pattern as those used at Neah Bay are employed by the Killisnoo Indians. The same bait is used and the fish taken are for their own consumption.

When salmon will not readily take a spoon at the surface, a baited hook towed near the bottom frequently induces them to bite.

There can be no doubt that there are many other places along the west coast where salmon could be taken by trolling. They have recently been taken from vessels 10 or 12 miles off the coast of Washington, the bait being towed at 30 fathoms where the soundings were 40 fathoms. It now seems probable that a thorough trial by deep trolling all along the west coast will show that the salmon are "on soundings" and not far from the coast during most of the time they spend at sea.

THE LOBSTER FISHERY.

During the summer of 1901 a canvass was made of the entire lobster fishery of the Atlantic coast of the United States. The number of persons engaged this fishery was 4,348, including 4,059 fishermen and 289 shoresmen. There were 191 vessels employed, aggregating 1,888 tons, valued with their outfits at $216,674. The boats in use, with launches and steam vessels under 5 tons, numbered 3,960, and were valued at $261,918. There were 208,563 lobster pots employed, worth $224,111. Shore and accessory property was valued at $454,457, and the cash capital amounted to $510,900. The total investment in the fishery was $1,668,060; of this amount $960,529 is credited to Maine, $570,923 to Massachusetts, $54,516 to Rhode Island, $59,133 to Connecticut, $14,589 to New York, $5,960 to New Hampshire, $2,320 to New Jersey, and $90 to Delaware.

The total yield of the fishery was 15,767,741 pounds, with a first value of $1,390,579. The yield is credited to the States as follows: Maine, 12,346,450 pounds, worth $1,062,206; Massachusetts, 1,805,042 pounds, $171,825; Rhode Island, 660,017 pounds, $58,026; Connecticut, 550,450 pounds, $51,484; New York, 156,260 pounds, $21,224; New Hampshire, 205,122 pounds, $19,078; New Jersey, 40,800 pounds, $6,400; and Delaware, 3,600 pounds, $336.

Table showing details of the lobster fishery of the United States in 1900.

States and counties.	Persons employed.		Vessels fishing.			Vessels transporting.		
	Fishermen.	Shoresmen.	No.	Tonnage.	Value.	No.	Tonnage.	Value.
Maine:								
Washington	542	33	10	65	$3,750	8	60	$6,890
Hancock	600	19	56	417	22,235	5	94	6,465
Waldo	6							
Knox	553	37	25	161	10,510	3	31	22,560
Lincoln	488	18	1	5	365			
Sagadahoc	88							
Cumberland	417	51	5	33	2,103	37	601	106,275
York	176	7						
Total	2,870	165	97	681	38,963	53	786	142,190
New Hampshire:								
Rockingham	45							
Massachusetts:								
Essex	178		2	16	825			
Suffolk	34	110				1	25	1,250
Norfolk	22							
Plymouth	161							
Barnstable	100		1	5	300			
Nantucket	14							
Dukes	61		1	5	800			
Bristol	35		3	17	2,100			
Total	605	110	7	43	4,025	1	25	1,250
Rhode Island:								
Newport	163	11	6	32	3,408			
Washington	45							
Total	208	11	6	32	3,408			
Connecticut:								
Fairfield	19		2	13	795			
New Haven	39		1	10	398			
Middlesex	23							
New London	141	3	19	180	18,020			
Total	222	3	22	203	19,213			

Table showing details of the lobster fishery of the United States in 1900—Continued.

States and counties.	Persons employed.		Vessels fishing.			Vessels transporting.		
	Fishermen.	Shoresmen.	No.	Tonnage.	Value.	No.	Tonnage.	Value.
New York:								
Kings	20	......	......	......	......	......	......	......
Richmond	14	......	......	......	......	......	......	......
Suffolk	18	......	2	18	$1,725	......	......	......
Westchester	5	......	......	......	......	......	......	......
New York	26	......	3	100	5,900	......	......	......
Total	83	......	5	118	7,625	......	......	......
New Jersey:								
Monmouth	20	......	......	......	......	......	......	......
Delaware:								
Sussex	6	......	......	......	......	......	......	......
Grand total	4,059	289	137	1,077	73,234	54	811	$143,440

States and counties.	Boats.*		Lobster pots.		Shore and accessory property.	Cash capital.	Total investment.	Lobsters caught.	
	No.	Value.	No.	Value.				Lbs.	Value.
Maine:									
Washington	608	$36,431	29,740	$29,740	$18,310	$21,200	$116,321	2,116,350	$148,039
Hancock	561	34,255	37,560	37,560	10,530	23,500	131,545	2,865,600	252,153
Waldo	6	90	125	125	60	......	275	5,175	517
Knox	578	27,879	31,335	31,335	30,415	43,200	165,899	2,937,175	260,014
Lincoln	603	34,433	30,280	30,280	35,740	32,000	132,818	2,353,450	213,770
Sagadahoc	88	1,265	3,300	3,300	890	......	5,455	268,500	23,770
Cumberland	330	18,272	15,555	15,605	95,475	142,500	380,230	1,211,500	114,262
York	183	9,010	7,720	9,515	2,461	4,000	24,986	588,700	49,681
Total	2,957	161,635	155,615	157,460	193,881	266,400	960,529	12,346,450	1,062,206
New Hampshire:									
Rockingham	44	1,520	2,501	3,515	925	......	5,960	205,122	19,078
Massachusetts:									
Essex	137	6,690	6,953	7,141	2,340	......	16,996	465,551	47,721
Suffolk	31	1,175	2,385	2,385	235,625	240,000	480,435	163,136	17,250
Norfolk	24	1,665	2,250	2,250	375	......	4,290	85,454	9,200
Plymouth	155	14,220	9,127	11,904	3,015	......	29,139	765,291	63,553
Barnstable	94	9,470	3,488	3,488	2,780	......	16,038	110,375	11,987
Nantucket	15	1,365	672	672	100	......	2,137	16,083	1,930
Dukes	90	9,165	2,388	2,388	625	......	12,978	129,990	13,174
Bristol	25	5,140	1,390	1,390	280	......	8,910	69,162	7,010
Total	571	48,890	28,653	31,618	245,140	240,000	570,923	1,805,042	171,825
Rhode Island:									
Newport	153	21,582	9,175	11,330	9,350	4,500	50,170	575,492	50,850
Washington	38	2,137	1,470	1,784	425	......	4,346	84,525	7,176
Total	191	23,719	10,645	13,114	9,775	4,500	54,516	660,017	58,026
Connecticut:									
Fairfield	16	1,025	459	676	249	......	2,745	13,350	2,001
New Haven	39	2,045	1,240	1,921	303	......	4,667	46,250	5,938
Middlesex	30	1,810	669	1,180	135	......	3,125	25,150	2,746
New London	65	17,675	4,594	9,027	3,874	......	48,596	465,700	40,799
Total	150	22,555	6,962	12,804	4,561	......	59,133	550,450	51,484
New York:									
Kings	10	700	1,020	895	......	......	1,595	24,530	3,120
Richmond	7	610	850	760	......	......	1,370	19,170	2,300
Suffolk	11	900	725	1,241	......	......	3,866	29,860	3,084
Westchester	4	375	51	73	175	......	623	6,300	1,260
New York	......	......	810	1,235	......	......	7,135	76,400	11,460
Total	32	2,585	3,456	4,204	175	......	14,589	156,260	21,224
New Jersey:									
Monmouth	12	990	665	1,330	......	......	2,320	40,800	6,400
Delaware:									
Sussex	3	24	66	66	......	......	90	3,600	336
Grand total	3,960	261,918	208,563	224,111	454,457	510,900	1,668,060	15,767,741	1,390,579

*Includes sailboats, ele[illegible]ic and naphtha launches, and steamboats under 5 tons.

YIELD AND VALUE OF LOBSTERS IN VARIOUS YEARS.

The following table showing the yield and value of the lobster fishery in former years is compiled from the reports of the U. S. Fish Commission, and shows the yield and value of lobsters in each of the lobster-producing States on the Atlantic coast in all years for which the fishery has been investigated from 1880 to 1898. No lobsters were reported for Delaware in 1880, but, with this exception, the omission of statistics for any of the States in any of the years enumerated is due to the fishery not being canvassed. The total yield of lobsters for all the States in 1880 was 20,128,033 pounds, value $483,891; in 1887, 28,882,180 pounds, value $799,717; in 1888, 28,108,970 pounds, value $836,617, and in 1889, 30,771,573 pounds, value $861,297. Complete totals can not be shown for other years because the fishery was not investigated in all the States. The total yield in 1892, omitting New York, was 23,559,432 pounds, value $1,046,647; and in 1898, omitting Delaware, it was 15,118,062 pounds, value $1,318,299.

Yield and value of the lobster fishery in former years.

Years.	Maine.		New Hampshire.		Massachusetts.		Rhode Island.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
1880	14,234,182	$268,739	250,000	$7,500	4,315,416	$158,229	423,250	$15,871
1887	22,916,642	512,044	142,824	6,268	3,511,075	156,204	570,039	27,128
1888	21,694,731	515,880	136,350	6,256	3,743,475	172,936	588,500	28,047
1889	25,001,351	574,165	137,175	6,415	3,353,787	148,492	456,000	21,565
1892	17,642,677	663,043	196,350	11,700	3,182,270	205,638	774,100	53,762
1897 a	10,300,880	683,082	90,300	5,493	2,089,502	157,330	....	....
1898	11,183,294	992,855	108,515	9,372	1,693,741	147,702	578,066	43,290
1900	12,346,450	1,062,206	205,122	19,078	1,805,042	171,825	660,017	58,026

Years.	Connecticut.		New York.		New Jersey.		Delaware.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
1880	613,385	$23,002	135,000	$5,062	156,800	$5,488	....	....
1887	1,487,020	82,594	114,000	6,850	101,580	7,719	39,000	$910
1888	1,477,226	85,723	248,000	13,900	181,688	12,965	39,000	910
1889	1,501,290	83,099	124,023	12,780	188,347	14,301	9,600	480
1890	....	....	150,400	14,754	185,321	13,683	7,200	360
1891	....	....	165,093	15,655	165,664	12,463	8,200	410
1892	1,614,530	101,358	....	....	143,905	10,861	5,600	285
1897 a	....	....	130,610	10,913	79,230	6,197	....	....
1897	....	....	381,020	31,458	99,230	8,573	5,095	459
1898	1,098,192	83,748	332,378	30,235	123,876	11,097	....	....
1900	550,450	51,484	156,260	21,224	40,800	6,400	3,600	336

a Fiscal year

NOTES ON THE LONDON FUR-SEAL TRADE.

While en route to The Hague, where he was detailed in connection with the arbitration of whaling and sealing claims against Russia, Mr. Townsend made inquiries in London respecting the trade in fur-seal skins, which has long been centered there.

The prices of fur-seal skins have been subject to considerable fluctuation for several years, owing to the effect of pelagic sealing in Bering Sea and the North Pacific Ocean on the sealing industries of the Pribilof and Commander islands. Frequently the majority of the seal skins on the market has consisted of the low-grade skins yielded by the pelagic fisheries.

The following table, showing the numbers and values of salted fur-seal skins from all sources placed on the London market during the period from 1871 to 1901, was procured from Messrs. C. M. Lampson & Co., of London. It is interesting chiefly on account of comparisons presented between the prices of the miscellaneous skins resulting from the wasteful pelagic sealing, and those of seals taken under the best conditions. The classification of the skins is that customarily used in the fur trade. The numbers indicate the catch of salted skins received from each source, not the yearly sales, as in some cases catches are not all sold during the years in which they were taken.

Yearly catch.	Alaska.		Copper.		Northwest coast.		Lobos.	
	Skins.	Average price realized.	Skins.	Average price realized.	Skins.	Average price realized.	Skins.	Average price realized.
1871	104,899	$10.26						
1872	96,283	10.91			1,728	(a)		
1873	103,724	12.65			40	(a)		
1874	99,150	12.77	30,349	$9.73	5,071	(a)		
1875	99,634	12.35	34,479	9.98	2,224	(a)		
1876	90,276	8.35	33,198	6.04	3,104	(a)	11,353	$3.53
1877	75,410	9.71	25,380	6.43	772	(a)	13,066	3.45
1878	99,911	16.83	18,686	9.41	2,698	(a)	12,301	8.37
1879	100,036	20.62	28,215	14.05	14,609	(a)	12,295	9.91
1880	100,161	22.24	38,900	19.47	13,501	(a)	14,865	9.81
1881	99,921	19.40	45,209	14.60	15,887	(a)	13,569	7.50
1882	100,100	13.04	39,311	11.05	22,886	(a)	13,200	4.07
1883	75,914	20.13	36,480	9.33	8,704	(a)	12,422	4.56
1884	99,994	12.59	26,675	14.38	19,357	(a)	14,580	3.61
1885	99,874	14.01	48,929	9.02	10,148	$6.28	10,862	4.34
1886	99.947	16.85	41,750	9.73	49,079	7.16	15,049	4.40
1887	99,949	13.61	54,584	9.73	39,419	6.33	14,831	3.97
1888	100,037	18.96	46,296	9.33	30,285	8.43	17,774	4.99
1889	100,031	16.28	47,411	12.29	39,884	10.22	13,205	6.73
1890	25,152	33.72	52,765	14.15	47,467	15.65	14,241	8.52
1891			59,746	20.01				
	13,494	30.50	30,681	16.67	63,733	13.32	13,634	8.15
1892	7,554	30.50	31,380	19.73	72,973	16.69	12,202	6.45
1893	7,500	26.40	32,832	17.48	106,368	12.47	13,624	7.38
1894	16,030	20.90	27,298	13.87	135,686	8.66	12,145	5.13
1895	15,002	19.89	17,721	13.14	102,460	10.66	12,017	4.87
1896	30,004	16.42	14,415	10.99	71,033	7.79	19,172	5.19
1897	20,762	21.13	13,727	13.67	40,280	10.34	15,926	4.38
1898	18,032	38.08	9,487	16.76	31,407	10.89	14,422	5.07
1899	16,804	33.54	9,786	29.97	42,857	15.44	14,918	7.36
1900	21,924	27.54	13,237	19.65	44,379	15.09	15,116	4.89
1901	22,672	(b)	11,298	23.31	31,476	13.99	12,831	8.05

Yearly catch.	Cape Horn.		Cape of Good Hope.		Australasian.		Unalaska.		South Sea.	
	Skins.	Average price realized.	Skins.	Average price realized.	Skins.	Average price realized.	Skins.	Average price realized.	Skins.	Average price realized.
1886	2,171	$3.36	3,156	$3.41			4,214	$1.90		
1887	2,867	4.95	1,439	3.55	345	$4.28	4,705	1.60	200	$37.43
1888	4,662	5.37	4,794	4.87	183	7.54	1,416	4.80	120	21.57
1889	3,812	7.79	3,195	5.70	265	6.97	3,333	3.93	315	13.38
1890	3,627	10.03	2,308	7.64	428	5.51				
1891	4,389	10.91	4,005	8.70	322	9.77	2,276	5.33	126	26.79
1892	6,386	7.99	1,397	6.45	393	8.31			834	21.39
1893	2,131	10.28	1,127	7.91	73	5.66	1,329	3.67	43	26.46
1894	62	5.47	1,528	10.20	15	6.08	1,272	5.86		
1895	1,888	7.81	1,394	8.74	2,354	8.74	1,148	2.87		
1896	2,510	7.28	3.080	6.77	2,011	6.49	2,602	1.70	589	12.57
1897	8,451	4.09	457	3.91	747	3.45	555	2.89		
1898	4,204	6.14	2,337	3.91	619	3.20	571	1.32		
1899	6,908	7.40	651	3.55	617	3.16				
1900	8,765	6.49	1,379	3.93	87	2.92				
1901	11,329	6.91	4,773	4.11	5	1.95				

Besides the above, data exist as follows: Robben Island, 1886, 1,832 skins at $7.87; Galapagos, 1886, 993 skins at $1.70; 1887, 99 skins at $1.46. Sundry sources; 1887, 239 skins at $4.14; 1899, 64 skins at $0.44.

a Figures for August not obtained.

b Not yet all sold.

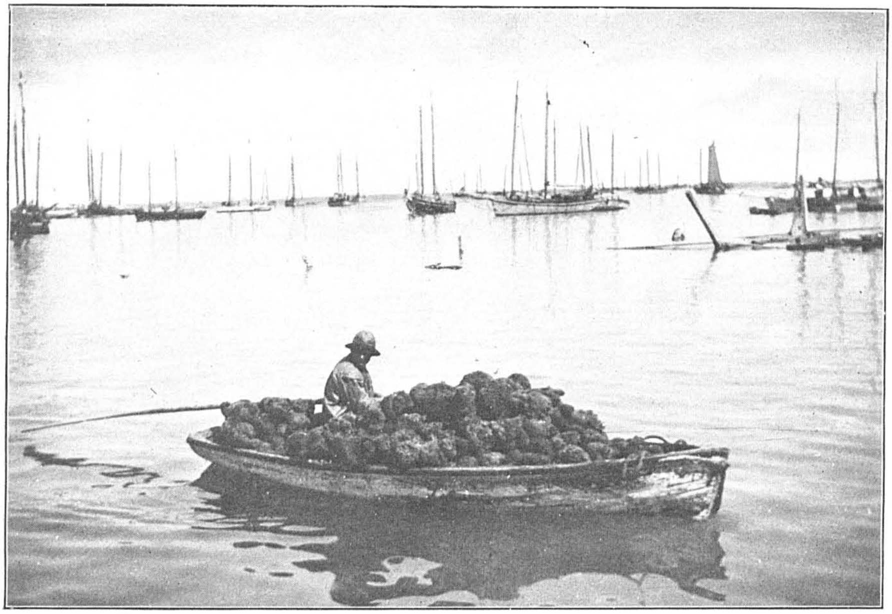
The sources from which fur seals are derived are as follows: The skins known to the trade as "Alaskas" are those of surplus male seals killed on the Pribilof Islands, under United States government supervision; "Copper" and "Robben Island" are similar in character, and are killed on the Commander and Robben islands, respectively, under direction of officers of the Russian Government; "Lobos" skins are those derived from the Lobos Islands in the mouth of the Rio de la Plata, and are killed under supervision of the Government of Uruguay. The term "Northwest coast" is used to designate the entire pelagic catch of the North Pacific Ocean and Bering Sea. Skins known as "Cape Horn," "Cape of Good Hope," "Australasian," "Galapagos," and "South Sea" are the result of irregular sealing in all of these regions, seals being killed indiscriminately on their breeding-grounds. "Unalaska" skins are those of young seals of the year, commonly known as "Gray Pups," and are killed by natives, in the passes of the Aleutian Islands during their first southward migration.

THE SPONGE FISHERY OF FLORIDA IN 1900.

BY

JOHN N. COBB,

Agent of the United States Fish Commission.



BRINGING SPONGES FROM THE VESSELS TO SPONGE WHARF AT KEY WEST.

A SPONGE AUCTION AT ANCLOTE.

THE SPONGE FISHERY OF FLORIDA IN 1900.

By John N. Cobb,
Agent of the United States Fish Commission.

In 1901 the writer was detailed to make an investigation of the commercial aspects of the fishery, and the following notes give complete data showing its condition in the calendar year 1900:

GROUNDS, VESSELS, METHODS OF THE FISHERY, ETC.[a]

There are two well-defined areas of the Florida coast in which sponging is prosecuted.

A chain of "keys," or islands, starts from the mainland at about Miami, on the east coast, and extends, in the shape of a horn, far into the Gulf of Mexico, the Dry Tortugas being the westernmost point of the horn. In the waters surrounding most of these keys, and also between the keys and the mainland as far as Cape Sable, sponges are found. This is called the "key grounds" and is worked exclusively by spongers from Key West and the few inhabitants of the many keys. The earliest sponging was on these grounds.

The "bay grounds," which are the most prolific, are on the west coast, in the Gulf of Mexico, and extend from Johns Pass, a few miles north of the entrance to Tampa Bay, to St. Mark's light-house, a distance of about 200 miles. Sponges are also found in the Gulf between Tampa Bay and Cape Sable, but not in sufficient quantities to justify making trips specially to this region.

The sponges taken from these grounds are classified as follows by the spongers and buyers: Sheepswool, yellow, grass, velvet or boat, and glove. A few other unimportant kinds, such as "wire," "hardhead," etc., are generally included with those previously mentioned.

Vessels of a schooner or sloop rig, ranging from 5 to 46 tons (averaging slightly over 11 tons), operate chiefly on the "bay grounds," while small sloops, usually of less than 5 tons burden, work mainly on the "key grounds." The larger vessels, which average about $1,168

[a] No effort has been made to give these subjects in detail, as they have been covered in other reports, to which the reader is referred as follows:

The Fisheries and Fishery Industries of the United States. Tenth Census of the United States.

The Fish and Fisheries of the Coastal Waters of Florida. Rep. U. S. Fish Com. 1896, pp. 263-342.

The Florida Commercial Sponges. By Hugh M. Smith. Bull. U. S. Fish Com. 1897, pp. 225-240, 19 pls.

Notes on the Florida Sponge Fishery in 1899. By Hugh M. Smith. Bull. U. S. Fish Com. 1899, pp. 149-151.

in value, exclusive of outfit, carry from 5 to 13 men, while the smaller vessels, which average in value about $780, including outfit, carry crews of from 3 to 5 men.

The larger Key West vessels make three to four trips per year to the "bay grounds," and some of them make one or two trips to the "key grounds." Each "bay" trip occupies about two months, while the "key" trip is made in about a month. The Tarpon Springs and Apalachicola vessels average about five trips each year, each trip occupying about two months. None of these latter vessels visits the "key grounds."

The "bay" trips are usually arranged as follows:

The first trip begins about the first week of January, and ends from the 10th to the 20th of March, the spongers working from the mouth of Anclote River to St. Martins Reef, about 40 miles. Many of the vessels do not make this trip, as the weather is usually cold and windy.

The second trip begins about April 1 and ends from the 10th to the 20th of June. The grounds between Johns Pass and Cedar Key are visited during this trip.

The next trip begins about July 1 and ends from the middle of August to the 1st of September, and is also carried on between Johns Pass and Cedar Key. This is usually the best trip of the year.

The fourth trip is called the "hurricane trip," from the fact that it is prosecuted during the hurricane season, and lasts from the middle of August to about the 10th of October, the same grounds being visited as on the two previous trips.

The last trip usually begins the early part of November and ends December 20, the Rock Island grounds being visited.

A number of the vessels refit previous to the last trip, while others wait until the first two months of the year for this purpose.

The crews work on shares. The owner, or "outfitter," furnishes the food, fuel, boats, apparatus, etc., for the trip. While sponging in the "bay" each member of the crew is assessed 35 cents per trip for watchman's fee at the "kraals," and 50 cents per trip for wood. After deducting these two items from the gross proceeds of the trip, the vessel takes half of the remainder, and the other half is divided up equally among the crew. Besides his regular share with the crew, the captain gets 10 per cent of the vessel's share, and each "hooker" gets one-fourth of one share from the vessel's portion. Should the captain also be a "hooker," which is generally the case, he only gets his regular 10 per cent.

The same division of proceeds is followed on the "key" trips, except that there are no charges for watchmen and for wood. The men generally camp on the keys where wood and water are convenient, and as settlers are scarce in this region the "kraals" do not have to be guarded.

The only apparatus used in this fishery is the sponge hook, a three-toothed curved hook attached to poles of varying lengths, according to the depth of water in which the sponger is working, and the sponge glass—a common water bucket with the bottom knocked out and a pane of window glass substituted. The latter is used for seeing below the surface when the water is disturbed by ripples.

A sponge "kraal," or pen, is generally about 10 feet square, built of wattled stakes, and is placed in shallow water in the shelter of some key or island. Each vessel usually owns one, and for better protection from thieves, a number of them are congregated at some convenient place and a watchman employed to guard them. For a number of years many of the "bay" spongers had their kraals at the north end of Anclote Key. As these were exposed to the full force of the wind when blowing from certain directions, considerable loss was sustained on several occasions by the storms washing the sponges out of the kraals and carrying them out to sea. Owing to this the kraals were removed in 1890 to Baileys Bluff, on the mainland about 2 miles north of the mouth of Anclote River. In 1900 certain of the spongers became dissatisfied and established kraals at Sawyers, about half a mile nearer the Anclote River. The latter are sometimes called the "Cabbage kraals," from a large cabbage palm standing on the beach just opposite the kraals. At Baileys Bluff there are about 85 kraals, while at Sawyers there are about 40. A few kraals are also located at North Key, close to the town of Cedar Key. This was at one time a very important kraaling place.

"Kraals" were also located at Rock Island and near St. Mark's light-house at various times.

The key spongers build their kraals at various places, no effort being made to keep them together, as in the "bay." The spongers usually select a convenient key and make their camp on shore, and build their kraal in some sheltered cove close to the shore. They suffer very little from thieves, so do not require watchmen. Should the key have any inhabitants, these usually watch over the kraal.

When first brought to the surface the sponges are black and slimy. As soon as a dingy has secured a load it is sculled to the vessel, unless the latter is too far away, when she sails down to the boat, and the load is transferred to the deck of the vessel. They are then spread carefully over the deck in their natural upright position so as to allow the slimy matter, or "gurry," to run off easily. At first they have a strong ammoniacal smell, exceedingly disagreeable to those unaccustomed to it; but this is soon succeeded by a scent very similar to that of decaying seaweed. After several days' exposure on the deck the sponges die and a good part of the "gurry" runs off. In the "bay" the vessels usually return to the kraals every Friday. The sponges are then transferred from the vessel to the kraal, where they are allowed to soak until the vessel returns from the next week's trip. Those brought in the previous week are then beaten out with a short, heavy stick, which removes most of the slime and animal matter still remaining in them, while those to which the black scum still adheres are scraped with a knife. The sponges are then squeezed out quite thoroughly with the hands, after which they are removed to the shore and strung on pieces of coarse twine about 6 feet in length, in which shape they are ready for sale. All sponges are sold by auction.

SPONGES GATHERED IN FOREIGN WATERS.

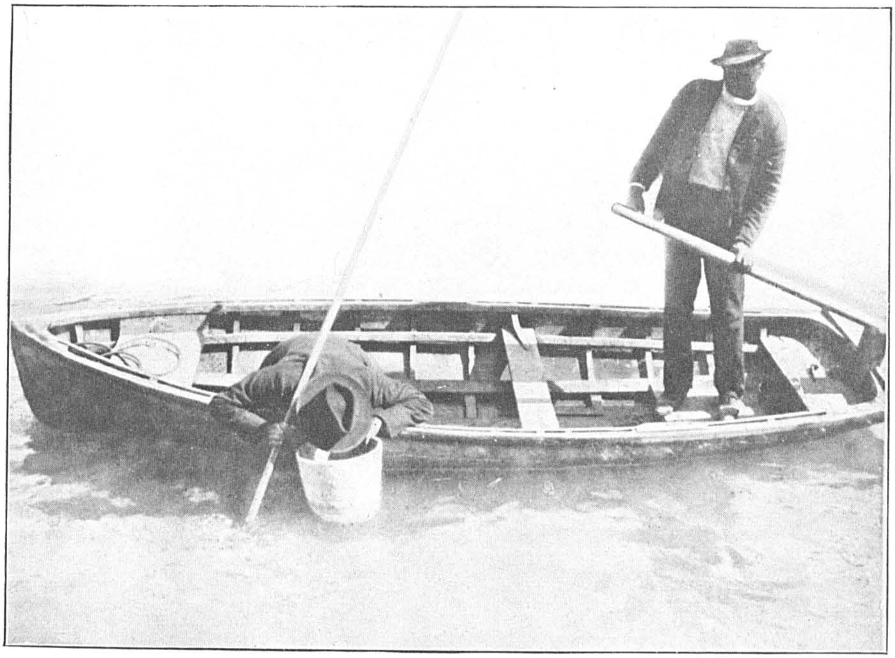
In September, 1900, the schooner *Serafina C.*, of Key West, made a trip to the Mosquito Coast of Nicaragua, and brought back about 1,016 pounds of sheepswool sponges and 44 pounds of velvet sponges. Most of these were taken in water shallow enough to permit of the sponges being secured by wading. No effort was made to gather other kinds, as they would not have sold for enough to pay for the collecting. The sheepswool and velvet sponges were of an inferior grade. On landing the sponges at Key West they were compelled to pay duty on them. Owing to the success of the *Serafina C.* several other vessels have since been working on these grounds. For some years past Key West vessels have made occasional visits to these grounds, the schooner *Sea Gull* having been wrecked while returning from such a trip in 1886.

Shortly after the close of the Spanish war one or two of the vessels visited Cuba and brought back a few sponges. These were not gathered by the crew, however, but were purchased from the natives. As they were of an inferior grade, and duty had to be paid upon them, no effort was made to continue the business.

PREVIOUS ABUNDANCE.

The four tables given below show for a series of years the catch of the sponge fleet by places, by kinds, the average price per pound, and the relative importance of the different kinds in percentages of the total quantity and value of the crop. In these the overwhelming preponderance of Key West is very evident. Cedar Key and St. Marks have dropped out of the fishery entirely, while Tarpon Springs and Apalachicola have decreased slightly since 1897 so far as the quantity is concerned. The catch for 1900, in both quantity and value, exceeded that for any other year for which figures are available. The catch of sheepswool sponges for 1900 is lower than for 1895, but higher than for the other years. The value of this kind has increased very much, however. The catch of yellow sponges increased nearly 90 per cent, while the catch of grass sponges has almost doubled since 1899.

In the table showing the average price per pound the most noticeable features are the great increases in value of the sheepswool and the yellow sponges. While the sheepswool has been steadily increasing in value for years, the yellow suddenly jumped from 29 cents per pound in 1899 to 59 cents in 1900, which is the highest ever known. In 1901 they soared even higher yet, some lots being sold on the Key West sponge wharf for an average price of about $1 per pound. This



SPONGERS AT WORK.

SPONGE YARD AT KEY WEST, SHOWING THE SPONGES DRYING.

increase is accounted for by the fact that the high prices prevailing for sheepswool sponges has caused many people to use yellow sponges in their stead for certain purposes. The general average for all kinds is also the highest for the period under question.

In the percentage table, while the average catch of sheepswool has been decreasing the average value has remained about the same. In 1900 the average value of yellow sponges is the highest of any previous year. The grass sponges show an increase in the average quantity over all other years, except 1897, which was an exceptional year for this kind.

Table showing, by places, the yield of the sponge fishery for a number of years.

Place.	1880.		1889.		1890.		1895.		1900.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Key West	....	....	307,595	$367,954	358,467	$427,375	280,372	$344,015	359,854	$488,744
Tarpon Springs	....	....	....	....	....	....	16,344	27,168	53,173	70,320
Cedar Key	....	....	952	965	4,160	5,000	2,048	3,707	....	....
St. Marks	....	....	990	990	640	640	....	....	....	....
Apalachicola	....	....	7,022	11,178	3,505	5,667	7,356	11,981	5,098	8,621
Total	207,000	$200,750	316,559	381,087	366,772	438,682	306,120	386,871	418,125	567,685

Table showing, by kinds, the yield of the sponge fishery for 1895, 1896, 1897, 1899, and 1900.

Kinds.	1895.		1896.		1897.		1899.		1900.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Sheepswool	231,272	$363,107	149,724	$248,196	157,476	$240,599	153,700	$332,390	181,311	$483,263
Yellow	29,509	11,798	23,655	9,318	32,362	13,082	55,800	16,205	74,466	44,045
Grass	21,387	5,464	44,617	11,508	128,622	29,188	76,900	14,319	143,112	33,263
Other	23,952	6,502	18,315	3,990	13,086	3,171	18,000	5,000	19,236	7,114
Total	306,120	386,871	236,311	273,012	331,546	286,040	304,400	367,914	418,125	567,685

Table showing, by kinds, the average price per pound for a series of years.

Kinds.	Average per pound in—				
	1895.	1896.	1897.	1899.	1900.
Sheepswool	$1.57	$1.66	$1.53	$2.16	$2.67
Yellow	.39	.40	.40	.29	.59
Grass	.26	.26	.23	.19	.23
Other	.27	.22	.24	.28	.37
Total	1.26	1.16	.86	1.21	1.36

Table showing the relative importance of the different kinds of sponges in percentages of the total quantity and value of the crop for a series of years.

Kinds.	1895.		1896.		1897.		1899.		1900.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Sheepswool	75.55	93.86	63.36	90.91	47.50	84.11	50.49	90.34	43.35	85.13
Yellow	9.64	3.05	10.01	3.41	9.77	4.57	18.33	4.41	17.81	7.76
Grass	6.99	1.41	18.88	4.22	38.79	10.21	25.26	3.89	34.23	5.86
Other	7.82	1.68	7.75	1.46	3.94	1.11	5.92	1.36	4.61	1.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

IMPORTS AND EXPORTS OF SPONGES.

As the yield of domestic sponges is not equal to the demand, large quantities are imported each year, the greater part of these coming from the Bahama Islands, Cuba, Haiti, Greece, Austria-Hungary, and Turkey. During the fiscal year ending June 30, 1900, the imports of foreign sponges amounted in value to $536,303, almost as much as the value of the catch of domestic sponges for the calendar year 1900, which was $567,685. During 1900 we exported 71,642 pounds of domestic sponges, valued at $32,199, most of which went to Great Britain, Germany, Netherlands, Belgium, and France. Most of these were grass sponges, for which there is very little demand in this country. We also exported $84,100 worth of foreign sponges which had been previously imported. Except in the imports during 1900 there has been very little fluctuation during the last three years. The following table shows the imports and exports for the fiscal years 1896, 1897, 1898, 1899, and 1900:

Table showing the imports and exports of sponges in 1896, 1897, 1898, 1899, and 1900.

Fiscal year.	Imports of foreign sponges.	Exports of domestic sponges.		Exports of foreign sponges.
		Lbs.	Value.	
1896	$199,766	36,398	$14,237	$73,704
1897	487,143	125,492	53,962	75,007
1898	401,725	75,819	34,517	89,192
1899	430,231	71,657	26,452	92,664
1900	536,303	71,642	32,199	84,100

STATISTICS OF THE FISHERY.

The season of 1900 was one of the best that the spongers have had for years. Owing to the unusual clearness of the water on the "key grounds" the spongers were enabled to work over almost all the grounds, a thing which has not happened for some years. This was especially noticeable around Sandy Key, near Cape Sable. Usually yellow, muddy water is found stretching out for about 40 miles in every direction from this key, except toward the mainland, which is about 4 miles distant, and from a distance the surface looks like a light yellow mud bank exposed at low water after the mud has had time to dry. Last season was the first time in about fourteen years in which the spongers were enabled to work this section. A noticeable feature was the unusual number of rotten sponges gathered on this ground. No sign of this rot appeared on the surface of the sponge, but after it had been cleaned it could easily be seen by pulling aside the fiber at the bottom. In some of them the whole inside had been rotted away while the exterior presented a clean, healthy appearance.

The tables show the condition of the industry for 1900. The great preponderance of Key West is very noticeable in all of the tables, and this place leads in persons engaged in all branches of the business, with a total of 1,827 persons. Tarpon Springs is second, with 354.

An interesting table is the one showing the color and nationality of the persons engaged in the business. Among the spongers themselves the colored people predominate, there being 1,356 engaged, while the whites number 757. This disproportion is especially high at Key West. Among persons employed exclusively on shore the whites predominate, with 119 to 13 colored. Of 2,113 persons employed directly in sponging, 1,268 are British provincials, mostly from the Bahamas; of these, 1,013 are colored. The native-born Americans numbered 839, of whom 343 are colored. One Norwegian and 5 Portuguese are also engaged in the business. Among the shore employees the native-born Americans lead, with 114, of whom 13 are colored. The British provincials numbered 17, all white. There was also 1 Greek.

In the matter of vessels, boats, apparatus, and shore and accessory property, Key West far exceeds all the others combined, with a total investment of $518,932. Tarpon Springs is second, with $65,014, followed by Apalachicola, with $10,652. The total investment for the fishery amounts to $594,598. The Key West fleet shows a most gratifying increase since 1895. In the latter year there were 99 vessels of over 5 tons, and 185 vessels under 5 tons measurement hailing from this place, while in 1900 there were 136 vessels of over 5 tons and 183 vessels of under 5 tons measurement, a gain of 37 vessels of over 5 tons and a loss of 2 vessels under 5 tons. So far as vessels of over 5 tons are concerned, Tarpon Springs has practically held her own, while Apalachicola has dropped off considerably, but in the matter of vessels under 5 tons Tarpon Springs has made a considerable increase.

Key West leads in the catch of all kinds of sponges with 359,854 pounds, valued at $488,744, followed by Tarpon Springs with 53,173 pounds, worth $70,320, and Apalachicola with 5,098 pounds, valued at $8,621. All the glove and velvet sponges were taken by Key West vessels. The total catch amounted to 418,125 pounds, valued at $567,685.

An interesting feature is the showing of the catch by kinds and grounds. The "key grounds" were worked exclusively from Key West and the surrounding keys. The total catch from the bay grounds amounted to 228,461 pounds, valued at $389,890, and for the key grounds 189,664 pounds, worth $177,795. Sheepswool sponges are more frequent on the "bay grounds" than on the key grounds, while the reverse is the case with yellow sponges. The grass-sponge catch is almost equally divided between the two grounds. Very few glove and velvet sponges are taken on the "bay grounds."

Table showing, by places, the persons employed in the sponge fishery in 1900.

	Key West.	Tarpon Springs.	Apalachicola.	Total.
Vessel fishermen	1,080	120	39	1,239
Boat fishermen	669	180	25	874
Shore employees	78	54	....	132
Total	1,827	354	64	2,245

Table showing the nationality and color of persons engaged in the sponge fishery in 1900.

Nationality.	Key West.	Tarpon Springs.	Apalachicola.	Total.
Vessel fishermen:				
Americans, white	240	26	30	296
Americans, colored	120	54	6	180
British provincials, white	144	8	2	154
British provincials, colored	576	32	1	609
Total	1,080	120	39	1,239
Boat fishermen:				
Americans, white	146	40	14	200
Americans, colored	77	80	6	163
British provincials, white	90	11	....	101
British provincials, colored	356	48	....	404
Norwegians	....	1	....	1
Portuguese	....	....	5	5
Total	669	180	25	874
Shore employees:				
Americans, white	55	46	....	101
Americans, colored	7	6	....	13
British provincials, white	15	2	....	17
Greeks	1	....	....	1
Total	78	54	....	132
Grand total	1,827	354	64	2,245

Table showing, by places, the vessels, boats, apparatus, and shore property employed in the sponge fishery in 1900.

Items.	Key West.		Tarpon Springs.		Apalachicola.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	136	$167,170	15	$11,831	5	$3,150	156	$182,151
Tonnage	1,584	....	129	....	37	....	1,750	....
Outfit	......	100,950	......	11,103	......	3,446	......	115,499
Boats	183	146,450	40	28,100	5	3,915	228	[a]178,465
Apparatus used in vessel fisheries	......	2,704	......	353	......	96	......	3,153
Apparatus used in boat fisheries	......	2,458	......	720	......	45	......	3,223
Shore and accessory property	......	99,200	......	12,907	......	......	......	112,107
Total	......	518,932	......	65,014	......	10,652	......	594,598

[a] Includes value of outfit.

Table showing, by kinds and places, the catch of the sponge fleet in 1900.

Kinds.	Key West.		Tarpon Springs.		Apalachicola.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Sheepswool	157,680	$413,629	20,995	$61,866	2,636	$7,768	181,311	$483,263
Yellow	66,537	40,080	6,727	3,364	1,202	601	74,466	44,045
Grass	116,401	27,921	25,451	5,090	1,260	252	143,112	33,263
Glove	12,428	1,794	....	....	....	....	12,428	1,794
Velvet or boat	6,808	5,320	....	....	....	....	6,808	5,320
Total	[a]359,854	488,744	53,173	70,320	5,098	8,621	418,125	567,685

[a] Includes 1,016 pounds of sheepswool, valued at $1,366, and 44 pounds of velvet, valued at $34, from the Nicaraguan coast.

Table showing, by places, kinds, and grounds, the catch, by vessels and boats, in the sponge fishery in 1900.

Kinds and grounds.	Key West.		Tarpon Springs.		Apalachicola.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Catch by vessels on bay grounds:								
Sheepswool	79,466	$229,401	12,572	$37,046	1,640	$4,834	93,678	$271,281
Yellow	19,269	11,305	3,168	1,584	618	309	23,055	13,198
Grass	35,785	8,140	10,926	2,185	780	156	47,491	10,481
Glove	948	134					948	134
Velvet or boat	386	64					386	64
Total	a135,854	249,044	26,666	40,815	3,038	5,299	165,558	295,158
Catch by vessels on key grounds:								
Sheepswool	19,199	41,856					19,199	41,856
Yellow	14,932	8,603					14,932	8,603
Grass	23,122	5,778					23,122	5,778
Glove	3,748	542					3,748	542
Velvet or boat	2,141	1,752					2,141	1,752
Total	63,142	58,531					63,142	58,531
Catch by boats on bay grounds:								
Sheepswool	19,674	57,009	8,423	24,820	996	2,934	29,093	84,763
Yellow	5,235	2,827	3,559	1,780	584	292	9,378	4,899
Grass	9,190	2,035	14,525	2,905	480	96	24,195	5,036
Glove	237	34					237	34
Total	34,336	61,905	26,507	29,505	2,060	3,322	62,903	94,732
Catch by boats on key grounds:								
Sheepswool	39,341	85,363					39,341	85,363
Yellow	27,101	17,345					27,101	17,345
Grass	48,304	11,968					48,304	11,968
Glove	7,495	1,084					7,495	1,084
Velvet or boat	4,281	3,504					4,281	3,504
Total	126,522	119,264					126,522	119,264
Grand total	359,854	488,744	53,173	70,320	5,098	8,621	418,125	567,685

a Includes 1,016 pounds of sheepswool, valued at $1,[illegible]66, and 44 pounds of velvet, valued at $34, from the Nicaraguan coast.

The following table shows the average price per pound received for each kind from the various grounds. The "bay" sheepswool are much more valuable than the "key" variety, while the "key" yellow, grass, and velvet are all more valuable than those from the "bay." There is no difference in the value of the glove sponges from either ground. The general average price was $1.36.

Kinds.	Lbs.	Value.	Average price per pound.
"Bay" sheepswool	123,017	$356,045	$2.89
"Key" sheepswool	58,294	127,218	2.18
"Bay" yellow	32,433	18,097	.55
"Key" yellow	42,033	25,948	.62
"Bay" grass	71,686	15,516	.22
"Key" grass	71,426	17,747	.25
"Bay" velvet or boat	386	64	.17
"Key" velvet or boat	6,422	5,256	.82
"Bay" glove	1,185	168	.14
"Key" glove	11,243	1,626	.14
	418,125	567,685	1.36

Heretofore the law in regard to the gathering of sponges less than 4 inches in diameter has been more honored in the breach than in the observance. This was largely owing to the fact that the law did not prohibit the sale of such sponges or the having of them in possession. The law was amended in 1901 to cover these points, and will doubtless prove useful in protecting the small sponges from the depredations of the spongers, if properly enforced.

DISASTERS TO THE FLEET.

The spongers have not been exempt from the many perils of the deep, as is well shown by the following brief record of the principal disasters to the fleet since 1880:

Year.	Vessel.	Remarks.
1882	Minnie	Struck on bar near Stump Pass.
1886	Sea Gull	Capsized by cyclone near Cuba while on her way back from sponging trip to Nicaragua; 7 lives lost.
1892	Ethel	Struck a drift log and foundered.
1893	Silver Spray	Burned.
1894	Adelaide	Capsized at Peckles Reef in gale.
1895	Marion, Rosalie, Euphemia, and Ada Norman.	Carried by cyclone up into the woods, near Cedar Key.
	Shamrock	Capsized near Sea Horse Key; 6 men lost.
1896	Competitor	Captured by Spanish gunboat while carrying cargo of contraband goods to Cuban insurgents. Crew condemned to death, but saved through intervention of United States.
	Rosalie	Capsized during cyclone; 4 of her crew lost.
1897	Euphemia	Capsized in gale.
1898	Speedwell	Capsized near Marquas Keys. Had just been launched and was getting ready to go into sponging; 9 persons lost.
1899	Amanda Rosalie	Stranded during heavy blow.
1900	Vim	Beached.
	Evening Star	Struck on St. Martins Reef.
	Lone Star	Struck a rock near Anclote and was sunk.

SPONGE BUYING.

The buying of sponges gathered by the Florida fishermen has developed into a business of considerable magnitude and one quite distinct from that of the gathering of sponges.

When the sponges are landed by the fishermen they have merely been roughly cleaned of the mud and dirt adhering to them, and it is necessary, before they can be placed on the market, to thoroughly clean them of the remaining dirt, see that no foreign substances are inside the sponge, and trim off the rough edges to give a symmetrical appearance. This work is done by the buyers, who have large warehouses at convenient places on the coast.

For many years Key West had almost a monopoly of this business, but in 1891 serious competition began at Tarpon Springs. Owing to the favorable situation of this latter place the business here rapidly expanded until in 1900 it amounted to almost as much as at Key West. The Spanish-American war was a great help to Tarpon Springs, as the Key West vessel captains avoided going to Key West with their cargoes for fear of being captured by Spanish war vessels, and so were constrained to sell at Tarpon Springs. During 1899 and 1900 a few sponges were sold at Lemon City, on the east coast. Some of the "key" boats from the upper part of Biscayne Bay found it more convenient to sell to the one buyer there than to make the long trip to Key West. The business did not thrive, however, as the spongers do

Plate 8.

Report U. S. F. C. 1902.

VESSELS AND KRAALS AT BAILEYS BLUFF.

not like to sell at a place where there is but one buyer, as they claim the lack of competition keeps the price down. None was sold at Lemon City after the spring of 1900.

At Key West and Tarpon Springs all of the buyers, except two—one at each place—represent New York, Philadelphia, and St. Louis wholesale houses. The two independent buyers market their own catch. Each buyer has a warehouse where the sponges are dried, cleaned, and baled ready for market. Some of these buildings are elaborate and costly structures, and a number of persons are employed at each in preparing the product. In 1900 the Key West establishments, which were valued at $90,400, employed 67 persons, whose wages amounted to $25,978. At Tarpon Springs, in the same year, the sponge establishments were valued at $9,332, and gave employment to 57 persons, whose combined wages amounted to $17,969. Property is much less valuable at Tarpon Springs than at Key West, which explains the great difference between the two places. The employees come under three classes, viz, "clippers," who clip the sponges and sort them; the "pressmen," who bale the sponges, and the draymen and common laborers. The "clippers" are paid about $1.50 per day, the "pressmen" about $2 per day, and the draymen and laborers about $1 per day. At Key West very few buyers own drays, preferring to hire them when needed.

Burlap, which costs about 10 cents per yard, delivered, and jute rope, with diameters of one-fourth and three-eighths inch, worth about 7½ cents, delivered, are used in baling the sponges. Formerly sisal rope was employed, but as it was found that jute rope could be secured at a much lower price, and would answer the purpose, the latter is now used almost exclusively.

In baling each kind is kept by itself. For the general trade sheepswool sponges are packed in 15, 30, and 50 pound bales. The medium-size sponges are placed in the 15 and 30 pound bales and the large ones in the 50-pound bale. The yellow sponges are packed in 30, 40, and 50 pound bales; the medium size in the 30-pound bale, and the larger sizes in the 40 and 50 pound bales. The grass sponges are generally packed in 50-pound bales, while the velvet and glove sponges are packed in 30 and 50 pound bales. The above weights represent the net weight of the sponges in each bale. The burlap, rope, and twine usually adds about 2 pounds to the net weight of each bale. Bales weighing differently from the above are also put up, but only for special orders. In baling the sponges presses, very much resembling cotton compresses, are used. The screw is purchased, but the framework is erected and the screw adjusted at the warehouse.

The great evil in the sponge business at the present time is the loading of sponges. Sheepswool sponges are nearly all loaded, while occasionally lots of yellow and grass sponges are also adulterated in this way. The loading is done for the purpose of increasing the weight of the sponge. Rock salt, glucose, molasses, lead, gravel, sand, and stones are the substances generally used. Most of the warehouses have water-tight bins in which glucose or molasses, sand, and rock salt are mixed together in water. According as more or less weight is desired, the quantity of certain of the ingredients is increased or decreased. The sponges are thoroughly soaked in this preparation and are then run through an ordinary clothes-wringer, or laid on an inclined rack and allowed to drain into the bin. Some years ago the loading of sponges was quite common, and became such an evil in the trade that an agreement was made by the dealers that loading would be abandoned. This agreement was lived up to until within the last two or three years, when certain dealers resumed the practice. As the loading enabled the buyers to pay more for their sponges and still not increase the price to their customers, the buyers who had not taken it up were compelled to do so in self-defense. Most buyers would gladly abandon the loading if the agreement was made unanimous.

No sponges are bleached at the warehouses in Florida, this part of the business being done at the wholesale houses or by the jobbers in the trade. Small sheepswool sponges are quite generally bleached, as it gives them a better color. The bleaching of the yellow sponge, and the consequent great improvement in its hitherto poor color, has made it more attractive, and the increase in its value during the past year has been quite remarkable. Owing to the prevailing high prices for sheepswool, it is supplanting the latter for many purposes. In bleaching, lime and acids are used. This bleaching undoubtedly injures the sponges, as it weakens the fiber and considerably shortens the period of its usefulness. The spongers bleach a few sheepswool. They are usually washed in soapy water and, after being covered with soapsuds, are hung up on poles on shore or on the masts of the boats. The action of the nightly dews and the sunlight in conjunction with the soapsuds bleaches them to a beautiful white or golden color in one or two weeks. This manner of bleaching preserves the fiber of the sponge intact, and it is as durable when bleached as before. These sponges are either given away by the spongers or sold to the merchants in Key West, who sell them to tourists.

The two following tables show the condition of the sponge-buying business during 1900, and the rapid increase in the quantity of sponges bought at Tarpon Springs. In 1895 there were three buyers at this place and the total value of the sponges purchased amounted to $60,000. In 1900 there were six buyers and their combined purchases amounted to $278,550, an increase of three buyers and $218,550 in value. In 1895 Key West had nine buyers, who purchased $312,020 worth of sponges, while in 1900 there were eleven buyers, an increase of two, and the combined purchases amounted to $289,135 in value, a decrease of $31,865 in value. The decrease at Key West would

THE SPONGE AUCTION WHARF AT KEY WEST.

undoubtedly have been greater had it not been for the exceptionally good catches on the "key grounds" during 1900. All the "key" sponges are sold at Key West and will likely continue so to be sold, as Tarpon Springs is too inaccessible for the "key" boats, but it is probable that in time most, if not all, of the sponges from the "bay grounds" will be marketed at Tarpon Springs. Over two-thirds of them were so disposed of in 1900. All of the data in the first table, except wages and buyings, have already been shown in the regular fishery tables.

Table showing the extent of the sponge-buying business in 1900.

Items.	Key West.[a]		Tarpon Springs.		Total.	
	No.	Value.	No.	Value.	No.	Value.
Buyers	11		6		17	
Employees	67		57		124	
Wages		$25,978		$17,969		$43,947
Property		90,400		9,332		99,732
Total		116,378		27,301		143,679
Kinds.	**Lbs.**	**Value.**	**Lbs.**	**Value.**	**Lbs.**	**Value.**
Sheepswool	95,490	$229,433	85,821	$253,830	181,311	$483,263
Yellow	49,135	31,975	24,129	12,070	73,264	44,045
Grass	81,055	20,613	63,259	12,650	144,314	33,263
Glove	12,428	1,794			12,428	1,794
Velvet or boat	6,808	5,320			6,808	5,320
Total	244,916	289,135	173,209	278,550	418,125	567,685

[a] Includes one buyer at Lemon City.

Table showing, by places, kinds, and grounds, the extent of the sponge-buying trade in 1900.

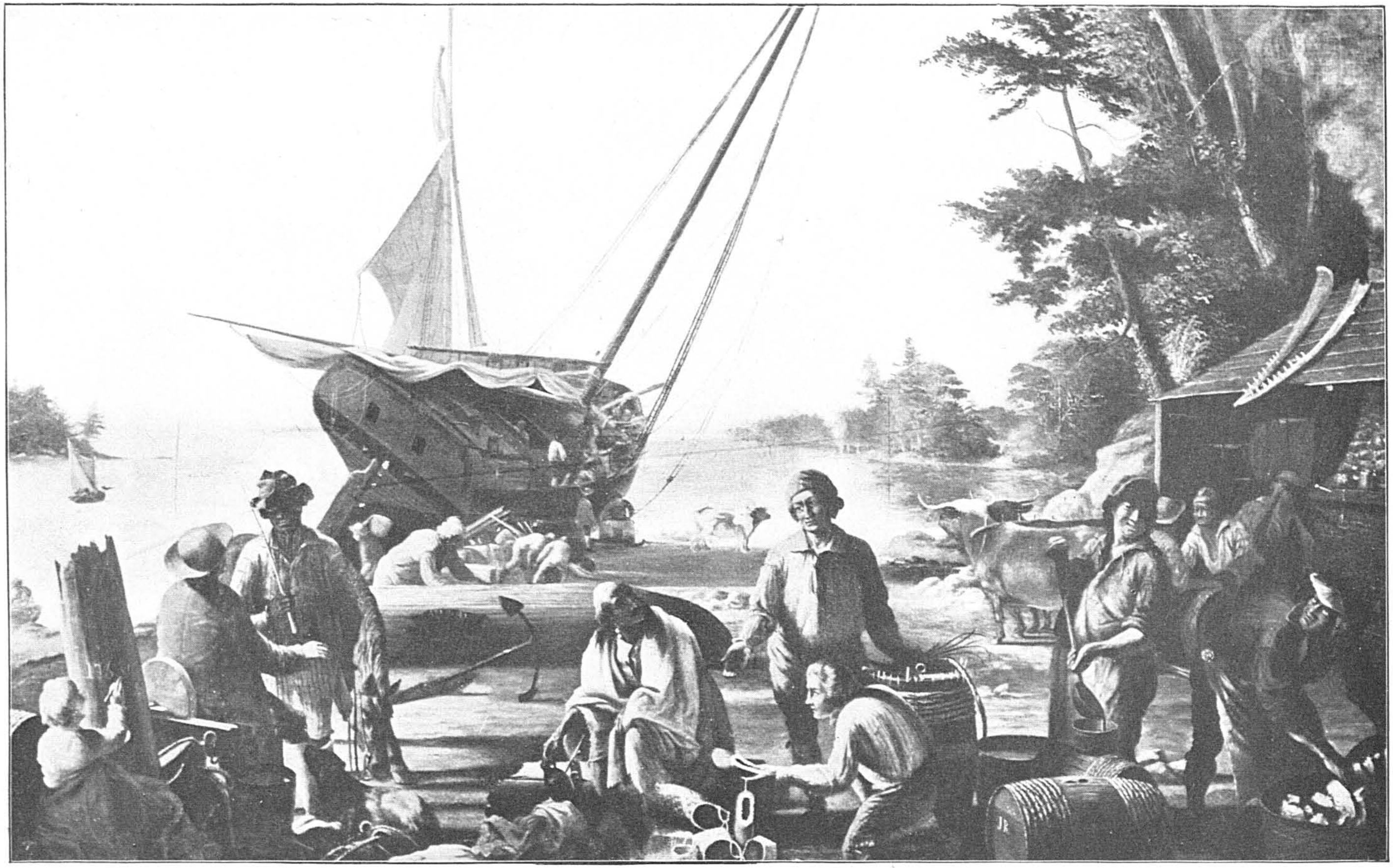
Kinds and grounds.	Key West.		Tarpon Springs.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
From bay grounds:						
Sheepswool	37,196	$102,215	85,821	$253,830	123,017	$356,045
Yellow	9,095	6,027	24,129	12,070	33,224	18,097
Grass	7,990	2,866	63,259	12,650	71,249	15,516
Glove	1,185	168			1,185	168
Velvet or boat	386	64			386	64
Total	55,852	111,340	173,209	278,550	229,061	389,890
From key grounds:						
Sheepswool	58,294	127,218			58,294	127,218
Yellow	40,040	25,948			40,040	25,948
Grass	73,065	17,747			73,065	17,747
Glove	11,243	1,626			11,243	1,626
Velvet or boat	6,422	5,256			6,422	5,256
Total	189,064	177,795			189,064	177,795
Grand total	244,916	289,135	173,209	278,550	418,125	567,685

AQUATIC PRODUCTS IN ARTS AND INDUSTRIES.

FISH OILS, FATS, AND WAXES. FERTILIZERS FROM AQUATIC PRODUCTS.

By CHARLES H. STEVENSON.

TABLE OF CONTENTS.



ORIGIN OF THE WHALING INDUSTRIES AT NEW BEDFORD, MASS., 1763.

Copy of painting by Wall.

AQUATIC PRODUCTS IN ARTS AND INDUSTRIES.

By Charles H. Stevenson.

PREFATORY NOTE.

The diversity and magnitude of the industries based on the utilization and manufacture of aquatic products are not fully appreciated. In a previous publication of this Commission[a] the great variety of fishery products used for food and their methods of preparation were discussed. In addition to the numerous items of food articles, the materials employed in the arts and industries compare favorably in variety and interest with similar products of the land. These may be roughly separated into five classes, viz, (1) oils, fats, and waxes; (2) fertilizers from aquatic products; (3) skins of aquatic animals and their products of furs and leathers; (4) the hard substances, as shells, scales, bones, ivories, etc., and (5) miscellaneous articles not properly classed with any of the foregoing, as glue, isinglass, seaweeds, sponges, marine salt, etc. The total value of the annual product of these throughout the world roughly approximates $45,000,000 in the condition in which they are first placed on the market, of which the United States contributes $11,000,000.

Some of the most extensive fisheries of the world have been prosecuted almost wholly for the purpose of supplying the oil markets. Whale oils were the first of all oils—animal or mineral—to achieve commercial importance, and for fully a century the whale fishery ranked as one of the principal industries of America. Indeed it was of far greater relative value in the industrial wealth of the country than the petroleum industries are at the present time. The seal fisheries of Newfoundland, Norway, and other northern countries, which rank among the most daring and venturesome of marine enterprises, are dependent for their prosperity on the oil obtained from the thick blubber underlying the skins of the animals. The taking of menhaden on the Atlantic coast of the United States for conversion into oil and fertilizer gives employment to thousands of men and to several million dollars of capital. And in the various cod fisheries of the world the rendering of the livers into oil for medicinal as well as for technical uses is a source of great profit. In addition to these extensive industries there are numerous minor fisheries supported entirely, or to a large extent, by the oil markets.

[a] The Preservation of Fishery Products for Food, Bulletin U. S. Fish Commission, 1898.

From all varieties of aquatic oils may be separated, at a low temperature, a solid fat or grease known as "foots" or "stearin," somewhat similar to the tallow obtained from sheep and oxen. This is obtained in the process of refining the oils, and the yield ranges from 3 to 20 per cent of the bulk of the crude oil. It is sold at a few cents per pound, and is used as a substitute for tallow from sheep and oxen in sizing yarns, as emollient in leather-dressing, and for various other technical purposes.

Bleaching the various marine oils produces a semi-solid fat known as "sperm soap," "whale soap," "menhaden soap," etc., according to the variety of oil treated. This material is used in smearing sheep, washing fruit trees, soap-manufacture, etc.

In the process of refining sperm oil, instead of the foots, the wax-like spermaceti is obtained, the quantity yielded approximating 11 per cent in weight of the crude sperm oil. Spermaceti is used principally in candle-making, as an ointment for medicinal purposes, for producing a polish on linen in laundering, and for self-lubricating cartridges.

Another wax-like substance peculiar to the sperm whale is ambergris, an extremely valuable substance found at rare intervals, but sometimes in comparatively large quantities within the intestines of that animal, and also afloat on the sea or cast up on the shores. A single whale has yielded $50,000 worth of this material, and several intances are reported in which $20,000 worth has been obtained from one cetacean. Ambergris was formerly used as an incense, in cookery, as a medicine, and as a perfume. Its principal use at present is in the preparation of fine perfumes.

The principal aquatic products used for fertilizer are seaweeds, shells of mollusks and crustaceans, non-edible species of fish, especially the menhaden, and waste parts of edible species. At present the quantity of this fertilizer produced annually in the United States alone approximates 420,000 tons, worth $2,120,000. This is capable of very great increase, especially in the quantity of seaweeds and waste fish employed.

Doubtless 50 per cent of the world's stock of furs is obtained from aquatic animals. Formerly this percentage was greater, but it is reduced by the decrease in product of beaver, fur-seal, otter, and sea-otter, and the large increase in quantity of certain land fur-bearers. Fully 75 per cent of all the furs produced in the United States are yielded by aquatic animals, principally the fur-seal, mink, muskrat, beaver, otter, and sea-otter. The value of the annual output of these in the United States approximates $2,500,000 in the raw or undressed state.

Leather is made from the skins of practically all the aquatic mammals and of most of the species of fish, but these usually rank among novelty or fancy leathers. Seal leather is produced in large quantities, the value of the annual product averaging $1,500,000.

The hide of the beluga, or white whale, is one of the best of all skins for leather purposes, on account of its durability, strength, and pliability. It is sold as porpoise leather, and probably $200,000 worth of tanned hides are marketed annually. Alligator skins are also obtained in large quantities, and owing to the peculiarity of their markings, are used entirely as fancy leather. Tanned walrus hides, especially the thick ones, are in great demand for polishing-wheels and other mechanical purposes, and about $100,000 worth are sold annually. Among the aquatic skins used to a less extent for leather purposes may be mentioned sea-lion, porpoise, sea-elephant, and a very large variety of fish skins, especially those of sharks.

Of the hard substances existing in the form of shells, bones, scales, etc., shells are by far the most important. Nearly, if not quite, 1,000,000 tons are secured annually in the United States, consisting principally of the shells of oysters, clams, river mussels, and a very much smaller quantity of other varieties. A fair valuation of these at the places of consumption would doubtless amount to $1,500,000; to this should be added about $600,000 as the value of pearls secured during the last year in the Mississippi Valley and elsewhere. The value of the shells secured outside of the United States, principally mother-of-pearl shells, amounts to $5,000,000 or $6,000,000 annually, and the pearls secured sell for nearly an equal amount. Pearls are not obtained in the seas in such large quantities as formerly, but their value is greatly increased. The manufacture of mother-of-pearl and sweet-water shell in the form of buttons, buckles, knife-handles, pistol-stocks, etc., gives employment to nearly 10,000 persons in this country and to probably three times that number in Europe and elsewhere.

The yield of whalebone in the United States fisheries is less than 5 per cent as much as it was 50 years ago, but the reduced yield has been largely counterbalanced by the increase in value per pound. The product in the American fisheries now approximates 120,000 pounds each year, worth $500,000, and about $150,000 worth is obtained in all other parts of the world. At the present market price the total value of whalebone secured in the United States fisheries since 1850 is not far from $200,000,000.

Comparatively little tortoise shell is produced in this country, the annual yield approximating $12,000 in value. The West Indies, South America, Africa, East Indies, Pacific islands, etc., supply probably $500,000 worth each year, much of which is manufactured in the United States.

Little economic use is made of fish scales, except in the production of artificial pearls and other ornamental objects. Unique and attractive artificial flowers are made from the scales of sheepshead, tarpon, drum-fish, channel bass, etc.

Cuttlebone and coral are not produced in the United States, but large quantities are imported into this country.

The yield of ivory in the form of walrus tusks, sperm-whale teeth, etc., is small at present, amounting to less than $25,000 annually.

The principal industrial use for bones of aquatic animals is for conversion into fertilizer. Several varieties of curious bones are used for ornamentation, but their aggregate value is inconsiderable.

The sponge output of Florida approximates $500,000 annually, and the value of the product throughout the world is probably not far from $5,000,000.

The uses of seaweeds are numerous. They furnish thousands of tons of fertilizer, many nutritious foods, and a variety of chemicals, especially iodine and bromine. Other uses are in sizing fabrics, as a mordant in dyeing, in refining beer, in making paper, fishing lines, ropes, for stuffing upholstery, packing porcelain, etc. The Japanese have been especially adept in discovering uses for seaweeds.

Glue-manufacture provides an outlet for the profitable use of much waste in dressing dried codfish. This material was formerly discarded as useless, but now tens of thousands dollars' worth of choicest glue for postage stamps, court-plaster, adhesive paper, labels, envelopes, for mechanical purposes, and for sizing of straw goods and textile fabrics, and likewise office and domestic mucilage are manufactured from fish skins. The product is very much stronger and more durable than glue made from the skins of mammals.

Isinglass made from the sounds or swimming bladders of sturgeon, hake, cod, squeteague, etc., is used for clarifying fermented liquors, the cellular construction forming a sort of net which carries down floating particles. However, the use of this material has been much reduced, owing to the numerous substitutes obtained from domestic animals.

Commercial albumen may be made from the eggs of cod and other species, but it has not yet been extensively manufactured.

The preparation of oils and fertilizers, to which the present report is devoted, is intimately associated, especially in the case of the menhaden industry. The tissues remaining after the extraction of oil from herring and other waste fish, from the blubber of seals, porpoise, and the like, from the livers of cod and related species, the livers of sharks, from the waste parts of fish in dressing, etc., are commonly prepared for fertilizing purposes, and the preparation of the two materials is usually carried on in the same factory and in some instances by the same workmen. For this reason it appears desirable to combine in one paper the account of the preparation of oils and fertilizers from aquatic products. This paper, however, is divided into two parts, one relating to the preparation, characteristics, and uses of fish oils, fats, and waxes, and the other to the utilization of aquatic products as fertilizers.

FISH OILS, FATS, AND WAXES.

GENERAL REVIEW.

Previous to 1600 there was comparatively little demand for oil of any kind. Tallow dips, pine knots, and the like afforded the principal means of illumination. The quantity of machinery in use was small and lubricants were in little demand. The leather industries were undeveloped and the greases required in currying were obtained principally from the fat of the animal furnishing the skin, supplemented later by certain vegetable oils.

The value of whale oils for purposes of illumination was not unknown previous to the seventeenth century, but the fishermen were unequal to the task of capturing the cetaceans, in large numbers. A few that drifted ashore were secured, the use of the oil for illuminating purposes developed; and, as the experience and daring of the fishermen increased, their wanderings extended not only offshore, but to distant seas. After the invention of the Argand burner in 1784, whale oil became the principal illuminating agent, and at the beginning of the nineteenth century it was in general use. Not only were residences lighted with it, but also streets and municipal buildings. A large quantity of sperm oil was used in residences of the wealthy and also in lighthouses, that being the principal illuminant in the coastal lights of the United States, England, Scotland, Ireland, France, and other advanced countries up to 1832. The currying trade had in the meantime increased in importance, and grease for softening was secured in the form of oil from seal, walrus, sea-elephant, cod livers, etc. The increasing use of machinery resulted in an enhanced demand for a lubricant, which was generally furnished in the form of sperm oil. This resulted in very high prices; sperm oil, for instance, ranged from $1 to $2 per gallon, although the fishery increased until it was one of the most important organized industries of the world. Other fish oils became important commercial products, including oils from the livers of cod, haddock, sharks, etc., from herring, menhaden, sardine, pilchard, and other species of the *Clupeidæ* family, and a miscellaneous variety of minor importance.

The continued upward tendency in prices, as a result of an increased demand, led to endeavors to find substitutes. Lard oil was successfully introduced as a summer lubricant in the place of sperm oil for ordinary uses. Colza or rape-seed oil likewise entered into competition with it as an illuminant, and the process of refining was improved until it became a fairly satisfactory substitute at about half the price. In 1832 France adopted colza in place of sperm oil as a light-house illuminant, and in 1845 it was adopted in the light-houses and light-ships of Great Britain. The difficulty of obtaining rape-seed oil in the United States and the importance of the whaling industry to the national welfare caused the use of sperm oil in this country for ten years longer, when through the researches and experiments of Professor Henry it was found practicable to use lard oil, and in 1862 that became the illuminant in the light-houses of the United States. A few years later both colza and lard oils were superseded by forms of petroleum.

Not only did the products of petroleum take the place of aquatic-animal oils as illuminants, but they seriously interfered with them in the markets as lubricants. Then came the development of rendering and refining a large number of vegetable oils, which are now used for many purposes formerly served by fish oils. Among these vegetable products are olive oil, cotton-seed oil, linseed oil, and, to a less extent, palm oil, cocoanut oil, corn oil, etc. The employment of these substances and a large decrease in the abundance of whales have resulted in a great reduction in the extent of the whale fishery, the fleet decreasing from 735 vessels in 1846 to 38 in 1902. Those marine enterprises more or less associated with the whale fisheries, as the taking of seals, sea-elephants, walrus, etc., have decreased correspondingly.

Fish oils have therefore, to a large extent, given place to land products, and their diminished sale and reduced price have greatly decreased the prosperity of many fisheries. At present the use of fish oils for illumination as compared with that of mineral oils is very small in those countries where the latter are obtainable, their principal use being in miners' lamps. But among many semicivilized people, especially those of subpolar regions, marine-animal oils are more easily obtained than petroleum, so that the native products continue in use. And notwithstanding the large amount of mineral oils now used for lubrication of heavy machinery, there is yet an extensive demand for fish oils for that purpose, experience having shown that by their judicious blending with hydrocarbon oils a greater uniformity of lubrication is secured, and that less quantity is required than by use of mineral oil alone. The outlook for an increased use of fish oils in leather-dressing is said to be not encouraging, owing to a decrease in "hand-stuffing" and the increasing popularity of chrome tannage, in which only a small quantity of oil is required, and that usually a superior quality of neatsfoot. There is a wide field of technical uses wherein certain fish oils can not readily be dispensed with, especially for lubricating delicate machinery, in steel-tempering and screw-cutting, as a body for paints to be applied to out-of-door surfaces, in the textile trades where only saponifiable oil can be satisfactorily employed, etc.

In addition to their many technical uses, marine-animal oils are also used for nourishment to a considerable extent. The Eskimos and other primitive people depend very largely on the blubber of seals, walrus, and whales, for food supplies. Among more civilized nations fish oils are not used ordinarily as an article of diet; an exception, however, is the well-known and valuable cod-liver oil, of which twenty or thirty thousand barrels are annually consumed in cases of malnutrition. Certain therapeutic qualities are also attributed to various minor oils, as those from the shark, eulachon, manatee, dugong, alligator, terrapin, etc., but the use of these is not general.

The marine-animal oils are divisible into four principal groups, viz: (1) blubber oils; (2) head oils; (3) liver oils, and (4) body oils. The blubber oils are obtained from the layer of fat between the skin and the flesh or muscular tissues of whales, seals, walrus, sea-lion, porpoise, black-fish, etc. Head oils are secured from cavities in the skull and from other head parts of sperm whales, black-fish, porpoise, sword-fish, halibut, etc. Some of these are of superior quality, as those of the black-fish and porpoise, for instance, which sell for $5 to $10 per gallon. The head oil of the sperm whale yields the valuable spermaceti. Those of the third group are obtained principally from the livers of cod and to a less extent from haddock, hake, pollock, cusk, ling, sharks, and skates. The bodies, heads, and viscera of these fish are so slightly oleaginous that they are rarely utilized economically for oil purposes. The body oils, or fish oils,[a] as they are now generally known commercially, are obtained principally from species of the herring family—the menhaden in America, the herring, sardine, and pilchard in Europe, and the iwashi in Japan. In case these fish are used for food in large quantities, the viscera are generally devoted to oil-rendering. Most of the other species of food-fish contain so little oil that it is profitable to use only the intestines or other refuse dressings for this purpose. And in some the yield of oil is so small that not even the waste parts can be profitably utilized in this manner. In addition to the foregoing, there are a number of oils produced in various localities which enter largely into the domestic economy of those procuring them and yet are of little commercial importance, as alligator oil, turtle oil, terrapin oil, etc.

The total annual product of crude oil from marine animals throughout the world is estimated at 18,300,000 gallons, of which 5,500,000 represents the product from the blubber and fat of whales, seals, and the like; 5,300,000 gallons is from the livers of cod, shark, etc., and 7,500,000 gallons from menhaden, herring, sardine, and other species, including waste in dressing fish.

Even a brief survey of the fish-oil industries reveals the fact that they are not by any means so extensive as the natural resources permit. True, the right-whale fishery is prosecuted apparently to an

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[a] The term "fish oil" is used by chemists and other technologists as comprising oils from all aquatic animals. Previous to 1800 it generally referred to whale oils. At the present time its commercial use is generally confined to oils obtained from fish alone. In a restricted sense it refers especially to oil obtained from the principal species of the herring family in the locality in which the term is applied. Thus "fish oil" on the Atlantic coast of the United States indicates in a restricted commercial sense the oil of the menhaden; in Norway, the herring; in France, the sardine; in Japan, the iwashi, etc.

extreme limit, and the same is possibly true of the seal fisheries of certain regions. However, there is probably no other oil-yielding fishery of which the same can be said. Sperm whales are more numerous than they were fifty years ago, when the United States employed 300 vessels in their capture, securing 100,000 barrels of oil annually, as compared with the present product of less than 20,000 barrels. Porpoise and other small cetaceans exist in such large numbers that hundreds of thousands if not millions of gallons of oil can be secured from them. Only a very small percentage of the oil-yielding sharks are utilized. Much greater quantities of menhaden might be taken than are secured at present, and comparatively little of the abundant waste fish and dressings or refuse from the markets, canneries, etc., are used in oil-production.

The principal reason for this is that the present economic conditions do not warrant an extension of these industries. The market for fish oils is regulated by that of the mineral and vegetable products which are used as substitutes, and which can be sold at very low prices, making it necessary to exercise very great economy in the production of fish oils. Vessels, factories, etc., already on hand may be used, but in the United States at least it is questionable whether the building of new and costly equipment for oil-production would prove profitable under present market conditions except in specially favorable instances, unless the closest economy be practiced. The vessels composing the present sperm-whaling fleet, for instance, may be kept employed with a fair profit, but with the present prices the fitting out of expensive new vessels can scarcely meet with a large return on capital invested. The present equipment of menhaden steamers and factories was built and paid for during a period of prosperity, when menhaden oil was high in price, and they may be continued in service with profit, but the conditions are not encouraging for a great extension of the industry. If a profitable market could be found for the product, the yield of fish oils throughout the world could probably be increased many times its present extent.

THE WHALE OILS.

BRIEF REVIEW OF THE WHALING INDUSTRIES.

It is scarcely within the province of the present report to enter into a detailed history of the whale fisheries, unquestionably the most picturesque and once the most extensive of all marine industries of the world. In order, however, to present a fair idea of the production and utilization of whale oils, it is desirable to review briefly the history and present conditions of these industries.

Whales are divisible into two groups, (1) toothed whales and (2) bone-bearing or whalebone whales. To the first group belongs the sperm whale or cachalot, which yields sperm oil, spermaceti, ivory, and ambergris. This group also includes the bottle-nose whale, the

PLATE 11.

WHALING VESSELS AT NEW BEDFORD, MASS., IN OCTOBER, 1901.

pilot whale, the beluga or white whale, and many species which are not popularly known as whales, including the narwhal, grampus, orca or killer, dolphins, porpoises, etc. The bone-bearing whales are divisible into two classes, (*a*) smooth whales and (*b*) furrowed whales, or rorquals. The first embraces the right whales of different species and the bowhead or Arctic whale, all of which are prized for their oil and baleen. Of the rorquals, or those whales possessing longitudinal folds of blubber on throat and stomach, may be mentioned the humpback, finback, sulphur-bottom, and California gray whale. As these are ordinarily difficult of capture and are of minor value, the whalebone being rather short for commercial use, they have not been pursued so extensively as have the sperm, right, and bowhead whales. In the United States markets the standard varieties of oils are "sperm oil" and "whale oil," and sometimes "humpback oil." "Whale oil" is a mixture of the product of all whales except the sperm whale, and sometimes includes that of black-fish and walrus.

The use of whale oil appears to be of ancient origin. Doubtless it was first obtained from whales accidentally stranded on the shores, a more frequent occurrence during the early abundance of the cetaceans than at present, when their numbers have been so greatly reduced by excessive fisheries. As the demand for the oil increased beyond the supply available from stranded whales, individuals sighted from the shore were attacked and beached. Owing to the frailty of the boats and equipment, this was a more daring attempt than might be supposed. It is difficult to trace the origin of the fishery, but certainly it was prosecuted a thousand years ago.

Just prior to the Revolutionary war, according to Starbuck and other authorities, there were 183 American vessels in the right-whale fishery of the North Atlantic waters, and 125 were engaged in cruising for sperm whales from Newfoundland to the coast of Brazil. The Revolutionary war and the war of 1812 interfered with the fisheries; but during the period of peace following 1815 they increased greatly in extent until 1846, when the fleet numbered 678 ships and barks, 35 brigs, and 22 schooners, a total of 735 vessels, with an aggregate tonnage of 233,189 tons, and a value of $21,075,000, exclusive of outfits and supplies. The entire capital invested in the fishery and its associated industries at that time approximated $40,000,000, and 40,000 persons derived from it their chief support. During the same year the whaling fleet of all Europe numbered but 230 vessels. The crude value of the American catch from 1840 to 1860 averaged about $8,000,000 annually. The greatest value was in 1854, when 2,315,924 gallons of sperm oil worth $1.48¾ per gallon, 10,074,866 gallons of whale oil worth 59⅝ cents per gallon, and 3,445,200 pounds of whalebone worth 39⅙ cents per pound were secured, the total value being $10,802,594. In the preceding year, 1853, the total product was 3,246,925 gallons of sperm oil, 8,193,591 gallons of whale oil, and 5,652,300 pounds of whalebone, the whole valued at $10,766,521.

Sperm oil and whale oil then served nearly all the diversified uses for which oil was required, the chief exception being leather-dressing, for which neatsfoot and cod oils were largely employed. The principal uses were as illuminant, lubricator, in cordage-manufacture, screw-cutting, and steel-tempering. The streets of the principal cities were lighted with the oil, and theaters and public buildings were lighted with gas made from the foots. A stock anecdote at the time referred to foreign sailors climbing up the posts of the New York street lamps to drink the whale oil, thus leaving the city in darkness.

The extent of the fisheries soon began to tell on the abundance of the whales, necessitating much longer and more costly voyages, and consequently higher prices for the products. With the increased price came the active search for substitutes, and colza oil and lard oil were largely employed. The competition, however, had little effect on the market for whale products until the adoption of petroleum as an illuminant, and subsequently as a lubricant. Its dangerous qualities at first greatly checked its use, but as improved methods of refining were introduced it was quite generally adopted and proved most influential in decreasing the profits of the whale fishery.

The restricted market and the reduced price resulted in a gradual decrease of the whale fishery. Various agencies accelerated this decrease, while others retarded it. Among the former may be mentioned the destructive influences of the civil war, including the sinking of 36 vessels in blockading Charleston Harbor, and the burning of 46 vessels, with outfit, supplies, and cargoes by privateers; also the loss of 33 ships in the ice of the Arctic Ocean in 1871, and a similar abandonment of 12 vessels in 1876. Among the agencies tending to retard the decrease in the fishery is the greatly enhanced value of whalebone, which increased from 13 cents per pound in 1833 to $7 per pound in 1891. Indeed it is the whalebone market alone which sustains the present right-whale fisheries of the world. The table on page 204, showing the annual product of sperm oil and whale oil from 1860 to 1902, inclusive, presents a fair idea of the gradual reduction in extent of the American whale fisheries. Owing to the decreased extent of the fishery, sperm whales are increasing in numbers and are apparently more abundant at present than at any time since the fifties. The bowhead and right whales, however, are doubtless more scarce than at any time since their capture became an object of commercial pursuit.

In 1901, the 20 sperm-whalers cruising in the Atlantic Ocean met with good success, especially those on the Hatteras and Charleston grounds, securing 12,550 barrels of oil, according to the *Whalemen's Shipping List*, an average of 627 barrels to each vessel. The same season in the Arctic and North Pacific, however, was the poorest for many years. The fleet there consisted of 11 steamers and 6 barks. Three steamers were lost, and the total catch was only 43 bowheads and 13 right whales, as compared with 80 bowheads and 14 right whales in 1900. The yield of oil approximated 2,870 barrels, and of whalebone 105,150 pounds. Five barks were employed in sperm-whaling off the coast of Japan, taking 4,100 barrels of oil. The market for sperm oil in 1901 opened at 55 cents per gallon, but gradually increased and closed the year at about 68 cents per gallon. The price of whale oil at San Francisco was 32 to 38 cents and in the Eastern markets 38 cents per gallon.

In 1902 the whaling fleet of the United States consisted of 8 steamers, 18 barks and brigs, and 12 schooners, aggregating 8,366 tons. Of these, 11 barks and 10 schooners were sperm-whale fishing in the Atlantic Ocean, 8 steamers in the Arctic, 6 barks in Okhotsk Sea and off the coast of Japan, 2 schooners in Hudson Bay, and 1 brig at Desolation Island.

The total whale-oil product of the world at present approximates 3,000,000 gallons yearly; of which 750,000 gallons are produced by the United States fisheries, 900,000 by those of Norway, and the remainder by Scotland, Russia, Japan, Newfoundland, and other countries.

THE BLUBBER AND ITS YIELD OF OIL IN DIFFERENT WHALES.

The blubber is a layer or blanket of fat lying between the skin and the flesh or muscles and encompassing the bodies of all cetaceans and likewise of most of the other aquatic mammals. It varies in thickness from 1 to 22 inches, according to the species, size, and condition of the animals. The blubber of right whales is thicker, on an average, than that of the cachalot or sperm whale, although an individual of the last-named species has afforded fat 22 inches thick. The blubber of most species is tough and elastic, but that of the humpback is soft and yielding, and the ropes and chains encompassing it tear out easily. The blubber of poor whales is hard, compact, and tenacious; but when the animals are fat it is softer and yields oil readily, even when handled. In color it varies from a yellowish or dirty white to a somewhat unusual pinkish or reddish cast. The whitish blubber is usually found on young whales, more especially sucking calves, and is of a milky appearance. That of old whales has a coarse grain, and yields or gives out the oil freely; hence it is not so difficult to boil as is the fat of young whales, from which it is almost impossible at times to extract the oil, the texture being so fine and close.

In case of the baleen whales the blubber from all parts of the animal is commingled and boiled together. With the sperm whale, however, the process of saving the oil is different. The most valuable oil of this species is found in a large cavity or reservoir known as the "case," situated anterior to the cranium, which yields clear oil and spermaceti, in equal quantities. These products are known as "head matter." Lying beneath the case is a wedge-shaped mass of pinkish fat, composed of oil, spermaceti, and "white horse," the last being an extremely tough and sinewy blubber-like substance found about the head and neck, as well as upon other parts of the whale. The lower anterior portion of the junk, known as the "nib end," is similar to the body blubber and devoid of spermaceti. Spermaceti is also found on certain parts of the body, especially in the core of the "hump" and about the "ridge," situated along the back toward the "small," but not in so great abundance as in the case. The yield of the head averages about one-third of the total oil-product of the sperm whale. Instances have been reported, however, in which it has been 50 per cent and even as high as 60 per cent of the total.

The following parts in the sperm whale are utilized as an oil-yielding product: The body blubber, case, junk, hump, ridge, lower jaw, head skin, scalp, small flukes, vertebræ, and fin bones. The bones of all whales are porous or spongy in texture, and the cavities are filled with more or less oil. The small bones, such as the fin bones and the vertebræ, as well as the "pans," or broad posterior extremities of the lower jaw-bone, are chopped up with axes and boiled out. The cranium, or, as it is known to whalemen, the "scalp," is generally thrown overboard, but sometimes it is chopped up and boiled. The "head skin," or the great mass of fat covering the scalp, may be rendered if whales are scarce, but when they are plentiful its utilization is not profitable. Some of it is exceedingly tough, and the small quantity of oil it contains is difficult of extraction.

Whales are generally rated by the amount of oil which they yield rather than by the size or length. The yield is expressed in barrels, and an animal may be a "40-barreler" or a "100-barreler." In appearance they are often deceptive, the largest ones not always yielding the greatest amount of oil. Usually the whalemen approximate the product with remarkable accuracy, but sometimes their guesses miss the mark widely. Blubber yields about 75 per cent of its weight in oil, 4 tons of blubber producing about 3 tons of oil, each containing 252 gallons wine-measure. Sperm whales yield from 5 to 145 barrels of oil, averaging about 25 or 30 for the cows and 75 to 90 for the bulls.

The oil-producing parts of the right whales are the body blubber; the tongue; the head gear, comprising the head, scalp, throat, lips, and head skin; and the blubber on the fins. The right whales yield a larger quantity of oil than the cachalot, and the bowhead or Arctic whale yields a larger quantity than the right whale of temperate waters. In 1861 the *General Pike*, of New Bedford, took a right whale on the Kadiak ground which stowed down 274 barrels of oil. The schooner *Lizzie P. Simmons*, New London, killed a bowhead whale on October 28, 1882, in Cumberland Inlet, which yielded 2,550 pounds of whalebone and 6,000 gallons of oil, the value of the former being $7,687 and of the latter $3,500, a total of $11,187 from a single animal. According to whalemen, the right whales now captured are not so large as formerly, but the sperm whales seem to average about the same.

The humpback whales and the finback whales of all oceans are frequently captured by deep-sea whalemen and often by shore whalemen, especially in the Finmarken fishery. Since both of these varieties usually sink when killed, they are rarely hunted except "on soundings." The oil-yielding portions of the humpback are the body blubber; head skin; lips, which are small; tongue; entrail fat, the source of a large percentage of the oil, and the striated folds of fat on the breast and abdomen. The entrail fat resembles very closely in appearance the corresponding fatty substance of the ox; its oil is of the same grade as that of the blubber of this species, which is equal in grade to the oil of right whales.

Not only are the oil and whalebone yielded by finback whales much less in quantity, but they are also inferior in quality to those obtained from the right whales. For this reason, and also on account of their great activity and the difficulty of capturing them by harpooning, they were formerly neglected by whalers; but since the employment of steam vessels with bomb guns and explosive lances an extensive fishery for them has been established on the Norwegian and Newfoundland coasts and minor fisheries on the coasts of Russia and Japan.

The California gray whale is occasionally taken in the lagoons of Japan and on the west coast of the United States. The oil-bearing parts of this species which are utilized are the body blubber, head skin, throat, lips, flukes, and entrail fat. According to Capt. George O. Baker, of New Bedford, during several years following 1866 a brig from New Bedford, Mass., made quite a business of catching California gray whales for the food markets of Japan.

The bottle-nose whale, so called from the peculiar shape of its head, yields on an average about 12 barrels of oil. The principal places where this species is caught are along the edges of the ice fields of northern Europe, between Bear Island and Iceland, the fishery being prosecuted principally by Norwegians hailing from Tönsberg and Sandefjord. Like the sperm whale, the bottle-nose possesses a quantity of oil in the cavity of the head, which yields spermaceti in the process of refinement. The blubber oil of the bottle-nose comes next to sperm oil in quality. It gives no residuum, and is therefore employed for lubricating small machines, spindles in mills, etc.

Besides the above, a number of minor cetaceans are occasionally utilized for their oil; among them the orca or killer whale, the narwhal, the beluga or white whale, the black-fish, and the porpoise. These have a coating of blubber ranging from one-half to 4 inches in thickness, and, although not extensively sought after, many are taken in various parts of the world.

The beluga is plentiful in the Arctic seas and in the North Pacific and comparatively numerous on the Labrador coast and in the St.

Lawrence River, where it forms the object of a small but profitable fishery. The steam-whalers sometimes pursue and capture it in great numbers in the Arctic, but only when the Greenland whale can not be found, for the yield of oil is small and the animal is so swift and active that it is not readily captured. The adult is from 10 to 15 feet in length, and of a creamy white color. The blubber is about 2 inches thick, and each animal yields from 20 to 100 gallons of oil excellent in lubricating qualities.

The orca affords a good variety of oil, but owing to its aggressiveness it is not often attacked by the whalers. It has occasionally been captured on the New England coast, and has also been taken on the west coast of Africa, especially off Walfisch Bay. The blubber is 2 or 3 inches thick, and similar in color and texture to that of the sperm whale.

The narwhal yields a small quantity of oil, which is used considerably by the Eskimos and Greenlanders. It is ordinarily very pale in color, in fact almost colorless. The narwhal is not usually an object of pursuit by our whalemen, as its capture is surrounded with many difficulties, owing to its retreats in the ice floes. The valuable black-fish and porpoise oils are discussed in a separate chapter.

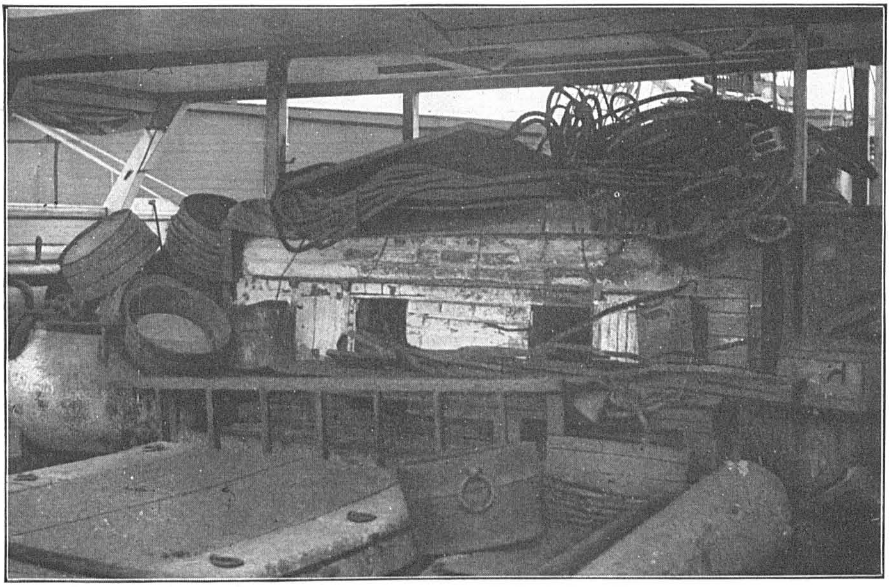
The following tabulated statement of the yield of oil from the several species of cetaceans has been prepared with much care after consultation with the most experienced whalemen of various ports:

Species.	Yield of oil in barrels of $31\frac{1}{2}$ gallons.	
	Variations.	Average.
Right whale, Pacific	25 to 250	90
Right whale, Atlantic	25 150	75
Bowhead	30 250	100
Sperm whale	5 145	45
Humpback, Pacific	10 110	42
Humpback, Atlantic	10 100	40
Finback, Pacific	10 70	35
Finback, Atlantic	20 60	38
California gray whale	15 60	30
Bottle-nose whale	4 25	12
Orca or killer whale	1 6	$2\frac{1}{2}$
Beluga or white whale	$\frac{3}{8}$ 3	$1\frac{1}{4}$
Black-fish	$\frac{1}{8}$ 4	$1\frac{1}{8}$

The methods of cutting-in and removing the blubber have already been described by numerous writers, and especially by James Temple Brown,[a] rendering unnecessary any extended description in this paper. Suffice it to state that the whale is attached to the side of the vessel, and by cutting in a spiral line and at the same time rolling the cetacean, the blubber is removed in a helical strip 5 or 6 feet wide, and this is boarded in lengths of 12 or 15 feet, called "blanket-pieces." The manner of doing this and of boarding the head gear is germane to nautical engineering rather than to the subject of oil-rendering.

[a] Fishery Industries of the United States, Vol 2, Sec. 5, p. 278.

REMOVING BLUBBER FROM WHALE BEACHED ON CALIFORNIA COAST.



TRY-WORKS ON MODERN WHALER, LOOKING AFT.

CONVERSION OF THE BLUBBER INTO OIL.

The following notes on the present methods of converting whale blubber into oil are the results of inquiries and investigations made by the writer during the last four years, and especially in October, 1901, when many practical whalemen were interviewed. Especially are we indebted to Capt. George O. Baker, Capt. Charles H. Robbins, Capt. James Avery, and Mr. W. R. Wing, of New Bedford, Mass.

The reduction of oil from the solid mass of blubber, though tedious in detail, is an operation of simple character, requiring merely that the substance shall be exposed to heat. The blanket-pieces, 12 or 15 feet long and 5 or 6 feet wide, are first "leaned," consisting in removing the pieces of muscles which cling to the fat during the process of cutting-in. By means of spades they are cut into smaller sections, called "horse-pieces," about 2 feet long and 6 inches wide. These are passed to the mincers. If the blubber is too thick, say over 12 inches, it is sometimes split before it is minced.

Two methods of mincing the blubber are employed, viz: by hand and by machinery. The former was the first adopted and is generally used at the present time. It is extremely laborious, but most whalemen prefer it, since the pieces are minced more uniformly and consequently the oil boils out more freely. The horse-pieces are laid lengthwise and with the flesh side downward upon a bench called the "mincing-horse," and are scored or cut into slices varying from one-fourth to three-fourths inch thick, called "minced horse-pieces." The knife cuts through the skin, but is stopped within about an inch of the base, so that the slices are held together like the leaves of a book, and in this condition they are pitched into the try-pots.

The try-works are built of brick athwartships between the foremast and the mainmast. The usual dimensions are 8 or 10 feet long, 7 or 8 feet wide, and about 4½ feet high. The first course of bricks, or the base, is laid in openwork, forming channels through which the water may freely circulate. The fireplaces, or "arches," as they are known aboard a whale ship, are strengthened by pieces of iron and are furnished with sliding doors. Two large metallic try-pots are placed within the try-works, with their bottoms resting upon the arches or furnaces. These are shaped like the old-fashioned 3-legged pots so intimately associated with the domestic hearths of our forefathers. They range in capacity from 120 to 200 gallons each.

While boiling the blubber, the fires are kept up day and night. Naturally, the fuel supply is an item of no small consideration to the whalemen. A quantity of cord-wood, each stick sawed into two pieces, and all kinds of refuse wood are included in the vessel's outfit and relied upon for starting the fires. But when fairly under way the highly combustible residue of the fat, known as "scrap," is mainly depended upon. Once in awhile a whale is secured so fat that the scrap is not sufficient to keep the fires going and the "fat lean" and similar materials are burned, and sometimes even a part of the rich blubber is consumed as fuel in order to save the remainder.

It is well known that the boiling point of oil far exceeds that of water. So intense is the heat at times that the solder upon the implements used about the pots is melted. It is important that all water should be expelled in order that the oil may not become rancid when barreled. It is equally important that every precaution should be taken to prevent water from getting into the pots during the process of boiling, the action of the oil under such circumstances depending upon the quantity of the extraneous fluid which is suddenly brought in contact with it. If the pots are not sheltered heavy rain may cause the oil to foam up, and when the vessel ships a heavy sea or when a very heavy rainstorm occurs, the contents of the pots are apt to throw up an immense cloud of steam and scatter the seething oil. Communicating with the fire, the oil is ignited with a flash, and the streams of burning liquid pour out upon the deck, sometimes with disastrous effect. As soon as the contents of the pots show a tendency to boil over, pieces of fresh blubber are pitched in, and if this is not sufficient the fire is immediately banked.

To prevent the vagrant pieces of lean which have accompanied the blubber from clinging and burning to the side and bottom of the pot and thus darkening the oil, the boiling mass is vigorously stirred. This is one of the most important duties in the process of oil-rendering.

Instruments are never used on a whale ship for testing the heat or culinary condition of the oil; the men rely mainly on their experience as to the best time for removing it, judging either by the color of the scrap or by spitting into the boiling mass, this producing a peculiar crepitating noise when the blubber has been sufficiently cooked.

As fast as the pieces of blubber are resolved into oil, the residuary fragments are transferred to a rough box called the "scrap-hopper" or "strainer-cooler." Its size depends upon the dimensions of the try-works, but usually it holds from 1 to 1½ pots of scrap. It consists of two compartments, the upper portion, or hopper, for the scrap and the lower part for the oil, the two separated by a wooden partition containing numerous holes, so that the oil may readily drain from the material.

The best and most economical way of utilizing the scrap has always been an important problem to the whalemen. The body of the sperm whale usually boils out freely, and consequently the scrap is dry, contains little oil, and is valuable only as fuel. The refuse of the right whale, however, retains considerable oil, and the whalemen are averse to burning it until after they have extracted the oil by compression. The scrap from both the sperm and the right whales is regarded as an important fuel supply and is economically saved at each fare during the voyage and used for boiling the blubber of whales taken subsequently.

Although the oil may be thoroughly cooked when the first scrap is removed, it is not bailed off, the usual plan being to fill the pot with fresh blubber and again boil it down until the pot is full. In this manner the hot oil melts the cold blubber and the latter reduces the temperature of the oil already rendered.

The bones of cetacea contain more or less oil, but they are utilized in oil-rendering only when whales are scarce. On a good voyage the endoskeletons are thrown overboard as fast as the coating of fat is removed, provided they are not required for fuel.

The blubber of the "small" and the lobes of the flukes are cut into horse-pieces and boiled out with the body blubber, being of the same nature. The entrail fat of the humpback whale may be boiled by itself or with the blubber, whichever is more convenient, the oil of the fat and that of the blubber being of the same grade. The fins of the sperm whale are cut up with spades; the fatty covering is boiled with the body blubber, and the bones with the fat-lean. The oleaginous covering of the fins of the right whale is cut into horse-pieces and boiled with the body blubber; the fin bones of this species are rejected. The head skin, or the fatty covering of the crown of both the right and bowhead whales, and, indeed, the "headgear" of both, are cut into horse-pieces and run through the pots with the body blubber.

The tongue of the bowhead as well as of right whales is also reduced to horse-pieces and boiled out. The tongue blubber is close-grained, or of much finer texture than that of the ordinary blubber, and is usually boiled out last. When "green" its oil is extracted with great difficulty, if, indeed, this can be accomplished at all when cooked by itself, unless very finely minced; hence it is sometimes laid aside and run through the pots in easy stages with the body blubber of the next cut. A muscular, fibrous substance known as "plum pudding" permeates the blubber of the tongues of these two species of whales, extending longitudinally through the central part and in greater abundance near the roots. Most of it is utterly worthless and is thrown overboard when detached from the fat of the tongue. At times, however, when the fat predominates, the "plum pudding" is saved and boiled out with the tongue or the refuse of the whale. It is almost impossible to render it when cooked alone.

The "ginger rolls," or plaited folds on the throat and breast of the humpback, are cut into horse-pieces and rendered with the body blubber; but the intermediate substance, resembling "white-horse" in some respects, is extremely tough and elastic, and is absolutely worthless as an oil-yielding substance.

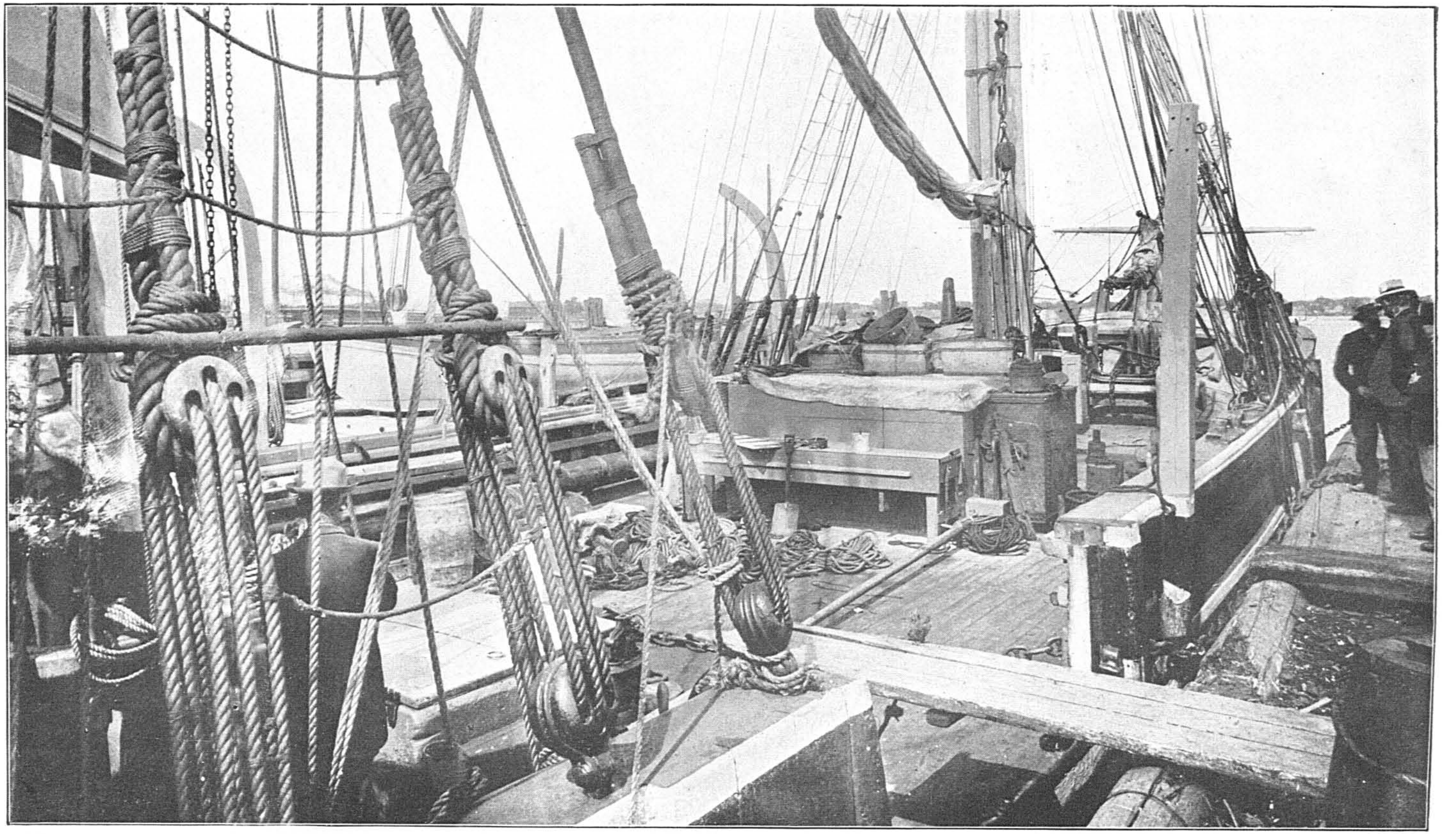
In trying out a sperm whale, either the body blubber or the head matter, including the junk and case, may be boiled out first; but they are never cooked together, since it is not policy to mix the oils, the head oil being worth a cent or two per gallon more than the body oil. The manner of preparing the case and junk for the pots being different, they will be described separately.

If the body blubber is tried out first, the head matter is deposited in junk casks as fast as it is whipped or bailed from the case. The junk is reduced to horse-pieces, placed in similar receptacles, and held in reserve with the head matter until the body blubber has been disposed of. The junk casks are ordinary oil casks with one head removed, and vary in capacity from 100 to 300 gallons each. They are also used to hold the scrap which is saved as fuel. Instead of the casks some of the larger vessels have one or two tanks between decks, which are used as temporary receptacles for the head matter and also for storing the oil.

When ready to boil out the head, the try-pots are well scrubbed, greater care being taken than when boiling the body blubber. They are next about half filled with some of the head matter as soon as it is bailed from the case, the remainder being stowed away as just mentioned. With legs and feet bare, men get into the pots and, standing in this odorous compound, squeeze out the soft pieces of fat. The oil flows freely between their fingers into the pots, while the refuse, called "twitter," is thrown into another receptacle, called the deck-pot, or perhaps into scrap-tubs. Notwithstanding the many improvements that have been made in the oil industries, no process of eliminating this membranous texture from the crude sperm oil has yet been discovered except the one just referred to—that of squeezing by hand. It is necessary to remove these fibers to prevent them from charring and darkening the oil. The case being carefully squeezed, the fires are started and the cooking then commences. The pots are spaded constantly to prevent the small but sometimes numerous particles of twitter, which have not been removed, from burning against the sides and bottoms. Meantime other men are squeezing out the remainder of the head matter deposited in the junk cases, and this is kept in scrap-tubs and poured into the pots as soon as the first installment has been properly cooked and bailed off, this operation continuing until all the head matter has been boiled out.

While the case is boiling, some of the crew cut the junk into horse-pieces somewhat larger than the body-blubber horse-pieces, and these sections, after mincing, are pitched into a pot of thoroughly cooked head matter. The hot oil of the case soon dissolves the junk, the two mingling most intimately, being of a kindred nature. Sometimes the case and the junk are boiled separately.

White-horse in considerable quantity ranges through the junk in streaks. It is tougher and whiter in large whales than in small ones. The fatty substance found between these layers, or strata, is soft—about the consistency of butter—and is of a pinkish cast, resembling somewhat in color the meat of a watermelon. The white-horse of large whales, especially of an aged male, is remarkably tough and is detached by means of sharp cutting-spades and thrown overboard. There is little oil in it, and its extreme toughness prevents it from being minced. If attempts are made to boil it out with the junk, it usually soaks up more oil than it yields. But the junk of small whales, more



DECK OF MODERN WHALER, SHOWING TRY-WORKS, SCRAP-HOPPER. AND UTENSILS EMPLOYED IN TRYING-OUT OIL.

particularly the cows, including both the white-horse and the fat, may be cut into horse-pieces, minced, and boiled out together. The process of mincing the pieces of junk and pitching them into the try-pots is identical with that previously described in connection with the body blubber. While some of the men are cutting out the white-horse and preparing the junk for the pots, others are scraping up the oil, which flows out profusely during the operations.

The hump and ridge of the sperm whale are cut into horse-pieces and boiled out with the head and with the fat secured from the jaws.

The term "twitter," which has been previously referred to as applied to the thread-like or membranous substance ranging through the contents of the case, is also applied to the lining of that reservoir. This is from 2 to 3 inches thick, glutinous, and extremely tough. In decapitating the sperm whale, especially in severing near the bunch of the neck, a very sharp spade is required to cut through this tough and elastic formation. Although it is very difficult to manipulate, an economical whaleman never throws this substance away. Since it can not be boiled out with the case, for the reason above given, it is saved and run through the pots with the fat-lean after the case and junk have been cooked.

There are two kinds of "lean," the "clear-lean" and the "fat-lean." The clear-lean, as the term signifies, is composed almost entirely of muscles, and is rejected as utterly worthless to the uses of whalemen. The fat-lean is composed of fat and lean so intermixed that separation by means of knives is impracticable. It is obtained principally about the jaw, as well as from other external parts of the whale. A large portion of it is cut from the blanket pieces during the process of leaning. When whales were abundant, the fat-lean was thrown away, but at present many, if not all, of the whalemen convert it into oil after the oil from the head and body blubber has been boiled out and bailed off. The fires are then drawn, the try-works cooled down, and the fat-lean is pitched in. This is a delicate operation, and if not performed in the proper manner there is danger of cracking the pots. Water is usually placed in the pots first and the fat-lean is pitched in until the pots are about two-thirds full, and then the twitter and lipperings are added. The fires are started, the admixture brought to the boiling point, and the works are again cooled down. When cold the oil floats upon the surface, and the water and cracklings remain at the bottom. If the process has been skillfully conducted, the oil may be almost as light and clear as any obtained from the better and purer parts of the whale. As a rule not more than two pots of this substance are boiled down, for the oil obtained from it is generally more or less sour—a result probably from either mixing it with water when boiling, or because it had become tainted through decomposition, or it may be due perhaps to both causes. This oil is usually barreled separately.

The oil obtained from the fat-lean of one whale is sometimes mixed with that obtained from the blubber of the next capture, this being effected by putting a few gallons of it into the cooling tank every time a pot of the subsequent fare is bailed off. Notwithstanding the importance of keeping the different grades of oil separate, some whalemen adulterate the blubber oil to a greater or less degree by the addition of fat-lean oil, yet they are prudent enough to save several casks of the latter grade to show on their return that the fat-lean has not only been economically saved, but also that its product has not been mixed with oils of higher grades.

The slivers, or small pieces that have been cut and hacked from the blubber while reducing it to horse-pieces and mincing it, are also saved and boiled with the blubber. The "slumgullion" and "lipperings" or "dreenings" of the blubber—consisting of a mixture of the blood which issues from the fat-lean and the salt water and oil which flows from the blubber while the men are handling it as they hoist it aboard ship, stow it away, and prepare it for the try-pots—though discarded in the palmy days of whaling, are now carefully husbanded and amalgamated. Like the sweepings of the floors of mints, this liquid refuse of the catch is refined in the whaleman's crucible in order that nothing may be lost. After the solid matter has been disposed of, both the deck lipperings and the blubber-room lipperings are usually deposited in barrels or tubs and there scalded with hot oil. The oil thus obtained is raked off and transferred to the cooling tank. In case the lipperings are not clean they are cooked with the fat-lean.

"Slush" is the skimmings from the tops of the pots, and is usually saved by the cook, who is commonly entitled to one-half of it. On arrival home it is sold to manufacturers of soap, and it is even clarified and mixed with lard. At sea the whalemen sometimes eat the slush as a dressing in the form of gravy on sweet potatoes, etc., but it is doubtful if they could be induced to eat it ashore, although it is quite clean and nutritious.

The different varieties of oils are barreled separately. A cask that has contained whale or humpback oil should be thoroughly cleansed before putting sperm oil into it, but a cask that has been used for sperm oil need not be cleansed should it be necessary to use it for whale oil; the small quantity of whale oil that might be left in the cask would perhaps make the sperm oil somewhat heavy, but a little sperm oil would not injure the whale oil. The casks of a ship engaged solely in right-whaling are not marked at all; should the vessel incidentally catch sperm whales, the casks containing oil from this species are marked S O, and the other casks are supposed to contain whale oil. Casks containing right-whale oil taken by a sperm-whaler are marked W or W O. The head oil of the sperm whale, unless the quantity be very small, is always kept in separate packages, which are marked H; those containing the body oil of this species are marked S O or Sp O. The packages of fat-lean oil bear the initials F L O, and black-fish oil B F O. Except when large catches are made, black-fish oil may be kept in meat barrels. The lettering is done in white paint, on the heads of the casks. When the oil is shipped home by another vessel the name of the ship is also branded on the cask, the impression being made with an implement called the "ship's marking iron," and the casks are numbered consecutively.

REFINING SPERM OIL AND WHALE OIL.

The rendering and care of the oil on shipboard having been described, there remains to be discussed its further treatment for commercial purposes, especially extraction of the foots and bleaching. The headquarters of the refiners of whale oils in the United States are at New Bedford, Mass., and San Francisco, Cal. Twenty years ago New Bedford monopolized the business, but large refineries have been erected at San Francisco, and at present about 20 per cent of the sperm oil and 60 per cent of the whale oil are refined at that port. The subjoined description is prepared almost wholly from information furnished by the principal refiners of New Bedford in 1901. The writer wishes especially to acknowledge, in this connection, the courtesies of Messrs. William A. Robinson & Co., and of Messrs. Frank L. Young & Kimball.

As received at the refineries, the casks of oil have been inspected and gaged by customs officers. They may have been kept in storage for months, and in some cases years, before reaching the refiner. Formerly, on the wharves at New Bedford might be seen thousands of casks filled with oil awaiting sale, being preserved from great leakage in the meantime by a covering of seaweeds; but in recent years the quantity has been much reduced, and on the occasion of the writer's last visit to New Bedford (October, 1901) not a single barrel of oil was on the wharves.

The oil is of two principal kinds, viz, sperm oil and whale oil, the former being obtained from sperm whales and the latter from all other varieties of whales and also from walrus, black-fish, sea-elephant, etc. It ranges in color from clear amber to very dark brown, depending on the variety of animal, the condition of the blubber, and the success of the rendering. The quality is determined by appearance, odor, and flavor. There is some difference in the value of crude oil of the same species of whale from Northern and from Southern seas, the former selling for a few cents more per gallon. Crude sperm oil was formerly worth about double the value of whale oil, but in recent years the difference has been much less. Little use is made of unrefined sperm oil, but considerable of the product of whale oil is sold in a crude state to steel-workers, miners, and cordage-manufacturers.

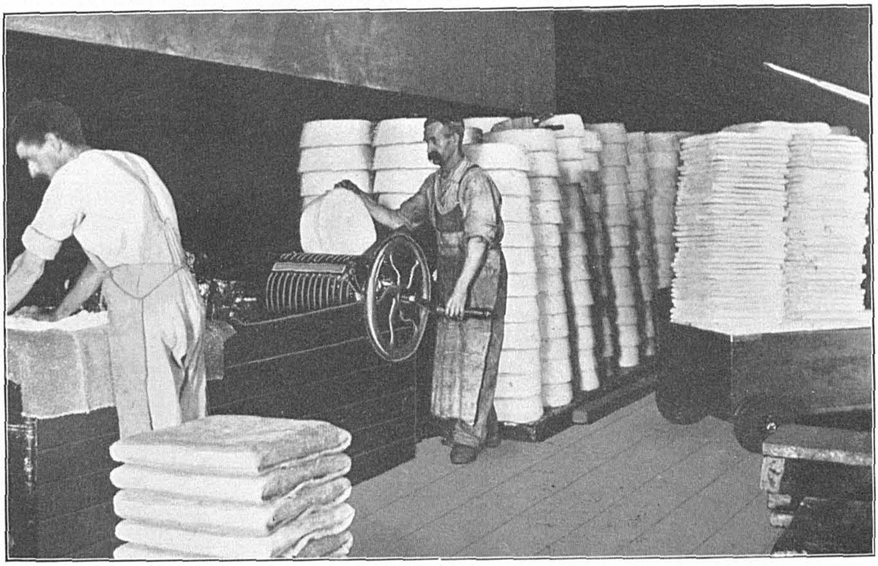
The products from refining sperm oil are the "winter sperm," which is the first running from the crude oil after it has been granulated by refrigeration; the "spring sperm"; the "taut-pressed," and spermaceti. The refined sperm oils are not generally sold in their natural color, however, but are usually bleached by a process which leaves "sperm-oil soap" as a product. The products of whale oil, including that of walrus, black-fish, sea-elephant, etc., are the winter, spring, and summer pressings, a tallow-like substance known as whale foots, and "oil soap."

Sperm oil.—The two varieties of oil obtained from sperm whales, viz, body oil and head matter, differ greatly in appearance. The former is of a light straw color, while the latter when first taken from the head of the whale is as clear and limpid as water, but after a short time thickens and hardens into a white mass. Each animal is supposed to yield about two-thirds body oil and one-third head matter. These are kept separate on shipboard, but when received at the refineries they are generally mixed in natural proportions and together submitted to the processes for separating the oil and spermaceti.

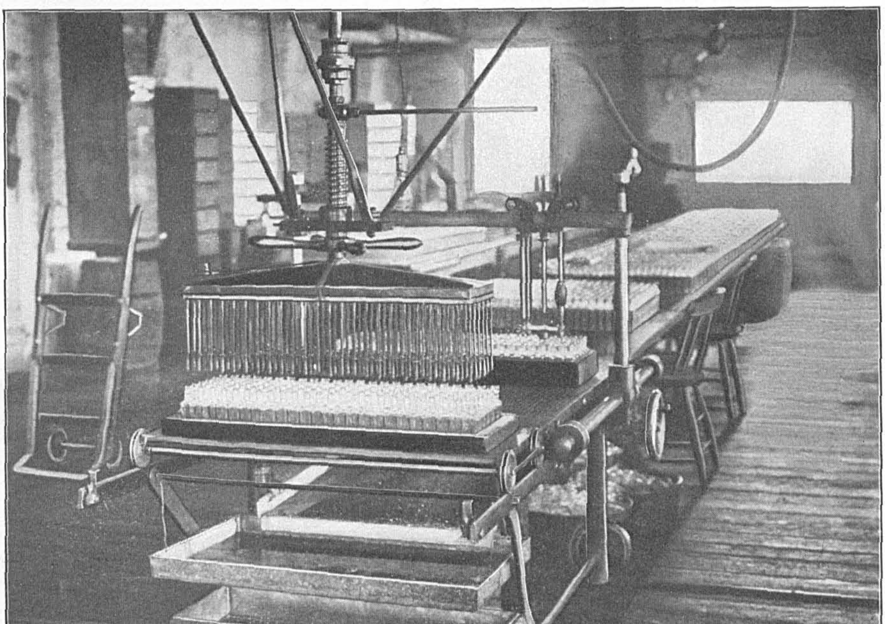
In the process of refining, the crude oil is drawn from the casks and heated for the purpose of driving off all the water. This is conveniently done by running it into large iron tanks of several hundred, or even thousand, gallons capacity, where it is subjected to heat by means of coils of steam-pipes running around the inside of the tanks. When heated in excess of 212° F. all moisture is soon expelled, and the oil resists water; that is, water will refuse to mix with it and will "snap" when dropped into the oil. By continuing the heating from six to ten hours the crude oil is converted into a clear liquid state, all particles of fat and blubber boiling out and the impurities settling at the bottom of the tank. The steam is then shut off and, after the oil has partly cooled, it is drawn off from the top of the tank into barrels or casks with capacity of about 50 gallons each. The sediment which precipitates at the bottom is drawn off and made into soap.

In the barrels the oil is chilled. In cold weather, from December 1 to March 31, this is done by exposing the barrels and their contents to the weather; but during the balance of the year it is necessary to place them in large covered pits, where the oil is frozen by using ice and salt packed among the barrels. To avoid the expense of artificial refrigeration, it is preferable to do the refining during the winter season.

After remaining in the pit from ten to fourteen days, at a temperature of about 32° F., the oil is thoroughly chilled, shrinks, and separates or granulates into little balls or grains. It is then removed from the refrigerator, shoveled from the barrels into canvas or hempen bags holding from 2 to 4 gallons each, and placed in a press, where it is subjected to a pressure of from one to two thousand pounds to the square inch. There is thus pressed out a clear, cold oil known to the refiners as "winter sperm oil," which will stand bright or will not congeal at a low temperature fixed as a standard. Formerly the standard was 32° F., but at present the usual commercial test is 38° F. Oil of 23° F. test has been prepared, but there was no demand for it. Since the lower the temperature at which the congealed oil is pressed the less the quantity yielded, it is not desirable to use any lower temper-



GRINDING AND PRESSING CRUDE SPERMACETI FOR REMOVAL OF TAUT-PRESSED OIL.



INTERIOR VIEW OF OIL REFINERY. FILLING BOTTLES WITH SPERM OIL.

ature than required. When producing oil of 38° F. test, the amount of "winter sperm oil" yielded is about 75 per cent of the original quantity. In former times when a 32° F. test was used, the "winter sperm oil" was about 67 per cent of the original bulk. This may be sold either in its natural state or bleached. It is used principally as a lubricant, and, to a less extent, as an illuminant in mines.

After the "winter sperm oil" has been pressed from the bags there remains in them a solid of a brownish color, which is again submitted to pressure at a warmer temperature, say 50° to 60° F., and there is produced an oil known as "spring sperm oil," which congeals at the test of 50° to 60° F. above noted. The quantity of "spring sperm oil" is about 9 per cent of the original quantity of crude oil.

The solid now remaining in the bags is emptied into receptacles and, after remaining for several days at a summer temperature, is dumped out in the form of solid cheese-like cakes. These are stored where the temperature is kept at about 80° F. and in the course of a week or so are shaved up by revolving knives and again bagged and subjected to a pressure of about 100,000 pounds to the square inch. This yields a third grade of oil called "taut-pressed oil," which will chill at a temperature of 90° to 95° F. The quantity of oil of this grade is about 5 per cent of the original bulk, making a total of 89 per cent of refined oil obtained. The residue in the bags after the extraction of "taut-pressed oil" is crude spermaceti of a brown color, which will melt at a temperature of 110° to 115° F. The methods of refining spermaceti are set forth on page 245.

As refined at the present time, sperm oil, including both body oil and head matter, yields about 11 per cent of crude spermaceti and 89 per cent of refined oils, in the following proportions: 75 per cent of "winter sperm," 9 per cent "spring sperm," and 5 per cent "taut-pressed oil." A barrel of crude sperm oil of 31½ gallons, weighing 231 pounds, yields 25 pounds of refined spermaceti, 23.6 gallons of "winter sperm," 2.8 gallons of "spring sperm," and 1.5 gallons of "taut-pressed oil." The prices of these (January, 1902) are: Spermaceti, 23 to 24 cents per pound; winter sperm, 75 to 77 cents per gallon; spring sperm, 60 to 61 cents; taut-pressed, 50 to 53 cents, and sperm soap 3 cents per pound; a total of about $24.50 resulting from one barrel of crude oil.

Sperm oil is one of the most characteristic and valuable oils in commerce. It is very generally conceded to be the best lubricator in existence for light, rapid machinery, such as the spindles of cotton and woolen mills, its viscousness, tenacity, and high flash-point causing it to work with great uniformity and with a small amount of friction. But there are many cheap substitutes—made from petroleum principally—which, though not so good, answer the purpose nearly as well; consequently the demand for sperm oil is far less than formerly, and even much of that sold as sperm contains a large admixture of hydrocarbon and other oils.

Whale oil.—The color of whale oil depends on the "age" of the blubber, or the time that elapses between the death of the whale and the trying-out of the oil. Usually it is brown, much darker than sperm oil, with a slightly disagreeable odor. In a crude state it is used to some extent by screw-cutters, steel-temperers, cordage-manufacturers, and as an illuminant for miners' lamps, but more than half is refined in a manner similar to the treatment of sperm oil. The first boiling and freezing processes are the same as with sperm oil. When removed from the refrigerator the congealed mass is usually dumped on woolen strainers, 2 feet wide and from 10 to 20 feet in length, stretched across frames. The process of straining is employed to reduce the bulk, since much oil will pass through the woolen cloth and leave a less quantity to be pressed. The thick part remaining on the strainers is placed in bags, as in case of sperm oil, and subjected to great pressure. The first oil from the press congeals at 36° to 40° F. and is called "winter whale oil." The foots or stearin that remains in the bags, averaging one-tenth of the original bulk, and about the consistency of leaf lard, is usually white and clean. This may be reheated and refrigerated, and upon a second pressing yields "spring whale oil" of a higher degree test; but this is not frequently done.

The oil with the foots removed may be sold in its natural color or it may be bleached. One-eighth of the whale oil and probably half of the sperm oil is bleached by the refiners. In this process it is first placed in the refining tanks and heated. When partially cooled the water and sediment are drawn off from the bottom of the tank, and while the oil is agitated or stirred some soda ash or caustic soda is added. This so acts on the oil as to cut the gum, and the thick part settles to the bottom, leaving the oil clearer and of a lighter color. It is also accomplished by exposing the oil under a glass roof to the sunlight for a few hours, or even days, in large shallow vats or pans from 3 to 12 inches deep, each with capacity for several hundred gallons.

The refuse in the bottom of the tanks is drawn off and boiled down into oil soap, which is worth about 3 cents per pound. The first bleaching will give about 2 per cent in hard soap, the second and third each give about the same. If the oil is clear and sweet the first bleaching is sufficient. Much of the oil soap is shipped to California, Florida, and other fruit-growing sections, where it is employed as a wash for trees to protect them from the ravages of insects. It is also used to some extent in fur-dressing.

In the usual pressings, the oil of the right whale taken in high northern latitudes gives about 8 per cent of foots or stearin; if taken in the vicinity of the equator, or south of it, about 15 per cent of stearin is yielded. Humpback and finback oils yield about 12 per cent of foots; sea-elephant yields 5 or 6 per cent; menhaden from 5 to 10 per cent; and seal oil yields only 3 or 4 per cent in the customary pressings. Of course this varies according to the temperature at which the oil is pressed. Tallow regulates the price, in a measure, as the stearin is substituted to quite an extent for that article. The market price approximates 5 cents per pound. It may be refined in a manner similar to spermaceti, though it is generally sold in the crude shape, packed in barrels. The chemical constituents are mainly glycerides of stearic and palmitic acids, mixed with oil. It is used principally as a sizing for yarns, smaller quantities being used in Europe for smearing sheep after shearing. Other uses are in making soaps and in filling or stuffing leather.

The various whale oils are hard and strong, and range in specific gravity from 0.900 to 0.927 at 59° F.. Oil of the right whale has specific gravity of 0.925 to 0.927 at 59° F. Oil from the humpback and likewise from the sulphur-bottom whale is somewhat lighter in weight, the specific gravity varying between 0.915 and 0.920 at 59° F. According to Brannt, the composition of right whale oil is carbon 76.85 per cent, hydrogen 11.80 per cent, and oxygen 11.35 per cent; while that of humpback and sulphur-bottom whales is carbon 77.05 per cent, hydrogen 12.05 per cent, and oxygen 10.90 per cent. Refined whale oil is extensively used in machine shops to reduce friction, particularly in cutting bolts and screws. It is also used as stuffing in leather-dressing, especially in the manufacture of chamois leather.

The following summary, compiled from the trade journals, shows the range of prices per gallon for crude sperm oil and for whale oil during a series of years ending in 1901:

Statement of the maximum and minimum prices per gallon of sperm and of whale oil each year from 1868 to 1902, inclusive.

Year.	Sperm oil, per gallon.	Whale oil, per gallon.	Year.	Sperm oil, per gallon.	Whale oil, per gallon.
1868	$1.75 to $2.00	$0.64 to $1.13	1886	$0.67 to $0.85	$0.36 to $0.48
1869	1.59 1.93	.84 1.13	1887	.57 .65	.35 .36
1870	1.22 1.55	.63 .75	1888	.55 .62	.37 .40
1871	1.22 1.57	.54 .84	1889	.62 .68	.40 .42
1872	1.35 1.63	.62 .73	1890	.58 .65	.42 .50
1873	1.40 1.55	.52 .68	1891	.63 .68	.50 .54
1874	1.50 1.66	.57 .63	1892	.63 .65	.50 .53
1875	1.48 1.84	.62 .70	1893	.62 .90	.40 .48
1876	1.27 1.62	.55 .70	1894	.56 .62	.38 .43
1877	1.03 1.40	.50 .70	1895	.50 .56	.36 .40
1878	.81 1.05	.35 .52	1896	.35 .45	.30 .35
1879	.71 1.00	.35 .57	1897	.36 .49	.32 .38
1880	.80 1.08	.45 .57	1898	.38 .57	.31 .39
1881	.87 1.05	.50 .59	1899	.40 .61	.32 .40
1882	1.05 1.15	.57 .60	1900	.45 .60	.33 .37
1883	1.08 1.15	.56 .60	1901	.55 .68	.34 .38
1884	.87 1.05	.55 .63	1902	.62 .70	.34 .38
1885	.85 1.00	.42 .55			

In the early years of the whale fishery nearly all the sperm oil produced in the United States fisheries was exported in a crude condition, and during the period of greatest prosperity in the fishery about one-half was exported, but at present the exports in a crude state are very small. For the first time in a hundred years none whatever was exported in 1901. Most of it is refined at New Bedford, and some of the refined oil and a large percentage of the spermaceti are exported. Of the whale oil the greater part is consumed in this country.

The annual product of sperm and whale oils, quantities exported, and quantities consumed in this country, are shown in the following:

Table showing, in barrels of 31½ gallons each, the production of sperm and whale oils by the whaling fleet of the United States, the export to foreign countries, and the home consumption from 1860 to 1901.

[Compiled from the Whaleman's Shipping List.]

Year.	Sperm oil.			Whale oil.		
	Production.	Export.	Home consumption.	Production.	Export.	Home consumption.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1860	73,708	32,792	38,507	140,005	13,007	143,009
1861	68,932	37,647	31,091	133,717	49,969	105,839
1862	55,641	27,970	27,759	100,478	68,583	67,254
1863	65,055	18,396	32,527	62,974	11,297	65,352
1864	64,372	45,000	30,190	71,863	12,000	62,528
1865	33,242	20,158	27,606	76,238	1,600	64,107
1866	36,663	10,630	19,133	74,302	618	69,534
1867	43,433	25,147	22,968	89,289	18,253	58,836
1868	47,174	18,916	23,258	65,575	9,885	72,390
1869	47,936	18,645	17,230	85,011	3,842	56,236
1870	55,183	22,773	28,812	72,691	9,872	68,452
1871	41,534	22,156	33,528	75,152	18,141	63,011
1872	45,201	24,344	24,052	31,075	1,528	42,852
1873	42,053	16,238	24,100	40,014	2,153	33,881
1874	32,203	18,675	21,768	37,782	3,300	44,357
1875	42,617	22,802	18,453	34,594	5,424	31,860
1876	39,811	23,600	14,473	33,010	10,800	22,020
1877	41,119	18,047	31,737	27,191	6,390	20,501
1878	43,508	32,769	11,124	33,778	14,371	12,557
1879	41,308	11,843	23,315	23,334	7,374	24,885
1880	37,614	12,283	17,750	34,776	4,305	23,856
1881	30,600	16,600	25,275	31,650	6,450	32,000
1882	29,844	13,006	13,053	23,371	4,421	21,425
1883	24,595	13,996	17,324	24,170	4,543	19,052
1884	22,099	5,143	15,481	24,670	2,343	23,777
1885	24,203	7,554	18,279	41,586	5,384	50,529
1886	23,312	3,118	15,170	27,249	18,253	9,176
1887	18,873	4,955	14,953	34,171	8,205	34,786
1888	16,265	1,345	21,410	17,185	8,578	7,747
1889	18,727	5,823	13,339	14,247	440	12,667
1890	14,480	2,000	11,015	17,565	4,366	14,549
1891	13,015	3,218	14,412	14,837	608	13,864
1892	12,944	1,787	12,757	13,382	291	12,746
1893	15,253	1,165	11,088	8,110	1,064	6,721
1894	16,333	1,720	7,764	9,720	276	8,379
1895	16,585	1,225	15,949	4,000	825	4,534
1896	15,124	215	20,419	4,800	500	5,050
1897	15,050	280	18,020	3,600	422	3,178
1898	12,520	1,952	11,848	5,295	075	4,450
1899	11,903	550	13,095	3,827	....	3,997
1900	18,525	1,100	17,973	5,510	500	3,410
1901	14,910	....	17,990	2,930	....	4,530
1902	21,970	470	[a] 18,250	4,725	400	[b] 4,325

[a] On hand Jan. 1, 1903, 3,600 barrels sperm oil. [b] There was no whale oil on hand Jan. 1, 1903.

PORPOISE AND BLACK-FISH OILS.

Among the minor oils of technical importance are those of porpoise and black-fish, which are nearly equal in texture and are used for similar purposes. These oils are in two grades of widely different characteristics, viz, blubber oil and head or jaw oil; the former is worth about the same as right-whale oil, or 35 cents per gallon, while the latter sells as high as $10 per gallon. They are generally known as "porpoise oil" and "porpoise-jaw oil," respectively, although the black-fish yields many times as much oil of each grade as the porpoise.

Porpoise have at times been taken in considerable quantities in shore fisheries established primarily for securing the hides for tanning purposes. 6,450 porpoise secured on the North Carolina coast in 1887 yielded 10,460 gallons of body oil; 2,283 porpoise in 1889 yielded 3,897 gallons, and 1,747 in 1890 furnished 2,746 gallons.

This oil is pale yellow to brown in color, and has a slight fishy odor, which disappears on exposure to air. The specific gravity, according to Brannt, is 0.918 at 59° F., and it congeals at about 3° F. When fresh it is indifferent to litmus paper, but absorbs acid properties from the air. It is used for tanning purposes and in compounding with mineral lubricating oils.

The sperm-whalers of the Atlantic occasionally harpoon Hatteras porpoise from the bow of the vessel and lift them aboard for food purposes. In many cases the blubber of these is removed and tried-out for oil. This blubber is of a yellowish white or pearl color, varies in thickness from ½ to 1½ inches, and is of about the same texture as that of the beluga or white whale. It is cut in longitudinal strips 4 or 5 inches wide, minced, and placed in the try-pots with other blubber. The yield of oil is usually less than 2 gallons to each animal, consequently the whalers do not often render it.

From the jaw-pans of porpoise taken more particularly for food, the whalers obtain the highly renowned "porpoise-jaw oil," which is used for fine lubricating purposes. The lower jaw is removed from the head, the pans extracted therefrom with a knife, minced, and placed in a small tin, such as a meat-can, and placed on the stove to simmer or boil gently. The quantity of oil obtained from each jaw is very small, probably about one-half pint, and the total quantity secured by the whaling fleet of New Bedford probably does not exceed 5 or 6 gallons annually, the market price of which is upward of $6 or $8 per gallon.

Some years ago the Passamaquoddy Indians on the Maine coast captured numbers of porpoise. Indeed, at one time that fishery furnished their principal means of support. As the animals were taken mostly during the winter and inshore, where food is abundant, they were very fat. The largest individuals measure about 7 feet in length and 5 feet in girth, weighing 300 pounds or more. The blubber of a large porpoise is from 1 to 2 inches thick and weighs 75 pounds and upward, yielding 5 or 6 gallons of oil, but the average for all taken was only 2 or 3 gallons. In the primitive method employed by the Indians, the blubber is stripped off and cut into small pieces, which are placed in a large pot. Inside a semicircle of large stones a fire is made, and when the stones are hot the fire is scattered and the pot containing the fat suspended over the stones and sufficient fire kept up to insure the melting of the blubber. The oil rising to the surface is skimmed off and placed in suitable receptacles. This oil, when pure, formerly sold for 60 to 80 cents per gallon, but was frequently adulterated with seal oil and sold at less price. It gives an excellent light, and also is good for lubricating machinery, as it is free from sticky characteristics and has quite a low weather-test. The superior oil in the jaw-pans is also extracted by hanging the jaws in the warm sunlight and permitting the oil to drip into cans placed underneath to receive it. About half a pint of this oil may be secured from each porpoise; it is sold at a very high price for lubricating watches, clocks, and the like. Very few of the Passamaquoddy Indians are now left, and these few have almost entirely abandoned "porpusin" for other occupations.

The "black-fish" (*Globiocephalus melas*) occurs in many parts of the Atlantic Ocean. Individuals vary in length from 8 to 22 feet. They are captured by the sperm-whalers, and also at irregular intervals they are secured when stranded on the shore, especially in Cape Cod Bay, where they have gone in pursuit of food, the fishermen getting to the seaward of them and driving them ashore. They are likewise secured on the rocky coast of Scotland and other parts of northern Europe.

According to Capt. James Avery, of New Bedford, the sperm-whalers take them at all seasons of the year and throughout the Atlantic, but probably in greatest abundance on the west coast of Africa in 20° W. longitude, and 6° to 10° N. latitude. The number caught annually has greatly decreased in the last fifteen or twenty years. In 1881 the *Eleanor B. Conwell* caught 196, probably the greatest number taken in any one year by a single vessel. During the last three or four years the entire whaling fleet probably has not captured more than 20 or 25 annually, yielding about 800 gallons of body oil and 50 gallons of head oil, the former worth $280 and the latter $350 at fisherman's prices.

The black-fish are captured in much the same manner as very small sperm whales, and for cutting-in they are hove up on deck by means of lifting tackle. The blubber is nearly white, from 1 to 5 inches thick, and is removed from the carcass in longitudinal strips 8 or 10 inches wide. These strips are cut in horse-pieces and minced in the same manner as already described for whale blubber, the blood being washed off the fat by dashing buckets of water over it. The minced blubber is then placed in the try-pots and cooked, and subsequently treated precisely as that of the right whale. The product of oil ranges from 5 to 120 gallons from each individual, averaging probably about 35 or 40 gallons. This is sometimes mixed with whale oil, although it has a greater value, selling usually for several cents per gallon more than that of the right whale.

The head oil of the black-fish is taken from the melon or junk and the jaw-pans. The melon is a fatty mass on the top of the head, reaching from the spout hole to the end of the nose, and weighs about 25 pounds. This is washed free from blood, minced, and placed in the try-pot. The lower jaw is cut off, the jaw-pans cut out with a knife, minced, washed, and placed with the cleaned jaws and the melon in the try-pot. Some whalers cook the melon and the jaw materials separately, but the above is the usual method.

It is customary to cook the head matter of black-fish in fresh water. About 15 gallons of fresh water is placed in the pot, the fat is then added, and the whole brought to a gentle boil by means of a slight fire. At this point a little overheating will effect great injury. When the cooking is completed the pot is allowed to cool and the following morning the oil is skimmed off. The product of head oil from individual black-fish ranges from three-fourths of a gallon to 3 gallons, averaging probably about 2 gallons. At ordinary temperatures the blubber oil and the head oil of black-fish are much alike in their appearance, thus furnishing great temptation to the fishermen to mix a little of the cheap product with that of greater value, resulting in much vexation and loss to the refiner, as it is only in the process of refinement that the adulteration is revealed.

In addition to the black-fish secured by the sperm-whalers, large numbers have been captured on the shores of Cape Cod, where they are attracted by squid on which they feed. The animals are surrounded by boats and driven like cattle to the beaches, and are there stranded in endeavoring to escape. They are lanced to death and when the tide falls the blubber and the oil-producing head matter are stripped off and conveyed to try-works on the shore, where the oil is extracted in much the same manner as already described for the vessel fishery.

The greatest catch of black-fish on Cape Cod was made in 1884. On November 17 of that year 1,500 were killed at Blackfish Creek, South Wellfleet, where they had been driven ashore. About a month later 500 more were slain in a great round-up in the bay. Since that time very few have been secured in the bay, nor have they been seen at sea in any such numbers as previous to the slaughter above noted.

The oil from the blubber of porpoise and of black-fish is refined in precisely the same manner as whale oil, but the process of treatment applied to the head oils is far more complicated. These are very limpid, of an unusually low weather-test, and have little corrosive effect on metallic surfaces, making them when refined superior for lubricating such delicate mechanisms as watches, chronometers, typewriters, etc. Practically all of these oils secured in the American fisheries are refined at New Bedford and Provincetown, Mass., there being two refiners at the former place and one at the latter. We are indebted principally to Mr. William F. Nye and to Mr. Joseph K. Nye, of New Bedford, for the subjoined notes relative to the methods of refining.

In the preparation of watch and chronometer oils much depends upon the freshness of the fat at the time the oil is rendered and the freedom of the material from adulterants. Fresh substance produces much better oil than that which has partly decomposed, the product being sweeter and less rancid. No choice seems to exist between the porpoise-jaw oil and the black-fish-head oil, both producing refined articles of equal merit; but that of the black-fish seems to be the favorite by a slight margin among the refiners, owing to its having more body, and possibly also to its greater abundance. A peculiarity of these oils is that they improve with age, differing in this particular from blubber oils. This is accounted for by the alternate gathering and emission of moisture upon exposure to changes of temperature, and by this and other treatment they become clear and brilliant, in consequence of which they are seldom used within less than a year or two after they are obtained.

On receipt of the oil at the factory the first step in the process of refining is to gently heat it to complete the process of cooking begun by the fishermen. The oil is then placed in tanks or casks to await the process of grading, and often two years may elapse ere the trained and skillful eye of the refiner can determine to what class it belongs. It is almost impossible to describe the extremely delicate variations in color, texture, odor, and flavor which enter into this grading. The claim is made that there are not half a dozen men in the world who have had the training and experience necessary to separate these delicate oils into their proper classes, and yet a very large part of the reliability of watch and chronometer lubricants lies in the gradation under the almost instinctive skill of the refiner.

According to Mr. Joseph K. Nye:

> After two years or more of rest, the oil has got to a condition where its surplus oxygens have united with whatever animal or loose organic matter may have been floating in microscopic particles within it, and they are easily removed by the ordinary strainers of an oil factory. But something is still left in the oil which is very sensible to the high or low range of temperature, and to remove this requires its subjection, while spread out in thin layers, to a temperature far below zero. No further change in its construction can be made except at this very low temperature, nor must it be cooled too rapidly. When properly done the process is one most interesting to watch. All through its liquid amber little flecks of translucent material appear, joining and rejoining like frost on a window pane into most beautiful forms, resembling a miniature forest whose foliage is white. By means of a certain fine and close-grained fabric these particles at this juncture are filtered out; and strange to say, this residuum, once a portion of a brilliant, almost colorless fluid, never even at normal temperature becomes anything but a slimy mass, resembling poor lard.

In order to get this low temperature, one of the New Bedford refiners has established a chilling plant at St. Albans, Vt., where long-continued cold can be depended upon.

To be thoroughly satisfactory the refined oil must be of uniform quality, entirely devoid of acidulous properties, absolutely gumless, withstand the rigors of the coldest climate without congealing, and maintain its body or stability in a high temperature. This is the most delicate and highly refined lubricant known, and some has been produced for which a temperature of −50° F. has been claimed. While all watch-oil users do not prefer colorless fluid, the average customer demands an oil almost if not absolutely colorless and of crystal clearness. Much of the product is sold for repairers' use in wooden boxes containing 1 dozen half-ounce bottles, each bottle inclosed in a small pasteboard box. The remainder, in tin cans having capacity for 1 pint, 1 quart, or of larger capacity, goes to the manufacturers of watches, clocks, chronometers, typewriters, etc.

SCHOOL OF BLACK-FISH STRANDED ON THE SHORE OF CAPE COD, MASS.

OILS FROM SEALS, WALRUS, ETC.

The blubber or fat lying between the skin and the muscular tissues of the various members of the *Pinnipedia* yields oil of much importance for technical purposes. The principal varieties on the market are from the common seals or hair-seals of the North Atlantic, the walrus, the sea-elephant, and the sea-lions. Each of these will be discussed separately.

SEAL OILS.

Seals are found in various northern waters and especially off the coast of Labrador and Newfoundland, in the waters of Greenland, the Arctic Ocean north of Europe, in Caspian Sea, along the Nova Scotian and New England coasts, in the Northern Pacific, and to a much less extent in the Antarctic seas. The principal fisheries are in the Arctic and North Atlantic oceans, especially off the coasts of Newfoundland, Greenland, and Northern Europe. The Caspian Sea also affords an important seal fishery.

The blubber of seals ranges in thickness from 1 to 3 inches, according to the species, age, and condition of the animals. It is removed from the pelts usually as soon as the latter are landed. If the weather is warm, considerable oil of prime quality flows from the blubber during the process of separating it from the pelt, and provision is made for this free oil to flow into suitable receptacles.

The oil may be at once extracted, or the blubber may be stored for a more convenient season, especially if the weather be cold, as it is much easier to extract the oil during warm weather. If the blubber is stored, it should be in well-ventilated apartments, so arranged that the oil forced out by compression and warmth may run into suitable reservoirs. In the best-arranged storage rooms the reservoirs are oak-wood casks, lined with lead in some instances, with capacity for a thousand or more gallons. These are placed at intervals in the floor, which is so inclined as to cause the oil to flow into the receptacle. The oil which flows under these circumstances is usually clear, sweet, and of prime quality.

There are several methods of extracting the bulk of the oil from the blubber, the one adopted depending to some extent on the proposed use of the product and also on the amount of capital available for equipment and the quantity of blubber to be handled. The methods may be divided into three principal classes, viz, (1) by maceration exposed to solar heat, (2) by cooking in open kettles, and (3) by the application of steam.

The simplest method of extracting the oil is by exposing the minced blubber in a mass to the weather. The blubber is heaped up in large tanks and—when the temperature is suitable—clear, pale oil flows from the mass. As putrefaction advances and the cellular texture is destroyed, the mass yields oil of a reddish yellow and then a dark brown color, with somewhat disagreeable odor and flavor, owing to the decomposition products evolved. When the oil ceases to flow, usually at the end of two or three months, the mass of fat is boiled in water with the fleshy or fat-lean portions. During this boiling the oil rises to the surface and is skimmed off. The residue is evaporated by pressure and drying, and is used for fertilizer. This was formerly the usual method employed in rendering seal oil in Newfoundland, but during the last twenty-five or thirty years the steam process has been generally adopted.

In treating a small quantity of blubber for extraction of the oil it is usually more convenient to mince it finely and cook it in a kettle over a fire. The oil rises to the surface and is skimmed off and placed in casks or other suitable receptacles. This is the method commonly employed by the shore hunters whose catch is small.

At the large sealing ports, as St. Johns, Tönsberg, Dundee, Astrakhan, etc., the oil is usually rendered by means of steam. The minced blubber is exposed to the action of steam in large inclosed tanks. The oil flowing therefrom passes through pipes into large reservoirs, of which there are usually three or more, the overflow from the first passing into the second, and the overflow from the second into the third. This furnishes the first quality of steam-refined oil. By pressing the steamed blubber, a second quality of dark-brown oil is obtained.

The steam process of rendering has the advantage of rapidity in operation, also the oil is free from disagreeable odor and is of superior burning qualities. However, for use in mines the sun-extracted oil is preferred, especially that of young seals, owing to its greater freedom from smoke, the odor being of little consequence to miners. According to Mr. Carrol,[a] oil from old seals is more smoky than that from young ones; it is also of greater specific gravity, and when the blubber of both are rendered together, the young seal oil comes out first.

Although the catch of seals in the Newfoundland fishery in 1901 was almost as large as in 1900, being 345,380 in 1901, as compared with 353,276 in 1900, the yield of oil was about 120,000 gallons less, representing a difference in value of about $50,000. This was principally because the average weight of the seals was small, owing to the fact that in 1901 the seals whelped some days later than in 1900, and furthermore, they were taken two or three days earlier than usual, the absence of pack ice enabling the vessels to reach them promptly after leaving harbor. In 1900 the average weight of the seal pelts was about 46 pounds, whereas in 1901 it was but 38 pounds. The young seals gain daily two or three pounds in weight of blubber, and if the vessels had been three or four days later in reaching the herds, the yield of oil in the Newfoundland fishery in 1901 would probably have been approximately the same as in 1900.

The decadence of the seal-oil industry, especially in the waters north of Europe, has been gradual but certain, owing to the introduc-

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[a] The seal and herring fisheries of Newfoundland, by Michael Carrol, Montreal, 1873, p. 30.

tion and adoption of cheaper substitutes for the relatively high-priced seal oil. Every year shows a decrease in the number of vessels employed in the fishery, and when a vessel is lost or sold it is rarely replaced. Comparatively little seal oil is imported into this country, the quantity in some years amounting to less than 1,000 barrels. The price in bond approximates 45 cents per gallon. The Newfoundland oils are marketed principally in St. Johns, Glasgow, London, and Leith; those from the waters north of Europe, at Dundee, Copenhagen, Hamburg, and Archangel, and that from the Caspian seal fisheries at Astrakhan.

Seal oils vary in specific gravity from 0.915 to 0.930 at 59° F. According to Brannt, they are composed principally of glycerides of physetoleic acid, of palmitic, stearic, and a small quantity of oleic acid and traces of butyric acid, valerianic acid, etc. They show a slight acid reaction when fresh, the acidity increasing with age. Instead of the albuminous substances present in vegetable oils, the seal oils contain a small quantity of glue which can be precipitated with tannin and metallic salts. They are very slightly soluble in alcohol, and require almost an equal volume for solution in ether. Mixtures of equal volumes of nitric and sulphuric acids produce a reddish color, quickly changing to brown. The adulteration of seal oils is detected principally by the incomplete saponification if resin oil be the adulterant, and by the degree of solubility in alcohol if other blubber oils are employed.

In addition to the pure oils there are several well-known compound seal oils on the markets, the best known being the "three crowns." Greenland "three crowns" is a mixture of several varieties of blubber oil, chiefly seal oil, or rather seal-oil foots, and small quantities of whale and walrus, combined with oil from shark livers, the fluidity and low specific gravity of the shark oil imparting the special qualities to this compound. Swedish "three crowns" oil is a compound of various seal oils with herring oil.

The principal use for seal oil is for burning in miners' lamps, and it is also employed in currying and to a very small extent for miscellaneous purposes, especially fiber-dressing. About 2,500 barrels are used annually as an illuminant in the light-houses in the British North American provinces. Owing to its sluggish nature it is usually improved by the addition of mineral colza. An excellent miners' lamp oil is said to be composed of seal oil, 40 per cent; whale oil, 25 pér cent; lardine (0.980), 10 per cent, and mineral colza, 25 per cent.

SEA-ELEPHANT OIL.

The sea-elephant or elephant-seal has furnished a large quantity of oil to the American markets during the last eighty years. The whalers operating in the extreme South Atlantic, and also the fur-sealers sailing to Falkland, South Georgia, and the coast of Patagonia, secured odd lots previous to 1803, but the first vessel specially fitted out for securing this article appears to have been the ship *Alliance*, which sailed from New Bedford in 1803 for Patagonia, and returned home in 1804 with a full cargo of oil. This was the pioneer of a large number of vessels sailing to the Patagonian coast for sea-elephant oil. That coast seems to have been abandoned about 1820 for the South Shetland Islands, which for seventeen years furnished many cargoes to the fur-sealers sailing from Stonington. Since 1837 Desolation or Kerguelen Island has furnished the great bulk of the sea-elephant oil. Heard Island has furnished many cargoes since 1857, but on account of the exposed situation of that island vessels do not usually go there when a cargo is obtainable elsewhere. South Georgia, South Shetlands, and the Patagonian coast also have many sea-elephants and are occasionally visited by the hunters, but the great bulk of the catch has been obtained at Desolation Island.

Although the taking of sea-elephant oil originated with the Nantucket whalers, it has been peculiarly a New London industry since 1820, the neighboring ports of Stonington and Mystic furnishing a number of vessels during certain seasons. From 1820 until the present time 94 per cent of all the voyages have been made by vessels from these three ports, and 80 per cent have been made by the New London vessels. The fleet was largest in 1858 and 1859, 18 vessels, with an aggregate tonnage of 4,527 tons, being employed in 1858, and 20 vessels, with 4,461 tons measurement, in 1859.

The last vessel to return with a cargo was the brig *Leonora*, which arrived in 1902 with 2,900 barrels of oil and a quantity of hides. In 1900 the schooner *Robert S. Graham* brought in 2,600 barrels of oil and 70 hides, the oil selling at 38 cents per gallon and the hides at $2 each. In 1898 the bark *Swallow*, of Boston, returned with 2,000 barrels of oil, the product of 4,000 sea-elephants secured during the three months of the summer of 1897–98.

According to Capt. James W. Budington, of Groton, Conn., to whom we are indebted for most of the subjoined data relative to methods of capture and of oil-rendering, sea-elephant blubber is somewhat whiter than whale blubber, and ranges in thickness from 1 to 8 inches, according to the size and condition of the individual. It is thickest on the males, especially the "March bulls," from the neck of which 10-inch blubber has been secured. On the cows the thickness is from 2 to 3 inches and on the pups it is much less.

Much variation exists in the yield of oil from sea-elephants. The quantity secured from the March bulls taken shortly after they land is very large, amounting sometimes to 220 gallons from a single individual. Only a small number of this variety is secured. The November bulls yield from 100 to 120 gallons each early in the season, but after remaining on the shore for months, abstaining from food, they become emaciated, and yield scarcely more than 30 gallons. The product from females and pups is much smaller, some of the pups yielding only 4 or 5 gallons, especially when the season is well advanced, thus greatly reducing the average take, which probably does not exceed 12 or 15 gallons to each individual throughout the season. The cargo of 2,000 barrels secured by the bark *Swallow* in 1898 represented an average yield of 15.75 gallons per individual. Another cargo of 600 barrels, secured late in the season when the animals were in poor condition, represented the capture of 2,000 individuals.

The hunters endeavor to arrive at the islands as soon as the sea-elephants come ashore, usually the early part of November. The animals are found in herds or pods varying in number from 20 to 300 or more each, the favorite resort apparently being the numerous mud puddles. The largest and fattest are selected for killing, females and pups being unmolested if a sufficient number of large bulls is obtainable. The bulls are sometimes of enormous size, frequently 16 feet or more in length and 12 feet in circumference. The females are very much smaller, probably one-third the size of the bulls, but generally they are fatter for their size and their blubber is somewhat more yellowish. A number of seals of various species, especially the leopard-seal, are frequently met with and are driven out and slaughtered when sea-elephants are scarce; otherwise they are not molested, as they are not nearly so fat as the sea-elephants. Rifles and lances are the weapons commonly employed in the slaughter.

After killing a sufficient number the skin is roughly and quickly gotten out of the way and the blubber taken off in horse-pieces of suitable size for handling, say about 18 inches wide and 2 feet long, or less, this varying according to the thickness. The horse-pieces are strung on a pole and carried down to the shore, 15 or 20 making a good load for two men. At the shore the pieces are strung on raft-tails or ropes, 18 or 20 feet long, and towed to the ship. The long immersion in the water soaks off the sand and blood and cleanses the blubber.

The oil is extracted in much the same manner as in the whale fishery. The blubber is lifted on deck, cut into strips about 2 inches wide, and these are minced or partly cut through at intervals of about 1 inch and placed in try-pots, precisely as in the case of whale blubber. The cooking is only slight, much less than applied to the whale blubber, being continued for only about 15 minutes. The fuel consists of the dry scrap, supplemented with wood procured on the islands. After cooking for about 10 or 15 minutes and dipping off all the oil on the surface, the scrap is placed in a receptacle and subjected to considerable pressure, in the manner customary in the right-whale fishery already described. The oil does not run as freely from the blubber as whale oil; especially is this the case with the fat of the pups, which is fine-grained and "milky." Occasionally the oil is tried out on shore in a manner similar to that aboard the vessel, the try-works being erected near a running stream wherein the blubber may be washed free from sand and blood.

The product from all the southern islands from 1803 to 1900, inclusive, amounted to upward of 242,000 barrels, or 7,643,000 gallons, worth $5,420,000, apportioned as follows:

Decade ending June 30—	Barrels.	Decade ending June 30—	Barrels.
1810	2,500	1860	62,754
1820	9,000	1870	48,783
1830	9,500	1880	34,015
1840	23,000	1890	8,150
1850	38,000	1900	6,300

This oil is classed as whale oil and has been included in the product of that article, as shown on page 204, although it is usually sold for 3 or 4 cents per gallon more than the latter. The process of refinement is precisely the same as in case of whale oil, the foots yielded amounting to 5 or 6 per cent of the original bulk. Its principal use has been in the dressing of morocco leather.

WALRUS OIL.

When the whalers entered the North Pacific, walrus were found in great numbers, but were not disturbed, owing to the abundance of cetaceans. At times when whales were not to be found and many walrus were met with, a number of these were killed and the blubber tried-out, and this practice extended with the increasing scarcity of whales. About 1863 the northern whalers began to make a business of taking walrus during the first part of each season, some vessels securing upward of 500 barrels. Mr. A. Howard Clarke estimated that, during the eleven years ending in 1880, 1,996,000 gallons of walrus oil were secured by the whaling fleet in the North Pacific, the value of which was about $1,000,000.[a] The hunt was carried on with much waste. It is stated that on one occasion 1,600 walrus were killed on a sand bar in one day, and the whole number were washed into the sea by an unusually high tide and thus lost. Since 1880 the quantity secured has decreased, and at the present time not more than 100 walrus are obtained annually by the entire North Pacific fleet, representing an oil product of less than 2,000 gallons.

The blubber of walrus averages 2 or 3 inches in thickness, and usually it is is not detached from the skin until after the removal of the latter from the carcass. In case the hide is to be saved for tanning, the pelt is placed on a flensing board or platform, skin-side down, and the blubber is cut off in irregularly shaped horse-pieces of 10 or 15 pounds' weight each. During the height of the Pacific walrus fishery the hides were not used, and then the skin and blubber were removed from the animal in horse-pieces of convenient size, say about 10 by 14 inches, and these were separated aboard the vessel.

The horse-pieces are next prepared for the try-pots. They are placed on the mincing-horse and scored or minced precisely in the manner described in the treatment of whale blubber. The cooking must be

[a] The Fishery Industries of the United States, Sec. V, Vol II, p. 318.

slow, the pot being well spaded during the boiling to prevent the blubber from sticking and burning to the bottom or side.

The individual yield of oil varies considerably, walrus being much fatter in some years than in others. But in general it is small in proportion to the size of the animal, an individual weighing 1,500 pounds yielding only as much blubber as a seal of 600 pounds. An old bull weighing 2,500 pounds might yield 600 pounds of blubber, but it is seldom more than 450 pounds, and the average for the entire catch is probably not in excess of 200 pounds. Nor is the blubber as rich in oil as is that of the seal, 100 pounds of walrus fat yielding an average of 10 gallons of oil, whereas an equal weight of seal blubber yields about 11¼ gallons. In 1869 the ship *Progress* secured 565 barrels of oil from 700 walrus, an average of 25.42 gallons each. This was considered an extra good yield. One thousand walrus secured by the ship *Onward* in 1874 yielded 600 barrels of oil, and 2,000 taken by the *Mercury* in 1877 produced 1,100 barrels of oil.[a]

Walrus oil is usually of a yellowish color, with greater fluidity than seal oil, and has a specific gravity of 0.925 at 59° F. according to Brannt. It is more difficult to refine than the oil of the right whale. Although classed roughly as "whale oil" in the United States, it is usually kept separate from the oil of the right whale and sold for 2 or 3 cents per gallon more than the latter. It is stated that the product in the fisheries north of Europe is generally mixed with and sold as seal oil.

OIL FROM SEA-LIONS AND FUR-SEALS.

The blubber of the sea-lion is from 1 to 4 inches thick, and that on each individual yields from 6 to 20 gallons of oil. Thousands of barrels of this oil were formerly secured along the coast of California, but owing to the decrease in number of these animals, comparatively little is now prepared. It is somewhat inferior to sea-elephant or walrus oils, but much better than fur-seal oil.

A number of years ago when whale and seal oils were quoted above a dollar per gallon, there was some sale in this country for oil prepared from the blubber of the fur-seal; but owing to the small quantity available, the cost of production, and the technical inferiority of the product, there has been no market for it for many years. The blubber may average 1½ inches in thickness, varying according to the time the animal has been on shore. The oil is of a yellowish-brown color, gummy, and possesses an offensive odor. According to the terms of the lease of the fur-sealing rights on the Pribilof Islands to the North American Commercial Company, the United States Government is entitled to receive 50 cents per gallon for all fur-seal oil produced there. This is in excess of the market value of the article, leaving nothing for the cost of production and transportation, and, needless to state, there is no revenue whatever from this item.

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[a] The Fishery Industries of the United States, Sec. V, Vol. II, p. 318.

OIL FROM LIVERS OF COD AND RELATED SPECIES.

SOURCES OF SUPPLY.

Cod oil is obtained from the livers of several species of fish. In its pure state it is obtained from the livers of cod only, but those of haddock, pollock, hake, cusk, ling, and even shark and dog-fish are also used. The last two, however, are not generally recognized as cod-liver oil sources, but are used mainly for purposes of adulteration. In the trade the term "cod-liver oil" is used in a restricted sense, applying to the best quality of oil made from choice fresh cod livers and intended for medicinal purposes; all other oil manufactured from livers of cod and related species, not of quality fitting it for medicinal uses, is designated as "cod oil" or "curriers oil."

Cod oil is of comparatively recent development as an article of commerce, although it was used locally previous to the nineteenth century. On account of the ease with which whale and seal oils could be secured, cod oil was not in great demand for technical purposes until after the beginning of the nineteenth century. There is nothing to indicate that in the early cod fisheries on the American coast the livers were utilized to any great extent for oil-rendering, and the same is true of the early fisheries prosecuted in the seas north of Europe. The small demand for medicinal and for technical purposes was readily supplied by a few fishermen of economical and industrious habits, but their output bore only a small proportion to the total quantity obtainable. Curriers used a small quantity, and some was employed on fruit trees for destroying insects and fungous growth.

Early in the nineteenth century the production of cod oil became quite general on the New England coast. The livers were placed in butts and permitted to decompose, and the oil exuding therefrom was dipped off from time to time. Not only was this done by the fishermen who landed their catch ashore each night, but also by the "bankers" who carried butts and barrels for the purpose. As the tanning industries developed, the output of cod oil increased, and by 1845 practically all the livers secured were rendered into oil. The output, however, did not keep pace with the demand and during the sixties the price went up to $1.25 per gallon. Mr. Eben B. Phillips, of Swampscott, was one of the pioneer dealers in this product and amassed a fortune in the business.

Gradually other substances were introduced as materials for dressing leathers, especially sod oil, degras, and compound greases, the cheapness of which has greatly affected the market for cod oil. The substitution of machine stuffing for hand stuffing in leather-dressing and the introduction of chrome tannage have also reduced the demand. However, the market for medicinal oil has constantly increased up to the present time. As a result of these combined uses, the rendering of the livers into oil is almost coextensive in point of territory with the prosecution of the cod fisheries. The only exception is in certain market fisheries where the men do not have time to handle the livers properly.

The market price of medicinal oil frequently falls so low that it pays the manufacturer better to prepare only low-grade oil for leather-currying, soap-making, and the like. The common oil is, of course, turned out at much less cost than the white, odorless, medicinal variety. The stearin, which is worth comparatively little and forms a considerable portion of the oil, need not be removed from the manufacturing grade. The use of the expensive refining plant required for medicinal oil is also obviated. And, finally, there is a very considerable saving in the cost of packing, as the ordinary oil is shipped in old petroleum barrels, while for the finer grade expensive new casks or metallic drums have to be provided. For several seasons there was a large overproduction of low-grade medicinal oil, and three years ago it sold in New York as low as 50 cents per gallon. Curriers' oil does not often sell for less than 30 cents per gallon, and the demand for it is fairly constant.

The principal sources of cod-liver oil are the coast of North America from Labrador to Cape Cod, Norway, Scotland, Iceland, the Pacific coast of the United States, and, during recent years, Japan. On account of its greater value, efforts are made on all these coasts to produce the light oil for medicinal purposes; but in most sections, on account of unfavorable natural conditions, only dark or low-grade oils are practicable. Medicinal oil is prepared chiefly on the coast of Norway and to a limited extent on the Massachusetts, Maine, Nova Scotia, and Newfoundland coasts.

Owing to the favorable conditions under which the cod fishery is there prosecuted, Norway ranks first among countries producing medicinal oil, the annual product amounting to about half a million gallons. The fishing-grounds are concentrated and situated very near the coast, so that the fish are landed in quantities within a few hours after capture and before decomposition of the livers has set in. Furthermore, the temperature during the fishing season is very low, being close to the freezing point, and this tends to retard putrefaction. In no other part of Europe are the conditions favorable for producing medicinal cod-liver oil. A large quantity of low-grade or curriers' oil is also produced in Norway, amounting probably to as much in bulk as the medicinal oil.

In Newfoundland much attention has been given to the production of medicinal oil, the manufacturers endeavoring to make it as near like the Norwegian product as possible. Freezing machines were introduced and a considerable quantity of white, odorless, and non-congealing oil was made. The general experience, however, was that the difference in market value of the medicinal and the trade oils was not sufficient to warrant the extra care and the additional expense. At present comparatively little medicinal oil is produced in Newfoundland. The livers are mostly all converted into curriers' oil, resulting in an annual output of about 1,100,000 gallons.

The situation in Nova Scotia is pretty much the same as in Newfoundland, although much less oil is produced, the annual output probably amounting to about 20,000 gallons of medicinal oil and 250,000 gallons of curriers' oil.

The bank fisheries of America are situated too far from the land to permit the use of the livers in making medicinal oil; but the shore fisheries during autumn and winter, when the spawning fish visit the coast, furnish good material for that purpose, resulting in the preparation of about 25,000 gallons each year. Much of this is of superior quality, and unsurpassed for color and pleasantness of odor and taste. The livers taken in the bank fisheries are practically all used in preparing curriers' oil, the total annual product of which is about 450,000 gallons.

Considerable cod oil has been exported from Japan for medicinal purposes, but that received in this country has not found favor with the wholesale druggists and has usually been sold for currying. The first shipment of 200 cases, made in 1889, sold at 35 cents per gallon. We have no data bearing on the cod-oil output in Japan, but with an annual catch of 7,000,000 fish it probably does not exceed 100,000 gallons.

The entire product of cod oil is estimated as follows: Norway, 1,200,000 gallons; Newfoundland, 1,100,000 gallons; Dominion of Canada, 300,000 gallons; United States, 475,000 gallons; Japan and all other countries, 450,000 gallons, making a total of 3,525,000 gallons of all varieties of oil produced from the livers of cod and related species. Of this quantity about 650,000 gallons represent the output of medicinal oil, and the remaining 2,875,000 gallons is curriers' oil.

DESCRIPTION OF LIVERS AND THE RESULTING OILS.

The following description of livers and the account of rendering them into oil are the results principally of an inquiry made by the writer on the New England coast in October and November of 1901. Most of the oil factories were visited and many of the principal fishermen were interviewed. The writer is especially indebted in this connection to Mr. A. W. Dodd and Messrs. George J. Tarr & Sons, of Gloucester, and to Messrs. Geo. H. Leonard & Co., Mr. John B. Baum, and Mr. F. F. Dimick, of Boston.

Normal cod livers in good condition are of a cream color, uniform texture, and very soft, so that the finger may be readily pushed quite through them. Lean livers are frequently found. These are tough and dark in color, the toughness and darkness increasing with the degree of leanness, the color finally reaching a dark brown hue. Lean livers furnish very inferior oil, as well as only a small quantity. A certain percentage of the livers are diseased. This condition is usually evidenced by a greenish color or by the presence of colored spots, which increase in size and number as the disease advances until the entire organ is affected. Diseased livers are never used in the preparation of medicinal oil, but are freely utilized in making curriers' oil. The size of the livers varies considerably, but averages about 12 inches in length and 2½ inches in thickness in the center, the weight being somewhat over half a pound. Some livers weigh only 1½ ounces each, and an instance is recorded by Dr. F. P. Moller of one taken in the Lofoden fishery which weighed 11 pounds, its length being 43 inches and its greatest thickness 6½ inches.

Considerable difference exists in the size, shape, and general appearance of livers of the cod family. Cod livers are elongated, with the large end near the dorsal fins and the small end toward the tail. Haddock livers are much shorter than those of cod, and have little frills or scallops on the edges, whereas those of cod are smooth. Haddock and pollock livers are of a cream color, similar to those of cod, while cusk and hake livers are of a light straw color. The livers of all *Gadidæ* are usually mixed together by the fishermen, but in the season when any particular species is abundant the livers of that variety are kept separate. On the New England coast of the United States cod livers predominate during the coldest months and pollock are taken mostly in October and November.

In the United States fisheries livers represent about 3½ per cent of the weight of the fish, and they yield about 40 per cent of their weight in oil; consequently 100,000 pounds of fish yield about 180 gallons of oil. On an average, from January to June, 1,000 pounds, dressed weight, of cod yield about 1 bucket, or 2½ gallons, of livers, and during the latter half of the year the yield increases to 4 gallons per 1,000 pounds of dressed fish. A bucket of these livers yields 5 or 6 quarts of oil on an average throughout the year, except that in the spring the product is sometimes reduced to about 3 quarts to the bucket of livers. The yield of hake livers per 1,000 pounds of fish is somewhat larger than in case of cod, but the quantity of oil secured from a bucket of livers is about the same. Haddock yield best from October to December, and during the spring and summer the result is small, sometimes not over 1½ quarts to the bucket. On account of the small yield and the conditions surrounding the haddock fishery, only about 15 per cent of the livers of that species are saved in the New England fisheries. At present pollock do not yield so much as cod, averaging about 5 quarts to the bucket of livers throughout the year; but previous to ten years ago on the New England coast they usually yielded 7 quarts of oil in the fall.

In the Lofoden fishery, according to the official returns, ordinarily 20 to 30 livers are required to produce 1 gallon of medicinal oil. During some seasons the livers are quite fat, and 8 to 12 are sufficient;

but when they are very lean, as was the case in 1896, for instance, from 36 to 56 are required for 1 gallon of oil. In that fishery the livers are fatter at the beginning than at the end of the season. They average about 55 pounds to the 100 fish; but during the years when they are unusually lean it is much less, as in 1883, when the average weight of 100 livers was only 12½ pounds. Usually at the Lofoden Islands 250 to 1,100 cod give 1 barrel of livers, and 2 barrels of livers yield 1 barrel of oil; but in 1883 from 700 to 1,100 fish were required for 1 barrel of livers, and 4 or 5 barrels of those were necessary for 1 barrel of oil. Aside from the benefits accruing from the fatness of the livers, anything gained in quantity is always lost in quality in the preparation of medicinal oil.

While it is somewhat difficult to distinguish among the oils made from the livers of the various members of the cod family, yet ordinarily there are certain distinctive characteristics apparent to the skilled oil-refiner. Cod oil is of a greenish yellow color and usually has less pressings or foots than any of the others. Hake oil is almost white, but that made from hake taken on certain grounds has a pinkish color, which may be removed by filtration through a mineral earth. Pollock oil is distinguished by a slightly bitter taste and has a faint reddish cast. Its weather-test is rather lower than that of cod oil, especially when it has been slightly overcooked in the rendering.

Oil extracted from perfectly fresh cod livers is light and odorless, and, owing to its extensive use in medicine, is known as medicinal cod oil or "cod-liver oil." According to the extent of decomposition of the material before the extraction of the oil, the color ranges through all shades of yellow and brown to very dark brown, this color being attributed to the decomposition of the hepatic tissues and fluids. These dark oils are of two general grades; one, the brown, which is inferior to the light-brown or medicinal oil, but is frequently used for such; and the other, the dark-brown or curriers' oil, is the poorest grade prepared, and is exclusively used for technical purposes. Probably it would be better to say that there are two principal varieties of oil, the medicinal and the curriers', and that unusual market conditions may result sometimes in the employment of the poorest of the medicinal oil for technical uses or the best of the curriers' oil for officinal purposes.

The medicinal value of cod-liver oil was known centuries ago among the Laplanders in northern Europe, the descendants of the Norsemen in Iceland, and the Eskimos in Alaska. The use of the oil gradually extended in Europe during the eighteenth century, being a popular home remedy among many seacoast communities and used empirically by physicians. Percival and Bardsley in 1782 recommended its use in cases of gout and chronic rheumatism. In 1841, J. Hughes Bennett, of Edinburgh, published a pamphlet on its medicinal qualities, strongly recommending it in many cases, and this had much to do with the general introduction of the oil as a medicine in England and America. From that time to the present it has held a prominent place in the confidence of physicians, and is regarded as a remedy of the highest value in diseases which are marked by malnutrition, pulmonary tuberculosis furnishing the most frequent occasion for its employment.

Few subjects connected with materia medica have provoked so much discussion as the comparative merits of the light and the dark grades of cod-liver oil. Formerly, the brown oil was considered superior in efficiency to the paler sorts, and was generally favored for medicinal purposes. In recent years, however, chemists have claimed that analysis does not reveal any substance in the dark oil which would account for greater beneficial activity than the paler grades are supposed to possess. While many physicians yet recommend the brown oil, the drift of public opinion seems to favor the pale oil, and certainly it is more popular with the patients. A discussion of these rival claims is beyond the scope of this paper. For information on the subject reference is made to A. Gautier and L. Morgues' *Les Alcaloides de l'Huile de Foie de Morue*, Paris, 1890, and to F. P. Moller's Cod-Liver Oil and Chemistry, London, 1895.

PREPARATION OF MEDICINAL OIL.

On account of its greater value, it is generally desirable to convert the livers into medicinal rather than curriers' oil. For this grade the livers must be perfectly healthy and fresh, all diseased, lean, or slightly decomposed ones being rejected. On account of the necessity for having the material perfectly fresh, it is impracticable to manufacture good medicinal oil during the warm months, and even in cold weather the sooner the extraction of the oil is begun the better the grade secured. Furthermore, it is desirable that the livers should be from cod only, those from other species being excluded. This, however, is not the uniform practice, and the livers of haddock, hake, cusk, etc., are sometimes thrown in with those of cod. It does not appear that American manufacturers are any more prone to this adulteration than those of other countries. Possibly oil from other livers may be equally as efficient as cod, yet until that fact is demonstrated beyond a doubt those should be rejected.

On the New England coast of the United States, the best medicinal oil is made from livers collected from the shore fishing boats, which land their catches almost daily, and thus deliver them in fresh condition. From May to October only a small amount of the best oil can be made, because of the scarcity of fish along shore during that season and the danger of the material putrefying before reaching the oil factory. From October to May the shore fishermen carefully save the livers in clean barrels, and if landed within a day or two they are sold for making medicinal oil, but if softened or damaged in any way they are used only for curriers' oil.

Second only to the careful selection of the livers is the observance of perfect cleanliness in the entire process of rendering the oil. The livers are thoroughly cleansed from blood and other impurities by washing in several waters, and the gall sacs and attached membranes are removed. Throughout the entire process of expressing and refining the oil, all tanks, receptacles, and the like are kept free from putrefying texture. Some oil-renderers chop the livers into small pieces for the purpose of securing a greater quantity of oil, but this is by no means the general practice.

There are two general methods of cooking the livers, viz, (1) by wood or coal fire under a water bath, and (2) by the use of steam. The first-named is the oldest in use and is also the most economical where the quantity of material to be rendered is small. Two metallic receptacles or pots are provided, one, in which the livers are placed, fitting loosely in the other, with 2 or 3 inches of space between, and the larger one set into a furnace so that a fire may be built beneath. The space between the two receptacles is filled with water during the process of cooking, and this is renewed as required. A fire is built in the furnace and the water brought to a boiling point, thus imparting a moderate heat to the contents of the pan. In order that the cooking may be expeditious the pan should be small, holding not over 50 or 60 gallons. Furthermore, it should be narrow, for greater ease in stirring and to minimize the oxygenizing of the oil. Owing to the cheapness of this apparatus it is quite popular with those who try-out only a small quantity of oil.

In the second method of cooking, steam-jacket kettles are used, the steam-chest being provided with a self-acting safety valve by which the pressure can be controlled and regulated. Within the kettle there is usually a stirring apparatus operated by steam power. By means of this apparatus the cooking may be performed much more expeditiously than with the former one, as any desired temperature may be secured and uniformly maintained.

In order to prevent, so far as practicable, the formation of hydroxylated compounds, the alleged cause of the unpleasant eructations or gastric disturbance from which many persons suffer after taking the oil, there was introduced in Norway in 1892 an apparatus for its extraction without permitting oxidation to take place. This apparatus is so contrived that the air can be completely excluded from it during the whole operation, the process being conducted in a current of carbonic acid gas from the moment the livers are placed in the apparatus until the oil is sealed up in the market receptacles.

Whatever process of cooking may be adopted, it is desirable that the oil be forced out of the hepatic cells in a short space of time and by a moderate degree of heat only. The length of time usually allowed for cooking is from 2 to 3½ hours, and at no time should the temperature exceed 200° F. The duration of the cooking process is an item of great importance in the preparation of medicinal oil, and on it is dependent in a large measure the quality of the product. In order to get the largest possible amount of oil, some producers cook the material entirely too long, notwithstanding that beyond a certain point anything gained in quantity is at great sacrifice of quality. In producing a choice grade of oil, the livers must not be exposed to heat any longer than absolutely necessary.

The longer the cooking is continued, the greater the quantity of acids and decomposed albumen extracted from the hepatic tissues. These substances render the oil strong and unpalatable, and detract from its appearance. Further, the longer the livers are exposed to heat, the more oxygenized the oil becomes, making it irritative to the stomach and causing disagreeable eructations. For the production of the clearest and lightest medicinal oil, the livers should not be exposed to a greater heat than 160° F., and that only for about 45 minutes. This, however, is not feasible because the quantity of oil produced in that case would be too small to make the business profitable. The time must, therefore, be extended as far as practicable without detracting too much from the quality. But in order to produce a first-class medicinal oil, the length of the cooking should on no account exceed 2½ or 3 hours, provided the capacity of the liver-receptacle does not exceed 50 gallons.

On completion of the cooking process, the mass of livers and oil is allowed to cool. The oil rises to the surface and is drawn off and filtered. The liver magma is subjected to pressure and yields a quantity of dark oil suitable only for curriers' use. The residuary mass of hepatic tissues is dried and used for fertilizing purposes. Its market value in Gloucester and Boston was formerly $6 or $8 per ton, but at present it is only about $3 per ton.

Filtering the medicinal oil is accomplished by running it through a box fitted with several straining frames covered with cloth of successive degrees of fineness and with a tap at the bottom through which the oil can be drawn. Or the filter may consist of one or two light canvas bags fitted inside of a white moleskin bag with the smooth side out. But in filtering the dark oil, it is better to run it through charcoal.

In the process of refining, the medicinal oil is placed in small receptacles, as 5-gallon cans, and refrigerated either naturally in cold weather or by means of ice and salt, as already described in the process of refining sperm oil. When thoroughly chilled and granulated the congealed oil is compressed through cotton or canvas bags holding about 4 gallons each, for the purpose of extracting the foots, white pressings, or stearin. Two or three bags are placed regularly upon a substantial wooden platform or table provided with grooves for conducting the outflowing oil to a receiving tank. On this row of bags there is laid a thin iron plate or slab, then another layer of bags, and so on, layer after layer, until 15 or 20 bags have been piled up. Heavy pressure is then applied and continued 10 or 12 hours, when practically all the oil drains from the bags, leaving behind an unctuous mass of the consistency of tallow or butter, composed of nearly pure stearin, with a small quantity of débris and fibers. The quantity of stearin removed depends on the temperature at which the congealed oil is pressed. At the usual temperature of 28° to 30° F., about 1¼ pounds are removed from each gallon of crude oil, the latter weighing about 7½ pounds. The stearin is sold at 5 or 6 cents per pound and is used by soap- and candle-makers and as a tallow substitute in leather-dressing.

Medicinal cod-liver oil should be exposed to the air as little as possible during the whole process of extraction, filtering, and pressing; and as soon as the last operation is completed, it should be placed in shipping packages and stored in a cool place until marketed. This oil has a greenish tint, is almost tasteless and odorless. For the purpose of making the oil lighter in color, it is sometimes bleached by exposing it in a thin layer to the sun's rays for an hour or more. Bleaching medicinal oil is an objectionable process, resulting in no particular benefit, and, on the contrary, is productive of much harm when long continued.

The style of the package in which medicinal oil is placed is of much importance. Since cod oil readily acquires the flavor of wood and becomes discolored thereby, glass or metal receptacles are preferred. Tin is much the best material when glass is not used. The Norwegians use tin-lined barrels. When wooden barrels are employed, white oak is preferable to other varieties.

During recent years many manufacturing pharmacists have prepared cod-liver oil in such a manner as to overcome the disagreeable flavor and the even more objectionable gastric disturbance which so frequently follows its use. These products are mostly in the form of emulsions, gelatinous capsules, with sirups, creams, jellies, etc.

Furthermore, some pharmacists remove the so-called "active principles" in cod-liver oil, the oil itself being subsequently used for technical purposes. These "active principles" are extracted by means of an alcoholic menstruum, then concentrated by evaporation and dissolved in wine. They are placed on the market under various proprietary names. In some factories the fresh livers, rather than the oil, are used in manufacturing the "active principles," since the latter are alleged to occur in far greater abundance in the liver tissues than in the oil. According to an account given by the proprietor of one of these preparations, the livers are thoroughly minced in a steam-power chopping-machine and macerated for several days in large stirring machines of special design, a menstruum being employed consisting of diluted alcohol containing a small quantity of citric acid. The extract is then drawn off and concentrated in vacuo at a temperature of 40° F. When the liquid is reduced to about the consistency of extract of beef, it is removed from the vacuum pan, assayed for alkaloidal contents, and then dissolved in wine in proper proportion to represent the "active principles" contained in one-fourth its bulk of cod-liver oil.

Only about 10 per cent of the cod-liver oil consumed in this country is produced in the American fisheries, the great bulk of it being imported from Norway. As already shown, the product of medicinal oil in the United States fisheries is only about 25,000 gallons each year, whereas the imports usually exceed 200,000 gallons annually, and in some years exceed 500,000 gallons.

The following summary, showing the total quantity and value of cod-liver oil imported for consumption into the United States during a series of years, is compiled from the United States customs returns:

Statement of the quantity and value of cod-liver oil imported into the United States during a series of years.

Year ending June 30—	Gallons.	Values.	Average value per gallon.	Year ending June 30—	Gallons.	Values.	Average value per gallon.
1880	315,910	$152,441	$0.483	1891	248,894	$98,865	$0.397
1881	516,657	236,763	.459	1892	202,959	115,577	.569
1882	302,137	162,563	.538	1893	190,432	99,709	.524
1883	218,716	159,271	.733	1894	209,865	99,318	.473
1884	412,135	275,078	.667	1895	207,145	131,804	.636
1885	221,030	153,945	.696	1896	179,660	203,588	1.133
1886	115,454	67,652	.586	1897	179,677	170,610	.961
1887	130,296	69,326	.532	1898	201,582	116,913	.582
1888	165,633	78,233	.472	1899	233,176	127,074	.545
1889	287,183	81,589	.284	1900	276,940	136,666	.494
1890	267,555	86,476	.323	1901	235,749	137,715	.584

PREPARATION OF COD OIL FOR TECHNICAL PURPOSES.

The methods of extracting cod oil for currying and other technical purposes does not differ essentially from the extraction of medicinal oil, the principal difference being the use of all livers secured, the absence of extreme cleanliness, and the greater putrefaction or the more extensive cooking of the material. Considerable common oil is also expressed from the livers cooked for medicinal oil after the latter has been dipped or skimmed off.

The original method of extracting cod oil, and the most common one at the present time, is by putrefaction. In the Grand and the Western banks fisheries, during the process of dressing the fish, the livers are collected and placed in liver-butts. These butts are characteristic of vessels engaged in a salt-fish trip; in the market fishery for cod, haddock, etc., their place is taken by upright barrels or gurry kids. There are two liver-butts on each vessel; they consist of large casks, with a capacity for about 150 gallons each, mounted horizontally on skids immediately in front of the house and lashed securely to the deck. On the top, in the bilge of each cask, there is a large square opening, covered with a piece of tarpaulin securely fastened at one end, through which the livers are dropped into the cask. As the oil cells in the livers are broken by decomposition and by their constant churning with the rolling of the vessel, the oil rises to the surface, and is bailed off from time to time to make room for fresh livers. The oil dipped or bailed off, known as "sun-tried oil" or "top dippings," is placed in barrels, while the refuse blubber remains until the vessel reaches port, when it is boiled to extract the remaining oil.

The "sun-tried oil" represents probably 20 to 40 per cent of the total quantity of oil produced. It is superior to that rendered by cooking, being heavier bodied, and does not chill so quickly, the quantity of foots being much less. The oil first obtained from the butts is of a light yellow color, and formerly was used to some extent for medicinal purposes. As putrefaction advances, the color deepens to a brownish shade, and that extracted by cooking the decomposed livers ashore is very dark, with a greenish fluorescence in reflected light. In small quantities it shows a brown color, and therefore is known as brown oil. None of this oil is used for medicinal purposes, owing to its strong odor and flavor and the abundance of decomposed tissue contained in it. The market fishermen, who return to port every two or three weeks, save the livers and sell them to the oil-merchants at 25 or 30 cents per bucket of 2½ gallons each.

Of the several grades of cod oil used for technical purposes, the best is that made from livers taken in the Grand Banks fisheries; this is known as "Newfoundland cod oil" and sells for about 2 cents per gallon more than "domestic cod oil" made from livers taken on Western and Georges Banks. "Straits oil" and "bank oil" were formerly well-known grades of cod oil, but these are now made entirely from menhaden. The low grades of cod oil are strained or filtered in the same way as the medicinal oil, 100 gallons yielding 15 or 20 pounds of foots, worth about 4 cents per pound.

Cod oil is used for currying mostly in New York, Pennsylvania, Ohio, Michigan, Illinois, and Wisconsin, only about 20 per cent being used in New England. Some of the best quality is exported. Small quantities are also used for soap-making and in various compounds.

The following table (based upon the closing quotations each week for prime domestic oil, as contained in the New York trade journals) shows the lowest and highest selling prices for cod oil for technical purposes in the New York market during each year from 1891 to 1902:

Year.	Price per gallon.	Year.	Price per gallon.
1891	$0.32 to $0.43	1897	$0.24 to $0.30
1892	.37 .39	1898	.28 .35
1893	.36 .39	1899	.32 .34
1894	.28 .38	1900	.30 .37
1895	.27 .30	1901	.31 .38
1896	.24 .27	1902	.33 .39

OIL FROM LIVERS OF SHARKS AND RELATED SPECIES.

The livers of various species of sharks and allied fish are suitable for oil-production, giving rise in some localities to important fisheries. The principal species used are the sleeper shark, otherwise known as the nurse, ground, or gurry shark (*Somniosus*), taken in northern waters from the Arctic seas southward to Massachusetts, Oregon, and France; the basking or bone shark (*Cetorhinus*), formerly quite numerous, but now taken to a less extent, north of Europe and on the coast of Peru, Australia, California, etc.; the oil shark (*Galeorhinus*), on the Pacific coast, especially in California, and the dog-fish (*Squalus*), distributed throughout both hemispheres. In addition to these, nearly every species of shark yields livers suitable for oil-rendering.

The sleeper shark appears to be the most important species so far as oil-making is concerned. This is a large fish, individuals ranging in length from 12 to 25 feet. The livers yield from 12 to 50 gallons of oil each when taken in the autumn, but in the spring and summer they are almost worthless for oil purposes. On the New England coast this species is much less numerous than formerly, but it is reported in abundance on the Pacific coast of the United States.

During the autumn the taking of the sleeper shark is a somewhat important branch of the minor Icelandic fisheries, and it is also taken by the Russians off the Kola Peninsula. The most important fishery, however, is off the coast of Norway, and especially between Lofoden Islands and Bear Island, in depths of from 150 to 200 fathoms of water. The Norwegians employ small vessels of 20 to 35 tons, carrying about six men each, the season beginning the first of October and ending in February. The fish are taken by means of large, strong hooks baited with fish or salted seal blubber.

The basking shark, probably the largest of all sea fishes, has been taken very extensively for the oil contained in the livers, but owing to decrease of the species the quantity now secured is much reduced. This fish attains an enormous size, the prevailing length of fully-grown individuals being 30 to 35 feet. The liver is proportionally large, yielding ordinarily from 80 to 200 gallons of oil and occasionally as much as 400 gallons. Indeed, a yield of 600 gallons has been reported from a single individual, but this has not been satisfactorily established. This species differs from other sharks in not being voracious. Therefore it must be taken with harpoons rather than with baited hooks. There is said to have been quite an extensive fishery for it on the Massachusetts coast about the middle of the eighteenth century. According to Captain Atwood, writing in 1880, "Not more than half a dozen have been caught near Provincetown since 1810."

The basking shark is numerous on the coast of Peru and Ecuador, and its capture gives employment to a large number of small vessels, manned by 6 or 8 men each. The American vessels fishing for humpback whales on that coast have occasionally engaged in its capture when whales were not in sight. Capt. George O. Baker, of New Bedford, reports that on one occasion in two days' fishing he secured 125 barrels of shark oil while on the lookout for humpback whales.

The method of taking this fish off the Peruvian coast, according to Captain Baker, is to approach it while it is lying motionless at the surface of the water and to fasten a harpoon in the top of the head forward of the eyes, so as to hold the head up and thus prevent the fish from going down or "sounding," and then the boat approaches and lances it until it is quite dead. It is taken alongside the vessel, a hole is cut in one side of the abdomen, a strap inserted on either side of the incision and the tail hoisted up so as to raise the body somewhat out of the water. A man then enters the abdominal cavity and with a knife cuts out the liver in pieces. These are passed up on deck, minced, as in the case of whale blubber, and placed in the try-pots. After a sufficient length of time the cooked liver-pieces are removed from the pot, placed in a canvas or hempen bag, suspended from aloft, and permitted to drain. Nothing but the oil is saved. A considerable market for it exists in South America, where it is used principally as a body for paints for exterior surfaces. The price is usually 8 or 10 cents per gallon more than that of humpback oil.

The basking shark is taken occasionally on the California coast, the individual yield of oil there averaging about 125 gallons. The same species is also said to be taken in the waters of British India, being harpooned in great numbers by the fishermen of Karachi and other coastal districts.

The common dog-fish (*Squalus*) of the Atlantic coast and a similar species on the Pacific coast are the principal oil-yielding sharks in America. These fish range from 2 to 5 feet in length and from 5 to 15 pounds in weight. They are the great pest of fishermen, destroying nets, robbing fish from the trawls, and committing other depredations.

It does not appear that any important fisheries are organized especially for the capture of these fish, but many are taken incidentally in the shore and Georges cod fisheries, particularly during the spring, and the livers are extracted and thrown in the liver-butts along with those of other fish. The livers are generally of a bluish-gray color, shaped somewhat like those of cod or pollock and are very brittle, breaking readily when lifted.

In Boston and Gloucester dog-fish livers are sold at the same rate as those of cod and related species—viz, 25 to 30 cents per bucket of 2½ gallons. The yield of oil during August, September, and October is about 6 quarts per bucket, but at other seasons it is much smaller.

Because of the small quantity secured, this oil is rarely kept separate from cod oil for currying purposes, and it sells for about the same price per gallon. A distinctive characteristic is its strong odor when warm, resembling that of ammonia; but this may be removed by proper refining. It is estimated that from 10,000 to 15,000 gallons of dog-fish oil are prepared on the New England coast annually, nearly all of which is combined with and sold as cod oil for currying purposes.

Captain Atwood writes:[a]

When I first began to go fishing, in 1810 to 1820, the dog-fish fishery was considered one of the most valuable fisheries that we had around the shore. They appeared here in the spring and were very plenty, and would last a day or two and then all would be gone. Then you would not see a dog-fish again all summer, but about the 10th or middle of September they came to us again, returning South. They would stay into November, and during that time the fishermen would get—a man and a boy—all the way from 8, 10, to 15 barrels of oil. Twenty-five years ago we would occasionally see dog-fish in the summer. The last fifteen years they have been here all summer. During the war they were plenty all summer, and the livers sold for $1 a bucket, and now they are worth but 20 or 25 cents.

On the coast of Oregon, Washington, and British Columbia, large numbers of dog-fish are taken for conversion of the livers into oil, which finds a ready sale, owing to the high cost of other oils on that coast. These fish are reported especially abundant in the vicinity of Queen Charlotte Island, in British Columbia, where they are captured by the Indians. The livers of 100 dog-fish yield 6 or 8 gallons of oil, and the rest of the carcass is utilized for fertilizer. Not only is there an abundance of this oil produced for local use, but also much for export. As long ago as 1876, about 60,000 gallons were exported from Victoria, at a valuation of 40 cents per gallon.[b] The present annual product is said to exceed 200,000 gallons. New York dealers have received some good samples which indicate a very low weather-test, but owing to the duty and freight rates little has come on the Eastern market.

Dog-fish oil has been used on the Pacific coast in competition with other oils with most favorable results, being "equal, if not superior, to oil supplied to Her Majesty's ships by the service, both for lubricating and lighting purposes."[c]

Similar species of dog-fish are taken on the coasts of Norway, Chile, and elsewhere, the fisheries being confined to the summer months and the catch secured with nets as well as with hooks.

Along the Atlantic coast of the United States but little attention is given to the capture of sharks for economic purposes, notwithstanding the many species which occur there in comparatively large numbers. In several localities on the southern coast small fisheries are prosecuted during the winter months, for then the yield of oil is greatest. Among the species taken, other than those above mentioned, are the sand or yellow shark (*Carcharias littoralis*), which

[a] Fishery Industries of United States, Sec. I, p. 674.
[b] Report of the Commissioner of Fisheries of Canada for 1876, p. 346.
[c] Fourteenth Annual Report of the Department of Marine and Fisheries of Canada for the year 1881, p. 214 of supplement No. 2.

attains a length of 5 feet, and yields from 1 to 2 gallons of oil; the leopard or tiger shark, length from 10 to 25 feet, yielding 10 to 20 gallons of oil; the mackerel shark, also known as porbeagle or blue shark, measuring from 8 to 10 feet in length, and the liver yielding from 2 to 7 gallons of oil; the dusky shark (*Carcharhinus obscurus*), which attains a length of 10 feet; the hammer-headed shark (*Sphyrna zygæna*), of 12 or 15 feet in length; the dog shark (*Mustelus canis*), 2 or 3 feet in length; and the thresher shark (*Alopias vulpes*). Some of the large sand and leopard sharks are difficult to secure and their capture gives considerable trouble. They are taken usually by means of harpoons or stout hooks and lines. When taken from a small boat at sea, immediately after the fish has been secured it is lanced to death, the belly is ripped open with a knife, the boat canted, and the large, slippery liver pulled over the side into the boat, and then the carcass is discarded. Many of the smaller sharks are captured with menhaden, in purse seines, and are utilized at the menhaden factories. Owing to the damage which they do to the twine, the fishermen prefer to not set the seines around sharks, but it is difficult to avoid taking a few of them with the menhaden. It is estimated that from 7,000 to 10,000 sharks are captured annually by the menhaden steamers, all of which are converted into oil and fertilizer.

On the Pacific coast of the United States, especially in California, the oil shark (*Galeorhinus*) is utilized. It is 4 to 6 feet in length and weighs from 40 to 70 pounds, the yield of oil from the livers varying from two-thirds of a gallon to 1 gallon each. The fish are taken by means of hooks and lines when they enter the lagoons for reproductive purposes during the summer. The fins of this species are dried and sold for 12 or 15 cents per pound, the Chinese using them in soup-making. Other species of shark utilized on the Pacific coast are the shovel-nose shark, thresher shark, and the man-eater or white shark. The shovel-nose shark was taken extensively along the coast of Humboldt County, Cal., from 1858 to 1868, from 50 to 60 men being employed at times in the fishery. It is harpooned in deep water and taken by means of hand lines in shallow water. This species measures from 6 to 10 feet in length, and the liver of each individual yields 3 to 7 gallons of oil.

There are several species of skates, rays, etc., occurring on the United States coasts which are utilized to some extent for oil-production. Principal among these are the common skate (*Raja erinacea*), the prickly skate (*R. eglanteria*), the smooth or barn-door skate (*R. lævis*), the sting ray (*Dasyatis centrura*), the cow-nose ray (*Rhinoptera bonasus*), etc. Many thousands of these are captured by the menhaden fishermen and utilized at the factories for conversion into oil and guano. Oil from the liver of the torpedo or cramp-fish (*Tetronarce occidentalis*), a large species, which at times attains a weight of 200 pounds, is said to be valued by the fishermen in the treatment of cramp and rheumatism.

Captain Atwood wrote in regard to the oil from the torpedo:

I used to go and look for them for their livers—for the oil. The oil is one of the best lamp oils that I ever saw. It has been used sometimes beneficially in cases of cramp. I got a gallon of oil from one liver. I do not know but I have seen a cramp-fish big enough to make three gallons of oil.[a]

The liver of the saw-fish (*Pristis*), numerous on the South Atlantic and Gulf coasts of the United States, yields from 6 to 18 gallons of oil. It is said that in British Guiana this oil is used for illumination and also for anointing the bodies of the inhabitants. The liver of the elephant-fish (*Chimæra*), which occurs in abundance on the California coast, is large and yields choice oil. This fish has a maximum length of 2 feet and weighs 6 or 7 pounds.

It appears from the above that the yield of oil from individual shark livers ranges from much less than 1 pint in case of the dog-fish and others to the 400 gallons procured from the basking shark. Other than the livers, the carcasses of sharks are slightly oleaginous, and are rarely ever utilized in oil-rendering, but they are of course useful for conversion into fertilizer. The method of extracting the oil from the livers is much the same in all cases. If they are large, they should first be cut in small pieces or minced, as is done with whale blubber. The pieces are then subjected to heat until the cells are thoroughly broken, when the oil is extracted by pressure or it is permitted to drain therefrom. In case the oil is to be used for medicinal purposes great cleanliness is observed, the livers being washed free from blood and the gall bladder removed. A quantity of water is placed in the kettle with the hepatic tissues and the whole boiled gently for an hour or two. On cooling, the oil floats on the surface and is dipped off and stored. It may be refined in precisely the same manner as cod oil.

According to Brannt, shark oils are distinguished as being the lightest of fixed oils, their specific gravities ranging from 0.870 to 0.880 at 59° F., so that a mixture with blubber or other fish oils can at once be recognized by the higher specific gravity. They are pale yellow and clear, remain fluid at 21° F., and contain very little stearin. They burn with a bright flame without carbonizing the wick. Brannt further states that they contain about the same constituents as cod-liver oil, but are richer in iodine. On account of their percentage of gall constituents the liver oils are readily distinguished from other fish oils.

Shark oils are largely used in tanneries, in steel-tempering, and in various compounds where it is desired to impart a low specific gravity. They are also valuable as a body for paints for out-of-door objects, as walls, fences, etc. In some localities certain kinds are used by medical practitioners, who consider them quite equal to cod-liver oil. In the drug stores of this country shark oil is occasionally found with a label suggestive of an oriental origin and recommending its use as an embrocation in numerous diseases.

[a] Natural History of Aquatic Animals, p. 667.

MENHADEN OIL.

In speaking of fish oil in a restricted sense along the Atlantic coast of the United States, reference is made generally to that yielded by the menhaden (*Brevoortia tyrannus*), a member of the *Clupeidæ* or herring family, known locally by a score or more of names. This species occurs from Maine to Texas, the principal fishing-grounds being the bays and sounds from Maine to North Carolina, with the addition of the Texas coast during the last two years.

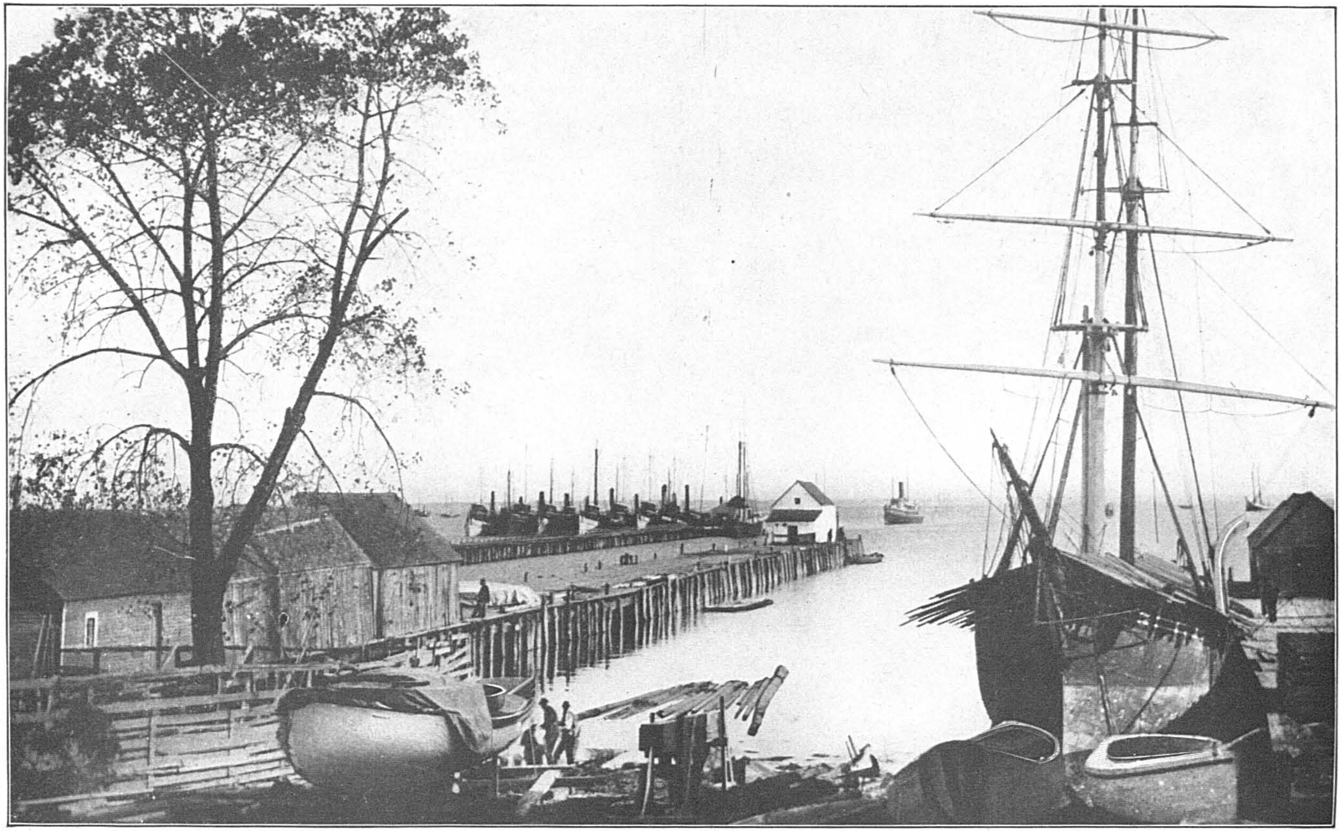
The extraction of menhaden oil differs from the preparation of other marine-animal oils in that the scrap or solid tissue remaining after the liquids have been removed is usually greater in value than the oil. Indeed, it was principally as a fertilizer that the menhaden was first utilized, the oil being extracted as an incidental product. Because of the greater value and importance of the scrap, the methods of manipulating the fish, extracting the oil, and the like are described in the second part of this report, relating to the preparation and utilization of fertilizers from fishery products. (See pp. 255–265.)

While small quantities of menhaden oil were prepared for domestic and local use previous to 1860, there was comparatively little marketed previous to the civil war. The first lot on the New York market sold at 75 cents per gallon and, its use giving satisfaction, the market price quickly advanced to $1.40 in 1865, the highest figure ever realized. For ten years the menhaden producers sold their crude oil within a range of 50 cents and $1 per gallon, resulting in great profit. This led to a large increase in the number of factories, the purchase of costly steamers and equipments, and a great overproduction.

The excess of production, a lack of cooperation among the factorymen, and competition with substitutes resulted in a gradual reduction of prices, until in the autumn of 1887 menhaden oil sold at 19 cents per gallon, which was much below the cost of manufacture. The necessity for protecting their invested capital led to concerted action among the producers and an attempt to bring about an agreement on prices and also a limitation of the fishing season. Many factories were closed and the vessels laid up, the owners preferring to keep them idle rather than to engage in unprofitable work.

The diminished extent of the output and a better understanding among the producers resulted in an improvement in prices, which finally reached 40 cents per gallon in the spring of 1893. Then, owing to unfavorable conditions, prices began to decrease until in the fall of 1896 crude northern menhaden oil was sold at 18 cents per gallon, the lowest price ever reached. Since 1896 the business has been conducted with much less competition and with greater economy by reason of improved machinery and increased facilities, and as prices have been somewhat higher a fair profit has been derived from the business by those whose invested capital is not greatly in excess of the value of their respective plants.

PLATE 16.



VIEW OF MENHADEN FLEET AT PROVINCETOWN, MASS.

During the last thirty years the product of menhaden oil has averaged about 2,000,000 gallons annually. The largest yield was in 1878, when 3,809,233 gallons were produced, and the smallest in 1881, when the reported product was only 1,266,549 gallons. The following summary, compiled from the returns of the United States Menhaden Oil and Guano Association, shows the product for each year from 1873 to 1898, inclusive, and also the number of fish taken. For purposes of comparison, the average quantity of oil to the thousand fish in each year is also given.

Statement of the quantity of menhaden oil manufactured, the number of menhaden utilized, and the average quantity of oil to the thousand fish in each year from 1873 to 1898, inclusive.

Year.	Oil made.	Fish utilized.	Quantity of oil to 1,000 fish.	Year.	Oil made.	Fish utilized.	Quantity of oil to 1,000 fish.
	Gallons.	*Number.*	*Gallons.*		*Gallons.*	*Number.*	*Gallons.*
1873	2,214,800	397,700,000	5.57	1886	1,805,544	283,106,000	6.38
1874	3,372,847	492,878,000	6.84	1887	2,273,566	333,564,800	6.81
1875	2,681,482	563,327,000	4.76	1888	2,051,128	439,388,950	4.67
1876	2,992,000	512,450,000	5.84	1889	3,327,030	555,319,800	5.99
1877	2,426,589	587,642,125	4.13	1890	2,939,217	533,686,156	5.51
1878	3,809,233	767,779,250	4.96	1891	1,946,642	355,138,873	5.48
1879	2,258,901	637,063,750	3.37	1892	1,329,644	223,623,750	5.95
1880	2,034,940	776,875,000	2.62	1893	1,269,002	366,406,625	3.47
1881	1,266,549	454,192,000	2.79	1894	1,999,506	533,361,900	3.75
1882	2,021,316	346,638,555	5.83	1895	1,767,754	461,747,000	3.83
1883	2,166,320	613,461,776	3.55	1896	1,741,530	401,425,800	4.34
1884	3,722,927	858,592,691	4.34	1897	2,147,113	584,302,980	3.68
1885	2,346,319	479,214,415	4.89	1898	2,450,000	542,500,000	4.51

The following shows the lowest and highest prices quoted for crude northern menhaden oil in the New York market each year from 1863 to 1901, inclusive. These figures are based on the closing quotations published in the New York trade journals, especially the *Oil, Paint and Drug Reporter*, each successive week.

Statement of the range of prices for crude northern menhaden oil in the New York market from 1863 to 1902, inclusive.

Year.	Lowest.	Highest.	Year.	Lowest.	Highest.
1863	$0.75	$1.00	1883	$0.35	$0.48
1864	1.10	1.35	1884	.26	.47½
1865	.80	1.40	1885	.21	.30
1866	.70	1.13½	1886	.20	.26
1867	.45	.70	1887	.19	.21
1868	.50	.95	1888	.20	.32
1869	.62½	1.02½	1889	.21	.32
1870	.40	.68	1890	.22	.30
1871	.35	.55	1891	.25½	.30
1872	.36	.65	1892	.30	.38
1873	.32	.60½	1893	.33	.40
1874	.35	.47½	1894	.21	.33
1875	.30½	.48½	1895	.19	.25
1876	.30	.50	1896	.18	.23
1877	.30	.46	1897	.18	.25
1878	.23	.45	1898	.22½	.24
1879	.24	.35	1899	.22½	.27
1880	.29	.43	1900	.25	.27
1881	.30	.39½	1901	.26	.30
1882	.32	.42	1902	.26	.29

Menhaden oil varies in color from clear straw, through amber and the various shades of brown to almost black, depending principally on the condition of the oliferous material when the oil is rendered. If the fish are fresh, the resulting oil is usually clear, bright, and comparatively odorless and tasteless; and according to the extent of the decomposition the oil becomes darker in color until it approaches a very dark brown. However, this is not always the case, for perfectly fresh fish sometimes yield dark oil.

The standard grades recognized for crude oil are A, B, C, and D; these terms being synonymous, respectively, with extra light crude, light crude, brown crude, and dark brown crude. The bulk of the output is of A grade, and little D oil is now prepared except in the Southern factories.

In the process of refining, menhaden oil is first heated and then placed in barrels and chilled in the manner already described for whale oil, either by exposure during cold weather or by refrigeration. This chilling grains the oil, the thick parts collecting together and the limpid oil forming globules. The grained oil is then placed in bags made of coarse material, and these carefully arranged one above another in a press. On applying compression, the thin oil comes out first and the impurities and stearin are left behind. The oil is then placed in shallow vats or tanks, exposed to the rays of the sun and protected by a glass covering, where it remains for a day or two. It may also be clarified by treating it with caustic soda and acids, resulting in a short time in a clear, light-straw color.

The pressing of the oil in connection with its refinement may be done at a summer temperature, but in that case only a portion of the foots are extracted and the oil has a poor weather-test. The usual weather pressing during the summer yields 5 per cent of foots, and the oil stands a temperature of about 50° F. If pressed at a temperature of 32° to 35° F., the foots extracted represent about 10 per cent of the original bulk. The foots are used as a substitute for tallow in leather-currying and also in soap-making, the market price approximating 3 cents per pound.

The products from refining menhaden oil are pressed extra light, pressed light, pressed light brown, pressed dark brown, bleached, extra bleached, oil foots or pressings, bleached oil foots, extra bleached oil foots, and menhaden oil soap. The first four grades of pressed oil are obtained respectively from A, B, C, and D grades of crude oil. A difference of about 1 cent per gallon exists between the prices of each of these consecutive grades of pressed oil. The pressed light is the standard grade, and when that sells at 30 cents per gallon the pressed extra light sells at 31 cents, the pressed light brown at 29 and the pressed dark brown at 28 cents per gallon. On the same basis the bleached sells at 33 cents per gallon, the extra bleached at 35 cents; and the same oils pressed at a low temperature sell for 1 or 2 cents more per gallon. A corresponding price for the unbleached foots is 2½ cents per pound; bleached foots, 3½ cents per pound; extra bleached foots, 4 cents, and menhaden-oil soap, 4 cents.

The names "straits oil" and "bank oil" were formerly applied to certain grades of cod oil, but at present these refer, respectively, to B and C grades of pressed menhaden oil, gradual increase in adulteration having resulted in complete change of material.

The principal uses for menhaden oil are currying or filling leather, illuminating, paint-making, lubricating compounds, tempering, soap-making, screw-cutting, wire-drawing, and cordage-manufacture, the first three consuming about 80 per cent of the total product. The light and extra light oils are generally employed in illuminating, lubricating, painting, and cordage-manufacture; the light brown for currying, and the dark oil for tempering and screw-cutting.

Large quantities of menhaden oil were formerly used by miners in safety lamps, but leather-currying has been the principal consumer during the last thirty years. Its use in steel works is of comparatively recent origin, and the steel industries now require many thousands of barrels annually.

It was as a substitute for linseed oil in painting that menhaden acquired its first popularity prior to 1865. The oil as then prepared was of very indifferent quality, the process of manufacture being comparatively crude, and much of the product would not now be considered marketable. On account of its being too highly recommended and all grades being sold for the purpose, considerable prejudice was soon created against it as a substitute for linseed oil. But with the improved methods of extraction and refining and with a better understanding of its limitations and technical qualities, these objections have been largely overcome. Its odor makes it undesirable for interiors and restricts its use to outside surfaces. According to Mr. A. H. Gill, its value for drying is somewhat less than that of linseed, but greater than that of poppy-seed, corn, cotton-seed, and sesame oils.

Menhaden stands the weather much better than linseed oil, especially when applied to tin roofs and ironwork. Owing to its glutinous nature, it is harder to apply than linseed oil, and consequently workmen do not always favor its adoption. This use of menhaden oil is now increasing and a single paint factory in New York City consumes 4,000 or 5,000 barrels annually.

If the oil is cleared from the foots by straining or pressing, cut with sulphuric acid of 45° strength in proportion of 1 gallon of acid to 50 gallons of oil, well stirred in and permitted to settle, and then washed down by a spray of cold water played on it, the acid and gluten are precipitated. Thus treated, menhaden makes a good substitute for linseed oil in mixing paints; it may also be used for leather-dressing and, mixed in equal proportions with paraffin and plumbago, makes a desirable lubricator.

The use of menhaden oil for illuminating purposes is confined to miners' lamps, especially in the coal mines of Pennsylvania and West Virginia. For this purpose it is generally combined with mineral or vegetable oils, the mixture giving better satisfaction than the use of menhaden oil alone. It is non-explosive and therefore much safer than mineral oil. The luminous effect of refined menhaden oil has been found to be high with a relatively low consumption, as compared with petroleum.

The following treatment of menhaden oil in combination with other substances for painting purposes is recommended by Andes:[a]

Into a wooden barrel are brought 144 liters of good vinegar, 6 kilograms of litharge, and 6 kilograms of zinc sulphate; then the barrel is rolled about for a long time, and the liquid then poured into 100 liters of fish oil. The mixture is well stirred, and then left at rest for twenty-four hours; when the clear oil is drawn off, seven-eighths of the original quantity is obtained. Fifty-four liters of linseed oil and 9 liters of turpentine are at once added. The liquid is left at rest for several days, and then drawn off. The residue is mixed with an equal volume of milk of lime, and used for painting wood and iron which are exposed to the air.

When whale and cod oils are scarce and high in price menhaden oil is extensively used as a substitute. Its chief competitors are degras, petroleum compounds, and herring oil made in the United States and in Japan and Europe, the latter competing with it principally in Europe. For further data in regard to this oil, especially the methods of manufacture, extent of production, and so forth, see pages 255–265.

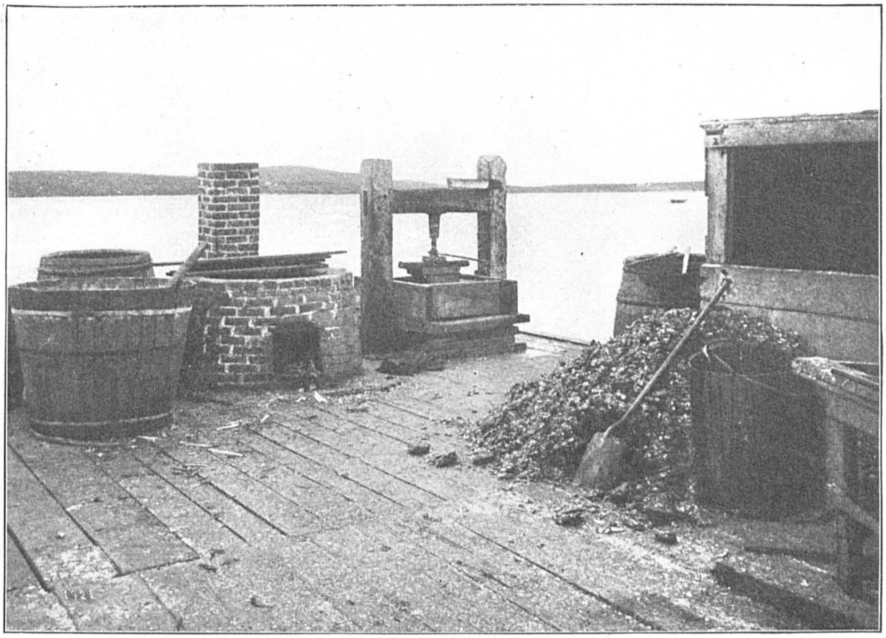
HERRING OIL.

The herring, including its related species—the sardine, pilchard, sprat, anchovy, etc.—is probably the most valuable and important product of the world's fisheries, not so much on account of the choice nutritive qualities, perhaps, as because of the enormous quantities obtained. When the product exceeds the demands of the food markets, including those required for salting, canning, etc., these fish furnish excellent material for oil-production. Their utilization for this purpose is by no means of recent origin, the production of herring oil in the Bohuslan fisheries of Sweden over a century ago ranging between 1,000,000 and 2,000,000 gallons annually. Nor is it of limited geographical distribution, as the oil is produced to a greater or less extent in nearly every maritime country of Europe, in the British North American provinces, on the northern coast of the United States, in Japan, certain parts of the African coast, etc.

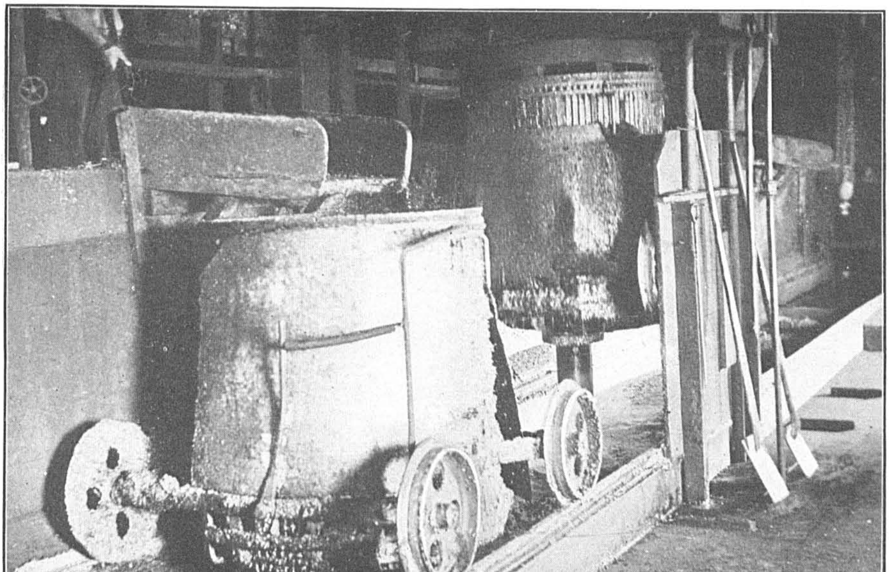
Since only the surplus or waste fish are used in oil-making, and as the catch fluctuates greatly, it follows that much variation occurs from year to year in the quantity produced. The figures showing the output in a certain territory are quite unreliable for any year except the one to which they particularly relate. It is therefore difficult to approximate the product of herring oil throughout the world. It seems probable, however, that a reliable estimate would place the average annual yield at not far from 3,500,000 gallons, of which only a small portion is produced in the United States.

During the fifteen or twenty years preceding 1875, when fish oils

[a] Andes: Drying Oils, p. 280, London, 1901.



PRIMITIVE FORM OF KETTLE AND PRESS FOR RENDERING OIL FROM HERRING ON THE MAINE COAST.



MODERN TYPE OF HYDRAULIC OIL-PRESS USED IN THE MENHADEN FACTORIES. (SEE P. 262.)

were worth about double their present values, there were small plants all along the eastern coast of Maine for utilizing the herring in oil-manufacture. The crude material consisted principally of refuse fish taken in connection with the smoked-herring business, especially the small fish which otherwise were valueless. Sometimes the larger herring—over 6 inches in length—were utilized, but only when the comparative prices of oil and smoked fish warranted. This business did not engage the attention of large establishments, but was conducted by many fishermen in a small way, each man working for himself.

As the refuse herring accumulated they were sprinkled with salt, using about 1 bushel to 3 or 4 barrels of fish. After remaining in the salt about 24 hours, they were boiled in open kettles and then subjected to pressure in a screw press with capacity for about 1½ barrels. The average yield was about 16 gallons of oil to the ton of fish, but at times the fish were so fat that 20 and even 25 gallons were secured to each ton. The chum or scrap was partly dried and then sold as fertilizer at about $12 per ton.

The development of the sardine business furnished more profitable use for small herring, and since 1875 the waste from the sardine canneries has provided most of the material for herring-oil production in Maine. This waste consists of the spoiled fish and of the heads and viscera of fish used in canning, each factory generally using its own refuse. The extent of the business is small. The total output in 1889 amounted to 34,316 gallons of oil, valued at $8,580, and 1,941 tons of scrap, worth $15,528. Owing to the decreased value of the oil, this business has since fallen off considerably, the output in 1898 amounting to only 12,672 gallons of oil, worth $2,116, and 785 tons of scrap, worth $5,910.

The method of manufacture is described by Mr. Ansley Hall on page 479 of Report of U. S. Fish Commission for 1896.

Considerable quantities of oil have been prepared from herring on the Pacific coast of the United States. The industry dates from 1867, but the output was irregular for a number of years. In 1885 the product amounted to upward of 200,000 gallons, much of which is alleged to have been sold as whale oil. In 1892, according to the *Oil, Paint, and Drug Reporter*, the output approximated 500,000 gallons, 60 per cent of which was prepared at Killisnoo, Alaska. The yield of oil ranges from 1 to 4 gallons to the barrel of fish. The value on the Pacific coast is about 20 cents per gallon, and the dried scrap sells for about $25 per ton. This oil is usually quite clear, and the foots extracted in refining are nearly as white as spermaceti and sell for about 1 cent per pound less than tallow from sheep and oxen, being used largely by soap-makers on the coast.

When herring are taken in the fisheries of Europe in such quantities that they can not be profitably used for food, it is customary to convert them into oil and fertilizer. Herring oil is extensively manufactured in Norway and Sweden, and with the exception of that obtained from cod livers, it is now the principal fish oil of those countries. The manufacture in Sweden developed rapidly eight or ten years ago, due to the abundance and consequent cheapness of herring. According to Capt. J. W. Collins, the number of factories increased from 3 in 1891 to 22 in 1895, the output in the season of 1895–96 amounting to about 500,000 gallons of oil and 16,000 tons of fertilizer. The scarcity and consequent high price of herring since 1896 have greatly restricted the output of these factories.

In the preparation of sardines in Europe the heads, viscera, and other waste parts are generally utilized in oil-production. They are cooked and pressed, the oil separated, and the refuse used for fertilizer. This oil is employed in leather-dressing, cordage-manufacture, the preparation of paints for exterior surfaces, and, in some country districts, for illumination. Unfortunately, we have no data bearing on the total extent of the output.

The herring-oil industry in Japan is probably much older than its counterpart, the menhaden industry in America, but it was in a crude state up to about twenty years ago. The species of fish utilized—known as "iwashi"—is found in large schools along the Japanese coast, especially on the northern side of the main island, and very large catches are made in the fall and winter, when the fish are fat.

According to a recent report by Consul Van Buren, of Kanawaga, the principal fisheries are on the island of Yezo and the peninsula of Ava, near Yokohama. The method of extraction is similar to that employed in the United States. The fish are cooked and pressed and the residuum used for fertilizer. The process of refining is likewise similar to that employed in America, the oil being pressed "in small filtering bags of paper, outside of which are similar ones of strong cloth. A number of these are placed in a press, which forces out the oil through the pores of this double envelope."

Japanese herring oil contains an unusually large amount of foots, amounting to about 25 per cent, according to some refiners. On account of this, the weather-test of the crude oil is high, from 65° to 70° F. Before the introduction of kerosene in Japan, refined herring oil was employed largely for illumination, but that is greatly reduced. It is now used locally in the manufacture of soap, in leather-dressing, in cordage-manufacture, as a body for paints, and for other technical purposes.

Since 1881 large quantities have been exported to Europe, and also at intervals to the United States. At first it found little acceptance on account of its unpleasant odor, due to the crude method of extraction. Another objection was the form of the packages, consisting of second-hand 5-gallon kerosene cans, which proved a nuisance to users of large quantities. The Hamburg market price is about 40 marks per 100 kilograms for the light oil and 37½ for the brown. The foots, after the process of refining, sell at about 43 marks per 100 kilograms.

It is only when domestic fish-oils are high that Japanese herring oil can be profitably imported into this country, and on that account the imports fluctuate largely from year to year. The United States markets will receive it at 3 to 5 cents less per gallon than menhaden oil, but it can not be exported to this country with profit when the menhaden market is less than 26 cents per gallon, since the freights, insurance, import duties, brokerage, etc., would leave very little for the exporter. In 1885 the imports into this country amounted to 101,265 gallons, valued at $24,832; in 1886, 5,010 gallons, valued at $786; then they were insignificant until 1893, when 191,852 gallons, worth $30,746, were received. In 1894 the imports were 156,456 gallons, worth $24,656. Some very choice specimens of refined oil have been received from Japan for exhibition purposes, thus demonstrating what the factories there are capable of producing, but some of the product sent here for consumption could be improved upon.

OIL FROM WASTE FISH.

In addition to menhaden and herring, several species of fishes not suitable or available for food are used in oil-production. The use of sea-robin, skates, and bellows-fish taken with menhaden is noted in the account of the menhaden industry. Of these species, the sea-robin is the most desirable for this purpose, yielding about 8 gallons of oil to the ton of fish. Skates and bellows-fish yield comparatively little oil, amounting sometimes to less than 1 gallon to the ton. This is combined with the menhaden oil, no noteworthy difference being apparent. These fish are purchased by the menhaden factorymen at 50 to 75 cents per thousand, but it would not pay to handle them were it not for the fertilizer into which the solid tissue is converted after the extraction of the oil. The oil of the sun-fish (*Mola*) is used by some fishermen for the cure of rheumatism.

On the coasts of Alaska and British Columbia, and to a less extent in Washington and Oregon, there is secured a fish closely allied to the smelt and capelin of the Atlantic coast, which is of considerable value owing to its oil-yielding properties. This is the eulachon or oulahon (*Thaleichthys pacificus*), called also the "candle-fish," for the reason that the natives use it as a candle in their dwellings, it being capable of ignition and burning with good illuminating qualities. For many years, according to Dr. Tarleton H. Bean, an excellent quality of oil has been made from it by the Indians both for their own use and for trade with the whites. The weather-test of this oil is very high, and at ordinary temperature it is opaque and butyraceous; indeed, among the Indians it supplies the place of butter.

According to Dr. A. B. Lyons, of Detroit, eulachon oil contains "about 20 per cent of palmitic and stearic acids, 60 per cent of oleic acid, 13 per cent of an unsaponified substance, which is the most peculiar and interesting thing about it. This substance is of an oily consistency at ordinary temperature in summer, has much lower specific gravity than oleic acid or any other constituent of ordinary fats (specific gravity 0.865 to 0.872 at 59° F.[a]), and seems to resemble the unsaponifiable constituent of sperm oil."[b] According to Dr. Schaedler, when eulachon oil is mixed with sulphuric acid (1 volume of acid to 5 parts of oil) the temperature of the mixture rises to 121° F., whereas under similar conditions cod oil rises to 235° F. This acid does not impart to eulachon oil the beautiful purple color that it does to cod oil, but a deep brown, subsequently inclining to reddish yellow. Under saponification the precipitated fatty acids amount to about 95 per cent of the original bulk of the oil. Efforts have been made to introduce eulachon oil in the markets in competition with cod-liver oil for medicinal uses. It is claimed that it has nourishing and stimulating properties that adapt it to certain cases of malnutrition, and that it is more easy of digestion than cod-liver oil.

Large quantites of lampreys are used for oil-rendering in southern Russia. Prior to 1870 the lamprey was not an article of commerce there, except a small quantity used locally as candles in much the same manner as the eulachon on the Alaskan coast. It is now taken in large numbers on the Volga and Kur rivers. A small quantity is pickled for food, but the greater portion of them are used in oil-manufacture. It is reported that between Tsaritsin and Yenotayevsk, on the Volga River, about 50,000,000 lampreys are taken annually, yielding about 100,000 gallons of oil.[c] When properly prepared this oil is clear and transparent, but it contains a large quantity of glue, and consequently it is quite viscous.

OIL FROM FISH HEADS.

During the last twenty years the market has received considerable oil made from refuse at the salmon canneries on the Pacific coast. This was first prepared, about 1876, at a factory above Astoria, on the Columbia River. The heads alone were utilized. These were purchased at the canneries at the nominal price of 50 cents to $1 per 1,000, that quantity yielding from 30 to 35 gallons of oil.[d] The heads were cooked by steam and the oil expressed from the mass. This product was sold for use on the Pacific coast at prices varying from 22 to 35 cents per gallon according to the supply and demand. The output of salmon oil was small until 1895, when somewhat more than 50,000 gallons was received on the market. In 1899, according to Mr. W. A. Wilcox, two small establishments at Astoria for utilizing salmon refuse prepared 19,600 gallons of oil and 140 tons of fertilizer, and one factory at Anacortes, Wash., produced 22,000 gallons of oil and 350 tons of fertilizer. Only a small portion of this refuse on the coast is used. This oil compares favorably with that from menhaden and, being a waste product, can be prepared at a very low price. The vis-

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[a] The specific gravity at 59° F. is given by Dr. Schaedler as 0.907.
[b] Journ. Soc. Arts, 1884, p. 1107.
[c] Fishing and Hunting in Russian Waters, p. 27.
[d] See Fishery Industries of the United States, Sec. V, vol. I, p. 750.

cera of salmon yields such a small quantity of oil that usually it is not profitable to attempt its extraction.

In the United States the heads of halibut have been generally utilized for oil-manufacture since 1870. They are of no value as food and are discarded in dressing the fish for market. In Gloucester and Boston, the headquarters of the halibut fishery, they are collected by the oil-manufacturers, cooked, and pressed in the same manner as other waste products. They are placed in large receptacles and treated with steam until the tissues are thoroughly disintegrated, when the oil and water are extracted by subjecting the mass to hydraulic pressure, 1,000 pounds yielding about 20 gallons of oil. The annual product in Boston and Gloucester is about 12,000 gallons, valued at about 30 cents per gallon. When refined by treating with caustic potash, refrigerated, pressed, and sun-bleached, it looks as fine as choice whale oil and is commonly sold as a substitute therefor and at about the same price.

Sword-fish heads are usually very fat, a single head sometimes yielding one gallon of oil. As a rule, however, 100 heads yield about 65 gallons of oil. It is extracted in precisely the same manner as in case of halibut-head oil. The quantity prepared is small, probably not exceeding 1,000 gallons annually on the entire New England coast. It is clear and sweet and is probably sold as whale or cod oil.

The heads of other food-fish as a rule contain little oil. Cod and related species, for instance, contain practically none, and in utilizing them for fertilizer in this country, as well as in the British provinces and in Norway, no effort whatever is made to secure oil therefrom.

OIL FROM VISCERA OF FISH.

The quantity of viscera resulting from dressing food-fish at the markets, canneries, drying establishments, and the like in the United States amounts to upward of 100,000 tons annually. In certain species of fishes this material is very oleiferous, yielding as high as 150 gallons to the ton; but in most species the viscera are so poor in oil as to preclude their use for this purpose, the possible yield in some instances being as low as 4 or 5 gallons to the ton of crude material.

Probably the greatest yield of oil is from the viscera of the blue-fin white-fish and the chub or deep-water herring of Lake Michigan. The quantity ranges from 7 to 16 gallons of oil to the barrel and is much greater in winter than in summer. The average quantity of oil from the waste of lake trout is about 4 gallons to the barrel of 200 pounds. The yield from herring is small, probably not exceeding 1 gallon per barrel. The total quantity of oil contained in the viscera of all food-fish taken in the United States amounts probably to upward of 800,000 gallons. Only a relatively small proportion of this oil is saved.

Very few establishments exist in this country for utilizing the oil contained in the viscera of fish. A majority of these are on the shores of the Great Lakes, especially Lake Michigan, owing to the fatness of the waste from chubs (Hoy's white-fish) secured in great quantities in that lake. These establishments are small, the necessary pots or kettles, boxes, barrels, etc., not exceeding $300 in value. The viscera are usually saved by the fishermen in tight barrels furnished by the oil men, who receive this refuse for carting it away; water is added, and the whole mass cooked in large open pots or kettles for a length of time ranging from three to six hours. As the oil accumulates at the surface it is skimmed off and stored in suitable receptacles, the solid matter being discarded as of no value. When a barrel or two of oil has accumulated, it is reboiled and coarsely refined.

There are 8 or 10 of these oil-producing plants on the shores of the Great Lakes, and the total output probably does not exceed 20,000 gallons, whereas the total possible is upward of 200,000 gallons. One plant at Sheboygan, Wis., receiving the viscera from a catch of 296,365 pounds of blue-fin white-fish and chubs and of 110,260 pounds of trout in 1899, produced 1,180 gallons of oil, which sold for $301.

Considerable oil exists in various parts of the body of sturgeon, especially in the viscera and under the dorsal scutes or bosses. In the sturgeon fisheries of Russia it is customary to extract this oil and use it not only technically but also for culinary purposes and for food, especially to soften caviar when it is somewhat dry. A few hundred gallons of sturgeon oil are prepared in the United States each year, but no special properties are attributed to it. It sells for about the same price as menhaden oil and is used for similar purposes. As a general rule, owing to its preparation from fresh materials, this oil is clear and bright and of pleasant odor and flavor.

MISCELLANEOUS OILS.

Alligator oil is much used among the hunters and swampers of the Gulf States. It is employed as a lubricant, an illuminant, for softening leather, and in the treatment of rheumatism, scrofula, etc. Although this oil is rarely met with in commerce, there are probably few professional alligator hunters who do not lay in a supply each season. About fifteen years ago alligator oil was introduced in France for leather-currying and met with much favor, owing to its imparting greater weight to the leather than whale, seal, or cod oils. It was received from Mexico and Central America and sold in France at about one franc per kilogram, equivalent to about 70 cents per gallon. It is described as of a reddish color, of 0.928 specific gravity, and to consist chiefly of 60 per cent of olein, 32 per cent of margarine and stearin, 1½ per cent of free oleic acid, and 0.02 of iodine.[a]

In many parts of the world oil is extracted from various species of turtle or terrapin and used for medicinal or technical purposes. In the Chesapeake region certain remedial qualities are supposed to exist in the oil of the celebrated diamond-back terrapin. It has been

[a] See Oil, Paint, and Drug Reporter, 1889, June 15, p. 55.

recommended especially for rheumatism. But little of this oil finds its way into trade, being for the most part bottled and put away in the family medicine-chest for home use only. The oil from a variety of turtle found in Mauritius and the adjacent islands has had a local reputation for more than two centuries as an excellent remedy in several diseases. On the coast of India turtle oil is prepared for a number of purposes, especially in the composition of a cement or pitch for paying the seams of vessels. It has been highly recommended as a medicinal oil, principally in cases of scrofula and anæmia. It is not often refined, notwithstanding that the percentage of foots is large. When bottled, the solid part is precipitated in an opaque and yellowish-white mass, leaving the oil transparent and brownish in color. When slightly warmed, as by exposure to the sun's rays, the two parts amalgamate.

Considerable quantities of turtle oil are prepared in the West Indies, on the northern coast of South America, on the Seychelles in the Indian Ocean, etc. Not only is the fat of the animal used for this purpose, but likewise the eggs, of which large numbers are secured on the Amazon and the Orinoco. It is said that a single turtle may yield 6 gallons of oil, and that 3,000 eggs are required for an equal quantity. The eggs are crushed, covered with water, and submitted to the heat of the sun, whereupon the oil quickly floats to the surface. According to consular reports, Para receives upward of 50,000 gallons of this oil during some seasons, and a much larger quantity is consumed by the natives inhabiting the shores frequented by the animals.

Turtle oil is used for culinary purposes, and likewise for illumination, lubrication, and currying.

While the oils of the dugong and of the manatee are comparatively unknown in the United States, they are of considerable local importance in several tropical and semitropical countries, especially in Australia, New Zealand, and Brazil. The oil is obtained from the blubber situated beneath the skin, and each animal yields 5 to 20 gallons. No difference has been pointed out in the characteristics of the oils of these animals; although, obtained in widely separated countries, it is natural that different uses should have developed.

Dugong oil has no prominent odor, is of a pleasant flavor, and when in good condition is almost as limpid as water. It is used in place of butter and sometimes in preference thereto, and as a cooking oil it is said to be unrivaled; but it is employed principally as a medicine, its properties resembling those of cod-liver oil, without the unpleasant effects of the latter. It is valued by some medical practitioners in Australia and New Zealand even more highly than cod-liver oil. Dr. Hobbs, of Queensland, was the first to draw attention to its virtues in Australia, receiving a prize medal at the Sidney Exhibition in 1854. By some persons dugong oil is believed to be efficacious in the treatment of debility, dyspepsia, chronic dysentery, bronchitis, etc. Occasionally it may be found in this country put up in bottles with labels indicative of an oriental origin, and recommended as a cure for consumption and diseases of the chest and back.

The oil of the manatee is one of the few blubber oils which does not become rancid on exposure to the sun, and on the contrary acquires a fine flavor and agreeable odor through such exposure. On the west coast of Africa, in the West Indies, Guiana, and Brazil, it forms an important item of domestic commerce; it is used as a lubricator, as an illuminant, in cooking, and for the table.

Speaking of the American species (*Manatus americanus*), Dr. R. Brookes in his "Natural History" states:

> The fat which lies between the cuticle and the skin, when exposed to the sun, has a fine smell and taste, and far exceeds the fat of any sea animal. It has this peculiar property, that the heat of the sun will not spoil it, nor make it grow rancid. The taste is like the oil of sweet almonds, and it will serve very well in all cases instead of butter. Any quantity may be taken inwardly with safety, for it has no other effect than keeping the body open. The fat of the tail is of a harder consistence, and when boiled is more delicate than the other.

The fat obtained from beaver is made into an ointment by the Indians, to which they attribute many curative and medicinal properties, especially its power to prevent frost bites, the anointed parts of the body not being affected even when exposed to the most extreme cold. An old treatise of 1685, credited to Joanne Mario, attributes marvelous curative properties to beaver oil:

> It is efficacious in all maladies which affect the nerves. It is useful in epilepsy, and prevents apoplexy and lethargy; stops spasms and convulsions, and is of great help in giddiness, toothache, asthma, dysentery, and strains.

On the Macquarie Islands, the coast of Patagonia, and several other places in the cold regions of the Southern Hemisphere, large numbers of penguin are caught and used in oil rendering. On Macquarie Island the royal penguin and the king penguin are used, while on the Patagonian coast the jackass penguin is the principal species, with smaller numbers of macaronis and red bills. These birds are found on the shores in great numbers and are easily killed with clubs. In some localities the breast skin, with the attached blubber, is the only part cooked, the rest being discarded; but usually the entire body is placed in pots and cooked. When thoroughly disintegrated the mass is pressed and the oil thus extracted.

SPERMACETI REFINING AND MANUFACTURE.

Spermaceti is the solid portion of the crude oil of sperm whales and of certain other cetaceans. As noted in the chapter on sperm-oil rendering, it occurs in a state of solution in special cavities of the skull and to a much less extent in various parts of the body, especially in the core of the dorsal hump. The process of its extraction and the separation of the oil therefrom have already been noted in the account of rendering sperm oil, and it now remains to describe the subsequent treatment of the crude and refined spermaceti.

After the extraction of the "taut-pressed-oil" the crude spermaceti is heated in vats or tanks, refined, and "whitened" by the introduction of some alkali, as a weak solution of caustic soda or caustic potash, to saponify any adhering oil. Care must be taken during this process that the spermaceti does not saponify, any tendency to do so being overcome by the addition of brine. The refined product is then molded into suitable shapes for marketing. Most of it is formed into blocks measuring 10 by 12 by 14 inches, and weighing about 62 pounds each. It is also molded into cakes weighing 1 pound, half-pound, quarter-pound, or of any other desired weight.

Spermaceti is white, semitransparent, unctuous or talcose to the touch, of a slight fatty taste and odor. A fracture of a cake reveals broadly foliated, crystallized pieces resembling quartz. According to Brannt, its specific gravity is 0.943 at 59° F. It yields nothing to water, and very little to cold alcohol, but is readily soluble in ether, chloroform, and bisulphide of carbon. It melts at about 125° F. and congeals immediately below the melting point. Its component parts, according to the same chemist, are carbon, 80.03 per cent; hydrogen, 13.25 per cent, and oxygen, 6.72 per cent.

It is not easy to adulterate spermaceti without detection, since its characteristic properties are readily diminished, the compound being harder, with decreased nacreous luster and smaller foliated crystals. Tallow is readily detected by the odor given off in melting, and also by the compound making fat stains on paper, which is not the case with pure spermaceti. Stearin renders it harder and smaller foliated, and its presence is readily detected by boiling the sample in a soda solution, effervescence occurring in the adulterated article. If exposed to the air for a long time spermaceti becomes yellowish and somewhat rancid, but when remelted and treated with diluted caustic soda or potash it regains its original condition.

In the early history of the sperm-whale fishery spermaceti was considered of great value for medicinal purposes, and was recommended for many ills of the body, but was employed principally for internal applications, especially in cases of inflammation. It was so much in demand before the full development of the fishery as to sell at times for its weight in silver. As it became better known, however, it occupied a minor position in materia medica, chiefly in the preparation of ointments, and its principal use was in candle-making.

The beginning of candle-making in America dated from about 1750. The number of factories increased rapidly, and in 1761 there was a total of eight in New England and one in Philadelphia. In 1772 the first candle factory was established at Nantucket, then the headquarters of the whale fishery, and the number increased until there were 10 in existence on the island in 1792, and an equal number then existed at New Bedford.[a] The business of preparing spermaceti was then separate from the general whale-oil refining industry, the candle-

[a] New Bedford Medley, Nov. 30, 1792.

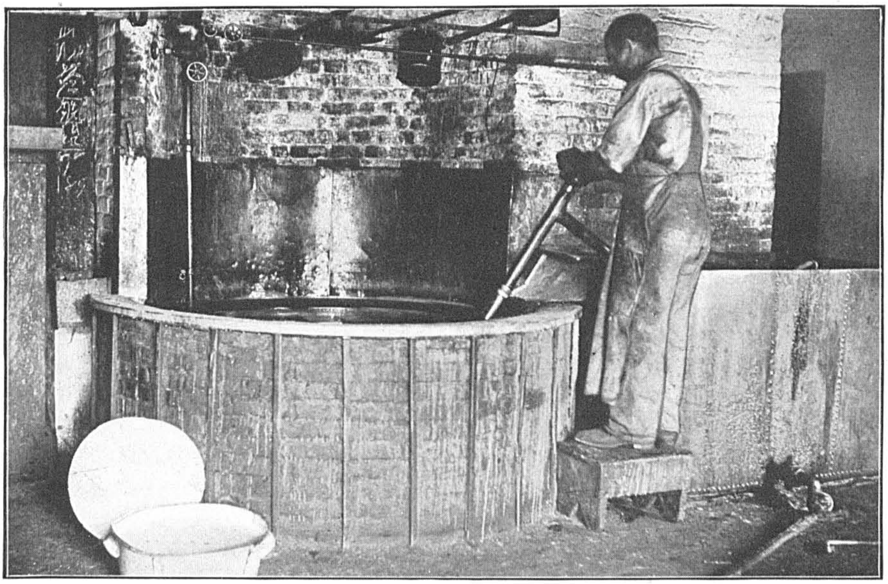
makers purchasing the crude head matter only. But gradually the two industries were combined to their mutual advantage. When the sperm-whale fishery developed to its full capacity, the production of spermaceti was very large, averaging more than 3,000,000 pounds annually from 1835 to 1845. With the decrease in extent of the fishery, there was a corresponding decrease in the yield of spermaceti, reaching its lowest product in 1890, when less than 200,000 pounds were prepared.

Spermaceti is among the very best materials for candle-making, the product being beautifully semitransparent and nacreous, burning with great regularity and with white light of high illuminating power; yet owing to the cheapness of other materials, especially paraffin, only a small percentage of the candles used at present are made of this material. To reduce the tendency of spermaceti to crystallize in molding and consequently lower its friability, it is customary to add a little paraffin wax, tallow, stearin, beeswax, or cerasin. The clear natural color of the refined spermaceti is usually preferred in candles, but sometimes coloring material is introduced, in so small a quantity, however, as not to destroy the transparency of the spermaceti. A yellow tint is imparted by adding gamboge, a red by carmine, and a blue by prussian blue. Owing to the cheapness and excellence of paraffin candles, the consumption of spermaceti in candle-making has been greatly reduced. The quantity thus used at the present time bears no relation to the extensive use of petroleum wax for that purpose, the consumption of which in Great Britain alone amounts to upward of 50,000 tons annually.

Sperm candles are at present the standard used by the principal gas-examiners for photometric measurements. The rules for the preparation of standard sperm candles for photometric purposes, published by the Metropolitan Gas Referees, of London, prescribe that, for the purpose of rendering the spermaceti less brittle, best air-bleached beeswax, melting at about 144° F., shall be used exclusively, and that the proportion of beeswax to spermaceti shall not be less than 3 per cent nor more than 4½ per cent; the spermaceti itself to be so refined as to have a melting-point lying between 112° and 115° F.[a]

The production of spermaceti in 1901 in the United States was about 400,000 pounds, worth $100,000. Of this amount probably 70 per cent was exported to Germany, England, and other foreign countries. Its principal foreign use is in the making of candles, large quantities being made in England and Germany for ecclesiastical use, especially in southern Europe. Minor uses are as an ointment for medicinal purposes, in laundries for producing a polish on linen, and for self-lubricating cartridges. Of the domestic consumption, probably 5,000 pounds are used in candle-making and the rest for medicinal and industrial purposes.

[a] Journal Society Chemical Industry, 1894, p. 65.



SPERMACETI REFINING. VAT FOR BOILING AND REMOVING SEDIMENT.

PACKAGES OF BLOCKS, CAKES, AND CANDLES OF SPERMACETI.

During the year 1901 the value of spermaceti greatly decreased, sales during November being made at 22 cents per pound, the lowest price reached in the last ten years.

No exact figures are available to show the product of spermaceti during a period of years, but the approximate yield may be determined from the figures on page 204, showing the yield of sperm oil, remembering that about 25 pounds of spermaceti is obtained from a barrel, or 31½ gallons, of sperm oil. It should be noted, however, that considerable crude sperm oil is exported and the spermaceti extracted abroad.

AMBERGRIS.

Ambergris is a wax-like substance found at rare intervals, but sometimes in relatively large quantities, in the intestines of the sperm whale. With the exception of choice pearls and coral, it is the highest-priced product of the fisheries, selling at upward of $40 per ounce. It has been a valuable object of commerce for hundreds of years. It appears to have been prized first by the Arabians, by whom it was called amber, and by this name it was first known among the Europeans. The name was later extended to the fossilized gum, the two being distinguished by their respective colors as amber gris and amber jaune.

In the writings of early travelers to the shores of the Indian Ocean and to southern Asia, references to ambergris are by no means infrequent. Before the time of Marco Polo (1254–1324), Zanzibar was famous for its ambergris. So plentiful was it on the shores of Indian Ocean in the sixteenth and seventeenth centuries that the name was given to various islands, capes, and mountain peaks of that region. It was also found on certain shores of the Pacific, notably the coast of Japan. From their station in Batavia the Dutch traders kept Europe supplied, and also exported it to Asiatic markets.

Though ambergris was a valuable commercial article, little or nothing was known of its origin before the eighteenth century. Some supposed it to be the "solidified foam of the sea," others that it exuded from trees and flowed into the sea, or that it was a "fungoidal growth of the ocean analogous to that on trees."

It is now generally conceded that ambergris is generated in either sex of the sperm whale, but far more frequently in the male, and is the result of a diseased state of the animal, caused possibly by a biliary irritation, as the individuals from which it is secured are almost invariably of a sickly appearance and sometimes greatly emaciated. It is not of frequent occurrence, many whalemen with half a century's experience never having seen any. The victim of the malady may eject the morbific substance, thus furnishing the lumps which have been found on the shores or floating on the seas frequented by sperm whales.

Although ambergris is of such rare occurrence, the sperm-whalers always search for it, especially in diseased or emaciated whales. It is found in all parts of the intestinal canal, but more generally at 2 to 6 feet from the vent. The instrument used in the search is a common cutting-spade. The presence of the prize is detected by the peculiar feeling or impression on striking it, very much like the cutting of cork or rubber, and also by its sticking or adhering to the spade, or by its floating out upon the water when the intestines are opened.

Ambergris occurs in rough lumps varying in weight from less than 1 pound to 150 pounds or more. It generally contains fragments of the beak or mandible of squid or cuttle-fish, which constitutes the principal food of the sperm whale. When first removed from the animal it is comparatively soft and emits a repugnant odor, but upon exposure to the air it grows harder, lighter in color, and assumes the appearance it presents when found floating on the ocean. It is light in weight, opaque, wax-like, and inflammable. Its color ranges from black to whitish gray, and is often variegated with light stripes and spots resembling marble somewhat. When dried—the only curing process it undergoes—it yields a subtle odor faintly resembling that of honey. It softens under heat like wax, and in that condition may be easily penetrated by a needle. A proof of its good quality is a polished needle meeting with no obstacle when thrust through it, and if the needle be red hot the substance will exude an oil. It fuses at 140° to 150° F., and when heated to 212° F. it dissolves into a blackish, thick oil, and gradually evaporates, leaving no trace of its presence. When stored for a length of time it becomes covered with dust like chocolate. It contains some moisture that gradually evaporates, reducing its weight, but increasing its intrinsic value.

The amount of ambergris produced annually from all sources varies greatly, scarcely an ounce being obtained in some years, while in others the product may exceed $50,000 in value. The small compass within which a very valuable quantity may be stored without attracting attention, and the ease with which it may be brought in where it is deemed advisable to preserve secrecy concerning a find, render it exceedingly difficult to follow closely the imports of the article. However, a brief account is here given of some of the principal masses obtained. In this compilation we are indebted to Mr. Francis H. Sloan and to Messrs. J. and W. R. Wing for information.

Probably the most valuable piece secured previous to the last century was a 182-pound lump purchased in 1693 from the King of Tydore by the Dutch East India Company for the sum of 11,000 thalers. Its origin is unknown. Probably it was found afloat on the sea or drifted ashore. It is stated that the Grand Duke of Tuscany offered 50,000 crowns for it—with what success is unknown.

An American fisherman is credited with finding a piece that weighed 130 pounds in a whale secured in 1782 about 150 miles southwest of Windward Islands. This sold for £500, the low price leading one to fancy that the reported weight is exaggerated.

Captain Coffin, a British whaling master, stated before a committee of the House of Commons in 1791 that—

He had lately brought home 362 ounces, troy, of this valuable substance. He had taken this from the anus of a female sperm whale captured off the coast of Guinea, and which he stated was very bony and sickly. At the time he brought this quantity to England the ambergris was selling for 25s. an ounce, but he stated that he sold his for 19s. 6d. per ounce to a broker, who exported it to Turkey, Germany, and France, among the natives of which it appears to have been long celebrated for its aphrodisiacal properties.[a]

The schooner *Watchman*, of Nantucket, is credited with bringing home from the Bahama Islands, in 1858, the largest mass ever found, weighing nearly 600 pounds. This was on the market for many months, as the owners were unwilling to divide it and dealers were adverse to taking the whole lot, but finally it was sold for $10,500.

The bark *Sea Fox*, of New Bedford, in 1866, secured a 30-barrel sperm whale off the eastern coast of Arabia. A long-handled cutting spade was thrust into the region of the anus and a piece of ambergris fell out. Some of the men proceeded to cut open the large intestine, which was about 10 feet long and 3½ inches in diameter, and for the entire length it was literally filled and closely packed with ambergris. They cleand out the stomach and found two large pieces weighing, respectively, 40 and 41 pounds. The ambergris in the large intestine, to all appearance, was originally composed of globular pieces, which, owing to pressure from all sides, were compressed into irregular shapes. The two large pieces found in the stomach were of a different shape from those found in the intestine. They measured about 36 inches in circumference, were flat on both sides, about 8 inches in thickness, and of a superior quality. The entire mass weighed 150 pounds and was sold to the Arabs of Zanzibar for $10,000 in gold.

During the year 1878 the bark *Minnesota*, in the same locality, found 18 pounds of ambergris in a whale, which was sold in Zanzibar to the agents of the Sultan for $150 per pound.

The bark *Adeline Gibbs* in 1878 brought in the most valuable lot of ambergris obtained by an American vessel up to that time. It was taken from a 50-barrel bull sperm whale south of St. Helena, weighed 132¾ pounds, and was sold for $23,231. This piece was the only one that a fleet of 12 vessels had taken in 45 years. About the same time the *Bartholomew Gosnold* secured 125 pounds in the vicinity of New Holland, which sold for about $20,000, and the *Lettitia* brought in 100 pounds, worth $17,500.

In 1882, the bark *Falcon*, in latitude 16° 55′ S. and longitude 11° 00′ W., secured a 28-barrel male sperm whale, which was apparently in healthy condition and without unusual appearance. A spade was accidently thrust into the abdomen, revealing the presence of ambergris in the viscera. A large piece of an ovate form, weighing about

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[a] Beale on the Sperm Whale, p. 183.

60 pounds, and several smaller pieces, irregularly shaped, were found in the intestinal canal. Some of the ambergris was brownish black on the outside and some of a grayish yellow cast; the exterior coating was filled with the mandibles of squid. The gross weight was 136 pounds, and it sold for $14,000.

Doubtless the most valuable lot ever secured was a mass weighing 162 pounds 11 ounces, obtained in 1891, known as the "Bank" lot, which sold in London for about £10,000. The following communication from the brokers who effected the sale of this remarkable find furnishes an excellent description of the lump and of the state of the ambergris market:

About the end of August, 1891, a gentleman called to consult us as to the best means of disposing of some ambergris which had been consigned to his firm. We suggested that if it were brought to us we could examine it and report upon its value, but when we were informed that the case which contained it weighed close on 224 pounds and was too large to go inside a cab our first feeling was one of incredulity as to the consignment being ambergris at all. It was finally decided that the case should remain in the strong room of the bank in which it had been deposited for safe custody and that we should go there to inspect it. This we did, and were shown a box measuring about 2 feet 4 inches in each direction and which we were told had with its contents been insured for £10,000.

In the presence of the merchant who had consulted us and the bank officials the lid of the case was opened, with the immediate result that everyone beat a hasty retreat from its vicinity, for the horrible smell which issued from the box was overpowering. When the odor had lost somewhat of its intensity, we began to take out the packing and found that the case (which was tin-lined) contained one huge mass of a blackish substance, measuring 6 feet 4 inches in circumference, nearly spherical, and which was undoubtedly ambergris. On being turned out of the case it was found to be saturated with moisture, as were the packings of paper and old gunny which had been put around it to prevent it from chafing to pieces during the voyage; and it was the liberation of the gases generated by the salt water and the animal matter which had caused the stench alluded to. By proper treatment this smell was eventually completely got rid of, and the ambergris obtained in marketable condition. The mass was next weighed and the certificate signed by the interested parties, the exact weight being at that time 2,603 ounces, or 162 pounds 11 ounces. This is probably the largest piece of ambergris which has ever been seen by anyone living, and approaches nearly in weight to the lump of 182 pounds purchased by the Dutch East India Company two hundred years ago.

The next thing to do was to split the lump, so as to see what the interior was like. This was accomplished with the aid of long chisels and crowbars. We then saw that the substance consisted of layers or laminæ rolled around a central core, the laminæ varying a good deal in texture, color, and flavor. Speaking generally, the outer layers were thin, friable, and shelly; dark, almost black in color, and mixed to a considerable extent with the beaks of the cuttle-fish, on which the whale feeds. As the layers approached the center they were denser, grayer in color, thicker, and of better flavor, until the core itself was reached. This core really consisted of two pieces, one the shape of a rifle bullet, but with a deepish depression like the "kickup" of a wine bottle in the base. It was from 10 to 11 inches high, with a diameter of about 6 inches at the bottom, tapering upward to about 2 inches at the top, which was slightly flattened. It was detached from the surrounding layers with the greatest ease, and stood alone, a pure, solid lump of the finest gray ambergris, weighing 83¼ ounces. Beside this magnificent piece was a smaller one, almost spherical in shape and about the size of a very large orange. It was rather darker in color and not of quite so fine a flavor, but was as easily detached from the surrounding layers as the other. Neither of these pieces contained any of the beaks which were so common in the outer layers, and it is almost needless to say that they realized by far the highest price which was obtained for any portion of the mass. The layers nearest to the core were of much finer flavor than the outer and darker. One of them was quite 4 inches in thickness, and the ambergris of which it consisted was of a silvery-gray color, different from the whitish gray of the core, and was of lower specific gravity. The layer outside this again was striated in places with the darker exterior, and the beaks began to show, though not to the same extent as in the black, shelly, exterior layers.

It is a matter of some regret to us that we did not secure a photograph of this extraordinary lump, but the fact weighed heavily upon us that if the real truth about it leaked out the depression of the market would be so great that we should not be able to do justice to our clients, and, consequently, as few people as possible were let into the secret. It is true that reports about it were rife for a month or two, but as nothing authentic could be ascertained they gradually died out, and we have ourselves been repeatedly assured that the thing was a myth altogether, one gentleman going so far as to tell one of our partners, about three months afterwards, that he held three-fourths of the total quantity of ambergris in London, not knowing that we were controlling about 1½ hundredweight.

Probably the finest lot of ambergris received in America was taken in 1894 by the schooner *Adelia Chase* from a 50-barrel whale near Cape de Verde Islands. It weighed 109⅝ pounds and sold for about $26,000, the best parts fetching $350 per pound. No large finds have been reported since 1894. In 1899 50 pounds of poor quality was secured by the bark *Charles W. Morgan* off the coast of Japan. In 1900 the *Morning Star* secured 7 pounds, and in 1901 the same ship brought in 20 pounds of medium quality.

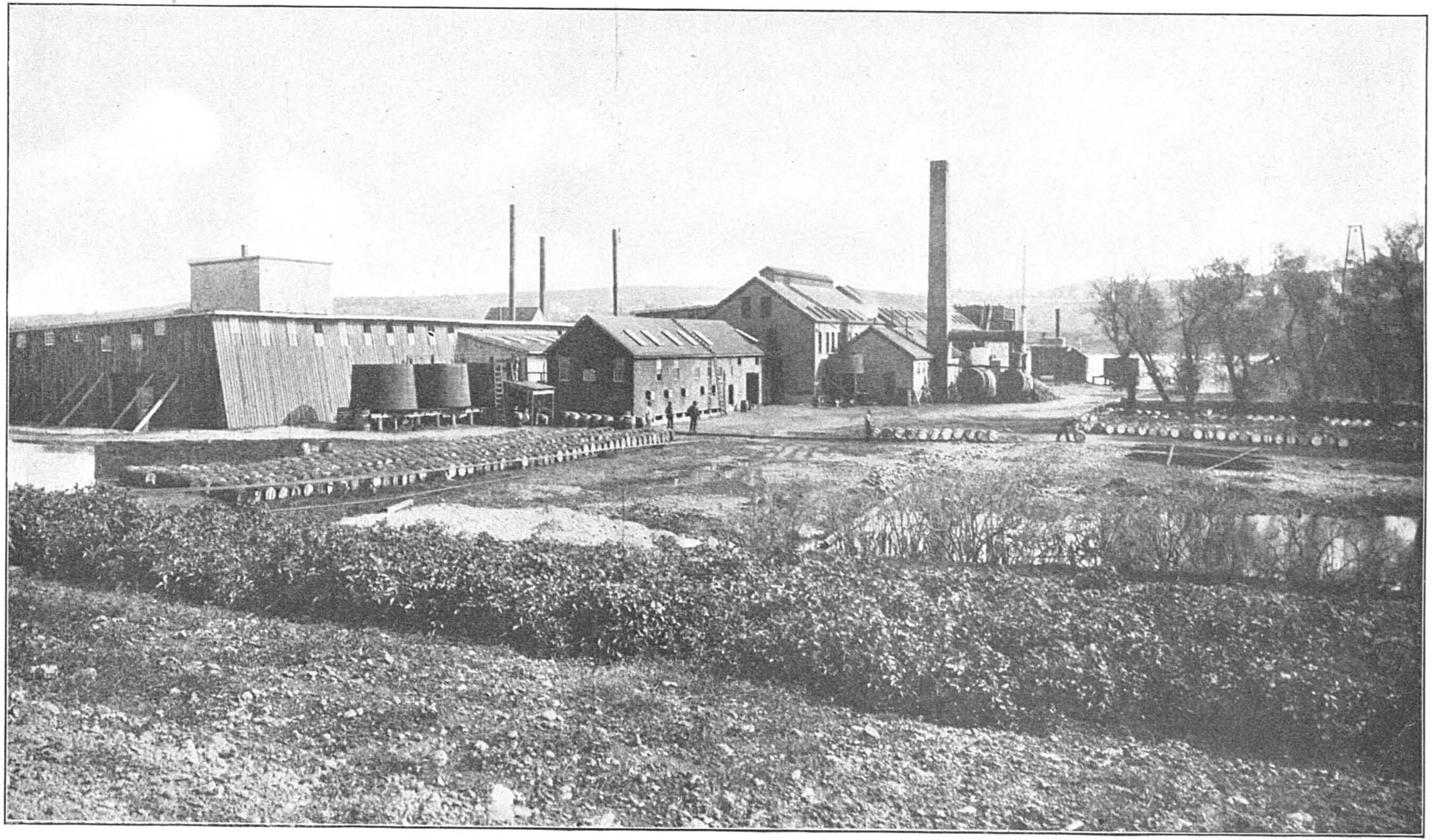
Ambergris has been used for centuries in the sacerdotal rites of the church, and, in connection with fragrant gums, it was formerly burnt in the apartments of royalty. It was formerly used in cookery, especially in the East, being added to flavor certain dishes. This custom spread through western Europe to a limited extent. Macaulay refers to rumors in connection with the death of Charles II of England that "something had been put into his broth, something added to his favorite dish of egg and ambergris." The principal use of ambergris, however, was as a medicine and as a perfume, especially in Asia and Africa. Until recently it held a place in pharmacy, being regarded as a cardiac and antispasmodic, somewhat analogous to musk, and was recommended in typhoid fevers and various nervous diseases.

The principal and almost the only use of ambergris at present is in the preparation of fine perfumes, furnishing an important ingredient in the production of choice bouquet of "extracts." It also acts as a "fixer" and serves to impart homogeneity and permanency to the different ingredients employed. For perfumers' use it is generally made into an essence or tincture by dissolving 4 ounces in a gallon of alcohol. This is facilitated by first crushing and mixing it with sand.

Perfumers exercise much care in the selection of the ambergris which they use. The wholesale dealer grades his stock of the material according to its odor, appearance, etc. But this is by no means sufficient for the trained olfactory sense of the perfume-manufacturer. Before determining the use of a special lot he tests it by his own standards, and these tests may extend over a month, especially for durability of perfume. Some manufacturers prize most highly those lots and grades which another manufacturer would not accept. The selection of just the proper quality to produce the desired bouquet forms one of the niceties of the perfumer's art.

The value of ambergris depends largely on its scarcity at the time and its freedom from impurities. During the last thirty years it has varied in price from $5 to $40 per ounce. At the present time it is quoted at $8 to $30 per ounce. In 1880 crude ambergris brought home by the whalers was sold at $10 an ounce and the dried article at $20 an ounce. In 1876 the value, dried, was $25 an ounce. In the London *Price Current of Colonial Produce* in 1807 ambergris is quoted at 40*s.* to 45*s.* per ounce for "gray, fine." Considering the respective purchasing powers of money two centuries ago and at the present time, that price is quite equal to the average value in recent years.

Report U. S. F. C. 1902.



MENHADEN FACTORY AT TIVERTON, RHODE ISLAND.

AQUATIC PRODUCTS AS FERTILIZERS.

GENERAL REVIEW.

A fertilizer is any substance added to the soil for the purpose of producing a better growth of crops. The food required by plants is supplied in part from the atmosphere, but principally from the soil. If the supply of any one of the necessary ingredients be deficient, a small crop is the result; and the purpose of fertilizers is to supply the plant-foods lacking in the soil.

The general use of fertilizers is of comparatively recent origin, yet the preparation of these substances supports an extensive industry, employing a large amount of capital and many thousands of men. Compared with the immense quantities of barnyard materials, phosphate rocks, etc., the use of aquatic products for fertilizer is relatively small, yet it is by no means unimportant in the fishery industries.

Fish, seaweeds, shells of mollusks and crustaceans, and various other aquatic products have long been known to possess rich fertilizing properties. All kinds of fish can be used for this purpose; but, owing to the greater value of choice species as food, only the non-edible ones and the waste parts are utilized. The menhaden is the only fish taken in great quantities in this country especially for conversion into fertilizer. The output of this species is very large, amounting to 30 per cent of the total catch of fish in the United States, and its capture maintains one of the most extensive and vigorously prosecuted of the American fisheries. Compared with that from menhaden, the quantity of fertilizer made from other fish is small, and only such are used for this purpose as can not be profitably employed in any other way.

The original use of fish for fertilizing purposes was in a fresh or green state, and they were added to the soil directly after their capture, although, of course, no special effort was made to preserve their freshness. Before the advent of the colonists in America, the Indians were accustomed to manure their small crops of corn by placing one or more fish in each hill or by spreading them broadcast over the field, and this practice was followed by the early settlers. Owing to the original richness of the soil and the limited agricultural operations, the use of fertilizers was of comparatively small extent until the latter part of the eighteenth century. It appears that fish were then employed for this purpose all along the Atlantic seaboard from Maine to North Carolina wherever they were obtainable in sufficient quantities.

Fresh fish contain usually from 65 to 80 per cent of water and from 1 to 16 per cent of oil. Neither of these has any value as a fertilizer. On the contrary they decrease the portability and storage qualities of the constituents, and the presence of the oil is prejudicial to the decomposition of the fertilizer when applied to the soil.

Early in the nineteenth century the fishermen occasionally extracted the oil from the fish when the latter were unusually fat, thus removing an injurious ingredient, for which valuable uses were found. This resulted gradually in the establishment of factories for removing the oil, and likewise most of the water, so that the fertilizing substance might be in better condition for transportation. At present most of the fish used for fertilizer are treated in this manner, even the farmer-fishermen finding it more profitable to sell their catch at the factories and purchase the scrap; but large quantities of fish in a fresh state are yet used precisely as was the custom three hundred years ago.

Owing to its great abundance, combined with its nonedible qualities, the menhaden is the principal fish used for fertilizer in this country, and the quantity used annually is about 800,000,000 in number, or 240,000 tons round or live weight. Of these fully 99 per cent are handled at the factories, and the remainder are used in a fresh or green state. With the menhaden are taken some skates, sea-robins, bellows-fish, and other waste fish. Aside from a few that may be taken with the menhaden, and occasionally some river herring or alewives, no other fish are captured in the United States especially for fertilizer to any great extent.

Formerly nearly all the waste produced in dressing fish for market was thrown away as useless; but in recent years, in the fisheries as in other industries, the utilization of waste material has been made a subject of careful investigation, and many substances formerly considered refuse are now found to contain elements of commercial value. The dressings at the fish markets and at the fishing centers, the refuse of canneries and boneless-fish factories, and even the carcasses of whales are turned to account in the production of fertilizer. In addition to these materials, the farmers use large quantities of seaweeds, horseshoe crabs, oyster shells, clam shells, etc.

The total annual product of menhaden fertilizer in the United States according to the latest returns amounted to 85,830 tons, for which the producers received $1,539,810. It is difficult to approximate the quantity of other fishery products used for fertilizer, but it is estimated that the waste fish of all kinds amount to about 20,000 tons, worth $200,000; horseshoe crabs, shells of shrimp, etc., 800 tons, worth

$16,000; shells and agricultural lime, 60,000 tons, worth $150,000, and seaweeds, 250,000 tons, worth $312,500, making a total estimated output for this country per year of 416,630 tons, worth $2,118,310.

THE MENHADEN INDUSTRY.

The menhaden belongs to the *Clupeidæ* or herring family, and is about the size of the common herring of the New England coast, but somewhat deeper and more robust. It is not considered a food-fish and is rarely eaten, owing to the abundance of bones, although the flavor is not unpleasant. However, it is one of the most important of all of the species on the coast, being the principal source of bait during the summer, in addition to its use in the manufacture of oil and fertilizer.

The menhaden occurs all along the Atlantic coast of the United States from Maine to Texas, and most abundantly between Cape Cod and Cape Henry, except that during certain years it seeks the coast of Maine in enormous quantities. It appears on the approach of warm weather, ranging from March and April in Chesapeake Bay to May and June on the Maine coast, and remains until late in autumn. Its bathymetrical range extends from the inland limits of salt water to the Gulf Stream, but probably 95 per cent of the catch is made within 2 miles of the coastal line. It is captured principally by means of purse seines, operated from steam vessels with carrying capacity for several hundred thousand fish.

About a quarter of a century ago several important reports relative to the menhaden were issued. The first was that of Messrs. Boardman and Atkins, made to the Maine board of agriculture in 1875.[a] Three years later was issued the report of Mr. Luther Maddox.[b] Each of these related especially to conditions existing in the State of Maine.

In 1879 the United States Fish Commission published the important report of Dr. G. Brown Goode, containing voluminous notes on the natural and economic history of the menhaden, with many extracts from previous reports on the subject.[c]

Many changes have been made in the methods of utilizing the menhaden since those papers were written, but they are yet the principal authorities in regard to the natural history of the subject, and the present writer is prepared to add little. Indeed, such additional matter would scarcely be in place in this paper, which is restricted to the economic use of menhaden in the preparation of oil and fertilizer.

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[a] The Menhaden and Herring Fisheries of Maine as Sources of Fertilization, by Samuel L. Boardman and Charles G. Atkins, 1875, pp. 67.
[b] The Menhaden Fishery of Maine. Portland, 1878, pp. 46.
[c] The Natural and Economic History of the American Menhaden, by G. Brown Goode. Report U. S. Fish Commission, 1877, pp. 1-529.

HISTORY AND EXTENT OF THE INDUSTRY.

A century and more ago, when a much larger number of the home requisites were prepared by consumers than is the case at the present time, it was a part of the duties of many farmers along the Middle Atlantic coast to devote a few weeks each spring to taking menhaden for the purpose of fertilizing the cultivated land. Large shore seines made of cotton twine were employed, and in some localities these were owned jointly by several farmers of the vicinity. The length of some of these seines was 3,000 feet or more, and frequently the catch at a single haul numbered several hundred thousand fish, although the average quantity was nearer 10,000 or 12,000. This farmer-fishery has continued up to the present time, but its extent is now very much reduced, owing to the ease with which prepared fertilizers may be purchased.

Following upon the development of this use of fresh or green menhaden came the discovery that the oil was valuable for painting, leather-dressing, etc. Some of the farmers would provide a few casks or hogsheads which they partly filled with fish, adding water to cover them, and with weighted boards placed on top to keep the mass down. On the disintegration of the fish through putrefaction they were occasionally stirred with a long pole to break up the mass and liberate the oil, which floated to the surface of the water and was skimmed off from time to time. After several weeks the oil ceased to flow, and the residuary mass was used as fertilizer. For many years the extent of this business was very small and the product was entirely for home use.

The first improvement in the above process consisted in boiling the fish in kettles to facilitate the extraction of the oil, the boiled fish being then placed in casks, as above noted, resulting in a much larger product. By 1830 the cooking of the fish was quite general among the few persons engaged in extracting oil from menhaden. The oil was dark and crude, and used only for rough painting and leather-dressing, the market being restricted to the neighbors of the manufacturers. The use of kettles, however, involved a great waste of heat, and the business was of very little consequence until the introduction of steam in cooking the fish. The first steam factory, according to the late Capt. E. T. Deblois, was a small one built in 1841 near Portsmouth, R. I.

In 1850 Daniel Wells built a factory on Shelter Island, New York. That was the first factory of considerable size on the coast, and the quantity of fish handled amounted to 2,000,000 or 3,000,000 in number annually. In 1853 Mr. Wells built a new factory on Shelter Island, and the old one was removed to Groton, Conn., being the first steam factory in that State. The first factory in Maine was put up in 1863 at South Bristol, and in 1866 eleven factories were built in Maine. In 1869 the factory at South Bristol, Me., was removed to Fairport, Va., and was the first factory in that State.

In the meantime the purse-seine had been improved and adopted in the menhaden fishery, permitting the capture of fish in much larger quantities, and without which the menhaden industry could never have reached its present proportions. The next improvement consisted in pressing the scrap to extract a greater percentage of the oil. The first press, operated by hand power, was built by Charles Tuthill at the Wells factory, on Shelter Island, in 1856. This worked so satisfactorily that soon all the factories were pressing the scrap, and in 1858 hydraulic presses were introduced for the purpose. The high price of oil during the sixties, when it reached $1.40 per gallon, resulted in much profit in the business and a large increase in the number of factories, their location extending from Maine to Virginia. Then came the preparation of the scrap in the form of portable fertilizer, the adoption of large cooking-tanks instead of kettles, and the introduction of steam vessels in the fishery.

In 1876 floating factories were introduced. These consisted of boilers, cooking-tanks, presses, etc., mounted on steamers, sail vessels, or scows, for convenience in going from place to place to follow the movements of the fish. Probably half a dozen of these were in use in 1880; but owing to the lack of convenience for drying and handling the scrap, this form of factory was soon abandoned. Another disadvantage of a floating factory is that the constant movement of the vessel prevents the oil from settling, and it remains cloudy and fails to fetch the best market price.

The business continued to expand until it reached high-water mark in 1884, when 858,592,691 fish were caught, yielding 3,722,927 gallons of oil and 68,863 tons of scrap, valued at $2,800,000. Since that time great improvements have been made in the methods of the industry, but owing to the low price of oil and scrap, resulting from competition with other products, the profits have not been so great, and many factories have been dismantled. The largest catch of fish in any one year, according to figures of the U. S. Menhaden Oil and Guano Association, was 858,592,691, taken in 1884; the smallest was 223,623,750, secured in 1892, and the average catch during the last thirty years approximates 500,000,000 annually. The incomplete returns for 1902 indicate that the catch exceeded 900,000,000, a greater quantity than for any previous year.

There are two separate and distinct sets of figures showing the extent of the menhaden industry during recent years. The first comprises the returns made by the U. S. Menhaden Oil and Guano Association, organized in 1873, and covers the operations of the factories in the United States during each year from 1873 to 1898, inclusive. The second series represents the returns made by the agents of the United States Fish Commission for certain years from 1880 to 1902. Slight differences exist in these figures, but in the main they agree closely.

The following summary shows the returns made by the United States Menhaden Oil and Guano Association:

Statement of the extent of the menhaden industry of the United States in each year from 1873 to 1898, inclusive, according to the returns of the United States Menhaden Oil and Guano Association.

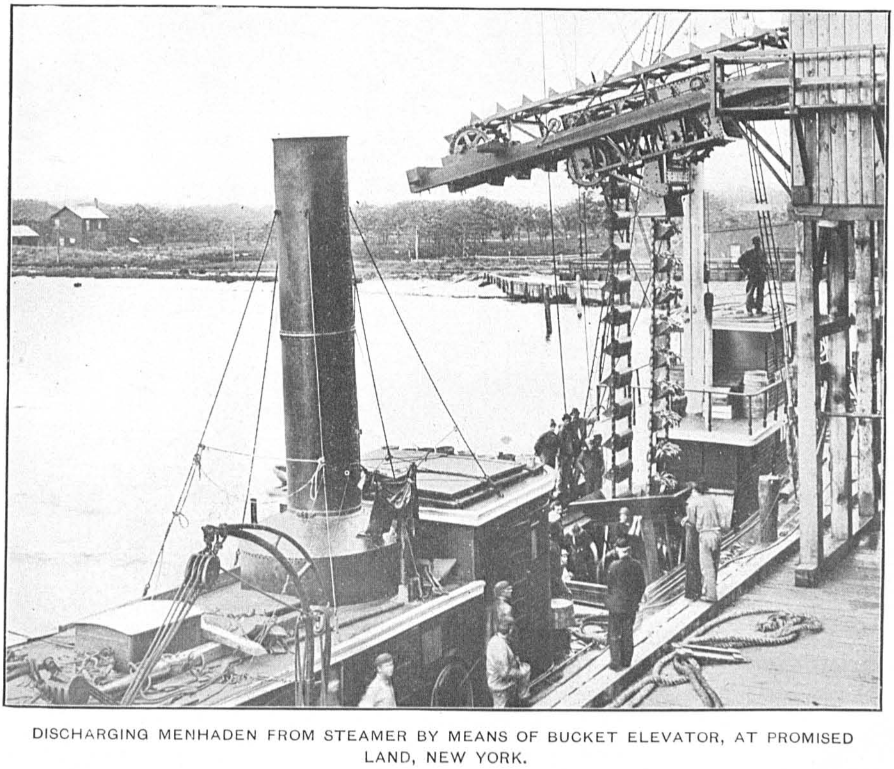
Year.	Factories.	Men employed.	Vessels employed.		Capital invested.	Fish received.	Oil made.	Scrap made.	
			Steamers.	Sail.				Dried.	Crude or acidulated.
	No.	*No.*				*No.*	*Gallons.*	*Tons.*	*Tons.*
1873	62	2,306	20	300	$2,388,000	397,700,000	2,214,800	....	36,299
1874	64	2,438	25	283	2,500,000	492,878,000	3,372,847	....	50,976
1875	60	2,633	39	304	2,650,000	563,327,000	2,681,482	....	53,625
1876	64	2,758	46	320	2,750,000	512,450,000	2,992,000	....	51,245
1877	56	2,631	63	270	2,047,612	587,642,125	2,426,589	5,700	49,744
1878	56	3,337	64	279	2,350,000	767,779,250	3,809,233	19,377	64,342
1879	60	2,296	81	204	2,502,500	637,063,750	2,258,901	20,563	37,496
1880	79	3,261	82	366	2,550,000	776,875,000	2,034,940	25,800	19,020
1881	97	2,805	73	286	2,460,000	454,192,000	1,266,549	25,027	7,592
1882	97	2,313	83	212	2,338,500	346,638,555	2,021,316	17,552	10,029
1883	78	2,427	69	136	2,651,000	613,461,776	2,166,320	34,216	10,920
1884	52	2,114	59	157	1,534,756	858,592,691	3,722,927	58,433	10,430
1885	50	2,064	78	84	1,314,500	479,214,415	2,346,319	33,910	7,225
1886	26	1,154	45	74	1,234,000	283,106,000	1,805,544	14,597	4,298
1887	28	2,499	46	38	1,000,000	333,564,800	2,273,566	17,262	5,368
1888	24	3,568	45	42	3,000,000	439,388,950	2,051,128	15,638	12,406
1889	29	4,400	46	84	2,500,000	555,319,800	3,327,030	24,859	25,859
1890	28	4,368	52	27	2,500,000	533,686,156	2,939,217	20,339	21,173
1891	27	2,985	54	13	1,775,000	355,138,873	1,946,642	12,608	15,069
1892	29	2,002	55	10	1,756,000	223,623,750	1,329,644	8,400	10,815
1893	33	2,235	57	27	1,721,000	366,406,625	1,269,002	13,150	15,465
1894	44	2,356	56	28	2,000,000	533,361,900	1,999,506	20,057	27,582
1895	42	2,276	48	35	1,600,000	461,747,000	1,767,754	18,682	21,965
1896	35	2,115	53	38	1,376,500	401,425,800	1,741,530	14,280	21,484
1897	41	2,750	60	45	1,871,000	584,302,930	2,147,113	18,430	34,372
1898	40	2,470	51	20	2,500,000	542,500,000	2,450,000	17,360	34,120

The following summary shows the extent of the menhaden industry according to the latest returns of the United States Fish Commission. The figures for Connecticut, New Jersey, and Virginia for 1902 are not yet available, and there have been no operations in Texas since 1901:

States.	Year.	Factories.	Fish received.	Oil made.		Dried scrap.		Acidulated scrap.		Total value of product.
		No.	*No.*	*Gallons.*	*Value.*	*Tons.*	*Value.*	*Tons.*	*Value.*	
Rhode Island	1902	1	114,757,900	897,188	$225,912	......	....	15,727	$203,906	$429,818
Connecticut	1900	2	19,975,700	118,750	30,475	450	$12,000	1,450	23,450	65,925
New York	1902	3	187,671,300	1,397,583	353,279	9,030	218,217	7,410	92,765	664,261
New Jersey	1901	6	27,000,000	109,789	25,440	1,131	52,046	......	....	77,486
Delaware	1902	1	84,869,100	394,119	96,724	1,642	39,069	8,871	110,668	246,461
Virginia	1901	15	378,727,331	723,215	164,465	21,130	517,872	10,591	135,388	817,725
North Carolina	1902	7	70,167,800	102,052	22,730	1,884	40,214	4,804	64,128	127,072
Texas	1901	1	26,806,500	69,639	14,654	1,710	30,087	......	....	44,741
Total	......	36	910,065,631	3,812,335	933,679	36,977	909,505	48,853	630,305	2,473,489

Although very small quantities of other fish are used, practically the entire catch in the menhaden fishery consists of that species alone. The principal species other than menhaden are sea-robin, skates, and bellows-fish. These are secured mostly in pound nets, especially in those set in Gardiner Bay. They sell for 50 to 80 cents per 1,000, and two or three million are used each year. The sea-robin yields

DISCHARGING MENHADEN FROM VESSEL BY MEANS OF TUBS.



DISCHARGING MENHADEN FROM STEAMER BY MEANS OF BUCKET ELEVATOR, AT PROMISED LAND, NEW YORK.

3 or 4 quarts of oil to the barrel. This oil is of good color and is readily sold for menhaden oil, but the scrap is not quite so desirable for fertilizer as that from menhaden. Skates and bellows-fish are comparatively dry, yielding less than one pint of oil to the barrel of fish.

Owing to much contention resulting from the claim that with the menhaden large quantities of choice food-fish are taken and rendered at the factories, the United States Fish Commission, in the season of 1894, made a thorough inspection of the catches made by two representative steamers of the fleet. This examination showed that in a catch of 27,965,756 fish only one-third of 1 per cent were food-fish, and only a very small proportion of this percentage was of choice and popular varieties. "As a general thing not enough desirable food-fish are taken by the menhaden steamers to keep the vessels' crews regularly supplied with fresh fish. As a rule, all the food-fish caught are eaten either by the crews or by the factory hands, but it occasionally happens that schools of blue-fish, butter-fish, shad, river herring, etc., are taken and more fish are thus provided than can be consumed."[a]

The menhaden factories are distributed along the coast at points convenient to the fishing-grounds. They vary in size and equipment according to the amount of invested capital and the degree of modernness. Some are of primitive type, consisting of two or three large kettles or try-pots and a simple press, the whole, with the accompanying equipment, costing only a few hundred dollars, and are capable of handling only 300,000 or 400,000 fish annually. From that they increase in size and capacity until the amount of invested capital in a single plant reaches half a million dollars, giving a working capacity of 200,000,000 fish annually.

COOKING AND PRESSING THE FISH.

The following account of the methods of the menhaden industry represents observations and inquiries made by the writer during the last four years, and especially in the season 1901. Most of the factories were visited either in 1901 or previously, and all details in the process of manufacture were inspected. The writer wishes to acknowledge in this connection the courtesy of Capt. N. B. Church, general manager of the Fisheries Company; Mr. H. H. Luther, superintendent of the Promised Land plant of that company, and of Capt. J. F. Bussels, of the Atlantic Fisheries Company.

There are two principal processes involved in the manufacture of oil and scrap from menhaden, viz, (1) cooking and pressing the fish and (2) drying or otherwise preserving the scrap, the methods varying according to the facilities of the plant. The great bulk of the fish are handled at large factories thoroughly equipped with modern machinery, including bucket elevators, automatic conveyors, continuous steam-cookers, hydraulic presses, artificial driers, etc.

Some of the factories, especially in Virginia, are quite small, with

[a] Bulletin United States Fish Commission for 1895, p. 297.

primitive methods of work. In one of them a fire is made under four cast-iron stationary boiling vats holding about 2 barrels of fish each. By means of a trough leading from a pump, water is permitted to run into the vats. After sufficient cooking, the fish are scooped out with large dip nets and put on a platform, whence they are pitched into tub presses having a lining of coarse canvas. By means of a vertical screw operated by a horizontal lever, pressure is applied to the mass, and the exuding oil runs through a trough to the oil vats. Another Chesapeake factory has six iron cooking-vats, in which are suspended an equal number of iron latticed baskets containing the fish. After cooking, the baskets are transferred by means of a crane and the fish placed in an hydraulic press. This method of cooking was formerly in general use all along the coast frequented by the menhaden.

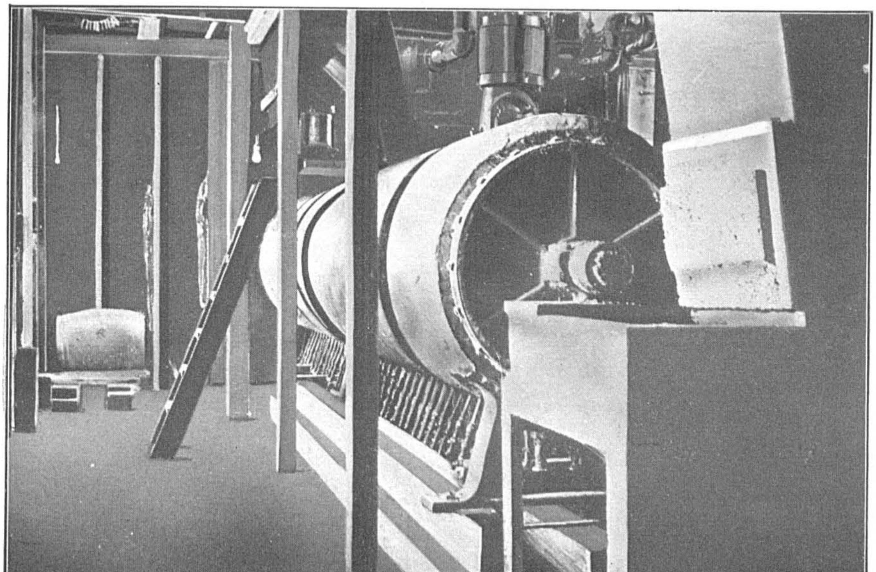
In the best-equipped factories the fish are removed from the hold of the steamer, where they have been stowed in bulk, by means of a bucket elevator. This contrivance, so important in the handling of grain and coal, was not introduced in the menhaden business until 1890, when a factory at Tiverton, R. I., was equipped with one. At present, however, they are in use in all the principal factories. Before their adoption the fish were shoveled into measuring tubs in the vessel's hold, and these raised and dumped in elevated receiving bins, or into cars holding 15 or 20 barrels each and running on inclined tramways to the receiving bins, requiring five or six hours to discharge 1,000 barrels. By using the bucket elevator, with four men to feed it, 1,000 barrels of fish may easily be discharged in an hour. This decrease in length of time required for discharging is frequently a matter of great importance when fish are abundant, as it enables the steamers to speedily return to the fishing-grounds.

The elevator dumps the fish into one of a pair of automatic weighing hoppers, with a dial-scale indicator of 1-ton capacity. When the required weight is in the hopper, by means of a lever the incoming fish are directed into the other hopper, and the bottom of the full one is dropped, thus dumping its contents into a conveyor, which deposits the fish into a receiving bin with capacity of 6,000 or 8,000 barrels.

The weighing of the fish is necessary to secure a record of the quantity received, furnishing a basis for compensating the captains of the vessels, and for other purposes. It thus appears that this method of discharging changes the standard of measurement from bulk to weight. Although it is customary to reckon the quantity of menhaden by so many thousand, the fish are not counted. An arbitrary size of 22 cubic inches is the standard measurement for each fish, or 22,000 cubic inches to the thousand. Two hundred pounds represent one barrel, and $3\frac{1}{3}$ barrels represent 1,000 fish. The size of the fish varies considerably, and the actual number required to make "one thousand" in measure ranges from 500 to 2,000 in number.

The floor of the large receiving bin slants toward the longitudinal

RECEIVING-BIN FOR FISH AT MENHADEN FACTORY.



CONTINUOUS STEAM-COOKER, USED BY FISHERIES COMPANY AT PROMISED LAND, NEW YORK.

middle, where is stationed a trough or chute with a covering movable in sections of short length. In this trough runs a conveyor, consisting of two parallel endless chains, between which, at intervals of 2 or 3 feet, are attached pieces of board which act as buckets to push the fish along through the trough when a section of the covering is removed. This trough with endless carrier is in use in practically all the large factories, irrespective of the method of cooking. It carries the fish to the cooking bins, or to the steam cooker in case the latter is employed, traps or slides in the bottom of the trough permitting the distribution of the fish into any of the tanks desired.

The cooking bins or tanks are large rectangular wooden boxes having capacity of from 50 to 100 barrels each and arranged with a lattice platform, about 4 inches above the bottom, on which the fish rest. Between the lattice platform and the bottom there is a nest of steam piping connected with a pipe leading from steam boilers. A water pipe also leads into the bin, through which salt water for cooking the fish is pumped into the tanks to a depth of about 1 foot or more. For convenience in handling the materials, the bins are commonly arranged in two adjacent rows, and above them runs the endless carrier conveying the fish from the receiving bin. On the outer side of each of the two rows of tanks runs a track leading to the presses, to be described later. When the bins are filled with fish, steam is turned into the piping in the bottom and heats the water, thus cooking the fish, reducing them to pulp, and breaking the oil cells. The amount of the cooking determines the extent to which the oil is removed. If carried to an extreme point, nearly all the oil can be pressed out. But severe cooking results in greatly damaging the quality of the oil and in loss of a certain amount of the nitrogenous compounds so important in determining the commercial value of the scrap. It is, therefore, important that the heat be so regulated as to extract as much oil as practicable without injuring the quality and with a minimum loss of nitrogen. The requisite degree of cooking is reached when the fish crumble to pieces easily. A high degree of temperature is maintained for about fifty minutes, when the mass of fish is broken up and then permitted to simmer for four or five hours. The free oil and water are then drawn off and the fish permitted to drain for several hours.

During the last two or three years the largest factories on the coast have been using continuous steam cookers. The most popular form is constructed so that a conveyor transmits the fish into a steam-tight receptacle, into which a large number of jets of steam are introduced, which thoroughly cooks the mass. The process is continuous, requiring about fifteen minutes for the fish to pass through, and the capacity of each cooker is about 600 barrels per hour. From the cooker the mass of fish is carried by means of a screw conveyor into an upright elevator casing, whence a bucket elevator carries it to receiving tanks, where it drains overnight. These tanks are usually about 10 feet square and 5 feet deep. Most factories use for this purpose the bins used in cooking before the adoption of the steam cooker. One factory has a total of 52 tanks for draining the fish.

The oil and water draining from the cooked fish is pumped or led off through pipes or troughs into the oil room, where it is received into large vats. After draining for ten or twelve hours, the mass of cooked fish is forked out of the tanks and thrown into curbs for pressing.

The curbs are of various designs. The most common form is a cylindrical tub with a hinged bottom firmly attached to axles, which are provided with wheels so as to run on a tramway. The staves are made of metal slats and are held together by stout bands. They are set at a convenient distance apart to allow the oil and water to pass through, and increase in width from the center to the bottom enough to overcome the enlargement of the opening between the slats consequent upon their outward slant. This outward slant commences at about the middle of the curb and extends to the lower end, and its effect is to give the curb an increasing diameter as the bottom is approached, so that the hard cake remaining after pressure is relaxed can be readily forced out at the bottom. Through the center of the curb runs a hollow core, stoutly constructed of metal slats. The bottom is attached by means of hinges to the lower end of braces, which are firmly fastened to the lower band of the curb, the axle, and the middle band. The opposite side of the bottom is suspended by means of latches which are caught and held by a bolt sliding freely within the braces and actuated by a lever pivoted upon the axles. The axles are also braced by stays on either side of the tub, which pass from one axle to the other, and, being curved to fit closely to a section of a band, are firmly attached thereto. The capacity of each curb is about 7 barrels. A metal shield surrounds it to protect the workmen from the spattering oil and water when pressure is applied.

The curb, having been filled with cooked fish, is run along the rail and placed under a solid stationary head made to fit closely inside the curb and against which the fish are pressed as the curb is slowly raised by a powerful hydraulic press. This forces out most of the remaining oil and water, which exudes from between the slats, and by means of troughs and pipes is conveyed to the oil room. On relaxing the pressure the curb resumes its position on the railway and is moved from the press stand and the core removed; the bottom is swung out of the way, and the hard cake remaining in the tub is forced through the bottom, falling into receptacles underneath.

Under ordinary conditions from 5 to 7 per cent of the oil is left in the pressed fish, it being difficult to remove all the oil and water, owing to the gelatinous or gluey state of the fish as a result of the cooking. In some factories the chum or pressed fish is washed with hot water and then repressed, but this is scarcely profitable if the first pressing is properly performed. The chum now passes to the scrap room and its further treatment is described on pp. 265–268.

About two-thirds of the total amount of oil obtained runs from the cooked fish while it drains in the vats, the remaining one-third being extracted by the presses. The former is a trifle better than the latter, as it is somewhat lighter in color. The two grades are sometimes kept separate, but such is not the general practice.

Among the many methods of extracting the oil which have been tried but not adopted is the use of fumes of benzine or bisulphide of carbon. When these are brought in contact with the fish in air-tight chambers, they absorb the oil, the liquid result collecting in tanks at the bottom of the receptacle and the benzine being subsequently expelled by evaporation.

Much attention has been paid to devising a continuous process of cooking and pressing, in which the elements of labor are reduced to a minimum. When the Stanley process was invented, about five years ago, it was thought that the problem was solved and the patent rights were sold for a very large sum of money. In this process the fish are cooked in boiling water in a large, comparatively shallow, semicylindrical tank, the lower portion of which is fitted with a worm conveyor, while near the top is a perforated plate or grating, above which the fish or other solid matter can not pass, but through which the water and oil rise. The material is fed in through a hopper at one end and is discharged at the other end, being carried forward by the worm conveyor, which also reduces the material to a finely divided state, thus enabling the action of the water upon all parts of the material freely to liberate the oil. The oil rises to the surface of the water in the cooking vessel and escapes through a pipe in the end into a settling tank. From the bottom of this tank whatever water has come over with the oil is pumped back into the cooking vessel, entering at the opposite end from the outlet through which the oil flows and at a point near the surface of the level at which the water in the boiler is constantly kept, thus creating a current which carries the oil constantly forward toward the outlet. The scrap from which the oil has been liberated is carried forward to an outlet in the bottom of the cylinder by the worm conveyor and falls into an upright elevator casing having elevator buckets running upon an endless chain, which carry the material up and over, dumping it into a receptacle suitable for removing for further treatment. The liquid matter is carried up by the elevator buckets, drains through them, and returns to the liquor in the cooking apparatus. This process, however, has not yet been found sufficiently practical for general adoption.

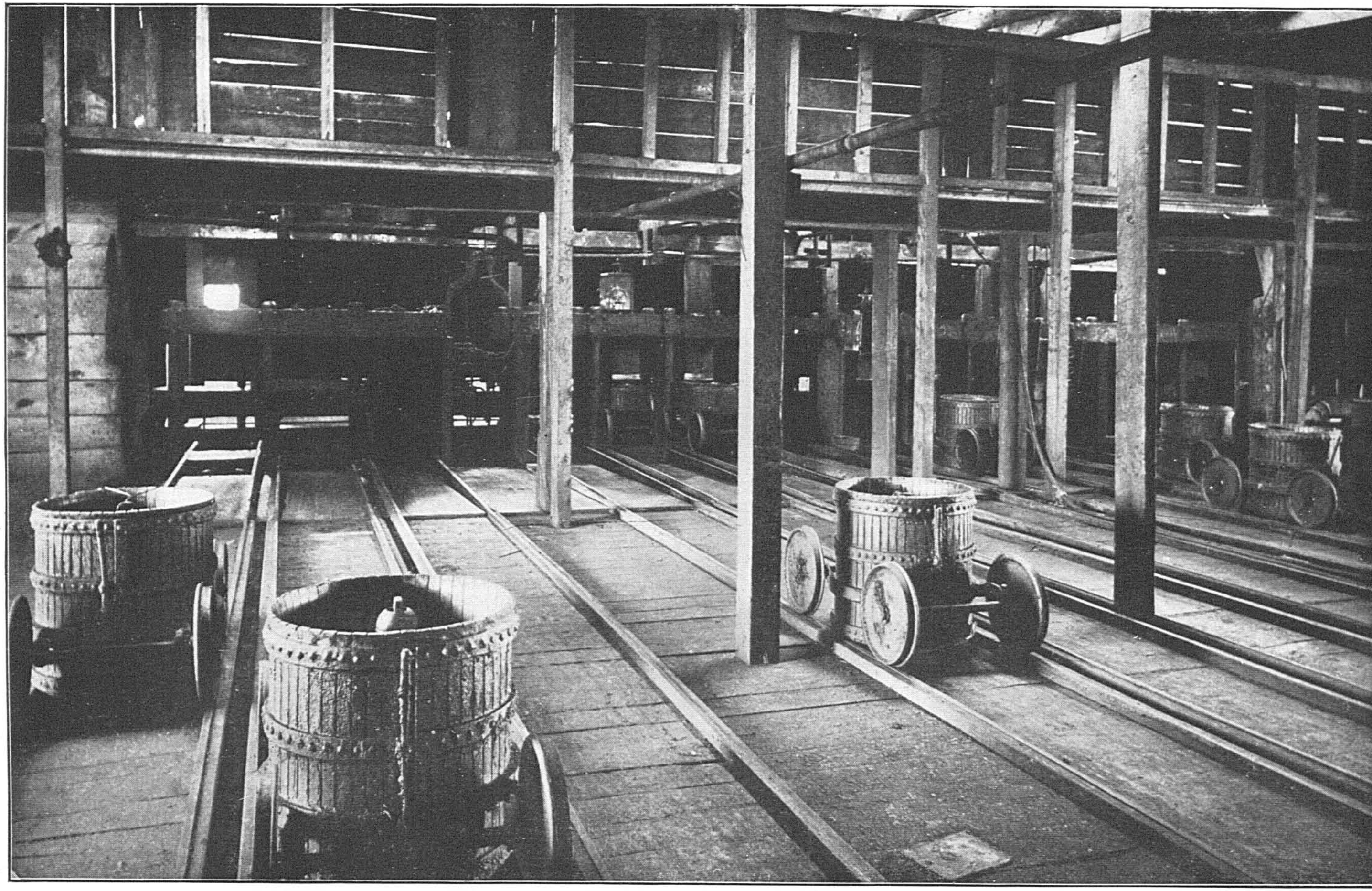
As long ago as 1858 the Ocean Oil and Guano Company, of Southold, N. Y., used a steam cylinder cooker somewhat similar to the continuous cooker now in use. This is said to have been invented by a Frenchman named De Molon, and is described in a pamphlet issued by the above company in 1860 as follows: The raw fish, in quantities of 1¾ tons, are placed in the inner chamber of a revolving cylinder, with double walls, the space between the inner and the outer walls being filled with steam at about 80 pounds pressure. Before admitting steam the cylinder is put in motion, so that as it revolves each fish is constantly changing its position. A uniform temperature is maintained by means of one head of the inner cylinder being perforated to permit the steam generated in the mass to escape through a safety valve.

In the oil room of the menhaden factories is a series of receptacles into which the oil and water are received from the draining tanks and the presses. The combined mass of oil and water is first subjected to a temperature of 150° F., which causes them to separate, the oil rising to the surface. It is permitted to overflow to other tanks containing hot water, where it is brought to the boiling-point by means of injected steam. It is important that the oil be separated from the water before the impurities begin to ferment, fermentation causing it to be dark and of lower grade. After settling for a while the oil is withdrawn into another tank and thence pumped into the storage tanks.

A contrivance for withdrawing the oil from the surface consists of a jointed pipe with open end at top, which in some cases is funnel-shaped. This passes up through the bottom of the vat, and the top of the pipe is so arranged that it may be raised or lowered to any desired distance beneath the surface to receive and guide the surface oil into the next vat. Sometimes there is a series of as many as 5 vats, from one to another of which the oil passes, each time becoming purer and purer as it is cooked and drained. The oil is led into the first of the cooking vats through the bottom, the pipe leading nearly to the surface. A second pipe passing through the bottom and terminating with an open top not a great distance above the bottom carries off the water-oil or less pure oil as it settles and conducts it to near the top of the second vat, where the oil and water are further separated.

At the bottom of each settling tank is deposited a quantity of finely-divided fleshy substance known as "gurry." This is removed from the tanks to the gurry room, where it is treated or sprinkled with sulphuric acid to facilitate the separation of the oil from the flesh fiber. It is then placed in bags, 2 gallons to the bag, and these placed in pairs under a press and subjected to great pressure, resulting in a small quantity of oil. The residuum in the bags, consisting of a hard cake, is broken up and either discarded or mixed with the scrap.

When thoroughly separated from the water, the oil is pumped into suitable storage tanks or barreled. The refining or bleaching of the oil is rarely done at the factories, but is performed by the oil-refiners of New York, New Bedford, Boston, etc., and the methods and results have already been described on p. 234.



PRESS-ROOM OF MENHADEN FACTORY, SHOWING ARRANGEMENT OF TRACKS, CURBS, PRESSES, ETC.

The yield of oil varies greatly, ranging from less than 1 pint to as much as 15 gallons or more per thousand fish, or rather for each 22,000 cubic inches of fish. As a rule, it is much greater in the autumn than in the spring, and also greater in Northern than in Southern localities. Even in the same locality the fish are very much fatter throughout some years than in others. For instance, the average yield of the fish taken in Chesapeake Bay in 1887 was nearly 6 gallons to the thousand, whereas in 1888 it was a little over 2 gallons, and early in that season it was less than 1 pint to the thousand fish. Some years ago one of the Shelter Island factories secured from one lot of fish a yield of 24 gallons to the thousand. The largest yield brought to the notice of the writer was derived from some menhaden that had been inclosed in Shinnecock Bay late in autumn. By feeding in the brackish water of that bay these became so fat that they yielded at the rate of 48 gallons of oil per thousand fish. Considering the entire Atlantic coast for a series of ten years ending in 1898, it is found that each thousand fish yielded 4.59 gallons of oil and 138 pounds of scrap containing 10 per cent of moisture. During the ten years ending in 1888 the yield per thousand fish was 4 gallons, and during the six years ending in 1878 it was 5.26 gallons.

The table given on page 233 shows the total yield of menhaden oil on the Atlantic coast of the United States and the average yield per thousand fish for each year since 1873. From those figures it appears that the largest yield per thousand fish was 6.84 gallons in 1874. The yield in 1887 and also that in 1886 were large, being 6.81 and 6.38 gallons, respectively. The smallest yield per 1,000 fish was in 1880, 2.62 gallons, and in 1881, 2.79 gallons.

Not only does the yield of oil vary from year to year, but it also differs greatly in different sections of the country. As a rule, the Northern fish, or rather those taken in Northern waters, especially off the Maine coast, are the fattest, while those from off the southern coast yield the smallest quantity. In the year 1900, for instance, the yield of oil at the Rhode Island factories was 5.76 gallons per 1,000 fish; in New York it was 6.39 gallons; in Delaware 4.92 gallons, and in Texas 3.51 gallons to the 1,000 fish. The menhaden taken off the coast of Maine are by far the fattest, and in the few seasons when fish are obtainable there the menhaden fishermen from other States hasten to that coast. In 1888 the Maine fish yielded 11.85 gallons of oil per 1,000; in 1889, 10.83 gallons, and in 1898, 9.73 gallons to the thousand measure. Menhaden have not been taken to any extent on that coast since 1898.

TREATMENT OF THE SCRAP.

As it leaves the press, fish scrap contains 45 or 50 per cent of water, which can not be removed by compression owing to the gelatinous condition of the fiber. Although suitable for immediate application as a fertilizer, the moist condition of this scrap renders it undesirable for economic transportation or for storage for a great length of time, and necessitates further treatment. Previous to 1875 most of the scrap was sold in a green state, just as it came from the press, but since 1878 practically all of it has been dried or treated with sulphuric acid.

Formerly in drying it was customary at all the factories to spread the green scrap upon platforms, where it was exposed to the action of the sun for several days. While this is the common method at present, most of the large factories have discarded it and are using artificial driers. The platforms are made of tight or matched boards laid flat upon a stout framework or upon the level ground, and are sometimes of large area, covering 2 or 3 acres. The scrap is transferred from the bin beneath the presses by means of screw conveyors and carried to a receiving bin, where it is dumped into hand carts with capacity of one-half ton each and carried to the platform. It is there spread to a depth of from 3 to 6 inches and is frequently turned or raked over, so as to expose all particles to the sun's influence. In threatening weather and when the night dews are heavy, the scrap is raked into windrows or heaps and, if necessary, covered with canvas to protect it from moisture. After two or three days' drying it is piled in heaps and left to sweat for a time, and then is again spread to evaporate the free moisture generated in the heaps. This second drying reduces the amount of moisture in the scrap to about 10 per cent, and the material may be safely bagged and stored for market, though that operation is usually deferred until immediately before its shipment. Frequently the dried scrap is ground, especially when it is to be sold direct to the farmers without further treatment, in order that it may be sown in drills with wheat and other grains.

If good weather could always be depended on, platform-drying would possibly be the most economical and satisfactory method; but owing to uncertainties of the weather much difficulty is frequently experienced in this process, resulting in a great waste of material and extra expenditure of labor and loss of ammonia in the scrap. This has resulted in the adoption of artificial driers at the largest factories. Several forms of apparatus have been employed, but the principle in most of them is similar, the scrap being subjected to a current of heated air by means of a blower. The drier adopted in the largest factories consists of an iron cylinder about 30 feet long and 5 feet in diameter, so mounted as to revolve horizontally. On the interior surface are shelves or paddles which, as the cylinder revolves, lift the scrap fed in at one end and permit it to fall to the bottom. A strong current of heated air is forced through the cylinder, extracting the moisture and gradually driving the scrap out at the further end.

Another form of drier in use consists of a large double cylinder of iron set on an incline, into which the scrap is fed through an opening at the higher end and guided along to the lower end by means of a revolving screw. The space between the inner and outer walls of the cylinder is filled with steam, which heats the scrap, thereby evaporating most of the moisture.

Labor-saving devices make the handling of the scrap almost automatic. From the presses it is transferred to the drier by means of screw conveyors and bucket elevators, and is fed intermittently in quantities of 200 pounds at intervals of 45 to 60 seconds. The capacity of a drier is 2½ to 3 tons per hour, and the largest factories usually have 2 drying machines. From these the scrap is conveyed to the storage room.

Although the term "dried" is popularly applied to all scrap from which a large portion of the moisture has been removed by evaporation, its use in a technical sense refers to scrap containing not to exceed 12 per cent of moisture. In modern factories, green scrap fresh from the presses contains from 45 to 50 per cent of water. When desiccated so that only 10 per cent of its weight is water, each ton of chum or green scrap yields about 1,156 pounds of "dried scrap." It is not always that so large a quantity of water is eliminated, and sometimes the finished scrap contains 25 and even 35 per cent of moisture. Owing to its tendency to lose nitrogen in the form of ammonia and its unsuitability for storage or transportation, the scrap containing a high percentage of moisture is for use principally in the vicinity of the factories.

Not all the scrap, however, is dried, a large percentage being treated with sulphuric acid for the purpose of "fixing" the ammonia, preventing fermentation, and dissolving the bones. To every ton of scrap, from 80 to 200 pounds of sulphuric acid of about 50° strength is added and thoroughly commingled, the quantity of acid used depending to some extent on the state of the weather and the extent of decomposition of the fish. This is conveniently done by depositing the green scrap in handcarts of 1,000 pounds capacity, wheeling these to an elevated platform and dumping the contents beneath, when the heap is immediately sprinkled with about 60 pounds of sulphuric acid contained in a leaden pot. After a short while the bones dissolve and the mass becomes homogeneous and of a rich brown color, instead of the former grayish color. The ammonia is fixed by the acid and the tendency to decomposition overcome. The scrap is then conveyed to the storage room and shipped in bulk as required.

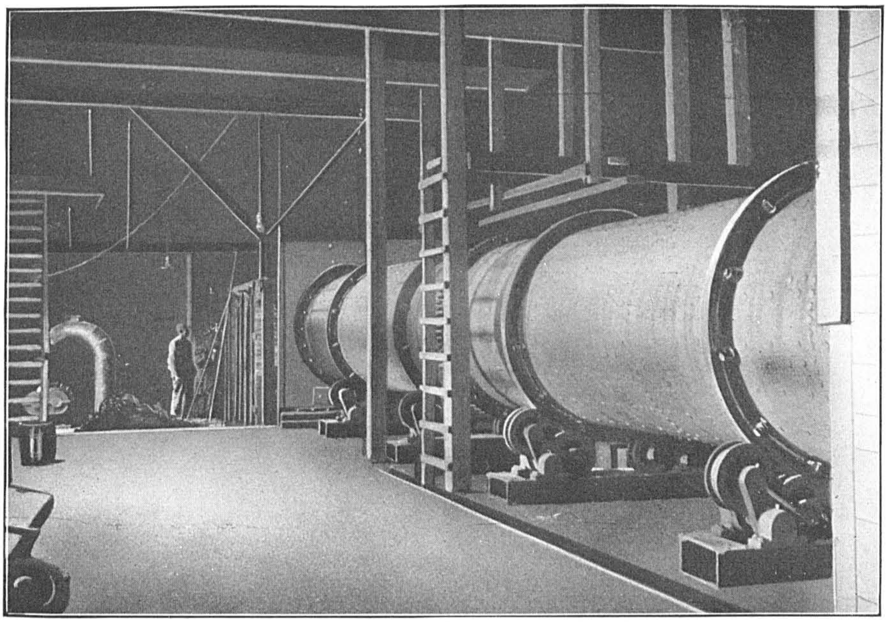
Instead of sulphuric acid, the solid granular sodium sulphate has been used to mix with the scrap, about 90 pounds being thoroughly combined with each ton. While this method is somewhat cheaper than applying sulphuric acid, it is not so satisfactory, and sodium sulphate is now little used for this purpose.

Owing to the difficulty in drying the scrap, most of that prepared at the Northern factories is acidulated, while the bulk of the Southern product is dried. In the last year for which data are available, the product of the entire coast was 48,853 tons acidulated and 36,977 tons dried, with a total selling value of $1,539,810. Of the 45,711 tons produced from Delaware northward, 33,458 tons were acidulated and 12,253 were dried, the average price of the former being $12.87 per ton and the latter $26.22 per ton. South of Delaware the product of green and of acidulated scrap combined, according to the latest returns, was 15,395 tons, while 24,724 tons were dried, the respective values per ton being $12.95 and $23.79.

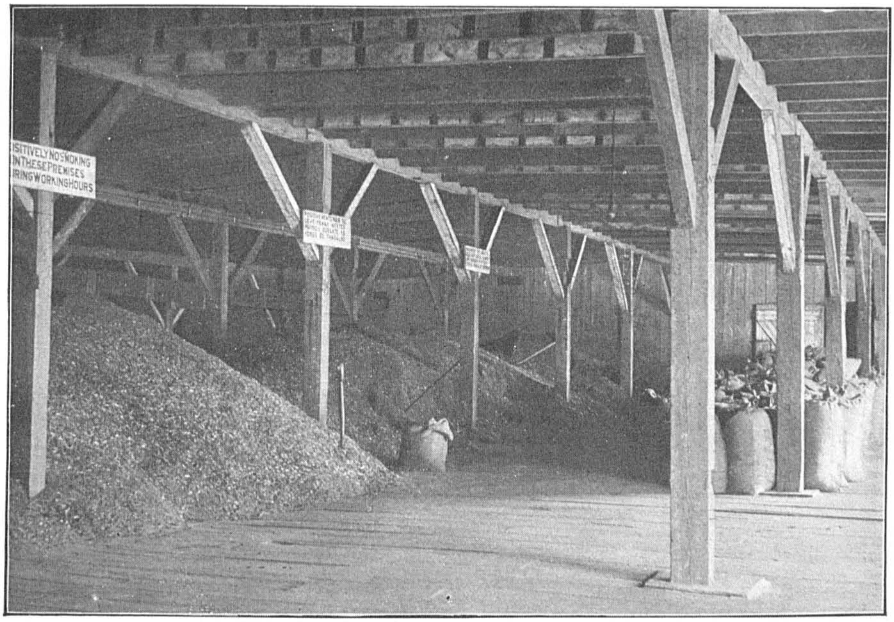
Only a small percentage of the fish scrap is used by the farmers in the condition in which it leaves the factories; most of it is ground and serves as an ingredient in compound or so-called "complete" fertilizers. Compound fertilizers are prepared at some of the menhaden factories, but as a general thing their preparation is in the hands of persons who have nothing to do with catching and rendering the fish.

The value of commercial fertilizers is dependent mainly on their content of nitrogen and phosphoric acid, which are the most important plant foods usually lacking in the soil. The nitrogen necessary is supplied mainly by fish scrap. Various other materials are also used, as dried blood, meat scrap and other slaughter-house refuse, cotton seed, sulphate of ammonia, nitrate of soda, Peruvian guano, etc. The phosphoric acid is supplied by fish scrap to some extent, but principally by the phosphate rocks, boneblack from the sugar refineries, bone meal, etc., the solubility of the phosphate being increased by treatment with sulphuric acid, thus making superphosphates. The value of fish scrap varies according to the percentage of ammonia and phosphoric acid contained therein. As a general rule, dried scrap contains about 8 per cent of nitrogen and 8½ per cent of phosphoric acid. On a selling basis of $24 per ton, the nitrogen costs about 10 cents per pound and the phosphoric acid about 3½ cents per pound for compounding purposes. Other necessary plant foods are potash, lime, magnesia, sulphuric acid, and iron. These usually exist in sufficient quantities in the soil itself, but are added under special conditions, especially the potash. The nature of the ingredients and the respective proportions required vary according to the soil and the crop for which the compound is intended.

Although the agricultural value of dried fish scrap is nearly equal to that of Peruvian guano, the market price is much below that article. In explanation of this fact it may be stated that fish scrap is not in such compact and good mechanical condition for shipment and general use. Its value as a fertilizing agent has not been so widely known as that of Peruvian guano, and thus its principal use is largely limited to the manufacturers of superphosphates, who are forced by competition to exercise great caution in the cost of manufacture. And, furthermore, there is a tendency to reduce the quantity of ammonia and increase that of phosphoric acid and potash in complete fertilizers to meet the requirements of the soil. Other ammoniated materials now compete with fish guano in the making of superphosphates, among



ARTIFICIAL DRIER IN FACTORY OF FISHERIES COMPANY, PROMISED LAND, NEW YORK.
(SEE P. 266.)



FERTILIZER ROOM IN FACTORY OF THE FISHERIES COMPANY, PROMISED LAND, N. Y.

which are cotton seed, sulphate of ammonia, nitrate of soda, tankage, meat scraps, slaughter-house refuse, etc.

The product of fish scrap, reduced to basis of dried weight, produced from 1873 to 1900 approximates 1,048,000 tons, or an annual average of 37,428 tons. As it is estimated that in a ton of compound fertilizer ready for the soil the usual proportion of fish scrap is 25 per cent, it is seen that the industry has contributed the ammoniate for 4,192,000 tons of fertilizer, or at the rate of 149,712 tons annually. In growing cotton, for which these fertilizers are largely used, 250 pounds are generally employed to raise one bale.

FERTILIZERS FROM FISH WASTE OR REFUSE.

Even in the food-fisheries large quantities of materials are obtained which can not be used for food. This includes not only non-edible species, but also those edible varieties which are not marketable, owing to such unusual conditions as lack of transportation facilities or a glut in the market. It likewise includes the refuse in dressing fish for the markets and for canning, drying, salting, etc.

Formerly, when the markets were overstocked during warm weather, large quantities of fresh fish spoiled and were suitable only for fertilizer. Even so choice a variety as the mackerel has been used for enriching land when taken in larger quantities than could be used for food purposes. In 1880, for instance, when the total catch of mackerel in New England approximated 132,000,000 pounds, 500,000 pounds of small fish were reported as having been used in Massachusetts as fertilizer.[a]

Previous to 1870, according to Capt. N. B. Church, many thousand barrels of scup and sea bass, taken in trap nets between Cape Cod and Montauk Point, were purchased by the farmers and spread on the land. Mr. A. B. Alexander states that large quantities of shad taken in the Columbia River are used for fertilizer. With the development of fish freezers and the improved means of communication and transportation this waste is much reduced. Yet the aggregate quantity of food-fish received in bad condition, or which "goes bad" in the markets, in the course of the year is very large in any populous city. During 1899, according to the *Fish Trades Gazette*, the quantity of fish condemned by the officers of the Fishmongers' Company in London was 1,520 tons, of which 232 tons were plaice, 228 tons Norwegian herring, 169 tons haddock, 94 tons mussels, 80 tons skate, 70 tons welks, and 60 tons of periwinkles. In New York City the quantity of spoiled fish condemned during the summer amounts to several hundred thousand pounds each year.[b]

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[a] Report U. S. Fish Commission, 1881, p. 219.

[b] During the interval between Wednesday, June 30, and Wednesday, July 14, the authorities of the health department of New York City condemned as unfit for food 41,650 pounds of fish. Of this amount, 39,650 pounds were seized in the Fulton Fish Market, the remaining 2,000 pounds being condemned by the local inspectors among the retail dealers in various sections of the city. (*The Fishing Gazette*, 1902, p. 458.)

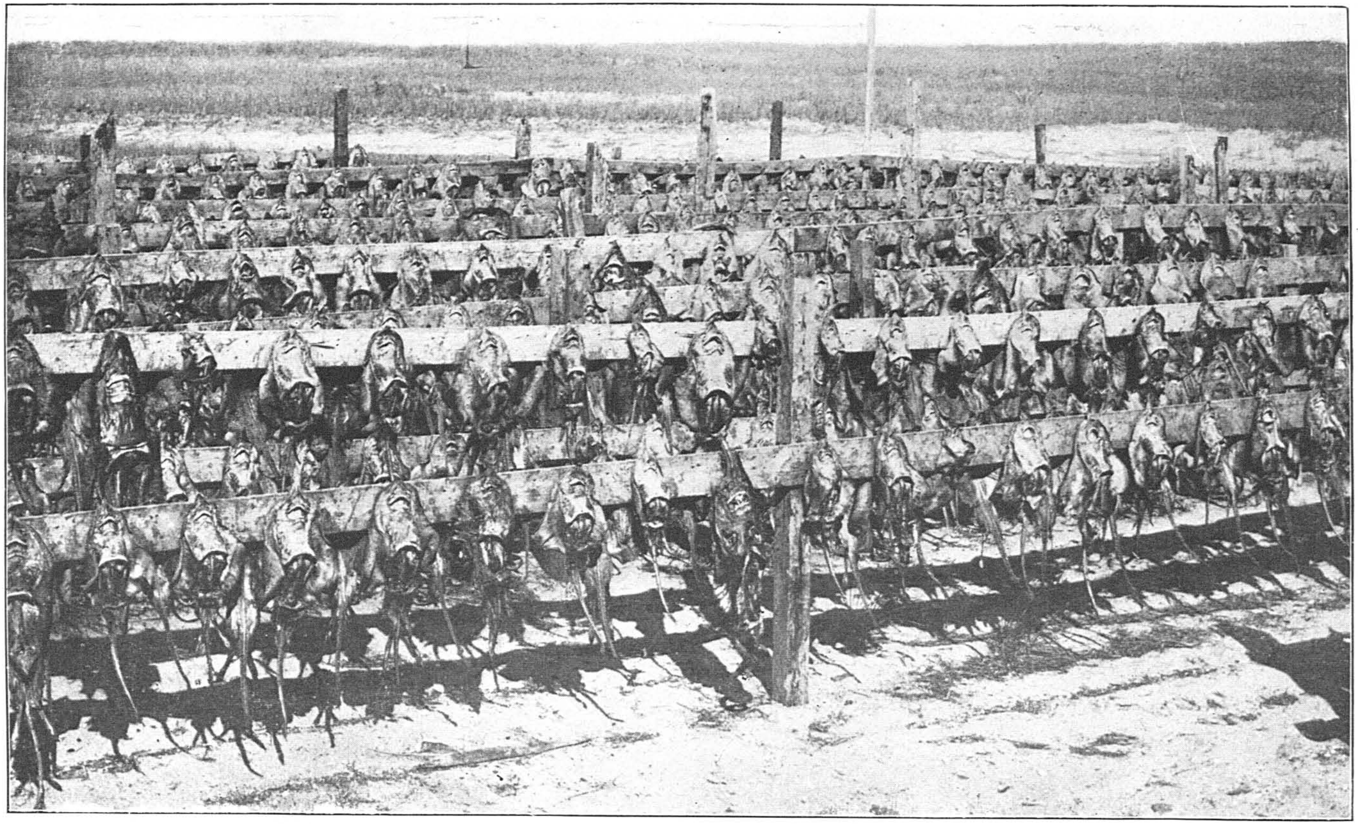
Before the development of the sardine industry in Maine, the small fish taken in connection with the smoked-herring business were commonly converted into oil and fertilizer. After the oil had been extracted by boiling and pressing, the chum was broken up, spread on a board platform, and dried by the action of the sun. It was then ground, bagged, and sold at $12 to $16 per ton.

About fifteen years ago a factory was established at Pillar Point, on the shore of Lake Ontario, for converting the surplus alewives occurring in that lake into fertilizer. The fish, obtained by means of seines and pound nets, were cooked for about 20 minutes in steam chests, permitted to drain for an hour, and then subjected to pressure in circular curbs holding about 5 barrels of chum each. The scrap was dried and ground and sold to the farmers for about $20 to $25 per ton. It is reported that in 1886 1,000,000 fish were utilized, yielding 500 gallons of oil and 63 tons of fertilizer. Along the shores of the Great Lakes and other waters, quantities of dead fish have been washed up in windrows, furnishing a harvest for the farmers in the vicinity.

In the pound-net fisheries of Cape Cod many skates and other "poor" fish, taken incidentally with the food-fish, are converted into fertilizer. If these contain much oil, it may be extracted by boiling and pressing. Ordinarily, however, the fish are dried without previous treatment. Especially is this the case with skates, which in some instances are suspended in rows above the ground until thoroughly dry, and are then ground fine. A large quantity of these fish hanging from a series of flakes or rails presents a very curious sight.

The quantity of waste and spoiled fish, however, is small compared with the very large amount of viscera and other offal resulting from dressing fish. The decrease in weight in dressing ranges from 15 to 35 per cent of the round weight, according to the species of fish and the season of the year. Assuming an average decrease of 25 per cent, it appears that in dressing the 900,000,000 pounds of food-fish produced in the United States each year the refuse amounts to 225,000,000 pounds, or 112,500 tons. While this is a very large amount in the aggregate, it is so widely distributed that the quantity at any one place is not of great importance, and usually its disposal is a sanitary problem rather than a source of revenue. In dressing fish at sea the waste is almost invariably thrown overboard. In the cities this material is usually combined with and handled in the same way as other market refuse. At the canneries where large quantities of fish are dressed, as in the salmon canneries of the Pacific coast, and the sardine canneries of Maine, the refuse is now in many cases rendered into oil and fertilizer. This has already been noted in the chapter on the preparation of oils from waste products in the fisheries. (See pp. 240-242).

In case the fish dressings contain little oil the inducements for utilizing them are not great. Water constitutes a very large proportion of the viscera, the quantity ranging from 65 to 90 per cent,



DRYING SKATES FOR MANUFACTURE INTO FERTILIZER, OPPOSITE PROVINCETOWN, MASS. (SEE P. 270.)

according to the species and the season. Even when the moisture is largely removed the quantity of fertilizing substances in the dried material is small. However, if the quantity of oil in the waste is sufficient to pay the cost of its extraction, it is usually profitable to perform the slight additional labor necessary to make the material suitable for fertilizer. The manurial content of fish heads is relatively large, and whenever they are accumulated in large quantities their conversion into fertilizer is profitable.

A convenient process of converting a small quantity of refuse from dressing fish into fertilizer is to store it in a receptacle made in the ground. This should be about 5 or 6 feet deep, with the area depending on the amount of refuse, but usually about 6 feet square. It should be dry and if the soil is sandy some clay should be spread at the bottom. First is placed a layer of wood ashes a few inches deep and then an equal layer of fish refuse covered by a sprinkling of lime. Then follow another layer of ashes, one of fish refuse sprinkled with lime, and so on until the hole is full. It should be covered with earth or sod and these covered with weighted boards and permitted to so remain for several months. The fish refuse quickly disintegrates and becomes mixed with the ashes, forming an excellent fertilizer.

Since 1875 the skins and bones resulting from the preparation of boneless codfish have been used for fertilizing purposes. After desalting them and extracting the glue, the remaining material is dried and sold for $15 or $20 per ton. The annual product amounts to about 3,000 tons. Most of this is produced at Gloucester, Mass., with smaller quantities at Boston, Provincetown, Portland, and Vinal Haven. According to analyses, this fertilizer contains about 10 or 12 per cent of phosphoric acid, 8 or 9 per cent of nitrogen, and 5 or 6 per cent of moisture.

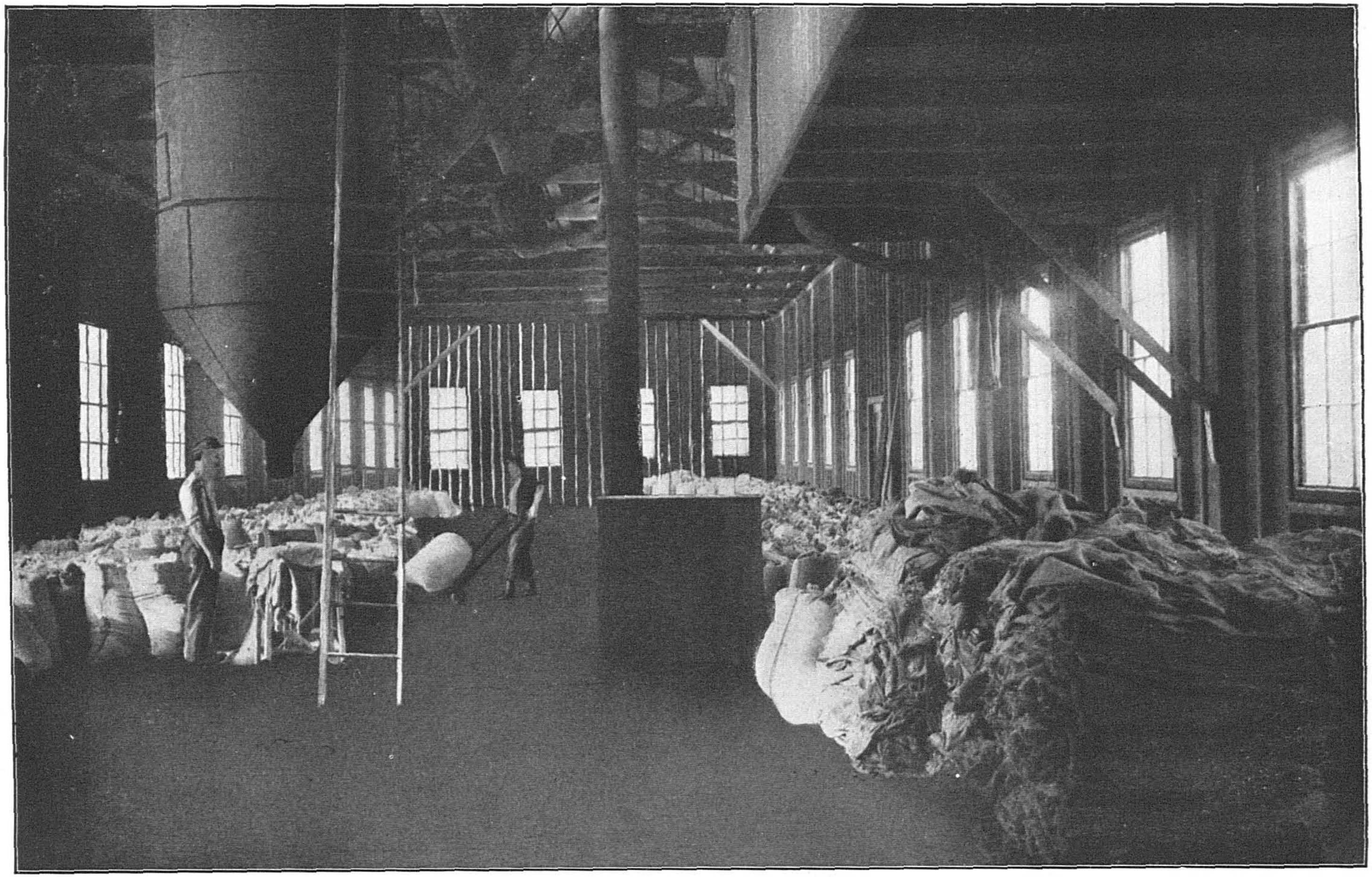
The refuse in preparing oil from livers of cod, sharks, and related species, from heads of halibut, sturgeon, and sword-fish, and from other materials is also dried and sold for fertilizer. The liver scrap formerly sold at $8 or $10 per ton, but at present its market value is only about half of that amount. Fertilizer made from fish heads is especially rich in phosphoric acid. A sample of guano made in Boston from fresh cod heads showed 20 per cent of phosphoric acid, 6¼ per cent of nitrogen, and 3½ per cent of moisture, and a sample of that made from fresh halibut heads contained 13 per cent of phosphoric acid, 5¼ per cent of nitrogen, and 5 per cent of moisture.

An important fish fertilizer in Norway is made from the refuse in dressing cod for drying, consisting principally of heads and backbones. These are merely dried by spreading them on the rocks and are then broken and ground to the condition of coarse bone-meal. In some localities the refuse is first steamed, to facilitate the drying and grinding. The utilization of these materials for fertilizer was begun about 1855, and the industry is centered at the Lofoden Islands, the location of the principal cod fishery of Europe. The present annual production is said to be upward of 10,000 tons of prepared scrap, about 20,000,000 cod heads being utilized for the purpose.

According to a report made by Consul-General Crowe, of the British service, the heads and bones are first partly dried in the open air and then cut into small pieces and thoroughly dried in a kiln. When all but 12 or 15 per cent of moisture has been driven off, the materials are crushed and then ground between millstones to the fineness of corn meal. The heads and bones are crushed separately, but are mixed together before the grinding process, the usual proportion of the mixture being one part of the backbones to five parts of the heads. Chemical analyses indicate an average content of water 13 per cent; organic substances 49.3 per cent, of which 8 per cent is nitrogen and 7.6 per cent ammonia; and inorganic substances 37.7 per cent, of which 14.9 per cent is phosphoric acid.

In utilizing whales at the Norwegian stations established in connection with the taking of these cetaceans, the flesh and bones are commonly prepared as fertilizer after the extraction of the oil. The blubber and the fat-lean are first removed from the flesh for oil-rendering, and then the flesh is cut into strips or minced in a machine and boiled with steam under pressure. As described by Michael Winnem, in *Chemische Revue*, the receptacles for boiling the flesh are horizontal iron cylinders provided with close-fitting openings. They are also provided with two outlet pipes, one at the very bottom, for removing the water, and the other about 4 inches higher up, for drawing off the oil. The flesh is spread on three superimposed perforated trays or false bottoms, and subjected within the cylinder to steam at a pressure of 40 or 50 pounds to the square inch for ten or twelve hours. At the end of that period the flesh is removed and placed in drying ovens. These are built of brick, 20 to 25 feet high, and fitted with internal sheet-metal trays, which are mounted alternately on the sides of the oven and on a central revolving shaft. The latter carries a number of slanting scrapers which revolve once in 5 minutes and slowly force the flesh from one tray to the next lower ones in succession. The descending flesh is dried by the heated air from a coke fire, which enters the oven at the top and passes out through an opening at the bottom.

The process is somewhat slow, the output during twenty-four hours not exceeding 2 tons for each oven. If desired, the fertilizer may be ground in a mill. The bones are broken and treated in much the same manner as the flesh. After boiling they are crushed in a disintegrator, ground in a bone-mill, and mixed with the flesh scrap. An analysis, made by Krocker, of Norwegian whale fertilizer indicated 7.63 per cent of nitrogen, 13.45 per cent of phosphoric acid, 16.49 per cent of lime, and 0.15 per cent of magnesia in a sample containing 5.35 per cent of moisture. The market price is about £5 per ton. In the bottle-nose fishery the oil is commonly extracted at sea, as in case of the American whale fishery, and consequently it is not practicable to utilize the flesh and bones as fertilizer.



FERTILIZER DEPARTMENT, RUSSIA CEMENT COMPANY'S GLUE FACTORY, GLOUCESTER, MASS.

FERTILIZERS FROM CRUSTACEANS.

Among the most curious of the marine products used for fertilizer is the horseshoe crab (*Limulus polyphemus*), which is found in comparative abundance at several points on the Atlantic coast and especially on the shores of Delaware Bay. The use of this fertilizer dates back at least a hundred years, old records indicating its employment by the farmers of Cape Cod in the eighteenth century. It is reported that they were first used in the Delaware Bay region about fifty years ago. In that section they are taken during May and June, when large numbers visit the shallow waters for spawning purposes. During the remainder of the year they are scarce inshore, although a few may be obtained. They are secured by picking them up at night on the shore either by hand or with pitchforks, or they are taken in pound nets constructed especially for that purpose. The pound nets cost $25 to $75 each, and they secure by far the greater number. At present the catch is very much less than it was twenty years ago. In 1880, according to the returns of the United States Fish Commission, the total catch in Delaware Bay amounted to 4,300,000 in number, worth $16,300. In 1890, it was only 1,939,670, worth $8,580, and in 1897 it was still further reduced to 1,206,095, worth $8,393. The value of the horseshoe crabs ranges from $4 to $8 per thousand and the weight averages about 2 pounds each.

In preparing them for fertilizer, the entire crabs are sometimes merely stacked in piles until they putrefy and become somewhat dry, when they are broken into fragments and composted with muck, lime, or other suitable materials. Two or three small factories exist at which the crabs are dried and ground, or they are ground while green and then mixed with sodium sulphate or sulphuric acid. The product sells for $15 to $25 per ton, and is an excellent fertilizer for grain and fruits. The output in 1880 approximated 1,950 tons, in 1890 it was reduced to 880 tons, and in 1901 it was still further reduced to 500 tons.

When lobsters were canned on the coast of Maine, a desirable grade of fertilizer was made from the shells and other refuse of the canneries. This refuse was sold at a nominal price at the factories, or given away for the hauling. The farmers collecting it would usually dry and grind it and then spread it on the land. Letters patent were issued to William D. Hall, in 1865, for the preparation of this fertilizer, but his rights in the matter were never protected. This waste is thus utilized at the present time at the lobster canneries in Nova Scotia and New Brunswick.

The shells of shrimp produced in the fisheries of California and Louisiana are used to a considerable extent for fertilizer, which is employed by the Chinese not only on the Pacific seaboard but also in the Orient. The shells are removed from the dried shrimp and sold at about $5 per ton. In California they are especially valued in strawberry and vegetable culture, while in China their principal use is as fertilizer for rice, tea plants, etc. In strawberry culture, from 300 to 400 pounds are commonly applied to each acre. It has also been used in wheat-growing, being spread broadcast on the land after the first plowing.

AGRICULTURAL LIME FROM MOLLUSK SHELLS.

The shells of oysters, clams, mussels, etc., have long been valued for agricultural purposes. All along the Atlantic coast of the United States, the extinct oyster beds, the old shell heaps, and even the living oyster reefs have long been resorted to by the neighboring farmers as a storehouse for top-dressing for their fields. In the Gulf States the most luxuriant vegetation along the shore is upon the shell mounds and marl deposits. Most of the material, however, is obtained from the shucking establishments where mollusks are opened in large quantities. Previous to the discovery of the limestone resources of Pennsylvania and other States, large quantities of shells were burned for lime; but at present their use for this purpose is confined largely to localities where the shells are unusually abundant and cheap.

An article in the *Country Gentleman*, volume 7, page 155, refers to the use of mussel shells for manure with especial reference to Essex County, Mass., as follows:

> Thousands of cords of mussel shells are annually taken from the beds of the streams bordering on the sea and used on cultivated ground. I have repeatedly witnessed the value of this fertilizer in the growing of carrots and onions. The very best crop of carrots I saw the last season, more than 34 tons to the acre, had no other fertilizer applied to the land. For the last thirty years I have known it applied to lands on which onions have been grown, with a product varying from 300 to 600 bushels to the acre. It sells, delivered several miles from where it is dug, at $4 to $5 the cord. It is usually gathered in the winter months, taken to the shore in scows or gondolas, and thence to the fields where it is used. Sometimes it is laid in a pile of several cords together, and after it has been exposed to the frosts of winter, distributed from 4 to 8 cords to the acre. At other times it is laid out in heaps of a few bushels only, which remain for a time exposed to the frost.

According to Storer, "lime is not a fertilizer in itself, but is of indirect value on land in unlocking the available potash, phosphorus, and nitrogen in the soil." It also renders heavy, compact soils looser in texture and tends to bind particles of loose, leachy soils.

It is difficult to approximate the sum total of value which shells confer on agriculture, owing to the extensive use of marl deposits. Of refuse shells from shucking-houses and the like, the quantity used in this country is doubtless upward of 60,000 tons annually.

The prepared lime is generally preferred to the ground shells. Analyses indicate that the organic matter contained in shells is well-nigh free from nitrogen, and there is no evidence that it is of any use as manure. It appears, therefore, that there is no need for the expense of grinding the shells and of carting the useless constituents which can be expelled by burning. Since grinding does not reduce the material to so fine a state as burning does, the ground shell is not so active chemically.

The most popular manner of utilizing shells is to burn them and slack the product with water. The slacking may be done in heaps covered with moistened earth, and the fine powdery hydrate of lime spread directly upon the land; or the lime may be used in the compost heap; or the quicklime may be left to become air-slacked by exposure to the air, and the product be applied to the land instead of leached ashes.

AQUATIC PLANTS AS FERTILIZERS.

Although it does not appear that the many properties of aquatic plants have been fully exploited, their uses are far more numerous and diversified than is generally supposed. Their most widely known economic value is as furnishing thousands of tons of fertilizer and a great variety of nutritious and wholesome foods. In addition thereto, they are utilized in the production of many chemicals, especially iodine and bromine, and as a constituent in glues and gelatines, and as a basis for trade fruit-jellies. They also serve in sizing fabrics, in refining beer, as a mordant in dyeing, as composition in cement for covering boilers, for stuffing upholstery, packing porcelain, in making paper, fishing-lines, ropes, buttons, handles for cutlery, as tents in surgical operations, etc. The gathering of seaweeds in Great Britain early in the present century is said to have given employment to about 100,000 persons, the product being used in the manufacture of carbonate of soda.

On the coasts of France and the British Isles thousands of tons of seaweeds are collected annually for fertilizing the crops. In China and Japan they have been used as fertilizer for many centuries, but in recent years the employment of seaweeds for this purpose has been much reduced, owing to their more extended use as food and in the chemical and manufacturing industries. In the New England States they are probably the most important fertilizing material used on those farms immediately adjoining the sea. According to Storer, with the exception of the farms of the Connecticut Valley and those enriched by fish scrap or by manures received from the cities, "the only really fertile tracts in New England are to be found back of those sea beaches upon which an abundant supply of seaweeds is thrown up by storms." In the Middle Atlantic States the use of seaweeds as fertilizer is not so extensive, but in the aggregate very large quantities are employed. Elsewhere in the United States their use is of less importance.

There are three principal groups of aquatic plants used in this country for fertilizer, viz, rockweeds, kelp, and eelgrass or grass rack. Rockweeds are the large dark-colored plants furnished with small bladders or snappers, which constitute at least 75 per cent of the covering of rocks and stones between high and low water marks on the coast from Nova Scotia to New York. There are two prominent species of these, the round-stalked and the flat-stalked. The principal species of kelp, viz, the ribbon-weed and the broad ribbon-weed or devil's apron, are common on the rocks at and below the low-water mark from Newfoundland to the New Jersey coast. In the north of Europe both of these species are used for food to a considerable extent. Dulse, Irish moss, and other species may also be used for fertilizer, but the quantity obtained is so small that they are of little importance in this connection.

The principal fertilizing agencies in aquatic plants are nitrogen and potash; the quantity of phosphoric acid is very small, amounting to only about 10 per cent as much as the above two combined. Seaweeds also contain considerable quantities of lime and magnesia. By the addition of some material containing a large percentage of phosphoric acid, as bone meal, for instance, a "complete fertilizer" is formed. This is frequently very important in order to secure the full value of the nitrogen and potash contained in the seaweeds.

According to analyses made by the Rhode Island Agricultural Experiment Station,[a] the average percentage of fertilizing constituents and of water contained in various aquatic plants in the fresh state collected at different seasons on the coast of Rhode Island is as follows. For convenience of comparison, analysis of average barnyard manure is appended.

Materials.	Nitrogen.	Phosphoric acid.	Potash.	Water.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Rockweed, flat-stalked	.38	.12	.65	76.55
Rockweed, round-stalked	.24	.08	.64	77.28
Broad ribbon-weed, or devil's apron	.23	.06	.81	87.50
Ribbon-weed, kelp, or tangle	.17	.05	.16	87.99
Dulse	.37	.09	1.07	86.25
Irish moss	.57	.13	1.02	76.03
Eelgrass	.35	.07	.32	81.19
Barnyard manure	.49	.32	.43	....

The total quantity of the fertilizing ingredients in plants is very small in proportion to the weight of the material, this being due principally to the large content of water. Usually at least 75 per cent of the weight of aquatic plants consists of water, and about 80 per cent of the remainder is a soft, easily decomposable form of organic matter. The plants decompose rapidly, and the water separates from them quickly, the weeds left in heaps on the beach being reduced to one-half or one-third of their original bulk in a few weeks. Since much of the fertilizing constituents, especially the nitrogen, wastes away in this process, it is important that the plants be used within as short a time as practicable after they have been collected. For the same reason it is much better to collect weeds directly from the rocks, or

[a] Bulletin No. 21 of Rhode Island Agricultural Experiment Station, January, 1893.

those just thrown up by a storm, rather than those which have lain on the beach for a considerable time.

The large content of potash makes sea plants, particularly rockweeds, especially favorable to the growth of clover. Storer refers to the abundant natural growth of red clover upon the tract of country back of Rye Beach, Maine, which has been manured with these plants since the settlement of the country. Seaweeds are also excellent for wheat, and are used for parsnips, turnips, and to some extent for potatoes, although it is claimed that they impart a somewhat unpleasant flavor to the last-named. The general opinion in this country is that potatoes grown with seaweeds are much less liable to be affected by scab than those grown with barnyard manure, but they are less mealy and of inferior flavor.[a] Seaweeds have been strongly recommended for tobacco-culture, but owing to their effect on the quality of the leaf, they are not much used for this purpose. They are also highly recommended for cauliflower and cabbages. They act very quickly, and the effect of their application is confined largely to the season in which they are used, having little action upon the second and succeeding crops.

Owing to their small content of fertilizing materials and the large amount of moisture, aquatic plants are usually rather expensive for fertilizer if long cartage is required, at least 4 tons of water being transported for every ton of dry material. This limits their value to the immediate vicinity of the beaches, and they are rarely used on land more than 10 or 12 miles from the coast.

However, the manurial value of seaweeds must not be regarded merely from the point of view of the fertilizing agencies which they contain. They have a mechanical action on the soil, tending to make it friable and binding its constituents together; but the manufacture of soil is rather expensive where there is so much good land available as in this country. They have an advantage over barnyard manure in the freedom from seeds of land weeds. Formerly it was considered desirable to apply the material in the form of a compost with lime or gypsum, but experience of recent years indicates that it does not pay as a rule to compost them, except possibly in case of eelgrass and also rockweeds, to be applied as a summer or autumn top-dressing for grass land.[b] The usual practice in applying them is to plow the seaweeds into the soil or to spread them upon the land as a top-dressing, the plants being in either case in as fresh a state as practicable. They also tend to prevent the crops from suffering from summer droughts, grass fields dressed with seaweeds frequently remaining green when adjacent fields are suffering.

So important is the crop of seaweeds in the Channel Islands that special laws are enforced to govern their collection and distribution. The cutting of weeds from the rocks is restricted to certain seasons comprising about four or five weeks each year. Those cast up on the

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[a] See Bulletin No. 21 of Rhode Island Agricultural Experiment Station, p. 20. [b] Ibid p. 8.

shores by the action of the waves are collected throughout the year and especially during stormy weather, furnishing employment to a large proportion of the inhabitants of Guernsey and Jersey. They are applied to the land not only in a green state, as in this country, but are also burned on the beach and on the cottage hearths and the ashes used as fertilizer.

Large quantities of seaweeds are also burned on the coast of France, especially in Brittany and Normandy, and on the coasts of Ireland and Scotland. In this process the plants are usually treated for the obtainment of iodine and salts of potassium and sodium, leaving the potash salts as the principal fertilizing agent. Although greatly reduced, owing to the production of iodine from South American caliche, the quantity of iodine made from the ashes of seaweeds is yet very large. The ashes of seaweeds are not used as fertilizer to any great extent, if at all, in this country, owing to the fact that, in burning, the valuable nitrogen is driven off and lost. However, for use at a greater distance than 12 or 15 miles from the coast it might be found practicable to burn them if this can be done with a small expenditure.

Several unsuccessful attempts have been made in this country to establish a profitable business in preparing commercial fertilizer from seaweeds. About thirty years ago a factory was built for this purpose at Boothbay, Me. Dried seaweeds were ground in a mill formed of 40 circular saws, 20 having teeth and 20 without. These were placed alternately on an iron shaft and so adjusted as to revolve in a concave trough fitted with 40 steel plates. The shaft weighed 1,000 pounds and made upward of 2,000 revolutions per minute. With this apparatus 3 tons per hour of the thoroughly dried seaweeds could be reduced to about the fineness of oats. There proved to be an insufficient market for the fertilizer, and its manufacture was discontinued in a few years.[a] Most of it was sold in Connecticut for the use of tobacco-growers. The average price at the factory for the prepared material was about $8 per ton.

Notwithstanding its relatively large content of nitrogen, phosphoric acid, and potash, as revealed by chemical analysis, eelgrass is of very little value as a fertilizer, owing to the difficulty in making those constituents available. According to Storer's well-known work on fertilizers (pp. 167–168, vol. 2):

> Eelgrass taken by itself has little or no fertilizing power. It will hardly rot anywhere, either in the ground, in the hogsty, or in the manure or compost heap. It is a distinctly inconvenient thing, moreover, to have in the way of the plowshare or the dungfork. It has long stood as a kind of reproach among the vegetable manures, much as leather scraps stand in the list of animal products. For mulching for covering bins or piles of roots as protection against frost, moldiness, and decay, and for banking up in autumn around stables, greenhouses, cisterns, cellars, and pumps, eelgrass has been found useful, and this is about all

[a] See The Fishery Industries of the United States, Sec. II, p. 69.

that could have been said in its favor until very recently. Considered as a manure, it was rejected by the farmers long ago. It has been tried and found wanting by numerous generations of men. Still, on analysis it appears that eelgrass contains a considerable proportion of fertilizing matters, and there can be no doubt that it will be found amenable to proper treatment and will eventually be prized as a manure. Besides 1⅛ per cent of nitrogen, air-dried eelgrass contains 1 per cent of potash and 0.25 per cent of phosphoric acid. The ashes of eelgrass contain 7 per cent of potash and 1½ per cent of phosphoric acid, which is about as much as is contained in ordinary house ashes from wood fires. The trouble with eelgrass is, as was said before, that it will not rot in the soil. It must be coerced in some way in order to make its fertilizing constituents available for crops. It might be burned, for example, to ashes in order to get the potash and phosphoric acid; or, much better, the organic matter may be disorganized by composting the grass with lime or with rockweed. That is to say, the eelgrass may either be thrown into heaps, with layers of lime interpolated, in order to reduce the resisting tissue to a manageable form, or it may be built into a heap, layer by layer, with fresh rockweed or sea manure, and so subjected to destructive fermentation.

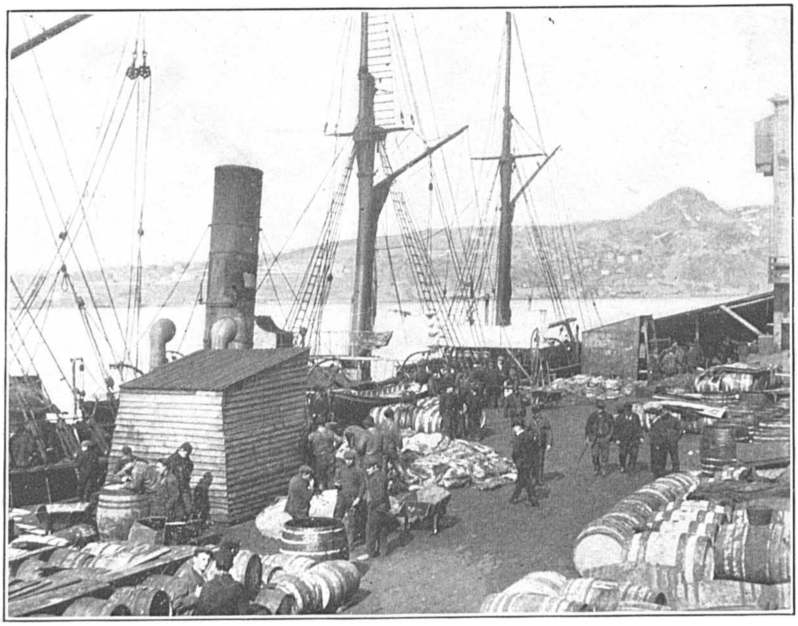
It is quite impracticable to form a close estimate of the total quantity of aquatic plants used for fertilizer in this country. The latest returns of the United States Fish Commission show an output on the New England coast of 75,000 tons, worth about $1 per ton, but these figures probably do not show the total production. According to the Rhode Island census of 1885, $65,044 worth of seaweeds were used in that State alone during the census year, compared with a total of $164,133 worth of "commercial" fertilizers. This represents only a small percentage of the total quantity obtainable, it being possible to collect a thousand or more tons to the mile of that coast. The growth of the plants is rapid, and rocks scraped bare may be covered with kelp 5 or 6 feet long the following year.

UTILIZATION OF THE SKINS OF AQUATIC ANIMALS.

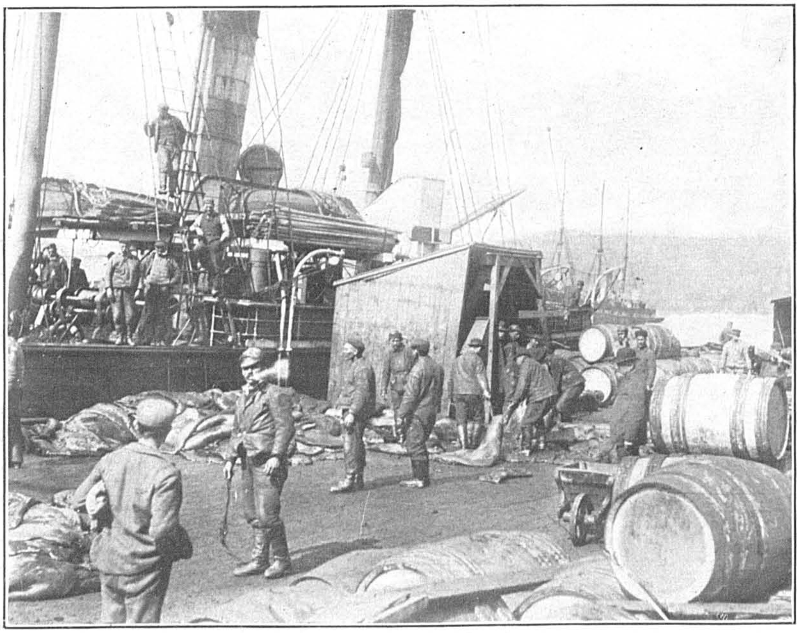
BY

CHARLES H. STEVENSON.

SYNOPSIS.



SEALING STEAMER AT ST. JOHNS, NEWFOUNDLAND.



WEIGHING SEAL PELTS AT ST. JOHNS, NEWFOUNDLAND.

UTILIZATION OF THE SKINS OF AQUATIC ANIMALS.

By Charles H. Stevenson.

PREFATORY NOTE.

The utilization of the skins of animals is coexistent with the development of human activities. To the primeval man they were invaluable. They clothed and protected his body from the weather; they supplied him with tents, with boats, with thongs for the chase, and with innumerable articles requiring the use of firm membranous structure. The development of the textile industries, however, greatly reduced their relative importance, and spinning and weaving now to a very large extent supply the articles formerly made from the skins of animals. While by no means so important to man as formerly, numerous uses yet exist for these products and create a demand for them approximately equal to the present resources.

The skins of most mammals are covered to a greater or less extent with hair, which serves to protect the body against external influences, especially that of low temperature. In addition to the hair, and coexistent with it, many animals, particularly those of cold latitudes, have fine, soft underhair, termed fur. When the fur is sufficiently thick and soft, its value, left on the skin, exceeds that of any leather which can be made from the membranous tissue alone. This gives two classes of skins, (1) those deriving their value from the covering of fine underhair, which are used as furs, and (2) those dressed as leather without the hair. The present paper is, therefore, naturally divisible into two parts, the first relating to aquatic furs and the second to aquatic leathers.

While the writer desires to acknowledge his indebtedness to all persons who have rendered assistance in the collection of material for this paper, yet the number is so large that to cite each one individually would be to list the principal manufacturers and merchants handling furs and fancy leathers in America and many in Great Britain, each of whom has been uniformly obliging in furnishing all information asked for. However, it is desired especially to refer to the courtesy of Mr. Alfred Frazer, Mr. Max Bowsky, Mr. Adolph Bowsky, Mr. Samuel Williams, Mr. Joseph Ullman, Mr. Belden, and Mr. Robert Badcock, of New York City. To Messrs. John Russitz & Co. and to Messrs. Revillon Frères, of New York City, we are indebted for the loan of furs for photographing purposes, and to Messrs. Tiffany & Co., of New York, for photographs of several aquatic skins.

AQUATIC FURS.

GENERAL REVIEW.

Exclusive of the great variety of rabbit, squirrel, and opossum skins produced in all parts of the globe, a large portion of the world's product of furs is obtained from aquatic animals. Indeed, the trade in fancy furs is made up very largely of the skins[a] of those animals. An examination of the sales made in 1901 by the largest fur-brokerage house in the world shows that the aquatic furs constituted 49 per cent in number and 54 per cent in value of all peltries handled. Of the furs produced in the United States, fully 75 per cent in value are yielded by aquatic animals. Formerly the proportion was much greater, but is reduced by a decrease in product of beaver, fur-seal, otter, and sea-otter, and the large increase in quantity of rabbit, opossum, raccoon, etc., which have multiplied with the settlement of the country.

The principal fur-producers among the aquatic animals are the fur-seal, mink, muskrat, beaver, otter, sea-otter, and nutria. The greatest value is placed on the sea-otter, the choicest skins selling for upward of $1,200; the number of sea-otters obtained annually, however, has been reduced to about 600. This fur has never been fashionable in western Europe or the United States; the market for it exists in China and Russia, those countries using probably 85 per cent of all the skins secured since its introduction into commerce in the seventeenth century. For two hundred years previous to 1800, beaver was by far the most important item in the fur trade as regards the total value of the product. The increasing scarcity of that animal, however, and the adoption of substitutes have greatly depreciated its prominence.

During the last thirty years, fur-seal skins have outranked all others in commercial importance, being the fashionable material in Europe and America for ladies' garments for use in the cold weather. Since 1890, the product of fur-seal has greatly decreased, especially in the territory of the United States, and at the present time the yield of mink in this country is more valuable. The latter is probably the most durable of all furs, but the demand for it is very irregular, the market sales not exceeding 200,000 or 300,000 skins in one year and in a short while increasing to a million or more. Next to these in

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[a] Among the furriers the term "skin" is used to designate the fur and the membranous tissue combined, while "pelt" is restricted to the membranous or coriaceous portion of the animal's coat, which is contrary to the general usage. The term "fur" in a general sense refers to the soft underhair of the fur-bearing animals. The skins of these animals, when removed from the body and cured, are called peltry. When the membrane is converted into a form of leather by a process called "dressing," the skin obtains the name of fur in a restricted sense. The term fur is also applied in a still more restricted sense to the underhair cut from the skin and presented in the form of delicate filaments for felting purposes, but this is more commonly known as hatters' fur.

aggregate value, but of far less value individually, is the muskrat, of which about 5,000,000 are slaughtered annually. The nutria or coypu is a small, beaver-like animal found in large numbers in South America, and about 2,000,000 are taken annually. Many thousands of beaver and otter skins are obtained each season, and each of these forms an important item in the fur trade.

The following summary, condensed from the table appearing on page 287, shows approximately the total quantity of aquatic furs produced throughout the world in 1900:

Classified statement of the world's product of aquatic furs in 1900.

Designation.	Number of skins.	Total area.
		Square feet.
Beaver	66,000	264,000
Fur-seal	95,485	535,700
Mink	728,000	400,000
Muskrat	5,285,000	3,488,100
Nutria	1,950,000	1,891,500
Otter	33,640	93,183
Sea-otter	590	4,595
Total		6,677,078

The foregoing table shows the great importance of the muskrat in the trade, the aggregate area of the skins yielded annually by that animal being as great as that of all other aquatic furs combined, and more than six times as great as that of the fur-seal. Indeed, the aggregate area of the muskrat skins secured annually in the United States is approximately twenty times as large as that of the fur-seal product. The nutria ranks second in total area, but about 30 per cent of those skins are used by manufacturers of hats. Far below these two comes the fur-seal with 535,700 square feet, or scarcely 8 per cent of the total area of aquatic furs produced. Lower yet, in this particular, rank the mink, beaver, and otter; while of sea-otter fur only 4,595 square feet were produced in 1900, or less than one-fifteenth of 1 per cent of the total area of aquatic furs yielded during that year.

There are many industries more or less directly associated with the fur trade. Omitting the manufacturers of traps, guns, boats, vessels, and other apparatus and equipment, the men principally interested are the many hunters, trappers, and the like engaged in securing the pelts. Then come large numbers of men who collect the furs, transport them to the trade centers, effect their sale, and distribute them to the places of consumption. Next are the fur-dressers, who prepare the raw, greasy pelts and make them suitable for manufacture. The fur-manufacturers employ a very large number of skilled workmen, including assorters, cutters, nailers, sewers, etc. In addition to these are the wholesale fur-dealers and the numerous retail merchants. It is estimated that the number of persons employed in the United States in the various branches of the fur trade approximates 15,000.

THE FUR SUPPLIES AND MARKETS.

From the Middle Ages to 1600, Russia was the great source of furs for the world. Many skins were obtained in other parts of Europe and Asia, but even in the aggregate the quantity was relatively small. The discovery of the resources of North America changed the current of the trade, this continent soon becoming the great fur territory; and during the last three hundred years the United States and Canada have been the principal fur-producing countries.

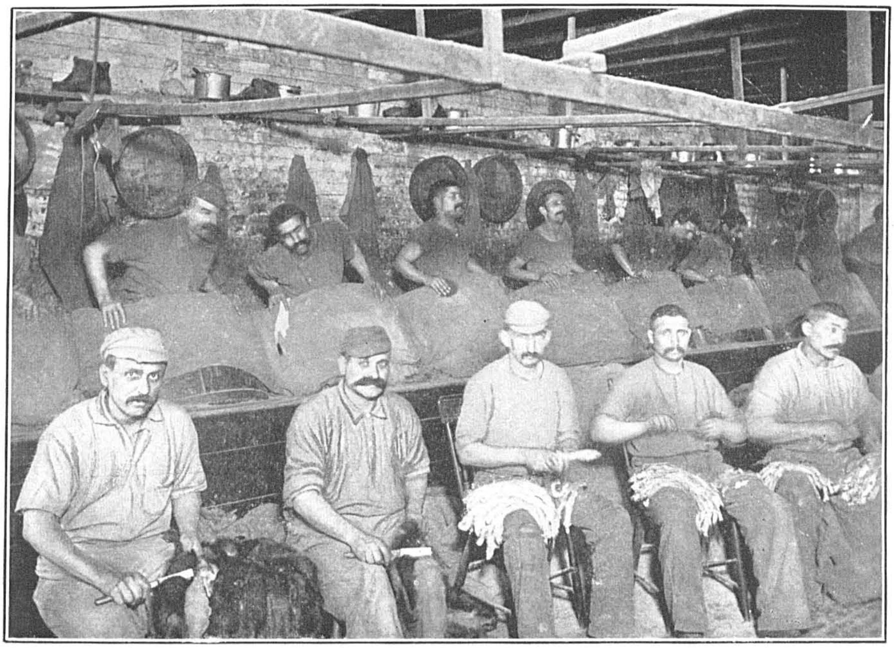
The prominence of the United States in the product of aquatic furs is especially notable, the value of the raw skins produced in 1900 being $2,302,100, whereas the total for all other countries was $2,960,610. This country yielded 80 per cent of the muskrat, 70 per cent of the mink, 56 per cent of the sea-otter, 35 per cent of the otter, 30 per cent of fur-seal, and 12 per cent of the beaver produced throughout the world.

The importance of the Dominion of Canada as a producer of aquatic furs is very much less than that of the United States. Indeed, excluding the take of the fur-seal in the pelagic fishery, the total value of aquatic furs secured in that country in 1900 amounted to less than $1,000,000, only 40 per cent as much as in the United States. The aquatic furs obtained in the limits of Canada are beaver, mink, otter, and muskrat. The fur-seal fishery as a Canadian enterprise is of comparatively recent origin, dating from about 1880, and the animals are caught in the Pacific Ocean and Bering Sea at a great distance from Canadian territory.

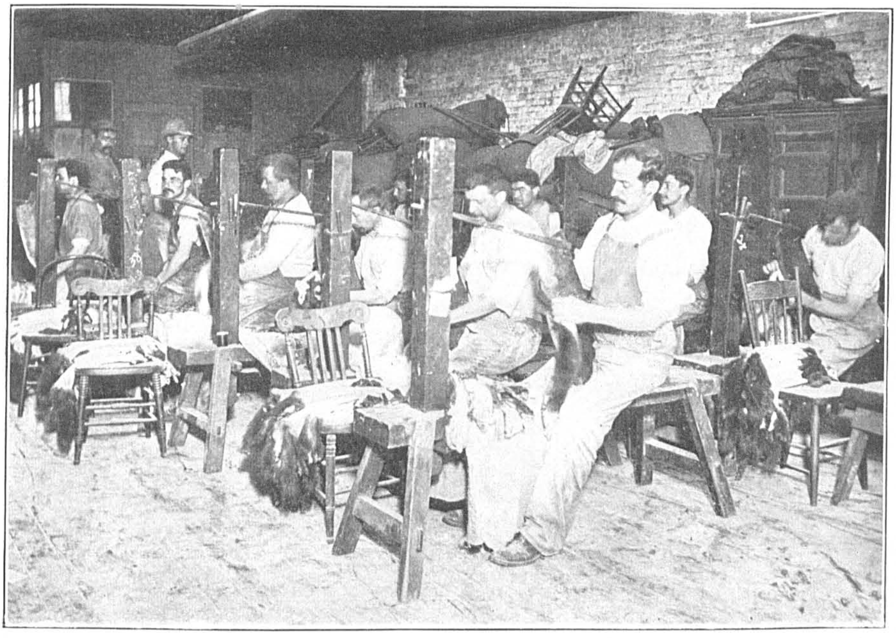
Russia, especially that portion bordering the Pacific Ocean, at one time yielded the great bulk of aquatic as well as of other furs on the market, the product of sea-otter and fur-seal being particularly large. Owing to the cession of Alaska to the United States and the increasing scarcity of furs on the Siberian coasts, the importance of Russia in this particular is now greatly reduced. South America yields only two aquatic furs of consequence, viz, nutria and fur-seal. Several species of otter occur there, but they are of little value and few are taken. Japan yields some fur-seal and sea-otter skins. From Europe, Africa, Australia, and the southern coast of Asia the product of aquatic furs is of very little importance.

The annual yield of aquatic furs fluctuates greatly, and an estimate of the collection is far from reliable, except for the particular year to which it relates. When furs of a special variety are fashionable, hunting becomes active; as a result the quantity placed on the market lowers the price and the hunt declines, giving the animals another opportunity to increase in numbers. While there are no means of learning the exact quantity collected during any one year, in view of the fact that the great bulk are handled at the London auction sales it is possible to form a very close estimate of the total product.

With the assistance of several of the principal fur-houses of the world, including the Hudson's Bay Company, Mr. Alexander Fraser,



TUBBING, COMBING, AND REVERSING FURS.



FLESHING MINK SKINS.

and Mr. Joseph Ullman, the following estimate is made of the number of aquatic skins produced in the United States and in all other countries combined during the year 1900, and their value in the wholesale trade:

Classified statement of the product of aquatic furs in 1900.

Designation.	United States.		All other countries.		Total.	
	Number of skins.	Value.	Number of skins.	Value.	Number of skins.	Value.
Beaver	8,000	$39,860	58,000	$301,200	66,000	$341,060
Fur-seal	24,000	660,000	71,485	1,471,000	95,485	2,131,000
Mink	578,000	810,000	150,000	330,000	728,000	1,140,000
Muskrat	4,035,000	565,000	1,250,000	138,000	5,285,000	703,000
Nutria			1,950,000	444,000	1,950,000	444,000
Otter	14,600	93,260	19,040	170,850	33,640	264,110
Sea-otter	330	133,980	260	105,560	590	239,540
Total value		2,302,100		2,960,610		5,262,710

During the summer months the skins of most of the fur-bearing animals are practically worthless, the thickest and finest part of the fur being shed as warm weather approaches, growing again in the fall to protect the animal in winter. This deterioration furnishes great protection to the animals, their value in the summer pelage being so small as to not warrant their capture. Furs in best condition are designated "prime," and this state is indicated by the color of the pelt. That of a prime skin is generally very light and clear, but as warm weather approaches it becomes bluish and dark. Most aquatic furs in the United States become prime about the middle of November and remain so until March, but beaver and muskrat are not thoroughly prime until late in December and are good until the last of April, while the fur of the otter may be prime as late as the end of May. There are two prominent exceptions to the general rule of taking fur-bearers during cold weather only, viz, the sea-otter and the fur-seal. The fur of the former is prime throughout the year, and the latter is taken principally during the summer for convenience of capture.

In addition to the protection afforded by the poor condition of the pelage, many governments have interdicted the capture of certain fur-bearing animals from a definite date in the spring to a fixed date in the autumn. There is no uniformity in these regulations in the different States and frequently in different counties in the same State.

None of the aquatic fur-bearers is utilized to any extent for food, though the meat of the muskrat is used by some persons; nor are these animals valuable except for the furs, which constitute the principal, and in most instances the sole, object of their capture.

With the exception of the taking of the fur-seals on the rookeries, practically all the aquatic furs are obtained by a resort to skill and stratagem. Many muskrat, mink, and otter are obtained by farmers and villagers. During cold weather, when furs are prime, comparatively little work is done in rural sections, and thousands of men and boys find profit and sport in matching their skill and cunning against those of the wary animals. The greater portion of the peltries, however, are secured by professional trappers and hunters, who devote themselves entirely to that work during the season.

In taking or killing fur-bearing animals the use of guns or spears is avoided whenever possible, as they injure the skin by making holes in the pelt. Shooting is especially wasteful in taking aquatic animals, since a large percentage of these sink when shot, and are thus lost; furthermore, the shot cut paths in the fur, sometimes several inches in length. Neither should they be taken by poisoning, as this spoils the skin, the poison spreading through the body of the animal and injuring the texture and gloss of the fur, greatly depreciating its value.

The best method of taking these animals is by clubbing them on the head whenever that is practicable, as in the case of fur-seals, or by means of steel traps in case of the smaller and wilder animals.

Previous to 1670 the fur trade was centered in Leipsic, Amsterdam, Paris, and Vienna, the markets of Leipsic being the most important. Comparatively few choice furs were handled in London or in any market center other than those named. But shortly after the inauguration of its business in 1670, the Hudson's Bay Company began disposing of its receipts of peltries at public auction in London. Within a few years the continental markets relinquished the bulk of their trade to the new insular rival, and from that time to the present London has been preeminent as the greatest fur center of the world. The series of sales occurring at stated intervals at the various warehouses in that city dispose of the great bulk of the world's product of fancy furs. The American merchant, for instance, goes to London to buy the pelts that were obtained and shipped even from the vicinity of his own home. The reason for this is not difficult to discover. The principal fur company of the world has its headquarters in that city; the fur trade is better understood there at present than in any other large commercial center, and the importance of its being centralized makes it comparatively easy to hold when once secured; also the business ranks well among the London bankers, and they advance money on consignments of furs, and the consignor can negotiate his bill of lading on the receipt of his bales of peltries.

Although none compares in extent with that of London, there are several other markets which assist in the general work of distribution. Most celebrated among these are the fairs at Leipsic, which have existed over five hundred years. The Easter fair is the most important. This commences a week after Easter and lasts about two or three weeks. Large quantities of American peltries, especially muskrat and mink, are disposed of there. Furs are marketed in much smaller quantities at two other fairs held in Leipsic, one at Michaelmas and the other at New Year.

New York City is the great fur center in this country, not only for accumulating the raw goods but for dressing, dyeing, and manufacturing as well. Indeed, New York leads the world as a consumer of furs, the sales to individuals there exceeding that of any other city in the world. Many firms long established, with large capital and of international reputation, carry on the business. At present there are 93 fur houses in New York, many of which have branch establishments and resident partners in London, Paris, Leipsic, Shanghai, etc. In view of the fact that a very large percentage of the furs of the world originate on the North American continent, and that the rank of the United States as a fur-consuming country is constantly increasing, it seems not improbable that the enterprise of New York may result in that city securing a large portion of the wholesale trade which now centers in London.

In addition to these large centers, the work of fur distribution is carried on by traders and merchants in almost every section of the world, scarcely any large town being without its quota of fur stores of greater or less importance, according to the climate and the wealth of the inhabitants.

In the markets, the skins of each variety are graded according to their size and the condition of the fur, the number of grades or classes depending on the importance of the particular variety, the cheaper peltries requiring fewer grades than those of greater value. For the purpose of showing the comparative value of the different aquatic furs, the following summary is presented, indicating for dressed prime skins of each variety the average area in square inches, the average value in the wholesale markets of the United States in 1901, and the resulting value per square foot of area.[a]

Comparative statement of the average area, value, and value per square foot of the different aquatic furs in the United States markets in 1901.

Designation.	Area.	Value per skin.	Value per square foot.
	Sq. inches.		
Sea-otter, dark	1,285	$600.00	$67.24
brown	1,285	200.00	22.41
Fur-seal, Alaska	940	45.00	6.89
Copper	890	34.00	5.58
Mink, Canadian	73	2.60	5.12
Minnesota	90	2.73	4.38
Pacific	83	1.80	3.12
Otter, Canadian	460	10.33	3.23
Pacific	448	7.90	2.54
Southern	400	6.80	2.08
Beaver, Canadian	635	7.55	1.71
Pacific	650	7.05	1.56
Southern	560	5.80	1.49
Nutria	214	.78	.52
Muskrat, dark	100	.34	.49
light	100	.23	.33

[a] It will be observed in comparing this summary with the tables on pages 285 and 287 that the average areas and values used here are in excess of those in the tables. The explanation of this seeming discrepancy is that the figures in those tables refer to all classes of skins in a raw state, including the smallest and cheapest, whereas the present figures are for dressed skins and only those of prime grade.

FUR DRESSING AND DYEING.

The appearance of aquatic furs as they come from the hunters and trappers is quite different from that which they present when ready to be cut into garments. They are more or less greasy and dirty and require thorough cleansing. The pelt or membrane must be converted into a form of leather and made soft and pliable, and in some varieties it must be reduced in thickness. The overhair of many skins is quite undesirable and must be removed, this being the case with the fur-seal, beaver, nutria, and cheap grades of otter. The overhair is not removed from all varieties, however; for in some it constitutes the principal attraction, as in the sea-otter, mink, muskrat, and choice grades of otter. The fur-seal alone among the aquatics is usually dyed, but many cheap grades of other varieties are also dyed for the purpose of imitating more valuable ones.

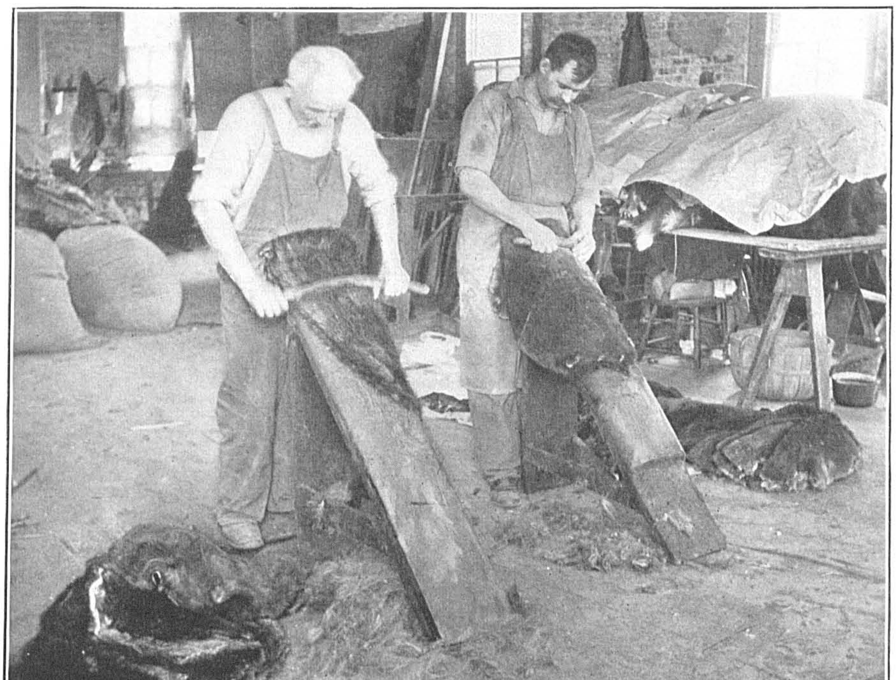
In the dressing of aquatic furs there are no especially valuable trade secrets; but, as in nearly every other industry, some establishments have methods of treatment which they consider superior to those used by others and which they desire to keep from general use. As a rule, however, these secret processes are for the purpose of substitution or imitation, and have little standing among the most successful fur-dressers. In the best establishments the excellent results are due to conscientious application of well-known methods, without stint either in amount of labor or quality of material.

The fur-dressers of the United States are preeminent in the preparation of otter, mink, and beaver, while those of Germany rank well in dressing beaver and muskrat furs. The English have excelled for forty years in the dressing and dyeing of fur-seal skins and have prepared the great bulk of those on the market, but the Americans and French now prepare them equally well. The Chinese fur-dressers are the most ancient and among the best in the world. They dress sea-otter skins remarkably well and secure wonderful effects in matching furs of all kinds.

The principal fur-dressing establishments in this country are located in New York City, where the great bulk of the skins are prepared. Smaller establishments exist in Chicago, St. Paul, Newark, and Philadelphia. In Europe the fur-dressing is centered at Leipsic, Weissenfels, and Lindenau, Germany; London, England; Paris and Lyons, France; and Moscow and St. Petersburg, Russia.

When received at the fur-dressers, peltries are usually hard, greasy, and dirty. If very greasy, as in the case of mink skins, the surplus grease is scraped or beamed off. The skins are soaked in water over night for softening and opening the texture preparatory to the unhairing and leathering processes. Salt water is generally used for soaking, especially during warm weather, as its tendency to loosen

SKIVING BEAVER SKINS.



BEAMING AND PLUCKING BEAVER SKINS.

the hair is less than that of fresh water. Heavy pelts, as of beaver, otter, etc., are beamed the following day for the purpose of breaking up the texture of the membrane and softening it. The beam on which the skins are successively placed for this purpose is made of some hard wood, as locust, boxwood, etc.; it is about 40 inches long and 8 or 10 inches wide, and is placed at an incline of about 45 degrees. The breaker is a dull scraping knife, with a handle at each end like a carpenter's draw knife, and is always operated in a downward direction. After beaming, the pelts are washed in warm soap water until perfectly clean and then they are freed of moisture.

If the overhairs are to be removed, that process is next in order, except in the dressing of muskrat skins, when it is usually postponed until after the dressing. In preparing for plucking, the hair side is dried and warmed by artificial heat, the membrane being kept moist in the meantime. Each skin is placed flesh side down on a flat, hardwood beam, similar to that used in breaking except that it is covered with thick, elastic leather. Chalk is first sprinkled over the hair, and then, using a knife similar to that employed in breaking, a workman rubs or works most of the overhairs out of the membrane. Those not removed in this manner are subsequently plucked out with a dull knife of soft metal. With this knife in his right hand and his thumb protected with a rubber cot about 4 inches in length, the picker grasps the hairs between the edge of the knife and his protected thumb, and with a quick, jerking motion pulls them out, going over the entire pelt in this manner. The fur-seal is quite difficult to unhair, and the process is more complicated, as may be seen from the description on page 305.

After plucking, the heavy pelted skins—as beaver and otter—are placed successively on a beam and shaved to a thin, even surface with a skiving knife. The blade of this knife is a straight piece of steel sharpened to a keen edge, which is then turned at right angles to the plane of the knife by means of a peculiar flat steel. This blade is fastened in a tool having two wooden handles differently attached, one running parallel to or in direct continuation of the blade, and the other placed at right angles thereto. Each skin is placed, fur down, on the beam, and by pushing the skiving knife downward and forward from his body, the workman scrapes the pelt perfectly clean and shaves off some of the membrane for the purpose of rendering it less bulky and more pliable.

The skins are now ready for leathering. The pelt side is dampened over night with cold salt water, and the following day butter or other animal fat is rubbed on the membrane. In dressing very fat or oily pelts, as those of mink, the greasing is omitted.

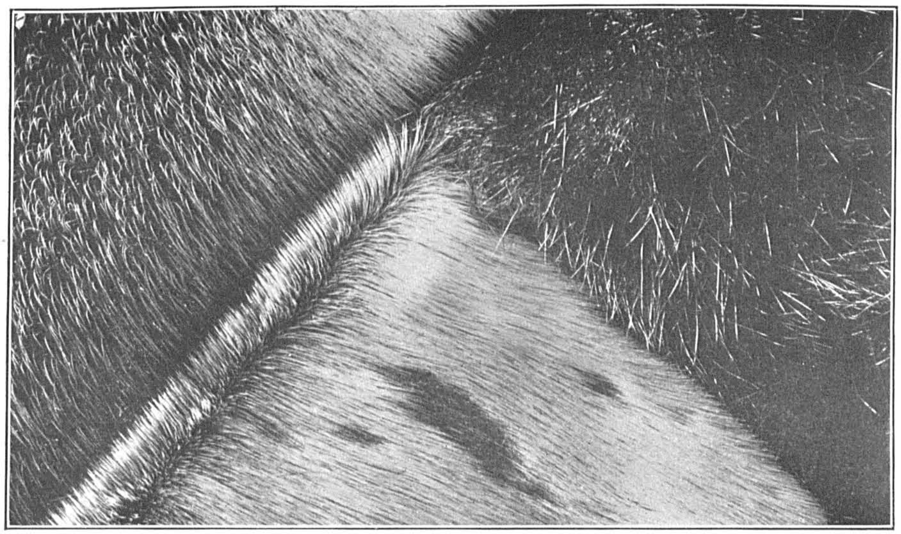
The pelts are then tubbed. This is probably the most noticeable operation in the fur-dressing establishment. Tubs or half hogsheads, slightly inclined backward from the floor, are located in a row along one side of the room. A number of skins are placed in each one, usually with a small quantity of sawdust. A workman with bared feet enters the tub, with a heavy cloth or piece of bagging tied about his waist and to the chimb of the tub to prevent the sawdust from flying out and to retain the heat. By treading and twisting movements he works the skin over and over for two or three hours or more until the pelt is thoroughly softened or leathered. It is a strange and interesting sight to see 10 or 12 men working in an equal number of tubs placed in a row, each person monotonously treading and swaying from side to side in solemn manner.

Tubbing is gradually giving way in a greater or less extent to the "tramping machine," whenever anything less than the very best work will suffice. This machine is adapted from the French apparatus for fulling wool stock. It consists of two wooden hammers, which are moved alternately back and forth or up and down in a suitable receptacle, agitating the skins slowly and constantly, turning them over and over each other, and developing by friction the necessary heat, thus rendering the pelts soft and pliable. This process is far more economical than tubbing, costing only 10 or 20 per cent as much. The result, however, is not always so satisfactory, and for the choicest skins tubbing is yet generally used.

At this stage of the dressing process comes the fleshing or skiving, the former being applied to small skins and the latter to large ones. Fleshing consists in removing all particles of flesh and fat by means of a fleshing knife, formed with a broad blade having a sharp edge, fastened in an upright position on a bench. The workman sits astraddle the bench immediately behind the knife, with the edge turned from him, and proceeds to flesh each pelt by grasping it with both hands and drawing it repeatedly across the sharp edge of the knife, cutting off the superfluous flesh. Only small skins, such as mink and muskrat, are fleshed in this manner. Large skins, as those of beaver, otter, etc., are shaved on a beam with a skiving knife, in much the same manner as before the leathering process, except that the operation is performed much more carefully.

After fleshing or skiving, the skins are usually put through the tubs or tramping machines a second time, and on removal therefrom are cleaned of grease. In this operation two forms of revolving drums are used, one known as the cleaning drum and the other as the beating drum. The purpose of the former is to extract the grease by means of dry sawdust, and of the latter to remove the sawdust. The drums are usually about 4 feet wide and 6 or 8 feet in diameter, but the size is entirely a matter of convenience and desired capacity.

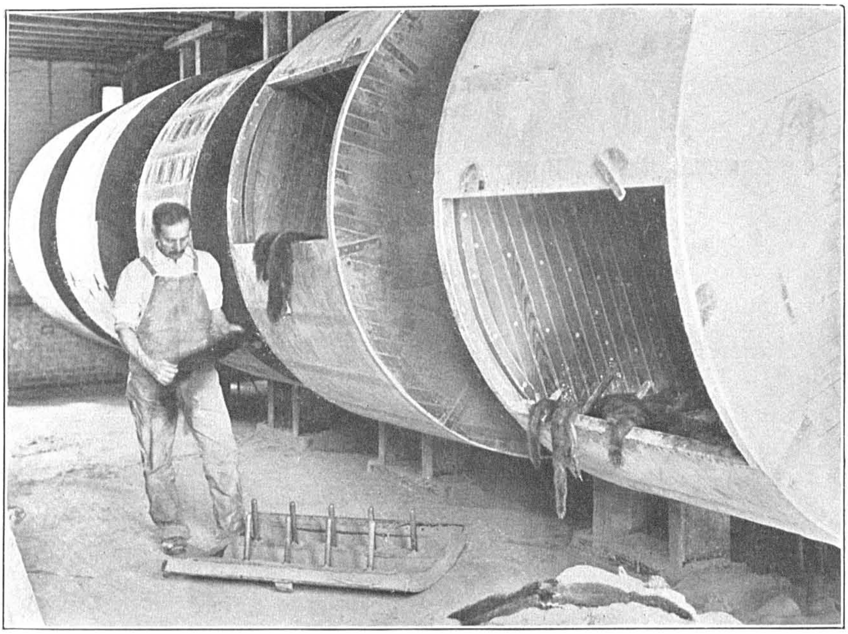
The cleaning drum is made of wood, and upon its interior circumference are four or five wooden shelves about 6 inches wide and at suitable distances apart. Instead of these shelves some drums are provided with rows of wooden pins or pegs 6 or 8 inches in length and similarly situated. Sometimes each cleaning drum is inclosed in a wooden



Blueback seal. Harp seal. Wool seal.

SEAL SKINS TANNED WITHOUT REMOVING THE HAIR (SEE P. 335).

SHAVING MINK SKINS.



CLEANING-DRUMS.

BEATING BEAVER SKINS FOR REMOVING SAWDUST, ETC.

closet, which is heated by steam pipes or a charcoal fire. A number of skins, with a quantity of fine, dry, hard-wood sawdust, are placed in each drum. The latter is revolved steadily, making about 20 revolutions per minute, and within three or four hours the dry sawdust absorbs the grease, leaving the fur clean and soft but filled with sawdust.

The beating drum, also sometimes inclosed in a closet, has wooden ends, and the side or circumference of wire gauze, with meshes about one-fourth inch square. Along the interior circumference are wire-gauze shelves about 10 inches wide, which catch the pelts at the bottom of the revolving drum and carry them nearly to the top, when they slide off and fall against the wire gauze covering the circumference of the drum. In this manner the pelts are cleaned of every particle of sawdust. Many of the larger pelts are beaten with rattans for the same purpose.

After removing the sawdust and straightening the fur with a steel comb, the dressing process is at an end. This general process would suffice fairly well for all varieties of aquatic furs, but it is modified to suit the characteristics of the different sorts. The special methods applicable to each variety are described at length in appropriate chapters.

Except in case of very cheap skins, the expense of dressing furs represents only a small percentage of their value. The following tabular statement shows the average charges that prevail in New York City for dressing skins in quantities for the trade:

Statement of average charges prevailing in New York City for dressing aquatic furs.

Species.	Dressing.	Dressing and plucking.
Beaver	$0.50	$0.60
Fur-seal[a]	....	3.00
Mink: Cased	.15	....
Open	.14	....
Mink tails	.03	....
Muskrat	.06	.08
Nutria	....	.25
Otter	.50	.65
Sea-otter	2.00	....

[a] Dressing, plucking, and dyeing, $5.

With the exception of the fur-seal, the choicest furs of any particular species are rarely dyed. Indeed, their degree of excellence is determined by the nearness of their approach in the natural color to the most desirable shade for that species. So important is this that a skin of the proper tint may be worth three or four times as much as one whose texture is equally fine but lacking just the right shade. For instance, the present average value of prime dark sea-otter skins is about $600 each, whereas the average price of prime brown skins is only $200. In case of mink, otter, and other choice species the difference is as great in proportion.

In order to obtain those shades which taste and fashion have determined to be the most desirable, much of the aquatic fur is dyed; either the ends of the fur and hair are merely tinted, or the color of the entire skin may be changed. The object of tinting or blending is to make all parts of the fur used in a garment of the same color, to make an inferior grade of fur like that of a superior, or to cause the fur of one animal to resemble that of another. Certain furs so closely resemble choicer ones in every particular except color that when dyed to a similar hue they are almost indistinguishable to the casual observer.

While dyeing may be a cheap and ready process in the treatment of low-priced furs, it is an art when applied to choice skins. Its perfection consists in the exact imitation of the proper color and tint, with the preservation of the glossiness of the fur and its natural firmness and pliability, and, finally, in the durability of the dye. In case of the fur-seal, fashion has decided that the color shall be changed to a lustrous blackish-brown, an original color resembling nothing whatever in the animal kingdom.

Some skins of beaver, otter, etc., are "silvered" by passing lightly over them a solution of sulphuric acid, and also some are made a golden yellow by means of peroxide of hydrogen. Dyed furs are generally not so durable as those left in the natural state, the artificial color fading and the garment sooner presenting an old and worn appearance.

The dyeing of furs is of great antiquity, but its principal development, in America and Europe at least, has been within the last forty years. Experiments on the part of conscientious and able chemists have resulted in greatly improving the permanency of the dyes and lessening their injurious effects. The methods are constantly undergoing changes and many improvements are introduced from time to time. The composition of the new dyes and the methods of applying them are carefully guarded from general knowledge. One frequently runs across published directions for compounding the dyes and methods of applying them, but usually these descriptions are totally valueless, the methods described being either superseded by better ones or lacking in certain essential ingredients.

The number of successful dyers in the world is very small; their prosperity is dependent as much upon the elimination of competition as on the excellence of their work, consequently they are not proclaiming from the housetops the composition of their dyes, frequently the results of long and costly experiments.

In the separate chapters devoted to each variety of furs certain general methods of dyeing those particular skins will be described, but the writer is unable to promise the formulæ and details of the newest and most successful dyes in every instance.

AQUATIC FURS USED BY HATTERS.

During the seventeenth and eighteenth centuries an important if not the principal use of aquatic furs in Europe was in making fashionable hats, commonly called beaver hats, beaver fur being the chief material in their make-up. The general adoption of the silk hat about sixty years ago resulted in greatly reducing the quantity of aquatic furs used by hatters, but those manufacturers are yet large consumers of these articles for the production of fine grades of soft hats.

The principal felting furs among the aquatics are nutria, muskrat, beaver, fur-seal, otter, and mink, named in the order of the extent to which they are now used. Rabbit, cony, and hare furs are used far more extensively than all the foregoing combined, owing to their cheapness, but are less desirable than most varieties of aquatic furs. Hatters' furs are both cut and blown, the former being taken from the whole skins, and the latter from small pieces, clippings, roundings, and other waste obtained in cutting skins for sewing into garments.

The choicest felting fur is that of the beaver; but its high cost limits its use in hat-making. A felt hat of average size and weight made of fur cut from choice beaver pelts could not be made for less than $500 per dozen, and no demand exists for such expensive goods. But manufacturers receive a quantity of beaver cut from damaged skins of little value as dressed fur and also considerable blown from clippings and the waste from cutting skins into garments. The choicest beaver fur for hatters' purposes is obtained from the cheeks of the animal, with that from the belly, the back, and sides, following in the order named.

Beaver clippings sell for about $1 to $1.25 per pound, and the fur, when blown free from hair and impurities, sells for $8 or $10 per pound. Cut beaver has been sold as high as $224 per pound by brokers yet in the business. The quantity of beaver fur used by hat-manufacturers throughout the world averages about 6,000 pounds annually. It is made into very light soft hats, which sell wholesale at about $80 or $90 per dozen. These are very durable, and if occasionally cleaned or dyed may be worn almost indefinitely. A small demand still exists for the old-fashioned beaver-napped hats, shaped somewhat like the present style of silk hat, being the fashionable headgear for the guards on drags and coaches, and to a small extent for ladies' riding hats.

The next highest grade of fur used by hat-manufacturers is nutria, which is the standard choice fur for making into soft felt hats. It is estimated that about one-third of the total product of nutria skins are cut for hatters' use, and in addition the hat-manufacturers receive large quantities of blown fur from manufacturers' clippings. Nutria is very nearly as desirable as beaver for felting, selling at present for about 80 per cent of the value of the latter, whereas in the dressed-fur trade it is worth only 30 per cent as much as an equal area of beaver fur. During the past twenty-five years the average value of cut and blown nutria fur has ranged between $2.25 and $7.50 per pound. In

1877 it was $5.50, and gradually decreased to $2.25 in 1886; it increased to $7.50 in 1897, and in 1900 it averaged $6.50 per pound. Single sales have been made as high as $14 per pound. The total product of nutria fur used in hat-manufacturing in 1900 is estimated at 80,000 pounds, valued at $520,000. It is claimed that a single manufacturer in Philadelphia has at times over a million nutria skins in warehouse.

Otter ranks next in grade among felting furs, but only a small quantity of this kind is used, and that is obtained from fur-cutters' waste. The clippings and waste sell for about 45 cents per pound, and the cut and blown fur for about $3.50 per pound. The quantity used by hat-manufacturers annually probably approximates 700 pounds.

Muskrat fur is used extensively in hat-making, the whole skin as well as cutters' waste being utilized. Like beaver fur, it is assorted into three grades—backs, sides, and bellies—on account of difference in color and texture. The belly fur is the choicest and is used for making light or pearl hats. During the last 25 years the price has ranged from $1.80 to $3.25 per pound, averaging about $2. In 1876 it was $2.25, from which it varied little till 1890, when it began to increase, reaching $3.25 in 1892, and since then it has steadily decreased to the present price, $1.80 per pound. The cutters' waste sells for 35 to 40 cents per pound and the blown fur for $1.30 to $2 per pound. The standard mixed grade of blown muskrat fur usually sells for 30 or 40 cents less per pound than the belly fur, while dyed muskrat sells usually for one-third the price of cut belly, or about 60 cents per pound.

A small quantity of mink fur is used by the hat-manufacturers, the amount not exceeding 1,500 pounds annually, obtained entirely from cutters' waste, no whole skins whatever being used for this purpose. Mink fur is rather poor for felting, as may be inferred from the price at which it sells, the clippings fetching about 15 cents and the blown fur about $1.10 per pound, or only one-sixth the price of beaver.

The cheapest aquatic fur received by the hatters is that of the fur-seal, of which probably 5,000 pounds are used annually. This is obtained almost exclusively from cutters' waste of dyed clippings, and when cut and blown sells for about 75 cents per pound.

The preparation of all of these furs for felting purposes is practically the same in each case. Preparatory to cutting them from the whole skins, the pelts are scoured thoroughly with soap water to remove the grease and other impurities, then they are properly dried and plucked, each one of these several processes being performed in much the same manner as in the fur-dressing establishments, except that it is done with greater expedition and less care. The overhairs are of no value in felting, and are sold as stuffing in upholstery, for plasterers' use, etc. The plucked skins are next carroted, consisting in moistening the fur with a solution of quicksilver and nitric acid or chloride of mercury, and then spreading them out flat to dry. This is done either in the open air or in rooms heated by steam, according to the color desired.

When dried in the open air the fur becomes whitish, and when dried by subjection to steam or other artificial heat it assumes a yellow, carrot-like hue. This explains the abbreviations W. C. (white carrot) and Y. C. (yellow carrot) always given in connection with the designation of each kind of felting fur. In the preparation of beaver and some other furs, the carroting is occasionally omitted, but this raw stock does not felt so readily and is usually mixed with properly carroted fur.

After drying, the carroted skins are brushed by holding each one for a few seconds against a revolving wheel studded with quills. This is for the purpose of removing all dust and to straighten the fur so that it may be readily cut from the skin. Originally the cutting was done by manual labor, a pair of shears being used, and later by means of an ingenious mechanism giving a chopping motion to a vertically mounted knife. At present a much better machine is used, which with great rapidity cuts the pelt from the fur in little narrow strips about one-sixteenth of an inch in width and equaling in length the width of the skin. These strips of coriaceous membrane fall into a receptacle and go to the waste heap or to the manufacturers of certain oleaginous compounds. An endless apron carries the fur forward without disarranging it or changing its natural formation, where it is properly assorted by experienced operators.

Each assortment consists of the fur from a particular part of the skin, the chief divisions being the back, the sides, and the belly. Fur cut from the back is the darkest in color; that from the sides is lighter, and somewhat lower in quality. The belly fur is nearly always the lightest in color. It varies in quality, however, being the finest of the principal grades when cut from the beaver, nutria, or muskrat skins, and the lowest when obtained from the skins of land animals, such as the cony and rabbit. Minor assortments consist of the fur cut from the tails of various animals and from the cheeks of the beaver, the latter being the choicest felting fur obtainable. Belly fur is used in making light-colored hats; that from other portions is available for the production of felt hats of every desirable color. All of these assorted furs are placed separately in paper bags, containing 5 pounds each in America and England and 1½ kilograms each in France, in which they are stored or marketed.

The blown furs are those obtained from fur-cutters' waste, which every furrier establishment saves carefully. These pieces are assorted and sold to the cutters of hatters' furs at prices ranging from $1.25 per pound for beaver to 15 cents per pound for mink clippings. The fur-cutter runs them through a chopping machine, where they are cut into minute pieces, and afterwards are repeatedly blown to separate the fur from the overhairs and pieces of skin. Blown fur is not usually carroted, and since it is short and is not readily assorted into various grades it sells for considerably less than cut fur.

THE SKINS OF FUR-SEALS.

DESCRIPTION OF THE SKINS.

There are two distinct groups of marine mammals commonly called seals. The members of one family, the *Otaridæ*, provide the fashionable fur, and are known generally as fur-seals; while the *Phocidæ* supply seal leather and oil, and are called seals or hair-seals.

The northern fur-seal pelts on the market are of three sorts, viz: Alaska skins, Copper skins or Copper Island skins, and Northwest Coast skins. Of the southern pelts the principal varieties are the Lobos, the South Shetland, the Cape Horn, and the Cape of Good Hope skins; but the present yield of these is quite small compared with that of the northern skins. These several classes of pelts are distinguishable from each other and sell at different prices. The Shetland Island skins are the choicest, but they are now very scarce and are rarely on the market. Of those obtainable in marketable quantities, the most valuable are the Alaska skins; next are the Copper skins; and the Lobos and Cape of Good Hope skins are of least value.

The pelage of the Alaskan fur-seal consists of a nearly uniform coating of dense, soft fur overtopped by coarse rigid hair of varying length. The coriaceous membrane is thin, pliable, and of light weight. The fur increases uniformly in thickness and fineness all over the body until the third or fourth year, when it is about three-eighths of an inch in length and is in its greatest perfection. After the fourth year it grows longer and thicker on the neck and shoulders and becomes thinner on the posterior parts, thus deteriorating in value. The hair overtopping the coating of fur is longest on the back of the neck, where in case of 4-year-old males it reaches a length of 2 inches or more; on the posterior parts it is shorter, and near the hind flippers it is usually less than an inch in length; on the limbs it is much shorter and less dense, and in some places quite absent. It is shed annually in August and September, new hair appearing as the old is cast. The process occupies about six weeks, and while in that condition the skins are known as "stagy," and are of inferior value owing to the amount of labor required in the process of dressing.

The Alaskan skins have constituted the greater part of those on the market since fur-seal has been fashionable in Europe and America. The Pribilof Islands, whence they are obtained, have probably yielded one-third of the total product of fur-seals of the last two centuries, and 80 per cent of those secured in the last seventy-five years. From the reports of the United States Treasury Department, it appears that from 1870 to 1900, inclusive, 1,837,563 marketable fur-seal skins have been shipped from the Pribilof Islands, and the revenue to the United States Treasury has amounted to $7,812,036.

The fur of Copper skins, from the Commander Islands, is coarser and less dense than that of the Alaska skins, and commands a lower price in the markets, usually about 70 per cent of the price of the latter. The pelt is also less porous than that of the Alaskan skins, this being especially noticeable in the process of working them preparatory to leathering. It is far more difficult to unhair a Copper skin, as the membrane is harder and stiffer and the hair more brittle.

Since 1871 the Russian Government has leased the sealing rights on the Commander Islands under conditions similar to those in the Pribilof lease. Following this, the number of skins secured averaged between 35,000 and 40,000 for upward of twenty years, but during the last six years it has greatly decreased.

The skins from Robben Island, in Okhotsk Sea, were formerly classed separately from those obtained on the Commander Islands, and were regarded as inferior, owing to the greater difficulty in removing the hair and the lighter color of the fur. Improved methods of dressing and dyeing have lessened this difference, and within the last fifteen years they have been combined with those caught on Copper Island and included in the term "Copper skins."

The Northwest skins are obtained in the North Pacific Ocean and the adjacent seas, and are the product of the so-called pelagic fishery, which has occupied so much attention in diplomatic correspondence and in the public press during the last twelve years. Previous to 1881 the output of this fishery never exceeded 10,000 skins; then it increased until 1894, when the catch was 141,143 skins, and since then it has greatly decreased, the product in 1900 being 38,923. Notwithstanding the fact that the Northwest skins are from the same herd as the Alaska skins, they are of much less value, many of them being taken out of season, when the fur is poor and the pelt stagy. As a rule they are not so well cured as the skins taken on the islands, and have many raw spots, a result of their being salted in the foul air of the ship's hold under indifferent supervision. They are readily distinguishable from the Alaskan and Copper skins by the fact that they are all pierced by bullet, buckshot, or spear, furnishing another reason for diminished value.

The Lobos Island fur-seal, at present the most numerous of all the southern members of this family, is obtained principally from Lobos Island, at the mouth of the Rio de la Plata, which is owned and controlled by the Republic of Uruguay. It is of a greenish or yellowish-brown color, with sides of a darker brown, and the fur is comparatively long. The pelt is thin, rather spongy, and easy to work. Since 1825 the right to take seals on the island has been leased under a system of regulations resembling somewhat those in force on the Pribilof and Commander islands. The annual product is from 15,000 to 20,000. The total number of skins obtained since 1873 approximates 415,000, valued at $4,000,000, a remarkable output for an island covering less than 1 square mile in area. The rookeries on this island are the only ones in all the southern seas which have been protected, and they are also the only ones whose output has continued undiminished to the present time.

The general color of the South Shetland or Cape Horn fur-seal, according to Mr. Henry Poland, is light gray with a silvery hue; the neck and cheeks are whitish, and the sides and belly are of a rich brown. The fur is thick and heavy, and of a reddish or deep pink color. The habitat of this seal is the islands in the Antarctic Ocean, and it is more numerous on South Shetland Island than elsewhere. When in good condition this fur is the choicest on the market, its quality being much superior to that of the Alaskan seal, the high latitude and the rigor of the climate developing the fur into full perfection at the time when the seals seek those shores. During the seventies the skins of the South Shetland fur-seals sold for nearly twice the price of Alaskan skins, although, owing to the inferior quality of the leather, they are less durable. Since 1882 the receipts of Cape Horn skins have been small and irregular, ranging from 6,000 to less than 100 a year. The high prices of the pelts have resulted in the searching of every accessible beach and rock in the southern oceans and the removal of all fur-seals that could be secured, their only protection being the severe weather, which often makes it impossible to effect a landing on the rookeries.

The total number of fur-seal skins marketed since their introduction in the early part of the eighteenth century aggregates probably 13,000,000, of which 5,000,000 were secured from northern localities and the remaining 8,000,000 from the rookeries of the southern seas, the great bulk of the latter being marketed at Canton, China, a hundred years ago. At the present market price the total value of these pelts would approximate $500,000,000, but owing to their cheapness in the early years, when the greater part of them were obtained, the actual returns have probably not exceeded a tenth of that amount.

In curing fur-seal skins preparatory to shipment it was formerly customary to dry them while held stretched upon the ground by the use of stakes and twine or by means of wooden pegs driven through the edges. It was often impossible to dry the skins thoroughly in the damp climate of Alaska; and even when artificial drying was resorted to, it was frequently difficult to prevent them from deteriorating while en route to market. The drying process also made it difficult to unhair the pelt in dressing. This led, about 1855, to the salting of the skins, which is now the general practice. However, a few are dried by the natives along the mainland and on the adjacent islands of Alaska, a thousand or more being marketed each year.

FUR-SEAL MARKETS.

Previous to 1855 fur-seal skins were in little demand in Europe or America. The fur was not fashionable and the skins were made into gloves and riding rugs, caps for cabmen and street peddlers, and even for the covering of trunks and boxes. Another use to which they were put when unusually cheap in the European market was to clip the fur from the skin and tan the latter for the general purpose of leather, while the cut fur was either discarded or manufactured into napping for "beaver hats." But few hats were made of this material after the adoption of silk felt.

About 1825 the unhairing and dyeing of fur-seal was introduced, and although the article was very poor compared with the choice product of the present time, it was a decided advance over the former methods of dressing. Between 1855 and 1870, through experiments on the part of Messrs. Oppenheim & Co., and of Messrs. Martin & Teichman, in London, and of Mr. George C. Treadwell, in Albany, the methods of dressing and dyeing fur-seal were greatly improved, resulting in an exquisitely soft and downy texture and rich dark-brown color, which was quickly adopted by the fashionable world for cloaks, jackets, muffs, trimmings, etc. So popular did the fur become that the demand quickly ran up from 10,000 skins in 1860 to 20,000 in 1865, to 150,000 during the seventies, and 200,000 during the eighties at greatly increased prices. The high prices resulted in excessive drains on the rookeries and unwise methods of slaughter at sea, so that the quantity of skins obtainable now is very much less than ten or fifteen years ago, only 95,485 being handled in 1900, and the price is much in excess of what it ever was before.

Previous to 1871 fur-seal pelts were comparatively cheap, the undressed Alaskan skin rarely selling for more than \$4 or \$5; but since that time the market price has greatly increased. In 1875 Alaskan skins averaged about \$13 each; in 1880, \$20; in 1885, owing to the large number received from the pelagic fishery, the price fell to about \$16 each, but in 1890 it increased to \$35, and in 1900 to \$40.

Since 1870 practically the entire world's product of fur-seal skins has been sold in London. Most of them are handled by Messrs. C. M. Lampson & Co., who receive consignments from the North American Commercial Company, the lessees of the right to take skins on the Pribilof Islands; from the Russian Sealskin Company, the lessees from the Russian Government of the rights on Commander Island and Robben Reef, and a large portion of the Northwest skins. Other prominent firms in London handling skins are the Hudson's Bay Company, Messrs. Boulcher, Mortimer & Co., the consignees for Lobos skins, and Messrs. Culverwell & Brooks, who receive many of the Northwest skins.

The skins are duly catalogued, and public-auction sales are held at stated times during the year, usually in March, October, and December, when all the leading furriers of Europe and America are represented, the number averaging about 50. Generally the entire stock on hand is sold at each occasion.

The consignments of skins are assorted according to the size, the following grades being recognized:

Name of class.	Age.
Wigs	6 to 10 years.
Middlings	4 to 5 years.
Middlings and smalls	4 to 5 years.
Smalls	4 years.
Large pups	3 years.
Middling pups	2 years.
Small pups	2 years.
Extra small pups	1 year.
Extra extra small pups	Under 1 year.
Grey pups	Under 1 year.

The following summary, compiled by Mr. Alfred Fraser, shows the total number of skins offered at the London auction sales during each year since 1872:

Statement of the number of each variety of fur-seal skins offered in London during a series of years ending in 1900.

Year.	Alaskan.	Copper Island.	Northwest coast.	Lobos Island.	Cape Horn.	Total.
1872	96,283	7,182	16,312	7,000	320	127,097
1873	101,248	21,614	931	6,956	9,000	139,749
1874	90,150	30,349	8,843	8,509	8,600	146,451
1875	99,634	34,479	3,575	8,179	9,500	155,369
1876	90,267	33,298	4,097	11,353	6,306	145,321
1877	75,410	25,380	1,945	13,066	7,631	123,432
1878	99,911	19,000	3,610	12,301	8,227	143,016
1879	100,036	28,211	15,527	12,295	12,180	168,249
1880	100,161	38,885	13,501	14,836	17,562	184,945
1881	99,921	45,209	16,573	13,569	13,164	188,436
1882	100,100	39,111	23,765	13,200	11,711	187,329
1883	75,914	36,500	5,028	12,861	4,655	139,474
1884	99,887	26,675	19,269	16,258	6,743	169,705
1885	99,719	48,929	20,265	10,958	3,404	183,270
1886	99,910	41,752	33,973	13,667	909	190,213
1887	99,940	54,584	43,339	11,068	2,762	211,693
1888	100,000	46,333	40,000	20,749	4,403	211,483
1889	100,000	47,416	41,808	8,755	3,021	201,000
1890	20,994	95,486	39,014	18,541	2,450	176,485
1891	13,473	17,025	55,263	16,834	3,114	104,709
1892	7,554	30,678	64,108	12,202	6,292	120,834
1893	7,492	32,832	121,618	13,624	2,131	177,697
1894	16,030	27,298	171,914	12,145	62	227,449
1895	15,002	17,721	57,842	12,017	1,888	104,470
1896	7,500	14,415	30,651	14,019	2,510	99,095
1897	22,504	(a)	68,623	13,407	2,037	106,571
1898	20,762	13,726	46,178	30,348	3,900	114,914
1899	26,434	8,942	44,993	15,381	6,291	102,041
1900	19,935	9,784	42,829	15,116	7,821	95,485

a The 1896 skins were sold in December, 1896; no 1897 skins were sold until March, 1898.

Previous to 1820 no market existed for fur-seal skins in the United States, and practically all of those received from the Southern oceans were reshipped to China, either direct or by way of Europe. In 1822 Mr. Denison Williams, a cap-manufacturer of Albany, N. Y., introduced fur-seal caps to the trade. From a manuscript written by him, and now in the possession of Mr. Samuel Williams, we have extracted the following notes in regard to the development of this business:

In 1822 the first fur-seal came into our market. At that time no one knew a process of removing the hair from the fur, therefore we made them into caps with the hair on, which took well. The next season we used large quantities of fur-seal, and after a number of experiments succeeded in removing the hair, greatly increasing the value of the fur. Those skins were from the South Shetlands, then just discovered, and were the finest ever found. The next season we prepared a lot of hair-seal caps which took well in the Southern markets. In the fall of the following season (1825) we succeeded in coloring both the fur-seal and the hair-seal skins, the first ever colored in this country, thus enhancing their value 100 per cent.

Mr. Williams was quite successful in the fur-seal cap business, establishing agencies in Boston, New Orleans, and Nova Scotia, and having made a net profit of $60,000 in four years, retired in 1827. The business was continued by Mr. Williams's former associates, Messrs. Packer, Prentice & Co., who built up a large trade, their manufacture of various furs in 1831 amounting in value to half a million dollars. In 1833 Mr. George C. Treadwell, who in later years enjoyed so prominent a reputation in fur-seal dyeing, began dressing the skins, and in a few years others embarked in the business, making Albany the principal center in the United States for this industry. Fur-seal skins constituted a large item in the business, 20,000 being unhaired and dyed in a single year, nearly all of which were used in the manufacture of caps. Previous to 1835, most of the skins were dyed "London brown." In that year Mr. James Chase, of the Treadwell company, discovered how to give them a dark plum color, and afterwards deepened it to a deep sable hue.

The skins were obtained from the South Shetlands and other places in the vicinity of Cape Horn and from various places on the west coast of Africa. With the decrease in yield from these localities about 1840, the business at Albany began to wane, and finally fur-seal skins became so scarce that nearly every manufacturer ceased using them. Mr. Treadwell continued their use for caps and gloves, obtaining his supply of raw skins from the occasional lots received from the southern seas, supplemented by shipments of Pribilof skins from London.

The attention of Mr. Treadwell having been called to the growing demand in London for fur-seal sacques, he began dressing and dyeing the skins for the trade in the United States. He did not produce the seal-black fashionable at the present time, but a reddish brown, which became known as seal-brown. This product gave excellent satisfaction, the dye retaining its bright color without fading. Meeting with sufficient demand for his output, he did not attempt to secure the black shade of color finally adopted by the London dyers in response to the demands of fashion.

Mr. Treadwell was the only fur-seal dresser in this country up to the year 1878, when Mr. J. D. Williams, of Brooklyn, the son of Mr. Denison Williams, referred to above, began dressing and dyeing the skins a dark brown, similar to the London color. At the present time, the sons of the late Mr. J. D. Williams, above noted, are the only fur-seal dressers and dyers in this country, although there are many who redye skins. The reason fur-seal skins are not dressed and dyed more extensively in the United States is not due to the high cost of labor here, for that is more than counterbalanced by the 20 per cent import duty on the prepared skins; nor is it due to the lack of expert workmen. The principal reason is that the raw skins are sold in London and harmonious cooperation exists among the fur-brokers, fur-dressers, and bankers there, so that a first payment may be made on skins purchased in the fall, and most of the purchase money be withheld until the skins have been dressed, dyed, and made ready for manufacture six or eight months later.

In estimating the industrial value of the manufacture of fur-seal articles in the United States, seven of the principal furriers made affidavit in 1892, as follows:

The number of Alaska fur-seal skins that are imported annually into the United States, after dressing and dyeing in London, is, upon the basis of the importations during the past ten years and upon a catch of 100,000 skins at the Pribilof Islands, correctly estimated at 65,000 to 75,000. The value, before paying duty thereon to the United States, of each dressed and dyed fur-seal skin so imported, may be said to range between $15 and $50, with an average value during the past ten years of about $25 per skin. The wages paid annually to people engaged in the manufacture and remodeling of seal-skin articles are, on an average, about $7 a skin, or upon 70,000 skins, $490,000. The profits made annually by merchants, wholesale furriers, and retail furriers amount to about $30 a skin, or upon 70,000 skins $2,100,000. The amount of silk consumed annually in the manufacture in the United States of 70,000 fur-seal skins into articles and in the repairing of these articles may be estimated at $150,000 to $200,000. All silk which is being so consumed at the present time is made in the United States. Working men and women are employed in the industry of manufacturing seal-skin articles in the United States as follows:

Classification.	Number.	Wages per diem.
Fur-cutters (i. e., people who trim, repair, and prepare the general shape of skins)	1,200	$3.50 to $4.50
Nailers (i. e., people who stretch and nail skins into shape on boards)	600	2.00 2.50
Sewers and finishers (i. e., people who put the article into final shape)	1,500	1.50 2.00
Those who machine skins (i. e., remove the portion of guard hairs left by the unhairers)	60	2.00
Total	3,360	

The fur-cutters represent skilled labor of a high order. No account is taken of porters, clerks, salesmen, etc., employed in the large establishments.[a]

Owing to the smaller quantity of skins received on the market at the present time, the number of persons employed in manufacturing them into garments is much less than in 1892, probably not over 60 per cent as many. The total number of persons actively employed at present in various parts of the world in handling fur-seal skins from the live animals to the finished garments probably aggregates 4,000, and the total value of the product $6,000,000 or $8,000,000 annually.

METHODS OF DRESSING AND DYEING.

The present method of dressing fur-seal skins represents the highest development in the fur-dresser's art. The difference in appearance between a raw and a finished pelt of beaver, otter, or muskrat is com-

[a] Fur-seal Arbitration, Washington, 1895, Vol. III, p. 526.

paratively small; but the raw fur-seal skins, as received at the fur-dresser's establishment in their dirty and unsightly condition, bear little resemblance to the finished product delivered to the garment manufacturers. The following account of the present methods of dressing these skins is based on information furnished by fur-dressers of New York and London, and especially by Mr. Samuel Williams and Mr. Max Bowsky, of New York City:

The moist skins are first freed of salt and then "blubbered," consisting in placing each skin, fur down, on an inclined wooden beam somewhat like a tanner's beam, and with a two-handled knife removing all particles of blubber, flesh, and other extraneous matter, care being taken that no cuts or uneven places are made in the pelt. These blubber scrapings are oleaginous and are usually handled by manufacturers of oils and greases. The skins are soaked in cold water over night and then washed in strong soap water, the amount of washing depending on the condition of the pelt, some pelts standing more than others, too much washing loosening the fur. Whale-oil soap was formerly considered necessary for this, but its use is now almost abandoned. After the washing, the skins are placed on a beam with the fur side up and the grease and water are removed by scraping or pressing with a beaming knife.

Then comes the depilation or unhairing, the most difficult and important single step in the process. In preparing for this, a slight difference of practice exists among the various dressers. Usually after the washing, as above noted, each skin is stretched and sewed with heavy cord to the rim of an iron hoop and suspended in dry atmosphere until thoroughly dry, usually requiring several days. Next they are soaked in cold water from one to three days, the length of time varying according to the condition of the skin and the temperature of the water. On removal the fur is dried and the skin made quite warm, doubled together, and sweated in a warm place from one to three hours or until the hair commences to start. In some establishments the drying of the skins on iron hoops is omitted entirely, and the fur is dried and the moist pelt warmed and sweated as above noted immediately after the washing process.

When the skins are in good working condition, the picker or unhairer bends several of them across boards by the side of a stove, and thus warms and dries the fur side, keeping the skin side moist in the meantime. Each skin while warm is successively placed on the unhairer's beam, pelt side down, and the hair removed by using a dull knife of soft metal, known as a picker's knife, the workman grasping the hair between the knife and his thumb, the latter being protected by a rubber cot. Extra force should not be used in case the hairs do not yield readily, for they are liable to break off; but the pelt should be again moistened and the fur side warmed. After a portion of the skin has been unhaired, it is necessary to warm another part of it at the stove, keeping the pelt moist as before, and the operation is continued until the entire skin has been unhaired. In order that the hairs may be easily removed, it is necessary to heat the skin to the limit which it will stand without injury, and much experience is required to determine this limit. Many skins have been so injured in the unhairing that the fur loosens and readily comes out after a few weeks' wear.

For economy of time, a workman generally operates on three or four skins at the same time, unhairing one while the others are warming. The hairs must be pulled out and not broken off. Care is also taken to avoid removing the fur with the overhairs, and thus leaving bare spots on the pelt. Even after the above process stagy skins retain many short or second-growth hairs which reach a short distance above the fur. Many of these may be removed by the picker warming the skin and passing a dull beaming-knife rapidly over the fur. When the skins are very stagy they are sometimes unhaired in part from the skin side. The roots of the hair penetrate the membrane farther than those of the fur, and when the skin is pared down thin the hairs may be pulled out by grasping the base of the roots.

The skins are next stretched and nailed on boards and dried very hard, the drying continuing from two to five days to remove every particle of moisture. On removal they present the appearance of thin, uneven boards with little curls of brown fur on one side; these may be cracked or split by a person walking on them almost as readily as though of wood.

When opportunity presents, the dried skins are dampened on the pelt side with fresh or salt water and skived or shaved on a beam with a currier's knife to a thin, even surface. Salt is used in the water to prevent the fur from coming loose, but too much salt "cuts" the leather, and its use is not desirable except in hot weather. Some dressers postpone this shaving until after the fur has been dyed, but others are so annoyed by the grease coming out of the thick membrane and interfering with the dyeing of the fur that they thin the pelt at this stage of the process. The pelts are stretched and partly dried, being "worked" in the meantime to prevent their drying stiff and hard.

The pelt side is then covered with butter or other animal grease, and the skins are softened or leathered by tramping them in tubs, with a quantity of fine or veneer hard-wood sawdust, or in a tramping machine built on the principle of a fulling mill (see p. 292). This leathering is continued until the grease is driven thoroughly into the pelt, requiring from two to four hours in either the tramping tub or the fulling machine. The skins are then cleaned free of grease by revolving them with a quantity of fine sawdust, and this is in turn removed in the beating drum, thus terminating the operation of dressing.

Next comes the dyeing process. All holes and defective spots are first mended. If the pelts have been already partly shaved, a sheet of paper is pasted on the flesh side; but if the pelt has been left thick, as is commonly the case, the paper pasting is omitted. The fur is treated with an alkali solution, followed by an acid mordant, for the purpose of "killing" the surface. Each establishment has its own formula for making the dye, the secret of which is usually carefully guarded. Formerly the fur was frequently bleached to a golden hue by means of chloride of calcium or peroxide of hydrogen, or, as was the usual practice in the United States, by a brushing of aqua fortis, over which hot irons were immediately passed; but this color is no longer fashionable. In most establishments the dye for the ends of the fur consist of various combinations of copperas, alum, salt, litharge, antimony, copper dust, verdigris, red tartar or argol, and salmiac. The ground color is formed of combinations of logwood, hippuric, fustic, nutgall, and iron liquor, in varying proportions, according to the experience and fancies of the dyer.

The fur is prepared for coloring by the application of a lime solution. Then the surface coloring is applied with a large brush, the points of the fur being carefully covered to the required depth. After lying folded, with the points touching each other for 6 to 12 hours, the skins are hung up and dried. When dry this dye forms a thin layer or crust, which is broken and beaten out with rattan sticks. Other coats of dye are then successively applied, dried, and the crust removed until the desired effect is secured. For the light brown shade formerly popular, 18 or 20 coats of the dye were necessary; but for the very dark shade popular at present fewer coats of a much stronger dye are used, the usual number applied being 8 or 10. Some years ago a process of dyeing was introduced by which the fur was dipped into the dye, which in this case must be hot. Fewer coats were necessary and a more brilliant color was imparted, but the texture of the fur was injured to some extent by the hot liquid.

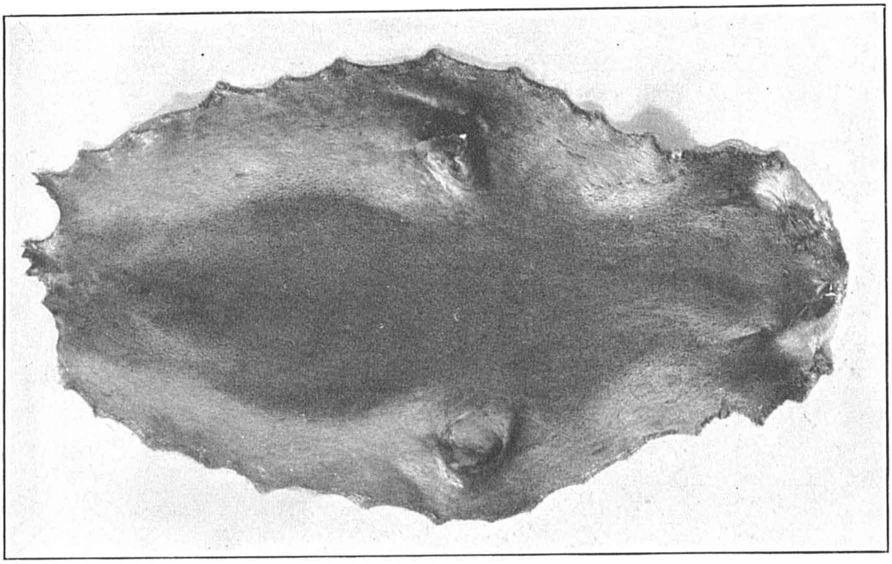
When the desired shade is reached for the top of the fur, four or five coats of the more delicate dye are successively brushed on heavily and tramped in, forming a base or ground color. In tramping this ground color in, two pelts are placed together on the floor with the fur sides against each other, and the dyer lightly treads on them for two or three minutes. The skins are thoroughly cleaned with sawdust and all superfluous dye removed. The pelt side is then moistened with water and shaved down to the required thinness, removing all superfluous flesh and leather and leaving the pelt clean and free from dye. The skins are revolved in a cleaning drum, with maple or other light-colored veneer sawdust for several hours, and on removal, and after beating free of sawdust, are ready for manufacture into garments.

While the foregoing is the general process, it is necessary to vary it for different skins, and successful dressing and dyeing require long experience and much judgment. Owing to the necessity for drying the skin a number of times in the dressing, and also after the application of each coat of dye, the length of time required for both operations is six to eight weeks. The expense of this work in London is about 14 shillings, while in New York, owing to the higher price for labor and materials, it is about $5 for each skin.

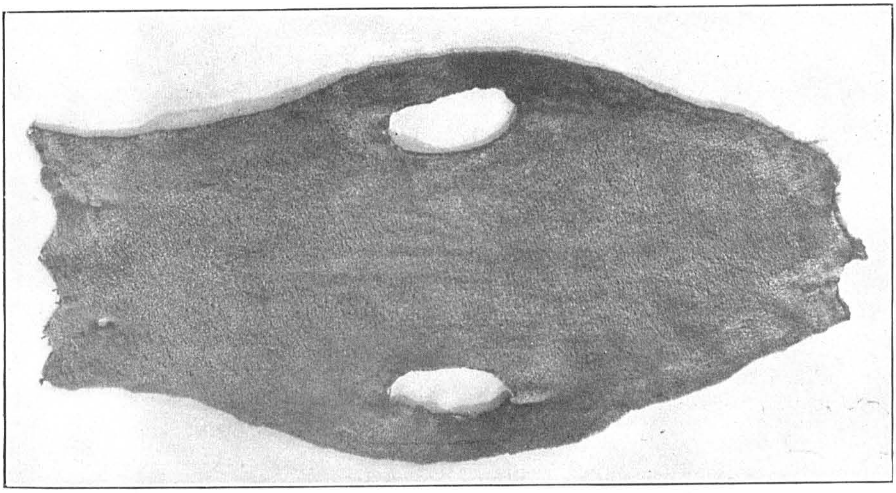
No matter how carefully the unhairing process is performed, a number of hairs are broken off near the surface of the fur, and there remain many of young growth and not yet above the surface, detracting from the beauty and softness of the fur, but adding thickness and durability, owing to the protection afforded. In the early history of fur-dressing in England and America these few hairs were left in, but when fur-seal increased in fashion it became important to have the fur as free from coarse hairs as possible. From 1870 to about 1882 the few hairs remaining after the process of depilation were removed commonly by hand labor, a slow and expensive process. Most fur-manufacturers employed girls to "pick" the skins. Blowing open the soft fur with her breath, the operator cut off the stiff, extended hairs with small shears, requiring one to five days for one person to complete a single skin.

Since 1883 most of this work has been done by complicated mechanism which accomplishes the work as effectually and far more expeditiously. In this process the skin is bent across the upper edge of a vertical board and the soft fur blown aside and divided by a thin, wide current of air from a bellows, when a pair of small knives descend and cut off the stiff, upright hairs. The knives are raised, the skin advanced the fraction of an inch, and the operation repeated until the entire surface is gone over, requiring about one hour to complete an average skin. This removal of the short hairs is invariably postponed until after the dressing and dyeing are completed.

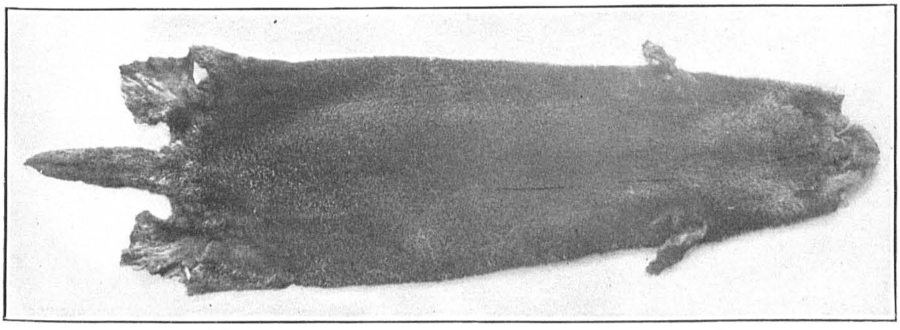
On the adoption of fur-seal as a fashionable material, about 1870, and the great increase in price which quickly ensued, many substitutes were introduced, and since then few furs have been so frequently imitated. These were prepared from numerous cheaper furs, as otter, beaver, nutria, muskrat, cony, and even sheep. The otter, beaver, and muskrat imitations were fairly successful, especially for the manufacture of caps, gloves, and trimmings. They were not satisfactory for cloaks, the membrane being too thick and too weak to trim down sufficiently thin. The garments looked well at first, but soon showed wear, especially at the seams, and the dye faded. A large market was developed on the continent of Europe, especially in Germany and Russia, for fur-seal imitation prepared from muskrat pelts, this cheap substitute greatly injuring the market for the genuine material. Owing to the general dissatisfaction resulting from their use, these imitations were gradually abandoned by reliable furriers, and with the exception of that made from the French cony or rabbit, and known as "electric seal," "coast seal," "China seal," "Canadian seal," etc., fur-seal is not frequently imitated at the present time, except, as before stated, for trimmings and small articles.



FUR-SEAL SKIN, DRESSED, NATURAL.



FUR-SEAL SKIN, PLUCKED, NATURAL.



SEA-OTTER SKIN, DRESSED, NATURAL.

BEAVER FURS.

DESCRIPTION OF BEAVER SKINS.

During the seventeenth and eighteenth centuries the beaver furnished the principal item in the fur trade of the world, but at present it is of somewhat minor commercial importance among the aquatic fur-bearing animals. The skins received by the wholesale dealers from various localities shows different characteristics of pelage. In winter, the color on the back and sides is generally dark bay or brownish black, tipped with chestnut or russet, and seal-brown on the under parts, legs, and feet. The prevailing color ranges toward the south to a yellowish tinge upon brown, and in the north approaching a glossy blackish brown. In general, the beavers obtained in cold latitudes are darker than those secured in warmer climates, but those from the northwestern part of the United States are very light in color. A few black beavers and still fewer spotted ones are obtained; also, at very rare intervals, a yellowish white or pure white one is taken. The Labrador beaver, now somewhat scarce, is superior to those caught farther west, while those of Canada in general, as well as of the northern parts of the United States, are superior to those taken in the Southern States.

The overhair of the beaver is from 1¾ to 2½ inches in length, rather stiff, and of a dull color for two-thirds of its length from the base, and is terminated by shining points ranging in color from the most delicate brown to rich, glossy blackish-brown, giving the general color to the pelage. The underhair or fur is very thick, fine, and soft, from one-half to three-fourths of an inch long, and of a uniform bluish or brownish gray color from the roots to the tips. It is denser and shorter on the underparts than on the back. The fur becomes prime in October in the latitude of the northern boundary of the United States, and continues in good condition until May, when it begins to deteriorate. The pelts are marketable, however, till about June 15, although they are somewhat thin, light in weight, and of less value.

THE MARKETS FOR BEAVER SKINS.

The economic use of beaver pelts antedates the discovery of America. As far back as the Middle Ages, at least, beaver skins were used as clothing by primitive people in Europe. Their principal use, however, was as furnishing material for fashionable hats for men. Beaver hats were worn as early as the twelfth century, but their popularity was not permanently established until the sixteenth century, and then for more than two hundred years the beaver supplied the fashionable world with hat material. As the business increased, it resulted in the slaughter of hundreds of thousands of the animals, the market consumption in certain years approximating 400,000 skins, practically all of which were obtained from Canada and the United States. So extensive and regular was the beaver trade that in the eighteenth and the early part of the nineteenth century the skins were accepted as currency throughout the western part of Canada and the United States and were the standard for bartering with Indians.

It was not long before the market demands outran the resources of nature and the beaver was in danger of extermination. The price of the skins increased correspondingly, selling at times for $8 or $10 per pound, and the finished hat for $20 or more. At length the supply of the fur became so inadequate that other materials were necessarily substituted, resulting about 1839 in the general adoption of the silk hat by the fashionable world.

The demand from manufacturers of hats diminishing, the price of beaver pelts fell so low that the hunt proved unprofitable. Later a demand developed for the skins in the dressed-fur trade, and the price became steady at about $2 or $3 each. This fur became fashionable about twenty years ago, and the indications are that it will be in favor for many years. Small quantities, partly damaged in the curing, are yet used by the hatters, but its employment is mainly as dressed fur for caps, mufflers, gloves, trimmings, etc. Sometimes entire garments are made of it, but its weight makes it objectionable for that purpose. The darker pelts are usually purchased for the European and Canadian markets, while the medium and paler shades are worked up for consumption in this country.

The greater portion of the beaver skins taken on the American continent during the last 200 years have been handled at the London auction sales. The first sale occurred on January 24, 1672, and was an event of much importance. From that time to the present the total number of skins handled in London approximates 30,000,000 with a total valuation of $100,000,000. The average annual sales at present approximate 50,000 in number.

In addition to those handled in London, about 20,000 beaver skins are now marketed each year, being sold at Leipsic and at private sale in the United States and Canada. This makes a total of about 70,000 skins marketed annually in recent years, of which about 10,000 are obtained in the United States and 60,000 in the Dominion of Canada.

In the markets, beaver skins are classed not only according to the general localities whence they are obtained, but also according to their size and the quality of the fur. In assorting them four grades are recognized. Those of the first grade have a flesh-colored pelt, which appears fresh and sound, and with long heavy fur, which separates down to the membrane when blown into and appears uniformly even, fine, and silky. The seconds are almost clear in the pelt and the fur only slightly scant or poor. In the thirds the fur is thin, scant and poor, and the pelt dark. Fourths are of the poorest quality, with pelt almost black or bluish-green color, and the fur short and thin. Each of these grades is divided according to size, the large, medium, small, and kitts. The prices range from $1.25 for the poorest to $10, $12, and even $16 for those of choicest grade, averaging somewhat less than $6 per skin.

Fifteen years ago large quantities of beaver fur were used in this country, and as much as 65 per cent of that sold in London was purchased for the United States trade. At that time long garments were fashionable, and plucked and dyed beaver was much in demand for trimmings. During recent years, however, beaver fur has been largely out of fashion in the United States and Canada, and consequently the consumption in these countries has not been extensive.

DRESSING AND FINISHING BEAVER SKINS.

On arrival in the markets beaver skins are rough and greasy, with the fine rich fur almost concealed by the coarse brownish hair. In the process of dressing, the skins are first soaked in water over night. The following day each one is placed, flesh side up, on a flat, hard-wood beam, and with a breaking knife a workman breaks up the grain of the pelt, thus softening it. The pelts are washed with warm water and soap, and then prepared for plucking. The water is removed by passing them through either an ordinary roller wringer or a centrifugal wringer, or, in some houses, by pressing them with the breaking knife. The hair side is dried and warmed by artificial heat, care being taken to keep the pelt side damp; chalk is sprinkled over the surface, and the hair is removed in the general manner described on page 291. A very small percentage of beaver skins, probably not more than 1 per cent, are left "in the hair"—that is, the overhair is not removed. Only a small demand exists for natural beaver, however, owing to its rough and coarse appearance.

Formerly it was customary to shear beaver skins, instead of plucking them, and many are yet prepared in that manner on the continent of Europe. In this case it is unnecessary to moisten the pelt preparatory to plucking; but, placing the skin, flesh side down, on a beam and using a comb and shears, a workman clips off the greater part of the long hairs in much the same way as a barber operates. Beaver thus prepared bears some resemblance to sea-otter fur, especially when very dark pelts are used, and sheared beaver is often used in imitation of that costly fur. The imitation is greatly enhanced when the overhairs are whitened by means of an acid.

After plucking, the pelt is shaved with a skiving knife, as described on page 291, for the purpose of reducing its bulk preparatory to leathering. The pelt side is then dampened with cold salt water and allowed to so remain over night. The following morning it is stretched lengthways and crossways and partly dried. Butter or other animal grease is rubbed on the pelt side, and a number of skins placed in a fulling or tramping machine in which two hammers push or beat and turn them for eight or ten hours. The skins are then placed with a quantity of hard-wood veneer sawdust in a large drum, over either gentle charcoal fire or steam heat, and revolved for three or four hours. Next they are placed with sawdust in tubs, where they are tramped by barefooted workmen for about three hours, each tub containing about twenty skins.

On removal from the tramping tubs the pelts are thoroughly stretched by hand, and the leather side dampened over night preparatory to shaving on the following day. Shaving is the most difficult feature and is intrusted only to skilled workmen. Each skin is placed, fur down, on a perfectly smooth hard-wood beam, similar to that used in skiving, and by means of a skiving knife the operator shaves off the membrane of the pelt until the roots of the fur are almost visible.

The skins are again stretched lengthways and crossways by hand, dried, and for the second time placed in the tramping tubs with hard-wood sawdust for further softening and leathering. After two or three hours' tramping they are removed, straightened or stretched out, and returned for two or three hours further tramping. They are next thoroughly beaten with bamboo sticks to remove the sawdust, and then combed with a fine steel comb to lighten up the fur. The skins are then placed on a beam and by means of a large flat-bladed knife, sharp as a razor, a workman shaves over the top surface of the fur, removing all scattering hairs and impurities, thus completing the dressing process.

While it is not customary to dye beaver fur, many light skins are blended to a darker shade, and a few are dyed in much the same manner as fur-seal. Some few skins are bleached golden brown, and a smaller number to a creamy white. Some are silvered by passing lightly over them a solution of sulphuric acid, and some are made a golden yellow by means of peroxide of hydrogen.

About twenty years ago many beaver skins were "pointed," the plain solid color being ornamented by inserting white hairs at irregular intervals, in imitation of the pelage of the sea-otter or the silver fox. The hairs were generally sewed in the pelt by wig-makers, but in some cases they were firmly fastened with cement. Badger hairs were most frequently employed, but white hairs of the gray fox, cony, and skunk were also used. On account of its varied white tips, the hair of the Egyptian ichneumon was also in great demand, being superior to the hair of the fox, or even the badger. Some skins were likewise ornamented with the white tips of small feathers taken from the breast of the grebe and less frequently of the peacock. This ornamentation was quite fashionable from 1881 to 1884.

Beaver fur is especially serviceable for making hats because of its remarkable felting characteristics and its durability and glossiness. So strong are its felting properties that coats made from cloth of this material, manufactured solely by the felting process, have been known to wear for years, and it is claimed that in former times beaver fur was sometimes felted for hosiery purposes. While it is the most desirable of all furs for hat-making, its high cost prevents its general use for that purpose. Practically the only beaver fur now received by the hatters is the blown fur obtained from manufacturers' clippings and that cut from skins damaged in curing or otherwise, as has been already noted in the chapter on hatters' furs. But even in using fur from these sources, a light hat made from beaver can not be purchased for less than about $10, and the price is likely to be $15 or more.

MUSKRAT FURS.

DESCRIPTION AND CHARACTERISTICS OF FUR.

The fur of the muskrat is dense and soft, somewhat like that of the beaver, but is shorter and inferior in denseness, fineness, and durability. The color is generally drab blue, in some cases with a whitish appearance, and tipped with reddish brown. The fur of the small muskrat found in Alaska is of a light silvery color, almost white on the abdomen, and very fine, the pelts from that locality being highly prized when beaver hats were in fashion. The fur is concealed by long, stiff, brown overhairs on the upper surface and sides of the body. The general color of the animal is dark umber brown, almost blackish brown on the back and gray below, but specimens are found ranging through the various shades of brown, blue, and yellow to pure white.

In the Chesapeake and Delaware regions and, to a less extent, in other parts of America, in addition to those of the usual coloring, some individuals are very dark, so nearly black, in fact, that they are designated "black muskrats" in the trade. These are of superior quality and value. In some specimens, especially among those found in certain regions of Canada, the chest and abdomen is of a chestnut brown and in others almost white, but the latter are by no means common. Pure white muskrats are occasionally found, but they are of no more value in the trade than those of the ordinary coloring, although highly prized by collectors of natural-history specimens. As is the case with most aquatic mammals, the skins of those occurring in southern localities are thicker and more spongy than those in the colder latitudes. Muskrat fur is inexpensive, the skins selling usually for 10 to 20 cents each; however, under the skill of the fur-dresser and the dyer, it assumes a high rôle in the form of imitations of more costly furs; in retail stores it is found prepared in so many different ways and with such a variety of finish as to be scarcely recognizable to the most expert trappers who are familiar with the raw skins only.

PRODUCT OF MUSKRATS AND THE MARKETS THEREFOR.

While the annual product of muskrats is at present very large, this extent is of comparatively recent development. During the eighteenth century the annual yield was relatively small and the fur was little prized. Many farmer boys found it convenient to set a few traps, using some of the skins for making caps, gloves, etc., and sending the rest to the market. The average quantity received on the market throughout that century probably did not exceed 100,000 skins annually, although on three or four occasions the annual receipts at London exceeded 200,000, but in other years they amounted to only 25,000 or 30,000. During the second and third decades of the nineteenth century the output increased considerably, principally on account of the greatly increased market value and the opening up of new trapping territory. In 1829, for the first time, the London receipts exceeded 1,000,000 skins, the total being 1,165,663. The annual receipts thereafter fluctuated greatly, but on the whole continued to increase, exceeding 2,000,000 in 1862, 3,000,000 in 1867, and 4,000,000 in 1871. Since the year last named, the price of the skins has greatly decreased, but the receipts at London have been fairly constant, averaging about 3,500,000 annually.

In addition to those handled at the London sales, about 2,000,000 muskrat skins are placed on the markets each year. Of these, 1,500,000 pass through Leipsic, and 500,000 are sold to the furriers of the United States and Canada without passing through the two large market centers. This makes an aggregate of over 5,000,000 skins annually, of which nearly one-fourth are obtained from the Dominion of Canada and the remainder are caught in the United States. The total product of muskrat skins in the United States and Canada during the nineteenth century reaches the enormous amount of 250,000,000 in number, sufficient to make a blanket covering nearly 4,000 acres.

Formerly the fur of the muskrat was used largely as a substitute for that of beaver in hat-making, forming a cheap and fairly satisfactory imitation. Owing to its scarcity it was then of much greater value than at present, selling for 40 or 50 cents per skin, even equaling the value of the mink at times. The general adoption of the silk hat resulted in a great decrease in the demand, and the price fell as low as 6 or 7 cents per skin, and trapping then was of little profit. During the last sixty years muskrat has been used principally as dressed fur, prepared in imitation of the more highly prized beaver, otter, and fur-seal. It is about the best of all the cheap furs.

In the market muskrat skins are classed as "firsts," "seconds," "thirds," "fourths," and "kittens." The firsts are those caught during the spring or very late winter; seconds are caught in midwinter; thirds, those taken in very early winter or fall; fourths, in early winter or fall, and are poor and small; and kittens are those less than 3 or 4 months old. The value of the skins varies from 5 to 40 cents each, according to color and condition. Those from the Chesapeake average about 14 cents each for brown and 25 cents for black. The black pelts are marketed principally in Russia, where they are used for coat linings, but many are used in England, France, and America for cloaks, trimmings, and gloves. The price of the No. 1 black skins at the last London sales averaged 1*s.* 3*d.*; in 1891 it was about 1*s.* 7*d.*, while in 1875 it was over 3*s.* The lighter skins fetch about 7*d.* each.

DRESSING MUSKRAT SKINS.

At the fur-dresser's, muskrat skins are first dampened on the pelt or flesh side with salt water and permitted to so remain over night, for the purpose of softening. The following morning the skins are placed in a tramping machine, where they are fulled or tramped for eight or ten hours. Formerly the tubbing process was used, but the tramping machine is much more economical and is now employed for these skins by nearly all dressers. In tubbing, a good operator can work 100 muskrat pelts in a day, whereas a tramping machine can work 2,000 in the same length of time.

The pelts are next covered with a mixture or paste of sawdust and salt water and so remain over night. The water is used to keep the pelt soft, the salt to prevent the hair from falling out in the heating, and the sawdust to hold the moisture. The following morning the skins are cut open down the front, provided they are cased, as is the general rule, and are then fleshed, in the manner described on page 292, one man being able to flesh 200 to 300 per day. They are now stretched lengthways and crossways and hung up to dry. When thoroughly dry, in the leather as well as in the hair, they are again moistened with salt water on the leather side, remaining thus over night. They are next brushed on the leather side with animal fat, such as butter or fish oil and tallow, most of the grease being placed in the center, and the skins laid in pairs with the hair side out. After remaining thus over night, they are placed in tramping machines and worked constantly for 6 or 8 hours or until thoroughly soft and pliable. On removal from the tramping machines the skins are stretched in every direction.

At this stage the fur has a dirty, greasy and uninviting appearance, the grease and sawdust having worked into it during the preceding operations. The skins are placed in quantities of 300 or 400 with sawdust in revolving cleaning drums; where, exposed to steam heat or charcoal fire, they are revolved for about three hours, the sawdust by that time having completely absorbed the grease, leaving the fur clean and soft. They are next inclosed in a beating drum, previously described (see pp. 293), where they are revolved for two or three hours. On removal they are beaten with rattans and the fur cleaned with a comb. The pelt of many muskrats is quite thick, and these are selected out at this stage of the process and fleshed down, thus completing the operation of dressing with the exception of plucking.

Plucking is performed the same as in case of beaver pelts, except that it is done after the pelt has been dressed rather than before; after plucking, the fur is again cleaned and the process is ended. Twenty years ago 85 per cent of the muskrats were plucked, but at present the conditions are reversed and only a very small percentage are so treated. Indeed, on one occasion the writer spent nearly two hours among the furriers of New York in fruitless quest of a plucked muskrat skin, visiting eight or ten of the principal establishments, and finally was obliged to have one specially plucked for his use.

For the home-dressing of a small quantity of muskrat skins the following has been recommended: After washing them in warm water, all fatty and fleshy matter is carefully removed. In a liquor composed of 10 gallons of cold soft water, 8 quarts of wheat bran, ½ pint of old soft soap, 1 ounce of borax, and 1 pound of salt, the skins are soaked eight or ten hours if they are fresh, or until very soft in case they have been previously dried. The salt should be omitted from the solution if the skins have already been salted, and the addition of 2 ounces of sulphuric acid to the solution will prepare them in about one-half the time. The skins should then be soaked in a liquor made of 10 gallons of warm soft water, ½ bushel bran, and 2½ pounds sulphuric acid. The bran should be stirred in the water until thoroughly mixed, and then left to stand in a warm room until it ferments, when the sulphuric acid is added by degrees and with constant stirring. After soaking in this liquor for about four hours, the skins are removed and rubbed with a fleshing knife and then over a smooth beam until dry.

Muskrat fur is used more extensively in Europe than in America, the Russians and Germans being especially large consumers. It is employed in making gloves, collars, capes, muffs, trimmings, linings, etc., and is made up either natural, plucked, plucked and pointed, or plucked and dyed black or various shades of brown. Large quantities are used as linings for overcoats and long wraps, from forty to sixty being necessary for each garment. Sometimes the under parts are used separately for this purpose, the natural bluish-white color being quite effective. The skins of young animals are especially suited for linings. The unplucked skins are frequently dyed to imitate mink, and sold as Alaska mink, water mink, or black mink.

Two or three decades ago quantities of muskrat skins were plucked and dyed to imitate fur-seal, the resulting article readily deceiving the uninitiated. While the fur is soft and short, it is not as thick as that of the fur-seal, and the leather is much heavier and not sufficiently strong to permit its being scraped to a suitable thinness. After a few weeks' wear the fur becomes matted down, being less elastic than seal fur. During the eighties the use of muskrat for this purpose was extensive, especially in Europe, thus providing a large market for this abundant and easily procured fur. It injured the popularity of fur-seal, persons hesitating about paying $200 for a garment when a fairly good imitation was obtainable for one-fifth of that amount. The imitation, however, was generally unsatisfactory to the trade, and on the introduction of "electric seal," made from the cony, the use of muskrat pelts for this purpose was generally abandoned, except for small articles, as gloves, caps, etc.

FUR OF THE COYPU OR NUTRIA.

Somewhat similar to the beaver and the muskrat is the coypu, sometimes called the South American beaver. In the fur trade it is known exclusively as nutria, from the Spanish *nutra*, the otter, owing to the similitude of its fur to that of the otter. It inhabits the river banks and low lands of South America, and is most numerous in the vicinity of Rio de la Plata. The hunting season is from May to October, and after the pelts have been cured by drying they are sold to traders, who bale and ship them to Hamburg, London, and New York.

Nutria fur is short and silky, and except on the back is quite thick, being choicest underneath the body. Its similarity to beaver fur is noticeable, differing principally in being much shorter and less brilliant. The overhairs are bristly, from 1 to 3 inches in length, and of a brownish-yellow color. This fur was introduced in commerce about 1810, as a substitute for that of beaver in hat-making. After the silk hat came into fashion, nutria was gradually adopted as a dressed fur and, as in case of muskrat, largely in imitation of beaver, otter, and fur-seal. Probably one-third of the output is yet consumed in hat-making, being used for choice grades of soft hats.

The product fluctuates considerably, but is always large. Two or three generations ago five or six million skins were sometimes shipped from South America in a single season, and over 5,000,000 have been received at New York in one year. Owing to imperfect curing, or improper storage afterwards, many of the pelts arrived in faulty condition and were suitable for little other than glue manufacture. The abundance of the animals was greatly reduced, and at the same time, owing to conditions in the hat trade, the value of the fur decreased, so that the output shrank from 6,000,000 pelts annually to about one-tenth of that number. But during the last two or three years the output has been much greater, amounting in 1900 to somewhat less than 2,000,000 skins, obtained principally from the valley of Rio de la Plata. It is estimated that about 75 per cent of the product is used in the United States. Owing to the varying supply, the price has fluctuated considerably, ranging from $4 to 30 cents per pound. The skins are usually sold by weight, one of fair size weighing 6 or 8 ounces.

The dressing is quite similar to that of beaver skins, the principal difference being that the pelt of the nutria is not "broken" (see p. 291), the overhairs are pulled out by the picking knife instead of with the beaming knife, the pelt is fleshed instead of being shaved, and it is oiled after fleshing instead of before. These differences in treatment are due principally to the greater thinness and weakness of the pelt. In dressing, the nutria skins are soaked in water overnight and washed thoroughly in warm soap water until the membrane is perfectly clean. The water is then removed and the skins prepared for plucking by drying the fur and overhair, at the same time keeping the pelt moist. The overhairs are removed principally by hand, the workman pulling them out by grasping them between a dull knife of soft metal and his thumb, protected by a rubber cot. Practically all nutria skins are plucked, it being difficult to find a single dressed unplucked skin in New York.

If convenient, the pelts are soaked again overnight in cold water, and then fleshed by drawing each one successively across the edge of a large vertical knife (see p. 292). After fleshing, the skin is brushed on the pelt side with strong salt water, and after remaining in that condition over night, it is treated in much the same manner as a beaver skin. It is moistened on the flesh side with some animal grease, preferably butter, worked in the tramping machine or the tramping tub, the grease removed by revolving in a drum with sawdust, and the skin freed from sawdust in a cleaning drum. It then goes to the picker, who places it upon a beam and skims over the surface of the fur with a large flat-bladed knife having a razor-like edge, removing the remaining hairs, thus completing the process.

Nutria fur, natural, plucked, or plucked and dyed, is used for all the purposes of beaver fur, and the choicest can be distinguished from the latter only by experts, being nearly as fine and durable. It is used principally as a dressed fur, the overhairs being removed and the fur dyed dark brown, affording one of the best imitations of fur-seal for small articles. It is also dyed various other shades of brown, and occasionally is silvered with acid as in case of beaver furs.

OTTER FURS.

CHARACTERISTICS OF PELAGE.

The fur of the otter is short, abundant, and of fine quality. It is slightly waved and silky and is similar in appearance to that of the beaver, but is somewhat shorter and more delicate and glossy. The fur on the stout tail is of the same character as that on the body, but not so long. That on the body is of a whitish-gray color for two-thirds of its length from the base, rich brown at the tips, and is interspersed with stiff, thick overhairs similarly colored. The general color of the overhairs is brown above and a little whiter beneath, with chin and throat whitish. The shade of brown varies according to the locality in which the animal lives; in eastern Maine this is almost black; in Canada, Nova Scotia, and Labrador it is dark brown; in Alaska and British Columbia the animal is light brown. The fur on the throat, under parts, and inner surface of the legs is usually of various shades of brown. White or albino skins are occasionally secured, and silvery, grizzly, mottled, and slate-colored are met with at times.

TRADE IN OTTER SKINS.

The early trade in otter skins in America, although never so extensive, was almost contemporaneous in its development with the trade in beaver furs. In the operations of the early fur-traders in the present limits of the United States many otters were obtained. It appears, however, that the capture of these was merely incidental to the taking of beaver. Indeed, during the first hundred years of the exploitation of America the beaver was almost the only fur-bearing animal whose capture was a special object of industry. Later, however, with the increase in value of the pelts, the otter became an object of special pursuit, and by 1777 the industry reached an extent from which it has varied little up to the present time.

It is quite remarkable that the number of otter skins which are handled annually at the London sales should have fluctuated so little during the last 140 years. From 1763 to 1900 the annual quantity exceeded 30,000 only twice, and it fell short of 8,000 the same number of times, and the average by decades is nearly the same throughout the last 120 years.

With the exception of the nutria, a smaller proportion of the total product of otter skins are now handled at the London sales than in case of any other aquatic fur, only about one-third of the American product being sold there. The others are sold at Leipsic or directly to the furriers of the United States and Canada. The best local markets for otters are in Russia and Greece, where the fur is much used for caps, collars, and trimmings.

Out of a total of 7,865 otter skins sold in London in March, 1901, 3,293 were No. 1; 2,498 were No. 2; 1,318 were No. 3, and 756 were cubs. The No. 1 averaged in value 28*s.* 6*d.*; the No. 2, 20*s.* 6*d.*; the No. 3, 12*s.* 1*d.*, and the cubs 5*s.* 6*d.* per skin. These prices were somewhat less than the average in 1900. The highest price secured at the 1901 sale was 115*s.* each for a lot of 42 skins, while the lowest price was 3*s.* each for a lot of cubs, and also for a number of part pale No. 3. Exclusive of the cubs, those of a brown color numbered 269, while 301 were partly brown, 693 pale, 1,691 partly pale, and the remaining 4,155 of the distinctive dark otter color.

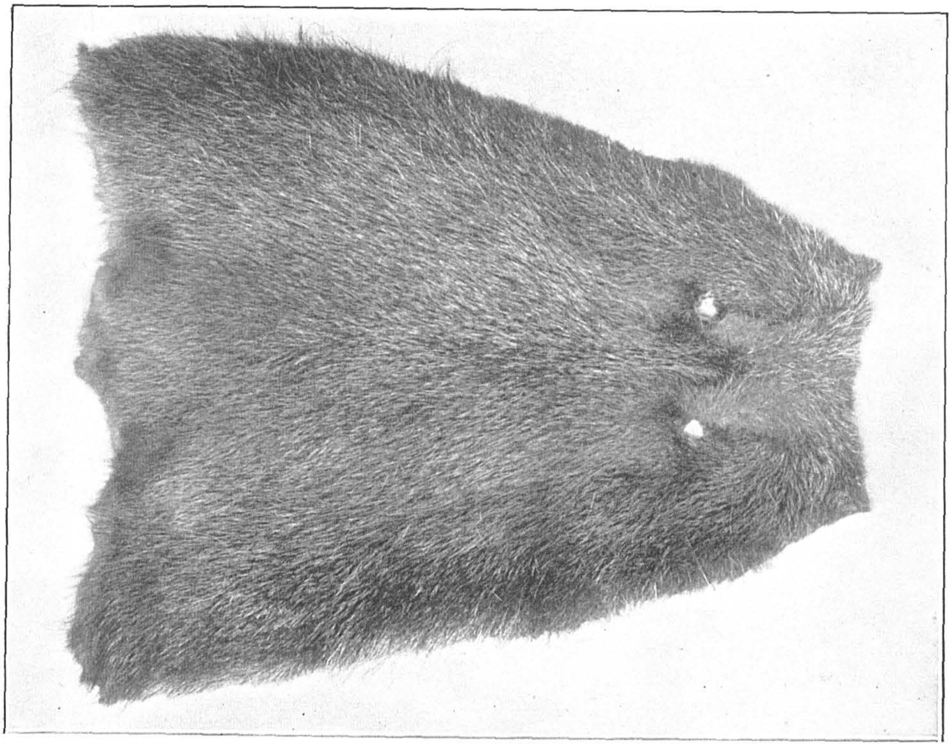
DRESSING OTTER SKINS.

When received at the fur-dresser's, otter skins are almost invariably cased, and are first cut open longitudinally down the chest and abdomen. The pelt is soaked in salt water over night for the purpose of softening it and preparing it for "breaking." The following morning each skin is placed on a beam, and a workman proceeds to break up the grain of the membrane by the process described on page 291. The pelt is now washed in warm soap water and the water removed, as in case of beaver skins. (See p. 311.) If the overhairs are to be plucked, that is done next. The choicest skins are left "in the hair," the number amounting to about a third of the total quantity dressed. The plucking is done in the manner described on page 291.

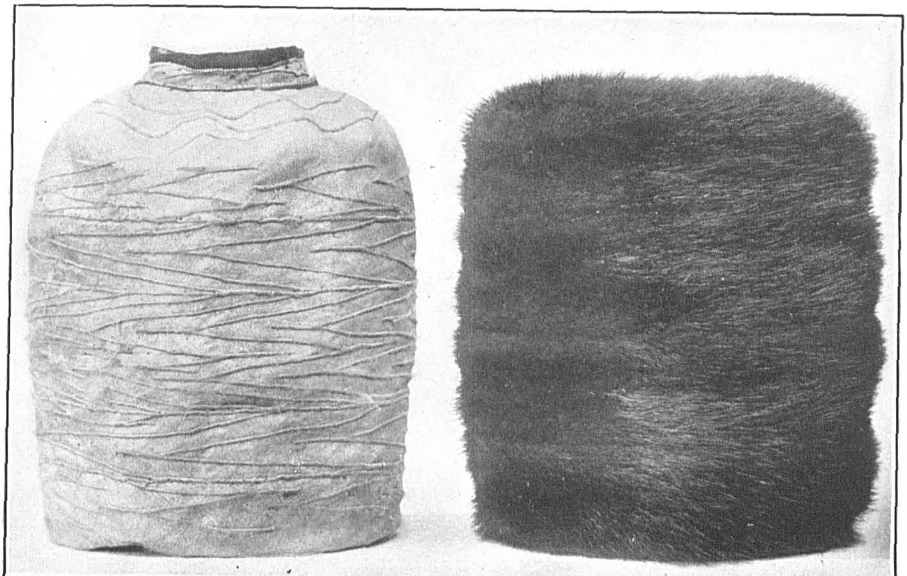
The pelt, which has become less bulky and quite soft from frequent handling, is now placed on a beam and skived in the general manner further described on page 291. It is next dampened with cold salt water and allowed to thus remain over night. The next morning it is stretched lengthways and crossways and partly dried, when it is ready for the leathering process. It is well rubbed with butter, or some other animal grease, and placed with others in a tramping machine, where it is worked for hours. On removal the skins are revolved for three or four hours with a quantity of hard-wood sawdust in a cleaning drum, under which there is steam heat or a charcoal fire. Next they are placed in tubs with a quantity of sawdust, where they are tramped for about three hours by barefooted workmen and on removal are thoroughly stretched. The leather side of the pelts is dampened over night and then shaved down to a uniform thickness as in case of beaver skins. (See p. 311.) A skillful workman can shave 30 or 40 otter pelts in a day. The skins are then stretched, dried, and placed for a second time in tubs with hard-wood sawdust and tramped for two or three hours, then removed, stretched again, and returned for two or three hours' further tramping, and then the fur is straightened out with a fine steel comb. The skins now receive a thorough beating with rattans to remove every vestige of sawdust and to lighten up the fur. If they have been unhaired, they go to the workman who removes all scattering hairs by means of a broad-bladed knife.

The methods of dressing otter furs have been greatly improved in this country in recent years, and the reputation of American workmen in this particular is preeminent. Otter skins having coarse overhairs are greatly improved in appearance by plucking, as the fur is extremely soft and dense. When plucked, the fur is used either natural or dyed various shades of brown. A few skins are clipped. This fur is very durable, the leather being strong and fine-grained. In the natural state choice otter makes rich trimmings for seal sacques; and the plucked fur, both plain and dyed, is used for caps, gloves, capes, and garments. The skins are also used for coat collars and storm coats, more especially in Europe. In Scotland many are used in making the characteristic sporrans.

During recent years otter has been extensively dyed in imitation of the fashionable fur-seal, being cheaper than the latter, and when carefully and newly prepared can be distinguished only by experts. The price of good otter skins and the cost of dyeing the same is so great that these dyed skins have cost nearly as much as fur-seal. This has retarded their popularity, but with the advancing price of fur-seal dyed otter will doubtless find a larger market. In appearance it is the equal of seal skin and its wearing qualities are excellent. It is desirable to dye otter skins while in the raw state, as the grease prevents the dye from penetrating and injuring the leather, which would be weakened if the dye were applied after the skin had been dressed. Only the heavy-furred skins are selected for this purpose.



NUTRIA SKIN, DRESSED, NATURAL.



MUFF OF MINK SKIN, SHOWING METHOD OF SEWING AND PIECING.

SEA-OTTER FURS.

The sea-otter yields the most valuable of all aquatic furs. The skins are of the greatest value in the third or fourth year of age, when the overhairs are scanty, exceedingly fine, and extend but little beyond the fur, which is unusually dense, fine, and silky. There appears to be little difference in the quality of the pelage at different seasons of the year. The glossy, durable fur is about three-fourths of an inch in length all over the body, except that on the feet, head, and tail it is rather shorter, finer, and with fewer overhairs. The under portion of the back, the nose, and the upper lip are the only naked parts.

The color of the pelt varies considerably, the predominant shade being lustrous brown brightened with silvery overhairs. Some pelts are a deep brown or a brownish black, and are known in the trade as "black." Others are brown, with a tendency toward bluish green or dark-plum color, and are known as "dark." The fur is in all cases lighter on the abdomen than on the back. The hair on the head is lighter in color, and is light brown in the brown variety, but in the black animals it is almost completely white, the effect of the large number of white overhairs. The skins from British Columbia, Washington, and Oregon are frequently of a yellowish-brown hue, and albino skins have been taken rarely.

The choicest sea-otters have dense, brownish-black fur of silky, shimmering gloss and extreme fineness, exhibiting a silver color when blown open and with a reasonable number of white hairs regularly distributed, too many white hairs depreciating the value of the pelt. The skin of the male is usually more valuable than that of the female, being more brilliant and velvety in appearance. After they pass the age of perfection the fur becomes a dingy brown.

The skin is remarkably loose, like that on the neck of a young dog, and 12 inches or more of slack may be gathered in the hands from most parts of the body, the pelt of an individual 3 feet long readily stretching to 5 feet. A full-grown prime skin, which has been stretched before curing, is about 6 feet long and 24 to 30 inches wide.

The sea-otter belongs exclusively to the shores of the North Pacific Ocean and the adjacent seas, its range extending from Bering Sea southward to Japan on the Asiatic coast and possibly to Mexico on the American coast. It was formerly quite abundant throughout that region, but its numbers have been so reduced by excessive hunting that it is now very rare and in great danger of extermination.

The territory within which sea-otters are at present taken extends along the American coast from the Aleutian Islands southward to Washington, and on the Asiatic coast from Kamchatka to Japan. In most of that region, however, the catch is exceedingly limited, the annual product on the entire coast of the United States, exclusive of Alaska, for instance, not exceeding one dozen. The bulk of the catch is obtained now, as 100 years ago, among the islands of southeast Alaska.

The total product of sea-otter skins, obtained from the North Pacific since the development of the hunt, about two hundred years ago, approximates 700,000, made up as follows:

By whom obtained.	Number of skins.
Russian traders, previous to 1797	130,000
Russian American Co., 1798-1867	160,000
Miscellaneous traders, 1785-1828	250,000
Miscellaneous traders, 1829-1867	15,000
Miscellaneous traders, 1868-1900	145,000

Assuming that these skins cost the consumers an average of $150 each, we have a total of $105,000,000 expended for sea-otter furs, of which doubtless over 95 per cent came from residents of China and of Russia, and probably more than 80 per cent from the Chinese alone. A single skin has sold for $1,400, and though that is a fancy price, $700 or $800 is not unusual. The value is determined by the size, richness of color and texture, and the depth of the blackish hue studded with a suitable number of silvery hairs. The market value has varied somewhat from year to year, but has been high ever since the origin of the traffic in these furs. At the time of Cook's celebrated voyage to the North Pacific in 1778, the price of a prime skin was about $120 in China. In 1802, when the largest collection was made—25,000 skins—the average price of large and small at Canton was about $50 each. In 1840 prime skins sold readily for $150 each out of the vessel. The average price of all skins at the London sales in 1888 was £21 10*s*.; in 1889, £33; and in 1891, £57; but the first-quality skins fetched much higher prices. At present, pelts average in value £65 each, including cubs as well as prime skins, while choice specimens readily fetch £200 each.

Seldom do the choicest sea-otter skins enter into the retail trade in America or England; and although the greater part of them are caught within the limits of the United States, it might be difficult at times to find a dozen skins in all the fur stores of the country. This fur has ever been held in high estimation by the Russians and Chinese, but the great cost limits its use to the wealthy classes exclusively. It is the royal fur of China, being worn by officers of State, mandarins, and other persons of importance in the Celestial Kingdom. In Russia it is used principally for the collars of overcoats. Sea-otter fur is also used for making muffs and for bordering fine garments made of textile fabrics or of other costly furs. Owing to its great weight as well as cost, entire wraps are rarely made of it.

While many sea-otter skins are marketed in Asia and Russia, probably 80 per cent of them pass through the London auction sales held in March of each year. The large decrease in the abundance of these animals is well illustrated by the decreasing numbers offered at those sales, the quantity sold at present being little more than 10 per cent of what it was twenty years ago.

The following shows the quantity offered at those sales during each of the last thirty years:

Year.	No. of skins.	Year.	No. of skins.	Year.	No. of skins.
1871	3,824	1881	5,647	1891	2,329
1872	4,307	1882	5,657	1892	1,368
1873	5,095	1883	5,680	1893	1,788
1874	4,920	1884	5,038	1894	1,533
1875	4,564	1885	4,908	1895	1,221
1876	5,059	1886	4,804	1896	1,550
1877	5,420	1887	4,413	1897	1,201
1878	5,258	1888	4,352	1898	955
1879	5,176	1889	3,511	1899	760
1880	5,583	1890	2,713	1900	584

The sales of Messrs. C. M. Lampson & Co., London, for March, 1901, included 409 sea-otter skins,[a] of which 145 were large black skins, which sold at prices ranging from £52 to £280 each, or a total of £12,585 for the 145. The next largest class was a total of 118 large dark skins, varying in price from £48 to £125 each, or a total of £7,640. Only 14 brown skins were offered at that sale, of which 13 were large and 1 was of medium size. Out of the total of 409 skins, there were 276 large ones, the others consisting of 96 medium, 25 small, 1 extra small, and 11 cubs. The average value of the large skins of all classes was £75 6*s.* 7*d.*; of the medium size, £50 8*s.* 10*d.*; of the small size, £35 6*s.* 5*d.*; of the extra small, £12; and of the cubs, £2 1*s.* 10*d.* Four very small cubs sold for 10 shillings each. While it is extremely gratifying that the large skins formed so high a percentage of the total number, yet it is to be regretted that there were any small skins whatever, and the taking of cubs was wanton destruction of valuable resources. The prices realized in 1901 were practically the same as in 1900, when 584 sea-otter skins were offered.

The following summary shows for each grade of skins at Messrs. C. M. Lampson & Co. March, 1901, sale, the number sold, minimum and maximum prices, total selling value, and average selling value:

Designation.	No. of skins.	Minimum price.	Maximum price.	Total value.	Average value.
Large, black	145	£52	£280	£12,585	£86.79
dark	118	48	125	7,640	64.75
brown	13	38	68	570	43.85
Medium, black	43	40	75	2,258	52.51
dark	52	32	70	2,549	49.02
brown	1	36	36	36	36.00
Small, black	11	32	42	393	35.73
dark	14	30	40	490	35.00
Extra small, dark	1	12	12	12	12.00
Cubs	11	½	3	23	2.09
Total	409	....	....	26,556	64.93

DRESSING SEA-OTTER SKINS.

The sea-otter should be skinned as soon as practicable after killing, and if caught far from the shore or from the vessel it should be laid out smoothly in the bottom of the boat and covered over with seaweed

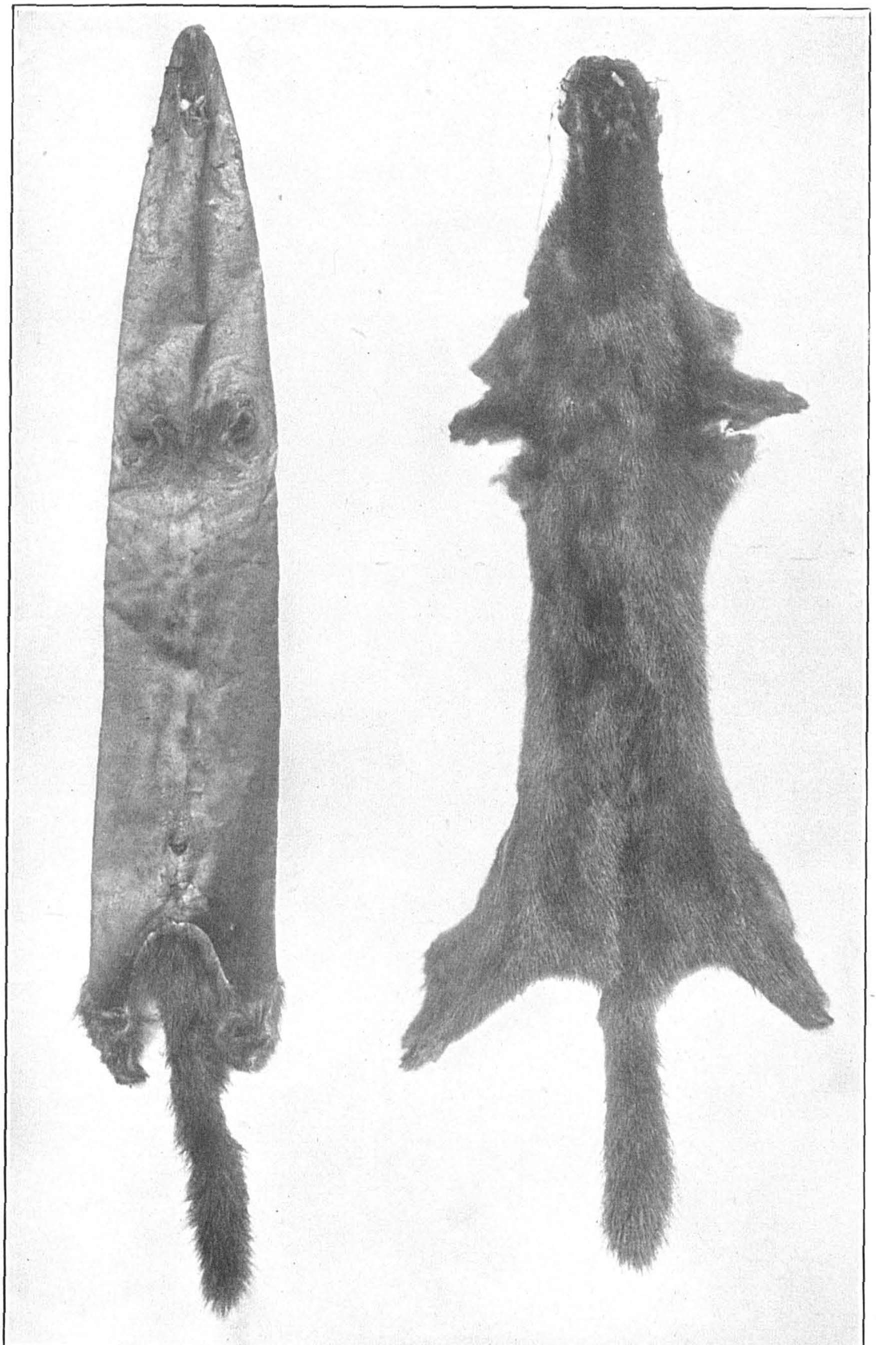
[a] A total of 422 were offered, but only 409 were sold. This comprises the bulk of the sales of sea-otters throughout the world for that year.

or otherwise protected. In skinning, a cross slit is made down the hind legs and a longitudinal cut made along the under side of the tail throughout its length, and the pelt drawn flesh side out over the body and head without cutting along the abdomen. No fur whatever is left on the carcass—tail, legs, and head being carefully stripped of their covering, though the fur on the legs and head is of relatively little value. The pelt, with the fur inside, is then tightly stretched on a stretching board. The fat adhering to the flesh side is carefully removed, the holes made by spears, or otherwise, carefully sewed up, and the pelt placed in the open air, protected from the sun, to dry. When quite dry, the fur is combed and the pelt rolled up and stored in a safe place, whence it is occasionally removed and examined for moths, etc.

The present method of dressing sea-otter pelts is much less complicated than the treatment of beaver or mink, but, owing to the great value of the fur, extreme care is taken at all stages. The flesh side is first dampened over night with salt water, and then greased with choice butter, and several skins at a time tramped in a foot tub for four or five hours. Fine hard-wood sawdust is then added, and the tramping continued for two or three hours longer. On removal they are moistened with soap water over night and then shaved to thin the pelt, the same as in dressing beavers. Next they are worked in a tramping tub with fresh sawdust for two or three hours, and on removal are cleaned of sawdust, either in a beating drum or by striking with rattan sticks. After combing with a fine steel comb, the skins are ready for delivery. Owing to the care necessary in the process, the cost of dressing sea-otter skins is about $2 each, compared with 50 cents each for those of beaver and otter. Unlike other cased pelts, sea-otters are rarely ever cut open at the fur-dresser's.

MINK FURS.

The pelage of the mink consists of dense soft fur, of excellent quality and nearly uniform on all parts of the body, overtopped by stiff, lustrous hairs about three-fourths inch long. The color shows marked variations, ranging from a light dull-yellowish brown to a dark brownish black, but is ordinarily of a rich dark brown or chestnut brown glossed with black. It is usually slightly darker on the upper parts than below, the back and tail being the darkest, and the gloss is also most marked in the fur of the upper parts. The choicest are nearly black, approximating the desirable hues of sable, these being generally from New England, the wooded districts of Nova Scotia, and the Province of Ontario. The lighter colored are of less value, and are usually dyed or blended to the desired dark shade. Albinos, as well as mottled and drab-colored pelts, are occasionally secured. Sometimes skins with white hairs sprinkled in the brown fur are obtained. Often there is a white spot on the throat similar to that of the marten, and a white spot or line of varying length sometimes occurs under-



MINK SKINS CASED AND DRESSED.

neath. At times the long, bushy, and somewhat tapering tail is tipped with white. Minks from southern localities generally have fuller and thicker tails than those from farther north.

The fur is generally dark bluish-brown and sometimes dark blue in case of very dark pelts. It is dense, glossy, short, and exceedingly durable, making it one of the most economical furs in use. The skin is very thin, the thinnest of all the aquatic fur-bearers, yet it is very tough. The mink pelts from cold localities are the choicest and most brilliant; those from southern regions are coarser, harsher and with less difference between the fur and the overhair. They are marketable only when taken late in autumn, in winter, or early in spring.

When the fur of the mink was very fashionable and correspondingly high in price thirty years ago, several attempts were made to raise these animals in confinement. But it was found difficult to rear them when large numbers were kept together, the breeding being reduced and the females quarreling and fighting and frequently killing the young. Practically all these experiments ended in failure.

MARKETS FOR MINK SKINS.

Few furs surpass that of the mink in richness of coloring, quality, and durability; yet, owing to the capriciousness of fashion, it has frequently sold at a comparatively low price. It furnishes a striking example of the vagaries of fashion in the fur trade. Formerly it was used almost solely for imitating marten. About 1860 the fashionable world took a fancy to it for cuffs, collars, trimmings, and even for garments of various sorts, resulting in increasing the market price of the pelts from about 50 cents each to $8, $10, or even $20 for very choice skins. A mink muff of good quality sold for $75 or $100, and a full-depth mink wrap sold at times as high as $1,500. Indeed, during the sixties, it was the leading fashionable fur of this country. Then its popularity gave way to fashion's demand for change of color and shorter pelage, and the price of prime skins decreased from $15 each in 1864 to $8.50 in 1866, to $3 in 1878, and to $1.25 in 1883. For many years the mink was out of favor and it almost disappeared from the market, But among those who could be independent of fashion, this warm, durable fur maintained its former popularity. It is now somewhat more in demand, but is moderately cheap compared with prices prevalent thirty-five years ago, rarely selling for more than $3 each wholesale, except for very choice skins. In consequence of its many good qualities, it merits much greater popularity than it enjoys.

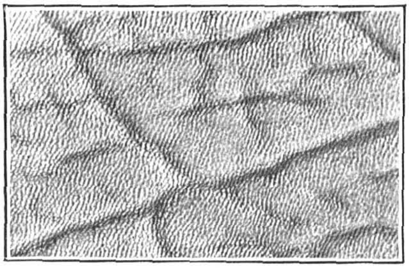
About 400,000 mink skins are sold in London each year. This represents about 55 per cent of the total product of mink, the other skins being disposed of at private sale to furriers in Europe and America. About 80 per cent of the total product is obtained from within the limits of the United States, the remainder coming principally from Canada.

DRESSING MINK SKINS.

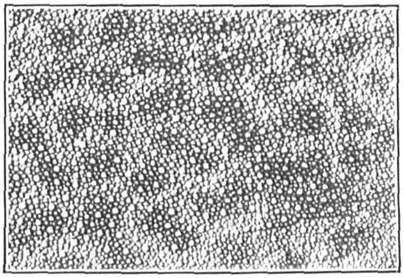
Mink skins as received at the dresser's are usually cased, the fur being turned inside and only the greasy skin appearing, and they usually remain cased during the entire operation of dressing. As may be required, the fur and the leather sides are successively turned outward, and this tedious process forms one of the principal items in dressing this fur. The first operation is to place each pelt on a beam and scrape or beam off all the grease and surplus flesh adhering to the membrane. They are next moistened on that side with salt water. After remaining thus overnight they are placed in a tramping machine, 2,000 pelts at a time, and revolved for four to six hours, until they are thoroughly softened. In the best establishments, the same result is accomplished in the tramping tubs. They are next turned fur side out and cleaned in a revolving drum containing sawdust and a few handfuls of plaster of paris or fuller's earth. This is continued until the grease is entirely removed, when they are revolved in the beating drum and the sawdust, etc., removed.

On removal therefrom the skins are turned leather side out, moistened with salt water over night, then fleshed, as described on page 292. After fleshing, they are stretched as wide as possible with special iron stretchers, hung up and dried. The following day they are placed in the foot tubs—100 skins and 1 peck of sawdust to each tub—where they are treaded by barefooted workmen for about three hours. On removal they are stretched lengthways and beaten with rattans or in a beating drum. Then they are turned fur side out, placed in the cleaning drum with fine hardwood sawdust and revolved until thoroughly clean, which may require five or six hours. They are again placed in the beating drum to remove all the sawdust. On removal therefrom the fur is combed straight and they are turned leather side out and cleaned and polished with a fleshing knife, or, according to more recent practice, on an emery wheel.

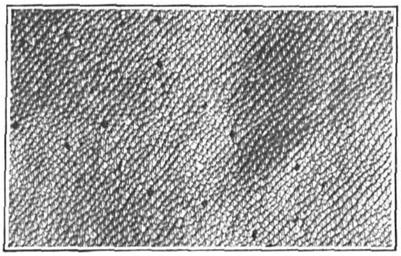
Mink fur is manufactured into muffs, wraps, gloves, caps, and boas, either in natural state or dyed. Many skins are also used for coat linings. The tails are usually made into capes. Mink pelts are never plucked unless the overhair is exceptionally poor. This fur is very durable, lasting with moderate care a generation or more. The writer recently examined a mink muff "almost as good as new," which had been in use for more than fifty years. Mink fur is very frequently sold under the name "American sable."



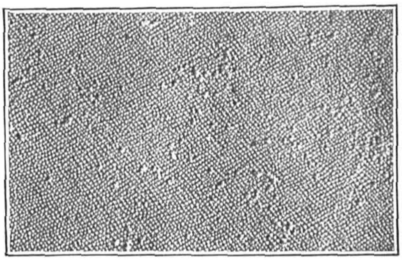
WALRUS LEATHER.



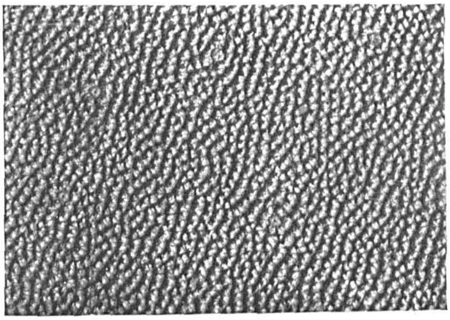
SKIN OF MOTTLED SHARK.



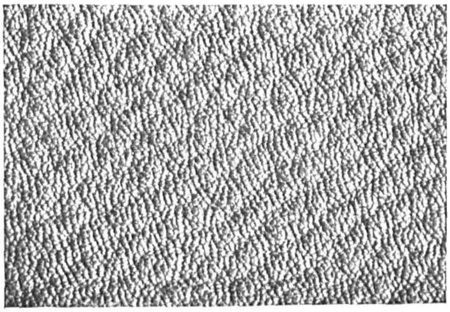
SKIN OF BRAZILIAN SHARK.



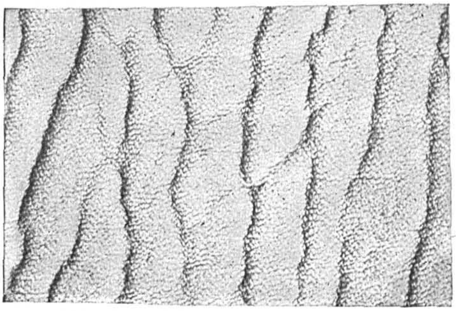
SKIN OF WHITE SHARK.



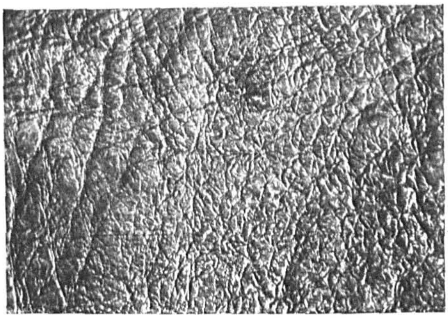
MANATEE LEATHER.



SEAL LEATHER.



SEA-LION LEATHER.



LEOPARD SEAL LEATHER.

AQUATIC LEATHERS.

GENERAL REVIEW.

The crude skins and hides of aquatic as well as of land animals are easily putrescible when left in a green state, and if dried they lack suppleness, and are hard, unpliable, and almost impermeable to air. Leather, on the contrary, is one of the most imperishable of animal products, and is supple and porous to a greater or less extent according to the process of manufacture. To transform the crude skins into leather is the business of the tanner and the currier; the former removes the tendency to putrefaction and incidentally increases its strength, durability, and imperviousness to water, and the currier renders it soft and pliable and at the same time imparts to it such finish and coloring as suit the special purposes for which it is intended.

Leather is made from the skins of practically all the aquatic mammals and of some species of fishes; but at the present time, except among primitive people whose stock of raw materials is limited, these products rank among novelty or fancy leathers. Ordinarily the supply of aquatic animals yielding skins suitable for tanning is so small or so difficult to obtain, compared with the enormous quantities of domestic animals available, that the leather made from the former can not compete in price with that from the latter. The nearest approach to competition is in the case of seal leather, of which large quantities are produced each year, the value of the annual product averaging $1,500,000; but the durability and choice grain of this article secures for it a much higher price than is obtainable for a good quality of calfskin. The hide of the beluga, or white whale, is one of the best of all skins for leather purposes on account of its durability, strength, and pliability; it is sold as porpoise leather, and probably $200,000 worth of tanned hides are marketed annually. Alligator skins are also obtained in large quantities, and, owing to the peculiarity of their markings, are used entirely as fancy leather; the total value of the output amounts to about $500,000 annually. Tanned walrus hides, and especially the thick ones, are in great demand for polishing wheels and other mechanical purposes, and probably $100,000 worth are sold annually. These are the only aquatic leathers which at present have an established position and a fairly constant price in the markets, but they are not the only aquatic leathers obtainable, the writer having collected 31 other varieties, although these are used in such small quantities that no constant market exists for them. Among those used to a less extent may be mentioned sea-lion, porpoise, sea-elephant, manatee or dugong, water moccasin, frog, otter, beaver, beaver tail, muskrat, and a variety of fish skins.

The art of the tanner has been so developed that the preparation of certain skins in imitation of others is by no means a difficult process.

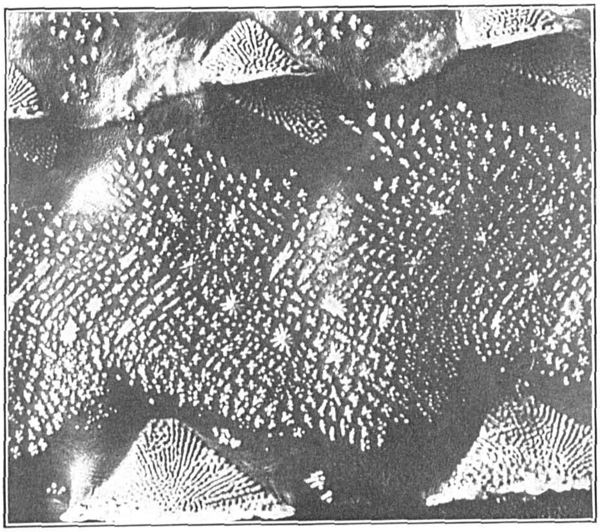
The hides of walrus, sea-lion, sea-elephant, etc., are generally so damaged by the animals fighting among themselves, and from other causes, that, while the raw pelts may be abundant and cheap enough, it is difficult to secure them sufficiently free from defect to permit of their use as fancy leathers with economy. On this account, seal skins, which are comparatively free from the objection noted, are generally used to imitate those leathers, the tanning and currying process being so modified as to develop the peculiar grain desired; and while there is much genuine walrus leather, sea-lion leather, etc., the great bulk of that on the market sold under those names is made from seal skins.

The skins of fish are generally glutinous and soluble in water, but the texture of most of them is sufficiently firm and strong to permit of their use as leather, although their employment for practical purposes is rather limited. Skins of cusk, cod, eels, flat-fish, and the like, have been converted into leather suitable for gloves, purses, boot tops, etc. The tubercular skins of many sharks, rays, and allied fishes are largely employed under various names for polishing purposes and for covering boxes, sword grips, etc. All of these miscellaneous skins are valued principally because of their peculiar grain or markings, and are tanned so as to bring the grain into prominence. Their use is principally in small articles as belts, cardcases, pocketbooks, and the like. Recently they have been applied to the artistic binding of books, planned at the suggestion of Mr. George F. Kunz. Among these was the catalogue of the Izaak Walton exhibition at the Grolier Club, New York City, in 1894. Beautiful effects have been secured by the use of variously colored shark skins, polished to a smooth surface and frequently inlaid with some other material. The possibilities for the development of this use of fish skins are remarkable.

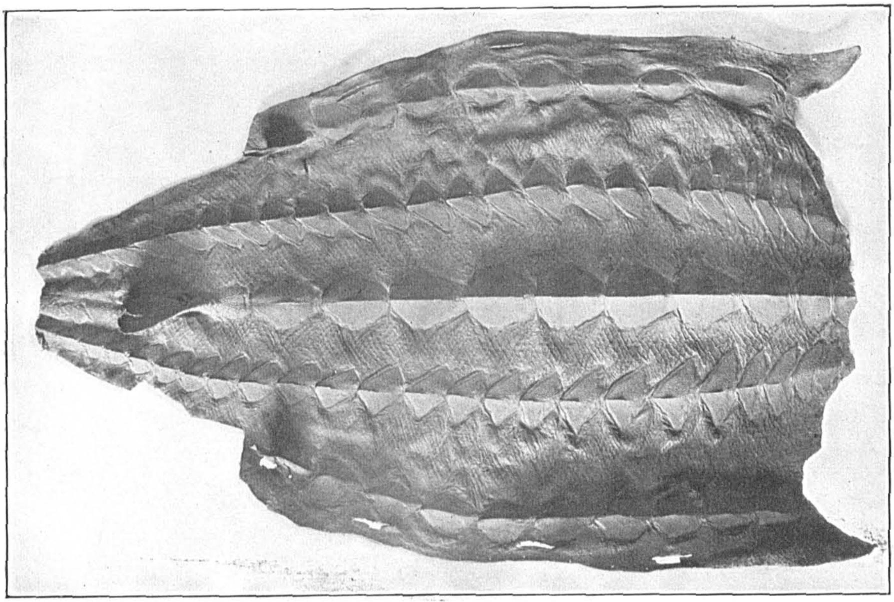
Fish skins are employed extensively in the preparation of glue and fertilizer stock. Especially notable in this connection is the waste from the New England factories engaged in preparing boneless codfish in the forms of bricks, and thousands of dollars' worth of skins of cod, hake, haddock, etc., are annually converted into fertilizer and glue.

GENERAL METHODS OF PREPARING AQUATIC LEATHERS.

Leather manufacture is of great antiquity. A process of tanning, differing principally in detail from that practiced at the present time, was doubtless followed long before the days of Simon the tanner. While its kindred industrial arts, spinning and weaving, have made enormous progress, the art of tanning has remained almost stationary for ages, the methods of the present day surpassing those in vogue centuries ago in expediting the process rather than in the quality of the product. Leather-making is simple, consisting in unhairing the skins, removing the fatty matter clinging to the membrane, soaking them in an infusion of tannin, and then softening them by means of greases.



SECTION OF EUROPEAN STURGEON SKIN (SEE P. 348).



SKIN OF DELAWARE RIVER STURGEON, TANNED IN NEWARK, N. J. (SEE P. 348).

The skins of most mammals are composed of four membranes or parts. The first is the fat-bearing tissue, situated between the flesh and the body of the skin; the second or middle portion, known as the dermis or true skin, is made up of layers of fibers interwoven and intersecting in every direction; the third or outer part is a more or less horny membrane, which contains the nerves, the smaller blood vessels, and the base of the perspiratory glands; the fourth is a thin, semitransparent cellular tissue, known as the epidermis, in which the hair is rooted. The dermis or true skin forms the leather, and the third layer above noted—the horn-like tissue containing the nerves and perspiratory glands—forms the "grain" or "bloom" of the leather. The fat-bearing tissue and epidermis, as well as the hair, are removed in the various processes of preparing the skin for tanning. In some leathers—for instance, porpoise—the grain or bloom is also removed.

Many persons in securing aquatic skins fail to appreciate the importance of care in removing them from the dead animals, and through carelessness make many knife-cuts in the membrane. In the case of furs these cuts are not so very serious, since the membrane can be sewed together and the damage concealed by the fur; but when skins are to be used for leather the cut portions are wholly valueless.

Under ordinary conditions, as soon as life ceases decomposition of the skin begins unless a detergent is applied. Salt is very generally used for this purpose and is plentifully sprinkled over the skin on its removal from the animal. Although effective, salt is not the least injurious agent that may be used, borax being generally more satisfactory and more easily removed by soaking.

On account of the great range of raw materials and requirements of the leather trade, the various processes of leather-making are necessarily numerous, differing even for skins of the same variety, according to their quality, the season of the year, and many other conditions, the correct understanding of which is the outcome of experience. However, the general principle is so far identical in all classes of leather-making that it may be outlined here.

The skins and hides usually reach the tanner after remaining in salt a greater or less length of time, depending on the distance from the place of slaughter. The first procedure is to cleanse the skins and to loosen and remove the hair and epidermis, neither of which is desired in the finished leather. In case the skins are received direct from the animals, they are easily cleansed from blood and dirt by soaking a few hours in fresh water and then washing for a few minutes in a perforated rotating drum, known as a wash-wheel, through which a stream of water is constantly flowing. If the skins have been salted, as is usually the case with aquatic pelts, a more thorough soaking and washing, with several changes of water, is necessary, the soaking sometimes extending over several days. In case of large hides which have been heavily salted the process may be assisted by a "hide-mill," in which, by means of cranks, heavy hammers are moved in pendulum fashion on the hides, or in which the hammers are alternately raised by cams. It may also be aided by using caustic soda in the tank water in the proportion of about 1 pound to each 100 gallons of water.

Various agencies are used for loosening the hair, viz, putrefactive fermentation; lime, either alone or in connection with caustic soda; *calcium or sodium* sulphohydrate, etc. The first is of ancient origin, and is the method even yet employed by primitive people. The green hides are permitted to remain several days in a warm, moist condition. Putrefaction soon begins, and quickly dissolves or destroys the epidermis and loosens the roots of the hairs embedded in it, when the latter easily slip out. This sweating process has little effect in splitting up the fiber bundles of the true skin and is usually employed only where a firm, solid leather is desired, as for polishing wheels, covering the Alaskan bidarkas, or more commonly in the preparation of sole leather.

A more important method of removing the hair, and the one in general use, is by means of a solution of lime or calcium oxide in water, making a milk of lime, or calcium hydrate. This not only has a solvent effect on the epidermis, but splits up the fibers of the skin, both of which are essential to the production of good, pliable leather. The skins are sunk flat and smooth in a tank or pit filled with milk of lime, and after twenty-four hours they are removed with hooks or tongs, the lime stirred up, and the skins returned, this process being repeated daily for a week or ten days, or until the hair is sufficiently loosened. The immediate effect of the lime is to swell the fibers of the skin and to split them up into their constituent fibrils, the dissolving of the epidermis being attributed to the action of the enzym products of bacteria. In preparing leather of different degrees of solidity or pliability, variations are made in the freshness and the temperature of the milk of lime, fresh lime at a low temperature being used for heavy leathers, while old lime at a high temperature is used in making thin, pliable leathers.

Comparatively few fish skins are limed, since it destroys the fiber rather than loosening it; therefore they are usually tanned without liming. Shark skins, however, will go through the lime, and eel and cat-fish skins may be limed for one or two days.

On removal from the liming tank the skin is laid, flesh side down, on a sloping beam having a convex surface, and scraped on the grain side with a blunt knife to remove the hair; then turned over and scraped on the flesh side with a sharp knife to remove all the adhering flesh, fat, and other loose tissue, this process being known as "fleshing."

Next it is necessary to remove the lime from the skin, as its presence would interfere with the subsequent tannage. Also, when soft, pliable leathers are desired, the swollen condition of the fiber produced by the lime must be reduced, and in some cases a further portion of the cementing substance of the fiber must be dissolved. Removal of the lime is sometimes accomplished by neutralizing it with an acid, as sulphuric or boracic, and then washing out the neutral salt.

A more common method, however, is by the "bran drench," either alone or supplemented by dung bates. Hot water is poured upon bran, and the mixture set with a few pailsful of a fermenting drench liquor. When the skins are placed in this liquid, maintained at a temperature of 70° F., fermentation soon ensues, floating the skins up to the surface. They are again forced mechanically down into the liquid, but soon rise as before. When this has occurred three or four times, in 12 to 16 hours, the action is generally sufficient. Large hides, especially those of alligators, are sometimes submitted to the action of paddle wheels to hasten the removal of the lime and make that removal more uniform.

This process is often preceded by treating the skin in a fermenting infusion of excrement of dogs in the preparation of lighter skins, and of pigeon or hen dung in case of heavy leathers. This not only acts on the lime so as to make it possible for it to be easily washed out, but it also renders the leather soft and pliable. The dog dung, called puer, is dissolved in water at a temperature of 90° F., and in this liquor the skins are kept in gentle motion for an hour or more. The previously plump skins become extremely soft and flaccid, and may be stretched in any direction without springing back. This operation is known as puering. The treatment with hen or pigeon bate is similar, except that it usually takes place without artificial heat and the process requires four or five days.

The hide is now a simple network of fiber, all the interfibrous substance, or filler, having been removed in the various processes above noted. Next comes the principal operation in the process of tanning, viz, dehydrating the skin and combining with it certain agencies which change the fiber network into leather. These agencies are (1) mineral salts, when the product is known as "tawed leather"; (2) oils and fats, making "chamois leather"; and (3) tannin or tannic acid, resulting in "tanned leather." Mineral salts are rarely used in tanning aquatic skins, being employed mostly in preparing laces for belts; and the chief use of the oils and fats for aquatic leathers is in preparing porpoise hides for shoelaces. Most of the aquatic leathers are prepared by the third process, the use of tannin or tannic acid.

After liming and bating, the hides are submitted to the action of infusions of tanning material. They are first worked by wheels in the tanning liquors for one to three days, according to the result desired, and then placed in tanks or pits, where, for several weeks, they are subjected to fresh tanning liquor, with frequent renewals of the liquor. On removal therefrom the skins are finished. This operation differs so much, according to the variety and quality of the skins, that accounts of the special treatment of the different kinds of skins are reserved for appropriate subchapters.

LEATHER FROM SEAL SKINS.

The seals whose skins are utilized for making leather are quite destitute of the coat of choice fur which gives to the fur-seals their great commercial prominence. Yet on account of the valuable products of leather and oil, the economic importance of this group of animals is scarcely less than that of the fur-seals. They are found in various northern waters, especially off the northern coast of Labrador and Newfoundland, in the waters of Greenland, the Arctic Ocean north of Europe, along the Nova Scotia and New England coasts, in the Northern Pacific Ocean, in the Caspian Sea, and to a much less extent in the Antarctic seas.

The principal sealing districts in the north are Newfoundland, Jan Mayen Seas, Nova Zembla, Kara Sea, and the White Sea. The Newfoundland fishery is by far the most extensive. It ranks among the most venturesome and important of all the marine industries of the world, giving direct employment to 5,000 men, while thousands of others are engaged in preparing the resultant products of leather and oil. American vessels have not engaged in this fishery except in a few instances, but the fishermen of Scotland unite with those of Newfoundland in reaping large returns from the seal hunt off the northeast coast of America.

According to Mr. Robert Badcock, the total product of seals in the Newfoundland fishery in 1901 approximated 345,000, of which 27,000 were young hoods or bluebacks, 13,000 were old hoods, 10,000 old harps, 4,000 bedlamers, and the remaining 291,000 were whitecoats or young harps. The catch of bluebacks was far greater than usual, the average take of that variety not exceeding 5,000 in one season. A small percentage of the whitecoats are known as "fast furs," the long, thick woolly or hairy covering not easily separating from the pelt, as the name implies. These are usually very young animals, less than fifteen days old. Owing to the vessels reaching the seals quickly in 1901 a larger number of fast furs were secured than usual, the total amounting to about 10,000, whereas it is usually much less. In the markets these are commonly known as wool-seal skins.

After discharge from the vessels the pelts pass through the hands of the "skinners," who remove the blubber, take out the flippers, cut off the noses, etc. The skins are at once dry-salted and placed one over the other, with the flesh side uppermost, in piles of small height. There they remain for about three weeks, when they are sufficiently cured for shipment to Europe or the United States to be tanned.

After removal of the blubber the skins of the young harp seals average 5 or 6 pounds each in weight, and are worth about 80 or 85 cents at the present time. Bedlamers' skins average about 12 pounds in weight and $1.30 in value, and old harps, from 14 to 18 pounds in weight and 90 cents in value. The skins of the young hood or blueback seal weigh 6 or 7 pounds and sell for about $1.35 each, and the old hoods range from 15 to 24 pounds and average about $1.65 each in value. Of the old seals the skins of the females are preferred to those of the males, as the latter are frequently damaged about the neck and foreflippers, by the animals fighting among themselves.

The principal seal fishery of northern Europe is prosecuted in the seas about Jan Mayen and Spitzbergen by vessels sailing from Dundee and various other ports of the North Sea, and engaged also in the capture of whales and walrus. As in the case of the Newfoundland fishery, the Greenland or harp seal is the principal species secured in the Jan Mayen district, but many hooded or bladder-nosed seals are also obtained, principally by shooting. During recent years about 35 vessels have been engaged from the various ports, mostly from Norway and Scotland, and the annual take of seals has ranged between 100,000 and 200,000, the proportion of mature seals being much greater than in the Newfoundland fishery. Owing to increasing scarcity of seals north of Europe, the British vessels have almost abandoned their pursuit, leaving it in the hands of Norwegians, whose more economical outfits enable them to continue the fishery at a profit.

In the seas north of Russia, especially the White Sea and in the vicinity of Nova Zembla, many harp seals are taken in the spring by vessels from Norway and also by natives of the coast. The fishery is not so extensive as that off the Newfoundland coast, the product amounting to probably less than 20 per cent of the latter. Another important seal fishery is that of the Caspian Sea, the species captured being peculiar to those waters. This industry is centered at Astrakhan, and the annual product is reported as less than 100,000 pelts.

METHODS OF TANNING SEAL SKINS.

The total quantity of seal skins received in the markets of the world approximates 650,000 annually, valued at $600,000. The majority are sold in London, but some are sold in Liverpool, Dundee, Hamburg, New York, Halifax, St. Petersburg, and Moscow. Most of them are tanned in Great Britain, London and Dundee being more extensively interested than any other places; but some are tanned in Norway, Russia, Germany, France, and the United States. Previous to 1901 the number tanned in the United States was small, not frequently exceeding 30,000 in any one year; but during 1901, owing to an overstocking of the trade in Great Britain, about 75,000 skins were purchased and prepared by leather manufacturers in the United States.

The general methods of tanning seal skins employed in Europe and America do not differ greatly from the treatment of similar pelts. As received at the tanneries, seal skins are thick, heavy, and extremely oily, but except in the last characteristic they closely resemble other raw skins. They are roughly cleaned of adhering flesh and blubber and as much of the oil as practicable is pressed out, when they are placed in lime pits to loosen the roots of the hair and prepare them for depilation. The skins are put first into an old-lime solution and frequently changed to stronger solutions until the liming effect is completed, three or four weeks being generally required for this operation.

The action of the lime is usually hastened by frequent "handling" and changing the skins from one tank to another. When the bulbous roots of the hair are thoroughly loosened, the skins pass to the fleshing house where each one is separately laid on a beam and carefully unhaired on one side and fleshed on the other. In some establishments the skins are partly unhaired before the liming process is completed. The choicest grades of hair are used largely by plasterers, but most of it is suitable only for fertilizer or the waste heap. After a thorough washing and "striking out," currier fashion, the skins are in condition to be converted into leather.

Owing to the excessive and irregular thickness of the skins, it is desirable at this stage of the process to split or shave them, although many tanners, especially those in the United States, postpone this until the tanning is complete. The splitting is effected with a machine of clever mechanism, its principal parts consisting of two metal rollers, revolving horizontally one above the other, between which passes the skin spread out smoothly. The advance edge of the skin is presented to a keen blade, moving with great rapidity parallel with the line of contact of the rollers, thus splitting the skin into two pieces of equal superficial area, of which only the grain or outside portion is desirable for leather-making. The other half is sometimes used for making an inferior grade of leather, or cheap and somewhat deliquescent size or glue, but ordinarily it goes to the waste heap to be converted into fertilizer. The thinned skins are puered with bran or dog dung, followed by drenching and a thorough working out on a beam to remove all traces of lime salts and other refuse materials, as already described on page 331, and thus made ready for the tanning solution.

The skins are next steeped in tanks or vats containing successively stronger baths of the astringent infusion of oak bark, japonica, sumac, or any other tanning agency. For fancy shades of coloring, sumac only is used, as a rule. During the first few days the skins are frequently "handled," so that the liquor may quickly strike through them. This "handling" or "working" is cheaply effected by means of paddle wheels, which turn the skins over and over in the solution. The more they are worked by the paddle wheel, the larger the grain of the finished leather. From four to six weeks' time is usually required to complete the tanning process, even with the use of paddle wheels. In England and Scotland large quantities of the skins are tanned by sewing together two skins, flesh to flesh, around the edges, so as to form sacks or bags, which are then filled with liquid sumac. This method is cheaper and gives a better color. It is also more expeditious, requiring usually less than one week.

The tanned skins are next submitted to a sumac bath containing a cleaning acid, such as oxalic acid or sulphuric acid, then "struck out" and lightly oiled. They are afterwards selected for coloring, and dyed if desired. To "finish" the skins, they are dampened, sammied or partly dried, and "struck out"—that is, stretched out on each side with a tool. If a bold grain be desired, in using the skins of old seals, they are embossed and dried out; but if the natural grain is retained they are blacked at once. A finish is imparted by a good bottom coat of logwood, prepared by subjecting 1 hundredweight of Campeachy hard wood and 5 pounds of carbonate of soda in 50 gallons of water until the logwood is extracted, the liquor being at once drained off.

After airing slightly in a warm place the skins are ready for "wet graining." They are again dried out in a warm place, laid away to cool, and then seasoned with three-fourths of a pint of milk and about 1½ pints of blood added to a gallon of water, which is rubbed in well with a stiff brush. The skins are now moistened with a mixture of milk and water, in the proportion of 1 to 6, and rolled up, half a dozen skins together, grain to grain. After a few hours they are rolled, grained off, and oiled with warm cod oil, when they are ready for the market.

When carefully prepared, seal leather has greater strength and durability in proportion to its weight than almost any other on the market, and on account of its choice and attractive grain it is very popular for such articles as cardcases, pocketbooks, shopping bags, etc. Much of it is enameled for belts and upper shoe leather. The market value of seal-skin leather in the United States is from \$20 to \$30 per dozen skins, equivalent to about 50 or 60 cents per square foot.

The "fast furs" or "wool-seal" skins are blubbered in the same way as the ordinary pelts, and are sold to the fur trade in the salted state. By the fur-dressers they are washed and leathered as in the first stages of fur-seal dressing. The thickness of the pelt is reduced by shaving or by friction on an emery wheel. When the dressing is completed the hairs are dyed black or brown, scarcely any of these skins being left in the undyed state. They are used for various purposes, especially for gloves and military busbies. During some seasons they are fashionable for trimmings, and a brisk demand exists for them. This was especially the case during the early eighties, when they sold for \$3 to \$6 each, dressed. At present the average price in the dressed condition is \$1 to \$2 each. Many furriers—in America, at least—fail to recognize the fast furs as from a species of hair seals, considering them as the skins of a distinct and separate species, to which they give the name "wool-seal."

On the Continent of Europe the bluebacks are used mostly for fur trimmings after they have been dressed with the hair on; but in Great Britain and America they are usually tanned for leather purposes. During the last season some blueback skins were tanned in this country with the hair on, but they did not take very well.

LEATHER FROM SEA-LION SKINS.

Sea-lion hide was formerly considered unfit for tanning purposes, owing to its thickness and coarse texture, consequently the hunters taking these animals for oil-rendering rarely saved the skins; but at the present time the hide is worth as much as the oil. When properly tanned the skins of the young animals make a soft, velvety leather, quite popular for fancy articles. The thick hides of the old animals are used to a limited extent as a substitute for walrus hide in polishing wheels for metal-workers. It is much like bull-neck leather, and, although inferior to walrus polishing wheels, is prized by silversmiths for small work. The hides suitable for polishing purposes are one-fourth to one-half inch thick, weigh 30 to 40 pounds when tanned, and are worth about 30 to 40 cents per pound wholesale. The poor or cheap hides are used to some extent as glue stock.

In preparing the skins of sea-lions for covering the Eskimo kaiaks or bidarkas, the green hides, as soon as removed from the animals, are closely rolled together and permitted to "sweat" until the hair becomes loosened, when it is readily removed by scraping with blunt knives or stone flensers. When unhaired, the moist skins are deftly sewed together in suitable patterns and stretched, flesh side out, over the boat frames, the entire structure being covered, with the exception of a circular hole or holes in the top. This boat is perfectly water-tight and substantial, and, although weighing usually less than 100 pounds, will carry several hundred pounds of goods in addition to the crew. Because of the softening influence of the water, after each day's use the boat must be hauled up out of the water, turned bottom side up and air-dried during the night. Protected in this manner and oiled occasionally, it lasts many seasons. Sea-lion skins are also used to some extent for covering the bidarrahs, which differ from the bidarkas in that they are much larger and more substantial. Usually, however, walrus hides are used for that purpose.

The natives make various other uses of sea-lion skins, such as tent coverings, harness for the sledge dogs and reindeer, and, in case of very young animals, even for clothing. When used for these purposes the hides are sweated, as when used for covering the bidarkas, then stretched for about ten days to cure, when they are taken down, rubbed between the hands to render them pliable, then cut into suitable size for use as may be desired.

In the fisheries of the southern seas, sea-lion hides were sometimes saved and brought to port. In curing them for this purpose they were removed from the animal with half an inch of blubber adhering. After washing and while yet wet they were plentifully sprinkled with salt rubbed well into the fat, particularly around the edges and neck folds, and then packed in tiers in the ship's hold.

Sea-lion skins for fancy leather are tanned in precisely the same manner as seal skins, and especially those of large seals. The only difference in treatment is due to the greater size and body of the former. On account of the difficulty in procuring sea-lion skins free from scars and markings, and also the ease with which its peculiar grain is imitated on seal leather, the great bulk of the sea-lion leather on the market is prepared from seal skins. The value of the genuine skins when converted into leather ranges from $2 to $12 each, according to their quality and freedom from damage.

LEATHER FROM WALRUS SKINS.

Formerly the principal use of walrus hides in Europe was for the rigging of vessels, for which it is especially adapted. For many years nearly all the rigging of vessels on the north coast of Norway and Russia was made of this article. The skins were also employed for protecting the rigging of vessels from chafing. Later came their use in northern Europe for manufacture into harness and sole leather.

Then the thick heavy leather was adopted by silversmiths and other manufacturers of bright metal objects, for removing mars and scratches and to polish fine metal surfaces. The hide is particularly desirable for this purpose because of its peculiarly tough grain. It is usually cut into circular shape, forming a wheel of solid leather, but sometimes a ring of leather is cemented to a wooden center by which it may be attached to a revolving head or mandril. Other than that made from bull neck, buffalo, or sea-lion hides, there is no satisfactory substitute for walrus leather for these purposes. The thickest parts of the hide are the most valuable, and the demand at the present time is quite large, the principal silver works of the United States and Europe making use of it. The London value of an average hide suitable for polishing purposes is in excess of $100.

About 30,000 pounds of tanned walrus hides are imported into the United States annually. The import value is about $25,000 and the selling value after it is cut in the form of wheels is from $40,000 to $50,000. The quantity used in Europe is probably double the amount of the importations into this country. A small quantity of walrus hide has been tanned on the Pacific coast of the United States, but the quality of the output is reported as inferior to that prepared in Great Britain. As shipped from the tanneries, the "sides" weigh from 30 to 200 pounds. The cub sides weigh from 30 to 40 pounds, measure from ¼ to ½ inch in thickness, and are worth about 30 cents per pound. The largest sides weigh 180 to 200 pounds each, are 1½ to 2 inches thick, and sell for $1 to $1.25 per pound. The average sides weigh 80 or 90 pounds, are ⅞ to 1 inch thick, and sell for 60 to 70 cents per pound. Of course, when cut into circular shape these are sold at very much higher prices. The average price paid by metal-workers in this country is probably between $1 and $2 per pound, and for the very thick hide as much as $5 per pound has been paid.

Another use to which tanned walrus hide is put is as covering for the rollers used in ginning long-staple cotton, such as Sea Island or Egyptian. This is a comparatively recent use, yet probably 6,000 pounds are consumed in the United States annually in this manner. The tanned hide is cut into thin strips and attached to the surface of the roller, entirely covering that portion that comes in contact with the cotton. It is peculiarly adapted to this use and much more satisfactory than bull-neck leather or any other material formerly employed.

Formerly the light or thin hides of walrus were little used, as they were not suitable for polishing purposes, and therefore they were of small value. But during the last few years the leather made from these thin hides has become quite fashionable for such articles as card-cases, pocketbooks, belts, etc. For this purpose the leather is split and so tanned that the grain has a remarkably smooth velvety appearance.

The process of tanning walrus hides depends on the purpose for which the finished material is designed. If intended for polishing purposes the hide should be tanned as thick and heavy as possible, with a hard, tough texture. The tanning of the heavy leather consumes from six months to one year or more when properly done. Acceleration of the process is likely to result in uneven texture, with the interior fibers imperfectly tanned. It is claimed that the best of the heavy hides are English tanned.

For thin, pliable fancy leather, the skins are tanned in precisely the same manner as seal skins, except the changes and the greater length of time due to the superior thickness of the leather. It is proper to state, however, that the greater portion, indeed possibly 90 per cent, of the so-called "walrus leather" manufactured into cardcases and other fancy articles is nothing more than seal leather with a walrus grain, which is easily given to it in the process of currying. The walrus skins are so difficult to obtain and are so frequently cut and damaged that they can not be economically used for fancy articles. The seal leather is equally durable, and when properly grained and finished the substitution can be detected by comparatively few persons.

LEATHER FROM MANATEE AND DUGONG.

For many years the market has received small quantities of curiously grained, tough, and durable leather made from hides of manatee and dugong.

The manatee is found in the shallow waters of the tropical seas on both sides of the Atlantic and in the large tributary rivers. It occurs principally among the West Indian Islands, the coasts of Brazil and Florida, and on the Senegambian coast of Africa. Owing to its gregarious and inactive habits it is easily killed. Being valuable for its oil as well as for its hides, it has been so extensively slaughtered that it is now quite scarce.

The dugong or halicore is the manatee of the Asiatic and Australian coasts. It differs from the Atlantic manatee only slightly in outward appearance, the difference being most noticeable in the shape of the tail, which in the dugong ends in flukes instead of being spoon-shaped.

The dugong is reported as much less numerous than formerly. It attains a length of about 10 feet and is reddish brown in color, somewhat lighter than the porpoise. The hide is so thick and tough that harpoons used by the whalers are almost ineffective in its capture.

The skin of the manatee, as well as of the dugong, is hard and thick, exceeding 1 inch in places, and has comparatively few hairs on the surface. When removed and salted it is of a dark lead color. The number of skins received on the markets of Europe and America is relatively small, probably not exceeding 50 annually, most of which come from Queensland. They are tanned in the same manner as seal skins, but as they are larger and heavier more time is required.

These skins produce the most characteristic grain of all marine leathers. It is quite unlike that of the seal, walrus, or sea-lion, consisting of closely associated and irregular rows of well-defined ridges, and at intervals of about one-half or three-fourths of an inch there are peculiar indentations or pin marks surrounded by a circular ridge, the locations of the hair follicles. Unlike that of walrus and sea-lion leather, this grain is rarely imitated. Indeed, it is difficult to make a satisfactory imitation. Owing to the small quantity received, there is no regular market for this leather and no standard price. It is used almost wholly for small articles, such as cardcases, belts, and the like.

PORPOISE LEATHER.

The most abundant porpoise on the Atlantic coast is the harbor porpoise or puffing pig, which occurs from Nova Scotia to the Gulf of Mexico, ascending the rivers to the limit of the brackish water. This species is not at present an object of fishery at any point on the United States coast, although occasionally it is taken incidentally in pound-nets and seines set for food-fish. Owing to the fact that the skins are rarely free from the markings of sharks' teeth, they are not used for leather purposes to any great extent.

Of much greater economic importance is the Hatteras porpoise or bottle-nosed dolphin, which occurs in great abundance on the coasts of the United States and Europe and at times has been the object of extensive fisheries. This species also has shark markings but the skins are usually in far better condition than those of the harbor porpoise. On the North Carolina and New Jersey coasts profitable fisheries have been maintained for its capture and its utilization for leather, oil, and even for food.

Porpoise fishing has been prosecuted during the winter season since 1810 at several points on the Atlantic coast, and especially along the "Banks" of North Carolina. It was abandoned for several years following 1860 and again in 1893, the period of greatest extent being from 1885 to 1890. During the last few years the fishery has not been prosecuted, owing to conditions in the leather market, but it appears probable that it will be reestablished at an early date.

The porpoise are dressed as soon as practicable after they are dead. The flippers and the dorsal fin are cut off and the skin and blubber cut along the middle of the back and of the abdomen from nose to flukes, and the whole peeled off in two uniform parts, the hide and blubber being removed together. The halves are laid on an inclined beam, similar to that used by curriers, and the blubber shaved off and processed for extracting the oil, while the skins are salted for the tanners. The largest catch of porpoise on the coast is reported to have been about 20,000 in 1887. The value of the green hides was about $2 per side, and when tanned they were worth $10 or $12 per side.

The commercial porpoise leather of England is made from the skin of the beluga or white whale. This species attains a length of 18 feet or more, and averages perhaps 14 feet in length and 10 or 12 feet in circumference. At several places along the coast of northern Europe, and to a much less extent in the Gulf of St. Lawrence, in Hudson Bay, on the coast of Newfoundland, etc., the beluga is captured chiefly for its hide, to be used in leather-making, and also for the oil that may be rendered from the blubber. The principal fishery is prosecuted by vessels from Dundee, Scotland, and from ports of Norway and Sweden. It is estimated that the annual take is over 7,000, of which 6,000 are obtained north of Europe, leaving 1,000 as the catch in the northern part of the American continent. The value of the hide when green is about $8 per side, and when tanned it averages probably $25 per side.

While the skins of other cetaceans are occasionally tanned, the product is of no commercial importance. These skins are very spongy and usually have a villous or woolly surface.

TANNING PORPOISE SKINS.

According to Mr. R. G. Salomon, of Newark, N. J., to whom we are indebted for most of our information in regard to the method of tanning this leather, skins of the beluga and of the Hatteras porpoise are tanned in precisely the same manner, but the former require much longer time on account of the greater body. Both are received at the tanneries in a salted condition, and the first operation consists in cleaning out the salt by soaking them in water for two or three days, according to the state of the hides and the temperature of the water. After this soaking, they are washed thoroughly in warm water and again soaked for a day or so, and the grease worked out by hand or by machinery. They are next immersed in lime solution for a length of time depending on the condition of the hides, but usually much shorter than for cowhides. After liming they are bated and washed thoroughly to remove the lime and other impurities. The skins are now immersed in whatever tannic acid is desired. When half tanned they may be reduced to the required thickness by splitting, or this operation may be postponed until the tanning is at an end. After the tanning is completed the nap is shaved off and the leather scoured and prepared for stuffing with oils and then finished in the usual manner. The new chrome or metallic tannages seem likely to produce excellent results in porpoise tanning and will doubtless soon be adopted.

Most of the beluga skins are tanned in Dundee and Glasgow, but several small tanneries in the province of Quebec prepare this leather. Porpoise tanning in the United States has been mainly at Newark, N. J.

Leather made from porpoise hides is remarkable for its tractility; a portion one square foot in area is easily drawn out to 1⅜ feet in length, losing correspondingly in width, a feature possessed by few other leathers. This makes it especially adaptable for shoemaking, for in whatever direction the foot is thrust by the weight of the body the leather will adapt itself to that shape. It is also exceedingly durable, readily outlasting two or three pairs of calfskin shoes. It has another recommendation apparent only when it is wet; then it swells up, becoming almost twice as thick as in its dry condition, and absorbs water but allows very little to penetrate it. This, added to its strength and suppleness, makes it most desirable for hunting and wet-weather boots, since it is not easily penetrated by moisture under ordinary conditions. It is sold by the pound, the price varying from $2.25 to $3.75 per pound, each side weighing from 1½ to 4 pounds. Ordinarily a pound is sufficient for about three pairs of shoes.

The skin of the beluga is among the very best for leather purposes of any obtained from either aquatic or land animals. It resembles the hide of the Hatteras porpoise in many respects, especially in having the fibers running mostly in one direction and in possessing great tractility. However, the beluga is more solid and durable than the latter. Beneath the nap it has a membrane like the "shell" on the rump of a horse,[a] which becomes soft and flexible in dressing and makes strong and durable leather. In comparing the tensile strength of the two, it is found that a shoestring of average size made of beluga sustains a weight of about 300 pounds, whereas one of Hatteras porpoise supports 85 to 100 pounds, and calfskin only 40 or 50 pounds. If a porpoise lace lasts three months, the life of a beluga lace subject to similar usage is said to be nearly two years. Beluga leather keeps its shape when made into shoes, whereas porpoise leather gives with the movement of the feet. Considering its great tensile strength and the large pieces obtainable, it is apparent that beluga leather is remarkably well adapted to the purpose of machinery belts. A continuous piece 60 feet long and 18 inches wide has been cut from a single skin.

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[a] The shell in horsehide is the flat muscle spread over the horse's rump from the tail to the forward point of the hips and extending down to the legs, making an oval-formed sheet about 2 feet long and 1½ feet wide in the widest part. This muscle grows firmly to the grain of the skin and furnishes remarkable pulling power. When shaved clean of its sinewy matter and properly tanned, this shell makes most durable leather. The members of the equinal or horse family are said to be the only land animals possessing this membrane, but it extends nearly over the entire skin of the beluga.

Leather from the beluga is especially suitable for use as shoelaces on account of its tenacity and durability. That from the Hatteras porpoise was never much used for this purpose, owing to its unfavorable size, causing much loss in cutting. Many shoelaces made of inferior leather are sold as porpoise. The genuine can be easily distinguished by grasping it with the thumb and forefinger of each hand about one-half inch apart and contracting or pushing it together in the direction of its length, when the contracted portion will increase about one-third in width. "The genuineness of the article is positively assured by this simple test, for no other leather has this feature."[a]

The beluga laces sell for about $8 or $10 per gross, while calfskin laces sell for about $1.25 per gross. No beluga laces are made in the United States, nor is the demand for them here of importance; but many are made in Scotland for the English and continental markets.

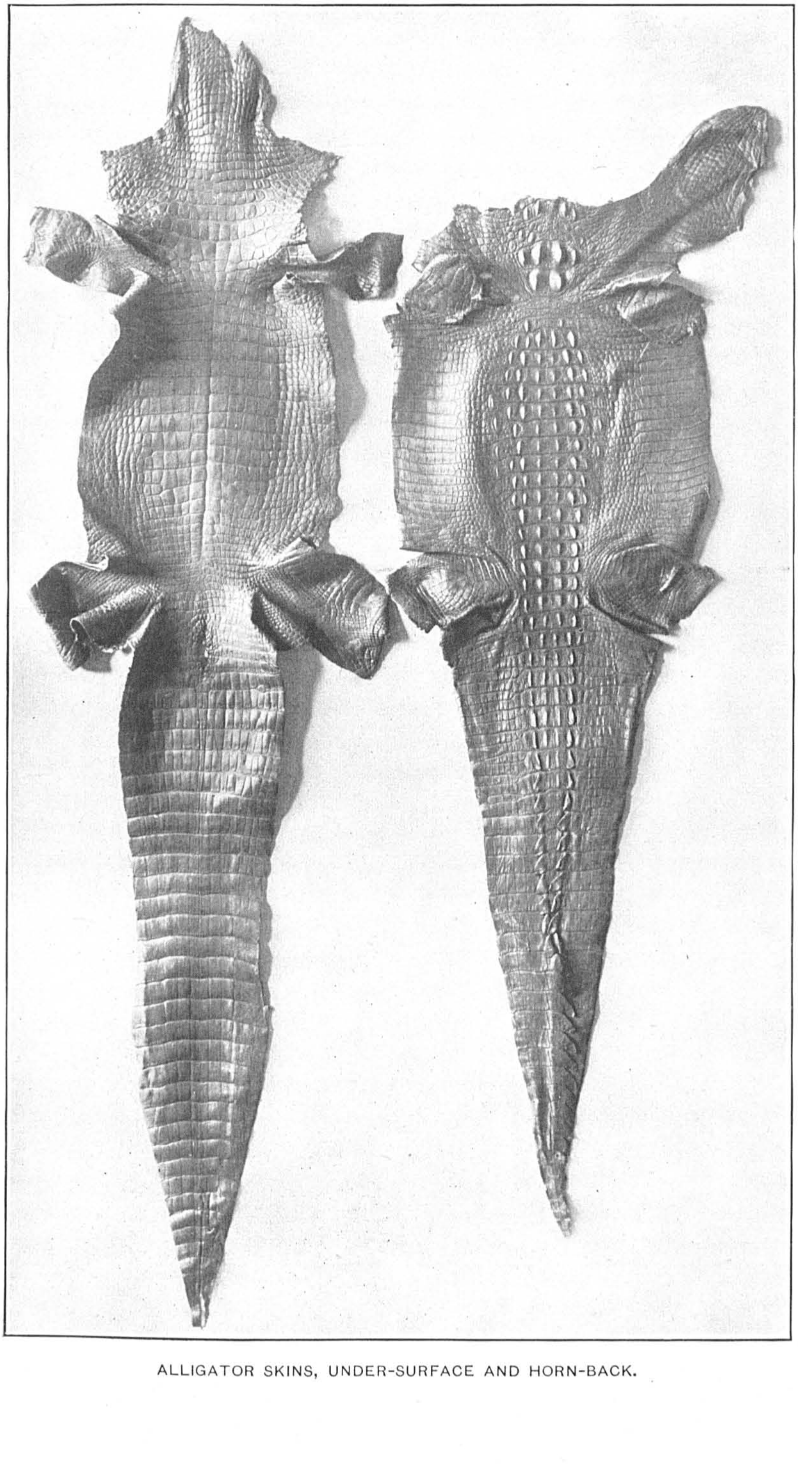
LEATHER FROM ALLIGATOR SKINS.

Occasional attempts to utilize the coriaceous epidermis of alligators in leather manufacture have been made for one hundred years or more, but not with much success until about 1855, when this novel leather became somewhat fashionable and a considerable demand developed. The market, however, was not long continued, and after a few thousand hides had been shipped from the Gulf States the demand ended. During the civil war another raid was made upon these saurians to supply shoe material, and they were again slaughtered in thousands; but with the cessation of hostilities and the restoration of free commerce in shoe materials, the alligators were again left to repose for a period.

This rest, however, was only temporary, for about 1869 fickle fashion again called for the leather for manufacture into fancy slippers, boots, traveling bags, belts, cardcases, music rolls, etc. An immense demand was soon created for it, resulting in the slaughter of many thousands of the animals every year, giving employment to hundreds of men. The demand soon exceeded the productive capacity of our own country, and large numbers of skins were imported from Mexico and Central America. The consumption of this leather at present is greater than ever before, and owing to the large importations the market price is somewhat less than a few years ago. The output of the tanneries of the United States approximates 280,000 skins annually, worth about $420,000. It is among the most characteristic of all aquatic leathers—indeed, of all leathers—being curiously checkered in oblong divisions, known as "scales" or "bosses," separated by intersecting grooves, and varying in size and character from the rough horn-like scutes on the back to smooth pliable markings on other parts of the body, giving the skin that peculiar effect which makes it so popular for leather purposes.

There are several distinct varieties of alligator skins on the markets, the most important being the Floridian, Louisianan, and Mexican;

[a] Shoelaces, by R. G Salomon, 1886, p. 21.



ALLIGATOR SKINS, UNDER-SURFACE AND HORN-BACK.

each differs from the others in certain well-defined characteristics, and owing to these differences each variety has its special uses.

The Florida skins are longer in the body—that is, from the fore legs to the hind legs—than those from Louisiana and Mexico, and consequently they are largely in demand by manufacturers of large handbags. They also have a number of so-called "buttons" or "corn marks" on the inside or under surface of an equal number of the scutes, resulting from embedded horn-like tissues in the center of those scales. These increase the difficulty in tanning the skins and detract somewhat from the appearance of the finished article, and for this reason the Florida skins are ordinarily the cheapest on the market. The farther south the skins are secured in Florida the greater the number of "corn marks," and those from the vicinity of Key West are almost valueless on this account.

The Louisiana skins differ from those of Florida in the absence of the "corn marks" above noted, and from both the Florida and Mexican skins in being more pliable and in having the scales more artistically curved and shaped. Consequently they are preferred for such small articles as cardcases and pocketbooks, and usually sell at the highest prices. Skins obtained in Mississippi and Texas are similar to those secured in Louisiana, while those from Georgia and South Carolina are similar to the Florida skins, except that the "corn markings" are not so numerous. All the Florida and Louisiana skins show greater uniformity of coloring, being of a bluish black on the upper surface and a peculiar bluish white on the under side.

In addition to an absence of the characteristics above noted, the Mexican and Central American skins are distinguished by having from 1 to 4 small dots or markings like pin holes near the caudal edge of each scale. The length of the Mexican skins varies greatly in proportion to the width, sometimes equaling that of the Florida skins. Those from the east coast of Mexico are the best, being lighter in color and with neat and attractively shaped scales. The west coast skins are yellowish in color when in the green state, and the scales are larger and not so artistically formed. The Florida and Louisiana skins are almost invariably split down the back, or rather along each side of the back, so as to preserve the under side in a solid piece, but most of the Mexican skins are split down the middle of the abdomen, keeping the back intact, making what is commonly known as "horn alligator."

On all of these hides the scales or bosses are far apart, without mutual articulation or overlapping. The number of nuchal scutes is usually four large ones, forming a square, separated on the median line, with a pair of small ones on front and another pair behind; there are 17 or 18 transverse series of dorsal scutes, the broadest series containing 8 scutes.

The skins of the alligators or caymans from Brazil, Venezuela, and other South American countries are distinguished by having a much heavier or more horny covering than the foregoing. The cuticular plates on the back are articulated together, and those on the under surface are more strongly developed than in skins from Mexico or the United States. They are of very little value for leather purposes, owing to the difficulty in properly tanning them.

Of the 280,000 skins used each year in the United States probably 56 per cent are furnished by Mexico and Central America, 22 per cent by Florida, 20 per cent by Louisiana, and the remaining 2 per cent by the other Gulf States. The South American hides do not come on the market in the United States.

The quantity of alligators has greatly decreased in all the Southern States, and it seems only a question of a few years when it will be impossible to obtain the hides at a price that will justify their general employment. Thousands of the animals have been slaughtered merely for sport, no use whatever being made of them. It is estimated that the number in Florida and Louisiana at present is less than 20 per cent of what it was twenty years ago. This decrease is attributed largely to the shooting of them in wanton sport. It has been deemed necessary to legislate for the protection of alligators in some localities, especially in Florida, owing to the rapid multiplication of the cane rat which threatened ruin to many harvests. There is a strong sentiment among the hunters in Florida and Louisiana favorable to a law interdicting the killing of those measuring less than 5 feet in length.

The hide should be removed shortly after the animal is dead, for in the warm climates putrefaction ensues quickly and the value of the hide is depreciated. The operation is begun by cutting through the scaly covering longitudinally from the nose to the end of the tail, along either side of the horny ridge along the back, or in the middle of the under surface of the animal. The former is the usual method in Florida and Louisiana, while the latter is common in Mexico and in Central America. Formerly it was considered difficult to tan the horn-like back properly, but it is now prepared almost as readily as the more pliable portions, and its use is very extensive.

After making the incision above noted, a cut is made running from the longitudinal one to and along the middle of each of the legs on their upper side; or, if the back is to be saved, along the under side, extending almost to the wrists. After cutting around the jaws, the skin is peeled off in a blanket piece. Great care should be exercised to avoid careless cuts in the membrane. A very large percentage of the hides received in the market are badly damaged in this manner. These knife cuts may be scarcely noticeable in the raw skins, but when dressed are so apparent as to render quite valueless the part of the skin in which they are contained, resulting in much waste.

The hide should be salted immediately, the salt being carefully rubbed in all folds and crevices as well as over the entire inner surface of the skin, the use of coarse-grained salt being avoided. The edges along the abdomen and the parts from the legs are folded over neatly and the entire skin rolled up in a compact bundle and placed in a dry, cool place. Many hides spoil by reason of insufficient or indifferent salting, the grain side becoming so damaged that at best they are suitable only for second-class leather. After thorough curing, the salted hides are placed in boxes, barrels, or bags, and are bartered at the neighboring trading store, whence they are duly shipped to the tanneries.

The price received by the hunters for alligator hides varies from 15 cents to $2 each, according to the length and condition of the skin, and averages probably about 90 cents. Prime hides 5 feet long, with no cuts, scale slips, or other defects, are worth about 95 cents each, in trade, when the hunter sells them at the country stores, and about $1.10, cash, at the tanneries. Those measuring 7 feet are worth $1.55; 6 feet, $1.12; 4 feet, 52 cents, and 3 feet, 25 cents. Little demand exists for those under 3 feet in length.

TANNING ALLIGATOR HIDES.

The principal tanneries in the United States handling alligator hides are situated at Newark, N. J., and New York City, N. Y. Some hides are also prepared in New Orleans, Jacksonville, and in one or two of the tanneries in Massachusetts. Many are also exported to Germany and to England and there tanned. Alligator hides of all lengths, from 2 feet up, are used, but those most in demand are about 7 feet long. Hides over 10 feet in length are not much used, owing not only to their scarcity but to the hardness of the cuticular plates, making them difficult to tan properly and almost valueless for leather purposes, although some over 17 feet long have been prepared.

Formerly only the skin from the underpart and the sides of the animal was used, that from the back being so heavily armored with tough, horny plates and shields as to be of little value, except in case of very small hides. During recent years, however, a demand has existed for "horn" alligator, i. e., leather from the back of the animal, and this demand has been supplied by the importations from Mexico and Central America, a very large percentage of which are cut down the abdomen so as to preserve the back in one piece. The Louisiana and Florida skins are not cut "horn back" because they are not so flexible on the back as the Mexican.

On receipt at the tannery the hides are assorted according to their size, the small, medium, and large being treated separately on account of the difference in texture. With plenty of salt they are placed in a suitable storage room, whence they may be removed as required.

In the process of preparing for tanning, the skins are first immersed in vats of clear water, the smaller ones remaining about two days and the larger ones six days, according to the condition of the membrane. When sufficiently soaked they are immersed in a solution of lime, which should not be so strong as for depilating, and there they remain from eight to fifteen days, according to their size and the conditions of the water and the temperature. Each day the hides are reeled or removed into a stronger lime solution, great care being observed to avoid injuring the skin during this handling. The wet hides are now placed on a beam and shaved on the flesh side, all fat and superfluous flesh being removed. The bate of bran into which they next pass is made very weak, and in it the hides are gently agitated by means of a wheel, remaining there for ten to fifteen hours.

The hides are next cleaned in a wash-wheel tank and then immersed in a vat of oak bark extract, gambia, or sumac liquor of about 4° strength. Every day or so the liquor is made stronger, increasing to about 20° at the end of eighteen or twenty days. A gentle agitation of the tanning liquor during the last ten or twelve days is very beneficial, as it aids in the more thorough tanning of the skins and prevents the sediment of the liquor from settling in the creases, which is liable to rot the tender portions, especially in case of small hides. The hides are removed from the tanning liquor and suspended in the open air for samming, or partial drying and hardening, so that they may be again shaved on the flesh side to further reduce the thickness. They are returned to the tan liquor, where they are reeled for four or five days, the strength of the liquor being increased from time to time.

On removal from the tan liquor the second time, the hides are scoured with sumac water and selected for the different colors. Many are left in the natural color, yellowish brown. The popular dyed effects are black, and various shades of brown, green, yellow, red, etc. The coloring is done in a bath with wood and aniline dyes, the immersion lasting from ten to sixty minutes. The skins are next stretched out, and in most cases nailed on wide boards or frames for drying, and when thoroughly dry they are "staked" over iron beams or stakes for the purpose of making them flexible and pliable. If intended for shoes they are seasoned before staking, this consisting in stuffing them with tallow, fish oil, etc. But very few alligator hides are now prepared for shoe leather, since they are rather fancy for that purpose. After dressing them on the polishing machine, the skins are measured and stored in the warehouse or delivered to the leather manufacturers.

Although green alligator hides are sold according to length, tanned hides are sold by the width of the leather at the widest part. The price for skins of standard grade ranges from $1 to $1.65 per 12 inches of width. Some skins tanned and dyed in a superior manner sell for $2 or more for single skins 2½ feet in length. As a rule the Louisiana skins fetch the highest prices, and those from Florida the lowest.

Imitation alligator leather is now prepared in large quantities, principally from sheepskins or the buffing from cowhides. These are tanned according to the usual process, and before the skins are finished they are embossed with the characteristic alligator markings by passing them between two rollers.

SKINS OF SHARKS, RAYS, AND DOG-FISH.

The skins of sharks, rays, and dog-fish are commonly very rough and studded with numerous horny tuberculous markings or protuberances. Some have small imbricated and triangular scale-like tubercles; others unimbricated and nearly rhomboid, which in one species are ranged near each other in quincunxes, or they may be quite square, compact, and comparatively smooth on top. These protuberances are usually firmly fixed to the skin so that they are not easily separated therefrom. They are rough and hard and take a polish almost equal to stone.

These skins, like those of all cartilaginous fishes, are very durable. A peculiarity, in addition to the markings above noted, is the nonporous character. The pores that are everywhere present in the skins of most mammals, which give the natural grain in the tanned leather, are entirely indiscernible in the skins of these fish. The result is to render them almost proof against water absorption. Although by skillful tanning the fibers of seal and other skins may be plumped and the body of the membrane solidified, yet much water exposure loosens up the fiber and gradually permits absorption. Not being of a porous nature, shark skin is naturally free from this defect. But the advantage is also a disadvantage in some respects. The nonporous leather is practically airproof as well as waterproof, and that is a serious defect when its use for footwear is considered. Beyond this, the skins of sharks and similar fishes may be prepared in a very durable, noncracking leather, for which many uses may be found.

Formerly, large quantities of these skins were used for polishing wood, ivory, etc., for which they are excellent, owing to their roughness, hardness, and durability. But the great improvements made in preparing emery compositions and sandpapers have resulted in substituting them almost entirely for polishing purposes. However, a small demand yet exists for shark skins for cabinet-workers' use.

The principal uses made of the skins of sharks and allied fishes at the present time are for covering jewel boxes, desk ornaments, cardcases, sword sheaths, sword grips, and a great variety of small articles for which the tuberculous markings peculiarly adapt them. The demand for these purposes, however, is small and restricted, and each producer has to develop his own market. Comparatively few of these skins are prepared in the United States, and diligent search among the tanneries and leather stores will result in the finding of only a few skins. Many, however, are prepared in France, Turkey, and other countries of southern Europe, and also in China and Japan.

A Parisian manufacturer has made quite a reputation tanning the skin of a species of Malabar shark into morocco, and establishments in Turkey make green leather from the skin of the angel shark found in the Mediterranean Sea. The skin of the diamond shark obtained in the North Sea, and so called because of the shape of the markings or protuberances, is used to cover the sword grips of German officers, and for this purpose is not surpassed by any material obtainable. Some parts of the skin of certain varieties of sharks when dried and hardened take a polish equal to that of stone, and bear a strong resemblance to the fossil coral porites, and are much used in the manufacture of ornaments and jewelry.

In preparing them for the use of cabinet-makers, shark skins are merely cleaned and not tanned. The hard, dry skins are soaked in lukewarm water for three or four days, shaved on the flesh side to remove surplus flesh and muscular tissue, and then dried. The skins of some species of sharks are so hard that they can not be shaved. The appearance of these skins is improved by bleaching, using chloride of lime and sulphuric acid. The durability of some of them is remarkable, outwearing many sheets of sandpaper of equal area.

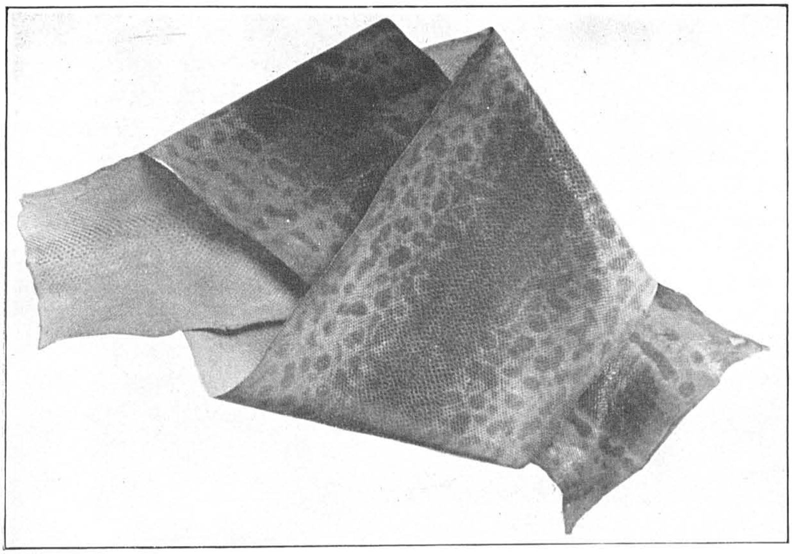
In tanning shark skin for leather or ornamental purposes an alum process is generally employed. Each establishment usually has its own particular method, but the general process is much the same, consisting of a preliminary soaking, liming, bating, and fleshing, and then tanning or preserving in an alum compound. The hard skins are first soaked in water four or five days, and then in limewater for two to six days, depending on the condition of the texture, temperature of water, etc. The skins are washed free of lime and bated in bran water; then shaved on the flesh side to remove all excess of flesh and the like. The alum solution in which they are immersed is composed of a pound of alum and one-fifth pound of salt to a gallon of water. The skins remain in the solution two or three days, with occasional stirring. On removal they are dried and are then ready for manufacturing.

STURGEON SKINS.

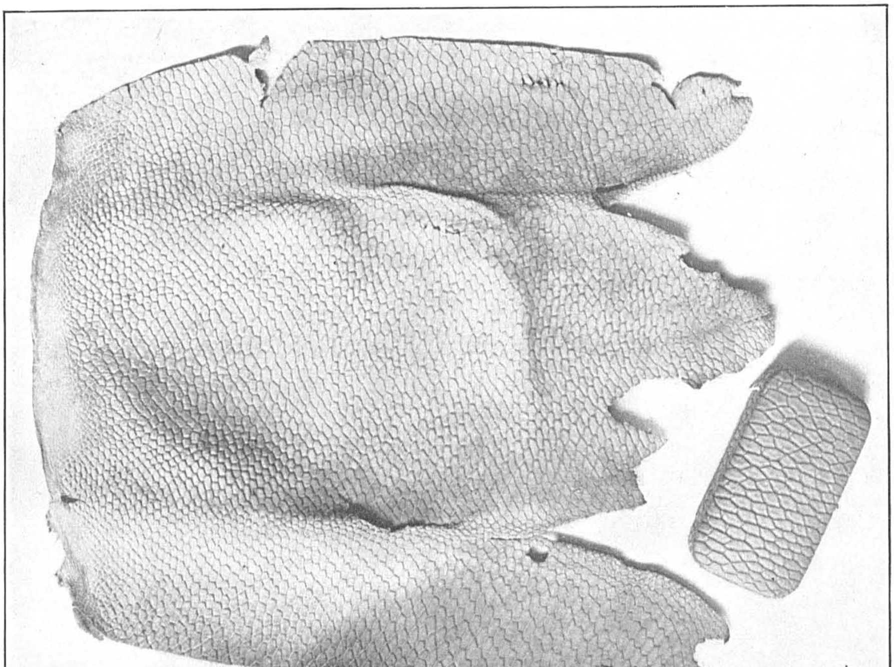
The skins of sturgeon are thick and unwieldy, and at first it might appear impossible to use them for any purpose other than glue or fertilizer stock. They are covered with rows of large prominent horny bosses, leaving space for comparatively little flexible membrane between each row. In the skin of the sturgeon common on the Pacific coast, and especially in the Columbia River, and those common in the Great Lakes and on the Atlantic coast the membrane between the rows of bosses may be tanned into a comparatively flexible and very durable leather, used as laces for mill belts and as durable as the belts themselves. But it is as ornamental leather, employed so as to display the rows of bosses, that sturgeon skins are especially desirable.

Some of these skins are remarkably attractive, particularly those from a species found on the coasts of Europe, which are distinguished by rows of small but very horny bosses, between which are numerous horny protuberances varying in form from a mere dot to beautiful, irregularly shaped bosses nearly half an inch in length. (See plate 35.)

Considerable variation exists in the methods of tanning sturgeon skins. Some varieties may be limed, while others go to pieces in a



SKIN OF WATER SNAKE.



SKIN OF BEAVER TAIL, AND JEWEL BOX COVERED THEREWITH.

lime solution. Alum and bark tannings are generally used, sometimes both together and at others first the alum and then the bark liquors. The method of tanning the skin shown in pl. 35 was as follows: This variety of skins is very oily, and half a gill of oil may be removed from the cavity beneath each of several of the bosses. The skin was soaked in lukewarm water for 2½ days, and then beamed to remove all grease, surplus flesh, and the like. It was then immersed in a solution of 1 pound of alum and 4 ounces of salt to 1 gallon of water, where it remained about four days; then retanned in oak liquors, the strength of the liquor being increased daily. On removal from the tan liquor the skin was dried without any special finishing.

BEAVER-TAIL SKINS.

A very characteristic leather seen occasionally in the markets is made from the skin of beaver tails. This is one of the most curiously marked of all of the aquatic leathers, being entirely covered with unimbricated scale-like bosses of irregular outline, usually hexagonal, a few pentagonal, and some quadrangular, the sides in all cases being slightly curved. Each of the bosses is about a third of an inch or less in length. The tail itself is about 10 inches long and 4 or 5 inches wide, and the skin produces a piece of leather about 8 inches square. Probably not over 50 pieces of this leather go on the market in the course of a year, but it might readily be increased to 20,000 or more. It is not especially durable and is used mainly for covering small jewelry boxes and the like.

For the preparation of this leather the skin is removed by cutting an incision along the middle of the under side from the base to the end, and stripping it off in one piece. Sometimes this is done by the trappers, but more frequently the entire tails, preserved in salt, are received at the tanneries. The skin is cleared out by soaking in tepid water for a length of time ranging from two to eight days, according to its condition, and is then limed for two or three days. It is shaved on the flesh side and submitted to a japonica, sumac, or alum tanning solution for about two weeks, shaved again, and cleaned with a sumac or sulphuric acid solution, and then colored if desired.

Very tough and durable leather may be made from the skin covering the body of the beaver. Before the adoption of the present method of cutting hatters' furs the tanneries received many of the skins from which the fur had been clipped, and beaver leather was comparatively common in the markets. Among the Huron Indians, whose wants were largely supplied by the beaver, the skin was much used for belts, bags, thongs, and even tent coverings. At present, however, leather made from beaver skin is comparatively unknown, many dealers in fancy leathers never having seen any. The grain is noticeable, but not especially attractive, no more than that of pig skin.

WATER-SNAKE SKINS.

The hide fiber of water snakes is scarcely distinguishable from that of alligator, being close and compact. While its thinness and consequent lack of durability render it unsuitable for many purposes, the curious markings and the novelty make it desirable as covering for cardcases and other small articles. For this purpose the skins should be treated in such a manner as to retain their original coloring and appearance as much as possible. The market for these skins is so small that the tanning of them does not amount to an industry at any place, although probably more are prepared in France than in all other countries combined. The quantity prepared in the United States probably does not exceed 100 skins a year on an average.

In preparing these skins bark tanning is not often used, and most of the methods are secret, being the result of individual experiments. Mr. A. M. Villon gives the following process in use in some establishments in France where these skins are prepared. The skins are soaked for a long time in water containing sulphate of zinc to prevent putrefaction. This requires at least ten days. They are fleshed, scraped, washed by hand, and placed in a bath made of water, 1,000 parts; borax, 10; boracic acid, 100; tartaric acid, 25; precipitated alumina, as much as liquid will dissolve. They are left in this for a day, then transferred to bath No. 2, containing water, 1,000 parts; phosphate of zinc, 25; benzoate of aluminum, 25; glycerine, 50; alcohol, 20.

They are left for a day in this solution, then placed in the first bath for a day, then back in the second bath for another day, this being continued for five or six days, when the tanning is usually completed, and the skins are dried, lightly staked, and finished off.

SKINS OF GAR-FISH OR ARMORED FISH.

Among the very ornamental fish skins seen in jewelry and novelty stores, and used for covering picture frames, cases and boxes of various sorts, is that of the gar-fish or armored fish. The skin of this fish is covered with slightly imbricated and firmly attached layers of rhomboid horny cuticle. It is very hard and may be polished smooth and even, retaining an ivory-like finish. The rows of scale-like cuticle readily separate from the mass, but the rhomboid sections in each row remain firmly attached to each other. In using the skin as many rows of the sections as may be necessary are broken off, and these are bent and shaped as may be required, and firmly glued to the body of the frame or box. When the whole has been applied and thoroughly dried it is polished as desired. These skins are obtained mainly from Louisiana; only a few score are used annually.

In preparing gar-fish skins for tanning they are first soaked in lukewarm water for from two to four days and cleaned of surplus flesh. In some establishments skins of this kind are not limed, owing to their tendency toward disintegration when put through that process. If limed at all, it must be done very carefully in a weak solution. The skins are then bated in bran water for eight or ten hours and washed in lukewarm water. Next they go into the tan liquor, consisting of a solution of extract of bark, sumac, and alum. This liquor is made somewhat weak at first, and the strength is increased from day to day until the tanning is completed, usually at the end of ten or twelve days. After drying in a flat shape, the skin is ready for use.

Certain tribes of savages have used the horny cuticle of the gar-fish in making breastplates which turn a knife or spear and even a hatchet, although they are readily pierced by bullets. With such a breastplate is usually worn a helmet of the skin of porcupine-fish, which is covered with formidable spines. The helmet serves not only as a protection to the head, but also as a weapon of offense in butting.

FROG SKINS.

The skins of frogs and toads are used to a limited extent for leather purposes. Two or three factories in France pay much attention to tanning them, obtaining the raw skins from northern Africa, Brazil, and other tropical regions. Elsewhere than in France comparatively few are tanned. Occasionally tanners in the vicinity of New York City prepare a few frog skins on special orders, but no regular market exists for them, and it would probably be difficult to find 50 prepared skins in all the tanneries and leather establishments of the country. This leather is thin and very pliable. It possesses a delicate but not especially attractive grain, and is used principally for cardcases and other small fancy articles.

MISCELLANEOUS FISH SKINS.

Although fish-skin leather can not yet be considered a commercial article, successful experiments have been made in the preparation of good leather from the skins of the cod, cusk, salmon, and other species. At Gloucester, Mass., shoes and gloves have been made from cod and cusk skins. Some very serviceable gloves were made at Berlin in 1880 from the skins of these fish sent from Gloucester. The skin of the wolf-fish (*Anarhichas*) is especially adapted to leather-making, and quantities of it have been placed on the market for cardcases, shopping-bags, and the like. In Egypt fish skins from the Red Sea are made into soles for shoes, and burbot skins have been used in Russia and Siberia to trim dresses. Eel skins have been largely used in Europe for binding books, and to a considerable extent in making whips, and have also been tanned and dyed and made into suspenders. In Tartary they are dried and oiled and used as a substitute for glass in windows.

Along the Yukon River, the Amur River, and in other northern regions as well, the skins of salmon, cod, and other fish are utilized for making various garments. They are taken from the fish in blanket pieces and the scales carefully removed. The skins are then dried and afterwards worked with a scraper until they become pliable. When finished the membrane resembles kid in appearance and softness, but is almost as tough as parchment. They are frequently dyed brown, red, yellow, and indigo, and some of the garments are highly ornate. They are sewed together with fine thread, made also of fish skin. The American Museum of Natural History in New York has many of these garments, obtained principally from Eastern Siberia.

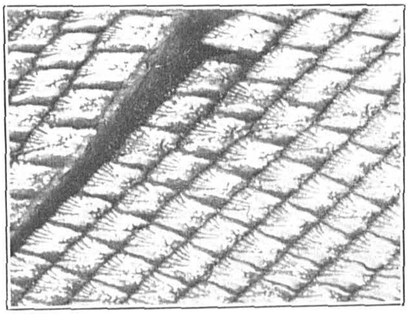
Bags and sacks of various kinds, with capacity varying from a pint to a bushel or two, are made from fish skins by some primitive peoples. Nelson describes one made from salmon skin and intended for storing clothing. It is neatly sewed with sinew thread and ornamented with bands of russet-colored fish skins and white parchment-like skin from the throats of seals. The bottom is oval shaped, with the seam inside. The upper border is hemmed, and through a series of rawhide loops, sewed at intervals around the top, passes a cord of the same material for use as a drawstring in closing the bag. These bags are said to be in common use from the Lower Yukon to the Lower Kuskokwim.

INTERNAL MEMBRANOUS TISSUES.

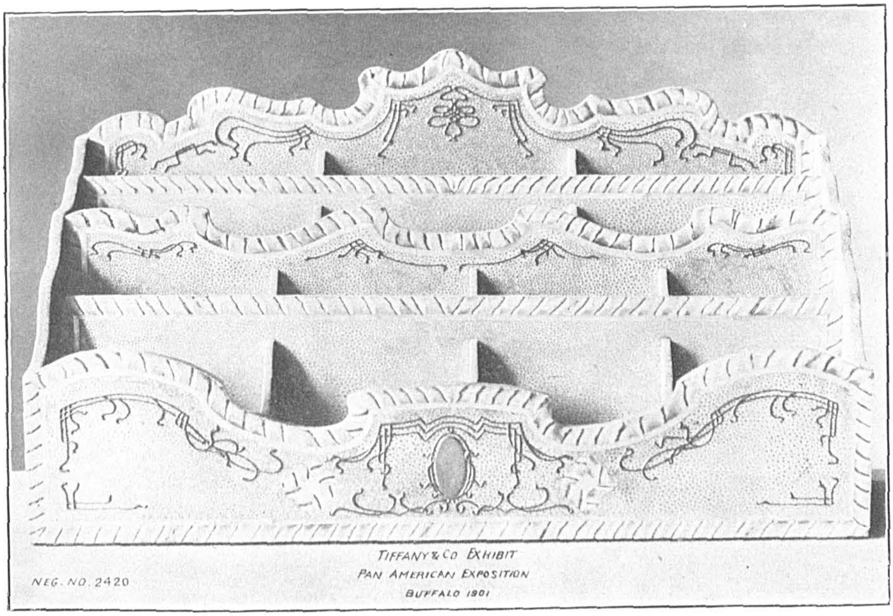
In addition to the skins, certain internal membranous tissues of several aquatic mammals are used for purposes of leather, especially among primitive peoples. Prominent among these are the throat lining, stomach, and intestines of seals, fur-seals, sea-lions, and walrus. The throat linings of all these animals may be made into gloves and similar articles.

The most important use of these membranes is for waterproof over-garments, or kamlaikas, from the intestines of pinnipeds, and especially of the sea-lion. For this purpose the intestines are distended with air, dried, and cut longitudinally, forming a long ribbon 3 or 4 inches wide. A number of these ribbons are neatly sewed together with a close seam in the pattern of a loose shirt, closed behind and before, provided with long sleeves, a hood fastened to the back of the neck for drawing over the head, and drawstrings around the wrists, neck, and bottom. These garments are very durable and are said to possess greater strength than india-rubber garments, are equally water-repellent, and are not affected by grease and oil.

Walrus intestines were used by the Alaskan Eskimo in making sails for their bidarrahs, or family boats. Although its total weight is only about 4 pounds, the sail is remarkably strong and durable.



SECTION OF GAR-FISH SKIN.



LETTER BOX, MOUNTED WITH SHARK SKIN, GAR-FISH SKIN, AND MOTHER-OF-PEARL.

THE COMMON NAMES OF THE BASSES AND SUN-FISHES.

By HUGH M. SMITH.

THE COMMON NAMES OF THE BASSES AND SUN-FISHES.

By Hugh M. Smith.

The strictly American family of fresh-water sun-fishes and basses (*Centrarchidæ*) consists of numerous species, including some of our best-known fresh-water fishes, which are much sought by anglers and contribute largely to the food supply. The family is well represented in nearly all parts of the United States east of the Rocky Mountains, in Canada and Mexico, and one species is found in California.

Some of these fishes are known only to the ichthyologist and have no distinctive names by which the layman may designate them; others can claim only book names which have never come into use and probably never will; and others have received a large number of vernacular names, some general and some local in their application. Some of the popular designations are appropriate and distinctive, but others are misleading, inaccurate, and indefinite, and much confusion has been occasioned thereby in popular literature and in legal papers. This compilation is offered in the belief that a key to the numerous names of these fishes will be useful to fishermen, fish-culturists, and legislators. There is no intention to lay undue stress on the importance of common names; on the contrary, it is thought that the multiplicity of names here shown serves to emphasize the necessity for definiteness which can, in many instances, be secured only through the use of the technical names.

The common names are presented in two lists. In the first an effort is made to bring together, in alphabetical order, all the common names that have been applied to the sun-fishes in the United States and Canada, to show the distribution of these names, and to identify the species to which each common name is given. Practically all the names in print are recorded, together with a number of others reported by correspondents and associates, which have apparently not been printed.

The following explanations of the list are given:

1. The vernacular names are arranged in strict alphabetical order and are recorded in the various forms in which they are spelled or pronounced. The fish may be identified by its vernacular name by noting its technical name, and then, if necessary, referring to the latter in the systematic list of the members of the family.

2. The geographical distribution of the names is indicated as accurately as possible. Names used over a wide area and appearing often in print are marked "general." The absence of locality indicates either a lack of knowledge as to where the name is employed or the appearance of the name only in books.

3. Whenever practicable a reference is given to a published record of the use of the name for the species and region cited. In the case of many names this record was the first known, but for other names, whose earliest application has not been determined, it has been considered sufficient to refer to a standard work. The works are mentioned by numbers, which correspond to a full citation of titles and authors at the end of the paper.

In the case of names which have not before appeared in ichthyological literature or other writings, so far as known, the authority has been indicated by Roman numerals corresponding with those prefixed to the names of the following persons, all connected with the U. S. Fish Commission, who have furnished information: (*i*) Charles G. Atkins, (*ii*) William Barnum, (*iii*) S. P. Bartlett, (*iv*) John N. Cobb, (*v*) T. M. Cogswell, (*vi*) R. E. Coker, (*vii*) S. W. Downing, (*viii*) B. W. Evermann, (*ix*) Waldo F. Hubbard, (*x*) Alexander Jones, (*xi*) W. C. Kendall, (*xii*) E. F. Locke, (*xiii*) W. F. Roberts, (*xiv*) Hugh M. Smith, (*xv*) J. J. Stranahan, (*xvi*) John W. Titcomb, (*xvii*) S. G. Worth.

The second list comprises the scientific and approved vernacular names of the *Centrarchidæ*, and under each species all the common names that have been applied to it.

NOTES AND COMMENTS ON THE COMMON NAMES.

The fertile imagination of Rafinesque induced him to coin many names for the members of this family, and he is responsible for a large proportion of the book names mentioned in the list. More recent writers have, however, contributed a number of such names, as will appear from the list. In some cases, where common names are given without comment in local lists of fishes and in general works, it has not been possible to determine whether they were in actual use or simply supplied by the writers. This compilation is therefore probably subject to correction in a number of such names which could not be corroborated from other sources.

The names "sun-fish," "bream," and "perch" are applied with little discrimination to all the smaller species, more especially those of the genera *Lepomis* and *Eupomotis* in the Southern States. "Bream" is often corrupted to "brim" and "perch" to "peerch" or "pearch." The same names are also given to *Pomoxis*, *Ambloplites*, *Chænobryttus*, and *Centrarchus*, with or without qualifying words.

The name tobacco-box, which is applied to *Eupomotis gibbosus* in Maryland and Virginia, doubtless was based on a real or supposed resemblance in size, form, or color to the old-fashioned pocket receptacles for smoking and chewing tobacco. In regard to another fanciful name of this fish, "Frank Forrester" remarked that "the numerous spots on its body have procured for it the absurd name of pumpkin-seed in many States."

The two members of the genus *Pomoxis* are very similar in appearance and habits, and exist together in many waters. It is, therefore, no wonder that they bear many of the same common names, although each has some particular appellations.

"Strawberry bass and calico bass seem to be very appropriate designations for *Pomoxis sparoides* and have the additional advantage of being already generally in use in a large district." (Goode.) For *Pomoxis annularis*, crappie may be recommended.

The names "campbellite" and "newlight," which appear to have originated in Kentucky and to have spread thence to Indiana and Illinois, are said by Goode (33) to have been given to *P. annularis* "by the irreverent during the great Campbellite movement in the West nearly half a century ago," and Klippart (35) shows the origin of the name in Kentucky by recalling that the fish "appeared in the waters of that State simultaneously with the advent of the disciples of Rev. Alexander Campbell." These names are seldom heard nowadays, but are carried along in the books on fishes and are interesting nomenclatural relics. That they have not entirely died out, however, is shown by the fact that as late as January, 1903, the Fish Commission received from Kentucky an application for "newlights" for stocking a pond, and Dr. S. P. Bartlett, of the U. S. Fish Commission station at Quincy, Ill., reports that he has occasionally heard the name "campbellite" in that State. Klippart attaches these names to *P. sparoides*, but other writers have restricted them to *P. annularis*.

Monsieur Montpetit ("Les poissons d'eau douce du Canada") thus discusses the names crappie and crapet:

> Crapet? Nothing similar exists in any French dictionary to designate a fish. I have reason to believe that the American word crappie is simply a transformation by the ear of the Canadian word *crapet*, which must have been applied to this fish a long time before the colonists of New England could have known it. Whether this fish took the name of *crappie* in the limpid waters of the Great Lakes or in the muddy waters of the mouths of the Mississippi, there is not less reason to believe that this name is only the alteration of the French word *crapet* which was given to it, either in Canada or Louisiana, a century and more before the English had become acquainted with it. *Ah! le crapet!* That is an essentially Canadian expression which we have all heard from the mouth of our mother, when for some teasing trick or mischievous act she threatened us with soft and affectionate blows. *Ah! le crapet!* Which meant: "No matter by what end he is taken, he is always bristling, ready to do us an injury—he is a crapet."

The euphonious French name sac-à-lait (bag of milk) which is heard in the lower Mississippi Valley and now apparently is applied to other centrarchids as well as to *P. annularis*, to which it was originally given, has been corrupted to "suckley perch" in Louisiana near New Orleans. John Demon and shad, names mentioned by Mr. Goode as being applied to the crappie, have not recently been heard, and their geographical distribution is unknown to the compiler. According to Professor Evermann, tin-mouth and paper-mouth are names now often heard in Indiana, the former having reference to the color of the inside of the mouth of the crappie, the latter to the fact that the mouth tears easily when hooked.

Of the numerous names applied to members of the genus *Micropterus*, none is so distinctive as black bass, with the qualifying terms large-mouthed and small-mouthed, and these are the designations which should be generally adopted and adhered to, even though few, if any, specimens are really black.

Mr. Goode (33) recalls that "Charlevoix, a Jesuit missionary who explored Canada in 1721, mentions a fish called *achigan*, which is thought to have been the large-mouth." M. Montpetit, in his "Les poissons d'eau douce du Canada," has adopted achigan as the most appropriate vernacular name and writes as follows regarding it:

In the province of Quebec, in more than one American State, the name achigan will persist and will perhaps finally prevail even on the continent of Europe. By priority, recognized as a principle by the naturalists of Europe and America, it has incontestable titles, since for centuries and centuries, doubtless, before Laudonnière called this fish *salmoides* the aborigines of Canada designated it under the name of achigan. It is a name of terror, the Algonquin name, picked up by Charlevoix and religiously preserved among us. One savant, versed in the savage languages, the Rev. Father Lacomb, O. M. I., has claimed that the word means the fish which disputes, which struggles, which shakes and bungles the line. Those who have seen it at work will admit that that is just its description.

Alphabetical list of the common names of the basses and sun-fishes.

Common name.	Locality.	Reference.	Remarks.	Identification.
Achigan	Canada	9,28	Indian	Micropterus salmoides.
Do.		8,28	do	Micropterus.
Achigan grande bouche		28	Book	Micropterus salmoides.
Achigan noir		28	do	Micropterus.
Achigan petite bouche.		28	do	Micropterus dolomieu.
Bachelor	Iowa	25		Pomoxis sparoides.
Do.	Ohio Valley	8		Pomoxis annularis.
Bachelor perch	Ohio River	14,31		Do.
Banded sun-fish		2	Book	Enneacanthus obesus.
Do.		1	do	Mesogonistius chætodon.
Bank-lick bass	Ohio	21,31		Pomoxis sparoides.
Bar-fish	Lake Michigan; Wis.	8,23		Do.
Bass	General			Micropterus.
Bass hog-fish		31	Book	Micropterus dolomieu (young).
Bass sun-fish		1	do	Acantharchus pomotis.
Bayou bass	Southern States	16		Micropterus salmoides.
Big-ear sun-fish		31	Book	Lepomis megalotis.
Big-fin bass		9		Pomoxis sparoides.
Big-mouth	Upper Miss. Valley.	8		Chænobryttus gulosus.
Big-mouth bass	General			Micropterus salmoides.
Big-mouthed black bass	do	8		Do.
Big-mouthed sun-fish	Kentucky; Ohio?	21,40		Chænobryttus gulosus.
Big-mouthed trout	Kentucky	40		Micropterus salmoides.
Big-nosed sun-fish		23	Book	Apomotis ischyrus.
Bitter-head	Ohio	8,23		Pomoxis sparoides.
Black-banded sun-fish		2	Book	Mesogonistius chætodon.
Black bass	General			Micropterus.
Black bass of the Huron.		15	Book	Micropterus salmoides.
Black crappie	Illinois	2, iii		Pomoxis sparoides.
Black-eared pond-fish		27	Book	Lepomis pallidus.
Do.		30,39	do	Lepomis auritus.
Black-ears	Ohio Valley	31		Lepomis megalotis.
Black-eyes	do	31		Lepomis cyanellus.
Black-eye sun-fish		31	Book	Do.
Black fresh-water bass.		6	do	Micropterus dolomieu.
Black huron		6	do	Micropterus salmoides.
Black perch	Ohio Valley; Miss.; Tenn.	9,31, viii		Micropterus dolomieu.
Black sun-fish	Miss.?	11,17	Book?	Chænobryttus gulosus.
Do.	Ohio	21,37		Ambloplites rupestris.
Black-tailed sun-fish	Ohio Valley	31		Lepomis megalotis.
Black warmouth		9	Book	Chænobryttus gulosus.
Bloody sun-fish		23	do	Lepomis megalotis.

Alphabetical list of the common names of the basses and sun-fishes—Continued.

Common name.	Locality.	Reference.	Remarks.	Identification.
Blue-and-green sun-fish		23	Book	Lepomis cyanellus.
Blue bass	Ohio Valley	31		Do.
Blue bream	General	8		Lepomis pallidus.
Blue-fish	Ohio Valley	31		Lepomis cyanellus.
Blue-gill (or blue-gills)	Maumee River, O.; Mich.	20, 26		Lepomis pallidus.
Blue-gilled bream	Mich	3		Do.
Blue Joe	N. C	36		Do.
Blue-mouthed sun-fish		11	Book	Do.
Blue perch	N. C	10, 36		Do.
Blue sun-fish	General	8		Do.
Do	Ohio	31		Lepomis cyanellus.
Blue-spotted sun-fish		7, 11, 40	Book	Do.
Do		2		Enneacanthus simulans et gloriosus.
Bream	Maine; Mass	30, xi		Eupomotis gibbosus.
Do	Maine	xi		Lepomis auritus.
Do	Southern Atlantic States.	35		Ambloplites rupestris.
Do	do	35		Chænobryttus gulosus.
Do	do	35		Lepomis auritus.
Do	do	35		Eupomotis gibbosus.
Do	Southern States; general.	8		Lepomis, Eupomotis, etc.
Brême	Quebec	28	French	Ambloplites rupestris.
Bride perch	Ohio	31		Micropterus salmoides.
Bridge perch		9		Pomoxis annularis.
Brilliant sun-fish		21	Book	Lepomis megalotis.
Brim (see Bream)	General, South		Corruption	Lepomis, Eupomotis, etc.
Bronze-backer		9		Micropterus dolomieu.
Bronzed centrarchus		32	Book	Ambloplites rupestris.
Brown bass	Ohio Valley	31		Micropterus dolomieu.
Brown river-bass		31	Book	Do.
Brown trout	Ohio Valley	31		Do.
Buffalo bass	Mich	3		Chænobryttus gulosus.
Buffalo sun-fish	do	3		Lepomis cyanellus.
Butter-fish	Illinois	iii		Pomoxis sparoides.
Calico bass	General	8		Do.
Calico bream	S. C	35		Do.
Campbellite	Ky	23		Pomoxis sparoides?
Do	Ky.; Ind.; Ill	8		Pomoxis annularis.
Chain-sided sun-fish		17	Book	Lepomis macrocheirus.
Chain side		5	do	Do.
Chinquapin perch	Fla	35		Lepomis punctatus.
Do	Lower Miss. Valley	8		Pomoxis annularis.
Do	N. C	10		Pomoxis sparoides.
Chub	do	36		Chænobryttus gulosus.
Do	N. C.; Va	1, 36, xiv		Micropterus salmoides.
Chub robin	N. C	34		Eupomotis gibbosus?
Common bass		31	Book	Micropterus salmoides.
Common sun-fish			do	Eupomotis gibbosus, Lepomis megalotis.
Copper-headed bream	Fla	35		Lepomis pallidus.
Copper-nosed bream	General	8		Do.
Cow bass	Ind	viii		Micropterus salmoides.
Crapet			French	Pomoxis, etc.
Crapet calicot		28	do	Pomoxis sparoides.
Crapet jaune		28	Book	Eupomotis gibbosus.
Crapet mondoux		28	do	Ambloplites rupestris.
Crapet noir	Montreal	28	French	Do.
Crapet vert		28	Book	Do.
Crappie	General	8		Pomoxis annularis.
Do	N. C.; general	8, 10		Pomoxis sparoides.
Crappy (see Crappie)				
Cropple (see Crappie)				
Do	Mo			Ambloplites rupestris.
Croppy (see Crappie)				
Dollardee	Ky	8		Lepomis pallidus.
Dolly Varden	Ill	iii		Pomoxis sparoides.
Dotted painted-tail		31	Book	Micropterus salmoides.
Dwarf bass		21	do	Micropterus dolomieu.
Eared sun-fish		31	do	Lepomis megalotis.
Female perch	Mo	19		Eupomotis gibbosus.
Flat-fish	Me.; Mass	30, xi		Do.
Do	Me	xi		Lepomis auritus.
Flier (or flyer)	N. C	18, 36		Centrarchus macropterus.
Flounder	Me	xi		Lepomis auritus.
Do	do	xi		Eupomotis gibbosus.
Flying perch	N. C	vi		Centrarchus macropterus.
Fresh-water bass		6	Book	Ambloplites rupestris.
Fresh-water perch		4		Eupomotis gibbosus.
Fresh-water sun-fish		39	Book	Lepomis auritus.

Alphabetical list of the common names of the basses and sun-fishes—Continued.

Common name.	Locality.	Reference.	Remarks.	Identification.
Fresh-water trout	S. C.; Ga.; Fla	35		Micropterus salmoides.
Gilded sun-fish		21, 23 31, 37	Book	Lepomis macrocheirus.
Goggle-eye	General in West	8		Ambloplites rupestris.
Do	General; N. C.; Tex.	7, 8, 35		Chænobryttus gulosus.
Do	Southern States	8		Pomoxis sparoides.
Do		9		Pomoxis annularis.
Goggle-eyed bass	Ohio	21, 37	Book	Ambloplites rupestris.
Goggle-eyed perch	Southern States	8		Pomoxis sparoides.
Do	La	xii		Lepomis auritus ?
Gold bass	Ohio Valley	31		Micropterus dolomieu.
Gold-fish	Ohio, etc	31		Lepomis macrocheirus.
Gold ring	Ohio Valley	31		Pomoxis annularis.
Gold-ring pomoxis		31	Book	Do.
Grass bass	Ind.; Minn	viii, xiii		Micropterus salmoides.
Do	Lake Erie; Ohio; Ill.; Miss. Valley.	2, 8, 21 iii		Pomoxis sparoides.
Gray bass	Mich	3		Micropterus salmoides.
Green bass	Mich.; Ohio River	3, 14		Do.
Do	Ky	40		Micropterus dolomieu.
Green perch		9		Micropterus sp.
Green sun-fish	General	8		Lepomis cyanellus.
Green trout	La	xii, xiv		Micropterus salmoides.
Do	Ky	40		Micropterus dolomieu.
Growler		6	Obsolete	Micropterus salmoides.
Harlequin roach		21	Book	Eupomotis gibbosus.
Hog bass	Ohio Valley	31		Micropterus dolomieu (young).
Huron		32	Book	Micropterus salmoides.
John Demon		9		Pomoxis annularis.
Jug-mouth	N. C	xvii		Chænobryttus gulosus.
Jumper	Southern States	8		Micropterus salmoides et dolomieu.
Kiver	N. H	ix		Lepomis auritus.
Do	Me	xi		Eupomotis gibbosus.
Lake bass	Ohio ?	2, 17	Book	Ambloplites rupestris.
Do	Ohio	23		Micropterus salmoides.
Do	Great Lakes ?	2		Pomoxis sparoides.
Lake crappie	do. ?	2		Do.
Lake Erie bass	Pa.; Ohio	2, 23		Do.
Lake Huron black bass		33	Book	Micropterus salmoides.
Lamplighter	Ohio	8, 23		Pomoxis sparoides.
Large-finned bass		17	Book	Centrarchus macropterus.
Large-mouthed bass	General			Micropterus salmoides.
Large-mouthed black bass	do			Do.
Large-scaled sun-fish		23	Book	Lepomis megalotis.
Leather-ear	N. C	36		Lepomis auritus.
Leather-wing	do	10		Do.
Little bass	Ohio Valley	31		Micropterus dolomieu (young).
Little bream		13	Book	Enneacanthus obesus.
Little red-eye			do	Lepomis cyanellus.
Little sun-fish			do	Enneacanthus.
Long-eared sun-fish		17	do	Lepomis megalotis.
Do		1	do	Lepomis auritus.
Long-finned sun-fish		11	do	Centrarchus macropterus.
Many-spined sun-fish		23	do	Do.
Marsh bass	Ohio	23		Micropterus salmoides.
Mill-pond chub	Va	xiv		Do.
Mill-pond flier	N. C	11		Pomoxis sparoides.
Mill-pond perch	do	36		Centrarchus macropterus.
Minny bass	Ohio Valley	31		Micropterus dolomieu (young).
More-mouth bream	S. C	35	Corruption	Chænobryttus gulosus.
Moss bass	Ind	8		Micropterus salmoides.
Mountain trout	Ala	8		Micropterus dolomieu.
Mud bass	Ind	viii		Micropterus salmoides.
Do		8		Acantharchus pomotis.
Mud chub	N. C	36		Chænobryttus gulosus.
Mud perch	do	18, 35		Acantharchus pomotis.
Mud sun-fish		2, 5	Book ?	Do.
New Light	Ky	23		Pomoxis sparoides ?
New Light	Ky.; Ind.; Ill	8		Pomoxis annularis.
Northern crappie		12	Book	Pomoxis sparoides.
Northern pomotis		32	do	Eupomotis gibbosus.
Obscure fresh-water bass		6	do	Micropterus dolomieu.
Orange-spotted sun-fish		17	do	Lepomis humilis.
Oswego bass	Great Lakes; New York.	8		Micropterus salmoides.

Alphabetical list of the common names of the basses and sun-fishes—Continued.

Common name.	Locality.	Reference.	Remarks.	Identification.
Painted-tail	Ohio	31		Micropterus salmoides.
Pale crappie	Ill	iii		Pomoxis annularis.
Pale river-bass		31	Book	Micropterus salmoides.
Pallid sun-fish		23	do	Eupomotis pallidus.
Paper-mouth	Ind	viii		Pomoxis annularis.
Pearch or peerch	Southern States		Corruption	Lepomis, Eupomotis, etc.
Perch	General	8		Do.
Do		9		Centrarchus macropterus.
Do	Southern States	9		Micropterus salmoides et dolomieu.
Do	do			Chænobryttus gulosus.
Do	Cal	8		Archoplites interruptus.
Perch-mouth bream	Florida	xi		Chænobryttus gulosus.
Pond perch		38	Book	Eupomotis gibbosus.
Do	Ohio	29		Micropterus salmoides.
Pumpkin-seed	New England and Middle States.	8, 30, 38		Eupomotis gibbosus.
Quiver	Maine	i		Lepomis auritus.
Do	do	i		Eupomotis gibbosus.
Razor-back		9		Pomoxis sparoides.
Red-bellied bream	N. C	9, 35		Lepomis auritus.
Do		17	Book	Lepomis megalotis.
Red-bellied perch	South Atlantic States.	9, 35		Lepomis auritus.
Do	Ga	35		Lepomis megalotis.
Red-bellied robin perch	N. C	10		Lepomis auritus.
Red-belly	do	36		Do.
Do	do	36		Eupomotis gibbosus.
Do	Ohio Valley	31		Lepomis megalotis.
Red breast		9		Lepomis auritus.
Red-eye	General	8		Ambloplites rupestris.
Do	do	8		Chænobryttus gulosus.
Do	Illinois	2, 17		Lepomis cyanellus.
Do	N. C	10		Micropterus dolomieu.
Red-eyed bream	South Atlantic States.	35		Ambloplites rupestris.
Do	Iowa; Ark.; Ohio?	17, 24, 25	Book?	Chænobryttus gulosus.
Red-eyed perch	General			Ambloplites rupestris.
Red-eyed sun-fish		21	Book	Lepomis megalotis.
Do		31	do	Ambloplites rupestris.
Red-headed bream	Pa	2, 9		Lepomis auritus.
Red perch	Tex	7		Lepomis miniatus.
Do	Georgia	xv		Lepomis auritus.
Red-spotted sun-fish	Miss.; Ark.; Iowa?	11, 25	Book?	Lepomis humilis.
Red sun-fish	Me	xi		Lepomis auritus.
Red-tailed bream		2		Do.
Red-tailed pomotis		38	Book	Do.
River bass		2, 9		Micropterus salmoides.
Do		34		Micropterus dolomieu.
River crappie	Ill	iii		Pomoxis annularis.
Roach	Me	xi		Lepomis auritus.
Do	Ohio; Me	21, xi		Eupomotis gibbosus.
Do	Ohio	21		Pomoxis sparoides.
Robin	N. C	35		Lepomis auritus.
Do	do	36		Eupomotis gibbosus.
Robin perch	do	35		Lepomis auritus.
Do	Va.; N. C	35, 36, xiv		Eupomotis gibbosus.
Rock bass	General	28		Ambloplites rupestris.
Do		9		Micropterus sp.
Rock-fish		22	Book	Pomoxis sparoides.
Round bass		16	do	Centrarchus.
Round sun-fish		16	do	Centrarchus macropterus.
Ruff	Mass	30, 38		Eupomotis gibbosus.
Sac-à-lait (lai)	Lower Miss. Valley.	8		Pomoxis annularis.
Sac-à-lait	La	xii		Chænobryttus gulosus?
Do	do	xii		Centrarchus macropterus?
Do	Texas	7		Pomoxis sparoides.
Do	do	7		Pomoxis annularis.
Sacramento perch			Book	Archoplites interruptus.
Salmon-formed grower.		15	do	Micropterus salmoides.
Sand perch	N. C	18, 35		Eupomotis gibbosus.
Do		2		Pomoxis sparoides.
Shad		9		Pomoxis annularis.
Shell-cracker	Florida	xi		Eupomotis holbrooki.
Shining bass		17	Book	Centrarchus macropterus.
Silver bass	Ill	9, iii		Pomoxis sparoides.
Silver perch	Ohio Valley	31		Pomoxis annularis.
Do	N. C	10		Pomoxis sparoides.
Slough bass		9		Micropterus salmoides.

Alphabetical list of the common names of the basses and sun-fishes—Continued.

Common name.	Locality.	Reference.	Remarks.	Identification.
Small green sun-fish		23	Book	Lepomis megalotis.
Small-mouthed bass	General			Micropterus dolomieu.
Small-mouthed black bass.	do			Do.
Southern chub		34	Book	Micropterus salmoides.
Southern crappie		12	do	Pomoxis annularis.
Speckled bass	Mich	3		Pomoxis sparoides.
Speckled hen	Canada	9, 34		Micropterus sp.
Speckled perch	N. C	10, 35, 36		Pomoxis sparoides.
	Fla.; Ark.; Ga	v, xv		
Do		2		Pomoxis annularis.
Spotted bass		9, 34		Micropterus sp.
Spotted bream		13		Lepomis punctatus.
Spotted perch	Florida	xi		Pomoxis sparoides.
Spotted river bass		31	Book	Micropterus dolomieu.
Spotted trout	Ga	35		Pomoxis sparoides.
Straw bass	Mich.; Ind	26, viii		Micropterus salmoides.
Do	Ohio	vii		Pomoxis sparoides.
Strawberry bass	General	8		Do.
Strawbery perch		2		Pomoxis sparoides et annularis.
Streaked-cheeks river-bass.		31	Book	Micropterus dolomieu.
Streaked-head	Ohio Valley	31	Book	Do.
Striped bass	Chautauqua Lake, N. Y.	viii		Micropterus salmoides.
Suckley perch	La		Cor. Sac-à-lait	Pomoxis annularis.
Sun bass	N. Y	ii		Eupomotis gibbosus.
Sun-fish		31	Book?	Ambloplites rupestris.
Do	N. C.; Southern States.	35, 36		Centrarchus macropterus.
Do		8		Chænobryttus gulosus.
Do	General			Lepomis, Eupomotis, etc.
Sun-fish bass	Kentucky River	31		Ambloplites rupestris.
Sun-fish river-bass		31	Book	Do.
Sunny	N. Y.; N. Eng	8		Eupomotis gibbosus.
Sun perch	Miss	11		Lepomis megalotis.
Do	Tenn	x		Ambloplites rupestris.
Do	Pa	2, 9		Lepomis auritus.
Do	Ga	xv		Pomoxis sparoides.
Sun trout	Ga	35		Chænobryttus gulosus.
Swago	N. Y.; Vt	iv, xvi	Cor. Oswego	Micropterus dolomieu.
Swago bass	do	iv, xvi	do	Do.
Swego	do	iv, xvi	do	Do.
Swego bass	do	iv, xvi	do	Do.
Timber croppie		2		Pomoxis annularis.
Tin-mouth	Ill	2, iii		Pomoxis sparoides.
Do	Ohio Valley; Ind	12, viii		Pomoxis annularis.
Tin perch		2		Do.
Tobacco-box	Md.; Va.; D. C	8		Eupomotis gibbosus.
Trout	Southern States	8		Micropterus salmoides et dolomieu.
Trout bass	Ohio Valley	31		Micropterus dolomieu.
Trout perch	Ohio Valley, Southern States.	2, 31		Do.
Trout river-bass		31	Book	Do.
Warm-mouth perch	Ga	35	Cor. Warmouth.	Chænobryttus gulosus.
Warmouth	General	8		Do.
Warmouth bream	Fla	13		Do.
Warmouth perch	S. C.; Ga.; Fla	35		Do.
Welshman	N. C.; Va	8, 10, 36		Micropterus salmoides.
White bass		9, 34		Do.
Do	Ohio Valley	31		Ambloplites rupestris.
White croppie		2, iii		Pomoxis annularis.
White perch	Ohio River	14		Do.
Do	Ga	xv		Pomoxis sparoides.
White salmon	Va	6	Obsolete	Micropterus salmoides.
White trout	Miss			Do.
Do	Ohio Valley	31		Micropterus dolomieu.
Wide-mouth sun-fish		17	Book	Chænobryttus gulosus.
Yaw-mouth perch	Ga	35		Do.
Yellow bass	Ohio Valley, Chautauqua Lake, N. Y.	14, viii		Micropterus dolomieu.
Do	Ohio Valley	31, 34		Micropterus salmoides.
Yellow-belly	Va.; N. C	18, 36		Lepomis auritus.
Do	N. C	36		Eupomotis gibbosus.
Yellow bream		13	Book	Lepomis holbrooki.
Yellow perch	Me.; Ga	xi, xv		Lepomis auritus.
Do	Mo	xi		Eupomotis gibbosus.
Do	Ohio Valley	9, 31		Micropterus dolomieu.
Yellow pond perch		29	Book	Micropterus salmoides.

Systematic list of the basses and sun-fishes, with the common names applied to each species shown thereunder.[a]

1. Pomoxis sparoides (Lacépède). *Strawberry Bass; Calico Bass.*

Bachelor.	Crappie.	Mill-pond flier.	Speckled bass.
Bank-lick bass.	Crappy.	New Light (?).	Speckled perch.
Bar-fish.	Dolly Varden.	Northern crappie.	Spotted perch.
Bitter-head.	Goggle-eye.	Razor-back.	Spotted trout.
Black crappie.	Goggle-eyed perch.	Roach.	Straw bass.
Calico bass.	Grass bass.	Rock-fish.	Strawberry bass.
Calico bream.	Lake bass.	Sac-à-lait.	Strawberry perch.
Campbellite (?).	Lake crappie.	Sand perch.	Sun perch.
Chinquapin perch.	Lake Erie bass.	Silver bass.	Tin-mouth.
Crapet.	Lamplighter.	Silver perch.	White perch.
Crapet calicot.			

2. Pomoxis annularis Rafinesque. *Crappie.*

Bachelor.	Crappy.	Paper-mouth.	Strawberry perch.
Bachelor perch.	Goggle-eye.	River crappie.	Suckley perch.
Bridge perch.	Gold-ring.	Sac-à-lait.	Timber croppie.
Calico bass (?).	Gold-ring pomoxis.	Shad.	Tin-mouth.
Campbellite.	John Demon.	Silver perch.	Tin perch.
Chinquapin perch.	New Light.	Southern crappie.	White crappie.
Crapet.	Pale crappie.	Speckled perch.	White perch.
Crappie.			

3. Centrarchus macropterus (Lacépède). *Flier; Round Sun-fish.*

Flier (or flyer).	Long-finned sun-fish.	Perch.	Sac-à-lait.
Flying perch.	Many-spined sun-fish.	Round bass.	Shining bass.
Large-finned bass.	Mill-pond perch.	Round sun-fish.	Sun-fish.

4. Acantharchus pomotis (Baird). *Mud Sun-fish.*

Bass sun-fish.	Mud bass.	Mud perch.	Mud sun-fish.

5. Ambloplites rupestris (Rafinesque). *Rock Bass.*

Black sun-fish.	Crapet vert.	Red-eye.	Sun-fish bass.
Bream (Brim).	Croppie.	Red-eyed bream.	Sun-fish river-bass.
Brême.	Fresh-water bass.	Red-eyed perch.	Sun perch.
Bronzed centrarchus.	Goggle-eye.	Red-eyed sun-fish.	White bass.
Crapet mondoux.	Goggle-eyed bass.	Rock bass.	
Crapet noir.	Lake bass.	Sun-fish.	

6. Archoplites interruptus (Girard). *Sacramento Perch.*

Perch.	Sacramento perch.

7. Chænobryttus gulosus (Cuvier & Valenciennes). *Warmouth.*

Big-mouth.	Chub.	Perch-mouth bream.	Warm-mouth perch.
Big-mouthed sun-fish.	Goggle-eye.	Red-eye.	Warmouth.
Black sun-fish.	Jug-mouth.	Red-eyed bream.	Warmouth bream.
Black warmouth.	More-mouth bream.	Sac-à-lait.	Warmouth perch.
Bream.	Mud chub.	Sun-fish.	Wide-mouthed sun-fish.
Buffalo bass.	Perch.	Sun trout.	Yaw-mouth perch.

8. Enneacanthus obesus (Baird).

Banded sun-fish.	Little bream.	Little sun-fish.

9. Enneacanthus gloriosus (Holbrook).

Blue-spotted sun-fish.	Little sun-fish.

10. Mesogonistius chætodon (Baird). *Banded Sun-fish.*

Banded sun-fish.	Black-banded sun-fish.

[a] There are 8 or 10 other species of sun-fishes to which no common names have been given.

Systematic list of the basses and sun-fishes, with the common names applied to each species shown thereunder—Continued.

11. Apomotis punctatus (Cuvier & Valenciennes). *Chinquapin Perch.*

Bream (Brim).	Chinquapin perch.	Spotted bream.

12. Apomotis cyanellus (Rafinesque). *Green Sun-fish.*

Black-eyes.	Blue bass.	Bream (Brim).	Perch, pearch, or peerch.
Black-eye sun-fish.	Blue-fish.	Buffalo sun-fish.	Red-eye.
Blue-and-green sun-fish.	Blue sun-fish.	Green sun-fish.	Sun-fish.
	Blue-spotted sun-fish.	Little red-eye.	

13. Apomotis ischyrus (Jordan & Nelson).

Big-nosed sun-fish.

14. Lepomis auritus (Linnæus).

Black-eared pond-fish.	Leather-wing.	Red-bellied robin perch.	Roach.
Bream (Brim).	Long-eared sun-fish.	Red-breast.	Robin.
Flat-fish.	Perch, pearch, or peerch.	Red-headed bream.	Robin perch.
Flounder.	Quiver.	Red perch.	Sun-fish.
Fresh-water sun-fish.	Red-belly.	Red sun-fish.	Sun perch.
Goggle-eyed perch (?).	Red-bellied bream.	Red-tailed bream.	Yellow-belly.
Kiver.	Red-bellied perch.	Red-tailed pomotis.	Yellow perch.
Leather-ear.			

15. Lepomis miniatus Jordan.

Red perch.

16. Lepomis megalotis (Rafinesque). *Long-eared Sun-fish.*

Big-ear sun-fish.	Brilliant sun-fish.	Perch, pearch, or peerch.	Sun-fish.
Black ears.	Common sun-fish.	Red-bellied bream.	Sun perch.
Black-tailed sun-fish.	Eared sun-fish.	Red-belly.	
Bloody sun-fish.	Large-scaled sun-fish.	Red-eyed sun-fish.	
Bream (Brim).	Long-eared sun-fish.	Small green sun-fish.	

17. Lepomis humilis (Girard). *Red-spotted Sun-fish.*

Bream (Brim).	Perch, pearch, or peerch.	Red-spotted sun-fish.	Sun-fish.
Orange-spotted sun-fish.			

18. Lepomis macrocheirus Rafinesque.

Bream (Brim).	Chain-side.	Gold-fish.	Sun-fish.
Chain-sided sun-fish.	Gilded sun-fish.	Perch, pearch, or peerch.	

19. Lepomis pallidus (Mitchill). *Blue-gill; Blue sun-fish.*

Black-eared pond-fish.	Blue joe.	Bream (Brim).	Perch, pearch, peerch.
Blue bream.	Blue-mouthed sun-fish.	Copper-headed bream.	Sun-fish.
Blue-gill (or Blue-gills).	Blue perch.	Copper-nosed bream.	
Blue-gilled bream.	Blue sun-fish.	Dollardee.	

20. Eupomotis gibbosus (Linnæus). *Pumpkin-seed; Tobacco-box.*

Bream (Brim).	Fresh-water perch.	Quiver.	Sun bass.
Chub robin (?).	Harlequin roach.	Red-belly.	Sun-fish.
Common sun-fish.	Kiver.	Roach.	Sunny.
Crapet jaune.	Northern pomotis.	Robin.	Tobacco-box.
Female perch.	Perch, pearch, peerch.	Robin-perch.	Yellow-belly.
Flat-fish.	Pond perch.	Ruff.	Yellow perch.
Flounder.	Pumpkin-seed.	Sand perch.	

21. Eupomotis holbrooki (Cuvier & Valenciennes).

Yellow bream.	Shell-cracker.

Systematic list of the basses and sun-fishes, with the common names applied to each species shown thereunder—Continued.

22. Micropterus salmoides (Lacépède). *Large-mouthed black bass.*

Achigan.
Achigan grandebouche.
Achigan noir.
Bass.
Bayou bass.
Big-mouthed bass.
Big-mouthed black bass.
Big-mouthed trout.
Black bass of the Huron.
Black Huron.
Bride perch.
Chub.
Common bass.
Cow bass.
Dotted painted-tail.
Fresh-water trout.
Grass bass.
Gray bass.
Green bass.
Green perch.
Green trout.
Growler.
Huron.
Jumper.
Lake bass.
Lake Huron black bass.
Large-mouthed bass.
Large-mouthed black bass.
Marsh bass.
Mill-pond chub.
Moss bass.
Mud bass.
Oswego bass.
Painted-tail.
Pale river bass.
Perch.
Pond perch.
River bass.
Rock bass.
Salmon-formed growler.
Slough bass.
Southern chub.
Speckled hen.
Spotted bass.
Straw bass.
Striped bass.
Trout.
Welshman.
White bass.
White salmon.
White trout.
Yellow bass.
Yellow pond-perch.

23. Micropterus dolomieu Lacépède. *Small-mouthed black bass.*

Achigan.
Achigan noir.
Achigan petite bouche.
Bass.
Bass hog-fish.
Black bass.
Black fresh-water bass.
Black perch.
Bronze-backer.
Brown bass.
Brown river bass.
Brown trout.
Dwarf bass.
Gold bass.
Green bass.
Green perch.
Green trout.
Hog bass.
Jumper.
Little bass.
Minny bass.
Mountain trout.
Obscure fresh-water bass.
Perch,
Red-eye.
River bass.
Rock bass.
Small-mouthed bass.
Small-mouthed black bass.
Speckled hen.
Spotted bass.
Spotted river bass.
Streaked-cheeks river bass.
Streaked-head.
Swago.
Swago bass.
Swego.
Swego bass.
Trout.
Trout bass.
Trout perch.
Trout river bass.
White trout.
Yellow bass.
Yellow perch.

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THE FISHERIES AND FISH TRADE OF PORTO RICO IN 1902.

By W. A. WILCOX,
Agent of the United States Fish Commission.

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INTRODUCTION.

During the winter of 1898–99, soon after the occupation of Porto Rico by the United States Government, an investigation of the fishery resources and fishery business of that island was made by the United States Commission of Fisheries. Four years having elapsed since the change from Spanish to United States rule, it was thought desirable to revisit the island and make a canvass of the fisheries, with special reference to the present conditions, the amount of capital invested, apparatus used, amount and value of products, and number of fishermen; also the amount and value of fishery products imported during the past four years. The results of this canvass, which was made by the writer in January, February, and March, 1903, are here presented. The statistical and general information pertain to the calendar year 1902 unless otherwise stated.

For courtesies and assistance rendered acknowledgments are given to the following persons: Hon. Charles Hartzell, secretary of state; Hon. James S. Harlan, judge-advocate; Hon. John R. Garrison, auditor; Hon. A. R. Cruzen, collector of customs and deputies; F. D. Griffith, of the auditor's office; Messrs. Fritze Lundt & Co., of San Juan and Mayaguez; and the French Transatlantic Steamship Company.

IMPORTATIONS OF FISHERY PRODUCTS.

Porto Rico is divided into seven districts, the population of each, by the census of 1899, being as follows:

Aguadilla	99,645
Arecibo	162,308
Bayamon	160,046
Guyama	111,986
Humacao	88,501
Mayaguez	127,566
Ponce	203,191
Total	953,243

The values of fishery products imported into Porto Rico during the past ten years, with the duties paid, are shown in the following table. The amounts given for 1899 to 1902 are in United States money, but for 1893 to 1897 are in the fluctuating Spanish currency, which averaged in value about 60 cents on the dollar:

Year.	Pounds.	Value.	Duty.	Year.	Pounds.	Value.	Duty.
1893	21,901,407	$1,325,070	$87,677	1898[a]			
1894	26,046,061	1,649,601	94,834	1899	17,867,619	$634,559	$43,246
1895	30,339,922	1,987,676	122,087	1900	11,934,589	397,548	38,869
1896	29,128,693	1,815,010	117,497	1901	14,145,017	537,645	80,993
1897	34,165,983	2,123,931	139,661	1902	16,757,923	641,409	97,914

[a] Data for 1898 are not attainable, on account of the war.

This table shows a large decrease in the importations of fishery products during the past four years. This is partly, perhaps chiefly, accounted for by the great destruction of property and loss of life caused by the hurricane of August 8, 1899. The coffee districts of the western and southern parts of the island, which are the largest consumers of imported fishery products, were the heaviest sufferers from the hurricane. Under the most favorable conditions recovery from such disaster is necessarily slow, as several years are required for the planting and maturing of coffee trees. The very low prices for coffee discouraged planters and prevented capitalists from advancing financial aid to the impoverished native coffee-planters. In the opinion of some the generally improved conditions in the island have enabled the people to buy better food, hence the decrease in importations of dried fish. Labor of all kinds, city and country, has been in steady demand at increased wages over those received under Spanish rule. With increased incomes a more varied food is said to be in demand at the expense of fish products, which for many years furnished so important a part of the diet of the natives. The decrease in fishery imports has probably been in part from both causes. As time restores the devastated sections to normal conditions, with continued prosperity, the demand for fish products may equal that of former years.

Trade conditions in receiving and handling fish products show few changes. Of the imports 90 per cent are dry fish and 10 per cent pickled, smoked, and canned. The proportion of dry fish is about 90 per cent cod, 7 per cent haddock, and 3 per cent hake. Boneless fish have been received in small shipments. Besides being more expensive, these products have usually been imperfectly cured, and are therefore not received with favor, and future shipments are not encouraged.

Canned sardines from Europe are quite largely used, the imports in 1902 being valued at $12,094, while those from the United States amounted to only $2,185.

All dry fish intended for this market should be thoroughly and well cured and dried. The best keeping season is said to be January, February, and March. The largest demand for dry and pickled fish is from October to February, inclusive.

Since the occupation of the island by the United States several of the custom-houses under Spanish rule have been discontinued. At present the chief office remains at San Juan. Mr. A. R. Cruzen is collector of customs for the entire island, with branch offices in charge of deputy collectors at the following ports: Ponce, Mayagüez, Arecibo, Aguadilla, Arroyo, Humacao, and Fajardo. The fishery imports at San Juan, Ponce, and Mayagüez will be referred to in some detail. The five remaining ports of entry, with several ports of less size and note, are quite large receivers of fish, most of which is drawn from the three first-mentioned, very few goods being imported direct.

A large amount of fish donated as relief supplies for sufferers by the hurricane of 1899 was admitted duty free during 1899 and 1900.

Since July 1, 1901, all fishery products from the United States (except bonded imported fish) have been admitted free of duty, those from foreign countries being subject to the following duties:

Duties on fishery products. (Approved May 28, 1902; revised to July 1, 1902.)

Duty free: Lobsters, canned or uncanned, shrimp and other shellfish, and turtles.

Dutiable: Anchovies, sardines, sprats, brislings, sardells or sardellen, packed in oil or otherwise. In bottles, jars, tin boxes or cans, containing 7½ cubic inches or less, 1½ cents per package; containing more than 7½ cubic inches and no more than 21 cubic inches, 2½ cents per package; containing more than 33 and not more than 70 cubic inches, 10 cents per package.

Fish (except shellfish) in tin packages or packages containing less than one-half barrel: Herring, mackerel, salmon, and other fish, 30 per cent; caviar, 20 per cent.

	Cents per lb.		Cents per lb.
Cod, haddock, hake, and pollock: Dried, smoked, salted, or pickled, fresh frozen or packed in ice	¾	Mackerel, fresh, pickled, or salted	1
Halibut, fresh, pickled, or salted	1	Salmon, fresh, pickled, or salted	1
Halibut, dried or smoked	¾	Alewives, smoked or salted	¾
Herring, dried or smoked	¾	Other fish, dried or smoked, pickled or salted, fresh frozen or packed in ice	¾
Herring, pickled or salted	½	Fresh-water fish, not specially provided for	¼
Herring, fresh	¼	Fish, skinned or boned	1½

SAN JUAN.

San Juan, the capital city, is credited by the last census with 19,487 population, the district of San Juan having 32,048. The city is one of the leading ports of entry for fishery products, a large portion of which on arrival are at once reshipped on local steamers or by sail to the numerous seaports of the island to which they are consigned. Several commission houses are large receivers of fishery products, the business in 1902, as compared with 1897, the last year of Spanish rule, showing an increase of 567,416 pounds and a decrease in value of $75,853, the decrease in value being chiefly due to the change from Spanish silver to United States money.

The fishery importations for 1897 and 1902, were as follows:

From—	1897.		1902.	
	Lbs.	Value.	Lbs.	Value.
British North American provinces	4,929,328	$290,588	3,328,959	$116,178
United States	270,955	15,458	2,377,801	103,163
Spain	4,863	287	56,380	9,956
France			4,850	865
Germany			4,572	318
Total	5,205,146	306,333	5,772,562	230,480

MAYAGÜEZ.

The city of Mayagüez ranks third, with a population of 15,187. The district of Mayagüez has a population of 127,566. This district suffered severely from the hurricane of 1899. The importations of fishery products received at this port in 1897 and 1902 were as follows:

Country from which exported.	1897.		1902.	
	Lbs.	Value.	Lbs.	Value.
British North American provinces	4,929,328	$290,588	947,560	$32,418
United States	270,955	15,458	420,192	16,199
Spain	4,863	287	125	24
France	....	....	550	132
Total	5,205,146	306,333	1,368,427	48,773

Besides the direct imports here shown, quite a large amount of fishery products from the United States was received in 1902 by local steamers from San Juan.

The fishery products are handled by Fritze Lundt & Co., Morales, Gonzales & Co., Sabater & Co., and Bravo & Co. The wholesale prices of fish at the date visited, February 16, 1903, were as follows: Codfish, 5¼ cents per pound; haddock, 4¼; hake, 3; pollock, 3; split herring, $6 per barrel; smoked herring, 20 cents a box.

Average wholesale values per pound of dry cod at Mayagüez (expressed in cents).

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899	4¾	5⅛	4⅜	4⅜	5	5⅛	5⅛	4¾	5⅛	5¼	4¼	4⅜
1900	4⅞	4⅞	4¼	4¼	4	4¼	4¼	4¼	4⅛	5⅓	6⅜	5¾
1901	4⅛	6¼	6⅛	5⅛	5⅛	6⅛	6	6¼	6⅛	5¼	5¼	5⅛
1902	5	5⅜	5	5	4⅜	4¾	4¾	4¾	5⅛	6	4⅓	5

Hake, haddock, and pollock meet with only a small demand; split herring in moderate request; round herring, alewives, and boneless fish are not desirable. Quite an amount of canned fishery products of various kinds is imported from Europe, sardines predominating. With the exception of canned salmon, canned fish from the United States is seldom seen.

PONCE.

In the number of inhabitants and the amount of fishery products handled the city and district of Ponce largely lead any other section of Porto Rico. The last census reports the city with 27,952, and the district 203,191 inhabitants.

The Spanish records show the total amount of fishery imports received at Ponce in 1897 as 17,289,196 pounds, of a value in Spanish silver of $1,030,854, on which the duties amounted to $72,332. In

1902 the total direct imports amounted to 8,377,680 pounds, valued at $330,074 in United States money, on which the duty was $56,008.

The imports from the United States in 1902 being admitted free accounts in part for the decrease in duties. The large decrease in direct imports in 1902 is due partly to the fact that the receipts were entered at the San Juan custom-house and forwarded from that port by local steamers, which was not the case in 1897.

The following quotations of values and notes on the market are of interest:

Feb. 10, 1903.—Total receipts of the past two weeks, 285 tierces, 79 drums, and 42 boxes of cod; 80 tierces of haddock, 8 of pollock, and 2 of hake. Last sales, cod 5¼ cents, haddock 4¼ cents, and split herring $6 per barrel.

Feb. 24.—Receipts past two weeks, 619 tierces and 100 boxes of cod, 90 tierces of haddock, 253 barrels of herring. Sales of cod 5¼ cents, haddock 4¼ cents, and split herring $5.50 per barrel. The demand just at present for cod is anything but satisfactory, and the explanation we offer is the low prices which our planters are receiving for our Porto Rico coffee, owing to the unsatisfactory situation of this article in the world's markets, and for this reason merchants and planters in the interior are buying only what they require for immediate consumption; therefore sales of round lots, such as were formerly effected, are nowadays quite out of the question.

THE DOMESTIC FISHERIES OF PORTO RICO.

Although there are many species of excellent food-fishes native to Porto Rican waters, none of them are canned, dried, smoked, or pickled. The local demand is good, yet poorly supplied with fresh fish at high prices. Whether fish can be well cured in the trying climate of the Tropics remains to be demonstrated. If some of the fine food-fishes now found are in ample abundance after supplying the local demand, they could be sent to northern markets quicker and cheaper than is now possible with fresh fish from the Pacific coast, from which shipments are made every year in increased quantities. The profitable canning of the spiny lobster, which is quite plentiful on the south side and eastern end of Porto Rico, is also a possibility.

Oysters of good flavor and small size are quite plentiful in the lagoons and arms of the sea at several places on the south side of the island; also in the waters of San Juan Harbor. At the latter place the sea wall is covered with small oysters ½ to 1½ inches in length. On the south side of the island they are usually attached to the roots and lower branches of the mangrove trees at the shore. The largest of the oysters compare with 2-year-old seed of Virginia waters, but are very poor and quite salty. No oysters are planted, nor is any attention given to their improvement or cultivation. Occasionally a few are gathered and peddled at 10 cents a dozen through the streets of the cities.

The few fishermen at most of the numerous ports are satisfied with small incomes derived from a small amount of labor. Many of the men combine a little fishing with work on the plantations, lightering of vessels, and other work. During the past few years a steady demand for labor on shore at increased wages has induced the most enterprising of the fishermen to give more time to shore work at the expense of the fisheries.

The only boats employed in the fisheries of Porto Rico are small open sail or row boats, and these are used only when the weather conditions are favorable.

The total consumption of fish-food products in Porto Rico during 1902 and the average amount per capita were as follows:

Kind.	Lbs.	Average pounds per capita.
Imported, cured	20,503,507	21½
Local catch of fresh fish	2,169,770	2¼

SAN JUAN.

The city of San Juan is but poorly supplied with fresh fish, sold from two stalls in the city market and to a small extent by street vendors, who carry their stock on their shoulders suspended from a pole, a small pair of scales completing the outfit. The market prices for undressed fish range from 8 to 12 cents a pound, the fishermen receiving an average of 5 cents a pound.

The local fishermen of 1902 numbered 25, having 10 small boats. Their aggregate catch amounted to 120,000 pounds, valued at $6,000. This catch was all by hook and line and most of it from the waters of San Juan Harbor, the species being the same as those taken by the neighboring fishermen of Palo Seco, which furnishes the chief supply to the citizens of San Juan.

PALO SECO.

This small fishing village is at the mouth of Bayamon River, nearly opposite the city of San Juan and the entrance to its harbor. During 1902 the fishermen numbered 80, with some $6,000 invested in boats and fishing gear. Their catch amounted to 280,000 pounds, valued at $16,800. They appear satisfied with a small income which might be largely increased by working more continuously. Of the 80 fishermen, the number daily engaged in fishing is said not to average over 20. The catch is in the waters of the harbor, and, at times, by trawls, hand lines, and trolling a few miles outside of the harbor, and is marketed at San Juan. This is one of the few places where fish are sold by weight, averaging the fishermen 6 cents a pound gross. Fish are fairly abundant at all seasons.

The fishing apparatus consists of haul-seines of 125 to 150 fathoms each, drift gill-nets 150 fathoms each, trawls with 150 hooks each, and hand lines with 3 or 4 hooks each, used in deep water. Fish pots have been discontinued.

The leading species taken by the several forms of apparatus are as follows:

Trolling: Spanish mackerel, king-fish, barracuda, hound-fish, gray snapper, dog snapper, schoolmaster, red grouper, Nassau grouper.
Cast-nets: Leather-jack, sardines, robalo, mullet, eels, pargo prieto, lane snapper.
Weirs: Sardines, pargo, picuda, jurel, liza, robalo, mullet, mojarra.
Haul-seine: Lane snapper, moon-fish, trunk-fish, toro, barracuda, hound-fish, mero, mullet, pargo prieto, balaju, robalo, leather-jack, sardines, mutton-fish, spade-fish, margate, runner, pompano, red goat, yellow goat; red snapper, dog snapper, gray snapper, schoolmaster.
Trawl: Margate, yellow-tail, red snapper, dog snapper, parrot-fish, mutton-fish.
Hook and line: Candil, toro, pargo prieto, yellow-tail, robalo, cabra mora, red goat, yellow goat, chopa amarilla, mero, lane snapper, cherna, margate, red snapper, dog snapper, schoolmaster.

ARECIBO.

Arecibo is located on the northwestern end of the island near the mouth of the Rio Grande. The city is credited with a population of 8,008, the district of Arecibo having 162,308. Quite a large amount of imported fish is used. The fresh-fish business is conducted by 50 fishermen who divide their time between fishing and work on the sugar plantations, an average of 25 men being engaged in fishing during the year when the conditions are favorable.

Fish are reported to be fairly abundant, yet the aggregate catch for 1902 amounted to only 75,000 pounds, which could have been greatly increased had the needed energy been shown. The catch is all disposed of locally by peddlers, who sell nearly everything by the bunch, averaging 5 cents a pound for undressed fish. A few large fish, among them the mero, are taken by hooks in deep water. These are cut up and sold for 6 to 8 cents a pound. Many cast-nets are also used. Bow hooks and lines have 2 to 4 hooks attached to short snoods, which are fastened near the end of the two long lines that are attached to the bow. These lines are as long as 150 fathoms and are fished 2 to 3 miles from shore in 50 to 150 fathoms of water during the summer; there is no hook-and-line fishing during the winter on account of rough water. These hook-and-line fishermen usually begin the day's work at 4 in the morning and leave off about noon. Fish-pots are used in and near the mouth of the Rio Grande during the high waters of May, June, July, and August. Haul-seines are more or less used at all seasons, from the beaches adjoining the city.

Sardines are taken by haul-seines during June, July, and August. The greater part of the seine catch is the jurel, which are most plentiful during November, December, and January, their weight being from 1 to 20 pounds.

Candil or squirrel-fish are taken by hook and line in 50 fathoms of water, but are not plentiful. Spanish mackerel are taken by trolling and by seines at all seasons, but most plentifully during June and July. A few pompano are taken by seines. The following are taken by hook and line: Cabra mora, in 3 to 70 fathoms; cherna or red grouper, weight 15 to 30 pounds; cabrilla, but few caught; pargo prieto, plentiful in 10 to 25 fathoms of water; toro are taken by hooks near the rocks in from 3 to 10 fathoms; mero by line with a single hook in deep water, weight 10 to 20 pounds; mullet are seined.

Small wooden box-pots are set in and near the mouth of the river, their catch being chiefly the common eel of small size. Eels are also taken with hook and line, and are sold in bunches of about 2½ pounds at 15 cents a bunch.

Commercial fishing of the Rio Grande is of small extent, being confined to the season of high water, at which time the river is fished at the mouth and for a short distance above. A little fishing is done higher up the river by the natives for family use.

AGUADILLA.

The city of Aguadilla has a population of 6,425, the district of the same name having 99,645.

Fishing is carried on at all seasons, when the weather is favorable, by 50 fishermen, who have $10,000 invested in boats and fishing apparatus. In 1902 the catch amounted to 160,000 pounds, valued at $10,310. This was largely disposed of by peddlers in filling a local demand from the city and near-by sugar plantations, any surplus finding a ready market in Mayaguez. The average prices received for the common species is 6 cents per pound. Spanish mackerel, kingfish, red snapper, and a few others of the best species bring 8 to 10 cents a pound for undressed fish.

The most important apparatus is the haul-seine, 100 fathoms in length and 15 to 20 feet deep, 2 to 3 inch mesh in the wings and ¾ inch in the bunt. The seines are hauled on the beach in front of the city by 8 to 12 men. The catch is chiefly made during March and April. Of the species taken in seines, scad are the most plentiful, as high as a ton or more having been taken at a single haul. Salmonete are quite plentiful. A few Spanish mackerel of small size, 1 to 2 pounds, are taken; also a few flying robin.

Next in amount to the catch by seines is that by the bow-rigged hook and line. These are used as far as 4 miles from shore in 5 to 100 fathoms of water. Of the numerous species taken, the following are the most important: Runner, or *Caranx crysos*, very plentiful in 8 to 9 fathoms of water; catalufa and toro, plentiful in 6 to 7 fathoms; a few cabrilla or red-hind in 20 to 25 fathoms (by hook and line only); gray snapper, not plentiful; schoolmaster and red snapper, weighing from 2 to 25 pounds, are plentiful in 10 to 12 fathoms; yellow-tail of 1 to 2 pounds, plentiful in 50 fathoms (only taken by bow-hooks and lines); margate of 1 to 3 pounds, plentiful in 150 fathoms of water; moon-fish, 2 to 3 pounds, in 25 fathoms.

Fish-pots made of woven bamboo splints are used at all seasons, and are anchored without bait near the mouth of the Culebrinas River, and up the same for about 2 miles. The native name of these fish-pots is "nasa." Of the numerous species taken in pots the following are noted: Salmonete, plentiful; lane snapper, of 1½ to 2 pounds; red parrot, of 3 to 4 pounds; mud-fish or old wife, of 5 to 6 pounds, are plentiful; blue parrot, 2 pounds; spade-fish, 1 to 1½ pounds; rock-beauty; palmoneta, of 3 to 6 pounds, are plentiful; mariposa, ½ to 1 pound; medico or barbero, ½ to 1 pound; old-wife (*Balistes vetula*), average weight 2 pounds. When sold in the market the skins of this fish are taken off and bring 2 or 3 cents a dozen, being dried and used for polishing or scouring. Spotted trunk-fish of 2 to 3 pounds are here sold for food; gobies (*Dormitator maculatus*) weighing ½ pound are taken in 4 fathoms, only by pots; spiny lobsters (*Palinurus interruptus*), occasionally taken in pots, are not much used by the natives. Outside the river, about 2 miles from shore, pots are fished in 5 to 6 fathoms. In the river pots are more or less fished at all seasons. Hooks and lines are also used in the river by 12 men having 6 boats. Their catch comprises the following, which are reported plentiful: Eels, big-eyed herring, bony-fish, and robalo.

Trawls are set as far as 3 miles from shore in 85 fathoms, 75 hooks on each trawl, the following species being taken: A few pompano in 50 fathoms; cabra mora, plentiful in 5 to 7 fathoms near shore, in deep water some weighing over 50 pounds are reported to be taken; cherna or Nassau grouper, plentiful in 5 to 6 fathoms; red grouper in 10 fathoms; catalufa; toro, plentiful; gray snapper, scarce, taken in 25 fathoms; dog snapper, a few from 7 fathoms; schoolmaster, not plentiful, 8 fathoms; red snapper, plentiful; mutton-fish; pargo, from 1 to 10 pounds, plentiful, taken only by trawl; pluma (*Calamus bajonado*), plentiful in 25 to 30 fathoms, average weight 4 to 10 pounds, taken here only by trawls.

Cast nets are used near the shore in the surf, no boats being used. Their catch consists chiefly of sardines and mullet, which are plentiful.

Trolling hooks and lines are used as the fishermen visit and return from the offshore fishing grounds, the following species being then taken: Spanish mackerel of 5 to 10 pounds; king-fish of 20 to 30 pounds, plentiful; also bonito of 15 to 20 pounds.

MAYAGUEZ.

The large city market at Mayaguez has at most seasons a greater abundance and larger variety of fresh fish than is elsewhere found on the island, yet the supply seldom, if ever, fills the steady demand. In addition to the fish furnished by the few local fishermen, small amounts are received from Aguadilla by rail and sail, and from the few fishermen of several near-by places north and south of the city. Fish are most plentiful during the winter months, but there is more or less fishing all through the year. The one fish stall of the city market handles about 150,000 pounds of fish a year, 50,000 pounds additional being sold through the streets by peddlers. Fresh fish, as sold in the market, average 8 to 10 cents a pound, undressed, with very small changes in prices of species or for seasons.

The market officials and fish handlers report very little, if any, change in the amount of receipts, prices, or abundance of the several species during the past four years. No record is kept of the receipts or sales, the aggregate for the year being from estimates of market officials and dealers. Of the numerous species at times found in the market, the following are the most common at all seasons: Salmonete, or red and yellow goat-fish, lane snapper, mullet, sardines, Spanish mackerel, king-fish, runner, grouper, scad, and snappers.

The following shows the catch by different forms of apparatus:

Haul seines (chinchorro): Leather-jack, runner, barbudo, and casabe, all very plentiful; pompano, Nassau grouper, red hind, red grouper, lane snapper, and jurel.

Trolling hook and line: Colirubia, picuda, jurel, green parrot, madregal, Spanish mackerel, and king-fish, the last two chiefly during December, January, February, and March; a few during other months.

Pots: Runner and margate, very plentiful; corocoro, Nassau grouper, red hind, red grouper, gray snapper, dog snapper, schoolmaster, red snapper, lane snapper, pluma, squirrel-fish, scarce; spiny lobsters, of 3 to 4 pounds weight, fairly plentiful, pots often having from 3 to 10 lobsters each at a single lift.

Cast nets: Sardines and balaju.

Trawl: Runner, mero cabrilla, red hind, red grouper, schoolmaster, mutton-fish, red snapper, and lane snapper.

Randal (line with 3 to 4 snoods near its end, one hook on each snood): Runner, cabra mora, Nassau grouper, red hind, red grouper, gray snapper, dog snapper, mutton-fish, lane snapper, and pluma.

MONA ISLAND.

Mona Island, about 25 miles southwest from Mayaguez, is at times visited by fishermen from Aguadilla and Mayaguez for fish and hawksbill or tortoise-shell turtle. Fish are reported plentiful about the island, though but little fishing is done. The chief attraction for fishermen and others from more distant sections of the main island is the turtle fishery. Turtles are found during May, June, and July, but are never numerous. The hawksbill turtles weigh 25 to 75 pounds each; the shells from 5 to 10 pounds. During 1902, 700 pounds of the shells were sold at Mayaguez at an average of $3 per pound, and the turtle meat at 6 to 7 cents a pound.

AÑASCO, SABINATA, AND ALGARROBO.

These three fishing settlements are a few miles north of Mayaguez. The amount of their fish business is small, and the species taken are the same as those taken by the fishermen of Mayaguez. This section of the island suffered much from the hurricane; many of the fishermen, having lost boats and fishing apparatus, gave up the business.

BOCA DE JOYUDA.

Eight miles south from Mayaguez a few fishermen live in a grove of cocoa palms that borders the beach. Their work is varied by fishing at times and extracting cocoa oil from the products of the trees at their doors. The men report fish fairly plentiful, and of the following species and weights, in pounds: Red grouper, 10 to 50; toro, 1; pargo, 5 to 30; dog snapper, 2 to 20; schoolmaster, 5 to 15; red snapper, 5 to 30; mutton-fish, 1 to 20; lane snapper, 1 to 4; margate-fish, 1 to 6; red parrot, 1 to 5; blue parrot, 1 to 5; rock beauty, 1 to 2; mariposa, 1; spotted trunk-fish, 1 to 5.

PORTO REAL.

This small settlement, near the southwestern end of Porto Rico, well represents the fisheries by its 30 fishermen who make it their entire business. Their catch during 1902 amounted to 175,000 pounds, all of which was sold fresh. The harbor is small and shallow but ample for their small draft boats. In this vicinity many species of food-fishes are quite plentiful, particularly during January, February, and March, at which time they are nearer land and the weather is most favorable. After March the fish draw away from the shore into deeper water, when the sea becomes too rough for the small boats.

Haul-seines were formerly used but have been discontinued. The bulk of the catch is now taken by pots that are anchored and buoyed in from 1 to 13 fathoms, no bait being used.

Pots are, as a rule, set singly, but occasionally in trawls, or a number are connected by a line. One trawl with 80 hooks is used in 7 to 8 fathoms. Trolling is chiefly carried on as the men go to and from the pots and trawls.

Fishing is done in the early hours of the day, pots and trawls being visited only once. The catch is then removed to the wells on their boats, the pots replaced, and hooks rebaited. On reaching the home harbor any fish not at once disposed of are removed to floating fish-cars and kept alive until such time as needed.

Buyers from Mayaguez visit Porto Real and purchase the bulk of the catch, paying 2½ cents a pound; the remainder of the catch is sold locally, at the village of Cabo Rojo, and at the sugar plantations of the vicinity. From the latter 4 to 5 cents a pound is received.

Spiny lobsters are scarce and of small size, ½ to 2 pounds each. They are taken in 10 to 15 fathoms of water and sold at the same price as the fish.

Spanish mackerel are fairly plentiful, those taken near shore averaging 1 to 3 pounds; 5 to 10 miles from shore larger sizes are found, the largest seen being 8 to 10 pounds. The mackerel and the king-fish are caught with trolling hook and line.

Hawksbill or tortoise-shell turtle are taken by hand on the beaches of Salinas and Mona Island, and by turtle gill-nets set off the same, each net having attached a wooden decoy turtle. This is said to attract the turtle and also helps buoy up the net. Turtles are reported scarce, the total catch of 1902 by the fishermen of Porto Real being 10 by hand and 12 by nets. The turtles weigh from 40 to 100 pounds each, having an average of 5 pounds of clear shell. The fishermen receive $3 a pound for shells and 3 to 6 cents a pound for the meat of the turtles.

The fishermen keep no record of their catch by species, but report most of the several species plentiful. Very many fish too small to be marketed are caught. These are given away to the poor and nothing is wasted.

The following species are reported as being taken by the apparatus named:

Pots or nasa: Red goat, yellow goat, lane snapper, rock hind, Nassau grouper, red hind, red grouper, red snapper, gray snapper, mutton-fish, pluma, loro colorado, blue parrot, candil, margaté, spade-fish, rock beauty, blue angel, trunk-fish (little esteemed), lobsters (scarce).
Cast nets: Sardines, scad, chopa amarilla.
Trawl (palangra): Runner, cabra mora, grouper, red hind, red grouper, gray snapper, dog snapper, schoolmaster, red snapper, mutton-fish.
Trolling: Spanish mackerel, pluma, zapatero or leather-jack, runner, schoolmaster, yellow-tail, lane snapper.

PONCE.

The district of Ponce is bordered on the south by the Caribbean Sea for some 40 miles, about half the water front of the south side of the island. The long stretch of water front back to the foothills and mountains is largely engaged in sugar culture, back of which the mountainous district is engaged in coffee and tobacco raising. The fisheries are represented by a large variety of fine food-fishes that the fishermen report as quite plentiful. No fish are dried, smoked, or pickled. Fresh fish are in demand at the several cities and villages, and at plantations, and prices are quite high. The business is apparently capable of being largely increased to the benefit of producer and consumer. The fisheries are represented, from west to east, by a few fishermen at the following places: Guanica, Guayanilla, Ponce, Isabel, and Salinas, the total being 110 men.

Guanica has 20 fishermen who dispose of their fish to a local demand and at the city of Yauco. The 14 fishermen of Guayanilla also sell at Yauco and to their own neighborhood.

Ponce has 40 men who fish more or less, about half of the number depending on the fisheries for a living; the remainder divide their time between fishing and other work on shore. Their catch is disposed of at the city market and by street peddlers.

Isabel has 22 fishermen who sell their catch near home and at Coamo by peddling.

The 14 fishermen of Salinas find a market near home and at Guayama:

The fishermen of the several places mentioned fish more or less at all seasons of the year. The catch is made in the waters of the home harbors and for 4 to 6 miles out. Fish are most plentiful near shore during January, February, and March.

Two-thirds of the catch is made by the use of pots that are anchored without bait and visited once a day.

The following species comprise the bulk of the catch by pots at the several fishing stations of the district of Ponce:

Pots: Squirrel-fish, zapatero, red goat, yellow goat, rock hind, red hind, red grouper, toro, gray snapper, red snapper, mutton-fish, yellow-tail, margate, pluma, red parrot, blue parrot, spade-fish, rock beauty, blue angel, medico, trunk-fish.
Haul seine: Runner, pompano, red hind, red grouper, lane snapper, casabe, barbudo, sardines, and Spanish mackerel.
Trolling hook and line: Spanish mackerel, king-fish, barracuda, yellow-tail, rock hind, red hind, red grouper, schoolmaster, mutton-fish, red snapper, lane snapper.
Cast-nets: Sardines, pompano, jurel, cutlas-fish.
Trawl: Cabra mora, Nassau grouper, red hind, dog snapper, schoolmaster, red snapper, mutton-fish, lane snapper.
Hand hook and line: Madregal, red grouper, pargo prieto, dog snapper, gray snapper, lane snapper, mutton-fish, pluma, runner, mero, Nassau grouper, red hind.

Spiny lobsters of 1 to 5 pounds each are taken in pots, but apparently are not very abundant. They are sold at same price as the fresh fish, or an average of about 4½ cents a pound.

Tortoise-shell turtles, weighing 20 to 100 pounds, are taken off the beaches of the main shore and the island of "Caja de Muertos," off the southeastern shore of Ponce, and other small islands. The catch is made by hand as the turtles come on shore to lay their eggs. Not over 400 pounds of shell are taken by the fishermen of the district.

Market fishery of Ponce.—The fisheries are represented in the large city market of Ponce by one fish stand, which poorly supplies the city demand for fresh fish. No account of the amount of sales is kept. The dealer and market official reported it as being about 200 pounds a day, or some 75,000 pounds a year. On visiting it February 20, about 200 pounds comprised the stock, which represented the following 14 species: Spanish mackerel, king-fish, runner, cabra mora, Nassau grouper, toro, margate, blue tang, medico, squirrel-fish, cabrilla, lane snapper, blue parrot, and file-fish. The fish are sold undressed, usually by the bunch instead of weight, averaging 8 to 10 cents a pound for fresh fish or spiny lobsters. A few small shell oysters arrive from Guayanilla in old kerosene tins, the fishermen receiving 20 cents a can for them. About 4,000 pounds of crawfish annually come from Portuguese or Dangerous River. These are taken by dip nets and bring at the market 8 to 10 cents a pound. Besides the 200 pounds of fish daily sold at the market, about half as much more is sold at the playa or landing and surrounding country by peddlers.

ARROYO.

This port has a population of 2,757, a custom-house, several stores that handle considerable dry fish, most of which comes from the larger cities, with occasional direct importations. The home fisheries are represented by 60 men who follow fishing, plantation, and other work. This is about the same number of fishermen as in 1899, though they fish less, work on shore being more plentiful and attractive.

Fish are reported fairly plentiful. When engaged in fishing, men leave the port at 4 a. m., returning about 8 a. m. of the same day, and as a rule do no more fishing that day. The catch is sold from half a dozen rough tables at the shore landing in front of the village. The local demand is poorly supplied, much of the time there being no fresh fish for several days, as was the case at the time of the writer's visit.

The boats are of small size, rough and strong, home-built. Sail or row boats, even the largest and best, do not venture over 3 or 4 miles from shore. No wells are in the boats, no ice or salt is used, and the catch must be disposed of at once on landing. If the catch is larger than needed for local use, it is peddled on the sugar plantations. Sales are usually by the bunch, single fish, or strips of the largest, which are cut up, the price averaging about 6 cents a pound, all species being sold at the same price. About four months of the year are lost to the fisheries from weather that is unfavorable for the small boats used, but would not prevent a New England fisherman, with good equipment, from fishing.

Hawksbill turtles, once plentiful, are now scarce, only 30 being taken during 1902. This small catch was made during January and February, one net being used on the coral reefs, and by hand as the turtles were found on the shore.

Spiny lobsters, weighing from 1 to 3 and 4 pounds, are taken quite plentifully in pots set in about 6 fathoms of water and also on the coral reefs at night, when a torch and forked stick are used. The torch attracts the lobsters, and the forked stick pokes them out from holes and impales them when emerging; or when found on the reefs they can be picked up by hand. Lobster pots are baited with refuse fish, either fresh or spoiled, of any kind. The runner, when taken in pots, will soon kill itself if not removed; moray, both black and olive, from 2 to 40 pounds, are plentiful at all times. Over two-thirds of the fresh-fish catch is by unbaited pots anchored in 3 to 6 fathoms if near the shore, and in 8 to 15 fathoms when 2 or 3 miles from land.

The following species are taken by the apparatus named, the average weight of many species being given:

Pots: Candil; red goat; yellow goat; zapatero, ½ to ¾ pound; runner, 1 to 20 pounds; pompano, 1 to 3 pounds; cabra mora, 1 to 3 pounds; Nassau grouper, 1 to 6; cabrilla, 1 to 3; gray snapper, 1 to 6; dog snapper, 1 to 6; schoolmaster, 1 to 3; red snapper, 4 to 5; mutton-fish, 1 to 3; lane snapper, 1 to 2; yellow-tail, 1 to 2; margate, 2 to 5; boca colorado, ½ to 1; chopa amarilla, 1 pound; red parrot, 1 to 10; old wife, 1 to 6; spade-fish 2 to 10; blue angel, 1 to 5; file-fish, ½ to 6; trunk-fish (scarce); puffer (not eaten); capitan or hog-fish (4 to 20 pounds).

Single hook and line: Cabra mora, 1 to 3 pounds; cabrilla, 3 to 30; red grouper, 20 to 50 pounds, in from 6 to 40 fathoms of water, are taken from July to October; gray snapper, 8 to 20; dog snapper, 8 to 20; schoolmaster, 5 to 20; red snapper, 10 to 20; yellow-tail, 2 to 3 pounds.

Trolling hook and line: King-fish, 10 to 60 pounds; Spanish mackerel, 1 to 10; red grouper, 20 to 50; gray snapper, 8 to 20; pompano, 5 to 10; cabra mora, 2 to 3; Nassau grouper, 5 to 70; gray snapper; dog snapper; schoolmaster; barracuda.

Haul seine: Zapatero, ½ to 1½ pounds; runner; pompano; Nassau grouper; mutton-fish; lane snapper; robalo, ½ to 15 pounds; Spanish mackerel; mullet, 1 to 3 pounds.

Cast nets: Sardines, mullet, robalo. These nets are here used only for taking bait.

Gill nets: Only 2 species reported, the balaju and hound-fish. The latter, weighing 5 to 8 pounds, are plentiful, but are not sold for food.

Bow hook and line (used in 40 to 60 fathoms): Catalufa, yellow-tail.

Trawls (seldom used): Yellow-tail, red snapper, cabrilla, Nassau grouper.

JOBOS HARBOR.

This small and quite good harbor is a few miles west of Arroyo. A few fishermen operate in the near-by waters on each side of the bay. The apparatus used and species taken are similar to those previously reported from Arroyo. The catch is disposed of at the city of Guayama and the surrounding sugar plantations; at the former to dealers at an average of 5 cents a pound; when peddled out at the plantations, 8 to 12 cents a pound is received. Not much system is used in disposing of the catch, sales being by the bunch, piece, single fish, or the lot. The catch is chiefly made by pots that are used inside of the bay. Haul seines are fished occasionally, but the rough water on the outside beaches interferes with their use. The fishermen divide their time between fishing and work on the sugar plantations.

Fish are reported of an average abundance both in the bay and the outside waters. Spiny lobsters are reported quite plentiful but are little cared for. Small-sized oysters are quite plentiful in the lagoons of the vicinity but receive very little attention.

The Guamani River, that has its outlet not far from Jobos Bay, is at times fished by the inhabitants living near its banks for their own use. Eels are plentiful in the river and are taken as needed by eel pots.

HUMACAO.

The district of Humacao, at the eastern end of Porto Rico, is credited with a population of 88,501; the city of Humacao with 4,428. The latter is 5 miles inland from the playa or landing at which is located the custom-house, several stores, and a small settlement of fishermen. The waters of this region are quite well supplied with a large number of species of fine food-fishes. Dry and pickled fish are received from the dealers of San Juan, Ponce, and Mayaguez. The fishermen and dealers find a good market for all fishery products at the city of Humacao and at the numerous large sugar plantations of the vicinity. This section of the island suffered severely by the hurricane of 1899, the local fishing business being almost ruined. Many fishermen and their families lost their lives, and all lost their fishing boats and fishing gear. Sugar plantations were for the time ruined and all business paralyzed.

The fishermen receive an average of 5 cents a pound for their catch. About one-third of the time is lost from the water being too rough for their small boats. The men appear satisfied with their small earnings that give them an average of $125 a year, an amount that could be more than doubled with more energy given to the business. Only small sailboats with 3 men each and rowboats with 2 men are used. Most of the catch is by pots that are seldom baited. Hooks lines, and nets are but little used. All fishing is near shore, the extreme distance being some 4 miles.

Spiny lobsters of 1 to 6 pounds weight are quite plentiful. They are taken by pots, and at night they are taken on coral reefs of the neighboring islands by hand, a torch and forked stick only being used.

Fish pots are anchored in 2 to 10 fathoms of water from near shore out to a distance of 4 miles.

The catch by apparatus includes the following species:

Pots: Red goat, runner, Nassau grouper, red hind, red grouper, catalufa, gray snapper, dog snapper, candil, schoolmaster, red snapper, lane snapper, margate, pluma, boca colorado or red-mouth fish, red parrot, capitan, spiny lobster, yellow goat, rock beauty, yellow-spotted eel, old wife, spade-fish, blue parrot, mariposa, medico, trunk-fish, moray, and file-fish.

Hook and line: Schoolmaster, pargo prieto, red grouper, red hind, rock hind, Nassau grouper, gray snapper, dog snapper, red snapper, mutton-fish, lane snapper, chopa amarilla.

Cast nets: Sardines, balaju.

Haul seine: Mutton-fish, lane snapper, pluma, trunk-fish, barracuda, mullet, balaju, hound-fish, soap-fish, moray, eagle ray, Spanish mackerel (small size), king-fish of small size, zapatero, runner, pompano, Nassau grouper, gray snapper, dog snapper, schoolmaster, red snapper.

Trolling: Spanish mackerel, barracuda, king-fish.

HUCARES.

This small town is 4 miles north of Humacao. A long sandy beach, bordered by cocoa and royal palms and settled by scattering homes of fishermen, connects the two ports. The total catch by the fishermen during 1902 was stated to be 80,000 pounds, consisting of the same species previously mentioned as caught by men of Humacao.

Fish are most plentiful during the winter months, and are disposed of fresh at Humacao, Hucares, and neighboring plantations. The catch is mainly by fishing pots. Two haul seines are at times used from the beach. Cast nets and hooks are also used to a limited extent.

GUAYANES.

The small harbor of Guayanes is about 8 miles south of Humacao. The river Guayanes, that is formed from several small mountain streams, enters the harbor. Near the mouth of the river a half dozen fishermen reside and use one haul seine and 20 fish pots in the fisheries. Their catch comprises the usual species of the section and finds a market in the vicinity.

FAJARDO.

The city of Fajardo, with 3,414 inhabitants, is 2 miles inland from the playa or landing, at the northeastern end of the island. This section has many natural advantages in connection with the fisheries, which in time will be more appreciated. The surrounding country is an important sugar-raising district, with numerous villages and towns, of which Fajardo is the largest. At the playa is located the custom-house, a few stores, and quite a little settlement of fishermen. The harbor contains several small islands that afford a shelter to the small boats of the fishermen. The surrounding waters are well supplied with a large variety of fine food-fishes, much more so than at any other fishing station. The catch is all disposed of fresh; no salt or ice is used. The small amount of ice received from San Juan is sold to hotels and a few families at 5 cents a pound. Quite an amount of dry salt-cod and some pickled fish are received via San Juan from the United States and Canada. There appears to be an opening for the catch and cure of some of the local species (including the spiny lobster) that would in a measure take the place of imported fish.

Spanish mackerel and king-fish are plentiful from December to May, but especially during January and February. Albacore or frigate mackerel are found in large schools during February, March, April, and May, after which they are not seen during the remainder of the year. They weigh from 15 to 20 pounds and are taken by seines and by trolling. Red snapper are plentiful; pompano are taken weighing 1 to 10 pounds. Numerous other fine table fish, but unknown in the markets of the United States, will be found in the list of species of food-fish taken by the various appliances. The list, while not complete, comprises most of the leading species taken in these waters.

Spiny lobsters are reported as very plentiful, their weight being from 1 to 10 pounds, those taken in pots being the smaller size. The largest are found on the coral reefs and are taken at night by hand, a torch and forked stick being used. The lobsters, seeing the light, do not move, permitting themselves to be picked up by hand. When hidden in holes they are poked out with the sticks and secured. Most of the lobster catch is secured at night by hand.

Oysters of small size and good quality are quite plentiful on the roots and lower branches of the trees bordering the lagoons near the Fajardo light-house and off Ceiba. A few oysters are taken and sold locally at about 1 cent a dozen.

Clams are found at the mouth of the Fajardo River but not used.

Of the 80 men of Fajardo that follow fishing more or less about 40 give nearly half their time to the sugar plantations. The fishing-grounds being more protected from rough seas by the several islands, less time is lost from rough water than at most places. The catch is all sold fresh to fill the local demand at Fajardo and vicinity. Prices average about 3 cents a pound for all species except Spanish mackerel and king-fish, which average 5 cents a pound.

After the volcanic eruptions at Martinique quite heavy showers of ashes fell in this vicinity, after which many small-sized fishes were found dead along the beaches.

Quite an important part of the revenue of some of the fishermen is from the sale of tortoise shell from the hawksbill turtles taken by them. The turtles are taken on and near the beaches of Mona, Vieques, and Culebra islands and those of the main shore. The catch is made from November to May, when the females come ashore to deposit their eggs in the sandy beaches, when they are taken by hand; the males are said to remain a short distance offshore from the beach and await the return of the females; here they are taken by gill nets.

The nets are from 10 to 12 yards in length and of 10-inch square mesh, each having a wooden decoy turtle attached. Turtles taken weigh from 30 to 100 pounds, occasionally more. The average weight of shell that is saved is 5½ pounds, for which the men received $3 a pound during 1902. The total amount of shells taken in this vicinity is reported as follows: By fishermen of Fajardo, 400 pounds; Culebra Island, 800 pounds; Vieques Island, 80 pounds; a total of 1,380 pounds, most of which was disposed of at Fajardo. Turtles are reported not very plentiful, and the fishermen pursue them with little energy; having taken and sold a few pounds, they are content to remain ashore and rest so long as any money is left.

Fajardo River is to a small extent fished for the first 6 or 7 miles up from its mouth by the citizens of the vicinity. The catch is chiefly a small-sized fish known as "dajao" (*Agonostomus monticola*) that is taken in small seines. Land crabs are quite plentiful along and in the banks bordering the river. The natives living along the river banks take the crabs from their holes in the bank during the dry season by digging them out. During the wet season the crabs are found above ground and are then caught by hand, a torch being used.

The proportion of the catch by fishing apparatus at Fajardo is approximately five-eighths by seine, one-eighth by hook and line, and one-fourth by fish pots, but a small amount is also taken by cast nets. All boats and nets are made by the fishermen. Seines are 125 to 150 fathoms long, with a bag in the center; mesh one-half inch in the center and 1½ to 2 inches in the wings. Pots are not baited, but anchored in 2 to 12 fathoms in the harbor and around the neighboring islands. The boats are small, rough, and strong, without wells; none large enough to have custom-house register. Those with sails have cat or sloop rig. The apparatus employed, with the species taken, given somewhat in the order of their importance, are as follows:

Fish pots: Candil; red goat, plentiful; yellow goat, scarce; runner or jurel, 5 to 10 pounds (in large schools during February, March, and April); cabra mora; Nassau grouper; red hind; red grouper; toro; pargo prieto; dog snapper; schoolmaster; red snapper; mutton-fish; lane snapper; yellow-tail; margate; porgy; pluma; loro colorado; oldwife; blue parrot; spade-fish; mariposa, one-fourth pound; rock beauty, 1 to 2 pounds; blue angel, 2 pounds; medico, 1 pound; trunk-fish, 1 to 4 pounds; file-fish, 3 pounds; chopa amarilla, 1 pound.

Haul seines: Mullet, red goat, Spanish mackerel of small size, king-fish, zapatero, scad, runner, bony-fish, pompano, Nassau grouper, pargo prieto, dog snapper, schoolmaster, red snapper, mutton-fish, tarpon, lane snapper, yellow-tail, margate, porgy, pluma, chopa amarilla, balaju, and hound-fish.

Hand lines: Candil; red goat; Spanish mackerel, 2 to 10 pounds; king-fish, 10 to 40 pounds; runner; cabra mora; Nassau grouper; red hind; toro; red grouper, 5 to 100 pounds; pargo prieto, 5 to 30 pounds; dog snapper, 5 to 20 pounds; schoolmaster; red snapper; mutton-fish; lane snapper; margate; yellow-tail; pluma, 2 to 8 pounds; chopa amarilla, 1 pound; red goat, 5 to 8 pounds; blue parrot, 3 to 8; trunk-fish, 1 to 4; robalo, 5 to 25 pounds; and balaju, ¼ to ¾ pound.

Trolling hook and lines: Bonito; hound-fish; frigate mackerel; tarpon; Spanish mackerel, 2 to 10 pounds; king-fish, 10 to 40 pounds; barracuda, 5 to 40 pounds.

Cast nets: Zapatero; scad; robalo; pompano; sardines, ⅛ to 1 pound; banana-fish, 5 to 15 pounds; mullet; big-eyed herring.

CEIBA.

The village of Ceiba is 5 miles south from Fajardo and 2 miles inland from the water front and fishing-camp. The 15 fishermen take three-fourths of their catch by pots and one-fourth by cast-nets. The men divide their work between fishing and work on shore at the sugar plantations. Their catch meets with a ready local demand.

The manatee is occasionally taken off the beach near Ceiba. A few are taken each year, usually by means of haul seines. The weight is said to run from 500 to 1,200 pounds. The flesh is highly prized and resembles beef in flavor.

LUQUILLO.

Luquillo, near the eastern end of the island, is one of the very few places on the north side of Porto Rico in which the fisheries are represented. Eight men make a small catch with pots and cast-nets. A ready home demand exists for all fish taken.

VIEQUES ISLAND.

Of the several islands belonging to Porto Rico, Vieques is the largest in size and population. It is 17 miles long by 5 miles at its greatest width, its western end being 11 miles from the eastern shore of Porto Rico. The island has several thousand population, with many quite large sugar plantations. The fisheries are represented by a few fishermen on the north and south sides of the island who find a ready local demand for their catch. Fish are plentiful in the near-by waters, yet receive but little attention, dry cod imported from far distant waters being more in demand than fresh fish taken in their own home waters.

CULEBRA ISLAND.

This island has no fishery business of importance. A few fishermen supply the few hundred inhabitants with fresh fish at times. Some fish pots are used and some attention is given to the turtle fishery, the latter furnishing 800 pounds of tortoise shells in 1902. The turtle-shell catch was sold at Fajardo at $3 per pound.

Table showing the fishermen, boats, and apparatus employed in the fisheries of Porto Rico in 1902.

Locality.	Fishermen.	Boats.		Cast nets.		Fish pots.		Hooks and lines.
		No.	Value.	No.	Value.	No.	Value.	Value.
Aguadilla	50	25	$690	30	$120	50	$200	$180
Algarrobo	15	8	310			28	35	10
Arecibo	50	20	695	30	120	60	25	52
Añasco	8	3	150					12
Arroyo	60	30	1,400	4	20	300	900	73
Boca de Joyuda	10	4	80			12	24	10
Boqueron	20	13	500	20	80	100	150	60
Ceiba	15	6	500	5	20	30	90	
Culebra (island)	12	8	500			25	75	6
Fajardo	80	25	2,190	4	32	100	300	76
Guayanilla	14	7	280	2	8	20	60	32
Guanica	20	9	435	3	12	40	120	30
Guayanes	6	4	210			20	50	
Hucares	32	13	660	2	8	104	260	26
Humacao	25	10	525	2	8	80	200	18
Isabel	22	10	775	3	12	30	90	52
Las Moreas	20	7	315	12	48	150	525	18
Luquillo	8	2	150	3	12	18	54	
Mayaguez	20	14	465	6	36	25	45	53
Palo Seco	80	40	2,000	25	100			88
Ponce	40	27	2,530	6	24	210	630	85
Patillas Bay	25	17	770	6	24	200	700	50
Puerto Real	30	20	606	9	36	100	150	9
Puerto de Jobos	12	8	450	4	16	75	225	20
Salinas	14	14	560	3	12	16	48	34
San Juan	25	10	500					45
Vieques (island)	35	15	525	4	16	125	375	
Total	748	369	18,771	183	764	1,908	5,331	1,039

Locality.	Haul seines.			Gill nets.			Weirs.		Total investment.
	No.	Length (feet).	Value.	No.	Length (feet).	Value.	No.	Value.	
Aguadilla	6	3,600	$750						$1,940
Algarrobo	2	450	65						420
Arecibo	3	1,800	375						1,267
Añasco	1	360	40						202
Arroyo	2	780	175	1	480	$15			2,583
Boca de Joyuda	1	480	75						189
Boqueron									790
Ceiba									610
Culebra (island)				50	1,800	125			706
Fajardo	4	3,300	1,200	50	1,800	125			3,923
Guayanilla	3	1,200	375						755
Guanica	2	900	250						847
Guayanes	1	400	125						385
Hucares	2	420	160						1,114
Humacao	1	480	100						851
Isabel	2	1,000	250						1,179
Las Moreas	2	600	150						1,056
Luquillo									216
Mayaguez	3	1,800	375						974
Palo Seco	15	7,500	2,250	20	18,000	1,500	4	$400	6,338
Ponce	3	1,200	375						3,644
Patillas Bay	3	1,050	175						1,719
Puerto Real				2	75	16			817
Puerto de Jobos	2	900	200						911
Salinas	1	400	125						779
San Juan									545
Vieques (island)	1	500	125	10	360	25			1,066
Total	60	29,120	7,715	133	22,515	1,806	4	400	35,826

Table showing the amount and value of the fishery products taken by the various forms of apparatus used in the fisheries of Porto Rico in 1902.

Localities.	Fish pots.		Haul seines.		Hooks and lines.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Aguadilla	15,000	$900	60,000	$3,750	73,000	$4,910
Algarrobo	9,000	450	31,500	1,575	12,000	600
Arecibo	7,000	350	37,500	1,875	22,500	1,125
Añasco			20,000	1,000	8,000	400
Arroyo	40,000	2,400	7,000	420	16,000	960
Boca de Joyuda	5,000	150	36,500	1,095	3,000	90
Boqueron	53,200	1,596			29,800	894
Ceiba	22,500	900				
Culebra (island)	12,000	480			3,000	120
Fajardo	39,600	1,386	99,000	2,465	19,800	693
Guayanilla	15,460	695	8,330	375	12,116	549
Guanica	30,920	1,391	5,653	254	11,360	511
Guayanes	10,000	500	5,000	250		
Hucares	50,060	2,500	20,000	1,000	8,000	400
Humacao	43,000	2,150	10,000	500	7,500	375
Isabel	23,190	1,043	5,553	250	19,840	893
Las Marias	25,000	1,250	8,000	400	6,000	300
Luquillo	12,000	600				
Mayaguez	7,500	375	50,700	2,535	28,000	1,400
Palo Seco			175,000	10,500	30,000	1,800
Ponce	162,481	7,312	8,230	370	28,515	1,283
Patillas Bay	30,000	1,800	12,000	720	15,000	900
Puerto Real	87,500	2,625			62,350	1,871
Puerto de Jobos	15,000	750	6,000	300	4,000	200
Salinas	12,368	556	2,775	125	12,786	575
San Juan					120,000	6,000
Vieques (island)	50,000	2,000	20,000	800		
Total	777,719	34,159	628,741	30,559	552,567	26,849

Localities.	Cast nets.		Gill nets.		Weirs.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Aguadilla	12,000	$750					160,000	$10,310
Algarrobo							52,500	2,625
Arecibo	8,000	400					75,000	3,750
Añasco							28,000	1,400
Arroyo	2,000	120	[a] 150	$450			65,150	4,350
Boca de Joyuda							44,500	1,335
Boqueron	50,000	1,500					133,000	3,990
Ceiba	7,500	300					30,000	1,200
Culebra (island)			[a] 800	2,400			15,800	3,000
Fajardo			[a] 400	1,200			158,800	5,744
Guayanilla	838	38					36,744	1,657
Guanica	1,257	56					49,190	2,212
Guayanes							15,000	750
Hucares	2,000	100					80,000	4,000
Humacao	2,000	100					62,500	3,125
Isabel	1,200	54					49,783	2,240
Las Marias	4,000	200					43,000	2,150
Luquillo	3,000	150					15,000	750
Mayaguez	2,000	100	[a] 140	420			88,340	4,830
Palo Seco	20,000	1,200	40,000	2,400	15,000	$900	280,000	16,800
Ponce	2,514	113					201,740	9,078
Patillas Bay	3,000	180					60,000	3,600
Puerto Real	25,150	755					175,000	5,251
Puerto de Jobos	1,400	70					26,400	1,320
Salinas	1,314	59					29,243	1,315
San Juan	5,000	200					125,000	6,200
Vieques (island)			[a] 80	240			70,080	3,040
Total	154,173	6,445	41,570	7,110	15,000	900	2,169,770	106,022

[a] Represents the amount and value of hawksbill-turtle shells.

Table showing the amount, value, and duty of fishery imports from the United States to Porto Rico during the years 1899, 1900, 1901, and 1902.

Description.	Aguadilla.			Arecibo.			Arroyo.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc				77,466	$2,343	$239.69	900	$25	$2.30
1900.									
Cod	68,995	$2,470	Free.						
Herring, smoked	4,137	131	$31.79						
Mackerel, pickled	979	60	9.79						
Cod oil				125	23	3.00			
Total	74,111	2,661	41.58	125	23	3.00			
1901.									
Cod				4,500	150	Free.	28,765	1,317	Free.
1902.									
Alewives, pickled	4,000	115	Free.				9,000	170	Free.
Cod	36,240	1,449	Free.	66,512	2,534	Free.	41,496	1,722	Free.
Hake							3,465	140	Free.
Herring, pickled							22,000	410	Free.
Herring, smoked	2,500	50	Free.	7,000	143	Free.			
Mackerel, pickled	1,000	105	Free.						
Salmon, pickled				1,000	51	Free.			
Cod oil				1,926	495	Free.			
Total	43,740	1,719	Free.	76,438	3,226	Free.	75,961	2,442	Free.

Description.	Fajardo.			Humacao.			Mayaguez.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc				46,891	$1,404	$136.70	667,941	$25,745	$1,800.00
1900.									
Cod							33,250	1,086	Free.
Herring, smoked							1,000	13	.75
Mackerel, pickled							200	14	2.00
Shrimp, canned							120	29	Free.
Total							34,570	1,142	2.75
1901.									
Cod							46,237	2,154	Free.
Herring, pickled							12,000	400	Free.
Mackerel, pickled							1,625	55	Free.
Total							59,862	2,609	Free.
1902.									
Alewives, pickled							15,000	290	Free.
Cod	7,500	$375	Free.				325,678	14,173	Free.
Herring, pickled	15,680	320	Free.				34,308	779	Free.
Herring, smoked	6,100	122	Free.				17,012	455	Free.
Salmon, pickled	200	14	Free.						
Salmon, canned							2,944	187	Free.
Fish guano							25,250	316	Free.
Total	29,480	831	Free.				420,192	16,199	Free.

Table showing the amount, value, and duty of fishery imports from the United States to Porto Rico during the years 1899, 1900, 1901, and 1902—Continued.

Description.	Ponce.			San Juan.			Total.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc	778,211	$19,692	$1,672.74	3,108,282	$103,533	$6,252.00	4,679,691	$152,742	$10,103.43
1900.									
Alewives, pickled				5,000	100	Free.	5,000	100	Free.
Cod	558,376	20,985	Free.	1,764,732	61,509	Free.	2,425,353	86,050	Free.
Hake	39,150	1,283	293.62	18,560	569	139.20	57,710	1,852	432.82
Herring, pickled	3,240	115	16.20	161,975	2,276	551.96	165,215	2,391	568.16
Herring, smoked	4,780	106	21.73	64,401	1,669	388.98	74,318	1,919	443.25
Mackerel, pickled	6,080	313	60.80	26,166	1,466	224.42	33,425	1,853	297.01
Mackerel, canned	278	21	5.56	2,238	235	43.51	2,516	256	49.07
Salmon, pickled	630	48	6.30	39,501	1,943	488.93	40,131	1,991	495.23
Salmon, canned	33	2	.35	952	44	23.95	985	46	24.30
Sardines				520	62	13.34	520	62	13.34
Shrimp, canned	250	50	Free.	330	97	Free.	700	176	Free.
Cod oil	75	10	1.50	2,833	221	44.70	3,033	254	49.20
Fish in tins	540	130	39.00	230	50	15.00	770	180	54.00
Lobsters, canned	132	25	Free.	30	10	Free.	162	35	Free.
Shellfish				300	88	Free.	300	88	Free.
Whale oil				100	14	.48	100	14	.48
Total	613,564	23,088	445.06	2,087,868	70,353	1,934.47	2,810,238	97,267	2,426.86
1901.									
Alewives, pickled				3,800	76	Free.	3,800	76	Free.
Cod	11,121	663	Free.	1,564,250	57,183	Free.	1,654,873	61,467	Free.
Haddock	14,412	536	Free.	111,020	4,561	Free.	125,432	5,097	Free.
Hake				62,370	1,940	Free.	62,370	1,940	Free.
Herring, pickled	285,802	4,592	Free.	740,051	15,989	Free.	1,037,853	20,981	Free.
Herring, smoked	2,080	54	Free.	44,481	1,364	Free.	46,561	1,418	Free.
Mackerel, pickled	7,700	189	Free.	68,398	4,198	Free.	77,723	4,442	Free.
Pollock				13,280	699	Free.	13,280	699	Free.
Salmon, pickled	1,200	50	Free.	18,550	968	Free.	19,750	1,018	Free.
Salmon, canned	117	13	Free.	750	93	Free.	867	106	Free.
Sardines	700	40	Free.	745	105	Free.	1,445	145	Free.
Shrimp, canned				30	6	Free.	30	6	Free.
Sword-fish				1,200	60	Free.	1,200	60	Free.
Fish in tins				400	75	Free.	400	75	Free.
Lobsters, canned				100	10	Free.	100	10	Free.
Oysters, canned				1,210	174	Free.	1,210	174	Free.
Total	323,132	6,137	Free.	2,630,635	87,501	Free.	3,046,894	97,714	Free.
1902.									
Alewives, pickled	45,000	775	Free.	68,500	1,248	Free.	141,500	2,598	Free.
Cod	397,713	18,340	Free.	1,686,882	81,647	Free.	2,562,021	120,240	Free.
Haddock	53,905	1,962	Free.	15,000	653	Free.	68,905	2,615	Free.
Hake	13,862	399	Free.	10,000	321	Free.	27,327	860	Free.
Herring, pickled	121,034	2,184	Free.	357,500	8,629	Free.	550,522	12,322	Free.
Herring, smoked	83,650	2,164	Free.	125,198	4,178	Free.	241,460	7,112	Free.
Mackerel, pickled	5,400	150	Free.	41,652	1,712	Free.	48,052	1,967	Free.
Pollock	9,700	375	Free.	16,500	520	Free.	26,200	895	Free.
Salmon, pickled	4,158	215	Free.	27,784	1,264	Free.	33,142	1,547	Free.
Salmon, canned	10,480	598	Free.	21,236	2,194	Free.	34,660	2,979	Free.
Shad				2,185	99	Free.	2,185	99	Free.
Sardines	580	82	Free.	1,940	158	Free.	2,520	240	Free.
Cod oil				1,282	322	Free.	8,208	817	Free.
Lobsters, canned				50	10	Free.	50	10	Free.
Oysters, canned	900	44	Free.	2,092	208	Free.	2,992	252	Free.
Fish guano							25,250	315	Free.
Total	746,382	27,288	Free.	2,377,801	103,163	Free.	3,769,994	154,868	Free.

Table showing the amount, value, and duty of fishery imports from the British North American provinces to Porto Rico during the years 1899, 1900, 1901, 1902.

Description.	Aguadilla.			Arecibo.			Arroyo.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc.				1,554,415	$55,576	$3,536.69			
1900.									
Cod	113,540	$3,819	$859.05	110,400	4,235	828.00			
Herring, pickled	13,700	260	68.00	15,000	263	75.00			
Mackerel, pickled	400	45	4.00	2,000	75	20.00			
Total	127,640	4,124	931.05	127,400	4,573	923.00			
1901.									
Cod	298,091	12,162	2,297.55	986,060	51,822	7,642.30			
Herring, pickled	26,300	478	131.50	87,600	1,831	438.00			
Herring, smoked				1,300	45	9.75			
Mackerel, pickled	5,800	198	58.00	3,500	138	35.00			
Total	330,191	12,838	2,487.05	1,078,460	53,836	8,125.05			
1902.									
Cod				814,167	19,870	6,098.75			
Haddock				9,000	255	67.50			
Herring, pickled	15,068	319	75.34	160,200	3,081	801.00			
Herring, smoked				3,350	97	29.19	10,800	$189	$81.00
Mackerel, pickled				900	20	9.00			
Fish in tins				150	33	9.90			
Total	15,068	319	75.34	987,767	23,356	7,015.34	10,800	189	81.00

Description.	Mayaguez.			Ponce.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.						
Dry, pickled, smoked, canned fish, etc.	399,610	$8,661	$796.00	9,022,923	$332,964	$21,053.11
1900.						
Cod	142,675	4,581	1,070.08	5,250,646	175,124	15,103.86
Haddock				69,652	1,788	160.36
Herring, pickled	59,186	808	295.43	382,249	6,332	1,500.45
Herring, smoked				32,152	1,080	166.75
Mackerel, pickled	220	5	2.20	14,659	450	144.75
Pollock				2,288	75	5.20
Total	202,081	5,394	1,367.71	5,751,646	184,849	17,081.37
1901.						
Cod	214,908	9,105	1,627.50	5,208,608	217,950	38,748.20
Haddock				58,982	2,029	442.00
Herring, pickled	12,967	511	65.27	891,792	19,107	4,446.02
Herring, smoked				97,250	2,096	660.16
Mackerel, pickled	2,800	110	28.00	122,027	5,165	1,219.95
Salmon, pickled				6,300	330	63.00
Lobsters, canned				20	6	Free.
Total	230,675	9,726	1,720.77	6,384,979	246,683	45,579.33
1902.						
Cod	759,709	28,119	5,774.75	6,506,594	270,670	48,800.56
Haddock				30,254	1,047	226.90
Herring, pickled	185,251	3,840	926.29	1,043,698	26,134	5,153.61
Herring, smoked				9,000	180	63.75
Mackerel, pickled	600	14	6.00	17,345	705	173.45
Salmon, pickled				192	5	1.92
Fish in tins	2,000	445	133.50	5,400	1,022	306.60
Total	947,560	32,418	6,840.54	7,612,483	299,763	54,726.79

Table showing the amount, value, and duty of fishery imports from the British North American provinces to Porto Rico during the years 1899, 1900, 1901, 1902—Continued.

Description.	San Juan.			Total.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.						
Dry, pickled, smoked, canned fish, etc	1,759,265	$59,803	$4,437.00	12,736,213	$457,004	$29,822.80
1900.						
Cod	2,673,640	93,304	13,704.56	8,290,901	281,063	31,565.55
Haddock	14,850	487	111.38	84,502	2,275	271.74
Herring, pickled	172,299	3,000	525.21	642,434	10,663	2,464.09
Herring, smoked	21,240	435	111.00	53,392	1,515	277.75
Mackerel, pickled	4,464	112	44.64	21,743	687	215.59
Pollock				2,288	75	5.20
Salmon, pickled	886	51	8.86	886	51	8.86
Total	2,887,379	97,389	14,505.65	9,096,146	296,329	34,808.78
1901.						
Alewives, pickled	980	15	7.00	980	15	7.00
Cod	2,662,945	101,486	18,627.81	9,370,612	392,525	68,943.36
Cusk	2,250	15	3.00	2,250	15	3.00
Haddock	36,351	1,239	273.00	95,333	3,268	715.00
Hake	14,969	497	112.00	14,969	497	112.00
Herring, pickled	266,805	6,205	1,332.25	1,285,464	28,132	6,413.04
Herring, smoked	12,750	379	113.70	111,300	2,520	783.61
Mackerel, pickled	39,887	1,326	399.00	174,014	6,987	1,739.95
Salmon, pickled	330	15	3.00	6,630	345	66.00
Lobsters, canned				20	6	Free.
Total	3,037,267	111,177	20,870.76	11,061,572	434,260	78,782.96
1902.						
Cod	2,932,096	107,321	20,930.74	11,012,566	425,980	81,604.80
Haddock				39,254	1,302	294.40
Herring, pickled	380,155	7,895	1,920.81	1,784,372	41,269	8,877.05
Herring, smoked				23,150	466	173.94
Mackerel, pickled	14,708	560	147.03	33,553	1,299	335.48
Salmon, pickled				192	5	1.92
Fish in tins	2,000	402	120.60	9,550	1,902	570.60
Total	3,328,959	116,178	23,119.18	12,902,637	472,223	91,858.19

Table showing quantity, value, and duty of fishery imports from Italy to Porto Rico in 1899, 1901, and 1902.

District.	Year.	Products.	Lbs.	Value.	Duty.
Arecibo	1901	Fish in tins	100	$10	$4.00
Ponce	1899	Dry, pickled, smoked, canned fish, etc	2,233	643	9.48
	1902	Fish sounds	110	29	Free.
San Juan	1899	Dry, pickled, smoked, canned fish, etc	113	19	3.00

Table showing quantity, value, and duty of fishery imports from England, Cuba, and Norway to Porto Rico in 1899 and 1900.

Whence imported.	Products.	Year.	San Juan.		
			Lbs.	Value.	Duty.
England	Dry, pickled, smoked, canned fish, etc	1899	43,230	$1,941	$190.00
Do	Cod	1900	450	21	3.38
Cuba	Dry, pickled, smoked, canned fish, etc	1899	960	28	2.00
Norway	do	1899	2,619	384	13.00

Table showing the amount, value, and duty of fishery imports from Germany to Porto Rico during the years 1899, 1900, 1901, and 1902.

Description.	Mayaguez.			Ponce.			San Juan.			Total.		
	Lbs.	Val.	Duty.	Lbs.	Val.	Duty.	Lbs.	Val.	Duty.	Lbs.	Val.	Duty.
1899.												
Dry, pickled, smoked, canned fish, etc	1,741	$64	$10	......	......	......	12,398	$878	$31.10	14,139	$942	$31.20
1900.												
Cod	......	......	......	......	......	......	8,045	541	48.86	8,045	541	48.86
1901.												
Cod	......	......	......	......	......	......	10,575	755	152.69	10,575	755	152.69
Salmon, canned	......	......	......	......	......	......	150	25	7.50	150	25	7.50
Sardines	......	......	......	......	......	......	2,000	379	202.50	2,000	379	202.50
Fish in tins	......	......	......	50	$5	$1.50	700	136	40.80	750	141	42.30
Total	......	......	......	50	5	1.50	13,425	1,295	403.49	13,475	1,300	404.99
1902.												
Cod	......	......	......	......	......	......	4,572	318	40.33	4,572	318	40.33

Table showing the amount, value, and duty of fishery imports from Spain to Porto Rico during the years 1899, 1900, 1901, 1902.

Description.	Arecibo.			Humaçao.			Mayaguez.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc	14,616	$615	$92.34	100	$13	$2.00	......	......	......
1902.									
Fish in tins	......	......	......	......	......	......	125	$24	$7.20

Description.	Ponce.			San Juan.			Total.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899.									
Dry, pickled, smoked, canned fish, etc	39,374	$2,541	$289.85	290,984	$15,125	$2,445.00	345,074	$18,294	$2,829.19
1900.									
Cod	44	2	.10	1,500	109	11.25	1,544	111	11.35
Devil-fish	354	26	4.00	......	......	......	354	26	4.00
Herring, pickled	......	......	......	1,587	59	7.93	1,587	59	7.93
Sardines	......	......	......	10,650	1,936	1,236.44	10,650	1,936	1,236.44
Fish in tins	......	......	......	3,350	857	257.10	3,350	857	257.10
Fish sounds	61	29	.14	......	......	......	61	29	.14
Oysters, canned	......	......	......	300	58	Free.	300	58	Free.
Total	459	57	4.24	17,387	3,019	1,512.72	17,846	3,076	1,516.96
1901.									
Cod	400	32	5.00	369	39	6.07	769	71	11.07
Herring, pickled	......	......	......	217	9	1.62	217	9	1.62
Sardines	4,060	716	301.20	9,800	2,079	1,017.17	13,860	2,795	1,318.37
Shrimp, canned	30	5	Free.	......	......	......	30	5	Free.
Fish in tins	......	......	......	2,900	631	199.20	2,900	631	199.20
Total	4,490	753	306.20	13,286	2,758	1,224.06	17,776	3,511	1,530.26
1902.									
Mackerel, pickled	......	......	......	1,000	30	10.00	1,000	30	10.00
Sardines	13,900	2,408	1,256.50	49,900	8,850	4,320.42	63,800	11,258	5,576.92
Shrimp, canned	4,225	472	Free.	2,300	439	Free.	6,525	911	Free.
Fish in tins	80	19	5.70	3,180	637	191.10	3,385	680	204.00
Total	18,205	2,899	1,262.20	56,380	9,956	4,521.52	74,710	12,879	5,790.92

Table showing the amount, value, and duty of fishery imports from France to Porto Rico during the years 1899, 1900, 1901, 1902.

Year.	Description	Mayaguez.			Ponce.		
		Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899	Dry, pickled, smoked, canned fish, etc.				30,038	$1,193	$182.00
1900	Herring, pickled				57	5	1.00
	Sardines	120	$20	$4.50	417	76	18.97
	Total	120	20	4.50	474	81	19.97
1901	Sardines				650	104	28.75
	Fish in tins				200	34	10.20
	Total				850	138	38.95
1902	Sardines	550	132	20.80	500	95	18.69

Year.	Description.	San Juan.			Total.		
		Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899	Dry, pickled, smoked, canned fish, etc.	13,309	$1,369	$60.00	43,347	$2,562	$242.00
1900	Herring, pickled				57	5	1.00
	Sardines	1,270	213	40.15	1,807	309	63.62
	Total	1,270	213	40.15	1,864	314	64.62
1901	Sardines	4,350	712	231.85	5,000	816	260.60
	Fish in tins				200	34	10.20
	Total	4,350	712	231.85	5,200	850	270.80
1902	Sardines	3,550	609	108.62	4,600	836	148.11
	Fish in tins	1,300	256	76.80	1,300	256	76.80
	Total	4,850	865	185.42	5,900	1,092	224.91

Table showing the quantity, value, and duty paid on fishery products imported into Porto Rico during 1899, 1900 1901, and 1902.

Year.	Foreign importations.			Domestic importations.			Total importations.		
	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.	Lbs.	Value.	Duty.
1899	13,187,928	$481,817	$33,142.67	4,679,691	$152,742	$10,103.43	17,867,619	$634,559	$43,246.10
1900	9,124,351	300,281	36,442.60	2,810 238	97,267	2,426.86	11,934,589	397,548	38,869.46
1901	11,098,123	439,931	80,993.01	3,046,894	97,714		14,145,017	537,645	80,993.01
1902	12,987,929	486,541	97,914.35	769,994	154,868		16,757,923	641,409	97,914.35

RECORDS

OF THE

DREDGING AND OTHER COLLECTING STATIONS OF THE U. S. FISH COMMISSION STEAMER ALBATROSS

IN

1901 and 1902.

List of abbreviations employed in these records.

Abbreviation.	Meaning.	Abbreviation.	Meaning.	Abbreviation.	Meaning.
alg	algæ.	mi	miles.	Alb. Blk	Albatross pattern Blake beam trawl.
bk	black.	min	mineral.		
botm	bottom.	mts	minutes.	4′ Blk., 5½′ Blk., etc.	4-foot Blake beam trawl, 5½-foot Blake beam trawl, etc.
br	brown.	nod	nodules.		
brk	broken.	oz	ooze.	Blk. Dr	Blake deep-sea dredge.
bu	blue.	p	pebbles.	Bt. Dr	Boat dredge.
c	clay.	part	particles.	Ch. Tgls	Chain tangles.
choc	chocolate color.	posn	position.	D. N	Dip net.
co	coral.	pter	pteropods.	Dr	Dredge.
corln	coralline.	pum	pumice.	E. L	Electric light.
crs	coarse.	r	rock.	Gl. N	Gill net.
dd	dead.	rad	radiolaria.	Hp	Hemp.
dk	dark.	rd	red.	L. B. T	Large beam trawl.
estd	estimated.	rky	rocky.	Op. Int	Open intermediate tow net.
fms	fathoms.	rot	rotten.	R	Reef collecting or reef collections.
fne	fine.	s	sand.	S	Shore collecting or shore collections.
for	foraminifera.	sft	soft.		
frag	fragments.	sh	shells.	S. B. T	Small beam trawl.
g	gravel.	slat	slate color.	Sh. Dr	Ship dredge.
glob	globigerina.	sml	small.	Sig. S. M	Sigsbee sounding machine.
gn	green.	sp	specks.	Surf. N	Surface tow net.
gy	gray.	st	stones.	Swbs	Swabs.
h or hr	hour.	stbd	starboard.	Td. Int	Townsend intermediate tow net.
hrd	hard.	stf	stiff.	Tgls	Tangles
lav	lava.	stk	sticky.	8′ Tnr., 10′ Tnr., etc.	8-foot Tanner beam trawl; 10-foot Tanner beam trawl, etc.
lge	large.	vol	volcanic.		
lt	light.	wh	white.	Tnr. Int	Tanner intermediate tow net.
m	mud.	yl	yellow.	Tnr. S. M	Tanner sounding machine.
mang	manganese.				

RECORDS OF THE DREDGING AND OTHER COLLECTING STATIONS OF THE U. S. FISH COMMISSION STEAMER ALBATROSS IN 1901 AND 1902.

In 1902 the dredging, trawling, and other collecting operations of the *Albatross* were all embraced within the limits of a cruise to the Hawaiian Islands in pursuance of investigations concerning the fishes and fisheries of that archipelago. In 1901 but four stations were occupied, all on the west coast of the United States.

In the following records all stations where apparatus was employed for the purpose of collecting natural-history specimens are given dredging numbers in chronological order, and each piece of apparatus used at each station is given a separate line.

The time of a sounding is the time when the plummet strikes the bottom by the ship's local time.

The time of a net or dredge haul is the hour when such apparatus is in place or position and the actual towing or dredging commenced.

In the case of open intermediate nets the time occupied in hoisting to the surface is also noted.

Where two surface nets were used the actual time that both nets were in the water together is given as if but one piece of gear were employed.

The remarks show how many single hauls of a surface net were made at each station.

Almost invariably the dredging stations were located by soundings at each end of the line, and a majority of the dredgings were on lines of continuous development.

The drift is the direction and distance traveled over the ground in the case of bottom gear, and through the water—after getting in position—in the case of other nets. No account is taken of the distance traveled by the ship while nets are being lowered or hoisted.

"Tanner with brace" is an ordinary Tanner beam-trawl frame with a T bar joining the upper sides of the runners near the heels, thus increasing the rigidity of the whole frame. This modification was suggested by Mr. A. B. Alexander.

The "Albatross-Blake beam-trawl frame" embraces a number of improvements on the old Blake frame, suggested by Commander Chauncey Thomas, U. S. Navy, and Mr. H. C. Fassett, U. S. Fish Commission.

Record of the dredging and other collecting stations of the Albatross in 1901 and 1902.

Station No.	Date.	Time of day.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			° ′ ″	° ′ ″	° F.	° F.	° F.	Fms.			Fms.	Hr. M.		′	
	1901.														
D. 3787	Apr. 25	11.26 a. m.	39 48 20	124 47 15	50	50	42.0	754	fne. s. gn. m...	8′ Tnr	....	....	S. 85° W...	1¼	
			Punta Gorda, N. 36° E., 33¼ miles.												
D. 3788	Apr. 27	8.36 a. m.	43 01 00	125 12 30	46	50	35.9	1,064	gn. m	8′ Tnr	....	....	East	2	
			Cape Blanco Light, S. 69° E., 30 miles.												
D. 3789	Apr. 30	9.23 a. m.	48 21 45	124 52 30	53	51	.....	115	crs. gy. s. g	8′ Tnr	....	....	N. 49° E...	1¼	
			Tatoosh Island Light, N. 73° E., 5.7 miles.												
D. 3790	Apr. 30	11.10 a. m.	48 20 15	124 59 00	58	52	.....	122	gn. m. st	20′ Special....	....	....	N. 35° E...	1¼	Frame badly damaged.
			Tatoosh Island Light, N. 72° E., 10.4 miles.												
			Erben Bank and vicinity, North Pacific Ocean, eastern part.												
	1902.														
D. 3791	Mar. 14	1.48 p. m.	33 08 45	130 41 00	57	60	.....	2,629	lt. br. m	Sig. S. M	....	....	....	....	Ran off [illegible] edge cable to [illegible]
		2.50 p. m.			57	60	.....			Surf. N	Surface.	0 30	W	0.7	Lining of [illegible]
		4.56 p. m.			58	60	.....			Op. Int	100	30	W	.7	Net torn [illegible]
D. 3792	Mar. 15	8.44 a. m.	32 54 00	132 23 45	57	60	38.5	1,059	bk. mang. s. for. r.	Sig. S. M	....	....	....	....	
		9.50 a. m.			57	60	.....			Surf. N	Surface.	47	N. 4° E...	.9	Hauled 2 times.
		10.20 a. m.			57	60	38.5			8′ Tnr.........	Bottom.	35	N. 4° E...	1	Lost frame; net wrecked.
D. 3793	Mar. 15	4.27 p. m.	32 52 55	132 34 10	62	61	39.0	545	mang. s. for. r.	Sig. S. M	....	....	....	....	
		4.52 p. m.			62	61	.....	.....	....	Surf. N	Surface.	40	N. 30° E...	1	Hauled 3 times.
		5.12 p. m.			61	60	39.0	545–412	mang. s. for. r.	10 hp. Tgls....	Bottom.	23	N. 30° E...	.5	Lost tangles and frame.
D. 3794	Mar. 16	11.26 a. m.	32 52 00	132 34 15	68	61	38.0	781	for. mang. sp. r	Sig. S. M	....	....	....	....	
		11.53 a. m.			69	62	.....			Surf. N	Surface.	7	N. 82° W..	.2	
		12.35 p. m.			70	62	38.0			Sh. Dr.; 2 Hp. Swbs.	Bottom.	5	N. 82° W..	.1	Lost dredge and swabs.
D. 3795	Mar. 16	3.06 p. m.	32 54 00	132 33 40	59	61	38.7	583	for. bk. sp. r...	Sig. S. M	....	....	....	....	
		3.44 p. m.			59	61	38.7			2 Hp. Swbs ...	Bottom.	13	N. 53° W..	.3	Set cod trawl.

			Erben Bank to Kaiwi Channel, Hawaiian Ids.												
D. 3796	Mar.17	9.00 a. m.	32 00 00	134 30 00	66	62	.....	(Did not sound.)		Surf. N	Surface.	45	S. 62° W ..	1.5	Hauled 3 times.
		9.00 a. m.			66	62	.....			Op. Int	4	45	S. 62° W ..	1.5	Do.
D. 3797	Mar.17	7.20 p. m.	31 55 00	136 00 00	60	63	.....	(Did not sound.)		Surf. N	Surface.	25	S. 62° W ..	1	Do.
		7.20 p. m.			60	63	.....			Op. Int	4	20	S. 62° W ..	.9	Hauled 2 times.
D. 3798	Mar.18	9.05 a. m.	30 08 05	138 00 00	60	63	.....	(Did not sound.)		Surf. N	Surface.	25	S. 62° W ..	1	Do.
		9.05 a. m.			60	63	.....			Op. Int	4	25	S. 62° W ..	1	Do.
D. 3799	Mar.18	7.20 p. m.	29 22 00	139 31 00	63	65	.....	(Did not sound.)		Surf. N	Surface.	31	S. 62° W ..	1.3	Hauled 4 times.
		7.43 p. m.			63	65	.....			Op. Int	100	20	S. 62° W ..	.5	10 min. coming up; 1 haul.
D. 3800	Mar.19	9.21 a. m.	28 23 00	141 41 05	63	66	.....	(Did not sound.)		Td. Int	100	6	S. 62° W ..	.3	5 min. coming up; 1 haul; failure.
		9.18 a. m.			63	66	.....			Surf. N	Surface.	12	S. 62° W ..	.3	1 haul.
		9.40 a. m.			63	66	.....			....do	Surface.	24	N. 1° E....	.7	2 hauls.
		9.59 a. m.			63	66	.....			Op Int	100	18	N. 1° E....	.5	9 min. coming up; 1 haul.
D. 3801	Mar.19	11.48 a. m.	28 31 00	141 47 00	69	66	.....	(Did not sound.)		2 Op. Int. set tandem.	100	22	N. 11° W..	.3	Do.
		12.35 p. m.			70	66	.....			....do	100 to 120	24	N. 11° W..	.5	6 min. coming up; 1 haul.
D. 3802	Mar.20	9.07 a. m.	27 04 15	144 18 30	71	68	.....	(Did not sound.)		....do	150	31	N. 11° W..	.8	12 min. coming up; 1 haul; upper net wrecked.
		10.04 a. m.			71	68	.....			Op. Int	4	15	N. 11° W..	.5	1 haul.
D. 3803	Mar.21	9.20 a. m.	25 39 45	147 41 45	69	70	.....	(Did not sound.)		....do	50	19	N. 68° W..	.5	4 min. coming up; 1 haul.
D, 3804	Mar.21	7.20 p. m.	24 58 42	149 11 00	67	69	.....	(Did not sound.)		Surf. N	Surface.	30	N. 46° W..	1	3 hauls.
		7.23 p. m.			67	69	.....			Op. Int	50	28	N. 46° W..	.7	5 min. coming up; 1 haul.
D. 3805	Mar.22	8.39 a. m.	24 08 15	150 51 00	69	70	.....	(Did not sound.)		....do	50	30	N. 23° E...	.8	4 min. coming up; 1 haul.
D. 3806	Mar.22	7.16 p. m.	23 25 36	152 24 30	70	71	.....	(Did not sound.)		....do	50	20	N. 16° E...	.5	5 min. coming up; 1 haul.
		7.47 p. m.			70	71	.....			....do	25	20	N. 16° E...	.5	2 min. coming up; 1 haul.
D. 3807	Mar.23	8.44 a. m.	22 43 15	154 17 30	70	72	.....	(Did not sound.)		Surf. N	Surface to 10ft.	30	S. 55° W ..	1	3 hauls.
		8.47 a. m.			70	72	.....			Op. Int	50	20	S. 55° W ..	.5	5 min. coming up; 1 haul.
D. 3808	Mar.23	7.30 p. m.	22 10 00	155 35 45	70	73	.....	(Did not sound.)		Surf. N	Surface.	30	S. 55° W...	1	3 hauls.
		7.33 p. m.			70	73	.....			Op. Int	50	30	S. 55° W...	.8	5 min. coming up; 1 haul.
			South coast of Oahu Island.												
D. 3809	Mar.27	2.36 p. m.	Honolulu Light, N. 28°, E. 2′.		72	75	.....	125	fne.co.s.bk.sp.	Tnr. S. M	....	....	....	....	
		2.36 p. m.			72	75	.....	....	....	Surf. N	Surface.	28	N. 77° E...	.7	2 hauls.
		2.51 p. m.			72	75	.....	125–51	fne.co.s.bk.sp.	8′ Tnr.; 2 Hp. Swbs.	Bottom.	15	N. 77° E...	.5	
D. 3810	Mar.27	3.38 p. m.	Honolulu Light, N. 2°, E. 2.4′.		72	75	47.7	211	fne. co. s	Tnr. S. M	....	....	....	....	
		3.40 p. m.			72	75	.....	....	....	Surf. N	Surface.	22	E	.7	Do.
		3.52 p. m.			72	75	47.7	211–53	fne. co. s	8′ Tnr.; Sh. Dr.; 2 Hp. Swbs.	Bottom.	20	E	.5	
D. 3811	Mar.27	4.52 p. m.	Honolulu Light, N. 4°, W. 3.9′.		72	74	70.5	238	co. s. r.........	Tnr. S. M	....	....	....	....	
		4.59 p. m.			72	74	.....	....	....	Surf. N	Surface.	27	N. 39° E...	1	Do.
		5.13 p. m.			72	74	.....	238–52	co. s. r.........	8′ Tnr.; 2 Hp. Swbs.	Bottom.	15	N. 39° E...	1.3	Frame broken; net badly torn.
D. 3812	Mar.27	7.30 p. m.	Diamond Head Lt., S. 63°, E. 1.3′.		72	74	.....	6½	co. co. s	E. L., D. N	Surface.	1 03	....	....	Night anchorage.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length	Drift. Direction.	Drift. Distance.	Remarks.
			South coast of Oahu Island—C't'd.	° F.	° F.	° F.	*Fms.*			*Fms.*	*Hr. M.*			
	1902.													
D. 3813	Mar. 28	7.03 a.m.	Diamond Head Light, N. 76°, E. 2.2'.	72	74	41.5	264	co.s.lav.sp.sh.	Tnr. S. M					3 hauls.
		7.07 a.m.		72	74				Surf. N	Surface.	0 32	S. 83° E	0.7	
		7.27 a.m.		72	74	41.5	264–183	co.s.lav.sp.sh.	8' Tnr.; 2 Hp. Swbs.	Bottom.	20	S. 83° E	.3	
D. 3814	Mar. 28	8.30 a.m.	Diamond Head Light, NE. 1.7'.	72	74	46.0	284	co. s. sh. st	Tnr. S. M					2 hauls.
		8.52 a.m.		72	74				Surf. N	Surface.	21	S. 82° E	.7	
		9.00 a.m.		72	74	46.0	284–42	co. s. sh. st	8' Tnr	Bottom.	21	S. 82° E	.5	
D. 3815	Mar. 28	10.11 a.m.	Diamond Head Light, N. 18°, W. 3.2'.	73	75	43.8	312	crs. co. s. brk. sh.	Tnr. S. M					Do.
		10.33 a.m.		73	75				Surf. N	Surface.	18	N. 39° E	.5	
		11.04 a.m.		73	75	43.8	312–228	crs. co. s. brk. sh.	8' Tnr	Bottom.	21	N. 39° E	.7	
D. 3816	Mar. 28	11.57 a.m.	Diamond Head Light, N. 70°, W. 5.3'.	77	76	74.0?	228	fne. co. s. co. part. r.	Tnr. S. M					
		12.22 p.m.		77	76	74.0?	228–320	fne. co. s. co. part. r.	8' Tnr	Bottom.	12	N. 70° E	.5	Lost 25 fms. dredge cable, 8' Tanner beam trawl, frame and net complete, 200-pound dredging sinker, 3 tail weights, bridle, shackles, clips, float, etc.
D. 3817	Mar. 28	1.12 p.m.	Diamond Head Lt., N. 77°, W. 8.4'.	76	76	73.5?	320	crs. lav. co. s. sh.	Tnr. S. M					
		1.46 p.m.		76	76	73.5?			5½' Blk	Bottom.	30	N. 76° E	.7	
D. 3818	Mar. 31	9.19 a.m.	Diamond Head Lt., N. 59°, E. 4.3'.	73	74	44.3	293	fne. co. s. bk. sp.	Sig. S. M					2 hauls.
		9.20 a.m.		73	74				Surf. N	Surface.	33	N. 52° E	.5	
		9.44 a.m.		73	74	44.3	293–295	fne. co. s. bk. sp.	5½' Blk	Bottom.	21	N. 52° E	.3	
			South coast of Molokai Island.											
D. 3819	Mar. 31	2.12 p.m.	Lae-o Ka Laau Lt., S. 48°, E. 5.4'.	79	75	73.0	70	co. s. co. r	Sig. S. M					
		2.30 p.m.		79	75	73.0	70–99	co. s. co. r.	Sh. Dr	Bottom.	10	N. 41° E	.3	
D. 3820	Mar. 31	3.13 p.m.	Lae-o Ka Laau Lt., S. 54°, E. 5'.	79	75	72.0	65	fne. co. s. brk. sh.	Sig. S. M					
		3.28 p.m.		79	75	72.0	65–121	fne. co. s. brk. sh.	8' Tnr	Bottom.	15	N. 1° W	.5	Water haul.

D. 3821	Mar. 31	7.10 p. m.	Lae-o Ka Laau Lt., N. 69°, W. 2.8′.	76	76	.....	6	co. s.	E. L., D. N.....	Surface.	1	20	....	....	Night anchorage. Set lobster pot, used hand lines.
D. 3822	Apr. 1	7.46 a. m.	Lae-o Ka Laau Lt., N. 37°, W. 4.9′.	76	76	76.1	45	fne. gy. s. brk. sh.	Sig. S. M	....		....	....	....	
		8.00 a. m.		76	76	76.1	45–78	fne. gy. s. brk. sh.	8′ Tnr.........	Bottom.		20	S. 6° W....	.4	
		8.05 a. m.		76	76	.....	....	....	Surf. N........	Surface.		20	S. 6° W....	.4	2 hauls.
D. 3823	Apr. 1	8.35 a. m.	Lae-o Ka Laau Light, N. 34°, W. 5.1′.	76	75	69.0	78	fne. s. p......	Sig. S. M......	....		....	....	....	Took series of temperatures.
		8.49 a. m.		76	75	.....	....	....	Surf. N	Surface.		10	S. 40° E...	.2	1 haul.
		9.13 a. m.		76	75	69.0	78–222	fne. s. p......	8′ Tnr.; Sh. Dr.; 2 Hp. Swbs.	Bottom.		12	S. 40° E...	.3	
D. 3824	Apr. 1	9.45 a. m.	Lae-o Ka Laau Light, N. 35°, W. 6.1′.	77	75	49.5	222	co. r. brk. sh..	Sig. S. M......	....		....	....	....	Took series of temperatures.
		10.05 a. m.		77	75	.....	....	....	Surf. N	Surface.		11	S. 66° E...	.3	1 haul.
		10.30 a. m.		77	75	49.5	222–498	co. r. brk. sh..	8′ Tnr.; Sh. Dr.; 2 Hp. Swbs.	Bottom.		20	S. 66° E...	.5	
D. 3825	Apr. 1	11.28 a. m.	Lae-o Ka Laau Lt., N. 43°, W. 8′.	78	75	62.0?	498	gy. m. s.......	Sig. S. M......	....		....	....	....	
		11.46 a. m.		78	75	.....			Op. Int	75		7	S. 66° E...	.3	11 m. coming up; 1 haul.
D. 3826	Apr. 1	12.08 p. m.	Lae-o Ka Laau Light, N. 46°, W. 9.2′.	74	76	41.5	430	gy. m. co. r...	Sig. S. M......	....		....	....	....	
		1.00 p. m.		74	76	41.5	430–371	gy. m. co. r...	8′ Tnr.; Sh. Dr.; 2 Hp. Swbs.	Bottom.		9	S. 29° E...	.1	Net badly torn; frame bent.
D. 3827	Apr. 1	2.09 p. m.	Lae-o Ka Laau Light, N. 44° 30′, W. 10.3′.	77	76	42.1	371	lt. gy. br. m ..	Sig. S. M......	....		....	....	....	
		2.48 p. m.		77	76	42.1	371–319	lt. gy. br. m ..	5¼′ Blk.; Sh. Dr.	Bottom.		3	S. 68° E...	.1	Net badly torn.
D. 3828	Apr. 1	3.42 p. m.	Lae-o Ka Laau Light, N. 46°, W. 11′.	76	76	43.8	319	brk. sh. g.....	Sig. S. M......	....		....	....	....	
		4.13 p. m.		76	76	43.8	319–281	brk. sh. g.....	6 Hp. Tgls	Bottom.		13	S. 80° E...	.7	
D. 3829	Apr. 1 – Apr. 2	7.40 p. m.	Avalu Point, Lanai Id., South, ¼′.	73	75	.....	20	hrd. s.........	E. L., D. N....	Surface.	1	40	....	....	Night anchorage.
		8.10 p. m.		73	75	.....			Surf. N	Surface.	1	10	(?)	2	Towed alongshore from boats; several hauls.
		7.00 a. m.		.....	.....	.....			R. and S. coll.	....	6		....	....	Shore and reef collections given same station number.
D. 3830	Apr. 2	8.49 a. m.	Lae-o Ka Laau Light, N. 54° 30′, W. 13′.	76	75	45.2	272	lt. br. m	Sig. S. M......	....		....	....	....	
		9.12 a. m.		76	75	45.2	272–261	lt. br. m	6 Hp. Tgls	Bottom.		13	S. 1° E....	.7	Water haul; no signs of gear having been on bottom.
D. 3831	Apr. 2	9.46 a. m.	Lae-o Ka Laau Light, N. 46°, W. 13.6′.	74	75	45.1	261	br. m. co. s. r. co.	Sig. S. M......	....		....	....	....	
		10.12 a. m.		74	75	45.1	261–178	br. m. co. s. r. co.	5¼′ Blk........	Bottom.		23	S. 46° E...	.5	Frame lost; net wrecked.
D. 3832	Apr. 2	2.32 p. m.	Lae-o Ka Laau Light, N. 69° 30′, W. 14.5′.	77	76	.....	153	br. m. s.......	Sig. S. M......	....		....	....	....	
		2.54 p. m.		77	76	.....	153–142	br. m. s.......	8′ Tnr.........	Bottom.		46	N. 76° E...	.7	
D. 3833	Apr. 2	3.59 p. m.	Lae-o Ka Laau Light, N. 72°, W. 15.6′.	75	76	63.0	142	s. p. brk. sh. r.	Sig. S. M......	....		....	....	....	
		4.25 p. m.		75	76	.....	....	....	Surf. N	Surface.		10	N. 11° E...	.1	1 haul.
		4.41 p. m.		75	76	63.0	142–88	s. p. brk. sh. r.	8′ Tnr.; Sh. Dr.	Bottom.		20	N. 11° E...	.2	Lost ship's dredge; 8′ Tnr. frame broken; net wrecked.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
	1902.		*South coast of Molokai Id.—C't'd.*	° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*			
D. 3834	Apr. 2 Apr. 3	6.50 p.m. 7.20 p.m. 8.00 a.m.	Kaunakakai Landing, N. 22°, E. ¾′.	74 74	74 74	....	8	co. r. s. sh	E. L., D. N. Surf. N S. and R. coll.	Surface. Surface.	1 55 1 5 4	....	....	Night anchorage. Towed from boom in tidal current; anchored. Shore collections given same station number.
D. 3835	Apr. 3	2.03 p.m. 2.28 p.m.	Lae-o Ka Laau Lt., N. 64°, W. 13.7′.	79 79	76 76	55.0 55.0	169 169–182	fne. br. s. m fne. br. s. m	Sig. S. M 9′ Tnr.; 2 Hp. Swbs.	.... Bottom.	 13	.... N. 65° W.	.... 0.2	
D. 3836	Apr. 3	3.43 p.m. 4.12 p.m.	Lae-o Ka Laau Light, N. 58° 30′, W. 11.8′.	76 76	76 76	48.0 48.0	238 238–255	br. gy. m. s br. gy. m. s	Sig. S. M 9′ Tnr.; 2 Hp. Swbs.	.... Bottom.	 22	.... S. 74° W.	9	
D. 3837	Apr. 3	8.00 p.m. 8.00 p.m.	Lae-o Ka Laau Lt., N. 82°, W. 7.4′.	74	76	....	13	yl. s	E. L., D. N. Gl. N. at boom	Surface. Surface.	1 25 All ni't	....	....	Night anchorage; 3/10 mile from shore.
D. 3838	Apr. 4	7.33 a.m. 7.54 a.m.	Lae-o Ka Laau Light, N. 74° 30′, W. 8.1′.	72 72	75 75	67.0 67.0	92 92–212	fne. gy. br. s. fne. gy. br. s.	Sig. S. M 6 Hp. Tgls	.... Bottom.	 22	.... S. 17° E.	6	
D. 3839	Apr. 4	8.59 a.m. 9.31 a.m.	Lae-o Ka Laau Lt., N. 64°, W. 9.7′.	76 76	76 76	46.3 46.3	259 259–266	lt. br. m. s lt. br. m. s	Sig. S. M 9′ Tnr.	.... Bottom	 25	.... S. 4° W.	7	
D. 3840	Apr. 4	10.28 a.m. 11.04 a.m. 11.13 a.m.	Lae-o Ka Laau Light, N. 60°, W. 10′.	74 74 74	75 75 75	46.0 46.0	266 266–314	lt. br. m. s. r lt. br. m. s. r	Sig. S. M 9′ Tnr Surf. N	.... Bottom. Surface.	.... 18 11	.... S. 88° W. S. 88° W.	.... .3 .1	Frame bent; net wrecked. 1 haul.
D. 3841	Apr. 4	12.21 p.m. 1.02 p.m.	Lae-o Ka Laau Light, N. 55°, W. 8.9′.	75 75	75 75	45.0 45.0	314 314–336	fne. br. s. m. r. fne. br. s. m. r.	Sig. S. M 5¼′ Blk	.... Bottom.	 21	.... N. 89° W.	5	Water haul; no signs of net having been on bottom.
D. 3842	Apr. 4	2.41 p.m. 3.37 p.m.	Lae-o Ka Laau Lt., N. 40°, W. 8.5′.	74 74	75 75	40.5 40.5	495 495–506	fne. br. s. m. r. fne. br. s. m. r.	Sig. S. M 5¼′ Blk	.... Bottom.	 15	.... N. 63° W.	1	
D. 3843	Apr. 4	7.35 p.m.	Lae-o Ka Laau Light, N. 68° 45′, W. 2.8′.	72	75	....	11	s	E. L., D. N	Surface.	55	....	....	Night anchorage; off Hale Lono coast.
D. 3844	Apr. 8	7.00 a.m.	Kaunakaki Harbor, Molokai.	....	....	....	(Did not sound.)		S. and R. coll.	....	2	....	....	
D. 3845	Apr. 8	9.48 a.m. 10.03 a.m. 10.15 a.m.	Lae-o Ka Laau Light, N. 69° 30′, W. 18.1′.	76 76 76	76 76 76	71.0 71.0	60 60–64	crs. s. p. sh crs. s. p. sh	Sig. S. M 6 Hp. Tgls Surf. N	.... Bottom. Surface.	.... 20 5	.... S. 73° E. S. 73° E.	.... .7 .1	1 haul.
D. 3846	Apr. 8	10.34 a.m. 10.49 a.m. 10.55 a.m.	Lae-o Ka Laau Light, N. 69° 45′, W. 19.1′.	76 76 76	76 76 76	71.5 71.5	64 64–60	crs. br. s. sh. g. crs. br. s. sh. g.	Sig. S. M 5¼′ Blk Surf. N	.... Bottom. Surface.	.... 22 16	.... N. 49° E. N. 49° E.	.... .6 .3	Do.

D. 3847	Apr. 8	12.05 p. m.	Lae-o Ka Laau Light, N. 64° 30′, W. 23′.	75	76	.....	23	s. st..........	Hand lead....		....	....	....	
		12.17 p. m.		75	76	.....	23–24	s. st..........	6 Hp. Tgls	Bottom.	21	N. 36° E...	.8	
D. 3848	Apr. 8	3.04 p. m.	Lae-o Ka Laau Light, N. 68° 15′, W. 22.4′.	80	76	71.1	44	s. g	Sig. S. M		....	....	....	
		3.22 p. m.		80	76	.....	.....	....	Surf. N........	Surface.	14	N. 8° E....	.4	Do.
		3.42 p. m.		80	76	71.1	44–73	s. g	5¼′ Blk........	Bottom.	4	N. 8° E....	.1	
D. 3849	Apr. 8	3.57 p. m.	Lae-o Ka Laau Light, N. 71°, W. 21.9′.	80	76	67.6	73	cr . s. brk. sh. co.	Tnr. S. M		....	....	....	
		4.14 p. m.		80	76	67.6	73–43	crs. s. brk. sh. co.	10′ Blk........	Bottom.	30	N. 25° E...	.8	
		4.18 p. m.		80	76	.....	.....	....	Surf. N........	Surface.	24	N. 25° E...	.6	Do.
D. 3850	Apr. 8	4.55 p. m.	Lae-o Ka Laau Light, N. 74° 15′, W. 22.2′.	80	76	71.7	43	crs. s. brk. sh. co.	Tnr. S. M		....	....	....	
		5.06 p. m.		80	76	71.7	43–66	crs. s. brk. sh. co.	10′ Blk........	Bottom.	22	N. 55° E...	.8	
D. 3851	Apr. 8	7.20 p. m.	Kamalo Landing, North, 0.8′.	74	74	.....	6¼	s. sh. co.......	E. L., D. N	Surface.	1 27	....	....	Night anchorage.
D. 3852	Apr. 9	8.24 a. m.	Mokuhooniki Islet, N. 49° 30′, E. 14.7′.	73	74	74.1	47	s. r. p.........	Tnr. S. M		....	....	....	
		8.42 a. m.		73	74	.....	.....	....	Surf. N........	Surface.	5	N. 50° E...	.3	1 haul.
		8.46 a. m.		73	74	74.1	47–115	s. r. p.........	10′ Blk........	Bottom.	10	N. 50° E...	.7	Net torn.
D. 3853	Apr. 9	9.06 a. m.	Mokuhooniki Islet, N. 49° 45′, E. 12.6′.	74	73	68.5	115	crs. s. sh	Tnr. S. M		....	....	....	
		9.41 a. m.		74	73	68.5	115–134	crs. s. sh	5¼′ Blk........	Bottom.	7	S. 83° E ...	.2	
D. 3854	Apr. 9	10.08 a. m.	Mokuhooniki Islet, N. 46° 45′, E. 12′.	75	74	69.7	134	s. sh. r	Sig. S. M		....	....	....	
		10.35 a. m.		75	74	69.7	134–130	s. sh. r	9′ Tnr..........	Bottom.	2	N. 15° E...	.1	Frame broken; net wrecked.
D. 3855	Apr. 9	11.03 a. m.	Mokuhooniki Islet, N. 50° 15′, E. 11′.	76	75	65.5	130	fne. br. s. g....	Sig. S. M		....	....	....	
		11.31 a. m.		76	75	65.5	130–127	fne. br. s. g....	6 Hp. Tgls	Bottom.	20	S. 79° E ...	.8	
			Pailolo Channel, between Molokai and Maui Ids., and NE. approach.											
D. 3856	Apr. 9	12.09 p. m.	Mokuhooniki Islet, N. 42° 45′, E. 10′.	76	74	66.5	127	fne. s. yl. m ...	S . S. M		....	....	....	
		12.38 p. m.		76	74	66.5	127–127	fne. s. yl. m ...	5¼′ Blk........	Bottom.	16	N. 74° E...	.3	
D. 3857	Apr. 9	1.20 p. m.	Mokuhooniki Islet, N. 38° 45′, E. 9′.	77	74	62.5	127	fne. s. yl. m ...	Sig. S. M		....	....	....	
		1.44 p. m.		77	74	62.5	127–128	fne. s. yl. m ...	10′ Blk........	Bottom.	19	N. 68° E...	.4	
D. 3858	Apr. 9	2.24 p. m.	Mokuhooniki Islet, N. 35°, E. 8.1′.	79	74	61.5 / 61.8	128	fne. s. gy. m ...	Sig. S. M		....	....	....	
		2.48 p. m.		79	74	61.5 / 61.8	128–138	fne. s. gy. m ...	10′ Blk	Bottom.	20	N. 62° E...	.3	
D. 3859	Apr. 9	4.04 p. m.	Mokuhooniki Islet, N. 18°, E. 5.6′.	76	74	60.2 / 60.5	138	fne. s. m	Sig. S. M		....	....	....	
		4.28 p. m.		76	74	60.2 / 60.5	138–140	fne. s. m	10′ Blk	Bottom.	20	N. 35° E...	.4	
D. 3860	Apr. 9	7.05 p. m.	Napili Landing, Maui, SW 0.5′.	73	75	.....	6¼	r. co. s	E. L., D. N	Surface.	2 15	....	....	Night anchorage.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures.			Depth.	Kind of bottom.	Instrument used.	Trial.		Drift.		Remarks.
				Air.	Surface.	Bottom.				Depth.	Length.	Direction.	Distance.	
	1902.		*Pailolo Channel, between Molokai and Maui Ids., and NE. approach*—C't'd.	° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 3861	Apr. 10	6.54 a. m.	Mokuhooniki Islet, N. 13° 15′, W. 7.4′.	72	74	.....	30	fne. s. sm. p. co.	Tnr. S. M	....	....	....	....	Position, ¼ west from Honokahu Point, NW. end Maui.
		7.06 a. m.		72	74	.....	30–52	fne. s. sm. p. co.	5 Hp. Tgls	Bottom.	0 8	N. 8° E....	0.3	
		7.10 a. m.		72	74	.....	....	....	Surf. N	Surface.	12	N. 8° E....	.5	1 haul.
D. 3862	Apr. 10	7.45 a. m.	Mokuhooniki Islet, N. 16° 45′, W. 4.9′.	73	75	68.0 68.5	108	crs. s. sh. r	Tnr. S. M	....	....	....	....	
		8.08 a. m.		73	75	68.0 68.5	108–127	crs. s. sh. r	5¼′ Blk	Bottom.	14	N. 1° W ...	.8	Net torn.
D. 3863	Apr. 10	8.42 a. m.	Mokuhooniki Islet, N. 31°, W. 2.7′.	74	76	60.0 61.0	127	brk. co. crs. g. r.	Sig. S. M	....	....	....	....	
		9.02 a. m.		74	76	60.0 61.0	127–154	brk. co. crs. g. r.	8 Hp. Tgls	Bottom.	20	N. 20° W ..	.9	
D. 3864	Apr. 10	11.40 a. m.	Mokuhooniki Islet, N. 67° 45′, W. 4.1′.	77	75	55.9 57.5	163	fne. vol. s. sh..	Sig. S. M	....	....	....	....	
		12.03 p. m.		77	75	.....	....	....	Surf. N	Surface.	27	N. 46° E...	1	1 haul.
		12.05 p. m.		77	75	55.9 57.5	163–198	fne. vol. s. sh..	5¼′ Blk	Bottom.	20	N. 46° E...	.9	Apron wrecked.
D. 3865	Apr. 10	1.22 p. m.	Mokuhooniki Islet, S. 79°, W. 6.9′.	77	76	44.8 45.0	256	fne. vol. s. r...	Sig. S. M	....	....	....	....	
		1.55 p. m.		77	76	.....	....	....	Surf. N	Surface.	10	N. 14° E...	.1	1 haul.
		1.59 p. m.		77	76	44.8 45.0	256–283	fne. vol. s. r...	10′ Blk	Bottom.	20	N. 14° E...	.2	Heavy strain on gear, but no damage done.
D. 3866	Apr. 10	3.07 p. m.	Mokuhooniki Islet, S. 70° 15′, W. 7.6′.	75	75	43.8 43.8	283	gy. m. fne. s...	Sig. S. M	....	....	....	....	
		3.47 p. m.		75	75	43.8	283–284	gy. m. fne. s...	10′ Blk	Bottom.	30	N. 37° E...	.4	
D. 3867	Apr. 10	5.06 p. m.	Mokuhooniki Islet, S. 64° 30′, W. 9.1′.	80	75	43.8 44.0	284	fne. s. m	Sig. S. M	....	....	....	....	
		6.00 p. m.		80	75	43.8 44.0	284–290	fne. s. m	10′ Blk	Bottom.	16	N. 54° E...	.2	
D. 3868	Apr. 11	5.37 a. m.	Mokuhooniki Islet, S. 57°, W. 14.3′.	74	74	43.6 44.5	294	fne. gy. s. r....	Sig. S. M	....	....	....	....	
		6.21 a. m.		74	74	43.6 44.5	294–684	fne. gy. s. r....	10′ Blk	Bottom.	31	N. 27° E...	.9	Net badly torn.

D. 3869	Apr. 11	7.40 a. m.	Mokuhooniki Islet, S. 52°, W. 17.0′.	74	74	38.8	684	br. m. r	Sig. S. M						
						38.8									
		9.03 a. m.		74	74	38.8	684–759	br. m. r	9′ Tnr	Bottom.		50	N. 49° E.	1	Lost everything below dredging sinker.
			Auau Channel, between Maui and Lanai islands.												
D. 3870	Apr. 11	7.00 p. m.	Lahaina Landing, Maui, N. 64°, E. 0.4′.	77	76	.....	14	co. s. sh. st. co.	E. L., D. N.	Surface.	2	30			Night anchorage.
D. 3871	Apr. 12	7.27 a. m.	Mokuhooniki Islet, N. 3°, W. 15.9′.	72	76	.....	13	fne. wh. s	Hand lead						About ¼ mile offshore; near preceding station.
		7.39 a. m.		72	76	.....	13–43	fne. wh. s	6 Hp. Tgls	Bottom.		20	S. 70° W.	1	
		7.51 a. m.		72	76				Surf. N	Surface.		10	S. 70° W.	.5	1 haul.
D. 3872	Apr. 12	8.10 a. m.	Mokuhooniki Islet, N. 3°, E. 16.6′.	77	76	74.6	43	yl. s. p. co.	Tnr. S. M						
		8.19 a. m.		77	76	74.6	43–32	yl. s. p. co.	5¼′ Blk	Bottom.		9	SW	.4	
D. 3873	Apr. 12	8.36 a. m.	Mokuhooniki Islet, N. 5°, E. 17.3′.	77	76	74.6	32	co. p.	Tnr. S. M						
		8.43 a. m.		77	76	74.6	32–37	co. p.	6 Hp. Tgls	Bottom.		15	S. 57° W.	.9	
D. 3874	Apr. 12	10.31 a. m.	Mokuhooniki Islet, N. 19° 45′, E. 18.2′.	81	76	75.3	21	s. p. sh	Tnr. S. M						
		10.38 a. m.		81	76	75.3	21–28	s. p. sh	6 Hp. Tgls	Bottom.		11	S. 25° W.	.3	
D. 3875	Apr. 12	12.25 p. m.	Mokuhooniki Islet, N. 14° 30′, E. 13.7′.	78	77	70.8	65	fne. gy. s	Tnr. S. M						
		12.37 p. m.		78	77	70.8	65–34	fne. gy. s	9′ Tnr	Bottom.		17	E.	.5	
D. 3876	Apr. 14	7.30 a. m.	Lahaina Light, Maui, N. 60° 45′, E. 1.6′.	73	75	.....	28	s. g	Sig. S. M						
		7.39 a. m.		73	75	74.0	28–43	s. g	9′ Tnr	Bottom.		5	S. 52° W.	.3	
D. 3877	Apr. 14	8.50 a. m.	Lahaina Light, Maui, N. 30° 15′, W. 4.8′.	76	77	74.0	25	co. r	Tnr. S. M						
		9.00 a. m.		76	77	74.0			6 Hp. Tgls	Bottom.	(?)				Lost 85 fms. dredging cable, 250-pound sinker, tangle gear complete, etc.
			South of Lanai Island, and west of Kahoolawe Island.												
D. 3878	Apr. 14	7.43 p. m.	Molokini Islet, N. 81°, E. 51.2′.	74	77	.....	(Did not sound.)		2 Surf. N., tandem.	Surface.		57	SE.	2	5 hauls.
		7.48 p. m.		74	77	.....			Op. Int		75	22	SE.	1	7 m. coming up; 1 haul.
D. 3879	Apr. 15	9.36 a. m.	Molokini Islet, N. 75°, E. 42.6′.	76	77	37.1	923	glob. oz. r	Sig. S. M						
		11.02 a. m.		76	77	37.1	923–1,081	glob. oz. r	5¼′ Blk.; Sh. Dr.	Bottom.		24	N. 50° E.	.3	Lost Blake frame and most of net. Cable stranded at 1,830 fms., and badly kinked in lower section.
D. 3880	Apr. 15	8.35 p. m.	Molokini Islet, S. 79°, E. 15.2′.	76	76	.....	(Did not sound.)		2 Surf. N., tandem.	Surface.		15	N. 20° E.	1	1 haul.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures.			Depth.	Kind of bottom.	Instrument used.	Trial.		Drift.		Remarks.
				Air.	Surface.	Bottom.				Depth.	Length.	Direction.	Distance.	
			Pailolo Channel, between Maui and Molokai islands.											
	1902.			° F.	° F.	° F.	Fms.			Fms.	Hr. M.		′	
D. 3881	Apr. 16	9.00 a. m.	Napili Harbor, Maui Island.	....	....	....	(Did not sound.)		S. R. coll	....	2 30	....	....	Landing party.
D. 3882	Apr. 16	12.15 p. m. 12.37 p. m.	Mokuhooniki Islet, N. 30°, W. 3.1′.	79 79	76 76	63.5 63.5	136	s. co. r	Tnr. S. M ..... 6 Ch. Tgls.....	.... Bottom.	3	N. 47° E...	0.1	Lost 1 chain swab.
D. 3883	Apr. 16	2.04 p. m. 2.44 p. m.	Mokuhooniki Islet, S. 80° 30′, W. 7.8′.	77 77	76 76	45.2 45.2	277 277–284	glob. oz .... glob. oz	Sig. S. M....... 9′ Tnr	.... Bottom.	31	N. 36° E...	.6	
D. 3884	Apr. 16	3.53 p. m. 4.42 p. m.	Mokuhooniki Islet, S. 75°, W. 9.2′.	76 76	75 75	44.0 44.0	284 284–290	glob. m .... glob. m	Sig. S. M....... 9′ Tnr	.... Bottom.	20	N. 68° E...	.5	
D. 3885	Apr. 17	7.47 a. m. 8.03 a. m.	Mokuhooniki Islet, N. 27°, W. 3.3′.	75 75	76 76	64.8 64.8	136 136–148	s. p .... s. p	Tnr. S. M..... 2 Ch. Tgls.; 1 Hp. Swbs.	.... Bottom.	21	N. 58° E...	.6	
D. 3886	Apr. 17	8.37 a. m. 8.49 a. m. 8.52 a. m.	Mokuhooniki Islet, N. 47°. W. 3.4′.	75 75 75	76 76 76	65.0 ..... 65.0	148 148–148	p. r .... p. r	Tnr. S. M..... Surf. N .... 3 Ch. Tgls	.... Surface. Bottom.	 23 21	 N. 10° W.. N. 10° W..	 .9 .8	2 hauls.
			North Coast of Molokai Island.											
D. 3887	Apr. 17	10.54 a. m. 11.59 a. m.	Mokuhooniki Islet, S. 15°, W. 8.8′.	76 76	74 74	39.5 39.5	552 552–809	glob. m....... glob. m.......	Sig. S. M....... 9′ Tnr	.... Bottom.	20	N. 50° W..	.4	
D. 3888	Apr. 17	1.34 p. m. 2.55 p. m.	Mokuhooniki Islet, S. 2°, W. 10.2′.	78 78	74 74	37.5 37.5	809	fne. yl. s. glob.	Sig. S. M..... 9′ Tnr	.... Bottom.	7	N. 79° W..	.1	Frame badly bent and broken; net wrecked.
D. 3889	Apr. 17	7.13 p. m.	Mokapu Islet, S. 73° 30′, W. 5.0′.	74	74	.....	(Did not sound.)		2 Surf. N., tandem.	Surface.	1 2	N. 78° W..	1	5 hauls.
D. 3890	Apr. 18	7.19 a. m. 7.34 a. m.	Mokapu Islet, S. 77° 30′, W. 2.8′.	75 75	74 74	71.2 71.2	71 71–283	bk. s.......... bk. s..........	Tnr. S. M..... 2 Ch., 1 Hp. Tgls.	.... Bottom.	20	N. 11° W..	.8	Evidently on bottom only part of time.
D. 3891	Apr. 18	8.35 a. m. 9.13 a. m.	Mokapu Islet, S. 30°, W. 4.1′.	75 75	73 73	40.1 40.1	466 466–641	vol. s. brk. sh. lav. vol. s. brk. sh. lav.	Sig. S. M..... Sh. Dr	.... Bottom.	10	N. 37° W..	.3	
D. 3892	Apr. 18	3.17 p. m. 3.58 p. m.	Mokapu Islet, S. 66° 15′, E. 9.8′.	77 77	74 74	42.5 42.5	328 328–414	fne. gy. s...... fne. gy. s......	Sig. S. M..... 5½′ Blk	.... Bottom.	15	N. 44° W..	.3	

			Kaiwi Channel, between Molokai and Oahu islands.											
D. 3893	Apr. 19	7.46 a. m. 8.18 a. m. 8.27 a. m.	Lae-o Ka Laau Light, S. 34°, E. 7.1′.	74 74 74	76 76 76	47.0 ..... 47.0	220 220–346	fne. wh. s. r... ..... fne. wh. s. r...	Sig. S. M...... Surf. N....... 9′ Tnr........	..... Surface. Bottom.	..... 20 27	..... N. 56° W.. N. 56° W..	..... .7 .8	2 hauls. Bridle stops parted; net capsized and torn.
D. 3894	Apr. 19	10.28 a. m. 11.05 a. m.	Lae-o Ka Laau Light, S. 60° 15′, E. 14.1′.	76 76	76 76	42.9 42.9	374	gy. s. sh. r....	Sig. S. M...... 10′ Blk........	..... Bottom.	10	N. 50° W..	.2	Frame complete wreck; net torn beyond repair.
			South of Molokai Island and west of Lanai Island.											
D. 3895	Apr. 28	2.51 p. m. 3.23 p. m.	Lae-o Ka Laau Light, N. 3° 30′, E. 6.5′.	73 73	75 75	47 47	252 252–429	co. r.......... co. r..........	Sig. S. M...... 5½′ Blk........	..... Bottom.	23	S. 41° W..	.4	Lost complete Blake beam-trawl frame and net.
			Auau Channel, between Maui and Lanai islands.											
D. 3896	Apr. 29	8.16 a. m. 8.37 a. m.	Mokuhooniki Islet, N. 30°, E. 12.4′.	73 73	74 74	63.1 63.1	126 126–130	s. p. brk. sh... s. p. brk. sh...	Tnr. S. M..... 9′ Tnr........	..... Bottom.	19	N. 5° E...	.3	
			Pailolo Channel, between Maui and Molokai islands.											
D. 3897	Apr. 29	9.42 a. m. 10.04 a. m.	Mokuhooniki Islet, N. 24° 45′, E. 11.2′.	72 72	74 74	62.9 62.9	123 123–134	fne. br. s...... fne. br. s......	Tnr. S. M..... 9′ Tnr........	..... Bottom.	20	N. 8° W...	.5	
D. 3898	Apr. 29	2.25 p. m. 3.00 p. m.	Mokuhooniki Islet, S. 81° 45′, W. 9.5′.	78 78	74 74	44.1 44.1	258 258–284	br. glob. m. fne. s. br. glob. m. fne. s.	Sig. S. M...... 9′ Tnr........	..... Bottom.	32	N. 7° W...	.8	
D. 3899	Apr. 29	4.02 p. m. 4.41 p. m.	Mokuhooniki Islet, S. 69°, W. 9.8′.	79 79	75 75	44.2 44.2	284 284–283	br. glob. m. fne. s. br. glob. m. fne. s.	Sig. S. M...... 9′ Tnr........	..... Bottom.	30	N. 16° W..	.7	
D. 3900	Apr. 29	5.42 p. m. 6.15 p. m.	Mokuhooniki Islet, S. 58°, W. 10.1′.	75 75	75 75	43.9 43.9	283 283–280	br. glob. m. fne. s. br. glob. m. fne. s.	Sig. S. M...... 9′ Tnr........	..... Bottom.	30	N. 13° W..	.8	
D. 3901	Apr. 29	7.23 p. m. 7.41 p. m. 8.02 p. m.	Mokuhooniki Islet, S. 48°, W. 10.9′	74 74 74	74 74 74	44.0 ..... 44.0	280 280–311	glob. s. brk. sh ..... glob. s. brk. sh	Sig. S. M...... Surf. N....... 9′ Tnr........	..... Surface. Bottom.	..... 40 30	..... N. 15° W.. N. 15° W..	..... 1 .8	4 hauls.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
	1902.		*North coast of Molokai Island.*	° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 3902	Apr. 30	8.17 a. m. 8.53 a. m.	Mokapu Islet, S. 76° 30′, W. 9.4′.	70 70	74 74	62.0 62.0	138 138–165	gy. s. co. sh gy. s. co. sh	Sig. S. M. 6 Ch. Tgls	Bottom.	21	N. 7° W.	0.6	Swabs came up clean; evidently not on bottom.
D. 3903	Apr. 30	10.15 a. m. 11.26 a. m.	Mokapu Islet, S. 58°, W. 10.5′.	76 76	74 74	38.1 38.1	714	fne. s. br. m. r.	Sig. S. M. 9′ Tnr	Bottom.	28	N. 13° E.	.2	Lost complete Tanner beam-trawl frame and net.
D. 3904	Apr. 30	3.55 p. m. 4.26 p. m.	Mokapu Islet, S. 76°, W. 13′.	76 76	75 75	43.9 43.9	295	br. m. s. r.	Sig. S. M. 8′ Blk	Bottom.	4	W.	.1	
D. 3905	Apr. 30	7.30 p. m.	Off Kalaupapa leper settlement, ¼′.	72	75	....	20	hard s. sh	E. L., D. N.	Surface.	1 15			Night anchorage.
D. 3906	May 1	2.35 p. m. 2.56 p. m.	Mokapu Islet, S. 74°, E. 12.8′.	74 74	75 75	72.0 72.0	66 66–96	gy. s. sh. p gy. s. sh. p	Sig. S. M. 6 Ch. Tgls	Bottom.	11	N. 16° W.	.3	Broke thrust spring of reeling engine.
			South coast of Oahu Island.											
D. 3907	May 5	9.42 a. m. 10.01 a. m. 10.12 a. m.	Diamond Head Light, N. 23°, E. 9.6′.	75 75 75	75 75 75	43.7 43.7	315 315–304	fne. wh. s. m fne. wh. s. m	Sig. S. M. Surf 8′ Blk.; 2 Hp. Swbs.	Surface. Bottom.	20 20	N. 29° E. N. 29° E.	.9 .9	2 hauls.
D. 3908	May 5	11.05 a. m. 11.33 a. m. 11.35 a. m.	Diamond Head Light, N. 21°, E. 6.9′.	73 73 73	75 75 75	43.8 43.8	304 304–308	fne. wh. s. m fne. wh. s. m	Sig. S. M. 8′ Blk Surf. N	Bottom. Surface.	31 20	N. 5° W. N. 5° W.	.8 .5	Do.
D. 3909	May 5	12.36 p. m. 1.05 p. m.	Diamond Head Light, N. 31°, E. 5.3′.	75 75	75 75	43.5 43.5	308 308–322	fne. wh. s. m fne. wh. s. m	Sig. S. M. 8′ Blk	Bottom.	30	N. 50° E.	.8	
D. 3910	May 5	3.33 p. m. 4.06 p. m.	Diamond Head Light, N. 7°, E. 12.5′.	73 73	76 76	43.7 43.7	311 311–337	fne. gy. s. m. fne. gy. s. m.	Sig. S. M 11′ Tnr	Bottom.	31	N. 13° W.	.6	
D. 3911	May 5	5.16 p. m. 5.34 p. m. 5.48 p. m.	Diamond Head Light, N. 10°, E. 11′.	74 74 74	76 76 76	43.2 43.2	337 337–334	fne. gy. s. m. fne. gy. s. m.	Sig. S. M Surf. N 11′ Tnr	Surface. Bottom.	1 3 32	N. 51° W. N. 51° W.	1.2 .6	4 hauls.
D. 3912	May 5	6.59 p. m. 7.13 p. m. 7.38 p. m.	Diamond Head Light, N. 20°, E. 10.2′.	72 72 72	76 76 76	43.0 .... 43.0	334 334–310	fne. gy. s. m. fne. gy. s. m.	Sig. S. M Surf. N 11′ Tnr	Surface. Bottom.	48 30	N. 20° E. N. 20° E.	.8 .5	Do.
D. 3913	May 6	5.07 a. m.	Diamond Head Light, N. 20°, E. 17′.	71	74	....	(Did not sound.)		Surf. N	Surface.	13	N. 40° W.	.8	1 haul.
D. 3914	May 6	5.28 a. m. 6.25 a. m. 6.34 a. m.	Diamond Head Light, N. 23° 10′, E. 16.4′.	71 71 71	74 74 74	....	289 289–292	gy. s. m. gy. s. m.	Sig. S. M Surf. N 11′ Tnr	Surface. Bottom.	10 20	N. 49° W. N. 49° W.	.3 .5	Do.

D. 3915	May 6	7.28 a. m. 7.58 a. m.	Diamond Head Light, N. 30°, E. 15.9′.	72 72	76 76	46.0 46.0	292 292-299	gy. s. r gy. s. r	Sig. S. M 11′ Tnr	Bottom.	3	N. 70° E	.1	Lost 80 fms. cable, and complete Tanner beam-trawl frame and net; also 250-pound dredging sinker.
D. 3916	May 6	10.12 a. m. 10.45 a. m.	Diamond Head Light, N. 40°, E. 9.7′.	74 74	76 76	44.0 44.0	299 299-330	gy. s. m gy. s. m	Sig. S. M 8′ Blk	Bottom.	30	N. 62° W	.8	
D. 3917	May 6	11.51 a. m. 12.22 p. m.	Diamond Head Light, N. 50° 30′, E. 10.3′.	76 76	76 76	44.0 44.0	330 330-294	gy. s. m gy. s. m	Sig. S. M 11′ Tnr	Bottom.	31	N. 16° E	1	
D. 3918	May 6	1.31 p. m. 1.58 p. m.	Diamond Head Light, N. 63°, E. 8′.	77 77	76 76	44.5 44.5	294 294-257	wh. s. m wh. s. m	Sig. S. M. 11′ Tnr	Bottom.	42	N. 14° W	1.3	
D. 3919	May 6	3.09 p. m. 3.36 p. m.	Diamond Head Light, N. 84°, E. 7.9′.	75 75	76 76	45.6 45.6	257 257-220	gy. s gy. s	Sig. S. M. 11′ Tnr	Bottom.	26	N. 17° W	.5	
D. 3920	May 6	5.18 p. m. 5.55 p. m.	Diamond Head Light, N. 74°, E. 8.9′.	75 75	76 76	44.6 44.6	280 280-265	gy. s. brk. sh gy. s. brk. sh	Sig. S. M 11′ Tnr	Bottom.	15	N. 34° E	.3	
D. 3921	May 6	8.45 p. m.	Diamond Head Light, S. 62°, E. 3.9′.	72	75	.....	13	co. s. brk. sh	E. L., D. N	Surface.	49			Night anchorage; off Honolulu.
D. 3922	May 7	8.39 a. m. 9.13 a. m.	Diamond Head Light, N. 73°, E. 13.3′.	77 77	76 76	44.5 44.5	281 281-369	lt. gy. s. brk. sh. co. r. lt. gy. s. brk. sh. co. r.	Sig. S. M 8′ Blk	Bottom.	8	S. 62° W	.2	Lost Blake beam-trawl frame and net
D. 3923	May 7	9.58 a. m. 10.29 a. m.	Diamond Head Light, N. 72° 30′, E. 14.5′.	77 77	76 76	40.7 40.7	369 369-298	fne. gy. s. r fne. gy. s. r	Sig. S. M 8 Hp. Tgls	Bottom.	33	S. 23° E	.8	Eye-bolt drew out of crown; lost complete tangle outfit.
D. 3924	May 7	1.37 p. m. 2.12 p. m.	Diamond Head Light, N. 23° 30′, E. 12.6′.	75 75	75 75	44.0 44.0	301 301-338	fne. s. yl. m. r. fne. s. yl. m. r.	Sig. S. M 11′ Tnr	Bottom.	22	N. 9° W	.3	Lost Tanner beam-trawl frame and net.
D. 3925	May 7	3.58 p. m. 4.27 p. m.	Diamond Head Light, N. 29° 30′, E. 10.2′.	75 75	76 76	43.7 43.7	323 323-299	fne. gy. s. m. r. fne. gy. s. m. r.	Sig. S. M 8′ Tnr. with brace.	Bottom.	16	N. 4° E	.5	Bridle stops parted; net capsized and torn.
			From Honolulu to Laysan Island.											
			Lat. N. / Long. W. ° ′ ″ / ° ′ ″											
D. 3926	May 10	7.15 p. m.	21 13 00 / 158 43 00	74	75	.....	(Did not sound.)		Surf. N	Surface.	50	N. 70° W	2	5 hauls.
D. 3927	May 11	6.26 p. m. 7.03 p. m.	21 31 00 / 161 55 00	74 74	76 76	35.1	2,529	br. m	Sig. S. M Surf. N	Surface.	1	N. 70° W	2.3	6 hauls.
D. 3928	May 12	5.49 p. m. 6.32 p. m.	22 28 00 / 164 30 00	74 74	76 76	36.7	2,535	br. m	Sig. S. M Surf. N	Surface.	1 11	N. 70° W	2.3	7 hauls.
D. 3929	May 13	6.38 p. m.	23 19 00 / 166 54 00	74	75	.....	(Did not sound.)		Surf. N	Surface.	1 10	N. 63° W	2.5	Do.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			From Honolulu to Laysan Island—Continued.												
	1902.		° ′ ″	° ′ ″	° F.	° F.	° F.	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 3930	May 15	6.37 p. m.	25 07 00	170 50 00	74	74	.....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	1 0	N. 50° W..	2	12 hauls (6 simultaneously each side).
D. 3931	May 15	11.00 p. m.	25 27 00	171 08 00	74	74	.....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	20	N. 50° W..	.7	4 hauls (2 simultaneously each side).
			Vicinity of Laysan Island.												
D. 3932	May 16	4.13 a. m	25 45 00	171 32 00	74	73	.....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	1 0	N. 50° W..	2	10 hauls (5 simultaneously each side).
								Fms.							
D. 3933	May 16	8.22 a. m. 8.28 a. m.	Laysan Island Light, S. 79° 30′, E. 3.8′		76 76	75 75	74.0 74.0	23 23–19	wh. s. brk. sh. r wh. s. brk. sh. r	Tnr. S. M...... 6 Ch. Tgls.....	Bottom.	13	N. 85° W..	.8	Eyebolt drew out in head of crown; lost frame complete, and 6 chain tangles swabs.
D. 3934	May 16	9.17 a. m. 9.23 a. m.	Laysan Island Light, S. 80° 30′, E. 6.1′.		75 75	75 75	73.2 73.2	28 28–57	wh. s. brk. sh.. wh. s. brk. sh..	Tnr. S. M....... 2 Hp. Swbs....	Bottom.	15	N. 73° W..	.9	
D. 3935	May 16	9.44 a. m. 9.55 a. m.	Laysan Island Light, S. 79° 30′, E. 7.3′.		76 76	75 75	71.1 71.1	57 57–79	wh. s. brk. sh. corln. wh. s. brk. sh. corln.	Tnr. S. M....... Oyster Dr.....	Bottom.	15	S. 27° W...	.4	
D. 3936	May 16	10.23 a. m. 10.35 a. m. 10.46 a. m.	Laysan Island Light, S. 84°, E. 7.5′		81 81 81	76 76 76	68.0 68.0	79 79–130	sml. brk. sh. corln. sml. brk. sh. corln.	Tnr. S. M....... Sh. Dr......... Surf. N........	 Bottom. Surface.	 15 10	 S. 27° W... S. 27° W...	 .3 .2	 1 haul.
D. 3937	May 16	10.59 a. m. 11.11 a. m.	Laysan Island Light, S. 87°, E. 7.2′.		79 79	76 76	63.0 63.0	130 130–148	wh. s. sml. sh.. wh. s. sml. sh .	Tnr. S. M...... Sh. Dr.........	Bottom.	20	S. 39° W...	.2	
D. 3938	May 16	11.38 a. m. 11.52 a. m.	Laysan Island Light, S. 88° 30′. E. 7.8′.		79 79	76 76	60.3 60.3	148 148–163	wh. s. brk. sh . wh. s. brk. sh .	Tnr. S. M...... 5¼′ Blk........	Bottom.	20	S. 65° W...	.3	
D. 3939	May 16	12.31 p. m. 12.59 p. m.	Laysan Island Light, S. 89° 30′, E. 8.1′.		77 77	76 76	57.5 57.5	163 163–59	wh. s. brk. sh. r wh. s. brk. sh. r	Tnr. S. M...... 8′ Tnr. with Brace.	Bottom.	31	N. 62° E...	.7	Lost frame, float, apron, weights, etc.; fragment net recovered.

D. 3940	May 16	1.47 p.m.	Laysan Island Light, S. 84°, E. 7.0′.	81	76	70.0	59	wh. s. brk. sh.	Tnr. S. M.	....	....	....	....	
		2.00 p.m.		81	76	70.0	59–70	wh. s. brk. sh.	5½′ Blk.	Bottom.	20	S. 31° W.	.3	
D. 3941	May 16	2.28 p.m.	Laysan Island Light, S. 87°, E. 7.2′.	81	76	68.5	70	brk. sh. rd. corln.	Tnr. S. M.	....	....	....	....	
		2.55 p.m.		81	75	68.5	70–146	brk. sh. rd. corln.	8′ Tnr.	Bottom.	20	S. 74° W.	.5	Water haul; net probably not on bottom.
D. 3942	May 16	3.25 p.m.	Laysan Island Light, S. 89°, E. 7.8′.	77	76	62.0	146	wh. s. brk. sh.	Tnr. S. M.	....	....	....	....	
		3.40 p.m.		77	76	....	....	....	Surf. N.	Surface.	10	S. 75° W.	.2	1 haul.
		3.44 p.m.		77	76	62.0	146–222	wh. s. brk. sh.	8′ Tnr.	Bottom.	22	S. 75° W.	.5	
D. 3943	May 16	4.28 p.m.	Laysan Island Light, N. 89°, E. 8.8′.	76	76	53.9	222	fne. wh. s.	Sig. S. M.	....	....	....	....	Shark bit stray-line lead while sounding; wire going down.
		4.57 p.m.		76	76	53.9	222–100	fne. wh. s.	8′ Tnr.	Bottom.	20	S. 82° E.	.3	
D. 3944	May 19	10.24 a.m.	Laysan Island Light, N. 77°, E. 8.6′.	75	74	51.4	253	fne. wh. s.	Sig. S. M.	....	....	....	....	
		10.50 a.m.		75	74	51.4	253–590	fne. wh. s.	8′ Tnr.	Bottom.	21	N. 58° W.	.4	Water haul; touched on one runner, for moment only.
D. 3945	May 19	11.38 a.m.	Laysan Island Light, N. 81°, E. 9.2′.	75	74	38.7	590	fne. wh. s.	Sig. S. M.	....	....	....	....	
		12.34 p.m.		75	74	38.7	590–1,140	fne. wh. s.	8′ Tnr.	Bottom.	15	S. 38° W.	.2	
D. 3946	May 19	3.09 p.m.	Laysan Island Light, S. 85°, E. 8.0′.	76	74	64.2	124	wh. s. co. frag.	Sig. S. M.	....	....	....	....	
		3.34 p.m.		76	74	64.2	124–199	wh. s. co. frag.	8′ Tnr.	Bottom.	20	N. 24° W.	.3	
D. 3947	May 19	4.13 p.m.	Laysan Island Light, S. 78°, E. 8.6′.	74	74	56.2	199	fne. wh. s. brk. sh.	Sig. S. M.	....	....	....	....	
		4.43 p.m.		74	74	56.2	199–97	fne. wh. s. brk. sh.	8′ Tnr.	Bottom.	32	N. 61° E.	1.1	
D. 3948	May 21	8.28 a.m.	Laysan Island Light, SE. 7.9′.	74	76	74.0	38	co. s.	Tnr. S. M.	....	....	....	....	
		8.44 a.m.		74	76	74.0	38–59	co. s.	7 Hp. Tgls.	Bottom.	12	N. 60° E.	1	
D. 3949	May 21	9.06 a.m.	Laysan Island Light, S. 35°, E. 7.7′.	76	75	69.5	59	wh. s. brk. sh.	Tnr. S. M.	....	....	....	....	
		9.23 a.m.		76	75	69.5	59–152	wh. s. brk. sh.	Oyster Dr.	Bottom.	5	N. 48° E.	.3	
D. 3950	May 21	9.37 a.m.	Laysan Island Light, S. 19°, E. 8.0′.	76	75	.....	152	wh. co. s. co. frag.	Tnr. S. M.	....	....	....	....	Stray line parted; lost instruments.
		10.01 a.m.		76	75	.....	152–329	wh. co. s. co. frag.	11′ Tnr.	Bottom.	20	N. 84° E.	.6	
D. 3951	May 21	10.45 a.m.	Laysan Island Light, S. 8°, E. 7.8′.	76	75	46.9	329	co. r.	Sig. S. M.	....	....	....	....	
		11.19 a.m.		76	75	46.9	329–351	co. r.	11′ Tnr.	Bottom.	20	S. 83° E.	.5	Very heavy strains; lost frame, net, float, and tail weight; everything except bridle and shackles.
D. 3952	May 21	12.47 p.m.	Laysan Island Light, S. 10°, W. 7.6′.	77	77	45.0	351	wh. s. g.	Sig. S. M.	....	....	....	....	
		1.22 p.m.		77	77	45.0	351–347	wh. s. g.	5½′ Blk.	Bottom.	5	S. 88° E.	.1	
D. 3953	May 21	2.12 p.m.	Laysan Island Light, S. 17°, W. 7.7′.	77	76	45.0	347	wh. s. g. co. r.	Sig. S. M.	....	....	....	....	
		2.40 p.m.		77	76	45.0	347–264	wh. s. g. co. r.	5½′ Blk.	Bottom.	8	S. 25° E.	.1	Frame, net, and apron recovered badly damaged.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures.			Depth.	Kind of bottom.	Instrument used.	Trial.		Drift.		Remarks.
				Air.	Surface.	Bottom.				Depth.	Length.	Direction.	Distance.	
	1902.		*Vicinity of Laysan Id.—Cont'd.*	° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 3954	May 21	4.10 p. m. 4.23 p. m.	Laysan Island Light, S. 14°, W. 6.4′.	77 77	75 75	73.0 73.0	30 30–20	wh. s. p. r wh. s. p. r	Tnr. S. M Oyster Dr.	Bottom.	0 2	S. 25° W	0.1	Framework badly bent
D. 3955	May 21	4.31 p. m. 4.39 p. m.	Laysan Island Light, S. 12° 30′, W. 6.1′.	77 77	75 75	74.0 74.0	20 20–30	co. r. alg co. r. alg	Tnr. S. M 7 Hp. Tgls	Bottom.	15	S. 77° E	.2	
D. 3956	May 22	8.36 a. m. 8.56 a. m.	Laysan Island Light, E. 7.9′.	80 80	76 76	61.1 61.1	135 135–96	crs. wh. s. r crs. wh. s. r	Sig. S. M 11′ Tnr	Bottom.	8	N. 1° W	.2	Lost frame, net, float, etc.
D. 3957	May 22	9.44 a. m. 10.11 a. m.	Laysan Island Light, S. 87°, E. 8.2′.	81 81	76 76	53.5 53.5	220 220–173	fne. wh. s fne. wh. s	Sig. S. M 8′ Tnr	Bottom.	28	N. 7° E	.7	
D. 3958	May 22	11.03 a. m. 11.32 a. m.	Laysan Island Light, S. 76° 30′, E. 8.2′.	81 81	76 76	59.0 59.0	173 173–182	crs. wh. s crs. wh. s	Sig. S. M 8′ Tnr	Bottom.	20	S. 20° W	.4	
D. 3959	May 22	1.45 p. m. 1.47 p. m.	Laysan Island Light, N. 75°, E. 1.3′.	80	78	.....	10	wh. s. co	Hand lead 6 Hp. Tgls	Bottom.	3	S. 32° W	.1	
D. 3960	May 22	2.18 p. m. 2.20 p. m.	Laysan Island Light, N. 67°, E. 1.5′.	81 81	76 76	....	10 10–19	s. sh. co s. sh. co	Hand lead 6 Hp. Tgls	Bottom.	15	S. 55° W	.5	
D. 3961	May 22	2.48 p. m. 2.55 p. m.	Laysan Island Light, N. 57°, E. 3.5′.	81 81	76 76	....	19 19–15	s. sh. co. r s. sh. co. r	Hand lead Sh. Dr	Bottom.	13	S. 58° W	.5	Frame wrecked; bag and net lost.
D. 3962	May 22	3.27 p. m. 3.41 p. m.	Laysan Island Light, N. 56°, E. 5.2′.	75	77	.....	16	wh. s. co	Hand lead 6 Hp. Tgls	Bottom.	16	S. 58° W	.6	
D. 3963	May 22	4.10 p. m. 4.36 p. m.	Laysan Island Light, N. 56° 30′, E. 6.6′.	75	77	73.7	319	wh. s. brk. sh	Tnr. S. M 6 Hp. Tgls	Bottom.	5	N. 30° E	.1	
D. 3964	May 22	4.54 p. m. 5.03 p. m.	Laysan Island Light, N. 59°, E. 6.0′.	76	76	.....	44	fne. wh. s. brk. sh. r.	Tnr. S. M Oyster Dr.	Bottom.	5	N. W	.1	Lost oyster dredge; iron bridle eyes opened and drew off shackle pin. Mast accumulator damaged.
D. 3965	May 23	9.30 a. m. 9.49 a. m.	Laysan Island Light, S. 83°, E. 8.1′.	78 78	75 75	63.0 63.0	147 147–116	Co. s Co. s	Sig. S. M 8′ Tnr	Bottom.	20	N. 20° E	.5	

D. 3966	May 23	10.25 a. m. 10.44 a. m.	Laysan Island Light, S. 73°, E. 7.9′.		76 76	75 75	58.6 58.6	116 116–168	crs. co. s...... crs. co. s......	Sig. S. M...... 8′ Tnr.........	Bottom.	20	N. 56° W..	.4	
D. 3967	May 23	11.18 a. m. 11.43 a. m.	Laysan Island Light, S. 71°, E. 8.7′.		76 76	75 75	58.5 58.5	168 168–177	crs. co. s. brk. sh. r. crs. co. s. brk. sh. r.	Sig. S. M...... 8′ Tnr.........	Bottom.	32	N. 2° W...	.8	Very heavy strains; frame badly bent, and apron torn to ribbons.
			French Frigate Shoal.												
			Lat. N. ° ′ ″	Long. W. ° ′ ″											
D. 3968	May 29	8.21 a. m. 8.25 a. m.	23 46 00	166 18 55	73 73	75 75	....	14¼ 14¼–16¼	crs. s. co...... crs. s. co......	Hand lead.... 6 Hp. Tgls	Bottom.	15	N. 68° W..	.8	Lost one swab.
D. 3969	May 29	8.55 a. m. 9.02 a. m.	23 45 50	166 20 15	74 74	74 74	....	15 15–16	crs. s. sh. co ... crs. s. sh. co ...	Hand lead.... 5 Hp. Tgls	Bottom.	15	N. 68° W..	.4	
D. 3970	May 29	9.38 a. m. 9.44 a. m.	23 45 50	166 20 50	74 74	74 74	....	17 17–17¼	crs. s. sh. co ... crs. s. sh. co ...	Hand lead.... 5 Hp. Tgls	Bottom.	15	N. 68° W..	.6	
D. 3971	May 29	10.14 a. m. 10.20 a. m.	23 46 05	166 21 45	72	76	.....	17	crs. s. sh. co ...	Hand lead.... 5 Hp. Tgls	Bottom.	15	N. 68° W..	.5	Do.
D. 3972	May 29	11.04 a. m. 11.42 a. m.	23 46 20	166 23 55	71 71	76 76	....	approx. 100 100–374	crs. s. co ...... crs. s. co	Tnr. S. M...... 4 Hp. Tgls	Bottom.	11	W	.2	Depth estimated; wire tending off at large angle.
D. 3973	May 29	12.33 p. m. 1.12 p. m.	23 47 10	166 24 55	73 73	76 76	41.0 41.0	395 395–397	crs. co. s. sh. co. r. crs. co. s. sh. co. r.	Sig. S. M...... 5¼′ Blk........	Bottom.	5	N. 17° W..	.2	Bridle stops parted; net capsized.
D. 3974	May 29	1.43 p. m. 2.10 p. m.	23 49 30	166 25 55	75 75	76 76	41.2 41.2	397 397–414	fne. co. s. glob. oz. fne. co. s. glob. oz.	Sig. S. M ...... 4 Hp. Tgls	Bottom.	24	N. 17° W..	.5	
			Necker Island Shoal and to Bird Id., or Modu Manu.												
D. 3975	May 31	3.10 p. m. 3.17 p. m.	23 30 00	164 41 00	77 77	75 75	....	16 16–17¼	crs. s. co. sh ... crs. s. co. sh ...	Tnr. S. M...... 4 Hp. Tgls	Bottom.	15	S	.5	Probably on bottom but part of time.
D. 3976	May 31	3.40 p. m. 3.57 p. m.	23 29 00	164 41 00	77 77	75 75	....	171 171–503	crs. s. co....... crs. s. co.......	Tnr. S. M ...... 4 Hp. Tgls	Bottom.	11	S	.3	No evidence of having been on bottom.
			Vicinity of Modu Manu, or Bird Id.												
D. 3977	June 2	2.51 p. m. 3.57 p. m.	Center of Bird Island, S. 75°, E. 11.2′.		78	75	38.0	876	fne. co. s. for. r.	Sig. S. M ...... 5¼′ Blk........	Bottom.	18	S. 35° E...	.3	Very heavy strains, but no damage.
D. 3978	June 3	8.25 a. m. 8.34 a. m.	Center of Bird Island, N. 14°, E. 2.2′.		76 76	74 74	....	32 32–46	co. s. for. r..... co. s. for. r.....	Tnr. S. M...... 4 Hp. Tgls	Bottom.	16	S	.4	Lost one swab.
D. 3979	June 3	12.53 p. m. 1.49 p. m.	Center of Bird Island, N. 64° 30′, E. 11.0′.		77 77	75 75	54.0 54.0	222 222–387	fne. wh. s. for. r. fne. wh. s. for. r.	Sig. S. M ...... 5¼′ Blk........	Bottom.	30	S	.2	Very heavy strains, but no damage.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position. Lat. N.	Position. Long. W.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Between Honolulu and Kauai Id.												
	1902.		° ′ ″	° ′ ″	° F.	° F.	° F.	*Fms.*			*Fms.*	*Hr./M.*		′	
D. 3980	June 9	7.01 p.m.	21 23 00	158 19 00	79	77	.....	(Did	not sound.)	2 Surf. N., 1 on each side.	Surface.	1 11	N. 67° W..	2	14 hauls (7 simultaneously each side).
			Vicinity of Kauai Island.												
D. 3981	June 10	7.57 a.m.	Nawiliwili Light, N. 82°, W. 4.2′.		83	77	(?)	636	glob. oz	Sig. S. M	....	....	....	....	Bottom temperature recorded 76.0° (?).
		8.20 a.m.			83	77	.....	....	glob. oz	Surf. N	Surface.	35	W	1	2 hauls.
		8.48 a.m.			83	77	.....	636–414	glob. oz	9 Hp. Tgls	Bottom.	10	W	.2	
D. 3982	June 10	10.05 a.m.	Nawiliwili Light, N. 68°, W. 1.6′.		84	78	48.5	233	crs. br. co. s. sh.	Sig. S. M	....	....	....	....	
		10.23 a.m.			84	78	48.5	233–40	crs. br. co. s. sh.	9 Hp. Tgls	Bottom.	10	N. 87° W..	.2	
D. 3983	June 10	11.39 a.m.	Nawiliwili Light, S. 76°, W. 3.7′.		83	79	39.1	506	glob. oz. r	Sig. S. M	....	....	....	....	
		12.11 p.m.			83	79	39.1	506–378	glob. oz. r	8′ Tnr	Bottom.	7	N. 59° W..	.1	Bridle stops parted; net capsized.
D. 3984	June 10	1.31 p.m.	Nawiliwili Light, N. 30° 30′, W. 3.5′.		84	78	47.0	237	fne. co. s	Sig. S. M	....	....	....	....	
		1.58 p.m.			84	78	47.0	237–164	....	9 Hp. Tgls	Bottom.	16	N. 36° W..	.3	
D. 3985	June 10	3.58 p.m.	Hanamaulu warehouse, S. 53° 30′, W. 6.0′.		85	78	40.0	477	gy. s. for. shore deposit.	Sig. S. M	....	....	....	....	
		4.36 p.m.			85	78	40.0	477–430	gy. s. for. shore deposit.	8′ Tnr	Bottom.	20	N. 27° W..	.2	Glass float smashed to pieces.
D. 3986	June 11	8.33 a.m.	Hanamaulu warehouse, S. 37° 30′, W. 6.5′.		78	76	41.8	362	gy. s. for. shore deposit.	Sig. S. M					
		9.06 a.m.			78	76	41.8	362–55	gy. s. for. shore deposit.	8′ Tnr	Bottom.	15	NW	.2	Heavy strains, but no damage.
D. 3987	June 11	9.52 a.m.	Hanamaulu warehouse, S. 29°, W. 6.8′.		78	77	73.0	55	crs. co. s. co. frag.	Sig. S. M	....	....	....	....	
		10.03 a.m.			78	77	73.0	55–50	crs. co. s. co. frag.	9 Hp. Tgls	Bottom.	13	N. 21° W..	.7	
D. 3988	June 11	1.17 p.m.	Hanamaulu warehouse, S. 21°, W. 12.6′.		80	77	40.0	469	gy. for. s. p	Sig. S. M	....	....	....	....	
		1.52 p.m.			80	77	40.0	469–165	gy. for. s. p	8′ Tnr	Bottom.	20	N. 57° W..	.8	
D. 3989	June 11	4.37 p.m.	Hanamaulu warehouse, S. 33°, W. 9.5′.		82	78	37.5	733	co. s. r	Sig. S. M	....	....	....	....	
		5.13 p.m.			82	78	37.5	500–385	co. s. r	8′ Tnr	Bottom.	20	S. 72° W...	.3	Estimated that net took bottom in about 500 fathoms.
D. 3990	June 12	7.39 a.m.	Mokuaeae Islet, S. 78°, W. 5.2′.		78	76	42.1	326	gy. s. for. r	Sig. S. M	....	....	....	....	
		8.09 a.m.			78	76	42.1	326–296	gy. s. for. r	8′ Tnr	Bottom.	4	N. 68° W..	.1	One runner broken from beam; net badly torn.
D. 3991	June 12	8.48 a.m.	Mokuaeae Islet, S. 66°, W. 4.0′.		80	79	43.7	296	fne. s. r	Sig. S. M	....	....	....	....	
		9.12 a.m.			80	79	43.7	296–272	fne. s. r	9 Hp. Tgls	Bottom.	5	N. 82° W..	.1	Heavy strains, but no damage.

D. 3992	June 12	1.16 p. m. 1.51 p. m.	Mokuaeae Islet, S. 54°, E. 3.5′.	79	77	39.6	528	fne. gy. s. m...	Sig. S. M ...... 8′ Tnr	Bottom.	4	S. 79° W...	.1	Heavy strains at once; net filled with mud; net slightly torn. Net took bottom in less depth than shown by sounding and did not sound again. Estimated that net was dragged at depths between 500 and 400 fathoms.
D. 3993	June 12	3.18 p. m. 3.56 p. m.	Mokuaeae Islet, S. 62° 30′, E. 6.7′.	78 78	77 77	50.0 50.0	218 218–201	fne. gy. s ...... fne. gy. s	Sig. S. M ...... 5¼′ Blk	Bottom.	4	N. 78° W...	.1	Heavy strains, but no damage.
D. 3994	June 12	4.51 p. m. 5.18 p. m.	Mokuaeae Islet, S. 63°, E. 10.2′.	78 78	77 77	42.9 42.9	330 330–382	fne. gy. s. for .. fne. gy. s. for ..	Sig. S. M ...... 5¼′ Blk	Bottom.	15	N. 67° E...	.3	
D. 3995	June 13	7.34 a. m. 8.14 a. m.	Mokuaeae Islet, S. 69° 30′, E. 11.5′.	75 75	76 76	40.6 40.6	427 427–676	fne. gy. s. r .... fne. gy. s. r	Sig. S. M ...... 5¼′ Blk	Bottom.	17	N. 88° W ..	.8	Apron lost; net torn slightly.
D. 3996	June 13	9.42 a. m. 10.52 a. m.	Kapuai Point, S. 23° 15′, W. 15.5′.	86 86	77 77	36.1 36.1	1,021 1,021–1,180	gy. s. r .... gy. s. r	Sig. S. M ...... 8′ Tnr	Bottom.	13	S. 87° W...	.4	Box broken from one runner; frame wrenched.
D. 3997	June 14	7.40 a. m. 8.16 a. m. 8.29 a. m.	Ukula Point, S. 79° 15′, E. 7.0′.	81 81 81	75 75 75	41.0 41.0	418 418–429	fne. gy. s. br. m fne. gy. s. br. m	Sig. S. M ...... 8′ Tnr .... Surf. N	 Bottom. Surface.	 30 17	 S. 72° W... S. 72° W ..	 .6 .3	2 hauls.
D. 3998	June 14	9.51 a. m. 10.34 a. m.	Ukula Point, S. 71°, E. 9.7′.	84 84	78 78	47.0 47.0	235 235–228	crs. br. co. s. sh. r. crs. br. co. s. sh. r.	Sig. S. M ...... 8′ Tnr	Bottom.	40	S. 86° E ...	1.4	Frame badly bent; one runner torn from box, which was broken.
D. 3999	June 16	7.32 a. m. 7.42 a. m.	Ukula Point, S. 51° 30′, E. 4.9′.	76 76	77 77	....	7 7–148	co. s. sh ...... co. s. sh	Hand lead .... 9 Hp. Tgls	Bottom.	20	N. 83° W ..	3	Strong westerly set encountered.
D. 4000	June 16	9.27 a. m. 9.54 a. m.	Kapuai Point, N. 21°, E. 4.8′.	91 91	78 78	53.6 53.6	213 213–104	co. s. for....... co. s. for.......	Sig. S. M ...... 8′ Tnr	Bottom.	15	N. 18° E...	.3	
D. 4001	June 16	11.21 a. m. 11.48 a. m.	Kapuai Point, N. 88° 30′, E. 3.8′.	83 83	78 78	44.3 44.3	277 277–230	co. s........... co. s...........	Sig. S. M ...... 8′ Tnr., Sh. Dr.	Bottom.	12	N. E	.3	
D. 4002	June 16	12.25 p. m. 12.44 p. m.	Kapuai Point, S. 73°, E. 3.0′.	80 80	78 78	47.1 47.1	230 230–53	fne. co. s. glob. co. fne. co. s. glob. co.	Sig. S. M ...... 8′ Tnr., Sh. Dr.	Bottom.	30	N. 53° E...	.8	Bridle one side ship's dredge parted; nothing lost.
D. 4003	June 16	4.11 p. m. 4.57 p. m.	Kapuai Point, S. 10°, E. 10.5′.	83 83	78 78	38.0 38.0	751 751–406	fne. s. br. m. glob. r. fne. s. br. m. glob. r.	Sig. S. M ...... 8′ Tnr	Bottom.	20	S. 30° E ...	.2	Lost all except fragments of net, bridle, etc.
D. 4004	June 17	7.57 a. m. 8.55 a. m.	Ukula Point, N. 86°, E. 5.0′.	76 76	78 78	37.5 37.5	773 773–645	br. m. r .... br. m. r	Sig. S. M ...... 8′ Tnr	Bottom.	23	S. 63° E ...	.5	Do.
D. 4005	June 17	10.52 a. m. 11.40 a. m.	Ukula Point, N. 60°, W. 2.2′.	80 80	78 78	39.2 39.2	577 577–480	fne. gy. s. for. r. fne. gy. s. for. r.	Sig. S. M ...... 8′ Tnr	Bottom.	30	S. 87° E ...	.8	Do.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Between Honolulu and Kauai Island—Cont'd.	° F.	° F.	° F.	Fms.			Fms.	Hr. M.			
	1902.													
D. 4006	June 17	1.08 p. m.	Ukula Point, N. 62°, W. 4.5'.	80	77	47.5	242	co. s. for. r.	Sig. S. M.					
		1.40 p. m.		80	77	47.5	242–57	co. s. for. r.	8' Tnr.	Bottom.	0 4	N. 72° E.	0.1	Frame badly bent; net wrecked.
D. 4007	June 17	3.01 p. m.	Ukula Point, N. 65° 30', W. 7.4'.	81	76	40.0	508	gy. s. for.	Sig. S. M.					
		3.50 p. m.		81	76	40.0	508–557	gy. s. for.	5½' Blk.	Bottom.	14	S. 73° E.	.4	
D. 4008	June 17	5.15 p. m.	Ukula Point, N. 80° 45', W. 10.7'.	80	76	50.0	206	fne. co. s. brk. sh. for. r.	Sig. S. M.					
		5.42 p. m.		80	76	50.0	206–198	fne. co. s. brk. sh. for. r.	5½' Blk.	Bottom.	16	N. 63° E.	.2	Frame bent; bridle stops parted one side; net slightly torn.
			Between Kauai and Oahu islands. Lat. N. ° ' " / Long. W. ° ' "											
D. 4009	June 17	6.48 p. m.	21 50 30 / 159 15 00	79	76	.....	(Did not sound.)		2 Surf. N.; 1 on each side.	Surface.	1 11	S. 62° E.	3	14 hauls (7 each side simultaneously).
D. 4010	June 17	11.06 p. m.	21 35 00 / 158 50 00	77	76	.....	(Did not sound.)		2 Surf. N.; 1 on each side.	Surface.	30	S. 62° E.	2	6 hauls (3 each side simultaneously).
D. 4011	June 18	4.03 a. m.	21 20 00 / 158 21 00	77	77	.....	(Did not sound.)		Surf. N.; stbd. side.	Surface.	20	S. 62° E.	1	2 hauls; net torn last haul.
		4.06 a. m.							Surf. N.; port side.	Surface.	43	S. 62° E.	2	4 hauls; net torn last haul.
			Vicinity of Kauai Island.											
D. 4012	June 20	6.06 a. m. / 7.50 a. m.	Hanamaulu warehouse, N. 21° 45', W. 6.8'.	74	75	35.9	1,219	yl. s. for. r.	Sig. S. M / 5½' Blk.	Bottom.	17	N. 60° W.	.3	Dredging cable parted; lost 1,086 fms. cable, 250 pounds sinker, complete Blake beam-trawl frame and net, etc.; mast accumulator badly bent and bracket damaged.
D. 4013	June 20	11.27 a. m.	Hanamaulu warehouse, N. 82° 45', W. 3.7'.	77	75	41.0	419	fne. gy. s. for.	Sig. S. M					
		11.59 a. m.		77	75	41.0	419–399		8' Tnr	Bottom.	12	N. 59° W.	.2	
D. 4014	June 20	12.39 p. m.	Hanamaulu warehouse, N. 85°, W. 3.4'.	77	75	40.8	399	s. for.	Sig. S. M					
		1.17 p. m.		77	75	40.8	399–362	s. for.	8' Tnr	Bottom.	10	N. 53° W.	.2	

D. 4015	June 20	1.57 p.m.	Hanamaulu warehouse, S. 82°, W. 2.6′.	77	72	41.2	362	gy. s. r.	Sig. S. M					
		2.30 p.m.		77	72	41.2	362-318	gy. s. r.	8′ Tnr	Bottom.	13	N. W.	.2	Net slightly torn.
D. 4016	June 20	3.14 p.m.	Hanamaulu warehouse, S. 62°, W. 2.2′.	78	74	42.9	318	bk. s.	Sig. S. M					
		3.46 p.m.		78	74	42.9	318-305	bk. s.	8′ Tnr	Bottom.	12	N. 16° W.	.1	
D. 4017	June 20	4.28 p.m.	Hanamaulu warehouse, S. 45° 45′, W. 2.4′.	77	75	43.3	305	gy. s.	Sig. S. M					
		5.05 p.m.							8′ Tnr	Bottom.	8	N. 20° W.	.1	
D. 4018	June 21	7.16 a.m.	Hanamaulu warehouse, S. 57°, W. 7.4′.	74	75	37.3	804	for. s. mang. frag.	Sig. S. M					
		8.04 a.m.		74	75				Surf. N	Surface.	20	N. 20° W.	.2	2 hauls.
		8.11 a.m.		74	75	37.3	804-724	for. s. mang. frag.	8′ Tnr	Bottom.	33	N. 20° W.	.4	
D. 4019	June 21	9.37 a.m.	Hanamaulu warehouse, S. 43°, W. 8.1′.	79	75	37.8	724	gy. s. for. r.	Sig. S. M					
		10.14 a.m.		79	75	37.8	550-409	gy. s. for. r.	8′ Tnr	Bottom.	19	N. 35° W.	.5	Frame bent slightly; net took bottom at depth estimated to be about 550 fms.
D. 4020	June 21	11.01 a.m.	Hanamaulu warehouse, S. 33°, W. 8.5′.	81	75	41.0	409	co. s.	Sig. S. M					
		11.33 a.m.		81	75	41.0	409-286	co. s.	8′ Tnr	Bottom.	29	N. 7° W.	.7	
D. 4021	June 21	12.13 p.m.	Hanamaulu warehouse, S. 28° 30′, W. 9.5′.	81	75	44.0	286	co. s. for.	Sig. S. M					
		12.42 p.m.		81	75	44.0	286-399	co. s. for.	10′ Blk	Bottom.	23	N. E.	.3	
D. 4022	June 21	1.25 p.m.	Hanamaulu warehouse, S. 30°, W. 10.2′.	80	74	41.0	399	co. s. for. r.	Sig. S. M					
		2.01 p.m.		80	74	41.0	399-374	co. s. for. r.	10′ Blk	Bottom.	36	N. 50° W.	.2	Frame caught on bottom and badly bent.
D. 4023	June 23	12.57 p.m.	Mokuaeae Islet, N. 85° 30′, E. 6.2′.	80	75	.....	18	gy. s. for. co. r.	Tnr. S. M					
		1.08 p.m.		80	75	.....	18-41	gy. s. for. co. r.	10′ Blk	Bottom.	20	N. 23° W.	.7	Net badly torn; bridle stops parted one side.
D. 4024	June 23	1.49 p.m.	Mokuaeae Islet, S. 83°, E. 7.6′.	75	75	73.7	24	crs. co. s. for.	Sig. S. M					
		2.22 p.m.		75	75	73.7	24-43	crs. co. s. for.	9 Hp. Tgls	Bottom.	11	N. 63° W.	.7	
D. 4025	June 23	3.16 p.m.	Mokuaeae Point, S. 66°, E. 10.4′.	76	75	44.9	275	fne. gy. s. brk. sh. for.	Sig. S. M					
		3.50 p.m.		76	75	44.9	275-368	fne. gy. s. brk. sh. for.	8′ Tnr	Bottom.	24	N. 11° W.	.3	
D. 4026	June 23	4.31 p.m.	Mokuaeae Point, S. 61° 30′, E. 11.0′.	79	75	41.2	368	fne. gy. s.	Sig. S. M					
		5.16 p.m.		79	75	41.2	368-1,021	fne. gy. s.	8′ Tnr	Bottom.	21	W.	.7	Depth increased quickly; results very meager; net probably on bottom but few moments—first part.
D. 4027	June 24	6.44 a.m.	Ukula Point, S. 74°, E. 6.0′	77	77	42.8	319	fne. gy. s. r.	Sig. S. M					
		7.04 a.m.		77	77			fne. gy. s. r.	Surf. N	Surface.	17	N. 57° W.	.2	2 hauls.
		7.13 a.m.		77	77	42.8	319-319	fne. gy. s. r.	10′ Blk	Bottom.	21	N. 57° W.	.3	Net badly torn.
D. 4028	June 24	9.16 a.m.	Ukula Point, S. 82° 30′, E. 10.2′.	83	78	40.0	444	gy. s. glob.	Sig. S. M					
		10.23 a.m.		83	78	40.0	444-478	gy. s. glob.	8′ Tnr	Bottom.	12	S. 20° W.	.3	
D. 4029	June 24	11.16 a.m.	Ukula Point, S. 86°, E. 11.0′.	86	78	40.0	478	gy. s. glob.	Sig. S. M					
		11.50 a.m.		86	78	40.0	478-453	gy. s. glob.	8′ Tnr	Bottom.	20	S. 40° W.	.3	
D. 4030	June 24	1.19 p.m.	Ukula Point, S. 82° 30′, E. 13.1′.	82	76	41.0	423	fne. co. s. for. r.	Sig. S. M					Wire jumped reel; cut out 2 fathoms and spliced.
		3.06 p.m.		82	76	41.0	423-438	fne. co. s. for. r.	8′ Tnr	Bottom.	13	S. 55° W.	.1	Frame bent; bridle stops parted; net capsized.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Penguin Bank, South coast of Oahu Island.											
	1902.			° F.	° F.	° F.	Fms.			Fms.	Hr. M.			
D. 4031	July 9	6.31 p.m.	Diamond Head Light, N. 20°, W. 18.0′.	80	76	.....	27	fne. co. s. for. co.	Sig. S. M	....	....	....	....	
		6.40 p.m.		80	76	.....	27–28	fne. co. s. for. co.	8 Hp. Tgls	Bottom.	0 17	N. 80° W ..	0.3	
D. 4032	July 9	7.27 p.m.	Diamond Head Light, N. 19°, W. 20.0′.	79	78	.....	27	fne. co. s. for..	Tnr. S. M	....	....	....	....	
		7.38 p.m.		79	78	.....	27–29	fne. co. s. for..	8 Hp. Tgls	Bottom.	15	S. 23° E ...	.2	
D. 4033	July 9	8.01 p.m.	Diamond Head Light, N. 19°, W. 20.8′.	79	78	.....	29	fne. co. s. for..	Tnr. S. M	....	....	....	....	
		8.39 p.m.		79	78	.....	29–28	fne. co. s. for..	8 Hp. Tgls	Bottom.	20	S. 23° E ...	.4	
D. 4034	July 9	9.07 p.m.	Diamond Head Light, N. 19°, W. 21.5′.	79	78	.....	28	fne. co. s. for..	Tnr. S. M	....	....	....	....	
		9.34 p.m.		79	78	.....	28–14	fne. co. s. for..	8 Hp. Tgls	Bottom.	21	S. 23° E ...	.4	
D. 4035	July 9	10.14 p.m.	Diamond Head Light, N. 21°, W. 23.0′.	78	78	.....	32	crs. co. s. sh. for.	Tnr. S. M	....	....	....	....	
		10.37 p.m.		78	78	.....	32–386	crs. co. s. sh. for.	8 Hp. Tgls	Bottom.	20	S. 23° E ...	.3	Depth increased rapidly; gear probably on bottom but few moments during first part.
			West coast of Hawaii Island.											
D. 4036	July 10	3.56 p.m.	Kawaihae Light, S. 80°, E. 24.2′.	89	78	38.2	687	fne. dk. gy. s. for.	Sig. S. M	....	....	....	....	
		4.57 p.m.		89	78	38.2	687–692	fne. dk. gy. s. for.	5¼′ Blk	Bottom.	34	N. 66° E...	.3	
D. 4037	July 10	6.32 p.m.	Kawaihae Light, S. 78°, E. 23.0′.	87	80	38.1	692	gy. m. for. r ...	Sig. S. M	....	....	....	....	
		6.47 p.m.		87	80	......	....	....	Surf. N	Surface.	50	N. 13° E...	.5	5 hauls.
		7.37 p.m.		87	80	38.1	692–689	gy. m. for. r ...	5¼′ Blk	Bottom.	21	N. 13° E...	.2	Frame wrenched; net torn; bridle stops parted; net capsized; results very meager
D. 4038	July 10	9.21 p.m.	Kawaihae Light, S. 75° 30′, E. 23.0′.	80	76	38.5	689	gy. m. for	Sig. S. M	....	....	....	....	
		10.26 p.m.		80	76	38.5	689–670	gy. m. for	5¼′ Blk	Bottom.	20	N. 70° W ..	.3	
D. 4039	July 10	11.42 p.m.	Kawaihae Light, S. 75° 30′, E. 24.9′.	79	76	38.7	670	gy. m. for	Sig. S. M	....	....	....	....	
	July 11	12.43 a.m.		79	76	38.7	670–697	gy. m. for	5¼′ Blk	Bottom.	33	N. 27° E...	.3	
D. 4040	July 11	2.19 a.m.	Kawaihae Light, S. 73° 45′, E. 25.5′.	78	77	38.7	697	gy. m. for	Sig. S. M	....	....	....	....	
		3.21 a.m.		78	77	38.7	697–707	gy. m. for	5¼′ Blk	Bottom.	23	N. 16° E...	.2	
D. 4041	July 11	9.22 a.m.	Kawaihae Light, S. 67° 30′, E. 10.0′.	83	77	41.6	382	gy. m. for	Sig. S. M	....	....	....	....	
		9.49 a.m.		83	77	41.6	382–253	gy. m. for	8′ Tnr	Bottom.	22	S. 55° E ...	.5	

D. 4042	July 11	10.42 a. m. 11.09 a. m.	Kawaihae Light, S. 70° 30′, E. 8.1′.	80 80	77 77	45.9 45.9	253 253–229	gy. m. for. r ... gy. m. for. r ...	Sig. S. M .... 8′ Tnr	Bottom.	8	S. 43° E ...	.1	Lost complete frame and net; bridles, etc., only saved.
D. 4043	July 11	12.12 p. m. 12.35 p. m.	Kawaihae Light, S. 74° 30′, E. 5.9′.	82 82	77 77	46.9 46.9	236 236–233	gy. s. brk. sh. r. gy. s. brk. sh. r.	Sig. S. M .... 5½′ Blk	Bottom.	24	S. 38° E ...	.3	Frame bent; apron lost; net badly torn.
D. 4044	July 11	1.19 p. m. 1.46 p. m.	Kawaihae Light, S. 80° 30′, E. 5.2′.	85 85	77 77	47.0 47.0	233 233–198	fne. gy. s ..... fne. gy. s	Sig. S. M .... 8 Hp. Tgls	Bottom.	21	S. 39° E ...	.5	
D. 4045	July 11	2.28 p. m. 2.53 p. m.	Kawaihae Light, N. 82° 30′, E. 4.1′.	86 86	78 78	49.0 49.0	198 198–147	co. s. for ...... co. s. for	Sig. S. M .... 8 Hp. Tgls	Bottom.	20	S. 40° E ...	.7	
D. 4046	July 11	3.32 p. m. 3.47 p. m.	Kawaihae Light, N. 52°, E. 3.4′.	85 85	78 78	59.0 59.0	147 147–71	co. s. for ...... co. s. for	Sig. S. M .... 8 Hp. Tgls	Bottom.	20	S. 30° E ...	.7	
D. 4047	July 11	5.14 p. m. 5.41 p. m.	Kawaihae Light, N. 64°, E. 8.5′.	85 85	78 78	47.6 47.6	217 217–232	fne. co. s. r ... fne. co. s. r ...	Sig. S. M .... 8′ Tnr	Bottom.	7	N. 14° W ..	.1	Bag of net badly torn.
D. 4048	July 11	7.33 p. m. 8.13 p. m.	Kawaihae Light, S. 71° 30′, E. 9.5′.	82	78	41.7	574	fne. gy. s. r ...	Sig. S. M .... 8′ Tnr	Bottom.	26	N. 25° W ..	.3	Lost 375 *fms.* dredging cable, 250-pound sinker, 8′ Tanner beam-trawl frame net complete; mast accumulator slightly damaged.
D. 4049	July 11	10.00 p. m. 10.47 p. m.	Kawaihae Light, S. 65° 30′, E. 10.6′.	79 79	78 78	41.0 41.0	456 456–532	fne. co. s. for . fne. co. s. for .	Sig. S. M .... 8 Hp. Tgls	Bottom.	33	S. 75° W ...	.5	
D. 4050	July 14	7.24 a. m. 7.31 a. m.	Kealakekua Light, N. 10°, W. 0.5′.	78 78	78 78	....	14 14–215	frag. co. r ..... frag. co. r	Tnr. S. M .... 8 Hp. Tgls	Bottom.	20	West	.8	Evidently on bottom but short time; depth increased.
D. 4051	July 14	7.59 a. m. 8.23 a. m.	Kealakekua Light, N. 63°, E. 1.2′.	83 83	79 79	....	215 215–256	vol. r .... vol. r	Tnr. S. M .... 8 Hp. Tgls	Bottom.	27	N. 57° W ..	.5	
D. 4052	July 14	9.19 a. m. 9.31 a. m.	Kealakekua Light, East 1.9′.	84	79	46.0	256	co. s. vol. r ...	Sig. S. M .... 5½′ Blk	Bottom.	2	None	......	Heavy strains at once; lost everything except bridle, etc., and fragment of bottom of net.
			Northeast coast of Hawaii Island.											
D. 4053	July 16	7.47 a. m. 7.57 a. m.	Alia Point Light (Hilo Bay), N. 4°, W. 5.7′.	81 81	75 75	....	29 29–26	fne. gy. s ..... fne. gy. s	Tnr. S. M .... 8 Hp. Tgls	Bottom.	23	N. 12° E ...	.8	
D. 4054	July 16	8.24 a. m. 8.30 a. m.	Alia Point Light (Hilo Bay), N. 8° 30′, W. 4.4′.	83 83	74 74	....	26 26–50	crs. co. s. corln. crs. co. s. corln.	Tnr. S. M .... 8 Hp. Tgls	Bottom.	21	N. 26° E ...	.8	
D. 4055	July 16	8.55 a. m. 9.05 a. m.	Alia Point Light (Hilo Bay), N. 20°, W. 3.5′.	83 83	76 76	....	50 50–62	fne. gy. s. for . fne. gy. s. for .	Tnr. S. M .... 8 Hp. Tgls	Bottom.	22	North	.8	
D. 4056	July 16	9.32 a. m. 9.39 a. m.	Alia Point Light (Hilo Bay), N. 28°, W. 2.6′.	77 77	76 76	....	62 62–77	co. corln ...... co. corln	Tnr. S. M .... 8 Hp. Tgls	Bottom.	21	N. 10° E ...	.8	
D. 4057	July 16	10.07 a. m. 10.14 a. m.	Alia Point Light (Hilo Bay), N. 43° 45′, W. 2′.	76 76	76 76	....	77 77–75	fne. gy. s. sh .. fne. gy. s. sh ..	Tnr. S. M .... 8 Hp. Tgls	Bottom.	25	N. 10° W ..	.8	

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Northeast coast of Hawaii Id—C't'd.											
	1902.			° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 4058	July 16	11.55 a. m.	Alia Point Light (Hilo Bay), N. 87°, W. 5.6′.	80	76	49.8	195	rky	Sig. S. M					
		12.20 p. m.		80	76	49.8	195–190	rky	8 Hp. Tgls	Bottom.	0 10	S.W	0.4	
D. 4059	July 16	1.24 p. m.	Alia Point Light (Hilo Bay), N. 67° 15′, W. 8.4′.	83	77	44.0	291	vol. s	Sig. S. M					
		1.46 p. m.		83	77	44.0	291–190	vol. s	5¼′ Blk	Bottom.	4	N. 64° W	.1	
D. 4060	July 16	2.47 p. m.	Alia Point Light (Hilo Bay), N. 70° 15′, W. 10.2′.	80	77	36.5	913	fne. gy. vol. s. for. r.	Sig. S. M					
		4.03 p. m.		80	77	36.5	913–759	fne. gy. vol. s. for. r.	5¼′ Blk	Bottom.	17	N. 6° W	.2	Net slightly torn.
D. 4061	July 18	8.00 a. m.	Kauhola Light, S. 79°, E. 6.7′.	78	77	.....	24	co. s. corln. nod. for.	Tnr. S. M					
		8.10 a. m.		78	77	.....	24–83	co. s. corln. nod. for.	8 Hp. Tgls	Bottom.	21	N. 3° E	.8	
D. 4062	July 18	8.37 a. m.	Kauhola Light, S. 69° 15′, E. 6.9′.	78	77	.....	83	co. vol. s. sh. for.	Tnr. S. M					
		8.49 a. m.		78	77	.....	83–113	co. vol. s. sh. for.	8 Hp. Tgls	Bottom.	22	NE	.8	
D. 4063	July 18	9.51 a. m.	Kauhola Light, S. 75° 30′, E. 6.8′.	78	77	.....	50	vol. s. for. co. r.	Tnr. S. M					
		10.03 a. m.		78	77	.....	50–63	vol. s. for. co. r.	5¼′ Blk	Bottom.	8	N. 30° E	.2	Net badly torn.
D. 4064	July 18	10.20 a. m.	Kauhola Light, S. 71°, E. 6.7′.	78	77	69.0	63	vol. s. for. co	Tnr. S. M					
		10.30 a. m.		78	77	69.0	63–107	vol. s. for. co	8 Hp. Tgls	Bottom.	20	N. 11° W	.7	
			Alenuihana Channel, between Hawaii and Maui islands.											
D. 4065	July 18	12.55 p. m.	Kauhola Light, S. 44° 30′, E. 16.1′.	79	76	40.2	491	for. s. r	Sig. S. M					
		1.38 p. m.		79	76	40.2	491–500	for. s. r	5¼′ Blk	Bottom.	3	NW	.1	Net badly torn.
D. 4066	July 18	4.16 p. m.	Ka Lae-o Ka Ilio Point, Maui Island, N. 79° 30′, W. 3.5′.	80	76	52.5	176	rky	Sig. S. M					
		4.38 p. m.		80	76	52.5	176–49	rky	8 Hp. Tgls	Bottom.	16	N. 37° E	1	
			Northeast and north coast of Maui Island.											
D. 4067	July 19	9.18 a. m.	Puniawa Point, N. 77°, E. 9.2′.	77	76	.....	10	fne. co. vol. s.	Tnr. S. M					
		9.23 a. m.		77	76	.....	10–14	fne. co. vol. s.	8′ Tnr	Bottom.	24	N. 18° W	.8	Net improperly landed; dragged upside down.

D. 4068	July 19	9.51 a. m.	Puniawa Point,	77	76	76.9	14	fne. gy. s......	Tnr. S. M.....	....	....	....	....	
		9.56 a. m.	N. 82°, E. 9.3′.	77	76	76.9	14–18	fne. gy. s......	8′ Tnr.........	Bottom.	20	N. 21° W..	1	
D. 4069	July 19	10.19 a. m.	Puniawa Point,	80	77	.....	18	fne. gy. s......	Tnr. S. M.....	....	....	....	....	
		10.24 a. m.	East 9.7′.	80	77	.....	18–23	fne. gy. s......	8′ Tnr.........	Bottom.	20	N. 17° W..	.8	
D. 4070	July 19	11.23 a. m.	Puniawa Point,	79	76	70.8	45	fne. gy. s......	Sig. S. M......	....	....	....	....	
		11.34 a. m.	S. 81° 30′, E. 6.4′.	79	76	70.8	45–52	fne. gy. s......	8′ Tnr.........	Bottom.	20	N. 39° W..	.3	
D. 4071	July 19	12.00 m.	Puniawa Point,	81	76	72.9	52	fne. co. vol. s. for.	Tnr. S. M.....	....	....	....	....	
		12.10 p. m.	S. 78° 30′, E. 6.8′.	81	76	72.9	52–56	fne. co. vol. s. for.	8′ Tnr.........	Bottom.	21	N. 18° W..	.4	
D. 4072	July 19	12.37 p. m.	Puniawa Point,	81	76	73.4	56	crs. co. s. for ..	Tnr. S. M.....	....	....	....	....	
		12.47 p. m.	S. 74° 30′, E. 7.1′.	81	76	73.4	56–59	crs. co. s. for ..	8′ Tnr.........	Bottom.	21	N. 48° W..	.5	
D. 4073	July 19	1.15 p. m.	Puniawa Point,	80	76	71.9	69	crs. co. s. for ..	Tnr. S. M.....	....	....	....	....	
		1.27 p. m.	S. 72°, E. 7.8.	80	76	71.9	69–78	crs. co. s. for ..	8′ Tnr.........	Bottom.	22	N. 48° W..	.6	
D. 4074	July 19	1.57 p. m.	Puniawa Point,	81	76	70.8	78	co. s. for	Tnr. S. M.....	....	....	....	....	
		2.07 p. m.	S. 70°, E. 8.5′.	81	76	70.8	78–85	co. s. for	8′ Tnr.........	Bottom.	21	N. 51° W..	.6	
D. 4075	July 21	8.09 a. m.	Puniawa Point,	77	76	72.4	49	fne. gy. s. for .	Sig. S. M......	....	....	....	....	
		8.18 a. m.	S. 79° 30′, E. 6′.	77	76	72.4	49–57	fne. gy. s. for .	8′ Tnr.........	Bottom.	21	N. 27° W..	.8	
D. 4076	July 21	8.48 a. m.	Puniawa Point,	77	76	70.4	57	co. s. sh. for...	Tnr. S. M.....	....	....	....	....	
		9.01 a. m.	S. 72° 30′, E. 6.7′.	77	76	70.4	57–68	co. s. sh. for...	8′ Tnr.........	Bottom.	15	N. 32° W..	.4	
D. 4077	July 21	9.52 a. m.	Puniawa Point,	78	76	70.0	99	fne. co. s. for .	Sig. S. M......	....	....	....	....	
		10.04 a. m.	S. 45° 45′, E. 6.1′.	78	76	70.0	99–106	fne. co. s. for .	10′ Blk........	Bottom.	20	N. 57° E...	.4	
D. 4078	July 21	10.33 a. m.	Puniawa Point,	78	76	66.7	106	fne. co. s. for .	Sig. S. M......	....	....	....	....	
		10.52 a. m.	S. 40°, E. 6.1′.	78	76	66.7	106–143	fne. co. s for .	10′ Blk........	Bottom.	20	N. 61° E...	.5	Net came up with bag inside bridles and over upper beam; was lowered too fast for the tail weight, which was 35 pounds.
D. 4079	July 21	11.21 a. m.	Puniawa Point,	78	76	60.8	143	gy. s. for......	Sig. S. M......	....	....	....	....	
		11.42 a. m.	S. 31° 30′, E. 6′.	78	76	60.8	143–178	gy. s. for......	10′ Blk........	Bottom.	20	N. 24° E...	.5	Used 60-pound tail weight; O. K. at same speed lowering.
D. 4080	July 21	12.20 p. m.	Puniawa Point,	79	76	56.4	178	gy. s. for......	Sig. S. M......	....	....	....	....	
		12.48 p. m.	S. 23°, E. 6.6′.	79	76	56.4	178–202	gy. s. for......	10′ Blk........	Bottom.	20	N. 13° E...	.5	
D. 4081	July 21	1.30 p. m.	Puniawa Point,	80	76	51.7	202	gy. s. for......	Sig. S. M......	....	....	....	....	
		2.01 p. m.	S. 17° 45′, E. 7.6′.	80	76	51.7	202–220	gy. s. for......	10′ Blk........	Bottom.	21	N. 51° E...	.4	
D. 4082	July 21	2.45 p. m.	Puniawa Point,	81	76	48.8	220	gy. s..........	Sig. S. M......	....	....	....	....	
		3.14 p. m.	S. 11° 30′, E. 8.1′.	81	76	48.8	220–238	gy. s..........	10′ Blk........	Bottom.	21	N. E	.4	
D. 4083	July 21	3.52 p. m.	Puniawa Point,	84	76	.....	238	gy. s..........	Sig. S. M......	....	....	....	....	
		4.27 p. m.	S. 4° 15′, E. 8.8′.	84	76	.....	238–253	gy. s..........	10′ Blk........	Bottom.	20	N. 2° E....	.5	
D. 4084	July 21	5.08 p. m.	Puniawa Point,	80	76	46.7	253	fne. gy. s	Sig. S. M......	....	....	....	....	
		5.36 p. m.	S. 3° 15′, E. 10.1′.	80	76	46.7	253–267	fne. gy. s	10′ Blk........	Bottom.	20	N. 16° E...	.3	
D. 4085	July 21	6.18 p. m.	Puniawa Point,	81	76	(?)	267	s. sh	Sig. S. M......	....	....	....	....	Botm. tempr. recorded 74.9°.
		6.49 p. m.	S. 2°, E. 10.9′.	81	76	.....	267–283	s. sh	10′ Blk........	Bottom.	21	N. 23° E...	.3	1 haul.
		6.55 p. m.		81	76	.....	....	....	Surf. N	Surface.	14	N. 23° E...	.2	
D. 4086	July 21	7.34 p. m.	Puniawa Point,	78	76	44.6	283	s. sh	Sig. S. M......	....	....	....	....	
		7.46 p. m.	South 11.8′.	78	76	.....	....	....	Surf. N	Surface.	36	N. W......	.8	Do.
		8.02 p. m.		78	76	44.6	283–308	s. sh	10′ Blk........	Bottom.	20	N. W......	.5	

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			N. E. approach to Pailolo Channel, bet. Maui and Molokai islands.											
	1902.			*° F.*	*° F.*	*° F.*	*Fms.*			*Fms.*	*Hr. M.*			
D. 4087	July 21	8.47 p.m.	Mokuhooniki Islet, S. 85° 45', W. 21.2'.	77	76	43.6	308	fne. gy. s	Sig. S. M					
		9.00 p.m.		77	76	.....	....	fne. gy. s	Surf. N	Surface.	0 43	N. W......	1.2	1 haul.
		9.18 p.m.		77	76	43.6	308–306	fne. gy. s	10' Blk	Bottom.	21	N. W......	.6	
D. 4088	July 21	10.07 p.m.	Mokuhooniki Islet, S. 81° 30', W. 20.1'.	76	75	43.8	306	fne. gy. s	Sig. S. M					
		10.20 p.m.		76	75	.....	....	fne. gy. s	Surf. N	Surface.	40	N. 14° W ..	1.2	Do.
		10.39 p.m.		76	75	43.8	306–297	fne. gy. s	10' Blk	Bottom.	21	N. 14° W ..	.6	
D. 4089	July 21	11.30 p.m.	Mokuhooniki Islet, S. 76°, W. 20.3'.	76	75	43.8	297	fne. gy. s	Sig. S. M					
	July 22	11.40 p.m.		76	75	.....	....	fne. gy. s	Surf. N	Surface.	41	N. 14° W ..	1.2	Do.
		12.01 a.m.		76	75	43.8	297–304	fne. gy. s	10' Blk	Bottom.	20	N. 14° W ..	.6	
D. 4090	July 22	12.53 a.m.	Mokuhooniki Islet, S. 71° 15', W. 20.7'.	76	76	43.8	304	fne. gy. s	Sig. S. M					
		1.03 a.m.		76	76	.....	....	fne. gy. s	Surf. N	Surface.	44	N. 14° W ..	1.3	Do.
		1.25 a.m.		76	76	43.8	304–308	fne. gy. s	10' Blk	Bottom.	20	N. 14° W ..	.6	
D. 4091	July 22	2.29 a.m.	Mokuhooniki Islet, S. 66° 15', W. 21.3'.	77	76	43.8	308	fne. gy. s	Sig. S. M					
		2.44 a.m.		77	76	.....	....	fne. gy. s	Surf. N	Surface.	36	N. 14° W ..	1	Do.
		2.59 a.m.		77	76	43.8	308–306	fne. gy. s	10' Blk	Bottom.	20	N. 14° W ..	.6	
D. 4092	July 22	4.07 a.m.	Mokuhooniki Islet, S. 61° 45', W. 21.9'.	76	76	43.8	306	fne. gy. s	Sig. S. M					
		4.21 a.m.		76	76	.....	....	fne. gy. s	Surf. N	Surface.	34	N. 14° W ..	1	Do.
		4.35 a.m.		76	76	43.8	306–308	fne. gy. s	10' Blk	Bottom.	23	N. 14° W ..	.7	
D. 4093	July 22	6.15 a.m.	Mokuhooniki Islet, S. 52° 30', W. 24.6'.	75	76	36.0	1,171	fne. gy. s. for. r.	Sig. S. M					
		7.42 a.m.		75	76	36.0	1,171–1,572	fne. gy. s. for. r.	5¼' Blk	Bottom.	20	N. 81° W ..	.3	Net badly torn.
D. 4094	July 22	10.36 a.m.	Mokuhooniki Islet, S. 51°, W. 20.7'.	80	76	38.0	753	br. m. fne. s. glob.	Sig. S. M	....	....	....	....	
		11.35 a.m.		80	76	38.0	753–787	br. m. fne. s. glob.	5¼' Blk	Bottom.	20	N. 85° W ..	.5	Net full of mud; frame slightly wrenched.
D. 4095	July 22	2.22 p.m.	Mokuhooniki Islet, S. 61°, W. 10.6'.	79	76	43.9	290	br. m. fne. s. glob.	Sig. S. M	....	....	....	....	
		2 59 p.m.		79	76	43.9	290–286	br. m. fne. s. glob.	8' Tnr	Bottom.	21	N. 22° W ..	.5	
D. 4096	July 22	5.16 p.m.	Mokuhooniki Islet, S. 77° 30', W. 7.0'.	78	77	45.3	272	fne. gy. s	Sig. S. M	....	....	....	....	
		5.43 p.m.		78	77	45.3	272–286	fne. gy. s	10' Blk	Bottom.	24	N. 12° E...	.6	
D. 4097	July 22	6.30 p.m.	Mokuhooniki Islet, S. 67° 15', W. 8.0'.	78	77	44.2	286	fne. gy. s	Sig. S. M	....	....	....	....	
		7.09 p.m.							10' Blk	Bottom.	23	N. 17° E...	.4	

			North coast of Maui Island.											
D. 4098	July 23	9.58 a. m. 10.15 a. m.	Puniawa Point, S. 52° 30′, E. 6.5′.	78 78	76 76	64.8 64.8	95 95–152	co. s. for. r ... co. s. for. r ...	Sig. S. M......... 10′ Blk.........	.... Bottom.	 20	.... N. 21° W ..	 1	Net slightly torn.
D. 4099	July 23	10.49 a. m. 11.14 a. m.	Puniawa Point, SE. 8.3′.	78 78	76 76	60.7 60.7	152 152–153	fne. s. for. sh .. fne. s. for. sh ..	Sig. S. M......... 8′ Tnr	.... Bottom.	 20	.... S. 85° W ..	9	
			Pailolo Channel, between Maui and Molokai islands.											
D. 4100	July 23	1.53 p. m. 2.08 p. m.	Mokuhoonik i Islet, N. 35°, W. 3.1′.	80 80	76 76	61.0 61.0	130 130–151	co. s. sh. for... co. s. sh. for...	Sig. S. M......... 8 Hp. Tgls....	.... Bottom.	 24	.... N. 17° E...	7	
D. 4101	July 23	3.39 p. m. 4.06 p. m.	Mokuhoonik i Islet, N. 8° 30′, E. 4.8′.	79 79	78 78	59.7 59.7	143 143–122	co. s. sh. for... co. s. sh. for...	Sig. S. M......... 10′ Blk.........	.... Bottom.	 21	.... S. 89° W ..	7	
D. 4102	July 23	4.43 p. m. 5.09 p. m.	Mokuhoonik i Islet, N. 29°, E. 5.6′.	78 78	79 79	....	122 122–132	fne. gy. s. for	Sig. S. M......... 10′ Blk.........	.... Bottom.	 20	.... S. 51° W ..	5	
D. 4103	July 23	5.44 p. m. 6.06 p. m.	Mokuhoonik i Islet, N. 32° 45′, E. 6.7′.	77 77	78 78	61.7 61.7	132 132–141	fne. gy. s...... fne. gy. s......	Sig. S. M......... 10′ Blk.........	.... Bottom.	 21	.... S. 63° W ..	6	
D. 4104	July 23	6.44 p. m. 7.07 p. m.	Mokuhoonik i Islet, N. 38° 15′, E. 8.1′.	77 77	78 78	60.8 60.8	141 141–123	fne. gy. s. for . fne. gy. s. for .	Sig. S. M......... 10′ Blk.........	.... Bottom.	 20	.... S. 80° W ..	5	
			Kaiwi Channel, between Molokai and Oahu islands.											
D. 4105	July 24	5.12 a. m. 5.50 a. m.	Lae-o Ka Laau Light, Molokai Island, S. 45° 30′, E. 10.6′.	76 76	76 76	43.8 43.8	314 314–335	fne. co. s. for . fne. co. s. for .	Sig. S. M......... 8′ Tnr	.... Bottom.	 20	.... N. 7° E ...	5	
D. 4106	July 24	6.35 a. m. 7.07 a. m.	Lae-o Ka Laau Light, Molokai Island, S. 40° 15′, E. 11.5′.	76 76	76 76	42.6 42.6	335 335–350	fne. s .... fne. s	Sig. S. M......... 8′ Tnr	.... Bottom.	 20	.... N. 20° E...	4	
D. 4107	July 24	7.56 a. m. 8.28 a. m.	Lae-o Ka Laau Light, Molokai Island, S. 34° 30′, E. 12.3′.	78 78	76 76	41.6 41.6	350 350–355	co. s. for ...... co. s. for	Sig. S. M......... 10′ Blk.........	.... Bottom.	 6	.... N. 13° E...	1	
D. 4108	July 24	9.44 a. m. 10.12 a. m.	Lae-o Ka Laau Light, Molokai Island, S. 21°, E. 15.5′.	79 79	76 76	40.4 40.4	411 411–442	co. s. for ...... co. s. for	Sig. S. M......... 8′ Tnr	.... Bottom.	 20	.... N. 51° W ..	5	
D. 4109	July 24	11.06 a. m. 11.42 a. m.	Lae-o Ka Laau Light, Malokai Island, S. 23° 45′, E. 17.0′.	79 79	76 76	40.4 40.4	442 442–449	co. s. for ...... co. s. for	Sig. S. M......... 8′ Tnr	.... Bottom.	 20	.... N. 28° W ..	5	

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Kaiwi Channel, between Molokai and Oahu islands—C't'd.											
	1902.			° F.	° F.	° F.	Fms.			Fms.	Hr. M.		'	
D. 4110	July 24	12.35 p. m. 1.27 p. m.	Lae-o Ka Laau Light, Molokai Island, S. 24°, E. 18.7'.	82 82	76 76	40.3 40.3	449 449–460	gy. s gy. s	Sig. S. M. 8' Tnr	Bottom.	0 20	N. 57° E.	0.6	
D. 4111	July 24	2.27 p. m. 3.15 p. m.	Lae-o Ka Laau Light, Molokai Island, S. 15° 30', E. 19.4'.	81 81	77 77	40.0 40.0	460 460–470	fne. s. r fne. s. r	Sig. S. M. 8' Tnr	Bottom.	20	N. 38° E.	.2	Bridle stops parted; net capsized.
D. 4112	July 24	5.42 p. m. 6.26 p. m.	Lae-o Ka Laau Light, Molokai Island, S. 19° 30', E. 17.5'.	79 79	76 76	40.5 40.5	447 447–433	fne. s fne. s	Sig. S. M. 8' Tnr	Bottom.	20	S. 34° W.	.5	
D. 4113	July 24	7.31 p. m. 8.14 p. m.	Lae-o Ka Laau Light, Molokai Island, S. 26°, E. 16.4'.	78 78	76 76	40.6 40.6	433 433–395	co. for. s co. for. s	Sig. S. M. 8' Tnr	Bottom.	21	N. 23° W.	.6	
			Northwest coast of Oahu Island.											
D. 4114	July 25	9.37 a. m. 9.56 a. m.	Kahuku Point, N. 72° 30', E. 9.3'.	82 82	78 78	60.7 60.7	154 154–195	co. s. for. co. s. for.	Sig. S. M. 8' Tur.	Bottom.	20	N. 3° W.	.8	
D. 4115	July 25	10.33 a. m. 10.59 a. m.	Kahuku Point, N. 83°, E. 9.0'.	80 80	77 77	55.1 55.1	195 195–241	co. s. for. co. s. for.	Sig. S. M. 10' Blk.	Bottom.	20	N. 5° W.	.7	
D. 4116	July 25	11.41 a. m. 12.15 p. m.	Kahuku Point, N. 86° 30', E. 9.1'.	81 81	77 77	48.8 48.8	241 241–282	co. s. for. co. s. for.	Sig. S. M. 10' Blk.	Bottom.	21	N. 16° E.	.8	
D. 4117	July 25	1.03 p. m. 1.35 p. m.	Kahuku Point, S. 69° 30', E. 9.0'.	81 81	77 77	45.6 45.6	282 282–253	co. s. for. co. s. for.	Sig. S. M. 10' Blk.	Bottom.	21	N. 55° E.	.8	
D. 4118	July 25	2.27 p. m. 2.58 p. m.	Kahuku Point, S. 53° 45', E. 7.9'.	83 83	77 77	45.8 45.8	253 253–322	co. s. for. r. co. s. for. r.	Sig. S. M. 10' Blk.	Bottom.	15	N. 54° E.	.3	Frame wrecked; upper beam badly bent and torn from bolt at one end; one runner badly bent; and net badly torn. Water haul.
D. 4119	July 25	6.31 p. m. 6.47 p. m.	Kahuku Point, N. 62° 30', E. 9.9'.	80 80	78 78	63.8 63.8	84 84–167	co. s. for. co. s. for.	Sig. S. M. 8' Tnr.	Bottom.	20	N. 25° W.	1	Water haul; probably on bottom but little.
D. 4120	July 25	7.19 p. m. 7.40 p. m.	Kahuku Point, N. 72° 30', E. 10.0'.	79 79	77 77	52.7 52.7	167 167–216	co. s. for. co. s. for.	Sig. S. M. 8' Tnr.	Bottom.	21	N. 21° W.	.8	

D. 4121	July 25	8.23 p. m. 8.53 p. m.	Kahuku Point, N. 79°, E. 10.1′.	79 79	77 77	48.8 48.8	216 216–251	co. s. for....... co. s. for.......	Sig. S. M...... 8′ Tnr.........	.... Bottom.	 23	.... N. 40° W..	.... 1.1	Heavy strains; cable jumped block on berth deck; runners and beam of frame badly twisted; net not torn.
			Southwest coast of Oahu Island.											
D. 4122	July 26	6.32 a. m. 6.55 a. m.	Barbers Pt. Light, N. 82°, E. 2.2′.	78 78	79 79	64.6 64.6	192 192–352	crs. co. s. sh .. crs. co. s. sh ..	Sig. S. M...... 8′ Blk.........	.... Bottom.	 25	.... N. 49° W..	6	
D. 4123	July 26	7.44 a. m. 8.12 a. m.	Barbers Pt. Light, S. 78°, E. 3.2′.	81 81	79 79	42.3 42.3	352 352–357	fne. gy. s. m .. fne. gy. s. m ..	Sig. S. M...... 8′ Blk.........	.... Bottom.	 15	.... N. 22° E ..	3	Heavy load of mud in net; upper beam of frame slightly bent from weight of load.
D. 4124	July 26	9.22 a. m. 9.58 a. m.	Barbers Pt. Light, S. 70°, E. 3.2′.	81 81	79 79	42.3 42.3	357 357–350	fne. gy. s. r.... fne. gy. s. r....	Sig. S. M...... 8′ Blk.........	.... Bottom.	 15	.... S. 19° E...	4	Heavy strains; cable jumped block on berth deck; frame bent; bridle stops parted; net capsized and badly torn.
			Kaieie-Waho Channel, bet. Oahu and Kauai islands.											
D. 4125	July 31	7.18 a. m. 8.45 a. m.	Kahuku Pt., Oahu I., S. 77°, E. 12.0′.	78 78	77 77	36.4 36.4	963 963–1,124	br. m. for. r ... br. m. for. r ...	Sig. S. M...... 5¼′ Blk........	.... Bottom.	 16	.... N. 79° W..	4	Lost everything except fragments of net, bridle, etc.
D. 4126	July 31	12.16 p. m. 1.50 p. m.	Kahuku Pt., Oahu I., S. 72°, E. 25.0′.	80 80	78 78	35.5 35.5	1,278 1,278–743	gy. s. for ...... gy. s. for	Sig. S. M...... 5¼′ Alb.-Blk...	.... Bottom.	 15	.... N. 82° W..	6	
			Vicinity of Kauai Island.											
D. 4127	July 31	10.19 p. m. 12.16 a. m.	Hanamaulu warehouse, S. 45° 30′, W. 12.8′.	78 78	78 78	35.3 35.3	1,362 1,362–358	brk. sh. vol. s. for. r. brk. sh. vol. s. for. r.	Sig. S. M...... 5¼′ Alb.-Blk...	.... Bottom.	 23	.... S. 74° W ..	4	Dragged over rough, steep, ascending slope with 900 fms. cable out; very heavy strains; lost complete outfit and 138 fms. cable, 250-pound sinker, etc.
D. 4128	Aug. 1	5.31 a. m. 6.22 a. m.	Hanamaulu warehouse, N. 44° 30′, W. 2.6′.	78 78	77 77	47.8 47.8	253 253–68–90–179	crs. br. co. s. for. crs. br. co. s. for.	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.	 20	.... N. 25° E ..	4	Depth 253 fms. at initial sounding; trawl took bottom in 68 fms.; was towed for time at 90 fms.; final sounding 179 fms. Position on line, between 68 and 90 fms., Hanamaulu warehouse bore N. 31° 30′, W. 2.5′.
D. 4129	Aug. 1	6.51 a. m. 7.13 a. m.	Hanamaulu warehouse, N. 42° 30′, W. 2.3′.	78 78	77 77	58.9 58.9	179 179–283	crs. co. s. for. sh. crs. co. s. for. sh.	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.	 20	.... N. 35° E ..	4	Water haul.
D. 4130	Aug. 1	7.48 a. m. 8.22 a. m.	Hanamaulu warehouse, N. 61°, W. 2.2′.	78 78	77 77	46.1 46.1	283 283–309	fne. gy. s ...... fne. gy. s	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.	 20	.... N. 10° E ..	4	

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Surface.	Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Length.	Drift. Direction.	Distance.	Remarks.
	1902.		*Vicinity of Kauai Island*—C't'd.	° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 4131	Aug. 1	9.12 a. m. 9.38 a. m.	Hanamaulu warehouse, S. 81° 30′, W. 2.2′.	79 79	77 77	43.7 43.7	309 309–257	fne. gy. s ...... fne. gy. s	Sig. S. M .... 8′ Alb.-Blk	Bottom.	0 28	N. 18° W ..	0.8	
D. 4132	Aug. 1	10.30 a. m. 11.05 a. m.	Hanamaulu warehouse, S. 37°, W. 27′.	80 80	77 77	46.8 46.8	257 257–312	fne. gy. s. m ... fne. gy. s. m ...	Sig. S. M .... 8′ Alb.-Blk	Bottom.	28	N. E	.6	Heavy load mud; net slightly torn from weight.
D. 4133	Aug. 1	12.22 p. m. 1.01 p. m.	Hanamaulu warehouse, S. 40°, W. 4.4′.	81 81	77 77	43.8 43.8	312 165–41	fne. gy. s. r .... fne. gy. s. r	Sig S. M .... 8′ Alb.-Blk	Bottom.	24	S. 81° W ..	.7	Trawl took bottom in 165 fms.; towed up steep slope to 41 fms.; bridle stops parted; net capsized and torn; no gear lost.
D. 4134	Aug. 1	2.14 p. m. 2.42 p. m.	Hanamaulu warehouse, S. 35° 30′, W. 5.2′.	82 82	78 78	43.3 43.3	324 324–225	fne. co. vol. s .. fne. co. vol. s ..	Sig. S. M .... 8′ Alb.-Blk	Bottom.	29	N. 12° E ...	.5	
D. 4135	Aug. 1	3.36 p. m. 3.57 p. m.	Hanamaulu warehouse, S. 31° 30′, W. 6.2′.	83 83	78 78	51.4 51.4	225 225–294	fne. co. s ...... fne. co. s	Sig. S. M .... 8′ Alb.-Blk	Bottom.	20	N. 33° E ...	.4	Almost a water haul; net evidently only on bottom a moment.
D. 4136	Aug. 1	4.32 p. m. 4.59 p. m.	Hanamaulu warehouse, S. 31° 45′, W. 6.9′.	83 83	78 78	44.2 44.2	294 294–352	fne. co. s ...... fne. co. s	Sig. S. M .... 8′ Alb.-Blk	Bottom.	7	N. 31° E ...	.1	Heavy strains, but no damage done to gear.
D. 4137	Aug. 1	7.26 p. m. 7.45 p. m. 8.24 p. m.	Hanamaulu warehouse, N. 65° 15′, W. 4′.	79 79 79	78 78 78	41.0 ..... 41.0	411 411–476	co. vol. s. for. r. .... co. vol. s. for. r.	Sig. S. M .... Surf. N .... 8′ Alb.-Blk	Surface. Bottom.	21 21	N. 5° W ... N. 5° W ...	.3 .3	Lining and inner net torn by short, quick surges. Bridle stops parted on one runner; net and apron slightly torn.
D. 4138	Aug. 1	9.26 p. m. 10.15 p. m.	Hanamaulu warehouse, S. 88°, W. 2.7′.	79 79	77 77	40.0 40.0	476 476–438	fne. br. s. r ... fne. br. s. r ...	Sig. S. M .... 8′ Alb.-Blk	Bottom.	24	N. 15° E ...	.4	Heavy strains; upper beam bent and frame bent and twisted; net complete wreck, but no gear lost.
D. 4139	Aug. 2	12.39 a. m. 1.25 a. m.	Hanamaulu warehouse, S. 57°, W. 5.2′.	78 78	77 77	40.3 40.3	512 512–339	fne. gy. s. r ... fne. gy. s. r ...	Sig. S. M .... 8′ Alb.-Blk	Bottom.	15	N. 54° W ..	.3	Bridle stops parted; net doubled over upper beam, but not torn.
D. 4140	Aug. 2	2.25 a. m. 3.09 a. m.	Hanamaulu warehouse, S. 39°, W. 4.9′.	78 78	77 77	43.4 43.4	339 339–437	fne. gy. s ...... fne. gy. s	Sig. S. M .... 8′ Alb.-Blk	Bottom.	21	N. 72° E ...	.5	

D. 4141	Aug. 2	3.57 a. m. 4.36 a. m.	Hanamaulu ware-house, S. 46°, W. 6.2′.	78 78	77 77	41.0 41.0	437 437–632	vol. s. for.	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.		 20	.... N. 28° E...	3	
D. 4142	Aug. 2	5.40 a. m. 6.42 a. m.	Hanamaulu ware-house, S. 43° 15′, W. 7.3′.	78 78	77 77	38.6 38.6	632 632–881	crs. mang. s. r. crs. mang. s. r.	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.		 8	.... N. 14° E...	1	Bridle stops parted one side; nothing lost.
D. 4143	Aug. 2	10.03 a. m. 11.00 a. m.	Hanamaulu ware-house, N. 64° 45′, W. 4.8′.	79 79	78 78	38.0 38.0	710 710–616	fne. gy. s. r.... fne. gy. s. r....	Sig. S. M...... 8′ Alb.-Blk....	.... Bottom.		 20	.... N. 5° W...	6	Bridle parted at shackle, losing complete Blake-Albatross outfit.
D. 4144	Aug. 2	1.14 p. m. 2.23 p. m.	Hanamaulu ware-house, S. 55° 45′, W. 7.5′.	81 81	78 78	37.4 37.4	850 850–767	fne. gy. s...... fne. gy. s......	Sig. S. M...... 8′ Blk.........	.... Bottom.		 20	.... N. 43° W...	2	
			Between Kauai Id. and Modu Manu, or Bird Island. Lat. N. ° ′ ″ | Long. W. ° ′ ″												
D. 4145	Aug. 4	7.05 p. m.	22 27 30 | 160 40 00	78	77	.....	(Did not sound.)		2 Surf. N.; 1 on each side.	Surface.	1	30	N. 61° W...	3	12 hauls (6 each side simultaneously).
			Vicinity of Modu Manu, or Bird Island.												
D. 4146	Aug. 5	8.46 a. m. 8.52 a. m.	Center of Bird Id., S. 62°, W. 0.5′.	79 79	77 77	78.7 78.7	23 23–26	crs. co. s. for ..	Tnr. S. M ..... 9 Hp. Tgls	.... Bottom.		 22	.... N. 1° E....	.... 1.2	
D. 4147	Aug. 5	9.18 a. m. 9.24 a. m.	Center of Bird Id., S. 21°, W. 2.0′.	81	77	77.9	26	co. corln......	Tnr. S. M ..... 8 Hp. Tgls	.... Bottom.		 21	.... N. 8° W...	 1	
D. 4148	Aug. 5	9.49 a. m. 9.54 a. m.	Center of Bird Id., S. 10°, W. 3.2′.	81 81	77 77	77.9 77.9	26 26–33	co. s. for ...... co. s. for	Tnr. S. M ..... 9 Hp. Tgls	.... Bottom.		 21	.... North	 1	
D. 4149	Aug. 5	10.19 a. m. 10.26 a. m.	Center of Bird Id., S. 7° 30′, W. 4.3′.	81 81	77 78	77.7 77.7	33 33–71	co. corln...... co. corln......	Tnr. S. M ..... 8 Hp. Tgls	.... Bottom.		 31	.... North	 1	
D. 4150	Aug. 5	11.02 a. m. 11.13 a. m.	Center of Bird Id., S. 6°, W. 5.5′.	82 82	78 78	74.0 74.0	71 71–160	co .... co	Tnr. S. M ..... 9 Hp. Tgls	.... Bottom.		 20	.... N. 2° W...	7	Depth increased rapidly; estd. dredging depth betn. 71 and 160 fms.
D. 4151	Aug. 5	5.07 p. m. 5.57 p. m.	Center of Bird Island, S. 32°, W. 12.8′.	85 85	79 79	37.8 37.8	871 800–313	fne. co. s. for. st. fne. co. s. for. st.	Sig. S. M...... 5½′ Blk........	.... Bottom.		 23	.... S. 76° W...	6	Estimated that trawl took bottom at about 800 fms. depth, and was dragged up steep slope.
D. 4152	Aug. 5	7.07 p. m. 7.23 p. m. 7.40 p. m.	Center of Bird Island, S. 23° 30′, W. 11.6′.	82 82 82	79 79 79	44.6 ..... 44.6	313 313–500	rky .... rky	Sig. S. M...... Surf. N........ 8′ Blk.........	.... Surface. Bottom.		.... 15 20	.... N. 88° W.. N. 88° W..	.... .6 .8	1 haul. Depth increased; estimated that trawl left bottom at about 500 fms. Lost frame and 35-pound tail weight; net wrecked.
D. 4153	Aug. 5	9.29 p. m. 10.45 p. m. 10.50 p. m.	Center of Bird Island, S. 12°, W. 9.7′.	81 81 81	79 79 79	37.0 37.0	962 962–1,059	co. s .... co. s	Sig. S. M...... 8′ Blk......... Surf. N........	.... Bottom. Surface.		.... 11 7	.... N. 81° W.. N. 81° W..	.... .4 .3	 1 haul.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures.			Depth.	Kind of bottom.	Instrument used.	Trial.		Drift.		Remarks.
				Air.	Surface.	Bottom.				Depth.	Length.	Direction.	Distance.	
	1902.		*Vicinity of Modu Manu, or Bird Islands*—C't'd.	° F.	° F.	° F.	*Fms.*			*Fms.*	*Hr. M.*			
D. 4154	Aug. 6	8.02 a. m. 8.52 a. m.	Center of Bird Island, S. 6° 30', W. 6.9'.	79 79	77 77	38.8 38.8	636 636–850	fne. wh. s fne. wh. s	Sig. S. M 8' Blk	Bottom.	0 25	N. 60° W	0.6	Depth increased; estimated that trawl left bottom at about 850 fms.
D. 4155	Aug. 6	1.33 p. m. 3.04 p. m.	Center of Bird Island, S. 31° 30', W. 13.0'.	82 82	78 78	36.0 36.0	1,164 1,164–1,594	glob. oz glob. oz	Sig. S. M 5¼' Blk	Bottom.	30	N. 71° W	.7	
D. 4156	Aug. 6	9.33 p. m. 10.04 p. m.	Center of Bird Island, S. 79°, E. 9.2'.	79 79	78 78	45.8 45.8	286 286–568	wh. m. for. r wh. m. for. r	Sig. S. M 5¼' Blk	Bottom.	16	N. 59° W	.2	Lost frame and 35-pound tail weight; upper part of net wrecked; apron torn.
D. 4157	Aug. 6 Aug. 7	11.27 p. m. 12.17 a. m.	Center of Bird Island, S. 77° 30', E. 11.1'.	79 79	77 77	38.0 38.0	762 762–1,000	wh. m. for. r wh. m. for. r	Sig. S. M 8' Blk	Bottom.	22	N. 63° W	.4	Depth increased; estimated that trawl left bottom at about 1,000 fms. Net slightly torn.
D. 4158	Aug. 7	6.57 a. m. 7.06 a. m.	Center of Bird Island, N. 1.0'.	79 79	78 78	78.6 78.6	20 20–30	co. corln co. corln	Sig. S. M 9 Hp. Tgls	Bottom.	21	N. 64° W	1	
D. 4159	Aug. 7	7.32 a. m. 7.37 a. m.	Center of Bird Island, N. 81°, E. 2.0'.	79 79	78 78	78.3 78.3	30 30–31	crs. co. s. brk. sh. for. crs. co. s. brk. sh. for.	Tnr. S. M 8 Hp. Tgls	Bottom.	24	N. 66° W	1.5	
D. 4160	Aug. 7	8.07 a. m. 8.12 a. m.	Center of Bird Island, S. 83°, E. 3.8'.	82 82	78 78	78.0 78.0	31 31–39	co. corln co. corln	Tnr. S. M 9 Hp. Tgls	Bottom.	25	N. 51° W	.9	
D. 4161	Aug. 7	8.42 a. m. 9.08 a. m.	Center of Bird Island, S. 75°, E. 5.0'.	82 82	78 78	77.9 77.9	39 39–183	co. corln co. corln	Tnr. S. M 8 Hp. Tgls	Bottom.	5	N. 75° W	.2	
D. 4162	Aug. 8	5.57 a. m. 6.01 a. m.	Center of Bird Island, N. 75°, E. 21.3'.	78 78	77 77	....	21 21–24	co co	Hand lead 8 Hp. Tgls	Bottom.	20	N. 27° E	1.6	Same position as night anchorage, Aug. 7–8.
D. 4163	Aug. 8	6.25 a. m. 6.33 a. m.	Center of Bird Island, N. 79° 30', E. 20.0'.	78 78	77 77	78.1 78.1	24 24–40	co co	Tnr. S. M 9 Hp. Tgls	Bottom.	10	N. 33° E	.8	
D. 4164	Aug. 8	6.56 a. m. 7.03 a. m.	Center of Bird Island, N. 84°, E. 18.5'.	78 78	77 77	78.1 78.1	40 40–56	co. s. p. sh co. s. p. sh	Tnr. S. M 8 Hp. Tgls	Bottom.	20	N. 38° E	1.1	

D. 4165	Aug. 8	7.50 a.m. 8.16 a.m.	Center of Bird Island, E. 17.0′.	80 80	78 78	56.3 56.3	167 167–293	fne. co. s. sh. r. fne. co. s. sh. r.	Sig. S. M....... 8′ Blk.........	.... Bottom.	 23	.... N. 34° E...	5	Upper beam bent badly; net wrecked.
D. 4166	Aug. 8	9.04 a.m. 9.46 a.m.	Center of Bird Island, S. 86°, E. 16.2′.	80 80	78 78	45.6 45.6	293 293–800	co. s. for. r..... co. s. for. r.....	Sig. S. M...... 8′ Blk.........	.... Bottom.	 14	.... N. 40° E...	4	Depth increased; estimated that trawl left bottom at about 800 fms. Upper beam bent more.
D. 4167	Aug. 8	12.22 p.m. 12.33 p.m.	Center of Bird Island, N. 78° 30′, E. 11.6′.	80 80	78 78	....	18 18–20	co. s .... co. s	Sig. S. M....... 8 Hp. Tgls....	.... Bottom.	 20	.... W	.... 1.1	
D. 4168	Aug. 8	12.52 p.m. 1.04 p.m.	Center of Bird Id., N. 80°, E. 13.0′.	81 81	78 78	78.3 78.3	20 20–21	co. s. for ...... co. s. for	Tnr. S. M....... 9 Hp. Tgls....	.... Bottom.	 20	.... W	.... 1.1	
D. 4169	Aug. 8	1.27 p.m. 1.31 p.m.	Center of Bird Id., N. 81°, E. 14.3′.	81 81	78 78	78.6 78.6	21 21–22	co .... co	Tnr. S. M....... 8 Hp. Tgls....	.... Bottom.	 20	.... S. 71° W...	.... 1.2	
D. 4170	Aug. 8	2.39 p.m. 2.50 p.m.	Center of Bird Id., N. 72°, E. 16.3′.	80 80	78 78	77.4 77.4	26 26–27	co. s. for ...... co. s. for	Sig. S. M....... 9 Hp. Tgls....	.... Bottom.	 20	.... N. 66° W..	.... 1.2	
D. 4171	Aug. 8	3.15 p.m. 3.27 p.m.	Center of Bird Island, N. 75° 15′, E. 17.2′.	79 79	78 78	78.0 78.0	27 27–31	co .... co	Tnr. S. M....... 8 Hp. Tgls....	.... Bottom.	 21	.... N. 56° W..	9	
D. 4172	Aug. 8	4.45 p.m. 5.36 p.m.	Center of Bird Id., N. 68°, E. 21.0′.	80 80	78 78	38.0 38.0	751 751–346	crs. co. s. for. r. crs. co. s. for. r.	Sig. S. M....... 8′ Blk	.... Bottom.	 10	.... N. 63° W..	2	Lost frame and 35-pound tail weight. Net wrecked.
D. 4173	Aug. 9	2.09 a.m. 2.53 a.m.	Center of Bird Island, N. 84° 30′, W. 12.4′.	78 78	77 77	38.0 38.0	722 722–100	co. s. r .... co. s. r	Sig. S. M....... 8′ Tnr	.... Bottom.	 27	.... N. 15° E...	4	Lost frame and float. Net complete wreck. Estimated trawl left bottom at about 100 fms.
			Vicinity of Niihau Island.											
D. 4174	Aug. 11	9.34 a.m. 10.37 a.m.	Kona Point, S. 18° 45′, E. 6.7′.	81 81	78 78	38.0 38.0	735 735–865	gy. s. m. glob. r gy. s. m. glob. r	Sig. S. M....... 9′ Tnr	.... Bottom.	 3	.... N.........	1	Bridle stops parted one side. Net slightly torn; frame bent one end.
D. 4175	Aug. 11	3.15 p.m. 3.57 p.m.	Kona Point, S. 43° 15′, W. 12.5′.	81 81	77 77	41.5 41.5	216 216–52	fne. gy. s. r..... fne. gy. s. r.....	Sig. S. M....... 8 Hp. Tgls....	.... Bottom.	 10	.... N. 41° E...	3	Cable caught in stbd. propeller while reeling in. Lost 750 fms. cable, 120-pound dredging sinker, and complete tangle gear.
D. 4176	Aug. 12	8.06 a.m. 9.04 a.m.	Kawahioa Point, N. 73° 30′, W. 8.6′.	79 79	78 78	38.3 38.3	672 672–537	gy. s. m. for ... gy. s. m. for ...	Sig. S. M....... 9′ Tnr	.... Bottom.	 4	.... N. 33° E...	2	
D. 4177	Aug. 12	11.44 a.m. 12.16 p.m.	Kawahioa Point, S. 54°, W. 17.5′.	81 81	78 78	41.0 41.0	451 451–319	gy. s. glob .... gy. s. glob	Sig. S. M....... 9′ Tnr	.... Bottom.	 20	.... S. 33° E...	7	
D. 4178	Aug. 12	1.05 p.m. 1.37 p.m.	Kawahioa Point, S. 61° 30′, W. 17.6′.	84 84	78 78	....	319 319–378	co. s. r. p ...... co. s. r. p	Sig. S. M....... 9′ Tnr	.... Bottom.	 11	.... N. 52° E...	4	Net slightly torn.
D. 4179	Aug. 12	2.09 p.m. 2.36 p.m.	Kawahioa Point, S. 60° 45′, W. 19.2′.	84 84	79 79	42.0 42.0	378 378–426	co. s. r. p ...... co. s. r. p	Sig. S. M....... 5½′ Blk	.... Bottom.	 14	.... N. 11° W..	3	Do.
D. 4180	Aug. 12	3.13 p.m. 3.40 p.m.	Kawahioa Point, S. 58°, W. 19.5 .	86 86	79 79	41.1 41.1	426 426–417	p. glob. r...... p. glob. r......	Sig. S. M....... 5½′ Blk........	.... Bottom.	 18	.... N. 50° E...	 1	Do.

Record of the dredging and other collecting stations of the Albatross in 1902—Continued.

Station No.	Date.	Time of day.	Position.	Temperatures. Air.	Temperatures. Surface.	Temperatures. Bottom.	Depth.	Kind of bottom.	Instrument used.	Trial. Depth.	Trial. Length.	Drift. Direction.	Drift. Distance.	Remarks.
			Vicinity of Kauai Island.											
	1902.			° *F.*	° *F.*	° *F.*	*Fms.*			*Fms.*	*Hr. M.*		′	
D. 4181	Aug. 13	5.25 a. m. 6.19 a. m.	Hanamaulu warehouse, N. 56°, W. 6.6′.	78 78	76 76	38.1 38.1	811 811–671	mang. s. glob . mang. s. glob .	Sig. S. M ...... 5¼′ Blk	.... Bottom.	.... 0 26	.... N. 2° W ...	.... 0.6	
D. 4182	Aug. 13	7.37 a. m. 8.35 a. m.	Hanamaulu warehouse, N. 74° 30′, W. 5.6′.	78 78	77 77	38.4 38.4	671 671–957	mang. s. glob. r	Sig. S. M ...... 10′ Blk	.... Bottom.	 20	.... N. 19° E...	6	Net completely wrecked; frame slightly wrenched.
D. 4183	Aug. 13	9.54 a. m. 11.04 a. m.	Hanamaulu warehouse, S. 87° 15′, W. 6.1′.	76 76	76 76	36.8 36.8	957 957–1,067	fne. gy. s. glob fne. gy. s. glob	Sig. S. M ...... 9′ Tnr	.... Bottom.	 20	.... N. 25° E...	4	
D. 4184	Aug. 13	12.31 p. m. 1.37 p. m.	Hanamaulu warehouse, S. 71° 45′, W. 7.2′.	81 81	77 77	36.3 36.3	1,067 1,067–1,000	gy. s. glob..... gy. s. glob.....	Sig. S. M ...... 9′ Tnr	.... Bottom.	 25	.... N. 7° W ...	6	
D. 4185	Aug. 13	3.10 p. m. 4.38 p. m.	Hanamaulu warehouse, S. 49° 30′, W. 8.4′.	81 81	77 77	36.6 36.6	1,000 1,000–1,314	gy. s. m. for ... gy. s. m. for ...	Sig. S. M ...... 9′ Tnr	.... Bottom.	 22	.... N. 17° E...	6	
D. 4186	Aug. 13	7.40 p. m. 8.38 p. m.	Hanamaulu warehouse, S. 48° 15′, W. 7.1′.	76 76	77 77	38.1 38.1	682 682–508	gy. s. for ...... gy. s. for	Sig. S. M ...... 9′ Tnr	.... Bottom.	 20	.... N. 5° W ...	4	Lost one 35-pound wing weight.
D. 4187	Aug. 13	9.49 p. m. 10.31 p. m.	Hanamaulu warehouse, S. 38° 45′ W. 8.1′.	76 76	77 77	40.0 40.0	508 508–703	gy. s. for ...... gy. s. for	Sig. S. M ...... 9′ Tnr	.... Bottom.	 21	.... N. 13° E...	4	
			Between Honolulu, Oahu Island, and San Francisco, Cal.											
			Lat. N. ° ′ ″ | Long. W. ° ′ ″											
D. 4188	Aug. 23	6.54 p. m.	28 13 42 | 145 44 00	74	72	....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	50	N. 56° E...	1.9	10 single hauls (5 each side, simultaneously).
D. 4189	Aug. 25	6.32 p. m.	31 34 12 | 139 08 00	74	69	....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	50	N. 56° E...	2	8 single hauls (3 each side, simultaneously; 2 single hauls; all 10-minute intervals). Both nets torn badly.
D. 4190	Aug. 27	6.33 p. m.	34 39 18 | 132 04 00	69	69	....	(Did not sound.)		2 Surf. N.; 1 each side.	Surface.	1 0	N. 65° E...	2	12 single hauls (6 each side, simultaneously).

STATISTICS

OF THE

FISHERIES OF THE MIDDLE ATLANTIC STATES.

PREPARED IN THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES, UNITED STATES FISH COMMISSION.

BARTON W. EVERMANN,
Assistant in Charge.

STATISTICS OF THE FISHERIES OF THE MIDDLE ATLANTIC STATES.

INTRODUCTION.

The present report on the fisheries of the Middle Atlantic States is for the calendar year 1901. The statistics of the oyster fishery, however, in all sections except Long Island, New York; Delaware; Worcester County, Md., and Accomac and Northampton counties, Va., are for the oyster season of 1900–1901.

The investigation on which this report is based embraced the commercial fisheries of all the coastal waters, including coast rivers, of the various States of this region. It was begun in January and completed in October, 1902. The inquiries in the field were made by the statistical agents of the Commission as follows: Mr. C. H. Stevenson canvassed Long Island, New York; Delaware; Accomac and Northampton counties, Va., and Worcester County, Md. Mr. John N. Cobb canvassed New York, exclusive of Long Island; the Atlantic coast of New Jersey, and, in December after the regular investigation closed, obtained statistics of the smoked-fish trade of Philadelphia and additional data on the shore fisheries of Philadelphia County, Pa., and Burlington and Mercer counties, N. J. Mr. W. A. Roberts canvassed the Eastern Shore of Maryland, except Worcester and Cecil counties, and also the Patuxent River, and the Chesapeake side of St. Mary, Calvert, and part of Anne Arundel counties on the western shore of that State. Mr. John B. Wilson assisted in the work at Crisfield, Md., and canvassed New Jersey on the Delaware River and Bay from Camden to Cape May. Mr. Thomas B. Gould obtained statistics of Pennsylvania on the Delaware and Susquehanna rivers, and of New Jersey on the Delaware River above Camden. Messrs. W. A. Wilcox and T. M. Cogswell canvassed Virginia, except Accomac and Northampton counties, and also that part of Maryland bordering the Potomac River. The remaining territory in Maryland was worked by Mr. G. H. H. Moore and Mr. E. S. King, the former canvassing Cecil and Harford counties and the wholesale trade and vessel fisheries of Baltimore City, and the latter collecting statistics on the shore fisheries of Baltimore County and Baltimore City and on the vessel and shore fisheries of a part of Anne Arundel County. Messrs. Stevenson, Cobb, Roberts, Wilcox, Cogswell, and Moore obtained explanatory notes on the fisheries which are embodied in the text, and also assisted in the work of preparing the text and compiling the statistics in the office. The general preparation and arrangement of the report was under the direction of Mr. Ansley Hall. The results of the inquiry, which in this report are presented in detail, have already been published in condensed form in Statistical Bulletin No. 131.

The fisheries of the Middle Atlantic States in 1901[a] gave employment to 93,661 persons, of whom 70,923 were fishermen and 22,738 were shoresmen in the wholesale fishery trade, oyster canneries, and other shore industries related to the fisheries. Maryland employed in its fisheries 36,260 persons, Virginia 29,325, New Jersey 12,030, New York 11,564, Pennsylvania 2,484, and Delaware 1,998. The last general investigation of the fisheries of this group of States was for the year 1897. In connection with that canvass statistics for New York and New Jersey were also obtained for 1898. Since 1897 there has been a decrease in the number of persons employed of 3,074. There was a decrease of 6,552 persons in Maryland, 464 in New Jersey, and 394 in Delaware, but this was partly offset by an increase in each of the other States.

The total capital invested in 1901 was $25,080,371. The investment in New York was $9,444,271; in Maryland, $6,506,066; in Virginia, $3,633,104; in New Jersey, $2,729,571; in Pennsylvania, $2,110,162, and in Delaware, $657,197. Compared with 1897 the investment has increased $4,973,900, or 24.73 per cent. About half of this increase is in New York and the remainder is distributed in various amounts in all the other States, the largest percentage in any State being 61.15 per cent in Delaware.

The number of fishing and transporting vessels employed was 3,721, valued at $3,657,103. Their net tonnage was 54,761 tons, and the value of their outfits was $1,088,706. There has been a decrease in the vessels of 153 in number, and of 3,554 tons in tonnage, but an increase of $339,080 in the value. The number of boats in the shore fisheries was 36,237, valued at $2,023,880. The apparatus of capture was valued at $1,713,454, the shore and accessory property at $9,561,356, and the cash capital amounted to $7,035,872.

The products of the fisheries aggregated 819,046,576 pounds, valued at $17,485,500. New York derived from its fisheries 228,092,285 pounds, valued at $3,894,270; New Jersey, 117,930,964 pounds, valued at $4,755,522; Pennsylvania, 6,029,538 pounds, valued at $251,491; Delaware, 5,835,186 pounds, valued at $203,872; Maryland, 82,975,245 pounds, valued at $3,767,461; and Virginia, 378,183,358 pounds, valued at $4,613,384. The most important species in the fisheries of these States is the oyster, the yield of which was 19,749,677 bushels, valued at $10,287,556, representing nearly 59 per cent of the total

[a] In the present report, it should be noted, the statistics for New York and Pennsylvania do not include the fisheries of the Great Lakes and other interior waters within the boundaries of these States.

value of products for the entire region. The yield of shad, which is next in importance, was 31,897,687 pounds, valued at $1,253,622. The catch of clams, hard and soft, was 1,118,777 bushels, valued at $1,074,834. Some of the other prominent species were alewives, 33,198,605 pounds, $243,340; blue-fish, 16,317,795 pounds, $758,122; menhaden, 493,936,462 pounds, $987,228; squeteague, 23,496,383 pounds, $558,653; crabs, hard and soft, 70,951,965 in number, $495,385. The catch of alewives, blue-fish, croakers, king-fish, yellow perch, pike and pickerel, scup, shad, striped bass, and oysters, as compared with 1897, has decreased in quantity, but increased in value. In the meantime there has been an increase in both the quantity and value of a large number of other species.

The products since 1897 have increased 224,874,366 pounds, or 37.84 per cent in quantity, and $3,161,037 or 22.06 per cent in value. There has been an increase in quantity in all the States except Delaware and Maryland, and in value in all except Delaware and Pennsylvania. The decrease in Delaware, which was 32.52 per cent in quantity and 19.34 per cent in value, is explained principally by a falling off in the catch of sturgeon, squeteague, and alewives. In Maryland the decrease in the yield of alewives, shad, and oysters has been largely instrumental in overbalancing the increase in other species. In New York the products have increased 108.19 per cent in quantity and 14.82 per cent in value. This is attributable mainly to the fact that since the consolidation of a number of the principal menhaden plants on the Atlantic coast in 1898, a considerable part of the menhaden catch formerly included in the products of other States has been credited to New York, where the home office of the company representing the combined interests is located. Therefore if the comparison is made with 1898 instead of with 1897 the increase is reduced to 8.35 per cent in quantity and 9.85 per cent in value. The next greatest increase is in New Jersey and Virginia, where it relates to a number of species. In Virginia, however, the products have been affected in quantity chiefly by the increased catch of menhaden, which has risen from 178,656,362 pounds, valued at $255,241, to 273,493,799 pounds, valued at $433,109. The oyster yield in this State has also increased from 7,023,848 bushels, valued at $2,041,683, to 7,885,447 bushels, valued at $2,923,456.

In connection with the fisheries of the Middle Atlantic States, one of the most important occurrences during the past few years is the adoption of gasoline and naphtha engines as an auxiliary means of propelling sailing vessels and boats. In New York and New Jersey these engines are used on a large number of boats in the oyster, clam, shad, and pound-net fisheries, and on many of the vessels engaged in transporting fishery products to market.

The following tables present the number of persons employed, the amount of capital invested, and the quantity and value of the products of the fisheries of the Middle Atlantic States in 1901, and also a comparison of the extent of the fisheries in 1897 and 1901:

Table showing the number of persons engaged in the fisheries of the Middle Atlantic States in 1901.

States.	Fishermen.	Shoresmen.	Total.
New York	8,676	2,888	11,564
New Jersey	11,170	860	12,030
Pennsylvania	1,748	736	2,484
Delaware	1,565	433	1,998
Maryland	23,707	12,553	36,260
Virginia	24,657	5,268	29,325
Total	70,923	22,738	93,661

Table showing the investment in the fisheries of the Middle Atlantic States in 1901.

Items.	New York.		New Jersey.		Pennsylvania.	
	No.	Value.	No.	Value.	No.	Value.
Vessels	633	$1,241,215	611	$643,475	27	$59,150
Tonnage	11,641		6,714		519	
Outfit		354,176		166,813		23,840
Boats	4,656	317,447	6,473	502,666	526	30,583
Seines	335	53,075	483	38,785	120	12,615
Gill nets	3,918	67,347	5,060	145,306	228	13,193
Pound nets, traps, and weirs	248	67,645	158	155,679		
Fyke nets	7,212	34,860	3,057	16,955	1,384	2,239
Stop nets			14	1,660	16	905
Dip nets	101	155			252	570
Lines		6,694		4,473		659
Eel pots	7,526	7,301	5,665	4,052	117	122
Lobster pots	4,986	8,350	850	2,358		
Dredges, tongs, nippers, rakes, and hoes		39,159		101,593		2,650
Crab scrapes			323	1,135		
Other apparatus		121		3,643		1,686
Shore and accessory property		4,221,226		785,428		1,168,243
Cash capital		3,025,500		155,550		793,707
Total investment		9,444,271		2,729,571		2,110,162

Items.	Delaware.		Maryland.		Virginia.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels	27	$20,200	1,337	$887,155	1,086	$805,908	3,721	$3,657,103
Tonnage	237		20,067		15,583		54,761	
Outfit		2,247		250,207		291,423		1,088,706
Boats	910	29,901	11,498	553,526	12,174	589,757	36,237	2,023,880
Seines	192	9,091	318	30,033	311	78,530	1,759	222,129
Gill nets	691	22,343	3,653	34,660	10,437	50,035	23,987	332,884
Pound nets, traps, and weirs	7	760	1,017	99,265	1,599	313,996	3,029	637,345
Fyke nets	548	899	4,064	11,372	729	7,444	16,994	73,769
Stop nets							80	2,565
Bow nets	12	32	106	529			118	561
Dip nets							353	725
Trammel nets			18	1,570			18	1,570
Slat traps					6	120	6	120
Lines		56		4,722		3,579		20,183
Eel pots	1,260	406	4,389	2,248	569	579	19,526	14,708
Lobster pots	60	60					5,896	10,768
Dredges, tongs, nippers, rakes, and hoes		2,430		157,398		72,592		375,892
Crab scrapes			2,831	10,247	933	2,256	4,087	13,638
Other apparatus		86		870		261		6,667
Shore and accessory property		352,086		2,164,749		869,624		9,561,356
Cash capital		216,600		2,297,515		547,000		7,035,872
Total investment		657,197		6,506,066		3,683,104		25,080,371

Table showing the quantity and value of products taken in the fisheries of the Middle Atlantic States in 1901.

Species.	New York.		New Jersey.		Pennsylvania.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Albacore			15,143	$259		
Alewives, fresh	1,368,614	$19,106	3,347,491	19,425	801,925	$2,448
Alewives, salted			374,000	2,865	334,000	6,960
Black bass			3,000	159	7,556	762
Blue-fish	9,350,502	473,366	6,110,318	254,682	1,345	67
Bonito	194,727	7,307	1,459,418	34,841		
Butter-fish	590,682	25,809	3,008,301	84,119		
Cat-fish	174,144	8,822	256,859	14,229	193,199	10,163
Cero	1,570	123	22,789	714		
Cod	1,172,291	51,921	2,300,771	67,603		
Crevalle			53	1		
Croakers			226,360	5,663	6,231	141
Drum			58,830	868		
Eels, fresh	722,859	50,038	1,362,988	70,636	140,504	6,151
Flounders	1,274,308	49,949	1,668,221	52,993	22,411	709
German carp	281,494	17,142	227,419	14,290	161,895	9,795
Haddock	160,703	6,516	226,963	8,101		
Hake	36,580	860	26,841	749		
Herring, salted	180,000	2,025				
Horse-mackerel			224	5		
King-fish	29,826	3,418	21,036	3,083		
Ling	26,140	516	817,868	4,375		
Mackerel	507,838	19,454	10,005	1,577		
Menhaden	180,409,767	454,505	32,910,666	88,041		
Mullet, fresh			36,300	1,842		
Mullet, salted			57,814	5,123		
Mummichog	140,000	800				
Perch, white	51,987	3,390	1,270,097	81,699	3,465	206
Perch, yellow	25,893	2,014	16,569	1,038	1,225	62
Pike and pickerel	2,050	185	2,560	210		
Pollock	42,581	1,240				
Salmon, Atlantic	163	78	233	73	1,397	202
Scup	804,589	25,379	607,099	16,367	22,593	585
Sea bass	231,517	15,216	1,495,247	76,003	687,412	32,791
Sea robins	385,000	433				
Shad, fresh	3,432,472	110,682	14,031,002	475,202	2,982,868	124,328
Shark			500	10		
Sheepshead	100	12	7,285	905		
Skates	139,200	140	2,875	48		
Spanish mackerel	4,104	933	38,928	5,729		
Spots	4,800	206	299,092	3,471		
Squeteague	2,846,688	73,939	11,973,394	315,770	3,600	115
Striped bass	71,840	9,102	354,467	49,734	13,092	1,153
Sturgeon	112,626	6,108	168,919	8,393	530	43
Caviar	4,291	2,215	19,108	10,959		
Suckers	218,874	11,023	110,415	5,459	29,355	1,313
Sun-fish	12,875	1,099			3,970	317
Swell-fish	134,870	101				
Tautog	49,662	1,798	91,105	3,186		
Tomcod	38,300	1,152	265,041	4,519		
Wall-eyed pike					14,675	2,321
Whitebait	24,510	1,784				
Whiting	33,975	480	405,804	7,874		
Clams, hard	1,478,368	257,686	4,246,070	552,953		
Clams, soft	779,450	58,843	902,770	54,918		
Clams, surf			13,336	500		
Crabs, hard	791,725	4,993	719,995	23,558		
Crabs, soft	40,440	2,104	417,910	51,861		
Frogs					800	240
King crabs			409,800	1,711		
Lobsters	183,539	21,742	65,943	8,340		
Mussels	262,400	1,860	374,600	920		
Oysters, market	12,380,921	1,703,985	14,646,345	1,696,767	282,352	35,517
Oysters, seed	3,808,525	268,555	10,617,572	550,918	302,638	14,232
Shells	2,286,000	1,330	144,000	32		
Scallops	1,109,724	107,337	114,000	3,200		
Shrimp			4,095	1,988		
Squid	180,846	5,114	17,748	826		
Terrapin	340	340	8,232	3,135		
Turtle			20,180	1,053	10,500	870
Total	228,092,285	3,894,270	117,930,964	4,755,522	6,029,538	251,491

Table showing the quantity and value of products taken in the fisheries of the Middle Atlantic States in 1901—Continued.

Species.	Delaware.		Maryland.		Virginia.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Albacore							15,143	$259
Alewives, fresh	597,374	$4,816	13,454,757	$87,021	13,633,444	$110,524	33,198,605	243,340
Alewives, salted			292,400	4,287	280,000	4,900	1,280,400	19,012
Black bass			23,383	2,124	199,439	16,735	233,378	19,780
Blue-fish	400	20	100,145	4,378	755,085	25,609	16,317,795	758,122
Bonito			250	10	14,160	537	1,668,555	42,695
Butter-fish			458,700	11,505	1,071,860	28,551	5,129,543	149,984
Cat-fish	130,280	5,075	488,777	15,547	820,825	23,560	2,063,584	77,396
Cero			500	10			24,859	847
Cod	1,250	50	600	12	100	4	3,475,012	119,590
Crevalle			400	2	468,791	13,533	469,244	13,536
Croakers	28,730	665	303,405	4,239	3,937,168	53,493	4,501,894	64,201
Drum	3,200	56	53,450	570	228,172	2,707	343,152	4,201
Eels, fresh	230,650	9,127	334,811	12,309	105,815	4,430	2,897,627	152,686
Eels, salted			2,200	60			2,200	60
Eels, smoked			1,100	128			1,100	128
Flounders	5,500	226	51,205	1,625	209,894	6,253	3,231,039	111,755
German carp	198,040	9,752	163,180	5,319	127,930	2,940	1,159,958	59,238
Gizzard shad			6,010	133	5,250	100	11,260	233
Haddock							387,666	14,617
Hake							63,421	1,609
Harvest-fish			12,800	110			12,800	110
Herring, salted							180,000	2,025
Hickory shad			8,315	209	448,600	11,427	456,915	11,636
Hog-fish					44,892	3,586	44,892	3,586
Horse-mackerel							224	5
King-fish			7,215	955	91,122	3,436	149,199	10,892
Ling							344,008	4,891
Mackerel			1,800	180			519,648	21,211
Menhaden			7,122,230	11,573	273,493,799	433,109	493,936,462	987,228
Moon-fish					70,400	2,161	70,400	2,161
Mullet, fresh	5,350	180	35,295	900	190,700	5,420	267,645	8,342
Mullet, salted							57,814	5,123
Mummichog							140,000	800
Perch, white	242,360	11,357	452,815	25,005	731,925	32,582	2,752,649	154,239
Perch, yellow			292,720	9,617	158,939	4,472	495,346	17,203
Pike and pickerel	16,310	654	67,530	5,390	32,103	2,848	120,553	9,287
Pollock							42,581	1,240
Pompano			140	14	96,186	7,549	96,326	7,563
Roach			200	1			200	1
Salmon, Atlantic							1,793	353
Scup			32,650	1,019			1,466,931	43,350
Sea bass	500	25	50,800	2,540	2,200	93	2,467,676	126,668
Sea robins							385,000	433
Shad, fresh	1,367,952	56,605	3,094,181	120,177	6,972,212	366,203	31,880,687	1,253,197
Shad, salted			17,000	425			17,000	425
Shark							500	10
Sheepshead			1,350	52	8,430	348	17,165	1,317
Skates							141,575	188
Spanish mackerel			2,922	348	520,142	44,017	566,096	51,027
Spots			22,170	387	806,827	24,306	1,133,189	28,370
Squeteague	722,435	13,916	1,018,775	26,921	7,431,496	127,993	23,496,383	558,653
Striped bass	47,595	5,114	824,418	68,568	527,507	45,177	1,838,919	178,848
Sturgeon	75,892	3,678	107,620	3,503	183,023	12,161	648,610	33,886
Caviar	10,307	6,766	5,818	3,486	18,318	10,204	57,842	33,630
Suckers	2,500	101	14,750	281	48,165	927	424,059	19,104
Sun-fish	200	2	3,970	72	4,000	95	25,015	1,585
Swell-fish							134,870	101
Tarpon					75	1	75	1
Tautog	3,600	180					144,367	5,114
Tomcod							303,341	5,671
Wall-eyed pike							14,675	2,321
Whitebait							24,510	1,784
Whiting					600	12	440,379	8,366
Clams, hard	8,200	1,203	107,600	14,384	1,764,680	134,777	7,604,918	961,003
Clams, soft							1,682,220	113,761
Clams, surf							13,336	500
Crabs, hard			9,824,793	85,884	6,113,277	52,863	17,449,790	167,298
Crabs, soft	150,509	5,587	4,303,582	202,563	1,288,424	65,972	6,200,865	328,087
Frogs			130	50	15,377	1,283	16,307	1,573
King crabs	720,400	2,380					1,180,200	4,091
Lobsters	2,760	294					252,242	30,376
Mussels							637,000	2,780
Oysters, market	678,300	40,290	39,798,927	3,031,518	42,473,683	2,621,915	110,260,528	9,129,992
Oysters, seed	534,030	22,318			12,724,446	301,541	27,987,211	1,157,564
Shells							2,430,000	1,362
Prawn					2,850	142	2,850	142
Scallops							1,223,724	110,537
Shrimp			728	708			4,823	2,696
Squid							198,594	5,940
Terrapin	512	491	1,593	1,139	5,130	1,444	15,807	6,549
Turtle	50,050	2,445	4,835	203	56,897	1,444	142,412	6,015
Total	5,835,186	203,372	82,975,245	3,767,461	378,183,358	4,613,384	819,046,576	17,485,500

Supplementary table showing certain of the above products in number and bushels.

Products.	New York.		New Jersey.		Pennsylvania.	
	No.	Value.	No.	Value.	No.	Value.
Clams, hard......bushels..	184,736	$257,686	530,759	$552,953	....	....
Clams, soft..........do....	77,945	58,848	90,277	54,918	....	....
Clams, surf..........do....	....	....	1,667	500	....	....
Crabs, hard......number..	2,375,175	4,993	2,159,985	23,558	....	....
Crabs, soft..........do....	121,320	2,104	1,253,730	51,861	....	....
King crabs..........do....	....	....	204,900	1,711	....	....
Mussels..........bushels..	10,240	1,860	11,860	920	....	....
Oysters, market.....do....	1,768,703	1,703,985	2,092,335	1,696,767	40,336	$35,517
Oysters, seed........do....	544,075	268,555	1,516,796	550,918	43,234	14,232
Shells..............do....	38,100	1,330	2,400	32	....	....
Scallops.............do....	184,954	107,337	7,333	3,200	....	....

Products.	Delaware.		Maryland.		Virginia.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Clams, hard......bushels..	1,025	$1,208	13,450	$14,384	220,585	$134,777	950,555	$961,073
Clams, soft..........do....	....	....	....	....	....	....	168,222	113,761
Clams, surf..........do....	....	....	....	....	....	....	1,667	500
Crabs, hard......number..	....	....	29,474,379	85,884	18,339,831	52,863	52,349,370	167,298
Crabs, soft..........do....	451,527	5,587	12,910,746	202,563	3,865,272	65,972	18,602,595	328,087
King crabs..........do....	360,200	2,380	....	....	....	....	565,100	4,091
Mussels..........bushels..	....	....	....	....	....	....	22,100	2,780
Oysters, market.....do....	96,900	40,290	5,685,561	3,031,518	6,067,669	2,621,915	15,751,504	9,129,992
Oysters, seed........do....	76,290	22,318	....	....	1,817,778	301,541	3,998,173	1,157,564
Shells..............do....	....	....	....	....	....	....	40,500	1,362
Scallops.............do....	....	....	....	....	....	....	192,287	110,537

Comparative table showing the extent of the fisheries of the Middle Atlantic States in 1897 and 1901.

States.	Persons engaged.				Capital invested.			
	1897.	1901.	Increase or decrease in 1901 compared with 1897.	Percentage of increase or decrease in 1901 compared with 1897.	1897.	1901.	Increase or decrease in 1901 compared with 1897.	Percentage of increase or decrease in 1901 compared with 1897.
New York.......	8,862	11,564	+2,702	+30.49	$7,012,725	$9,444,271	+$2,431,546	+34.67
New Jersey.....	12,494	12,030	− 464	− 3.71	2,371,253	2,729,571	+ 358,318	+15.11
Pennsylvania...	1,898	2,484	+ 586	+30.87	1,601,528	2,110,162	+ 508,634	+31.76
Delaware.......	2,392	1,998	− 894	−16.47	407,819	657,197	+ 249,378	+61.15
Maryland.......	42,812	36,260	−6,552	−15.30	5,821,610	6,506,066	+ 684,456	+11.76
Virginia........	28,277	29,325	+1,048	+ 3.71	2,891,536	3,633,104	+ 741,568	+25.64
Total......	96,735	93,661	−3,074	− 3.18	20,106,471	25,080,371	+ 4,973,900	+24.73

States.	Products.							
	Pounds.			Percentage of increase or decrease in 1901 compared with 1897.	Value.			Percentage of increase or decrease in 1901 compared with 1897.
	1897.	1901.	Increase or decrease in 1901 compared with 1897.		1897.	1901.	Increase or decrease in 1901 compared with 1897.	
New York.......	109,555,566	228,092,285	+118,536,719	+108.19	$3,391,595	$3,894,270	+ $502,675	+14.82
New Jersey.....	103,782,517	117,930,964	+ 14,148,447	+ 13.63	3,614,434	4,755,522	+1,141,088	+31.57
Pennsylvania...	5,604,263	6,029,538	+ 425,275	+ 7.59	269,507	251,491	− 18,016	− 6.68
Delaware.......	8,647,897	5,835,186	− 2,812,711	− 32.52	252,123	203,372	− 48,751	−19.34
Maryland.......	88,588,018	82,975,245	− 5,612,773	− 6.34	3,617,306	3,767,461	+ 150,155	+ 4.15
Virginia........	277,993,949	378,183,358	+100,189,409	+ 36.04	3,179,498	4,613,384	+1,433,886	+45.09
Total......	594,172,210	819,046,576	+224,874,366	+ 37.84	14,324,463	17,485,500	+3,161,037	+22.06

The study of the fisheries of this region will be greatly facilitated by consulting the earlier publications relating to them, as follows:

The Fishery Industries of the United States, Section II. Geographical Review of the Fisheries for 1880. Parts VI to XI, inclusive.

The Fishery Industries of the United States, Section V. History and Methods of the Fisheries.

A statistical report on the Fisheries of the Middle Atlantic States, by Hugh M. Smith, M. D. Bull. U. S. Fish Com. 1894, pp. 339–467.

The Oyster Industry of Maryland, by Charles H. Stevenson. Bull. U. S. Fish Com. 1892, pp. 203–297.

The Sturgeon and Sturgeon Industries of the Eastern Coast of the United States, by John A. Ryder. Bull. U. S. Fish Com. 1888, pp. 231–328.

The Sturgeon Fishery of Delaware River and Bay, by John N. Cobb. Rept. U. S. Fish Com. 1899, pp. 369–380.

Notes on the Oyster Industry of New Jersey, by Ansley Hall. Rept. U. S. Fish Com. 1892, pp. 463–528.

The Shad Fisheries of the Atlantic Coast of the United States, by Charles H. Stevenson. Rept. U. S. Fish Com. 1898, pp. 101–269.

Notes on the extent and condition of the Alewife Fisheries of the United States in 1896, by Hugh M. Smith. Rept. U. S. Fish Com. 1898, pp. 31–43.

Statistics of the Fisheries of the Middle Atlantic States. Rept. U. S. Fish Com. 1900, pp. 195–310.

FISHERIES OF NEW YORK.

Considering the value of the fishery product, New York now ranks second among the Middle Atlantic States, being surpassed only by New Jersey. The returns for 1901 show about 10 per cent increase over those for 1898, the total value amounting to $3,545,189 in 1898, and $3,894,270 in 1901.

The oyster industry yields about 50 per cent of the value of the fisheries of New York, the product in 1901 amounting to 1,768,703 bushels of market oysters and 544,075 bushels of seed oysters to be replanted, the whole worth $1,972,540. This industry is now almost wholly dependent on the growing of oysters on private areas, which a few years ago were entirely barren and unproductive. In the same year, the natural oyster reefs, to which the public resorted, yielded only 5,480 bushels of market oysters and 33,890 bushels of seed oysters, with a valuation of $20,104, or little more than 1 per cent of the total oyster product of the State.

One of the most interesting of the recent developments in the oyster industry of New York is the extensive planting of seed oysters at the eastern end of Long Island, especially in the vicinity of Greenport and Southold. This began ten years ago, and at present about 350,000 bushels are planted annually, the seed being obtained from Long Island Sound. The oysters in those waters grow very rapidly, but, not fattening readily, they are usually taken up within a year and again planted in Great South Bay and elsewhere.

An offset to the development of oyster-planting in Peconic Bay is the decrease in this industry in Shinnecock Bay, on the south side of Long Island. In 1898 the private areas in that bay yielded 43,000 bushels of oysters, worth about $1 per bushel; but, owing to the failure on the part of the town authorities to secure the planters in their holdings of ground, the planting has almost ceased. In 1901 less than 2,000 bushels were taken from private areas and no seed was planted.

A new departure in the fishery industries of New York, and one which gives promise of extensive development, is the cultivation of hard clams or quahogs. During the last three or four years many thousands of bushels of small clams have been bedded on private areas on the south side of Long Island. Comparatively few of these were marketed previous to 1901; in that year 9,260 bushels were sold for $25,565. The increasing scarcity of clams on the public areas and the high market price which now prevails indicate that the cultivation of this mollusk will be greatly extended. The popularity of small clams is constantly increasing in the markets, and in time their cultivation on the south side of Long Island may even rival oyster-culture.

During the year covered by these returns, the scallop fishery at the eastern end of Long Island was in a prosperous condition, yielding 169,294 bushels, which sold for $100,607. In 1898 the yield was 103,063 bushels, worth $49,960; and in 1891, 69,565 bushels, worth $48,340. This mollusk is taken entirely by means of light dredges, which are usually operated from sailboats, but to a very small extent from rowboats.

The blue-fish now ranks first in value among the food-fishes of New York State, the yield in 1901 being 9,350,502 pounds, worth $473,366. These were taken principally by line fishermen sailing from New York City, 617 men and 48 vessels engaging in this fishery in 1901, and to a less extent in gill nets, seines, and pound nets operated along the Long Island coast. Compared with 1898, it appears that there has been a decrease in the quantity of blue-fish taken and an increase in value, the yield in 1898 being 11,214,433 pounds, worth $387,167. The catch in 1891 was reported at 5,506,575 pounds, worth $237,010; and in 1880 at 3,000,000 pounds, worth $67,500. These figures furnish an illustration of the increase in value of food-fish during the last twenty-three years. Thus it appears that in 1880 the value of blue-fish was 2.25 cents per pound; in 1891, 4.30 cents; in 1898, 3.45 cents; and in 1901, 5.07 cents per pound. The demand for blue-fish in the food markets is constantly increasing. To secure early supplies, a part of the fleet now leaves port in March, going southward as far as Cape Fear, and the season extends until late in November.

The yield of menhaden in New York is second only to that in Virginia, 300,682,545 being secured in 1901. Of these, 233,667 were landed at oil and fertilizer factories in Maine, 25,703,000 in Rhode Island, 154,102,335 in Delaware, and 33,118,338 in Texas, as they were caught in those respective localities. Thirty-two steamers, valued at $489,350, including their seines and outfit, and 3 sail vessels engaged in this fishery, employing 745 men. In addition to these 191 men were employed in rendering the fish into oil and fertilizer at the factories in the State, these factories representing an investment of $558,500.

Exclusive of the oyster and clam industries and the taking of blue-fish and menhaden, the use of pound nets is the most important fishery in New York. The pound nets are set principally at the eastern end of Long Island, and to a much less extent at the western end of Great South Bay and off Gravesend. This fishery was more valuable in 1901 than ever before, the 248 nets yielding 8,769,082 pounds of fish, worth $164,557. In 1898 the yield was valued at $108,939, and in 1891 at $125,719. The large increase in 1901 was due principally to the higher prices prevailing in the markets. The principal species taken in pound nets are squeteague, butter-fish, flounders, and scup.

The shad yield in New York in 1901 shows a gratifying increase over 1898; indeed, it was greater than for any previous year for which returns are available since 1888. The number captured in 1901 was 888,240, valued at $110,682. In 1898 the catch was 488,611; in 1897, 506,273; in 1896, 542,814; and in 1891, 762,946. Most of the shad are taken in Hudson River, and especially in Dutchess, Ulster, West-chester, and Columbia counties.

The sturgeon fishery shows a remarkable falling off, the value of the product decreasing from $46,573 in 1898 to $8,323 in 1901. This fish is now very scarce, not only in Hudson River, but also along the south side of Long Island, where it was secured in abundance six years ago. A large percentage of the sturgeon taken in Hudson River are small—under 20 pounds in weight—and are known locally as "peelicans." In 1892 the State interdicted the capture of these small fish, and this is expected to have a beneficial effect on the abun-dance of mature sturgeon.

The catch of sturgeon on the south side of Long Island furnishes an instance of the development and decline of coastal fisheries. The fish are taken by means of floating gill nets with 12 or 14-inch mesh, operated during May and June, and also to a limited extent in Sep-tember. The nets are set 1 or 2 miles from the shore from Blue Point to Montauk Point, and especially off Amagansett, Wainscott, and Westhampton. This fishery began in 1892. In 1896 there were 103 men employed, using 37 boats and 223 gill nets, and the catch of sturgeon amounted to 314,430 pounds, gross weight, worth $15,125. In 1898, when the fishery probably reached its greatest development, 187 men used 70 boats and 454 nets, and the gross weight of sturgeon secured was 509,365 pounds, worth $43,864. Notwithstanding a large increase in the quantity of twine used by each boat, the average catch of fish in succeeding years showed a great decrease, and in 1901 the 57 men, using 25 boats and 257 nets, secured only 65,130 pounds, gross weight, of sturgeon, worth $4,801. This fishery is so unprofitable at present that it promises to become extinct in a few years.

The returns for most of the minor species of fish show a considerable increase during the last five years, a result doubtless of the high cost of meats. Especially is this true of eels, which are generally distributed throughout the waters of New York. The yield in 1898 was 396,945 pounds, worth $27,517, and in 1901 it was 722,859 pounds, worth $50,033. In the same time the yield of flounders increased from 876,683 pounds, worth $28,455, to 1,274,308 pounds, worth $49,949.

The high market value of lobsters during recent years has resulted in great activity in their capture in the coastal waters of New York, as well as on other portions of the Atlantic coast; but the catch has declined from 381,020 pounds in 1897 and 332,378 pounds in 1898 to 183,539 pounds in 1901. The average catch per pot in 1897 was 81 pounds; in 1898, 59 pounds, and in 1901, 37 pounds. This decrease occurred although the number of months in which the lobster fishery is prosecuted has increased somewhat.

Probably the most noteworthy change in the methods of the fisheries of New York is the extensive adoption of auxiliary power in the vessels and boats, which makes the work to a large extent independent of weather conditions. Especially is this the case in oyster-culture and in the pound-net fisheries. Gasoline and naphtha engines are the popular forms adopted. These were introduced about ten years ago. In 1901 35 boats, worth $30,720, and 55 vessels, worth $176,900, were thus equipped.

The following tables show the number of persons employed, the amount of capital invested, and the quantity and value of the products of the fisheries of New York in 1901:

Number of persons employed.

How engaged.	No.
On vessels fishing	3,131
On vessels transporting	455
In shore or boat fisheries	5,090
Shoresmen	2,888
Total	11,564

Table of apparatus and capital.

Items.	No.	Value.	Items.	No.	Value.
Vessels fishing	437	$1,005,665	Apparatus—shore fisheries:		
Tonnage	8,458		Seines	259	$16,700
Outfit		328,865	Gill nets	3,453	62,724
Vessels transporting	196	235,550	Pound nets	248	67,645
Tonnage	3,183		Fyke nets	6,607	32,745
Outfit		25,311	Dip nets	101	165
Boats	4,656	317,447	Lines		2,104
Apparatus—vessel fisheries:			Eel pots	7,021	6,766
Seines	76	36,375	Lobster pots	2,196	3,270
Gill nets	465	4,623	Spears	198	121
Fyke nets	605	2,115	Dredges	1,563	5,530
Lines		4,590	Tongs	1,986	10,954
Eel pots	505	535	Rakes	1,196	7,313
Lobster pots	2,790	5,080	Hoes	585	480
Dredges	1,195	12,731	Shore property		4,221,226
Tongs	364	1,633	Cash capital		3,025,600
Rakes	83	518	Total		9,444,271

Table of products.

Species.	Lbs.	Value.	Species.	Lbs.	Value.
Alewives	1,363,614	$19,106	Spanish mackerel	4,104	$933
Blue-fish	9,350,502	473,366	Spots	4,800	206
Bonito	194,727	7,307	Squeteague	2,346,683	73,939
Bullheads	135,585	6,788	Striped bass	71,840	9,102
Butter-fish	590,682	25,809	Sturgeon	112,626	6,108
Carp, American	89,072	4,894	Caviar	4,291	2,215
Carp, German	281,494	17,142	Suckers	129,802	6,129
Cat-fish	38,559	2,034	Sun-fish	12,875	1,099
Cero	1,570	123	Swell-fish	134,870	101
Cod	1,172,291	51,921	Tautog	49,662	1,798
Eels	722,859	50,033	Tomcod or frost-fish	38,300	1,152
Flounders	1,274,308	49,949	Whitebait	24,510	1,784
Haddock	160,703	6,516	Whiting	33,975	480
Hake	36,580	860	Crabs, hard	791,725	4,993
Herring, salted	180,000	2,025	Crabs, soft	a 40,440	2,104
King-fish	29,826	8,418	Lobsters	183,539	21,742
Ling	26,140	516	Squid	180,846	5,114
Mackerel	507,838	19,454	Clams, hard, public reefs	b 1,404,288	232,121
Menhaden	180,409,767	454,505	Clams, hard, private areas	c 74,080	25,565
Mummichog	140,000	800	Clams, soft	d 779,450	58,843
Perch, white	51,987	3,390	Oysters, market, public reefs	e 38,360	3,554
Perch, yellow	25,893	2,014	Oysters, market, private areas	f 12,342,561	1,700,431
Pike	2,050	185	Oysters, seed, public reefs	g 237,230	16,550
Pollock	42,581	1,240	Oysters, seed, private areas	h 3,571,295	252,005
Salmon	163	78	Mussels	i 262,400	1,860
Scup	804,589	25,379	Scallops	j 1,109,724	107,337
Sea bass	231,517	15,216	Terrapin	340	340
Sea robins	385,000	433	Shells	k 2,286,000	1,330
Shad	3,432,472	110,682			
Sheepshead	100	12			
Skates	139,200	140	Total	228,092,285	3,894,270

a 121,320 in number.
b 175,536 bushels.
c 9,260 bushels.
d 77,945 bushels.
e 5,480 bushels.
f 1,763,223 bushels.
g 33,890 bushels.
h 510,185 bushels.
i 10,240 bushels.
j 184,954 bushels.
k 38,100 bushels.

STATISTICS OF THE FISHERIES BY COUNTIES.

In comparing the returns by counties for 1901 with those for 1898 and previous years, a large decrease in the fisheries of Queens County is apparent. This is due to the formation of a new county, Nassau, within the former limits of Queens County, and Queens and Nassau counties combined now represent the Queens County of previous years. Also there appears an extension of the fisheries of New York County and a corresponding decrease in Westchester County, owing to a change in the boundary lines.

The extent of the fisheries in each county of New York in 1901 is shown in detail in the following tables:

Table showing the number of persons employed in the fisheries of New York in 1901.

Counties.	On vessels fishing.	On vessels transporting.	In shore or boat fisheries.	Shoresmen.	Total.
Albany			132		132
Columbia			266	4	270
Dutchess			299		299
Greene			126		126
Kings	37	51	418	29	535
Nassau	169	73	739	13	994
New York	635	20	38	2,077	2,770
Orange			114		114
Putnam			20		20
Queens	15	54	236	6	311
Rensselaer			132		132
Richmond	194	120	451	16	781
Rockland			117		117
Suffolk	2,072	137	1,396	742	4,347
Ulster			352	1	353
Westchester	9		254		263
Total	3,131	455	5,090	2,888	11,564

Table showing, by counties, the vessels, boats, and apparatus employed in the fisheries of New York in 1901.

Items.	Albany.		Columbia.		Dutchess.		Greene.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Boats	64	$1,657	110	$3,942	157	$6,750	68	$2,256
Apparatus—shore fisheries:								
Seines	19	1,345	24	1,660	13	905	7	685
Gill nets	1	20	70	2,245	536	12,320	77	2,475
Fyke nets	332	1,735	343	1,595	589	2,563	153	765
Dip nets	4	18					10	50
Shore property		410		1,220		1,620		532
Total		5,185		10,662		24,158		6,763

Items.	Kings.		Nassau.		New York.		Orange.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	11	$7,500	52	$45,370	51	$226,950		
Tonnage	84		449		2,534			
Outfit		2,635		12,008		133,900		
Vessels transporting	26	24,300	27	43,750	9	7,050		
Tonnage	312		529		93			
Outfit		2,125		2,710		1,190		
Boats	511	35,210	877	66,893	52	5,290	53	$2,540
Apparatus—vessel fisheries:								
Seines			2	115	7	2,350		
Gill nets			11	1,250	90	810		
Lines		260		636		3,343		
Eel pots	175	175						
Lobster pots					700	1,400		
Dredges			98	1,478				
Tongs	2	8	4	20	2	16		
Rakes			18	154	4	32		
Apparatus—shore fisheries:								
Seines			28	2,460	1	70	12	1,175
Gill nets	8	1,160	4	280	3	50	324	5,200
Pound nets	2	980						
Fyke nets	46	512					110	550
Dip nets	15	12	38	13				
Lines		605		40				
Eel pots	650	628	876	806				
Lobster pots	474	438						
Spears	19	15	70	35				
Dredges	38	324	245	1,508				
Tongs	404	2,266	491	2,490	43	344		
Rakes	123	561	269	1,371	83	786		
Hoes	143	132	135	94				
Shore property		39,575		71,625		3,541,245		568
Cash capital		5,000				2,813,500		
Total		124,416		255,196		6,738,276		10,033

Items.	Putnam.		Queens.		Rensselaer.		Richmond.		Rockland.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing			3	$9,250			40	$94,150		
Tonnage			43				549			
Outfit				735				32,127		
Vessels transporting			22	31,500			50	48,850		
Tonnage			335				619			
Outfit				2,125				11,847		
Boats	10	$520	273	14,643	57	$1,210	486	46,085	69	$3,188
Apparatus—vessel fisheries:										
Lines								162		
Lobster pots							1,250	2,500		
Dredges			12	235			128	6,205		
Tongs							40	323		
Rakes							18	144		
Apparatus—shore fisheries:										
Seines	2	110			19	1,570			11	785
Gill nets	35	1,050			3	60	80	1,200	564	4,940
Pound nets							2	2,100		
Fyke nets	5	25	1	25	160	800	34	1,580	69	545
Dip nets					2	20				
Eel pots			532	661			50	25	100	125
Lobster pots							400	800		
Spears			16	15						
Dredges			54	364			6	150		
Tongs			210	1,115			318	2,569		
Rakes			66	359			373	3,159		
Hoes			57	39						
Shore property		45		16,280		275		18,240		577
Total		1,750		77,346		3,935		272,216		10,160

Table showing, by counties, the vessels, boats, and apparatus employed in the fisheries of New York in 1901—Continued.

Items.	Suffolk.		Ulster.		Westchester.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	277	$614,045			3	$8,400	437	$1,005,665
Tonnage	4,769				30		8,458	
Outfit		146,775				685		328,865
Vessels transporting	62	80,100					196	235,550
Tonnage	1,295						3,183	
Outfit		5,314						25,311
Boats	1,584	113,494	182	$8,735	153	5,034	4,656	317,447
Apparatus—vessel fisheries:								
Seines	67	33,910					76	36,375
Gill nets	364	2,563					465	4,623
Fyke nets	605	2,115					605	2,115
Lines		189						4,590
Eel pots	330	360					505	535
Lobster pots	840	1,180					2,790	5,080
Dredges	953	4,693			4	120	1,195	12,731
Tongs	316	1,266					364	1,623
Rakes	39	138			4	50	83	518
Apparatus—shore fisheries:								
Seines	92	3,920	19	1,330	12	685	259	16,700
Gill nets	391	12,936	427	9,275	930	9,513	3,453	62,724
Pound nets	244	64,565					248	67,645
Fyke nets	4,262	19,788	368	1,587	135	675	6,607	32,745
Dip nets	15	8	17	34			101	155
Lines		1,459						2,104
Eel pots	4,708	4,449			105	72	7,021	6,766
Lobster pots	1,205	1,738			117	299	2,196	8,270
Spears	93	56					198	121
Dredges	1,220	3,094					1,563	5,530
Tongs	520	2,170					1,986	10,954
Rakes	233	705			49	422	1,196	7,318
Hoes	238	203			12	12	585	480
Shore property		524,945		821		3,248		4,221,226
Cash capital		207,000						3,025,500
Total		1,853,178		21,782		29,215		9,444,271

Table showing, by counties, the yield of the fisheries of New York in 1901.

Species.	Albany.		Columbia.		Dutchess.		Greene.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	183,302	$2,755	397,497	$5,960	33,931	$548	139,267	$2,116
Bullheads	19,518	977	20,021	1,003	31,729	1,588	6,150	308
Carp, American			5,583	115	20,000	1,036	1,300	26
Carp, German	2,045	101	2,095	53	10,868	562	381	10
Cat-fish			69	3	2,645	134		
Eels	594	54	89	8	341	25	15	1
Perch, white	488	49	944	87	3,202	192	310	27
Perch, yellow	1,458	146	1,967	175	5,474	422	979	88
Shad	350	15	381,917	12,709	923,512	27,904	147,160	5,236
Striped bass			150	6	3,742	470		
Sturgeon	2,101	54	723	19	16,181	908	5,388	294
Caviar					924	463	1,200	600
Suckers	8,494	326	6,784	242	25,300	1,265	2,345	86
Sun-fish	1,015	102	1,752	148	4,491	369	312	31
Total	219,365	4,579	819,591	20,528	1,081,340	35,886	304,816	8,823

Table showing, by counties, the yield of the fisheries of New York in 1901—Continued.

Species.	Kings.		Nassau.		New York.		Orange.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	12,870	$360					500	$15
Blue-fish	90,400	5,290	166,800	$12,124	8,754,420	$437,825		
Bonito	3,125	125	260	13				
Bullheads					100	5	8,350	418
Butter-fish	69,650	1,480						
Carp, American					440	22	24,800	1,488
Carp, German					2,800	224	21,600	1,296
Cat-fish					15	1	2,650	133
Cod	96,400	4,595	298,120	12,006	263,700	13,185		
Eels	103,780	9,211	102,690	7,462			60	4
Flounders	8,700	410	123,175	5,518				
Haddock	17,575	830	48,000	1,902	3,333	100		
Hake	29,700	718	1,900	46				
Herring, salted					180,000	2,025		
King-fish			470	106				
Ling	22,900	458						
Mackerel					193,500	7,800		
Menhaden	4,200	50						
Perch, white							2,958	177
Perch, yellow					200	16	4,648	325
Scup	8,900	450	9,500	373	212,005	7,428		
Sea bass	7,050	564			90,152	5,409		
Shad	45,975	2,715			3,600	250	207,600	6,228
Sheepshead			100	12				
Spanish mackerel	60	12	185	37				
Spots	4,800	206						
Squeteague	38,600	1,580	216,280	8,817	27,250	1,090		
Striped bass			6,886	1,028	500	50	6,211	780
Sturgeon							3,253	132
Caviar							32	16
Suckers					841	29	30,672	1,534
Tautog	13,300	788						
Tomcod or frost-fish	300	12						
Crabs, hard			12,000	210				
Crabs, soft			33,200	1,140				
Lobsters	10,960	1,126			21,000	2,520		
Clams, hard, public reefs	158,880	24,542	359,824	61,591	23,600	3,677		
Clams, hard, private areas	60,960	22,400	13,120	3,165				
Clams, soft	328,050	24,684	115,300	7,915				
Oysters, market, private areas	2,194,220	295,737	2,012,080	320,506	79,800	11,400		
Oysters, seed, public reefs			63,630	4,460	14,000	1,000		
Oysters, seed, private areas			842,170	57,444				
Mussels			62,400	1,740				
Scallops			33,960	3,730				
Total	3,831,355	398,343	4,522,050	511,345	9,871,256	494,056	313,334	12,546

Species.	Putnam.		Queens.		Rensselaer.		Richmond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives					222,615	$3,350	3,600	$10
Bullheads	790	$40			5,142	257		
Carp, American	3,700	222						
Carp, German	2,600	156			1,746	88		
Cat-fish	75	4						
Cod							73,451	3,673
Eels			52,210	$4,534	204	19	2,600	208
Haddock							500	15
Perch, white	80	6			119	12		
Perch, yellow	290	21			527	53		
Sea bass							5,200	312
Shad	50,800	1,524			88	4	118,700	6,360
Striped bass	250	36						
Sturgeon					1,632	33	1,500	165
Suckers	3,500	175			2,731	96		
Sun-fish					951	95		
Lobsters							62,067	7,448
Clams, hard, public reefs			70,480	11,722			175,200	18,485
Clams, soft			33,200	2,824				
Oysters, market, public reefs			700	100				
Oysters, market, private areas			1,351,840	180,385			2,042,887	273,617
Oysters, seed, public reefs							56,700	3,430
Oysters, seed, private areas							42,000	3,000
Scallops							60,000	3,000
Total	62,085	2,183	1,508,430	199,565	235,755	4,007	2,644,405	319,723

Table showing, by counties, the yield of the fisheries of New York in 1901—Continued.

Species.	Rockland.		Suffolk.		Ulster.		Westchester.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	225	$7	267,105	$2,315	101,536	$1,635	1,166	$35
Blue-fish	......	......	338,882	18,127	......	......	......	......
Bonito	......	......	191,342	7,169	......	......	......	......
Bullheads	6,282	315	......	......	31,066	1,556	6,428	321
Butter-fish	......	......	521,032	21,329	......	......	......	......
Carp, American	8,893	534	......	......	4,513	260	19,843	1,191
Carp, German	20,160	1,210	176,440	11,615	22,759	747	18,000	1,080
Cat-fish	991	50	30,700	1,638	245	12	1,169	59
Cero	......	......	1,570	123	......	......	......	......
Cod	......	......	440,620	18,462	......	......	......	......
Eels	4,873	245	404,628	25,295	200	16	10,575	551
Flounders	......	......	1,182,433	46,421	......	......	......	......
Haddock	......	......	91,295	3,669	......	......	......	......
Hake	......	......	4,980	96	......	......	......	......
King-fish	......	......	29,356	3,312	......	......	......	......
Ling	......	......	3,240	58	......	......	......	......
Mackerel	......	......	314,338	11,654	......	......	......	......
Menhaden	......	......	180,405,667	454,455	......	......	......	......
Mummichog	......	......	140,000	800	......	......	......	......
Perch, white	1,945	118	31,910	2,111	2,899	184	7,132	428
Perch, yellow	3,083	217	......	......	4,327	343	2,940	208
Pike	......	......	2,050	185	......	......	......	......
Pollock	......	......	42,581	1,240	......	......	......	......
Salmon	......	......	163	78	......	......	......	......
Scup	......	......	574,184	17,128	......	......	......	......
Sea bass	......	......	129,115	8,931	......	......	......	......
Sea robins	......	......	385,000	433	......	......	......	......
Shad	232,240	7,160	9,771	580	844,359	26,005	466,400	13,992
Skates	......	......	139,200	140	......	......	......	......
Spanish mackerel	......	......	3,859	884	......	......	......	......
Squeteague	......	......	2,064,553	62,452	......	......	......	......
Striped bass	5,285	670	39,454	4,990	1,754	220	7,608	852
Sturgeon	1,629	49	63,106	3,722	6,392	345	11,721	387
Caviar	......	......	2,024	1,079	85	43	26	14
Suckers	19,943	998	......	......	9,696	403	19,496	975
Sun-fish	......	......	......	......	4,354	354	......	......
Swell-fish	......	......	134,870	101	......	......	......	......
Tautog	......	......	36,362	1,010	......	......	......	......
Tomcod or frost-fish	......	......	38,000	1,140	......	......	......	......
Whitebait	......	......	24,510	1,784	......	......	......	......
Whiting	......	......	33,975	480	......	......	......	......
Crabs, hard	......	......	779,725	4,783	......	......	......	......
Crabs, soft	......	......	7,240	964	......	......	......	......
Lobsters	......	......	72,712	6,952	......	......	16,800	3,696
Squid	......	......	180,846	5,114	......	......	......	......
Clams, hard, public reefs	......	......	469,104	90,104	......	......	147,200	22,000
Clams, soft	......	......	260,900	19,220	......	......	42,000	4,200
Oysters, market, public reefs	......	......	37,660	3,454	......	......	......	......
Oysters, market, private areas	......	......	4,647,734	616,973	......	......	14,000	1,813
Oysters, seed, public reefs	......	......	102,900	7,660	......	......	......	......
Oysters, seed, private areas	......	......	2,617,125	185,061	......	......	70,000	6,500
Mussels	......	......	200,000	120	......	......	......	......
Scallops	......	......	1,015,764	100,607	......	......	......	......
Terrapin	......	......	340	340	......	......	......	......
Shells	......	......	2,286,000	1,330	......	......	......	......
Total	305,549	11,573	200,976,265	1,780,688	1,034,185	32,123	862,504	58,302

The shad fishery.

Counties.	No.	Value.	Counties	No.	Value.
Albany	100	$15	Rensselaer	25	$4
Columbia	101,455	12,709	Richmond	31,800	6,360
Dutchess	232,528	27,904	Rockland	58,160	7,160
Greene	39,440	5,236	Suffolk	2,792	580
Kings	13,136	2,715	Ulster	216,704	26,005
New York	900	260	Westchester	116,600	13,992
Orange	51,900	6,228			
Putnam	12,700	1,524	Total	[a] 888,240	110,682

[a] 3,432,472 pounds.

THE PRODUCTS, BY APPARATUS.

The products of the vessel fisheries aggregated 199,925,663 pounds, valued at $2,240,582, and those of the shore fisheries 28,166,622 pounds, valued at $1,653,688. The yield of seines was 177,736,396 pounds, $538,351; gill nets, 6,235,399 pounds, $151,533; pound nets, 8,769,082 pounds, $164,557; fyke nets, 939,182 pounds, $41,884; lines, 10,963,390 pounds, $525,139; dip nets, 48,691 pounds, $2,299; lobster pots, 183,539 pounds, $21,742; eel pots, 486,158 pounds, $33,435; spears, 180,960 pounds, $12,192; and of dredges, tongs, rakes, etc., 22,549,488 pounds, $2,403,138.

The following tables present, by apparatus of capture, the products of the fisheries of New York in 1901:

Table showing, by counties, the yield of the seine fisheries of New York in 1901.

Species.	Albany.		Columbia.		Dutchess.		Greene.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Alewives	182,666	$2,740	394,997	$5,925	32,998	$520	136,667	$2,050
Bullheads	416	21	2,055	103	994	51	150	8
Carp, American			4,425	89	20,000	1,036		
Carp, German	1,260	61	2,095	53	10,868	562	300	6
Cat-fish					595	31		
Eels	50	5						
Perch, white	100	10	220	22				
Perch, yellow	80	8	417	42	1,896	136	101	10
Shad	350	15	167,317	5,973	46,200	1,584	65,450	2,291
Striped bass			150	6	2,134	267		
Sturgeon	897	30	315	6				
Suckers	4,860	194	3,360	126	15,700	785	1,206	48
Sun-fish	100	10	309	31			200	20
Total	190,779	3,094	575,660	12,376	131,385	4,972	204,074	4,433

Species.	Nassau.		New York.		Orange.		Putnam.		Rensselaer.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Vessel fisheries:										
Blue-fish	1,690	$134	18,000	$900						
Herring, salted			180,000	2,025						
Mackerel			6,000	300						
Flounders	3,250	135								
King-fish	130	26								
Scup	1,250	50	194,205	6,805						
Sea bass			47,384	2,843						
Squeteague	10,200	408	24,000	960						
Striped bass	106	16								
Total	16,626	769	469,589	13,833						
Shore fisheries:										
Alewives					500	$15			221,667	$3,325
Blue-fish	25,290	1,724								
Bullheads			100	5	4,350	218	415	$21		
Carp, American			440	22	24,800	1,488	3,700	222		
Carp, German			2,800	224	21,600	1,296	2,600	156	1,611	81
Cat-fish			15	1	2,050	103	55	3		
Eels	8,600	640								
Flounders	74,775	2,777								
King-fish	340	80								
Perch, white									70	7
Perch, yellow			200	16	4,268	299	250	18	40	4
Scup	8,250	323								
Shad									88	4
Sheepshead	100	12								
Spanish mackerel	105	21								
Squeteague	168,930	7,015								
Striped bass	6,780	1,012	500	50	3,413	429	250	36		
Sturgeon									838	17
Suckers			841	29	25,472	1,274	2,800	140	1,205	34
Sun-fish									141	14
Total	292,570	13,604	4,896	347	86,453	5,122	10,070	596	225,655	3,486
Total vessel and shore	309,196	14,373	474,485	14,180	86,458	5,122	10,070	596	225,655	3,486

Table showing, by counties, the yield of the seine fisheries of New York in 1901—Cont'd.

Species.	Rockland.		Suffolk.		Ulster.		Westchester.		Total.	
	Lbs.	Val.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.
Vessel fisheries:										
Blue-fish									19,690	$1,034
Herring, salted									180,000	2,025
Mackerel									6,000	300
Flounders									3,250	135
Menhaden			174,535,267	$441,039					174,535,267	441,039
King-fish									130	26
Perch, white			3,250	260					3,250	260
Scup									195,455	6,855
Sea bass									47,384	2,843
Squeteague									34,200	1,368
Striped bass			3,800	465					3,906	481
Total			174,542,317	441,764					175,028,532	456,366
Shore fisheries:										
Alewives	225	$7	112,000	420	96,770	$1,513	1,166	$35	1,179,656	16,550
Blue-fish			5,400	290					30,690	2,014
Bullheads	1,478	75			1,875	95	1,220	61	13,053	658
Carp, American	8,893	534			4,213	253	19,843	1,191	86,314	4,835
Carp, German	20,160	1,210	171,360	11,311	22,542	742	18,000	1,080	275,196	16,782
Cat-fish	396	19	2,660	135	45	2	409	21	6,225	315
Cod			120	5					120	5
Eels									8,050	645
Flounders			12,340	585					87,115	3,362
King-fish			200	25					540	105
Menhaden			76,800	160					76,800	160
Mummichog			140,000	800					140,000	800
Perch, white			25,960	1,687	150	12			26,500	1,738
Perch, yellow	2,723	191			1,091	80	2,502	177	13,568	981
Scup									8,250	323
Shad					157,199	5,390			436,604	15,257
Sheepshead									100	12
Spanish mack'l									105	21
Squeteague			3,750	152					172,680	7,167
Striped bass	4,161	530	10,005	1,445	150	19	2,192	275	29,735	4,069
Sturgeon									2,045	53
Suckers	13,946	698			6,616	275	12,992	650	88,998	4,253
Sun-fish					260	21			1,010	96
Whitebait			24,510	1,784					24,510	1,784
Total	51,982	3,264	585,105	18,799	290,911	8,402	58,324	3,490	2,707,864	81,985
Total vessel and shore	51,982	3,264	175,127,422	460,563	290,911	8,402	58,324	3,490	177,736,396	538,351

NOTE.—Of the menhaden taken by Suffolk County vessels, 140,200 pounds were landed at oil and fertilizer factories in Maine, 15,421,800 in Rhode Island, 50,426,200 in New York, 92,461,400 in Delaware, and 19,871,000 in Texas, as they were caught in those respective localities.

Table showing, by counties, the yield of the pound-net fisheries of New York in 1901.

Species.	Kings.		Richmond.		Suffolk.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Alewives	12,870	$360	3,600	$10	155,105	$1,895	171,575	$2,265
Blue-fish	400	20			90,290	3,382	90,690	3,402
Bonito					184,232	6,870	184,232	6,870
Butter-fish	69,650	1,480			521,032	24,329	590,682	25,809
Cero					1,570	123	1,570	123
Cod					10,230	392	10,230	392
Eels					43,740	2,972	43,740	2,972
Flounders	2,500	100			516,163	18,743	518,663	18,843
King-fish					29,156	3,287	29,156	3,287
Ling					3,240	58	3,240	58
Mackerel					306,868	11,040	306,868	11,040
Menhaden	4,200	50			3,531,900	7,311	3,536,100	7,361
Pollock					42,581	1,240	42,581	1,240
Salmon					163	78	163	78
Scup					515,894	14,394	515,894	14,394
Sea bass					65,211	4,558	65,211	4,558
Sea robins					385,000	433	385,000	433
Shad	4,500	240	38,150	2,180	9,771	580	52,421	3,000
Skates					137,970	104	137,970	104
Spanish mackerel					3,734	861	3,734	861
Spots	4,800	206					4,800	206
Squeteague	13,800	520			1,671,241	47,600	1,685,041	48,120
Squid					180,846	5,114	180,846	5,114
Striped bass					24,769	2,957	24,769	2,957
Sturgeon			1,500	165			1,500	165
Swell-fish					134,870	101	134,870	101
Tautog					13,561	324	13,561	324
Whiting					33,975	480	33,975	480
Total	112,720	2,976	43,250	2,355	8,613,112	159,226	8,769,082	164,557

Table showing, by counties, the yield of the gill-net fisheries of New York in 1901.

Species.	Albany.		Columbia.		Dutchess.		Greene.		Kings.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Alewives	202	$6	2,500	$35	933	$28	1,000	$30		
Perch, white					2,263	136				
Shad			214,600	6,736	877,312	26,320	81,710	2,945	17,100	$1,195
Striped bass					1,608	203				
Sturgeon			125	8	15,181	908	5,280	292		
Caviar					924	463	1,200	600		
Total	202	6	217,225	6,779	898,221	28,058	89,190	3,867	17,100	1,195

Species.	New York.		Orange.		Putnam.		Nassau.		Rensselaer.		Richmond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.
Vessel fisheries:												
Blue-fish							129,870	$9,552				
Bonito							260	13				
Mackerel	187,500	$7,500										
Spanish mackerel							80	16				
Squeteague							29,450	1,072				
Total	187,500	7,500					159,660	10,653				
Shore fisheries:												
Alewives									700	$19		
Blue-fish							9,950	714				
Perch, white			2,515	$152								
Shad	3,600	250	207,600	6,228	50,800	$1,524					59,200	$2,960
Squeteague							7,700	322				
Striped bass			2,798	351								
Sturgeon			3,253	132								
Caviar			32	16								
Total	3,600	250	216,228	6,879	50,800	1,524	17,650	1,036	700	19	59,200	2,960
Total vessel and shore	191,100	7,750	216,228	6,879	50,800	1,524	177,310	11,689	700	19	59,200	2,960

Species.	Rockland.		Suffolk.		Ulster.		Westchester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:										
Blue-fish			69,417	$4,349					199,287	$13,901
Bonito			210	9					470	22
Flounders			15,196	622					15,196	622
Mackerel									187,500	7,500
Menhaden			1,664,400	3,897					1,664,400	3,897
Scup			1,160	54					1,160	54
Spanish mackerel									80	16
Squeteague			174,622	5,912					204,072	6,984
Tautog			86	4					86	4
Total			1,925,091	14,847					2,272,251	33,000
Shore fisheries:										
Alewives					900	$27			6,235	145
Blue-fish			67,030	4,069					76,980	4,783
Bonito			2,700	145					2,700	145
Carp, German			4,200	252					4,200	252
Cat-fish			9,000	540					9,000	540
Flounders			10,600	798					10,600	798
Mackerel			7,470	614					7,470	614
Menhaden			597,200	2,048					597,200	2,048
Perch, white	1,475	$89			2,200	132	6,700	$402	15,183	911
Pike			2,050	185					2,050	185
Scup			3,500	149					3,500	149
Sea bass			800	72					800	72
Shad	232,240	7,160			687,160	20,615	466,400	13,992	2,897,722	89,925
Spanish mackerel			75	15					75	15
Squeteague			197,985	8,066					205,685	8,388
Striped bass	1,124	140	220	33	1,604	201	5,416	577	12,770	1,505
Sturgeon	1,629	49	63,106	3,722	6,392	345	11,721	387	106,687	5,843
Caviar			2,024	1,079	85	43	26	14	4,291	2,215
Total	236,468	7,438	967,960	21,787	698,341	21,363	490,263	15,372	3,963,148	118,533
Total vessel and shore	236,468	7,438	2,893,051	36,634	698,341	21,363	490,263	15,372	6,235,399	151,533

Table showing, by counties, the yield of the fyke-net fisheries of New York in 1901.

Species.	Albany.		Columbia.		Dutchess.		Greene.		Kings.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Bullheads	18,892	$945	17,966	$900	30,735	$1,537	6,009	$300	....	....
Carp, American	....	....	1,158	26	....	....	1,300	26	....	....
Carp, German	510	26	....	....	....	....	81	4	....	....
Cat-fish	....	....	69	3	2,050	103	....	....	....	....
Eels	544	49	89	8	341	25	15	1	2,100	$378
Perch, white	38	4	724	65	939	56	200	16	....	....
Perch, yellow	1,203	120	1,550	133	3,578	286	588	49	....	....
Shad	....	....	....	....	....	....	....	....	24,375	1,280
Sturgeon	804	16	283	5	....	....	108	2	....	....
Suckers	3,254	117	3,424	116	9,600	480	1,139	38	....	....
Sun-fish	915	92	1,443	117	4,491	369	112	11	....	....
Tomcod	....	....	....	....	....	....	....	....	300	12
Total	26,160	1,369	26,706	1,373	51,734	2,856	9,552	447	26,775	1,670

Species.	Orange.		Putnam.		Queens.		Rensselaer.		Richmond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Bullheads	4,000	$200	375	$19	....	....	5,036	$252	....	....
Carp, German	....	....	....	....	....	....	85	4	....	....
Cat-fish	600	30	20	1	....	....	....	....	....	....
Eels	60	4	....	....	1,200	$120	204	19	....	....
Perch, white	413	25	80	5	....	....	49	5	....	....
Perch, yellow	380	26	40	3	....	....	415	42	....	....
Shad	....	....	....	....	....	....	....	....	21,350	$1,220
Sturgeon	....	....	....	....	....	....	499	10	....	....
Suckers	5,200	260	700	35	....	....	1,341	55	....	....
Sun-fish	....	....	....	....	....	....	810	81	....	....
Total	10,653	545	1,215	63	1,200	120	8,439	468	21,350	1,220

Species.	Rockland.		Suffolk.		Ulster.		Westchester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:										
Flounders	....	....	124,900	$5,017	....	....	....	....	124,900	$5,017
Shore fisheries:										
Bullheads	4,804	$240	....	....	29,191	$1,461	5,208	$260	122,216	6,114
Carp, American	....	....	....	....	300	7	....	....	2,758	59
Carp, German	....	....	880	52	217	5	....	....	1,773	91
Cat-fish	595	31	19,040	963	200	10	760	38	23,334	1,179
Eels	73	5	1,000	80	200	16	675	48	6,501	753
Flounders	....	....	478,035	19,641	....	....	....	....	478,035	19,641
Perch, white	470	29	2,700	164	549	40	432	26	6,594	435
Perch, yellow	360	26	....	....	3,236	263	438	31	11,788	979
Shad	....	....	....	....	....	....	....	....	45,725	2,500
Squeteague	....	....	100	4	....	....	....	....	100	4
Striped bass	....	....	320	49	....	....	....	....	320	49
Sturgeon	....	....	....	....	....	....	....	....	1,694	33
Suckers	5,997	300	....	....	3,080	128	6,504	325	40,239	1,854
Sun-fish	....	....	....	....	4,094	333	....	....	11,865	1,003
Tautog	....	....	22,700	681	....	....	....	....	22,700	681
Tomcod	....	....	38,000	1,140	....	....	....	....	38,300	1,152
Terrapin	....	....	340	340	....	....	....	....	340	340
Total	12,299	631	563,115	23,114	41,067	2,263	14,017	728	814,282	36,867
Total vessel and shore	12,299	631	688,015	28,131	41,067	2,263	14,017	728	939,182	41,884

Table showing the quantity and value of lobsters taken in pots in New York in 1901.

County.	Vessel fisheries.		Shore fisheries.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Kings	....	....	10,960	$1,126	10,960	$1,126
New York	21,000	$2,520	....	....	21,000	2,520
Richmond	47,867	5,744	14,200	1,704	62,067	7,448
Suffolk	28,580	2,388	44,132	4,564	72,712	6,952
Westchester	....	....	16,800	3,696	16,800	3,696
Total	97,447	10,652	86,092	11,090	183,539	21,742

Table showing, by counties, the yield of the dip-net fisheries of New York in 1901.

Species.	Albany.		Greene.		Nassau.		Rensselaer.		Suffolk.		Ulster.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Shore fisheries:														
Alewives	434	$9	1,600	$36			248	$6			3,866	$95	6,148	$146
Bullheads	210	11					106	5					316	16
Carp, German	275	14					50	3					325	17
Perch, white	350	35	110	11									460	46
Perch, yellow	175	18	290	29			72	7					537	54
Sturgeon	400	8					300	6					700	14
Suckers	380	15					185	7					565	22
Crabs, soft					33,200	$1,140			6,440	$844			39,640	1,984
Total	2,224	110	2,000	76	33,200	1,140	961	34	6,440	844	3,866	95	48,691	2,299

Table showing, by counties, the yield of the line fisheries of New York in 1901.

Species.	Nassau.		New York.		Richmond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:						
Blue-fish			8,736,420	$436,925		
Cod	276,920	$11,158	263,700	13,185	73,451	$3,673
Haddock	44,750	1,772	3,333	100	500	15
Hake	1,900	46				
Scup			17,800	623		
Sea bass			42,768	2,566	5,200	312
Squeteague			3,250	130		
Total	323,570	12,976	9,067,271	453,529	79,151	4,000
Shore fisheries:						
Cod	21,200	848				
Haddock	3,250	130				
Total	24,450	978				
Total vessel and shore	348,020	13,954	9,067,271	453,529	79,151	4,000

Species.	Kings.		Suffolk.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:						
Blue-fish	39,000	$2,310	80,495	$1,467	8,855,915	$443,702
Bonito	625	25	1,820	75	2,445	100
Cod	37,900	1,830	74,260	8,622	726,231	38,468
Flounders			6,499	242	6,499	242
Haddock	4,975	230	20,820	843	74,378	2,960
Hake	7,800	170			9,700	216
Ling	4,100	82			4,100	82
Scup	2,900	150	28,365	1,504	49,065	2,277
Sea bass	1,750	140	36,766	2,412	86,484	5,430
Skates			1,230	36	1,230	36
Spanish mackerel	10	2			10	2
Squeteague	2,800	120	7,045	331	13,095	581
Striped bass			280	33	280	33
Tautog	1,300	78	15	1	1,315	79
Total	103,160	5,137	257,595	13,566	9,830,747	489,208
Shore fisheries:						
Blue-fish	51,000	2,960	26,250	1,570	77,250	4,530
Bonito	2,500	100	2,380	70	4,880	170
Cod	58,500	2,765	356,010	14,443	435,710	18,056
Eels	2,000	200	1,200	72	3,200	272
Flounders	6,200	310	18,100	743	24,300	1,053
Haddock	12,600	600	70,475	2,826	86,325	3,556
Hake	21,900	548	4,980	96	26,880	644
Ling	18,800	376			18,800	376
Scup	6,000	300	25,265	1,027	31,265	1,327
Sea bass	5,300	424	26,338	1,889	31,638	2,313
Spanish mackerel	50	10	50	8	100	18
Squeteague	22,000	940	9,810	387	31,810	1,327
Striped bass			60	8	60	8
Tautog	12,000	710			12,000	710
Crabs, hard			347,625	1,451	347,625	1,451
Crabs, soft			800	120	800	120
Total	218,850	10,243	889,343	24,710	1,132,643	35,931
Total vessel and shore	322,010	15,380	1,146,938	38,276	10,963,390	525,139

Table showing, by counties, the catch by dredges, tongs, rakes, etc., in New York in 1901.

Species.	Kings.		Nassau.		New York.		Queens.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Clams, hard—								
Public areas			37,440	$6,160				
Mussels			15,900	530				
Oysters, market—								
Private areas	7,700	$980	551,600	83,350	9,800	$1,400	172,200	$22,140
Oysters, seed—								
Public reefs			32,130	2,275				
Private areas			478,450	32,885				
Total	7,700	980	1,115,520	125,200	9,800	1,400	172,200	22,140
Shore fisheries:								
Crabs, hard			12,000	210				
Clams, hard—								
Public reefs	158,880	24,542	322,384	55,431	23,600	3,677	70,480	11,722
Private areas	60,960	22,400	13,120	3,165				
Clams, soft	328,050	24,684	115,300	7,915			33,200	2,824
Mussels			46,500	1,210				
Oysters, market—								
Public reefs							700	100
Private areas	2,186,520	294,757	1,460,480	237,156	70,000	10,000	1,179,640	158,245
Oysters, seed—								
Public reefs			31,500	2,185	14,000	1,000		
Private areas			363,720	24,559				
Scallops			33,960	3,730				
Total	2,734,410	366,383	2,398,964	335,561	107,600	14,677	1,284,020	172,891
Total vessel and shore	2,742,110	367,363	3,514,484	460,761	117,400	16,077	1,456,220	195,031

Species.	Richmond.		Suffolk.		Westchester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Crabs, hard			203,600	$1,612			203,600	$1,612
Clams, hard—								
Public areas	42,400	$4,505	96,160	23,617	16,000	$1,500	192,000	35,782
Mussels			200,000	120			215,900	650
Oysters, market—								
Private areas	2,000,187	267,112	4,093,054	544,029	14,000	1,813	6,848,541	920,824
Oysters, seed—								
Public reefs	56,700	3,430	52,850	4,100			141,680	9,805
Private areas	42,000	3,000	2,549,715	179,787	70,000	6,500	3,140,165	222,172
Scallops	60,000	3,000	486,900	48,370			546,900	51,370
Shells			1,236,000	719			1,236,000	719
Total	2,201,287	281,047	8,918,279	802,354	100,000	9,813	12,524,786	1,242,934
Shore fisheries:								
Crabs, hard			228,500	1,720			240,500	1,930
Clams, hard—								
Public reefs	132,800	13,980	372,944	66,487	131,200	20,500	1,212,288	196,339
Private areas							74,080	25,565
Clams, soft			260,900	19,220	42,000	4,200	779,450	58,843
Mussels							46,500	1,210
Oysters, market—								
Public reefs			37,660	3,454			38,360	3,554
Private areas	42,700	6,505	554,680	72,944			5,494,020	779,607
Oysters, seed—								
Public reefs			50,050	3,560			95,550	6,745
Private areas			67,410	5,274			431,130	29,833
Scallops			528,864	52,237			562,824	55,967
Shells			1,050,000	611			1,050,000	611
Total	175,500	20,485	3,151,008	225,507	173,200	24,700	10,024,702	1,160,204
Total vessel and shore	2,376,787	301,532	12,069,287	1,027,861	273,200	34,513	22,549,488	2,403,138

Table showing, by counties, the yield of eels in pots in New York in 1901.

Counties.	Vessel fisheries.		Shore fisheries.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Kings	28,500	$2,280	59,700	$5,243	88,200	$7,523
Nassau			67,190	4,802	67,190	4,802
Queens			38,960	3,300	38,960	3,300
Richmond			2,600	208	2,600	208
Rockland			4,800	240	4,800	240
Suffolk	18,500	1,125	256,008	15,734	274,508	16,859
Westchester			9,900	503	9,900	503
Total	47,000	3,405	439,158	30,030	486,158	33,435

Table showing, by counties, the yield of fish by spears in New York in 1901.

Species.	Kings.		Nassau.		Queens.		Suffolk.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Eels	11,480	$1,110	67,500	$4,420	12,050	$1,114	84,180	$5,312	175,210	$11,956
Flounders			5,150	206			600	30	5,750	236
Total	11,480	1,110	72,650	4,626	12,050	1,114	84,780	5,342	180,960	12,192

Table showing the extent of the menhaden industry of New York in 1901.

Items.	No.	Value.	Items.	No.	Value.
Factories	3	$405,500	Steam vessels fishing	a 32	$357,500
Cash capital		153,000	Tonnage	2,646	
Persons in factories	191		Outfit		99,350
Persons on vessels	745		Seines	63	32,500
Menhaden received	84,043,667	125,582	Sail vessels fishing	3	3,700
Tons of dry scrap prepared	4,357	97,716	Tonnage	64	
Tons of acidulated scrap prepared	2,019	22,504	Outfit		2,245
Gallons of oil made	656,286	156,638	Seines	3	900

a These vessels also supplied menhaden to factories in Delaware, Rhode Island, and Texas.

Table showing the extent of the wholesale trade in fishery products of New York City in 1901.

Items.	Fresh-fish trade.	Salt-fish trade.	Oyster and clam trade.	Sponge trade.	Miscellaneous.	Total.
Number of firms	55	25	27	12	6	125
Number of persons	648	440	478	232	32	1,830
Value of shore property	$1,081,425	$796,150	$154,150	$883,750	$125,550	$3,041,025
Amount of cash capital	$813,000	$691,500	$438,000	$555,000	$86,000	$2,583,500
Amount paid for wages	$344,110	$204,712	$176,445	$125,848	$17,258	$868,373

FISHERIES OF NEW JERSEY.

New Jersey is very favorably situated for carrying on extensive commercial fisheries, and, as all parts of the State have easy rail communication with New York, Brooklyn, Philadelphia, Jersey City, Newark, Camden, Trenton, and the immense population of the States of New York, New Jersey, and Pennsylvania outside of the above-named cities, the fishermen have a constant and ready market for their catch.

As New Jersey fronts on New York and Delaware bays, the Hudson and Delaware rivers, and the ocean, both salt and fresh water species are taken, and fishing is carried on throughout the year in at least some part of the State. In the spring many of the fishermen along the coast and in the interior resort to the Delaware and Hudson rivers and participate in the shad fishery, after the close of which some of the river fishermen engage in salt-water fishing along the coast.

An important feature of the fisheries is the increasing number of sailing vessels and boats fitted with gasoline and naphtha engines as an auxiliary means of propelling them. This applies not only to the vessels used by clam buyers and clam and fish transporters, but many boats under 5 tons burden used in the clam, shad, oyster, and pound-net fisheries are so fitted, giving much greater facility in carrying on fishing operations in variable weather.

The increasing use of steamers in dredging oysters from the planted beds in Monmouth County is a noticeable feature of the industry. Formerly this work was done by sailing vessels owned by the planters, but lately they have been using these vessels merely in the preliminary thinning out of the beds or carrying oysters to market, while steamers are hired to dredge the main body of market oysters. By operating in this manner but few steamers and men are needed to do the work which formerly required a much larger number of sailing vessels and men to perform.

A point in connection with the pound-net fisheries which is not shown clearly in the tables is that for every net set in the water the owner has a duplicate on shore. As the net after being fished for several days must be brought ashore to be cleaned and repaired, the fishermen have the duplicate net to put in its place, thus avoiding any loss of time in fishing. The value of these duplicate nets has been included in the general value of the pound nets, but not the number.

During the past ten years the "stop net" has been much used, principally in catching German carp. This is a long, fine-meshed net, which is stretched across the mouth of a small creek or bight at high tide, preventing the escape of the fish when the tide turns. As the tide recedes the ground is left bare, and the fishermen walk along the inner side of the net and pick up such fish as they want. Unfortunately this net does considerable damage, as the mesh is so fine that but few fish can go through, and many too small to be of any value to the fishermen are left upon the mud to die.

Bag nets, which are used only in Burlington and Atlantic counties, principally on the Mullica River, are large, bag-shaped nets and are operated under the ice. Holes are cut in the ice, through which the net is lowered by means of ropes attached to it at each side of its entrance, and the tide sweeping in fills it out and keeps it extended its entire length. When the tide turns the net is lifted out of the water, emptied, and fished the reverse way if the fisherman desires.

German carp.—The catch of this species in 1889 was 2,725 pounds, valued at $218, while in 1897 785,409 pounds, worth $39,370, were taken. Since 1897 the catch has been steadily declining, amounting in 1898 to 245,983 pounds, valued at $13,884, and in 1901 to 227,419 pounds, worth $14,290. As a result of the good prices realized this fishery will probably be prosecuted with greater activity in the future.

Shad.—The shad season of 1901 was good in nearly all parts of the State, and all but six of the counties show an increase over the figures for 1898. The decreases in these counties are insignificant, while the increases in the other counties are important. In 1898 the catch numbered 2,749,723, valued at $293,173, while in 1901 the number was 3,243,142, which sold for $475,202, an increase for 1901 over 1898 of 493,419 shad and $182,029. The greater part are taken on the Delaware River and Bay, and the remainder comes chiefly from the Hudson River and New York Bay. A few are caught along the coast, principally in pound nets.

The following shows the number taken in each county of the State:

Table showing the number of shad taken in each county of New Jersey in 1901.

Counties.	No.	Value.	Counties.	No.	Value.
Atlantic	1,170	$293	Mercer	52,140	$15,117
Bergen	144,315	21,647	Middlesex	2,217	418
Burlington	331,390	58,545	Monmouth	58,096	11,768
Camden	350,690	46,144	Ocean	4,422	929
Cape May	1,766	444	Salem	1,347,440	180,894
Cumberland	275,750	38,415	Sussex	1,202	342
Gloucester	468,097	66,863	Warren	6,035	1,710
Hudson	184,500	27,675			
Hunterdon	13,912	3,998	Total	3,243,142	475,202

Sturgeon.—The sturgeon fishery of New Jersey is prosecuted chiefly in the Delaware River and Bay, a small percentage of the catch being taken in the ocean. This fishery was at one time very extensive, but is rapidly declining; the fishermen are growing fewer in number each year, and as the season of 1902 was less favorable than that of 1901 it is probable that few persons will engage in the fishery in 1903. A gill-net fishery for sturgeon in the ocean off Holly Beach has been in operation for several seasons with fair success.

Efforts have been made in recent years to propagate sturgeon in the Delaware, but on account of the difficulty in securing a sufficient quantity of ripe spawn very little has been accomplished.

The following table shows the quantity and value of sturgeon, including caviar, taken in New Jersey in various years since 1890:

Year.	Lbs.	Value.
1890	3,635,350	$90,085
1891	3,520,370	86,419
1892	3,187,342	64,982
1897	1,013,604	94,056
1898	868,326	100,966
1901	188,027	19,352

Oysters.—Since the last general canvass of this State a number of changes have occurred in the oyster industry. For many years the planters had been striving earnestly for State control of the industry, and in 1899 success crowned their efforts so far as the Delaware Bay was concerned. Under the provisions of an act passed in that year, "all oyster grounds, lands, and beds included within lands of the State of New Jersey under the tidal waters of the Delaware Bay and Maurice River Cove" are placed under the exclusive control of a State oyster commission, composed of three members, to be appointed by the governor, all of whom should be directly interested or engaged in the oyster business in this region. The commission is authorized to appoint an oyster superintendent, who has immediate supervision of the industry and attends to the enforcement of the law.

The law further authorizes the commission to lease to "applicants therefor any of the lands of the State under the tidal waters of the Delaware Bay and Maurice River Cove south of the line running direct from the mouth of Straight Creek to Cross Ledge light-house, and commonly known as the 'southwest line,'" to be used for the taking, planting, and cultivating of oysters. The granting of leases to nonresidents is forbidden, except in cases where such persons already held ground at the time the law went into effect. Leases are granted for terms not exceeding thirty years, at an annual rental of not less than 25 cents per acre or fraction thereof. Persons having ground or grounds staked up at the time the law went into effect are entitled to have lease or leases for such granted to them in preference to others upon making written application to the commission within a certain time after the act took effect. Leases are to be renewed to the original lessee at the end of each term should he care to continue the business. Penalties are provided for persons robbing such beds. All the natural oyster beds of the bay are exempt from lease.

All vessels and boats engaged in the industry are required to pay a license fee of not exceeding $2 per ton on the tonnage measurement, and these licenses are to remain in force for one year from the time of issuance. All vessels and boats must be wholly owned by citizens and actual residents of the State.

The law further provides that no oysters shall be taken north of the said "southwest line" except from April 1 to June 15 of each year, while it is forbidden to take oysters south of the "line" except from September 1 to June 15, both inclusive, of each year. Except on the natural beds south of the "line," no oysters can be taken on ground not leased of the State. The seed beds are located north of the "line," while the market oysters are to be found south of it. One of the best features of the law is the provision requiring that all oysters taken on the natural beds shall be immediately culled, and all shells and other material except oysters at once thrown back upon the beds.

In 1902 this law, with slight variations, was extended to the Keyport region in Monmouth County.

On March 26, 1902, a special act relating solely to Ocean County went into effect. This act is similar in many respects to the Delaware Bay law. One notable exception is in the setting apart of a portion of the grounds to be known and held as public clam-grounds. Leases are to be granted for terms not exceeding ten years, at an annual rental of not less than 50 cents nor more than $3 per acre or fraction thereof, for the first 10 acres leased, and not less than $1 per acre for each additional acre or fraction thereof. Persons having ground staked out at the time the law went into effect have first claim on such grounds. Leases are restricted to actual residents of the State. Persons who engage in the business pay a yearly license fee of $2.50. Oystering on natural beds is restricted to the period between October 1 and April 30, while all oysters are to be immediately culled and the shells and refuse thrown back upon the bed from which taken. In 1902 a similar law went into effect in Atlantic County.

The greater part of the grounds suitable for oyster cultivation are now under the direct supervision of commissions authorized by the legislature, and beneficial results should soon be apparent through the protection given to the planters in their efforts at cultivating oysters. The authoritative surveying and mapping of the leased grounds in the various sections of the State is progressing rapidly and efficiently.

During the year ending October 31, 1901, the New Jersey State Oyster Commission distributed upon the natural beds of the State, exclusive of Delaware Bay, 62,335 bushels of shells. This is done to replenish the natural beds, which are the principal sources of supply of seed oysters for the planted beds. There is no published record of the quantity distributed in the bay.

One of the most serious problems confronting the oyster planter is the securing of enough seed oysters each year to keep the planted beds up to their full capacity. As the natural beds of the State do not furnish oysters enough for this purpose it is necessary for the planters to buy seed from other States. For many years nearly all the seed oysters planted, in addition to those taken from the natural beds, have come from Virginia. It is estimated that the oysters purchased from that State have averaged in late years about $450,000 in value. On February 16, 1901, a Virginia law forbidding the export of oysters less than 3 inches in length went into effect and prevented the planters from securing their usual seed supply from that source. This very much hampered the planters, and many of them, in 1901, planted only a fraction of the usual quantity of seed. The result of this scarcity of seed does not appear in the present statistics, as the small oysters require several years to attain their full growth. Most of the seed planted now comes from the Raritan River, Staten Island Sound, Newark Bay, and Connecticut. During the season of 1901 seed oysters were unusually plentiful on the natural beds off Keansburg, Monmouth County. During the past two years drum-fish have done considerable damage to the planted beds. In 1902 dynamite was used to destroy them in Tuckerton Bay.

Clams.—During 1901 hard clams were fairly abundant in the waters of this State, but in the summer of 1902 they became very scarce and the price rose unusually high. Owing to the heavy cost of running the large clam vessels of Monmouth County many of the clammers tied up their vessels and went clamming in small boats, which could be run much more cheaply. Except in Monmouth County the soft-clam business is insignificant; here it is centered largely around Highlands, where a number of wholesale dealers buy from the clammers and ship either in the shell or opened. At Ocean City, in Cape May County, surf clams are gathered along the sea beach, for bait in the line fisheries. None is used for food.

Mussels.—During 1901 mussels were very scarce, there having been no set in most of the counties during the last four or five years. In Monmouth County in 1902 several medium-sized beds were worked. In Burlington and Atlantic counties mussels are used for fertilizer; in Cape May and Monmouth counties they are used principally for food.

Terrapin.—On March 25, 1898, a law was passed by the legislature forbidding the taking of terrapin for three years from the date of the passage of the act, and providing that fishing could be carried on thereafter from November 1 to April 1. The industry was resumed in 1901, and the catch amounted to 8,232 pounds, valued at $3,135. During 1897, the last year before the law went into effect, 13,528 pounds, valued at $6,096, were secured. But few persons resumed the business in 1901, which probably accounts for the small quantity taken after three years' complete protection. The fishermen classify the terrapin secured as follows: "Cow," those 6 or more inches long on the under shell; "one-half count," those under 6 inches and not less than 4 inches in length on the under shell; "bulls," all under 4 inches long. Under the present law terrapin under 4 inches in length must be returned to the water. The animal is usually secured by means of a short stick with a hook fastened to the end. With this the fisherman pokes around under the overhanging banks and in likely holes, and hooks the animal out far enough to get hold of it with his hands.

GENERAL STATISTICS.

As compared with 1898 the present canvass shows increases, except in a few instances. In the number of persons employed there was a decrease of 240, but the total investment increased $392,148. In 1898 the total quantity of fishery products secured in the State was 90,297,118 pounds, valued at $3,563,766, while in 1901 it was 117,930,964 pounds, worth $4,755,522, a gain of 27,633,846 pounds and $1,191,756. The species showing notable increases are the following: Alewives, bluefish, bonito, butter-fish, eels, menhaden, white perch, shad, squeteague, spots, market and seed oysters. The increase in the catch of butter-fish is especially noteworthy, having risen from 262,627 pounds, valued at $8,080, in 1898, to 3,008,301 pounds, valued at $84,119, in 1901, a gain of 2,745,674 pounds and $76,039. The principal decreases occurred in croakers, sea bass, sturgeon, king crabs, lobsters, and mussels.

During the last few years cold-storage plants have been erected at various places on the seacoast, in which the surplus catch of the pound nets is frozen when the price is low, to be ultimately shipped when the price advances, or during the winter months when fishing can not be carried on.

The three tables below show, in a condensed form, the number of persons engaged, the number and value of vessels, boats, and of the various kinds of apparatus employed, the value of shore and accessory property, the amount of cash capital, and the quantity and value of the products of the fisheries of New Jersey in 1901:

Number of persons employed.

How engaged.	No.
On vessels fishing	2,142
On vessels transporting	200
In shore or boat fisheries	8,828
Shoresmen	860
Total	12,030

Table of apparatus and capital.

Items.	No.	Value.	Items.	No.	Value.
Vessels fishing	533	$518,025	Apparatus—shore fisheries:		
Tonnage	5,371		Seines	469	$33,000
Outfit		143,067	Gill nets	5,058	145,146
Vessels transporting	78	125,450	Pound nets and weirs	158	155,679
Tonnage	1,343		Bag nets	89	3,110
Outfit		23,746	Fyke nets	3,057	16,955
Boats	6,473	502,666	Stop nets	14	1,660
			Lines, hand and trawl		3,421
Apparatus—vessel fisheries:			Eel pots	5,275	3,829
Seines	14	5,785	Lobster pots	850	2,358
Gill nets	2	160	Oyster tongs, rakes, dredges	5,096	35,660
Lines, hand and trawl		1,052	Clam tongs, rakes, and hoes	3,372	22,337
Eel pots	390	223	Minor apparatus		533
Crab dredges	323	1,135	Shore and accessory property		785,428
Oyster dredges and tongs	1,654	37,188	Cash capital		155,550
Clam tongs and rakes	577	6,408			
			Total		2,729,571

Table of products.

Species.	Lbs.	Value.	Species.	Lbs.	Value.
Albacore	15,143	$259	Shark	500	$10
Alewives, fresh	3,347,491	19,425	Sheepshead	7,285	905
Alewives, salted	374,000	2,865	Skates	2,375	48
Black bass	3,000	159	Spanish mackerel	38,928	5,729
Blue-fish	6,110,318	254,682	Spots	299,092	3,471
Bonito	1,459,418	34,841	Squeteague	11,973,394	315,770
Butter-fish	3,008,301	84,119	Striped bass	354,467	49,734
Cat-fish	256,859	14,229	Sturgeon	168,919	8,393
Cero	22,789	714	Caviar	19,108	10,959
Cod	2,300,771	67,603	Suckers	110,415	5,459
Crevalle	53	1	Tautog	91,105	3,136
Croakers	226,360	5,663	Tomcod	265,041	4,519
Drum	58,330	868	Whiting	405,804	7,874
Eels	1,362,988	70,636	Clams, hard	[a] 4,246,070	552,953
Flounders	1,668,221	52,993	Clams, soft	[b] 902,770	54,918
German carp	227,419	14,290	Clams, surf	[c] 13,336	500
Haddock	226,963	8,101	Crabs, hard	[d] 719,995	23,558
Hake	26,841	749	Crabs, soft	[e] 417,910	51,861
Horse mackerel	224	5	King crabs	[f] 409,800	1,711
King-fish	21,036	3,083	Lobsters	65,943	8,340
Ling	317,868	4,375	Mussels	[g] 374,600	920
Mackerel	10,005	1,577	Oysters, market	[h] 14,646,345	1,696,767
Menhaden	32,910,666	88,041	Oysters, seed	[i] 10,617,572	550,918
Mullet, fresh	36,300	1,842	Oyster shells	[j] 144,000	32
Mullet, salted	57,814	5,123	Scallops	[k] 114,000	3,200
Perch, white	1,270,097	81,699	Shrimp	4,095	1,988
Perch, yellow	16,569	1,038	Squid	17,748	826
Pike and pickerel	2,560	210	Terrapin	8,232	3,135
Salmon	233	73	Turtles	20,130	1,053
Scup	607,099	16,367			
Sea bass	1,495,247	76,003	Total	117,930,964	4,755,522
Shad	14,031,002	475,202			

[a] 530,759 bushels.
[b] 90,277 bushels.
[c] 1,667 bushels.
[d] 2,159,985 in number.
[e] 1,253,730 in number.
[f] 204,900 in number.
[g] 11,860 bushels.
[h] 2,092,335 bushels.
[i] 1,516,796 bushels.
[j] 2,400 bushels.
[k] 7,333 bushels.

STATISTICS OF THE FISHERIES BY COUNTIES.

Fishing is carried on in 17 counties of the State. Essex County has no fishing, but there is considerable wholesale trade in fishery products at Newark. Of these counties Bergen, Hudson, Union, Middlesex, and part of Monmouth are on the Hudson River, Staten Island Sound, and New York Bay; Ocean, Atlantic, and portions of Monmouth, Burlington, and Cape May are on the ocean side, while Sussex, Warren, Hunterdon, Mercer, Camden, Gloucester, Salem, Cumberland, and parts of Burlington and Cape May are on the Delaware River and Bay.

Monmouth County leads in the quantity of products, while the large oyster industry of Cumberland places that county ahead so far as total value of catch is concerned. Ocean County also surpasses Cumberland County in quantity, but is far behind both Cumberland and Monmouth in the value of the catch. A feature of the fisheries of Salem County is the immense preponderance of the shad fishery.

The three following tables show the extent of the fisheries by counties.

Table showing the number of persons employed in the fisheries of New Jersey in 1901.

Counties.	On vessels fishing.	On vessels transporting.	In shore or boat fisheries.	Shoresmen.	Total.
Atlantic	211	25	646	7	889
Bergen			85	10	95
Burlington		7	466	30	503
Camden	87	3	309	11	410
Cape May	115	18	923	16	1,072
Cumberland	1,356	16	777	289	2,438
Essex				85	85
Gloucester			334	8	342
Hudson	4	2	182	29	217
Hunterdon			99	1	100
Mercer			236		236
Middlesex	10	19	217	24	270
Monmouth	295	65	1,740	203	2,303
Ocean	64	32	1,443	96	1,635
Salem		13	1,062	44	1,119
Sussex			26		26
Union			210	7	217
Warren			73		73
Total	2,142	200	8,828	860	12,030

Table showing, by counties, the vessels, boats, and apparatus employed in the fisheries of New Jersey in 1901.

Items.	Atlantic.		Bergen.		Burlington.		Camden.		Cape May.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	57	$59,150					13	$21,000	29	$29,975
Tonnage	486						196		313	
Outfit		15,129						4,203		5,948
Vessels transporting	12	9,300			3	$3,350	1	900	7	12,650
Tonnage	125				66		13		138	
Outfit		1,372				340		244		1,165
Boats	659	60,056	65	$6,450	394	30,100	143	14,195	785	41,311
Apparatus—vessel fisheries:										
Seines	4	785							1	400
Lines, hand and trawl		855								197
Eel pots									60	25
Oyster dredges and tongs	111	1,195					52	1,300	72	1,728
Clam tongs and rakes	102	714							16	112
Apparatus—shore fisheries:										
Seines	53	2,441			32	4,435	14	2,960	80	2,160
Gill nets	81	625	1,230	6,415	161	5,612	103	4,693	128	3,924
Pound nets and weirs	3	4,000							75	17,135
Bag nets	30	750			59	2,360				
Fyke nets	27	340	3	60	672	1,197	45	54	33	540
Stop nets					11	1,030	2	530		
Lines, hand and trawl		327								684
Eel pots			490	602	7	7			60	50
Oyster tongs, rakes, and dredges.	722	4,782			245	927	8	124	548	3,562
Clam tongs, rakes, and hoes.	704	4,886			104	448			552	3,821
Minor apparatus		67								98
Shore and accessory property		23,060		2,200		10,693		2,020		29,429
Cash capital										5,000
Total		189,834		15,727		60,499		52,223		159,914

Items.	Mercer.		Salem.		Sussex.		Union.		Warren.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels transporting			1	$35,000						
Tonnage			244							
Outfit				3,950						
Boats	109	$3,800	524	55,500	8	$100	106	$10,600	19	$335
Apparatus—shore fisheries:										
Seines	25	1,729	20	1,667	5	110			15	693
Gill nets	72	2,155	452	62,885						
Fyke nets	384	729								
Stop nets	1	100								
Lines, hand and trawl				3						
Oyster tongs, rakes, and dredges			2	12			210	1,260		
Minor apparatus				114						
Shore and accessory property		2,939		38,769		470		1,600		781
Cash capital								1,000		
Total		11,452		197,900		680		14,460		1,809

Table showing, by counties, the vessels, boats, and apparatus employed in the fisheries of New Jersey in 1901—Continued.

Items.	Cumberland.		Essex.		Gloucester.		Hudson.		Hunterdon.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	300	$300,775					2	$1,050		
Tonnage	3,040						18			
Outfit		58,325						545		
Vessels transporting	4	3,500					1	700		
Tonnage	70						14			
Outfit		1,195						310		
Boats	581	47,198			171	$19,480	117	9,645	48	$1,070
Apparatus—vessel fisheries:										
Crab dredges							6	21		
Oyster dredges and tongs	1,186	29,700								
Clam tongs and rakes							8	82		
Apparatus—shore fisheries:										
Seines	18	785			5	850			23	2,285
Gill nets	176	18,427			141	12,923	592	3,191		
Fyke nets	291	291			407	585	330	4,450		
Lines, hand and trawl		4								
Pots, eel							310	310		
Pots, lobster							125	183		
Oyster tongs, rakes, and dredges	620	6,079					107	856		
Clam tongs, rakes, and hoes							4	32		
Minor apparatus		46						2		
Shore and accessory property		169,702		$83,000		1,747		23,260		6,935
Cash capital		12,000		42,200				30,000		
Total		648,027		125,200		35,585		74,637		10,290

Items.	Middlesex.		Monmouth.		Ocean.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	5	$3,750	117	$77,725	10	$24,600	533	$518,025
Tonnage	31		1,095		192		5,371	
Outfit		1,610		49,862		7,446		143,067
Vessels transporting	6	8,500	29	38,650	14	12,900	78	125,450
Tonnage	84		416		173		1,343	
Outfit		2,115		11,475		1,680		23,746
Boats	153	14,635	1,395	91,569	1,286	96,622	6,473	502,666
Apparatus—vessel fisheries:								
Seines			6	2,700	3	1,900	[a]14	5,785
Gill nets			2	160			[b]2	160
Lines, hand and trawl								1,052
Pots, eel			60	60	280	138	390	223
Crab dredges			317	1,114			323	1,135
Oyster dredges and tongs	6	51	210	3,103	17	111	1,654	37,188
Clam tongs and rakes	20	250	408	5,100	23	150	577	6,408
Apparatus—shore fisheries:								
Seines	5	2,550	67	3,976	107	6,359	[c]469	33,000
Gill nets	15	90	868	9,900	1,039	14,306	[d]5,058	145,146
Pound nets and weirs	1	300	67	120,344	12	13,900	158	155,679
Bag nets							89	3,110
Fyke nets	18	530	205	3,984	642	4,195	3,057	16,955
Stop nets							[e]14	1,660
Lines, hand and trawl				1,933		470		3,421
Pots, eel	115	95	1,343	1,258	2,950	1,507	5,275	3,829
Pots, lobster			695	2,085	30	90	850	2,358
Oyster tongs, rakes, and dredges	262	1,834	470	3,167	1,902	13,057	5,096	35,660
Clam tongs, rakes, and hoes	10	90	744	5,293	1,218	7,767	3,372	22,337
Minor apparatus				179		27		533
Shore and accessory property		14,150		315,033		59,640		785,428
Cash capital		5,000		44,350		16,000		155,550
Total		55,550		793,020		282,764		2,729,571

[a] 11,340 yards in length.
[b] 320 yards in length.
[c] 68,303 yards in length.
[d] 888,253 yards in length.
[e] 9,625 yards in length.

Table showing, by counties, the yield of the fisheries of New Jersey in 1901.

Species.	Atlantic.		Bergen.		Burlington.		Camden.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	54,500	$514			143,370	$735	50,500	$255
Alewives, salted					368,000	2,760		
Blue-fish	30 911	2,063						
Butter-fish	15,000	300						
Cat-fish	6,100	305			56,985	2,836	15,730	1,316
Cod	831,140	24,998						
Croakers	73,825	1,629						
Eels	120,800	6,580	37,500	$1,898	8,125	410	3,690	185
Flounders	38,032	1,727						
German carp					61,613	3,219	57,910,	4,516
Haddock	6,846	211						
Hake	5,710	178						
King-fish	5,875	885						
Menhaden	4,500,000	6,000						
Mullet, fresh	3,000	170						
Mullet, salted	5,000	500						
Perch, white	202,019	9,299	1,200	48	112,078	5,483		
Perch, yellow					1,483	78		
Pike and pickerel					365	32		
Salmon					99	27	70	28
Scup	12,600	518						
Sea bass	209,400	10,470						
Shad	4,680	293	577,260	21,647	1,199,590	58,545	1,402,760	46,144
Sheepshead	3,360	559						
Spots	3,400	68						
Squeteague	713,766	23,496			55,400	2,062		
Striped bass	61,075	9,872	43,385	4,339	52,245	9,771	1,000	100
Sturgeon					472	39		
Suckers					25,890	1,507	3,685	295
Tautog	1,500	59						
Tomcod			1,800	54				
Whiting	5,000	200						
Clams, hard	726,360	71,666			124,792	16,380		
Crabs, hard	5,767	303						
Crabs, soft	2,400	480						
Mussels	54,000	540			320,000	320		
Oysters, market	1,197,959	137,098			146,020	16,681	578,200	73,115
Oysters, seed	352,499	15,859			22,750	885	365,820	18,186
Shrimp	285	47						
Terrapin	400	200						
Total	9,253,209	327,087	661,145	27,986	2,699,227	121,770	2,479,365	144,140

Species.	Cumberland.		Gloucester.		Hudson.		Hunterdon.		Mercer.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Value.
Alewives, fresh	10,100	$101	20,500	$103					8,900	$89
Cat-fish	29,300	2,159	15,837	883	700	$35	615	$72	49,700	2,478
Eels	8,340	657	11,857	952	17,100	1,205	100	6	9,700	392
German carp	350	21	6,520	521	820	49	3,335	163	43,357	2,602
Perch, white	10,200	635			592	24			500	25
Perch, yellow									1,000	51
Pike and pickerel							20	2	75	8
Salmon							55	17	9	1
Shad	1,280,450	38,415	2,232,118	66,863	738,000	27,675	68,560	3,998	201,860	15,117
Squeteague	36,650	2,305								
Striped bas	42,955	3,854	570	51	1,683	168	1,135	123	1,830	149
Sturgeon	98,614	4,497							400	27
Caviar	13,836	7,611								
Suckers	1,000	50	1,365	74			9,325	465	39,210	1,981
Tomcod					1,200	36				
Clams, hard					10,400	1,625				
Clams, soft					3,500	263				
Crabs, hard					8,000	430				
Crabs, soft					1,000	333				
King crabs	51,000	128								
Lobsters					22,000	2,220				
Oysters, market	7,420,686	971,727								
Oysters, seed	7,392,749	389,367			422,100	21,105				
Turtles	1,800	162								
Total	16,398,030	1,421,689	2,288,767	69,447	1,227,095	55,168	83,145	4,846	356,541	22,920

Table showing, by counties, the yield of the fisheries of New Jersey in 1901—Continued.

Species.	Cape May.		Middlesex.		Monmouth.		Ocean.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Albacore	1,600	$37			11,065	$197	2,478	$25
Alewives, fresh	110,100	894	34,400	$65	680,763	8,861	2,234,358	7,808
Alewives, salted							6,000	105
Black bass							3,000	159
Blue-fish	358,852	21,091	18,500	555	5,352,068	214,494	349,987	16,479
Bonito	13,480	502			1,293,802	29,641	152,136	4,698
Butter-fish	719,945	20,695	700	21	1,845,097	50,276	427,559	12,827
Cat-fish			450	23	4,170	178	65,450	3,273
Cero	4,590	168			17,619	529	580	17
Cod	370,834	11,111			663,979	19,025	434,818	12,469
Crevalle					53	1		
Croakers	95,575	2,849			38,845	652	18,115	533
Drum	11,830	682			46,500	186		
Eels	119,450	6,339	14,600	841	412,951	21,314	598,700	29,851
Flounders	110,851	4,803	13,560	575	847,178	22,830	658,600	23,058
German carp					80	2		
Haddock	13,930	419			77,771	2,334	128,416	5,137
Hake	6,840	215			11,580	274	2,711	82
Horse mackerel					224	5		
King-fish	11,060	1,567			3,046	495	1,055	136
Ling	22,033	661			258,393	3,152	37,442	562
Mackerel	2,879	507			5,003	752	2,123	318
Menhaden	755,000	12,430	260,880	489	17,099,342	54,308	10,295,444	14,814
Mullet, fresh	19,800	990			13,500	682		
Mullet, salted	52,814	4,623						
Perch, white	26,288	1,306	3,614	145	11,793	683	901,688	64,043
Perch, yellow	13,653	885						
Pike and pickerel							2,100	168
Scup	251,300	8,238			301,795	6,783	41,404	828
Sea bass	579,690	29,799			443,977	19,863	262,180	15,871
Shad	7,064	444	10,068	418	235,344	11,768	17,688	929
Shark					500	10		
Sheepshead	3,925	346						
Skates					2,375	48		
Spanish mackerel	2,510	381			32,096	4,700	4,322	648
Spots	5,750	292			244,199	2,654	45,743	457
Squeteague	1,117,455	33,030	36,100	855	8,874,124	222,564	1,135,149	31,173
Striped bass	48,645	5,643	3,120	434	22,669	2,845	65,700	11,447
Sturgeon	40,595	2,645			6,683	437		
Caviar	2,060	1,411			1,172	509		
Suckers					11,350	361	12,315	369
Tautog	780	23			88,425	3,046	400	8
Tomcod					214,839	3,720	47,202	709
Whiting	350	7			400,454	7,667		
Clams, hard	700,384	67,225	43,798	7,093	2,020,952	317,949	619,384	71,015
Clams, soft					788,130	48,659	111,140	5,996
Clams, surf	13,336	500						
Crabs, hard	13,600	404	1,200	46	665,006	21,199	26,422	1,176
Crabs, soft	6,400	1,200			360,478	43,070	47,632	6,778
King crabs	358,800	1,583						
Lobsters					40,043	5,574	3,900	546
Mussels	600	60						
Oysters, market	386,050	51,701	340,900	48,700	1,340,801	177,960	3,235,729	219,785
Oysters, seed	497,287	23,736	455,000	26,000	189,406	10,852	282,261	13,098
Oyster shells					144,000	32		
Scallops			42,000	350	72,000	2,850		
Shrimp					210	140	3,600	1,801
Squid	16,600	792			948	28	200	6
Terrapin	7,832	2,935						
Turtles	150	2			8,605	154	8,300	646
Total	6,902,567	325,171	1,278,890	86,610	45,205,403	1,346,313	22,293,431	579,848

Species.	Salem.		Sussex.		Union.		Warren.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Cat-fish	11,822	$671						
Eels							75	$6
German carp	52,469	3,148					965	49
Perch, white	125	8						
Perch, yellow	483	24						
Shad	6,029,280	180,894	5,645	$342			20,635	1,710
Squeteague	4,750	285						
Striped bass	8,430	934					25	4
Sturgeon	22,155	748						
Caviar	2,040	1,428						
Suckers	4,575	235					1,700	122
Oysters, seed	7,700	330			630,000	$31,500		
Turtles	1,275	89						
Total	6,145,104	188,794	5,645	342	630,000	31,500	23,400	1,891

THE PRODUCTS BY APPARATUS.

In the vessel fisheries seines lead in the quantity of products secured—over nine-tenths of the catch consisting of menhaden—but dredges, tongs, rakes, etc., rank first in the value of the catch. In the shore fisheries dredges, tongs, rakes, etc., occupy first place, both as regards quantity and value of catch, while the pound net and weir fisheries are second in quantity secured, but are outstripped by gill nets in the value of the yield. A feature of the shore fisheries is the great increase—6,811,064 pounds and $204,409—shown in the pound-net catch of Monmouth County over 1898. Ocean and Cape May counties also show relatively large increases.

Cod show a great falling off in the pound-net fisheries. In 1897 1,191,000 pounds, valued at $14,795, and in 1898, 280,000 pounds, valued at $5,590, were secured, while in 1901 the catch amounted to only 30,686 pounds, worth $903. According to the reports of the pound-net owners the catch of 1897 was very large, as cod are generally taken in but small quantities in this form of apparatus. Butter-fish, bonito, and squeteague taken in pound nets show large increases over 1897 and 1898, while king crabs have fallen off considerably.

Table showing, by counties, the yield of the seine fisheries of New Jersey in 1901.

Species.	Atlantic.		Burlington.		Camden.		Cape May.		Cumberland.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:										
Bonito							2,000	$80		
Blue-fish							4,000	160		
Croakers							2,000	40		
Menhaden	4,500,000	$6,000								
Scup							80,000	2,400		
Perch, white	15,100	604								
Sea bass							8,000	960		
Squeteague	7,600	304					4,000	80		
Striped bass	3,900	312								
Total	4,526,600	7,220					100,000	3,720		
Shore fisheries:										
Alewives, fresh	42,700	417	143,370	$735	50,500	$255	89,100	818	10,100	$101
Alewives, salted			368,000	2,760						
Blue-fish							6,630	403		
Butter-fish							1,445	66		
Cat-fish			19,949	979	13,730	1,176			12,450	942
Drum							1,000	60		
Eels	59,500	3,515					32,550	1,648		
Flounders	4,400	206					34,516	1,612		
German carp			30,900	1,652	47,410	3,676			350	21
Hake							440	18		
King-fish	1,525	229					2,405	445		
Mullet, fresh	2,000	120					19,800	990		
Mullet, salted							52,814	4,623		
Perch, white	53,100	2,124	12,578	508			10,913	457	8,700	530
Perch, yellow			1,433	78			13,653	885		
Pike			365	32						
Salmon			75	23	70	28				
Shad	4,680	293	181,910	10,241	470,108	18,167	1,104	71	14,200	426
Spots							5,300	265		
Striped bass	17,700	2,019	9,145	1,151	1,000	100	34,894	4,182	24,840	2,211
Sturgeon			412	36						
Suckers			17,890	907	2,485	199			1,000	50
Squeteague	87,300	2,722	31,400	1,102			181,800	7,872	24,340	1,513
Shrimp	285	47								
Total	273,190	11,692	817,427	20,204	585,308	23,601	488,364	24,405	95,980	5,794
Grand total	4,799,790	18,912	817,427	20,204	585,308	23,601	588,364	28,125	95,980	5,794

Table showing, by counties, the yield of the seine fisheries of New Jersey in 1901—Cont'd.

Species.	Gloucester.		Hunterdon.		Mercer.		Middlesex.		Sussex.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Alewives, fresh	20,500	$103			8,900	$89	34,400	$65		
Blue-fish							16,400	492		
Cat-fish	3,247	195	615	$72	15,200	753				
Eels			100	6						
Flounders							2,250	90		
German carp	6,520	521	3,335	163	42,467	2,548				
Menhaden							212,880	399		
Perch, white					500	25	700	28		
Perch, yellow					1,000	51				
Pike			20	2	75	8				
Salmon			55	17						
Shad	220,950	6,529	68,560	3,998	20,100	1,525	2,988	90	5,645	$342
Striped bass	570	51	1,135	123	1,830	149	400	56		
Sturgeon					400	27				
Suckers	1,365	74	9,325	465	39,210	1,981				
Squeteague							20,200	303		
Total	253,152	7,473	83,145	4,846	129,682	7,156	290,218	1,523	5,645	342

Species.	Monmouth.		Ocean.		Salem.		Warren.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.
Vessel fisheries:										
Bonito									2,000	$80
Blue-fish									4,000	160
Croakers									2,000	40
Menhaden	13,063,959	$30,120	10,283,000	$14,690					27,846,959	50,810
Scup									80,000	2,400
Perch, white									15,100	604
Sea bass									8,000	960
Squeteague	2,000	60							13,600	444
Striped bass									3,900	312
Total	13,065,959	30,180	10,283,000	14,690					27,975,559	55,810
Shore fisheries:										
Alewives, fresh	66,100	1,072	2,094,166	7,116					2,559,836	10,771
Alewives, salted			6,000	105					374,000	2,865
Black bass			3,000	159					3,000	159
Blue-fish	6,500	353	1,800	90					31,330	1,338
Butter-fish									1,445	66
Cat-fish	1,070	51	65,450	3,273	8,912	$517			140,623	7,958
Drum									1,000	50
Eels	85,860	4,293					75	$6	178,085	9,468
Flounders	5,054	165	3,200	128					49,420	2,201
German carp	80	2			36,200	2,172	965	49	168,227	10,804
Hake									440	18
King-fish	40	2							3,970	676
Menhaden	138,000	389	6,500	65					357,380	853
Mullet, fresh	13,300	666							35,100	1,776
Mullet, salted									52,814	4,623
Perch, white	4,100	282	646,765	40,977	125	8			737,481	44,939
Perch, yellow					483	24			16,569	1,038
Pike									460	42
Salmon									200	68
Scup	110	2							110	2
Shad	13,120	657	4,528	271	98,630	2,973	20,635	1,710	1,127,158	47,293
Spots									5,300	265
Striped bass	10,460	1,755	59,275	10,349	8,430	934	25	4	169,704	23,084
Sturgeon									812	68
Suckers	10,750	343	4,615	135	4,575	235	1,700	122	92,815	4,511
Squeteague	43,100	1,453	61,700	2,301					449,840	17,266
Crabs, hard	88,064	2,936	22,850	1,003					110,914	3,939
Crabs, soft	186,900	20,153	39,532	5,421					226,432	25,574
Shrimp			3,210	1,606					3,495	1,653
Snappers			300	6					300	6
Turtles	320	3							320	3
Total	672,928	34,577	3,022,791	73,005	157,355	6,863	23,400	1,891	6,898,580	223,372
Grand total	13,738,887	64,757	13,305,791	87,695	157,355	6,863	23,400	1,891	34,874,139	279,182

Table showing, by counties, the yield of the gill-net fisheries of New Jersey in 1901.

Species.	Atlantic.		Bergen.		Burlington.		Camden.		Cape May.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.
Shore fisheries:										
Alewives	6,700	$71							1,200	$9
Blue-fish									600	36
Butter-fish									2,100	84
Croakers									500	15
Flounders	100	6							180	9
King-fish	75	15							326	40
Menhaden									418,000	5,220
Mullet, fresh	1,000	50								
Mullet, salted	5,000	500								
Perch, white	36,400	2,674							10,525	537
Salmon					24	$4				
Scup									900	36
Shad			577,260	$21,647	1,017,680	48,304	932,652	$27,977		
Spanish mackerel									150	23
Striped bass	200	24	42,985	4,299					806	69
Sturgeon					60	3			26,475	1,709
Caviar									1,080	756
Suckers					8,000	600				
Squeteague	100	8			24,000	960			3,540	109
Total	49,575	3,347	620,245	25,946	1,049,764	49,871	932,652	27,977	466,882	8,652

Species.	Cumberland.		Gloucester.		Hudson.		Mercer.		Middlesex.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.
Shore fisheries:										
Perch, white	1,500	$105								
Salmon							9	$1		
Shad	1,266,250	37,989	2,011,168	$60,334	478,800	$17,955	181,760	13,592	1,200	$36
Striped bass	18,115	1,643			500	50				
Sturgeon	98,614	4,497								
Caviar	13,836	7,611								
Squeteague	7,010	474								
Total	1,405,325	52,319	2,011,168	60,334	479,300	18,005	181,769	13,593	1,200	36

Species.	Monmouth.		Ocean.		Salem.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Blue-fish	4,300	$215					4,300	$215
Shore fisheries:								
Alewives	5,000	100	119,000	$480			131,900	660
Blue-fish	202,400	8,096	300,465	14,472			503,465	22,604
Bonito	3,308	100	21,375	775			24,683	875
Butter-fish							2,100	84
Croakers	1,800	23					2,300	38
Flounders							280	14
King-fish			200	10			601	65
Menhaden	9,700	84					427,700	5,304
Mullet, fresh							1,000	50
Mullet, salted							5,000	500
Perch, white			231,810	21,535			280,235	24,851
Pickerel			2,100	168			2,100	168
Salmon							33	5
Scup							900	36
Shad	130,776	6,539			5,930,650	$177,921	12,528,196	412,294
Spanish mackerel	3,254	488					3,401	511
Striped bass			5,925	1,063			68,531	7,148
Sturgeon	1,789	113			22,155	748	149,093	7,070
Caviar	36	20			2,040	1,428	16,992	9,815
Suckers			7,800	234			15,800	834
Squeteague	73,250	1,784	166,175	5,990			274,075	9,325
Whiting	50,000	1,000					50,000	1,000
Total	481,313	18,347	854,850	44,727	5,954,845	180,097	14,488,388	503,251
Grand total	485,613	18,562	854,850	44,727	5,954,845	180,097	14,492,688	503,466

Table showing, by counties, the yield of the pound-net and weir fisheries of New Jersey in 1901.

Species.	Atlantic.		Cape May.		Middlesex.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:						
Albacore			1,600	$37		
Alewives			19,800	67		
Blue-fish	600	$30	5,822	331	2,100	$63
Bonito			11,480	422		
Butter-fish	15,000	300	716,400	20,545	700	21
Cero			4,590	168		
Croakers			18,508	540		
Drum			2,690	79		
Eels	300	15	9,500	565		
Flounders	13,340	400	44,300	1,784	4,000	160
King-fish	1,334	200	5,090	555		
Ling			2,100	63		
Mackerel			2,879	507		
Menhaden			337,000	7,210	48,000	90
Perch, white			4,400	285		
Scup			81,400	3,122		
Sea bass			290	35		
Shad			5,960	373	120	4
Spanish mackerel			2,360	358		
Spots			450	27		
Striped bass	334	50	9,195	980		
Sturgeon			14,120	936		
Caviar			980	655		
Squeteague	90,000	2,700	824,500	21,040	3,400	68
Whiting	5,000	200	350	7		
Crabs, hard	2,000	20	12,000	324		
King crabs			358,800	1,583		
Squid			16,600	792		
Turtles			150	2		
Total	127,908	3,915	2,513,314	63,392	58,320	406

Species.	Monmouth.		Ocean.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:						
Albacore	11,065	$197	2,478	$25	15,143	$259
Alewives	598,769	7,541	21,192	212	639,761	7,820
Blue-fish	93,638	4,014	12,112	435	114,272	4,873
Bonito	1,277,894	29,289	130,161	3,905	1,419,535	33,616
Butter-fish	1,845,097	50,276	427,559	12,827	3,004,756	83,969
Cero	17,619	529	580	17	22,789	714
Cod	21,201	627	9,485	276	30,686	903
Crevalle	53	1			53	1
Croakers	37,045	629	18,1[illegible]	533	73,668	1,702
Drum	46,500	186			49,190	265
Eels	82	4			9,882	584
Flounders	513,432	13,648	68,036	2,041	643,108	18,033
Haddock	2,105	64			2,105	64
Hake	1,680	34			1,680	34
King-fish	2,760	454	655	96	9,839	1,305
Ling	249,913	3,067	37,442	562	289,455	3,692
Mackerel	5,003	752	2,123	318	10,005	1,577
Horse mackerel	224	5			224	5
Menhaden	3,850,743	23,474	5,944	59	4,241,687	30,833
Perch, white					4,400	285
Scup	263,650	5,718	40,804	816	385,854	9,656
Sea-bass	57,311	2,243	80	5	57,681	2,283
Shad	89,832	4,491	13,160	658	109,072	5,526
Shark	500	10			500	10
Skates	2,375	48			2,375	48
Spanish mackerel	28,756	4,206	4,322	648	35,438	5,212
Spots	232,569	2,332	45,743	457	278,762	2,816
Striped bass	2,304	145	500	35	12,333	1,210
Sturgeon	4,894	324			19,014	1,260
Caviar	1,136	489			2,116	1,144
Squeteague	8,698,374	217,759	892,174	22,304	10,508,448	263,871
Tautog	2,059	77	400	8	2,459	85
Tomcod	181,539	2,722	47,202	709	228,741	8,431
Whiting	347,304	6,604			352,654	6,811
Crabs, hard	21,220	590	900	6	36,120	940
King crabs					358,800	1,583
Squid	948	28	200	6	17,748	826
Turtles	8,285	151			8,435	153
Total	18,517,879	382,728	1,781,367	46,958	22,998,788	497,399

Table showing, by counties, the yield of the stop-net fisheries of New Jersey in 1901.

Species.	Burlington.		Camden.		Mercer.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Cat-fish	1,300	$65	2,000	$140			3,300	$205
Eels			1,050	53			1,050	53
German carp	30,713	1,567	10,500	840	890	$54	42,103	2,461
Suckers			1,200	96			1,200	96
Total	32,013	1,632	14,750	1,129	890	54	47,653	2,815

Table showing, by counties, the yield of the fyke-net fisheries of New Jersey in 1901.

Species.	Atlantic.		Bergen.		Burlington.		Camden.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Cat-fish					28,736	$1,442		
Eels					6,975	352	2,640	$132
Perch, white	9,319	$373	1,200	$48				
Striped bass	2,941	267	400	40				
Tomcod			1,800	54				
Total	12,260	640	3,400	142	35,711	1,794	2,640	132

Species.	Cape May.		Cumberland.		Gloucester.		Hudson.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Cat-fish			16,850	$1,217	12,590	$688	700	$35
Eels	6,800	$590	8,340	657	11,857	952		
Flounders	800	48						
German carp							820	49
Perch, white	450	27					592	24
Shad							259,200	9,720
Squeteague	3,000	150						
Striped bass	3,600	396					1,183	118
Tomcod							1,200	36
Total	14,650	1,211	25,190	1,874	24,447	1,640	263,695	9,982

Species.	Mercer.		Middlesex.		Monmouth.		Ocean.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Alewives					10,894	$148			10,894	$148
Blue-fish					630	32			630	32
Cat-fish	34,500	$1,725	450	$23	3,100	127			96,926	5,257
Eels	9,700	892			39,575	2,260			85,887	5,335
Flounders			7,310	325	50,300	1,697	257,600	$9,263	316,010	11,233
German carp									820	49
King-fish					246	39			246	39
Menhaden					36,940	241			36,940	241
Mullet					200	16			200	16
Perch, white			2,914	117	7,693	401	23,113	1,531	45,281	2,521
Scup					160	5			160	5
Shad			5,760	288	1,616	81			266,576	10,089
Spanish mackerel					86	6			86	6
Spots					11,630	322			11,630	322
Squeteague			12,500	484	57,400	1,508			72,900	2,142
Striped bass			2,720	378	9,905	945			20,749	2,144
Suckers					600	18			600	18
Tautog					1,900	57			1,900	57
Tomcod					100	2			3,100	92
Whiting					250	5			250	5
Crabs, hard			1,200	46	12,000	864			13,200	910
Total	44,200	2,117	32,854	1,661	245,225	8,674	280,713	10,794	984,985	40,661

Table showing, by counties, the yield of the line fisheries of New Jersey in 1901.

Species.	Cumberland.		Ocean.		Salem.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:						
Blue-fish			35,610	$1,482		
Bonito			600	18		
Cod			425,333	12,193		
Flounders			329,764	11,626		
Haddock			128,416	5,137		
Hake			2,711	82		
King-fish			200	30		
Scup			600	12		
Sea-bass			262,100	15,866		
Spots	5,300	$318	15,100	578	4,750	$285
Total	5,300	318	1,200,434	47,024	4,750	285

Species.	Atlantic.		Cape May.		Monmouth.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Blue-fish	15,851	$831	22,500	$1,141			38,351	$1,972
Cod	784,530	23,554	221,434	6,649			1,005,964	30,203
Croakers	4,230	169	3,500	87			7,730	256
Flounders	4,727	258	6,840	292			11,567	550
Haddock	6,446	197	6,700	201			13,146	398
Hake	5,010	154	1,900	57			6,910	211
Ling			10,000	300			10,000	300
Scup	7,600	318	13,800	414			21,400	732
Sea bass	183,500	9,175	70,600	3,570			254,100	12,745
Sheepshead	360	19					360	19
Squeteague	14,200	852	8,000	450			22,200	1,302
Total	1,026,454	35,527	365,274	13,161			1,391,728	48,688
Shore fisheries:								
Alewives	5,100	26					5,100	26
Blue-fish	14,460	1,202	319,300	19,020	5,044,600	$201,784	5,413,970	223,488
Bonito					12,600	252	13,200	270
Cod	46,610	1,444	149,400	4,462	642,778	18,398	1,264,121	36,497
Croakers	69,595	1,460	71,067	2,167			140,662	3,627
Drum			8,140	553			8,140	553
Eels			600	36			600	36
Flounders	15,465	858	24,215	1,058	278,392	7,420	647,836	20,962
Haddock	400	14	7,230	218	75,666	2,270	211,712	7,639
Hake	700	24	4,500	140	9,900	240	17,811	486
King-fish	2,941	441	3,239	527			6,380	998
Ling			9,933	298	8,480	85	18,413	383
Scup	5,000	200	75,200	2,266	37,875	1,058	118,675	3,536
Sea bass	25,900	1,295	500,800	25,234	386,666	17,620	1,175,466	60,015
Sheepshead	3,000	540	3,925	346			6,925	886
Spots	3,400	68					3,400	68
Squeteague	514,566	16,910	92,615	3,329			632,331	21,420
Striped bass			150	16			150	16
Tautog	1,500	59	780	23	84,466	2,912	86,746	2,994
Whiting					2,900	58	2,900	58
Terrapin	400	200					400	200
Total	709,037	24,741	1,271,094	59,693	6,584,323	252,097	9,774,938	384,158
Grand total	1,735,491	60,268	1,636,368	72,854	6,584,323	252,097	11,166,666	432,846

Table showing, by counties, the yield of the bag-net fisheries of New Jersey in 1901.

Species.	Atlantic.		Burlington.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:						
Cat-fish	6,100	$305	7,000	$350	13,100	$655
Striped bass	36,000	7,200	43,100	8,620	79,100	15,820
White perch	88,100	3,524	99,500	4,975	187,600	8,499
Total	130,200	11,029	149,600	13,945	279,800	24,974

Table showing, by counties, the catch by dredges, tongs, rakes, etc., in New Jersey in 1901.

Species.	Atlantic.		Burlington.		Camden.		Cape May.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Clams, hard	86,024	$8,913	...	...	...	...	8,480	$893
Mussels	17,000	170	...	...	...	...	...	...
Oysters, market	146,286	17,685	...	...	578,200	$73,115	177,611	23,281
Oysters, seed	83,349	4,505	...	...	332,220	16,631	186,578	10,056
Total	332,659	31,273	...	...	910,420	89,746	372,669	34,230
Shore fisheries:								
Clams, hard	640,336	62,753	124,792	$16,380	...	...	691,904	66,332
Clams, surf	...	...	...	...	...	...	13,336	500
Mussels	37,000	370	320,000	320	...	...	600	60
Oysters, market	1,051,673	119,413	146,020	16,681	...	...	208,439	28,420
Oysters, seed	269,150	11,354	22,750	885	33,600	1,555	310,709	13,680
Total	1,998,159	193,890	613,562	34,266	33,600	1,555	1,224,988	108,992
Grand total	2,330,818	225,163	613,562	34,266	944,020	91,301	1,597,657	143,222

Species.	Cumberland.		Hudson.		Middlesex.		Monmouth.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Clams, hard	...	...	10,400	$1,625	24,598	$4,213	756,624	$117,980
Crabs, hard	...	...	6,000	180	...	...	426,770	12,805
Oysters, market	7,320,943	$958,703	...	...	...	...	301,700	38,780
Oysters, seed	5,282,690	296,431	...	...	...	...	179,956	10,312
Scallops	...	...	...	...	42,000	350	42,000	350
Total	12,603,633	1,255,134	16,400	1,805	66,598	4,563	1,707,050	180,227
Shore fisheries:								
Clams, hard	...	...	...	...	19,200	2,880	1,264,328	199,969
Clams, soft	...	...	3,500	263	...	...	788,130	48,659
Oysters, market	99,743	13,024	...	...	340,900	48,700	1,039,101	139,180
Oysters, seed	2,110,059	92,936	422,100	21,105	455,000	26,000	9,450	540
Oyster shells	...	...	...	...	...	...	144,000	32
Scallops	...	...	...	...	...	...	30,000	2,500
Total	2,209,802	105,960	425,600	21,368	815,100	77,580	3,275,009	390,880
Grand total	14,813,435	1,361,094	442,000	23,173	881,698	82,143	4,982,059	571,107

Species.	Ocean.		Salem.		Union.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Clams, hard	9,792	$1,267	...	...	...	...	895,918	$134,891
Crabs, hard	...	...	...	...	...	...	432,770	12,985
Mussels	...	...	...	...	...	...	17,000	170
Oysters, market	5,600	601	...	...	...	...	8,530,340	1,112,165
Oysters, seed	11,690	557	...	...	...	...	6,076,483	338,492
Scallops	...	...	...	...	...	...	84,000	700
Total	27,082	2,425	...	...	...	...	16,036,511	1,599,403
Shore fisheries:								
Clams, hard	609,592	69,748	...	...	...	...	3,350,152	418,062
Clams, soft	111,140	5,996	...	...	...	...	902,770	54,918
Clams, surf	...	...	...	...	...	...	13,336	500
Mussels	...	...	...	...	...	...	357,600	750
Oysters, market	3,230,129	219,184	...	...	...	...	6,116,005	584,602
Oysters, seed	270,571	12,541	7,700	$330	630,000	$31,500	4,541,089	212,426
Oyster shells	...	...	...	...	...	...	144,000	32
Scallops	...	...	...	...	...	...	30,000	2,500
Total	4,221,432	307,469	7,700	330	630,000	31,500	15,454,952	1,273,790
Grand total	4,248,514	309,894	7,700	330	630,000	31,500	31,491,463	2,873,193

Table showing the catch of eels and lobsters, by pots, in New Jersey in 1901.

Counties.	Vessel fisheries.		Shore fisheries.				Total.	
	Eels.		Eels.		Lobsters.			
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Bergen			37,500	$1,898			37,500	$1,898
Burlington			1,150	58			1,150	58
Cape May	7,100	$355	3,700	185			10,800	540
Hudson			17,100	1,205	22,000	$2,220	39,100	3,425
Middlesex			14,600	841			14,600	841
Monmouth	3,600	180	156,884	8,230	40,043	5,574	200,527	13,984
Ocean	45,300	2,265	545,300	27,181	3,900	546	594,500	29,992
Total	56,000	2,800	776,234	39,598	65,943	8,340	898,177	50,738

Table showing the catch by minor apparatus in New Jersey in 1901.

Species.	Atlantic.		Cape May.		Cumberland.		Hudson.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Eels	61,000	$3,050	59,200	$2,960				
Crabs, hard	3,767	283	1,600	80			2,000	$250
Crabs, soft	2,400	480	6,400	1,200			1,000	333
King crabs					51,000	$128		
Terrapin			7,832	2,935				
Turtle					1,800	162		
Total	67,167	3,813	75,032	7,175	52,800	290	3,000	583

Species.	Monmouth.		Ocean.		Salem.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Cat-fish					2,910	$154	2,910	$154
Eels	126,950	$6,347	8,100	$405			255,250	12,762
German carp					16,269	976	16,269	976
Tomcod	33,200	996					33,200	996
Crabs, hard	116,952	4,004	2,672	167			126,991	4,784
Crabs, soft	173,578	22,917	8,100	1,357			191,478	26,287
King crabs							51,000	128
Shrimp	210	140	390	195			600	335
Terrapin							7,832	2,935
Turtle			8,000	640	1,275	89	11,075	891
Total	450,890	34,404	27,262	2,764	20,454	1,219	696,605	50,248

THE MENHADEN INDUSTRY.

While the greater portion of the catch of menhaden is sold to the factories to be turned into oil and fertilizer, large quantities are also utilized by the line fishermen as bait. In 1901 one steamer, two gasoline vessels, and one sailing vessel spent much time during the fishing season in running menhaden from the fishing vessels to Seabright, Monmouth County, for the numerous colony of line fishermen located at that place. These are prepared as "chum" by the fishermen and used for attracting the blue-fish to the vicinity of their boats. At many places the line fishermen have gill nets which they use in catching their own menhaden bait.

In 1901 there were six factories for the preparation of oil and fertilizer in operation, viz: One at Keansburg, two at Belford, and one at Port Monmouth, in Monmouth County; one at Tuckerton, Ocean County, and one at Leesburg, Cumberland County. Part of the plant of the latter factory is at Bakersville, Atlantic County, but as most of the work is done at Leesburg it is all credited there.

Table showing the extent of the menhaden industry in New Jersey in 1901.

Items.	No.	Value.	Items.	No.	Value.
Factories	6	$124,000	Steam vessels fishing	4	$30,000
Cash capital		40,000	Tonnage	69	
Wages paid factory employees		22,825	Outfit		7,655
Persons in factories	147		Purse seines	4	2,500
Persons on vessels	139		Sail vessels fishing	6	6,800
Menhaden pressed	27,090,000	27,090	Tonnage	54	
Menhaden caught by vessels	38,108,615	51,810	Outfit		12,575
Tons of dry scrap prepared	1,131	52,046	Purse seines	6	2,700
Gallons of oil made	109,789	25,440	Sail vessels transporting	8	6,100
			Tonnage	107	
			Outfit		2,805

FISHERIES OF PENNSYLVANIA.

As Pennsylvania has no frontage on the ocean, its fishery interests are quite limited. With the exception of the small fleet of vessels engaged in line fishing in the ocean during the summer and in working planted oyster beds in Delaware Bay, the fisheries of the State within the scope of this report are confined to the Delaware and Susquehanna rivers. Several of the largest seine fisheries on the New Jersey side of the Delaware River are operated by Pennsylvania, however, while Pennsylvania capital controls a considerable part of the oyster industry of New Jersey and Delaware.

The three tables which follow show in detail the extent of the coast fisheries of Pennsylvania in 1901:

Table of persons employed.

How engaged.	No.
On vessels fishing	209
On vessels transporting	7
On boats in shore fisheries	1,532
Shoresmen	736
Total	2,484

Table of apparatus and capital.

Items.	No.	Value.	Items.	No.	Value.
Vessels fishing	25	$54,650	Apparatus—shore fisheries:		
Tonnage	452		Seines	120	$12,615
Outfit		21,740	Gill nets	228	13,193
Vessels transporting	2	4,500	Stop nets	16	905
Tonnage	67		Fyke nets	1,384	2,239
Outfit		2,100	Dip nets	252	570
Boats	526	30,583	Lines		269
Shore and accessory property		1,168,243	Eel pots	117	122
Cash capital		793,707	Fish baskets	122	1,686
Apparatus—vessel fisheries:					
Dredges	80	2,650	Total		2,110,162
Lines		390			

Table of products.

Species.	Lbs.	Value.	Species.	Lbs.	Value.
Alewives, fresh	801,925	$2,448	Shad	2,982,868	$124,328
Alewives, salted	334,000	6,960	Squeteague	3,600	115
Black bass	7,556	762	Striped bass	13,092	1,158
Blue-fish	1,345	67	Sturgeon	530	43
Cat-fish	193,199	10,163	Suckers	29,355	1,313
Croakers	6,231	141	Sun-fish	3,970	317
Eels	140,504	6,151	Wall-eyed pike	14,675	2,321
Flounders	22,411	709	Frogs	800	240
German carp	161,895	9,795	Oysters, market	[a] 282,352	35,517
Perch, white	3,465	206	Oysters, seed	[b] 302,638	14,232
Perch, yellow	1,225	62	Turtles	10,500	870
Salmon	1,397	202			
Scup	22,593	585	Total	6,029,538	251,491
Sea bass	687,412	32,791			

[a] 40,336 bushels. [b] 43,234 bushels.

THE FISHERIES BY COUNTIES.

Eight counties in the eastern part of Pennsylvania engage in the fisheries—Bucks, Delaware, Monroe, Northampton, Philadelphia, and Pike counties on the Delaware River, and Lancaster and York counties on the Susquehanna River. Nearly half of the total number of persons employed, over two-thirds of the total investment, and almost one-half of the catch are credited to Philadelphia County. This is largely owing to the wholesale trade of the city of Philadelphia and the vessel fishery for oysters from that city. The relative importance of the fisheries of each county in 1901 is exhibited in the three following tables:

Table showing the number of persons employed in the fisheries of Pennsylvania in 1901.

Counties.	On vessels fishing.	On vessels transporting.	In shore or boat fisheries.	Shoresmen.	Total.
Bucks			335	25	360
Delaware			160	26	186
Lancaster			437		437
Monroe			16		16
Northampton			59		59
Philadelphia	209	7	257	685	1,158
Pike			39		39
York			229		229
Total	209	7	1,532	736	2,484

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Pennsylvania in 1901.

Items.	Bucks.		Delaware.		Lancaster.		Monroe.		Northampton.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Boats	135	$5,291	72	$9,752	114	$2,385	5	$65	14	$210
Apparatus—shore fisheries:										
Seines	40	6,030	6	430	36	3,060	4	131	11	480
Gill nets	42	2,650	66	5,938	14	425				
Stop nets			6	430						
Fyke nets	45	45	100	98	215	296				
Dip nets			2	6	157	344				
Lines		10		15		124				4
Eel pots	55	42	62	80						
Fish baskets					80	1,128				
Shore and accessory property		59,945		10,069		2,380		413		297
Cash capital				12,099						
Total		74,013		38,917		10,142		609		991

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Pennsylvania in 1901—Continued.

Items.	Philadelphia.		Pike.		York.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	25	$54,650					25	$54,650
Tonnage	452						452	
Outfit		21,740						21,740
Vessels transporting	2	4,500					2	4,500
Tonnage	67						67	
Outfit		2,100						2,100
Boats	139	11,880	7	$110	40	$890	526	30,583
Apparatus—vessel fisheries:								
Dredges	80	2,650					80	2,650
Lines		390						390
Apparatus—shore fisheries:								
Seines	10	1,365	6	169	7	950	[a] 120	12,615
Gill nets	104	4,030			2	150	[b] 228	13,193
Stop nets	10	475					[c] 16	905
Fyke nets	924	1,675			100	125	1,384	2,239
Dip nets	13	60			80	160	252	570
Lines		40				76		269
Eel pots							117	122
Fish baskets					42	558	122	1,686
Shore and accessory property		1,093,621		1,000		518		1,168,243
Cash capital		781,608						793,707
Total		1,980,784		1,279		3,427		2,110,162

[a] 20,179 yards. [b] 88,440 yards. [c] 5,110 yards.

Table showing, by counties and species, the yield of the fisheries of Pennsylvania in 1901.

Species.	Bucks.		Delaware.		Lancaster.		Philadelphia.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	669,800	$1,696	102,500	$407			29,625	$345
Alewives, salted	334,000	6,960						
Black bass	156	21			6,000	$600		
Blue-fish							1,345	67
Cat-fish	7,195	360	7,750	427	60,950	3,502	93,054	4,654
Croakers							6,231	141
Eels	3,560	323	13,000	520	53,875	2,290	23,999	1,201
Flounders							22,411	709
German carp	23,885	1,551	67,025	4,205	11,150	556	54,350	3,211
Perch, white			3,100	188			365	18
Perch, yellow			1,150	59			75	3
Salmon	1,380	185					17	17
Scup							22,593	585
Sea bass							687,412	32,791
Shad	1,033,089	43,241	933,800	29,264	319,376	18,533	567,545	25,504
Squeteague							3,600	115
Striped bass	5,040	418	3,040	253	1,725	173	1,792	159
Sturgeon			530	43				
Suckers	12,050	569	2,625	92	3,200	156	6,955	295
Sun-fish	70	5			2,100	168		
Wall-eyed pike					8,850	1,442		
Frogs					100	30		
Oysters, market							282,352	35,517
Oysters, seed							302,638	14,232
Turtles	1,500	150	9,000	720				
Total	2,091,725	55,479	1,143,520	36,178	467,326	27,450	2,106,359	119,563

Species.	Monroe.		Northampton.		Pike.		York.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Black bass							1,400	$141
Cat-fish			350	$25			23,900	1,195
Eels			70	7			46,000	1,810
German carp			1,135	60			4,350	212
Shad	3,995	$357	17,800	1,275	17,300	$1,275	89,963	4,879
Striped bass							1,495	150
Suckers			1,900	122			2,625	79
Sun-fish							1,800	144
Wall-eyed pike							5,825	879
Frogs							700	210
Total	3,995	357	21,255	1,489	17,300	1,275	178,058	9,699

THE CATCH OF SHAD.

The following supplementary table shows the number of shad caught, and the value, in each county of Pennsylvania on the Delaware and Susquehanna rivers in 1901:

Counties.	No.	Value.
Bucks	230,187	$43,241
Delaware	217,000	29,264
Lancaster	78,679	18,533
Monroe	1,330	357
Northampton	5,100	1,275
Philadelphia	145,831	25,504
Pike	4,700	1,275
York	20,204	4,879
Total	703,031	124,328

THE FISHERIES BY APPARATUS.

Vessel fishing is carried on in Philadelphia County only, lines and oyster dredges being the apparatus of capture. The line fishery is prosecuted in the summer months, after the oyster season has closed, by a few of the oyster vessels. Pennsylvania has no waters suitable for the cultivation of oysters and is compelled to carry on the industry in other States, principally in Delaware, where Pennsylvanians have bought or leased large tracts of suitable ground.

Some of the oldest seine fisheries in the United States are to be found on the Delaware River. A few of the fishing shores at present in use were cleared and operated by the Indians long before the white man settled in the country. The seine fisheries are operated primarily for shad and alewives, though various other species are obtained in smaller quantities. Gill nets are also used extensively, and in 1901 the catch, consisting principally of shad, was greater in value than that taken in seines.

The following tables show the quantity and value of products in the vessel and shore fisheries by each form of apparatus:

Table showing the yield of the vessel fisheries of Pennsylvania in 1901.

Species and apparatus.	Philadelphia County.	
	Lbs.	Value.
Lines:		
Blue-fish	1,345	$67
Croakers	6,231	141
Flounders	22,411	709
Scup	22,593	585
Sea bass	687,412	32,791
Squeteague	3,600	115
Total	743,592	34,408
Dredges:		
Oysters, market	282,352	35,517
Oysters, seed	302,638	14,232
Total	584,990	49,749
Grand total	1,328,582	84,157

Table showing, by counties, the yield of the seine fisheries of Pennsylvania in 1901.

Species.	Bucks.		Delaware.		Lancaster.		Monroe.		Northampton.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	669,800	$1,696	80,000	$270						
Alewives, salted	334,000	6,960								
Cat-fish	4,075	204	1,600	64					100	$5
Eels			2,600	104					50	4
German carp	14,385	806	40,250	2,605	650	$31			1,135	60
Perch, white			3,000	180						
Perch, yellow			1,000	50						
Salmon	1,380	185								
Shad	595,389	25,766	1,600	48	245,200	13,906	3,995	$357	17,800	1,275
Striped bass	5,040	418	200	16						
Suckers	12,050	569							1,900	122
Total	1,636,119	36,604	130,250	3,337	245,850	13,937	3,995	357	20,985	1,466

Species.	Philadelphia.		Pike.		York.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	7,500	$100					757,300	$2,066
Alewives, salted							334,000	6,960
Cat-fish	11,370	569					17,145	842
Eels	434	22					3,084	130
German carp	24,550	1,473			4,350	$212	85,320	5,187
Perch, white	265	13					3,265	193
Perch, yellow	50	2					1,050	52
Salmon							1,380	185
Shad	19,697	838	17,300	$1,275	71,763	3,894	972,744	47,359
Striped bass	1,792	159					7,032	593
Suckers	5,480	231					19,430	922
Total	71,138	3,407	17,300	1,275	76,113	4,106	2,201,760	64,489

Table showing, by counties, the yield of the gill-net fisheries of Pennsylvania in 1901.

Species.	Bucks.		Delaware.		Lancaster.		Philadelphia		York.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives			22,500	$137			18,600	$198			41,100	$335
German carp	9,500	$745	2,800	244							12,300	989
Salmon							17	17			17	17
Shad	437,700	17,475	932,200	29,216	55,896	$3,494	547,248	24,636	10,200	$510	1,983,244	75,331
Striped bass			2,840	237							2,840	237
Sturgeon			530	43							530	43
Total	447,200	18,220	960,870	29,877	55,896	3,494	565,865	24,851	10,200	510	2,040,031	76,952

Table showing, by counties, the yield of the stop-net fisheries of Pennsylvania in 1901.

Species.	Delaware.		Philadelphia.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives			3,525	$47	3,525	$47
Cat-fish	1,050	$118	5,290	265	6,340	383
Eels			100	5	100	5
German carp	21,400	1,219	23,400	1,404	44,800	2,623
Perch, white			100	5	100	5
Perch, yellow			25	1	25	1
Shad			600	30	600	30
Suckers			975	39	975	39
Total	22,450	1,337	34,015	1,796	56,465	3,133

Table showing, by counties, the yield of the fyke-net fisheries of Pennsylvania in 1901.

Species.	Bucks.		Delaware.		Lancaster.		Philadelphia		York.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Black bass	.....	.....	.....	.....	1,500	$150	.....	.....	.....	.....	1,500	$150
Cat-fish	1,700	$85	4,050	$187	46,250	2,725	67,144	$3,357	20,000	$1,000	139,144	7,354
Eels	400	36	1,900	76	.....	.....	13,865	694	.....	.....	16,165	806
Striped bass	.....	.....	.....	.....	825	83	.....	.....	.....	.....	825	83
Suckers	.....	.....	.....	.....	3,000	150	200	10	.....	.....	3,200	160
Sun-fish	.....	.....	.....	.....	1,800	144	.....	.....	.....	.....	1,800	144
Wall-eyed pike	.....	.....	.....	.....	6,600	1,032	.....	.....	.....	.....	6,600	1,032
Total	2,100	121	5,950	263	59,975	4,284	81,209	4,061	20,000	1,000	169,234	9,729

Table showing, by counties, the yield of the dip-net fisheries of Pennsylvania in 1901.

Species.	Delaware.		Lancaster.		Philadelphia.		York.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Cat-fish	....	....	200	$12	2,800	$140	....	....	3,000	$152
Eels	....	....	2,000	80	....	....	....	....	2,000	80
German carp	2,575	$137	10,500	525	6,400	334	....	....	19,475	996
Shad	....	....	18,280	1,133	....	....	8,000	$475	26,280	1,608
Suckers	2,625	92	....	....	....	....	....	....	2,625	92
Total	5,200	229	30,980	1,750	9,200	474	8,000	475	53,380	2,928

Table showing, by counties, the yield of the line fisheries of Pennsylvania in 1901.

Species.	Bucks.		Delaware.		Lancaster.		Northampton.		Philadelphia.		York.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Black bass	156	$21	.....	.....	2,500	$250	.....	.....	.....	.....	1,400	$141	4,056	$412
Cat-fish	1,420	71	500	$30	500	25	250	$20	6,450	$323	2,900	145	12,020	614
Eels	1,160	102	2,000	80	3,500	185	20	3	9,600	480	2,400	96	18,680	946
Perch, white	.....	.....	100	8	.....	.....	.....	.....	.....	.....	.....	.....	100	8
Perch, yellow	.....	.....	150	9	.....	.....	.....	.....	.....	.....	.....	.....	150	9
Striped bass	.....	.....	.....	.....	900	90	.....	.....	.....	.....	1,495	150	2,395	240
Suckers	.....	.....	.....	.....	200	6	.....	.....	300	15	2,625	79	3,125	100
Sun-fish	70	5	.....	.....	300	24	.....	.....	.....	.....	1,800	144	2,170	173
Wall-eyed pike	.....	.....	.....	.....	2,000	360	.....	.....	.....	.....	5,825	879	7,825	1,239
Frogs	.....	.....	.....	.....	100	30	.....	.....	.....	.....	700	210	800	240
Turtles	1,500	150	9,000	720	.....	.....	.....	.....	.....	.....	.....	.....	10,500	870
Total	4,306	349	11,750	847	10,000	970	270	23	16,350	818	19,145	1,844	61,821	4,851

Table showing the yield of the fish-basket and pot fisheries of Pennsylvania in 1901.

Species.	Fish baskets.						Pots.					
	Lancaster.		York.		Total.		Bucks.		Delaware.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Black bass	2,000	$200	......	......	2,000	$200	......	......	......	......	......	......
Cat-fish	14,000	740	1,000	$50	15,000	790	......	......	550	$28	550	$28
Eels	48,375	2,025	43,600	1,714	91,975	3,739	2,000	$185	6,500	260	8,500	445
Wall-eyed pike	250	50	......	......	250	50	......	......	......	......	......	......
Total	64,625	3,015	44,600	1,764	109,225	4,779	2,000	185	7,050	288	9,050	473

THE WHOLESALE FISHERY TRADE OF PHILADELPHIA AND CHESTER.

There is a large wholesale trade in fresh, salted, and smoked fish, oysters, sponges, and other fishery products in Philadelphia, while a much smaller business is carried on in Chester. The following table shows the persons employed, wages paid, and capital invested in both cities:

Persons and capital in the wholesale fishery trade of Philadelphia and Chester in 1901.

Items	Philadelphia.		Chester.		Total.	
	No.	Value.	No.	Value.	No.	Value.
Establishments	95	$526,306	6	$7,584	101	$533,890
Cash capital	....	673,308	....	12,099	....	685,407
Wages paid	....	262,842	....	4,559	....	267,401
Persons engaged	535	....	26	....	561	....

THE SMOKING OF FISH IN PHILADELPHIA.

The smoking of fish is quite an important industry in Philadelphia, and a few of the establishments located there compare very favorably with the best in the country.

The following table shows the extent of this industry:

Items.	No.	Value.
Establishments	18	$148,530
Cash capital	....	56,400
Wages paid	....	49,176
Persons engaged	150	....

Products sold.	Lbs.	Value.
Eels	17,950	$2,693
Haddock	114,300	13,716
Herring	2,132,043	129,853
Lake herring (cisco)	302,050	36,246
Mackerel	300	45
Salmon	200,200	40,040
Shad	77,500	9,360
Sturgeon	68,750	24,063
Total products	2,913,093	256,016

FISHERIES OF DELAWARE.

Compared with 1897 the fisheries of Delaware in 1901 show a decrease in the number of persons employed and in the value of the product, the number of persons decreasing from 2,392 in 1897 to 1,998 in 1901, and the value of the product from $252,123 to $203,372 in the same period. The returns for 1897 differed little from those of 1892 and the three years immediately preceding.

More than half of the decrease occurred in the sturgeon fishery, the output of which in 1897 was valued at $34,750, and in 1901 at $10,444. This decrease occurred notwithstanding the fact that caviar and dressed sturgeon were much higher in price in the latter year, the caviar increasing from 37 to 65 cents per pound, and the dressed sturgeon from less than 5½ cents in 1897 to 8¼ cents per pound in 1901. In 1901 this fishery gave employment to 122 men, using 57 boats, worth $5,690, and 37,680 yards of drift gill nets, worth $5,190; the catch was 553 sturgeon, weighing 86,199 pounds, which yielded 10,307 pounds of caviar, worth $6,766, and 44,499 pounds of dressed sturgeon, worth $3,678. The sturgeon product of the State is now less than 7 per cent in quantity and 35 per cent in value of what it was ten years ago, notwithstanding an increase in the number of boats employed. At Delaware City, one of the principal centers of this fishery, there were 422 kegs of caviar produced in 1895, 244 in 1896, 106 in 1897, 54 in 1898, 35 in 1899, 20 in 1900, and only 6 in 1901.

The yield of shad also shows a large decrease in number, but from the point of view of the fisherman this is more than offset by an increase in the value, the fish averaging $11.09 per hundred in 1897 and $15.61 in 1901. More than 90 per cent of the shad in this State are taken by means of drift nets, which are operated principally in Delaware River, especially at Newcastle, Delaware City, and Port Penn, and to a small extent in the headwaters of Nanticoke River. In 1891 this fishery employed 397 men, using 201 boats worth $8,826, and 236 nets worth $16,833, and the catch of shad numbered 394,952. In 1901 the fishermen numbered 443, using 244 boats worth $13,726, and 285 nets worth $13,842, and the catch amounted to 329,750 in number. This represented an average for each man of 995 shad in 1891 and only 744 in 1901.

The oyster business, the most important fishery industry of the State, has changed little during the last ten years. As in other Middle Atlantic States, there is a steady decrease in the resources of the public reefs of Delaware, with a corresponding increase in private oyster culture. At the present time most of the market oysters obtained from the public reefs are scarcely more than large enough for planting purposes; but owing to local conditions and regulations they are sold in the markets of the adjacent towns.

The returns presented in the subjoined tables show only imperfectly the extent of the oyster resources of this State. Most of the oysters credited to Pennsylvania and a small percentage of those credited to New Jersey were taken from within the limits of the State of Delaware; but they have been credited to Pennsylvania and New Jersey, respectively, owing to the fact that they were taken by vessels owned in those States. During the year covered by the returns 15 non-resident vessels engaged in dredging oysters on the natural reefs, and 34 in cultivating oysters on the private areas in this State, whereas only 21 resident vessels engaged in this industry. The oyster fishery is centered at Bowers Beach and Little Creek in Kent County, but many oysters are tonged near the mouths of creeks in that county and also in Sussex County. At Seaford, Sussex County, about 125 persons are employed in the wholesale oyster trade, receiving supplies from Chesapeake Bay in Maryland.

The yield of alewives, perch, squeteague, and striped bass shows a decrease of about 50 per cent compared with 1897, while that of German carp, cat-fish, and eels shows an increase. These species are taken mostly by seines, gill nets, and fyke nets, and many eels are taken in pots. The fisheries are not centered in particular localities, but are well distributed throughout the State, except the squeteague, which is taken mostly below the mouth of Delaware River. The increase in the yield of German carp is especially noteworthy. Ten years ago very few were caught, but in 1897 111,300 pounds were reported, and in 1901 the catch amounted to 198,040 pounds.

While the lobster fishery of Delaware is of little economic importance, it is interesting on account of its representing the southernmost limit of that fishery on the Atlantic coast. It is prosecuted at Lewes, in Sussex County, and the lobsters are taken in pots set in the vicinity of Delaware breakwater. In common with that on other parts of the coast, the yield of lobsters in Delaware shows a gradual decrease. In 1891 the catch was 8,200 pounds, in 1897 it was 5,095 pounds, and in 1901 it was further reduced to 2,760 pounds.

The factory at Lewes, Del., receives large quantities of menhaden for conversion into oil and fertilizer. These fish, however, are credited as part of the product of the fisheries of New York, owing to the fact that the vessels taking them are owned in that State. In 1901 46,260 tons of menhaden were converted into $325,982 worth of oil and fertilizer. With the exception of Virginia this was a greater quantity of menhaden than was utilized in any other State, and represented one-sixth of the total product of menhaden in the United States.

The extent of the fisheries of Delaware in 1901 is shown in the following tables.

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Delaware in 1901.

Items.	Kent.		Newcastle.		Sussex.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	20	$15,550			1	$350	21	$15,900
Tonnage	147				5		152	
Outfit		1,691				51		1,742
Vessels transporting	2	2,200	1	$750	3	1,350	6	4,300
Tonnage	20		21		44		85	
Outfit		105		80		320		505
Boats	318	9,813	201	14,532	391	5,556	910	29,901
Apparatus—vessel fisheries:								
Dredges	55	1,360			2	60	57	1,420
Apparatus—shore fisheries:								
Pound nets	3	600	4	160			7	760
Seines (total length 28,795 yards)	44	3,226	24	1,407	124	4,458	192	9,091
Drift nets—								
Shad (total length, 138,055 yards)	62	1,862	115	10,822	108	1,158	285	13,842
Sturgeon (total length, 37,680 yards)	23	2,200	23	1,360	29	1,630	75	5,190
Miscellaneous (total length, 17,880 yards)	11	1,365	4	240	1	15	16	1,620
Stake gill nets (total length, 15,890 yards)	79	611			236	1,080	315	1,691
Fyke nets	108	132	275	392	165	375	548	899
Eel pots	40	14	90	60	1,130	332	1,260	406
Eel spears					26	12	26	12
Lobster pots					60	60	60	60
Lines		5		30		21		56
Bow nets	8	24			4	8	12	32
Dredges	4	75					4	75
Tongs	118	703			38	180	156	883
Rakes	2	4			24	48	26	52
Other apparatus		45				29		74
Shore and accessory property		12,100		21,500		318,486		352,086
Cash capital		1,600		4,000		211,000		216,600
Total		55,285		55,333		546,579		657,197

Table showing, by counties and species, the yield of the fisheries of Delaware in 1901.

Species.	Kent.		Newcastle.		Sussex.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	8,200	$143	289,070	$1,173	300,104	$3,500	597,374	$4,816
Blue-fish					400	20	400	20
Carp, German	43,700	2,485	154,340	7,267			198,040	9,752
Cat-fish	27,200	1,365	88,000	3,126	15,080	584	130,280	5,075
Cod					1,250	50	1,250	50
Croakers	12,800	175			15,930	490	28,730	665
Drum	3,200	56					3,200	56
Eels	7,850	401	95,500	3,570	127,300	5,156	230,650	9,127
Flounders					5,500	226	5,500	226
Mullet					5,350	180	5,350	180
Perch	64,430	4,247	7,600	276	170,330	6,834	242,360	11,357
Pike	2,460	130			13,850	524	16,310	654
Sea bass					500	25	500	25
Shad	145,920	6,299	1,012,332	40,100	209,700	10,206	1,367,952	56,605
Squeteague	371,995	5,787	500	10	349,940	8,118	722,435	13,915
Striped bass	17,295	2,086	3,450	347	26,850	2,681	47,595	5,114
Sturgeon	24,484	1,185	42,608	2,027	8,800	466	75,892	3,678
Caviar	4,797	3,183	3,350	2,121	2,160	1,462	10,307	6,766
Suckers	2,500	101					2,500	101
Sun-fish					200	2	200	2
Tautog					3,600	180	3,600	180
Crabs, soft					150,509	5,587	a 150,509	5,587
King crabs	720,400	2,380					720,400	2,380
Lobsters					2,760	294	2,760	294
Oysters—								
Market, public reefs	344,939	18,989			232,785	9,710	b 577,724	28,699
Market, private areas	94,976	10,966			5,600	625	c 100,576	11,591
Seed, public reefs	529,480	22,108			4,550	210	d 534,030	22,318
Clams	640	90			7,560	1,113	e 8,200	1,203
Turtles	7,150	378	32,400	1,500	10,500	567	50,050	2,445
Terrapin	30	15	30	22	452	454	512	491
Total	2,434,446	82,569	1,729,180	61,539	1,671,560	59,264	5,835,186	203,372

a 451,527 in number.
b 82,532 bushels.
c 14,368 bushels.
d 76,290 bushels.
e 1,025 bushels.

Table showing, by counties, the number of persons employed in the fisheries of Delaware in 1901.

Items.	Kent.	Newcastle.	Sussex.	Total.
On vessels fishing	72	....	2	74
On vessels transporting	3	2	8	13
On boats, in shore fisheries	458	352	668	1,478
Shoresmen	16	40	377	433
Total	549	394	1,055	1,998

Table showing, by counties, the yield of the vessel fisheries of Delaware in 1901.

Apparatus and species.	Kent.		Sussex.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Dredges:						
Oysters, market, from private areas	86,275	$9,980	5,600	$625	91,875	$10,605
Oysters, seed, from public reefs	240,450	11,323	4,550	210	245,000	11,533
Total	326,725	21,303	10,150	835	336,875	22,138

Table showing, by counties and apparatus of capture, the yield of the shore fisheries of Delaware in 1901.

Apparatus and species.	Kent.		Newcastle.		Sussex.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Gill nets:								
Alewives	....	....	44,670	$396	16,820	$181	61,490	$577
Cat-fish	14,400	$720	....	....	1,200	53	15,600	773
Croakers	700	28	....	....	500	9	1,200	37
Drum	1,200	20	....	....	....	....	1,200	20
Flounders	....	....	....	....	4,150	166	4,150	166
Perch, white	41,780	3,012	....	....	39,950	1,678	81,730	4,690
Pike	2,300	122	....	....	4,000	160	6,300	282
Shad	127,080	5,356	1,010,012	40,003	99,471	4,982	1,236,563	50,341
Squeteague	800	16	....	....	28,500	340	29,300	356
Striped bass	8,720	1,196	....	....	7,350	713	16,070	1,909
Sturgeon	24,484	1,185	42,608	2,027	8,800	466	75,892	3,678
Caviar	4,797	3,183	3,350	2,121	2,160	1,462	10,307	6,766
Suckers	2,500	101	....	....	....	....	2,500	101
Total	228,761	14,939	1,100,640	44,547	212,901	10,210	1,542,302	69,696
Pound nets:								
Carp, German	30,000	1,800	1,000	50	....	....	31,000	1,850
Cat-fish	....	....	2,400	120	....	....	2,400	120
Perch, white	....	....	200	12	....	....	200	12
Squeteague	....	....	500	10	....	....	500	10
Striped bass	....	....	1,100	110	....	....	1,100	110
Terrapin	....	....	30	22	....	....	30	22
Total	30,000	1,800	5,230	324	....	....	35,230	2,124
Seines:								
Alewives	8,200	143	244,400	777	269,284	3,159	521,884	4,079
Carp, German	11,200	560	126,840	5,892	....	....	138,040	6,452
Cat-fish	500	20	49,800	1,660	13,880	531	64,180	2,211
Croakers	12,100	147	....	....	12,230	339	24,330	486
Drum	2,000	36	....	....	....	....	2,000	36
Eels	....	....	500	20	6,300	272	6,800	292
Flounders	....	....	....	....	1,350	60	1,350	60
Mullet	....	....	....	....	5,350	180	5,350	180
Perch, white	21,650	1,185	6,600	240	112,860	4,442	141,110	5,867
Pike	....	....	....	....	8,350	289	8,350	289
Shad	15,960	799	2,320	97	109,029	5,164	127,309	6,060
Squeteague	320,895	4,541	....	....	296,740	6,910	617,635	11,451
Striped bass	8,575	890	2,350	237	19,500	1,968	30,425	3,095
Sun-fish	....	....	....	....	200	2	200	2
Terrapin	30	15	....	....	210	108	240	123
Turtles	....	....	1,000	50	....	....	1,000	50
Total	401,110	8,336	433,810	8,973	855,283	23,424	1,690,203	40,733

Table showing, by counties and apparatus of capture, the yield of the shore fisheries of Delaware in 1901—Continued.

Apparatus and species.	Kent.		Newcastle.		Sussex.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Fyke nets:								
Alewives					14,000	$160	14,000	$160
Carp, German			26,500	$1,325			26,500	1,325
Cat-fish	10,900	$555	35,800	1,346			46,700	1,901
Eels	4,000	170	66,500	2,630	600	24	71,100	2,824
Perch	400	20	800	24	17,520	714	18,720	758
Pike	160	8					160	8
Turtles	7,150	378			9,550	520	16,700	898
Total	22,610	1,131	129,600	5,325	41,670	1,418	193,880	7,874
Lines:								
Blue-fish					400	20	400	20
Cod					1,250	50	1,250	50
Croakers					3,200	142	3,200	142
Pike					1,500	75	1,500	75
Sea bass					500	25	500	25
Squeteague	50,300	1,230			24,700	868	75,000	2,098
Tautog					3,600	180	3,600	180
Turtles			31,400	1,450	950	47	32,350	1,497
Total	50,300	1,230	31,400	1,450	36,100	1,407	117,800	4,087
Pots:								
Eels	3,850	231	28,500	920	97,900	3,930	130,250	5,081
Lobsters					2,760	294	2,760	294
Total	3,850	231	28,500	920	100,660	4,224	133,010	5,375
Spears:								
Eels					22,500	930	22,500	930
Minor nets								
Carp, German	2,500	125					2,500	125
Cat-fish	1,400	70					1,400	70
Perch	600	30					600	30
Shad	2,880	144			1,200	60	4,080	204
Crabs, soft					150,509	5,587	150,509	5,587
Total	7,380	369			151,709	5,647	159,089	6,016
Dredges, tongs, etc.:								
Oysters, market, from public areas	344,939	18,989			232,785	9,710	577,724	28,699
Oysters, market, from private areas	8,701	986					8,701	986
Oysters, seed, from public areas	289,030	10,785					289,030	10,785
Clams	640	90			7,560	1,113	8,200	1,203
Total	643,310	30,850			240,345	10,823	883,655	41,673
Other apparatus:								
King crabs	720,400	2,380					720,400	2,380
Terrapin					242	346	242	346
Total	720,400	2,380			242	346	720,642	2,726
Grand total	2,107,721	61,266	1,729,180	61,539	1,661,410	58,429	5,498,311	181,234

The menhaden industry.

Items.	No.	Value.
Factories	1	$300,000
Cash capital		200,000
Persons in factories	250	
Menhaden utilized	154,200,670	231,301
Tons of dried scrap	3,314	69,598
Tons of acidulated scrap	11,392	120,273
Gallons of oil made	582,584	136,111

FISHERIES OF MARYLAND.

In 1901 the fishery products of Maryland show a small increase in value over 1897, at which time the State ranked first among the Middle Atlantic States in the value of its fisheries. Notwithstanding this increase, the State is now surpassed in the value of fishery products by New Jersey, Virginia, and New York. The value of Maryland's fishery resources depends largely upon the oyster, the yield being worth more than four times as much as that of all other products combined. The greater part of the capital in this fishery is invested at Baltimore in oyster canneries, shucking houses, and dredging and transporting vessels.

Though the oyster season of 1900-1901, compared with 1897-98, shows a decided decrease in the number of bushels taken, there has been an increase in the value of the catch. The best catches by dredging vessels were from grounds in the upper part of Chesapeake Bay, and being near Baltimore were sold direct to dealers there instead of to transporting vessels.

The diminished supply of oysters on natural beds in some localities has induced many oystermen to engage in planting on private beds. The benefits of oyster-planting are already apparent, and the future promises greater success, provided more ample protective laws are enacted. It is difficult, however, to pass laws that would suit both oystermen and crabbers in Dorchester and Somerset counties, as the crabbers object to crabbing grounds being taken for oyster-planting purposes. Maryland oyster planters have also suffered considerably through a law passed by the State of Virginia prohibiting the shipment of seed oysters from that State, thus cutting off a prolific source of supply. Before this law went into effect Maryland planters could obtain their seed oysters from Virginia at an average cost of 15 cents a bushel, while now the prices range from 20 to 40 cents. The principal sources of supply of seed oysters are the Potomac, Little Choptank, Choptank, and Honga rivers, and Eastern Bay. The most important planting grounds are in Fishing Bay, Pocomoke Sound, Chincoteague Bay, and the Nanticoke and Wicomico rivers. The planters in these waters are assured of a considerable degree of safety, as the crabbing industry is practically of no importance there.

The following extract from an editorial in the *Baltimore Sun* of April 20, 1903, may be of interest as showing the attitude of those who advocate more extensive oyster planting:

Oyster planting.—A dispatch to *The Sun* from Prince Frederick says that many tongers in Calvert County have taken up lots for planting oysters. This is gratifying intelligence and indicates that the oystermen are beginning to awaken to the situation. There has been much complaint lately of seed oysters being taken from the State. It is to be hoped that a great number of lots will be staked off before the supply of seed oysters is exhausted. Then the oyster planters will have to go to the legislature for the enactment of a law which will protect them from marauders who come by night and carry off their property, as well as those who despoil them by legal process. The present law under which these lots are staked off and planted affords no manner of protection to the industrious planter. Planting on natural beds is prohibited, and the common practice is for persons interested to wait until the oysters in a private lot are marketable, and then they go into court and prove that at some time long past the lot staked off was a natural bed. This is easy to do, as in past years nearly the whole bottom of the coves and creeks where oysters will grow had oysters on them. After this proof is submitted the court orders the lot to be vacated, and then outsiders carry off the oysters which have been planted. This has gone on so regularly and persistently that it is surprising to hear that men will take the risks. If all or a large majority of those interested in the oyster industry in a locality become planters, then all will be equally interested in protecting the beds. Then the oystermen will, perhaps, cease their opposition to the enactment of a law which will protect planters in their rights. * * *

While Maryland is neglecting her opportunities and frittering away a vast mine of wealth, other States, by enlightened legislation, are growing rich from oyster bottoms greatly inferior to ours. Not only is a great food supply disappearing, but people are losing a profitable employment and oyster canneries are moving from the State to other States where a supply of oysters can be procured.

As a rule, oysters are marketed as soon as caught, but at Solomons, Calvert County, and vicinity the oystermen bed their catch and let it remain down for a better market. This insures an increased price, the oysters having a chance to fatten. This is especially advantageous during the early part of the season, when the oysters are rather poor and the demand for them light.

With the exception of Baltimore the most important oyster centers in the State are Cambridge and Crisfield, the number of men and boats engaged in the fishery from these towns being very much greater than from Baltimore. Deal Island, Oxford, Tilghman Island, and St. Michael also have large investments in this fishery.

Clams.—Clams are of commercial importance in only two counties, Somerset and Worcester. In the former they are taken in Pocomoke Sound by fishermen from Crisfield and vicinity. In 1901, however, a few men from Fairmount fished for clams to a limited extent in Tangier Sound. In Worcester County the entire catch is taken from Chincoteague and Sinepuxent bays.

Crabs.—The crab fishery is next in commercial importance to the oyster, though the investment in boats, apparatus, and shore property is small compared with that in the oyster fishery, and practically no revenue is derived from it by the State, as no license of any kind is required, except in Dorchester County, where a fee of $2.50 is charged for the privilege of scraping. No restrictions as to seasons or size of crabs are imposed. There has been a noticeable increase in this fishery since 1897, and the outlook for the industry appears bright, though the catch in most localities in 1902 was small. The demand for both live crabs and crab meat is constantly growing, and the number of factories engaged in the preparation of crab meat is increasing. It is not unlikely that in the near future there will be a demand for crabs during the winter as well as in the summer.

Practically the entire catch of soft crabs is taken in scrapes and scoop nets, though a few are caught in small seines of from 40 to 50 yards in length, which are handled by two men. The seines are used interchangeably with scoop nets, the latter being used on low tides and the former on high tides or when the water is too thick to see the crabs.

With the exception of a few hard crabs taken in scrapes with soft crabs and in dredges during the oyster season, the catch is taken on trot lines. These lines vary in length from 200 to 1,000 yards, and are baited principally with beef tripe and eels. As the transportation companies object to handling tripe, it is being superseded by eels.

Though the crab industry is of greatest importance on the eastern shore of the State, quite a number are caught on the western shore, and in 1902 increased catches were taken in Anne Arundel County and in the vicinity of Solomons Island, Calvert County. The preceding cold winter seemingly did not affect the supply in these counties, and with the decreased catch on the eastern shore and advanced prices many residents of the western shore were encouraged to engage in the fishery.

Shad.—This is the most important species of fish taken in the waters of the State and, together with alewives, is the incentive for a great many men to engage in fishing. This is especially applicable to the gill-net fishermen, who set their nets as soon as the run of shad begins in the spring and fish until the close of the season, when the nets are laid aside and other occupations are followed until the next spring. Although the investment is small, the shad fishery sometimes proves quite remunerative to a large number of men. With the exception of Betterton and vicinity, where the catch of shad in gill nets was exceptionally heavy, this species shows a falling off of nearly 50 per cent in 1901 compared with 1897. It is probable, however, that the decline is only temporary, and is attributed by many fishermen to the late and cold spring, the low temperature of the water in the rivers tending to prevent the shad entering for the purpose of spawning. While the catch was small, the fishermen were compensated to a large degree by advanced prices. Shad are taken principally in gill nets, pound nets, seines, and bow nets, five-sixths of the total yield of the State being from the gill-net and pound-net fisheries.

Alewives.—Alewives are next in importance to shad and are taken during the same season. Practically the entire catch is secured in pound nets and seines, though in some localities many are also caught in gill nets. Like the shad, and for similar reasons, they show a decrease in 1901 as compared with 1897.

Menhaden.—The increase in this species over 1897 is due to the fact that during that year the factory at Crisfield purchased its supply from Virginia vessels, while in 1901 it employed its own steamer and bought only a small proportion from vessels outside of the State.

Striped bass and white perch.—Striped bass is one of the best selling species taken in the State. Very little change has taken place in its abundance, though it was a more special object of capture in 1901 than in 1897, an increased number of purse-seiners fishing for this species and incidentally for white perch. There has been a noticeable decline in the catch of white perch since 1897.

German carp.—While this species is not of great importance compared with many others, there has been a large increase in the catch, especially in Harford, Kent, Calvert, Cecil, Charles, and Prince George counties. One small pound net set in the Patuxent River, off Calvert County, caught 10,000 pounds of carp during the fall of 1901, which were sold at an average price of 4 cents a pound.

Gar pike.—This species is not of great importance in any one locality, but in the aggregate quite a number are caught in pound nets and shad gill nets. They are sold principally to colored people for a few cents a piece and it is not uncommon at some places to see several colored people awaiting the return of fishermen to buy their gar pike.

Terrapin.—This fishery has decreased in value within the past ten years from $22,333 in 1891 to $1,139 in 1901, and it is now followed in but few localities as a business, most of the catch being taken incidentally by men engaged in other pursuits. If this decline continues it will be only a few years when the terrapin will be practically extinct in the State.

Other species.—Other important species are squeteague, cat-fish, butter-fish, sturgeon, and eels, all except squeteague and butter-fish showing a decrease since 1897. The increase in these two species is chiefly due to the extension of the pound-net fisheries in the Atlantic Ocean off Worcester County.

Apparatus.—Taking the value of the catch as a basis, the most important kinds of apparatus of capture are tongs and nippers, dredges, pound nets (including trap nets and weirs), seines, crab scrapes, lines, gill nets, scoop nets, and fyke nets, in the order named. The catch by these kinds of apparatus ranged from $1,873,905 worth taken by tongs and nippers to $24,211 worth in fyke nets. Minor forms of apparatus were used, but their catches were small.

With the exception of $14,384 worth of clams and $99 worth of terrapin, the catch by tongs and nippers consisted of oysters. Two kinds of tongs are used, the ordinary shaft tongs and the patent tongs, the former being in much more general use. The employment of patent tongs is confined almost exclusively to Kent, Calvert, and St. Mary counties, their use being general in the two latter counties near the mouth of the Patuxent River, where they are especially advantageous owing to the depth of water being too great in most places for shaft tongs. The shafts of the latter vary in length in different parts of the State from 16 to 35 feet, an average being about 18 feet. The use of winding gear for operating patent tongs makes necessary the employment of larger boats than for shaft tonging, these larger boats being generally used later in the season for dredging.

Pound nets are fished principally in the spring for shad and alewives, but very often they are set in rivers in the fall for striped bass.

Two kinds of seines are used, haul and purse seines. The former are used principally for alewives, striped bass, shad, white perch, and other fishes, while menhaden, striped bass, and white perch are the most important species taken by the latter. Haul seines are usually fished in the spring, but often in the fall also. Purse seining for striped bass and white perch is carried on during the summer. Haul seines are in most cases fished in the rivers, an average crew consisting of from four to six men, except on the Potomac and Susquehanna rivers, where longer seines are used. The longest seine used on the Maryland side of the Potomac River in 1901 was 1,600 yards, 22 men being necessary to handle it and look after the catch. The longest seine used in the State was on the Susquehanna River in Cecil County. Its length was 2,200 yards, and there were 65 men in the crew. Purse seines are fished in the open waters of Chesapeake Bay for menhaden, striped bass, and white perch. Almost the entire menhaden catch of the State was taken by the steamer already mentioned as being owned at Crisfield. Purse seining for striped bass and white perch is confined exclusively to fishermen from Kent County, Rock Hall being the center of the fishery. Vessels of about 5 net tons and over are used. The crew usually consists of seven men, and a trip varies in length from one to two weeks, according to the abundance of fish. This fishery, while not new, has been prosecuted more vigorously during recent years than formerly and has proved quite profitable, notwithstanding the large outlay and heavy running expenses. The crew, as a rule, work on shares.

Two kinds of lines are used, the trot line for hard crabs and catfish, and the hand line for sea bass, squeteague, and various other species. The same kind of line is used for crabs as for cat-fish, except that no hooks are needed for the former. Crabs constitute over 90 per cent of the entire line catch.

The preponderance of shad over other species taken in gill nets is so great that this apparatus may be said to be used primarily for that species. In Kent County, however, large catches of striped bass and white perch are made in sunken gill nets set during the winter and early spring before the run of shad has begun. As soon as that species appears the anchors (usually bags of sand) are removed from the nets and the latter allowed to drift. The drift gill net is the most important style of gill net used, though quite a number of shad are also taken in stake gill nets. Drift gill nets vary in length from 50 yards set in the rivers to 2,200 yards set in Chesapeake Bay. The longest are used in the bay off Betterton, Kent County. An average of those used at this place is about 1,400 yards. Nets of this length consist of sections of from 200 to 300 yards each, fastened together while fishing. As the nets are set about 3 feet under water it is very seldom necessary to make any provision for the passage of vessels, as most of the latter can go over the nets without injuring them. Occasionally, however, in the case of larger vessels or steamers, it is necessary to separate the net to allow them to pass. Another advantage in setting the nets under water is to prevent them catching logs or driftwood. In fishing one man can handle a net from 50 to 100 yards long, while it takes two men for a net varying in length up to 1,000 yards, or two of the shorter ones. Three men are commonly engaged in handling the longest nets used in the bay. In some localities drift gill nets are fished exclusively in the daytime, while in others they are fished during the day in the early part of the season when the water is muddy, and, later, when the water becomes clear, they are fished at night, the men usually going out about midnight and remaining until noon the next day. The nets are then spread out and dried before using them again.

A comparatively new and profitable style of net, called "buck net," is used in a few localities. These are from 225 to 400 yards in length, from 25 to 40 feet deep, and are fished in the open waters of Chesapeake Bay, the catch consisting principally of blue-fish and occasionally a few Spanish mackerel. The net is hauled around a school of fish, the latter gilling in it. A crew of about five men is required in handling a net of this kind.

Owing to the almost complete disappearance of sturgeon in the rivers of the State, very few sturgeon gill nets are used; but in Worcester County an increase in the catch of this species is shown, due to an extension of the fishery by fishermen from New Jersey.

Men.—The total number of persons engaged in the fisheries of Maryland in 1901 was 36,260. Of this number, 16,880 are credited to the shore fishery; 12,553 were engaged in oyster shucking and packing houses, crab houses, and other occupations incidental to the fisheries; 5,715 were engaged on fishing vessels, and 1,112 on transporting vessels. One hundred and ten men were engaged both in the shore and vessel fisheries. There has been a decrease of 6,552 since 1897 in the total number of persons engaged in the State, this being due principally to the decline in the oyster fishery.

Investment.—The total investment in the fisheries was $6,506,066. Of this, $2,297,515 represents the cash capital employed; $2,164,749, the amount invested in shore and accessory property; $1,137,362, the value of 955 fishing and 382 transporting vessels with their outfits; $553,526, the value of 11,498 boats under 5 tons. The remainder represents the value of the apparatus used.

In the following tables is shown, first, the number of persons engaged in the fisheries; second, the vessels, boats, and apparatus used and the value of the shore and accessory property and cash capital employed; third, the quantity and value of fishery products taken in the State during 1901, the statistics on oysters, however, being for the season of 1900-1901.

Persons employed.

How engaged.	No.
On vessels fishing	5,715
On vessels transporting	1,112
In shore or boat fisheries	16,880
Shoresmen	12,553
Total	36,260

Table of apparatus and capital.

Items.	No.	Value.	Items.	No.	Value.
Vessels fishing	955	$512,955	*Apparatus—shore fisheries:*		
Tonnage	10,811		Seines	[b] 312	$28,648
Outfit		193,089	Gill nets	[c] 3,653	34,660
Vessels transporting	382	374,200	Pound nets	997	98,765
Tonnage	9,256		Trap nets and weirs	20	500
Outfit		57,118	Fyke nets	4,064	11,372
Boats	11,498	553,526	Trammel nets	[d] 18	1,570
Shore and accessory property		2,164,749	Bow nets	106	529
Cash capital		2,297,515	Minor nets	2,144	837
			Lines		4,722
Apparatus—vessel fisheries:			Eel pots	3,149	1,678
Oyster dredges	3,570	51,730	Spears	25	33
Crab scrapes	178	607	Oyster dredges	2,183	20,576
Tongs	54	512	Crab scrapes	2,653	9,640
Seines	[a] 6	1,385	Tongs and nippers	13,959	84,580
Eel pots	1,240	570	Total		6,506,066

[a] Total length, 1,445 yards.
[b] Total length, 60,640 yards.
[c] Total length, 348,061 yards.
[d] Total length, 7,520 yards.

Table of products.

Species.	Lbs.	Value.	Species.	Lbs.	Value.
Alewives, fresh	13,454,757	$87,021	Scup	32,650	$1,019
Alewives, salted	292,400	4,287	Sea bass	50,800	2,540
Black bass	23,383	2,124	Shad, fresh	3,094,181	120,177
Blue-fish	100,145	4,378	Shad, salted	17,000	425
Bonito	250	10	Sheepshead	1,350	62
Butter-fish	458,700	11,505	Spanish mackerel	2,922	348
Carp	163,180	5,319	Spot	22,470	387
Cat-fish	488,777	15,547	Squeteague	1,018,775	26,921
Cero	500	10	Striped bass	824,418	68,568
Croakers	303,405	4,239	Sturgeon	107,620	3,503
Drum	53,450	570	Caviar	5,818	3,486
Eels, fresh	334,811	12,309	Suckers	14,750	281
Eels, salted	2,200	60	Sun-fish	3,970	72
Flounders	51,205	1,625	Other fish	2,300	143
Gizzard shad	6,010	133	Crabs, hard	[a] 9,824,793	85,884
Harvest-fish	12,800	110	Crabs, soft	[b] 4,303,582	202,563
Hickory shad	8,315	209	Shrimp	728	708
King-fish	7,215	955	*Oysters, natural rock*	[c] 36,298,717	2,732,274
Mackerel	1,800	180	Oysters, private beds	[d] 3,500,210	299,244
Menhaden	7,122,230	11,573	Clams	[e] 107,600	14,384
Mullet	35,295	900	Turtles	4,835	203
Perch, white	452,815	25,005	Terrapin	1,593	1,139
Perch, yellow	292,720	9,617	Frogs	130	60
Pike	67,530	5,390			
Pompano	140	14	Total	82,975,245	3,767,461

[a] 29,474,379 in number.
[b] 12,910,746 in number.
[c] 5,185,531 bushels.
[d] 500,030 bushels.
[e] 13,450 bushels.

Several fishery products shown in the preceding table in pounds, for convenience of comparison, are presented in the following table in number and bushels, as usually marketed:

Products.	Quantity.	Value.
Crabs, hard .... number..	29,474,379	$85,884
Crabs, soft .... do....	12,910,746	202,563
Oysters, natural rock .... bushels..	5,185,531	2,732,274
Oysters, private beds .... do....	500,030	299,244
Clams .... do....	13,450	14,384

THE FISHERIES BY COUNTIES.

While the fisheries are prosecuted on both the eastern and western shores of the State, by far the larger catches are made in the former section, this being particularly true in the case of oysters and crabs. Somerset and Dorchester counties possess the most valuable fishery resources in the State, this preeminence being due to oysters and crabs. Dorchester leads slightly in the catch of oysters, but Somerset's valuable crab fishery more than offsets this advantage, three-fourths of the State's soft-crab catch being taken in this county. Practically all of these are handled at Crisfield and Deal Island and shipped from these points to the large cities throughout the United States and Canada. Talbot County leads in the catch of hard crabs, the principal part of the catch being used in factories, where the meat is extracted and shipped in tin buckets. Most of these factories are located at Oxford, St. Michaels, and vicinity, and Tilghmans Island. Large quantities of hard crabs are also taken at Cambridge, Dorchester County, and Mount Vernon, Somerset County, practically all of these being shipped alive. The fisheries proper are prosecuted to the greatest extent in Worcester County. This is the only county bordering on the Atlantic Ocean, and most of the fishing is now done by means of pound nets, which, since 1897, have increased from 1 to 7 in number. Talbot ranks next to Worcester County in its pound net fishery, the principal catches being made in the Choptank River and in Chesapeake Bay off Tilghman Island. Squeteague is the most important species taken in Worcester, and shad and alewives in Talbot County.

Increased values are shown in 1901 compared with 1897 in the fisheries of Anne Arundel, Calvert, Charles, Kent, Queen Anne, Somerset, and Wicomico counties, while decreases are shown for the other fishery counties, especially in Caroline County, where a decline from $22,012 in 1897 to $5,787 in 1901 has taken place. This is due almost entirely to the decrease in shad. With the exception of Charles County, the counties showing increased values owe it to the better prices received for oysters. A decided improvement is shown in the crab fishery in every county except Kent and Queen Anne. This compensated to a degree for the poor showing made in some of the other fisheries, particularly the shad and alewife. Harford and Worcester counties are the only counties showing an increase in shad. The former county represents a natural increase, while in Worcester County it was due to more extensive fishing. On the basis of persons employed, the most important counties are Baltimore (including Baltimore city), Somerset, and Dorchester, where 9,642, 6,340, and 5,229 persons, respectively, were engaged. Baltimore's lead over the other counties is due entirely to its wholesale oyster trade. The extensive haul-seine fisheries formerly prosecuted in Cecil County are being superseded by pound nets, the advantages of the latter being reduction of first cost and economy of operation. Baltimore and Kent counties have the most important fyke-net fisheries.

The three following tables show the extent of the fisheries in each county of Maryland in 1897:

Table showing the number of persons employed in the fisheries of Maryland in 1901.

Counties.	On vessels fishing.	On vessels transporting.	In shore or boat fisheries.	Shoresmen.	Total.
Anne Arundel	61	127	1,962	375	2,525
Baltimore	1,257	243	170	7,972	9,642
Calvert	209	82	1,195	10	1,496
Caroline			157		157
Cecil		2	341	4	347
Charles	6	12	653	45	716
Dorchester	1,791	146	2,243	1,049	5,229
Harford		6	468	154	628
Kent	35	69	1,171		1,275
Prince George			80		80
Queen Anne	2	36	1,279		1,317
St. Mary	36	69	1,115		1,220
Somerset	1,912	155	2,772	1,501	6,340
Talbot	366	70	1,559	1,049	3,044
Wicomico	40	58	975	379	1,452
Worcester		37	740	15	792
Total	5,715	1,112	16,880	12,553	36,260

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Maryland in 1901.

Items.	Anne Arundel.		Baltimore.		Calvert.		Caroline.		Cecil.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	13	$5,750	146	$82,450	43	$22,300				
Tonnage	119		3,550		356					
Outfit		1,525		58,005		6,935				
Vessels transporting	57	35,800	68	95,350	24	28,050			1	$500
Tonnage	902		2,683		712				12	
Outfit		5,571		15,470		4,015				45
Boats	1,040	61,856	92	2,058	640	30,316	81	$475	139	5,900
Apparatus—vessel fisheries:										
Oyster dredges	30	557	584	7,085	149	2,075				
Tongs	9	54			28	344				
Apparatus—shore fisheries:										
Seines	58	1,225	32	3,144	11	640	8	790	6	3,325
Gill nets	43	423	18	215	82	197	191	1,187	297	4,291
Pound nets	56	5,580	4	230	62	5,910	9	350	150	9,935
Fyke nets			1,702	4,093			34	152	1,134	1,460
Trammel nets	1	50	1	30					4	255
Minor nets	157	83	6	20	100	20	1	2		
Lines		470		1		131		22		
Eel pots			147	71	152	164			130	93
Oyster dredges	16	265			94	1,470				
Tongs and nippers	1,687	12,364			663	4,597				
Shore and accessory property		27,834		1,814,655		968		2,555		7,200
Cash capital		19,800		1,968,350		300				500
Total		179,197		4,051,227		108,432		5,533		33,504

NOTE—In tables for Maryland showing statistics by counties the returns for Baltimore County and Baltimore city are combined.

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Maryland in 1901—Continued.

Items.	Charles.		Dorchester.		Harford.		Kent.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	1	$400	331	$153,515			5	$2,650
Tonnage	9		2,603				88	
Outfit		275		50,757				1,560
Vessels transporting	4	1,950	44	55,450	3	$3,400	32	18,050
Tonnage	91		1,160		28		640	
Outfit		630		7,044		120		8,345
Boats	313	11,649	1,750	93,758	158	14,497	765	39,982
Apparatus—vessel fisheries:								
Oyster dredges	2	80	1,291	19,458				
Crab scrapes			117	386				
Tongs			13	85				
Seines							5	685
Eel pots			1,075	505				
Apparatus—shore fisheries:								
Seines	14	4,590	8	435	14	5,910	32	1,683
Gill nets	68	5,110	902	2,126	298	4,360	518	7,056
Pound nets	107	11,750	204	12,230			74	5,735
Trap nets and weirs							19	475
Fyke nets	2	50	26	112	691	847	237	2,032
Trammel nets					12	1,235		
Minor nets			298	104			23	4
Lines		45		819				314
Eel pots	18	18	519	248	482	246	555	376
Oyster dredges	4	100	924	7,964				
Crab scrapes			220	755				
Tongs and nippers	332	1,224	2,193	13,896			1,044	8,435
Shore and accessory property		6,465		63,882		38,850		3,000
Cash capital		600		93,440		2,500		
Total		44,936		576,969		71,965		95,382

Items.	Prince George.		Queen Anne.		St. Mary.		Somerset.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing			1	$100	6	$2,600	336	$203,215
Tonnage			6		45		3,411	
Outfit				85		1,195		60,713
Vessels transporting			16	10,900	23	14,100	50	56,425
Tonnage			191		390		1,313	
Outfit				2,290		3,045		7,506
Boats	33	$940	777	34,080	644	34,990	2,817	128,375
Apparatus—vessel fisheries:								
Oyster dredges			4	20	14	265	1,208	18,180
Crab scrapes							61	221
Tongs					1	14		
Seines							1	700
Apparatus—shore fisheries:								
Seines	12	1,855	29	764	1	200		
Gill nets	22	128	47	325	7	295	30	230
Pound nets	5	450	26	1,415	47	6,140	39	4,040
Trap nets and weirs	1	25						
Fyke nets			24	475			45	540
Bow nets							24	120
Minor nets			36	14	50	13	1,443	562
Lines				199		147		315
Eel pots			92	78	40	40	155	85
Spears							19	30
Oyster dredges					75	393	932	9,096
Crab scrapes							2,431	8,876
Tongs and nippers			2,255	12,245	975	5,028	1,506	9,275
Shore and accessory property		449		1,985		555		117,203
Cash capital								161,250
Total		3,847		64,975		69,020		776,957

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Maryland in 1901—Continued.

Items.	Talbot.		Wicomico.		Worcester.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	66	$36,700	7	$3,275			955	$512,955
Tonnage	573		51				10,811	
Outfit		11,099		940				193,089
Vessels transporting	27	20,125	18	20,550	15	$13,550	382	374,200
Tonnage	480		395		269		9,256	
Outfit		4,260		2,720		1,057		57,118
Boats	1,186	60,727	617	21,657	446	12,266	11,498	553,526
Apparatus—vessel fisheries:								
Oyster dredges	260	3,660	28	350			3,570	51,730
Crab scrapes							178	607
Tongs	3	15					54	512
Seines							a 6	1,385
Eel pots	165	65					1,240	570
Apparatus—shore fisheries:								
Seines	17	197	3	300	67	3,590	a 312	28,648
Gill nets	60	1,141	488	4,038	582	3,538	b 3,653	34,660
Pound nets	175	19,445	32	4,200	7	11,355	997	98,765
Trap nets and weirs							20	500
Fyke nets	12	95	157	1,516			4,064	11,372
Trammel nets							c 18	1,570
Bow nets			4	18	78	391	106	529
Minor nets	30	15					2,144	837
Lines		1,929		301		29		4,722
Eel pots			69	34	790	225	3,149	1,678
Spears					6	3	25	33
Oyster dredges	120	1,138	18	160			2,183	20,576
Crab scrapes	2	9					2,653	9,640
Tongs and nippers	2,302	11,478	761	4,850	241	1,188	13,959	84,580
Shore and accessory property		54,411		9,460		15,277		2,164,749
Cash capital		40,775		20,000				2,297,515
Total		267,284		94,369		62,469		6 506,066

[a] Total length of seines, 62,085 yards. [b] Total length of gill nets, 348,061 yards.
[c] Total length of trammel nets, 7,520 yards.

Table showing, by counties, the yield of the fisheries of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	1,010,522	$6,146	133,600	$565	457,000	$4,779	34,700	$688
Black bass			543	62				
Blue-fish	750	37			2,300	119		
Butter-fish					200	10		
Carp	24,185	890	4,700	184	21,870	686	2,810	95
Cat-fish	11,266	280	68,820	1,917	24,850	858	17,070	415
Croakers	2,100	69			18,950	414		
Drum					1,300	13		
Eels, fresh	29,370	1,060	13,041	388	20,405	712		
Flounders	450	22			9,515	335		
Gizzard shad	110	5						
Harvest-fish					300	10		
Hickory shad	1,275	38			2,890	74		
Mullet	900	26					3,050	46
Perch, white	17,820	996	16,235	905	33,300	2,016	17,020	713
Perch, yellow	6,650	321	120,005	4,341	1,380	61	5,350	175
Pike	750	66	26,800	2,695	510	49	300	23
Shad, fresh	141,652	6,047	10,036	387	74,200	3,605	84,250	3,499
Sheepshead					150	12		
Spanish mackerel					100	12		
Spots					1,000	28		
Squeteague	2,615	90			5,850	224		
Striped bass	36,902	3,021	53,555	4,808	47,300	3,977	3,015	133
Suckers			1,830	55				
Sun-fish	1,100	22						
Other fish			1,000	120				
Crabs, hard	1,162,565	8,794	480	12	181,333	884		
Crabs, soft	171,267	14,435	16,288	1,258	60,266	2,251		
Shrimp			728	708				
Oysters, natural rock	4,398,702	350,758	2,297,050	229,515	1,705,690	147,400		
Oysters, private beds					55,720	5,300		
Turtles	125	6	60	2				
Terrapin	138	169						
Frogs			130	50				
Total	7,021,214	393,298	2,764,901	247,962	2,726,379	173,829	167,565	5,787

Table showing, by counties, the yield of the fisheries of Maryland in 1901—Continued.

Species.	Cecil.		Charles.		Dorchester.		Harford.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	3,030,000	$13,445	1,865,600	$9,728	434,900	$4,309	3,837,500	$25,500
Alewives, salted			239,000	3,525	4,000	85		
Black bass	1,900	144	19,840	1,820			100	8
Blue-fish			6,800	328	33,200	1,328		
Butter-fish					100	3		
Carp	22,700	882	14,385	313	820	26	33,300	1,209
Cat-fish	20,650	902	64,561	1,879	32,795	1,150	27,200	1,176
Croakers					49,850	717		
Drum					1,900	28		
Eels, fresh	9,400	492	4,585	129	80,820	3,367	26,400	1,056
Flounders			3,650	110	2,270	100		
Gizzard shad					4,400	94		
Menhaden					6,800	12		
Mullet	750	34			2,050	51	3,100	93
Perch, white	37,300	1,836	79,645	4,455	23,870	1,185	22,750	1,474
Perch, yellow	3,700	174	17,745	610	7,470	229		
Pike	12,200	769	6,350	350	7,595	547	1,050	34
Shad, fresh	513,300	15,661	415,040	12,384	209,405	10,338	510,400	16,470
Shad, salted			17,000	425				
Spots					14,860	163		
Squeteague			6,600	291	4,060	146		
Striped bass	8,200	750	141,082	11,309	29,325	2,123	45,750	6,090
Sturgeon			3,760	302	1,690	108		
Caviar			485	295	130	65		
Suckers			8,025	148	1,170	22		
Sun-fish					600	8		
Other fish					300	9		
Crabs, hard			210,000	2,100	1,664,333	18,337		
Crabs, soft					518,999	23,525		
Oysters, natural rock			443,275	27,340	7,770,490	566,024		
Oysters, private beds			25,900	2,400	574,350	49,082		
Terrapin					435	510		
Total	3,660,100	35,089	3,593,328	80,241	11,482,987	683,691	4,507,550	53,110

Species.	Kent.		Prince George.		Queen Anne.		St. Mary.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	542,240	$3,122	358,500	$2,034	160,250	$1,549	377,800	$2,490
Alewives, salted	44,400	552	5,000	125				
Black bass			1,000	100				
Blue-fish					2,200	88	11,475	550
Butter-fish							12,000	363
Carp	13,025	242	14,050	489	7,720	225	2,250	45
Cat-fish	83,980	2,229	39,200	1,108	27,050	736	1,000	26
Croakers					9,000	210	17,750	534
Drum							500	5
Eels, fresh	66,725	1,625	1,175	32	26,030	883	3,100	191
Eels, salted	1,700	50						
Flounders					2,800	117	2,080	52
Harvest-fish							500	15
Hickory shad							4,150	97
Mullet	4,775	113	1,300	38	1,500	24		
Perch, white	66,315	3,487	14,800	845	11,825	540	7,375	420
Perch, yellow	95,095	2,575	12,475	303	17,530	655		
Pike	4,510	350	1,480	137	450	33		
Shad, fresh	314,210	13,028	62,750	2,145	19,850	1,008	73,925	3,309
Sheepshead							200	15
Spanish mackerel							1,582	199
Spots	100	3					700	25
Squeteague	200	7			940	45	31,170	1,242
Striped bass	286,290	20,704	10,150	741	51,125	3,671	34,777	3,507
Sturgeon							1,500	115
Caviar							80	60
Suckers			3,525	52				
Sun-fish	900	13			200	4		
Crabs, hard	391,333	2,535			691,166	4,908	197,500	1,975
Crabs, soft	17,607	1,305			39,366	2,470	5,025	419
Oysters, natural rock	2,878,050	168,930			2,470,699	145,142	1,980,650	140,010
Oysters, private beds	10,500	1,458						
Total	4,821,955	222,328	525,405	8,149	3,539,701	162,308	2,767,089	155,664

Table showing, by counties, the yield of the fisheries of Maryland in 1901—Continued.

Species.	Somerset.		Talbot.		Wicomico.		Worcester.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	84,700	$962	709,400	$7,598	148,250	$1,883	269,795	$2,223
Blue-fish	13,860	561	18,700	829			10,860	538
Bonito							250	10
Butter-fish	3,200	49					443,200	11,080
Carp			1,000	24	365	9		
Cat-fish	16,175	423	11,595	321	41,565	2,097	1,000	30
Cero							500	10
Croakers	124,435	730	32,800	713	5,650	107	42,870	745
Drum	23,200	416	200	1	100	2	26,250	105
Eels, fresh	17,700	879	3,000	100	4,700	221	28,360	1,174
Eels, salted					500	10		
Flounders	2,085	43	5,645	229	910	43	21,800	574
Gizzard shad			100	4	1,400	30		
Harvest-fish	12,000	85						
King-fish	65	5					7,150	950
Mackerel							1,800	180
Menhaden	6,055,600	10,071					1,059,830	1,490
Mullet	2,500	30	200	3	340	8	14,830	434
Perch, white	5,640	204	9,050	475	12,190	785	77,680	4,669
Perch, yellow			3,150	99	2,170	74		
Pike	75	5			400	34	5,060	298
Pompano	140	14						
Scup							32,650	1,019
Sea bass							50,800	2,540
Shad, fresh	42,650	2,202	360,200	18,267	187,485	8,722	74,828	3,105
Sheepshead							1,000	25
Spanish mackerel	540	54	300	33			400	50
Spots	810	23	500	10			4,500	135
Squeteague	45,950	1,352	4,330	133	9,760	384	907,300	23,007
Striped bass	5,737	488	32,120	2,299	14,810	1,208	24,280	3,789
Sturgeon	1,100	59			365	34	99,205	2,885
Caviar					63	24	5,070	3,042
Suckers					200	4		
Sun-fish					670	5	500	20
Other fish	400	2					600	12
Crabs, hard	768,900	12,496	3,771,517	28,753	784,000	5,040	1,666	50
Crabs, soft	3,368,232	153,937	106,532	2,963				
Oysters, natural rock	6,548,129	548,686	3,918,047	272,876	1,868,055	134,120	19,880	1,473
Oysters, private beds	611,800	56,740	2,100	150	1,162,700	78,245	1,057,140	105,869
Clams	72,600	10,884					35,000	3,500
Turtles	300	15			4,350	180		
Terrapin	150	100					870	360
Total	17,828,673	801,465	8,990,486	335,880	4,250,988	233,269	4,326,924	175,391

The number and value of shad taken in each county of Maryland in 1901 is shown in the following table:

Counties.	No.	Value.	Counties.	No.	Value.
Anne Arundel	40,426	$6,047	Prince George	15,687	$2,145
Baltimore	2,867	387	Queen Anne	5,671	1,008
Calvert	24,733	3,605	St. Mary	21,121	3,309
Caroline	24,071	3,499	Somerset	14,217	2,202
Cecil	128,325	15,661	Talbot	120,067	18,267
Charles	108,010	12,809	Wicomico	62,495	8,722
Dorchester	69,802	10,338	Worcester	21,379	3,105
Harford	127,600	16,470			
Kent	89,774	13,028	Total	a876,245	120,602

a3,111,181 pounds.

The following table shows the shad catch of Maryland in 1901, by waters, in the order of their importance, their rank being based upon the pounds of shad taken:

Waters.	No.	Lbs.	Value.	Waters.	No.	Lbs.	Value.
Chesapeake Bay	314,860	1,242,600	$44,858	Pocomoke and Tangier sounds	3,700	12,200	$715
Potomac River	146,000	490,065	14,800	Sassafras River	2,500	8,700	298
Choptank River	135,412	417,070	19,827	Patapsco River	1,900	6,400	160
Susquehanna River	67,000	252,400	8,874	Blackwater River	2,125	6,370	290
Patuxent River	43,000	148,950	6,941	Honga River	1,555	4,660	266
Nanticoke River	34,985	122,440	5,977	Gunpowder River	850	2,836	177
Wicomico River	34,348	103,045	4,500	North East River	600	2,000	60
Severn River	27,500	94,652	4,259	Atlantic Ocean	550	1,925	110
Pocomoke River	28,575	93,633	4,004	Chincoteague and Sinepuxent bays	520	1,820	83
West River	8,200	28,000	1,050	South River	470	1,600	60
Little Choptank River	6,885	20,655	1,091	Middle River	235	800	50
Fishing Bay	6,000	18,000	905				
Chester River	4,475	15,660	739				
Elk River	4,000	14,700	478	Total	876,245	3,111,181	120,602

Of the rivers shown in the preceding table, the Potomac, Susquehanna, Nanticoke, and Pocomoke have shad fisheries in two States, including Maryland. The value of Virginia's shad catch in the Potomac is over seven times that of Maryland. The catch from the Susquehanna River in Pennsylvania is nearly three times as valuable as in Maryland. Delaware's catch from the Nanticoke slightly exceeds that of Maryland. The proportion of Virginia's catch in the Pocomoke was comparatively small. The total yield of shad for each of the above rivers is shown, by States, in the following table:

Waters and States.	No.	Lbs.	Value.	Waters and States.	No.	Lbs.	Value.
Potomac River:				Nanticoke River:			
Maryland	146,000	490,065	$14,800	Maryland	34,985	122,440	$5,977
Virginia	648,462	2,446,604	104,566	Delaware	37,097	129,840	6,315
Total	794,462	2,936,669	119,366	Total	72,082	252,280	12,292
Susquehanna River:				Pocomoke River:			
Maryland	67,000	252,400	8,874	Maryland	28,575	93,633	4,004
Pennsylvania	98,883	409,339	23,412	Virginia	2,137	7,480	414
Total	165,883	661,739	32,286	Total	30,712	101,113	4,418

The following tables show, by counties, the quantity and value of products taken by each form of apparatus in the shore and vessel fisheries of the State in 1901:

Table showing, by counties, the seine catch of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.		Cecil.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:										
Alewives, fresh	46,000	$352	83,600	$415	18,000	$142	14,600	$283	600,000	$3,000
Black bass			93	7					900	78
Blue-fish	550	27								
Carp	21,750	818	2,200	69	1,800	67	1,500	58	21,000	790
Cat-fish	10,116	223	12,630	364	17,000	605	2,100	52		
Croakers	1,800	54								
Eels	22,240	797	3,891	116	3,355	138				
Flounders					25	1				
Mullet	900	26					300	3		
Perch, white	5,000	277	10,610	611	13,550	853	3,400	119		
Perch, yellow	2,175	98	13,255	455	1,030	51	125	5	2,000	100
Pike	550	46	5,550	545	310	33			2,500	125
Shad, fresh	1,100	43	3,636	227	3,100	120	28,300	1,107	80,000	2,400
Squeteague	2,140	67								
Striped bass	13,975	1,173	50,555	4,575	7,660	648			5,500	500
Suckers			330	10						
Sun-fish	850	17								
Crabs, soft	46,480	3,704	16,000	1,200						
Turtles	125	6	60	2						
Terrapin	36	48								
Total	175,787	7,776	202,410	8,596	65,830	2,658	50,325	1,627	711,900	6,993

Species.	Charles.		Dorchester.		Harford.		Prince George.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Alewives, fresh	1,040,800	$4,803	13,400	$135	3,837,500	$25,500	281,300	$1,600
Alewives, salted	239,000	3,525						
Black bass	17,590	1,631			100	8	1,000	100
Blue-fish	1,500	75						
Carp	6,560	129	100	3	23,000	900	18,000	455
Cat-fish	19,818	587	3,500	102	200	8	36,100	1,032
Croakers			150	3				
Eels	800	27	40	1			850	24
Mullet			160	8	1,000	30	1,300	38
Perch, white	20,440	1,124	7,950	431	450	36	11,300	625
Perch, yellow	7,990	267	1,800	45			12,350	296
Pike	2,200	142	270	27	50	4	1,450	135
Shad, fresh	48,400	1,452	3,420	141	130,000	5,550	46,100	1,520
Shad, salted	17,000	425						
Spots			200	3				
Squeteague	800	32	250	5				
Striped bass	24,200	1,963	2,980	247	6,100	730	6,180	446
Suckers	5,505	98					3,525	52
Total	1,452,603	16,280	34,210	1,146	3,998,400	32,766	414,455	6,323

Species.	Queen Anne.		St. Mary.		Talbot.		Wicomico.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:								
Alewives, fresh	4,600	$69					2,700	$46
Blue-fish			2,000	$100	400	$20		
Carp	4,070	98			400	4		
Cat-fish	7,850	210	500	15			2,400	125
Eels	250	10						
Mullet	300	8						
Perch, white	4,750	236	5,350	321	600	30	1,175	58
Perch, yellow	2,950	100						
Pike							25	2
Shad, fresh	1,200	56					2,300	102
Spots					500	10		
Squeteague			3,750	150	600	24		
Striped bass	26,825	1,930	7,142	571	500	34	1,750	139
Sun-fish	100	2						
Crabs, soft	22,166	1,425			8,166	510		
Total	75,061	4,144	18,742	1,157	11,166	632	10,350	472

Table showing, by counties, the seine catch of Maryland in 1901—Continued.

Species.	Kent.		Somerset.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Cat-fish	250	$5					250	$5
Menhaden			6,000,000	$10,000			6,000,000	10,000
Perch, white	9,800	550					9,800	550
Striped bass	111,000	7,650					111,000	7,650
Total	121,050	8,205	6,000,000	10,000			6,121,050	18,205
Shore fisheries:								
Alewives, fresh	1,400	19			209,600	$1,762	6,153,500	38,126
Alewives, salted							239,000	3,525
Black bass							19,683	1,824
Blue-fish							4,450	222
Carp	3,200	49					98,580	3,440
Cat-fish	14,750	402			1,000	30	127,964	3,755
Croakers					1,900	45	3,850	102
Eels	2,725	81					34,151	1,194
Flounders					350	14	375	15
Menhaden					1,059,830	1,490	1,059,830	1,490
Mullet					1,000	40	4,950	148
Perch, white	6,060	300			54,660	3,304	145,295	8,325
Perch, yellow	4,025	120					47,700	1,537
Pike					4,860	288	17,765	1,347
Shad, fresh	85	5			7,434	329	355,075	13,052
Shad, salted							17,000	425
Spots							700	13
Squeteague					17,550	622	25,090	900
Striped bass	34,275	2,543			16,400	2,572	204,042	18,071
Suckers							9,360	160
Sun-fish							950	19
Crabs, soft	6,707	430					99,519	7,269
Turtles							185	8
Terrapin					870	360	906	408
Total	73,227	3,949			1,375,454	10,856	8,669,920	105,375
Total, vessel and shore	194,277	12,154	6,000,000	10,000	1,375,454	10,856	14,790,970	123,580

Table showing, by counties, the gill-net catch in the shore fisheries of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.		Cecil.		Charles.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives, fresh	14,630	$439			3,200	$71	9,200	$187			70,000	$560
Carp	400	10			300	10						
Perch, white			150	$9	3,000	207						
Pike			1,300	130								
Shad	12,500	500			11,400	518	53,900	2,315	395,000	$12,075	291,440	8,585
Striped bass	705	69	1,490	119	1,540	108	395	21			2,750	194
Sturgeon											3,610	289
Caviar											465	280
Total	28,235	1,018	2,940	258	19,440	914	63,495	2,523	395,000	12,075	368,255	9,908

Species.	Dorchester.		Harford.		Kent.		Prince George.		Queen Anne.		St. Mary.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives, fresh	30,800	$320			52,000	$578	1,200	$14	27,200	$320		
Alewives, salted	4,000	85					5,000	125				
Blue-fish	33,200	1,328									5,000	$250
Carp					1,465	31	800	22				
Cat-fish					9,380	216			1,400	41		
Eels	100	3										
Mullet					160	2						
Perch, white					21,670	1,165	800	40				
Perch, yellow					670	17						
Pike					1,700	119						
Shad	42,405	2,071	380,400	$10,920	284,525	11,726	12,300	482	4,200	188		
Spanish mackerel											1,167	140
Spots	60	2										
Squeteague	150	5									2,000	100
Striped bass	810	59	9,700	1,164	83,100	5,989	250	18	4,500	175		
Total	111,525	3,873	390,100	12,084	454,660	19,843	20,350	701	37,300	724	8,167	490

Table showing, by counties, the gill-net catch in the shore fisheries of Maryland in 1901—Continued.

Species.	Somerset.		Talbot.		Wicomico.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh			2,000	$50	36,400	$619	32,160	$242	278,790	$3,400
Alewives, salted									9,000	210
Blue-fish	12,500	$500	17,700	779					68,400	2,857
Carp									2,965	73
Cat-fish									10,780	257
Eels									100	3
Flounders							200	8	200	8
King-fish							1,750	140	1,750	140
Mullet							13,830	394	13,980	396
Perch, white			150	10	840	62	23,020	1,365	49,630	2,858
Perch, yellow									670	17
Pike							200	10	3,200	259
Shad	10,400	485	9,200	392	140,220	6,355	7,438	221	1,655,328	56,833
Spanish mackerel			300	33					1,467	173
Spots									60	2
Squeteague			2,000	69			1,350	47	5,500	211
Striped bass			600	50			7,880	1,217	113,720	9,183
Sturgeon					365	34	96,570	3,188	100,545	3,511
Caviar					53	24	4,680	2,574	5,188	2,878
Total	22,900	985	31,950	1,373	177,878	7,094	189,078	9,406	2,321,273	83,269

Table showing, by counties, the fyke-net catch in the shore fisheries of Maryland in 1901.

Species.	Baltimore.		Caroline.		Cecil.		Charles.		Dorchester.		Harford.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Black bass	450	$45			800	$50						
Carp	2,000	100	590	$20	1,700	92	425	$8				
Cat-fish	53,190	1,483	1,420	88	14,900	655	4,600	92			26,800	$1,152
Eels	5,250	154			1,400	92					3,000	120
Mullet			2,450	89	600	30						
Perch, white	4,700	245	5,400	313	29,800	1,529	3,500	175			22,300	1,438
Perch, yellow	97,700	3,614	2,580	102	1,600	70	750	15				
Pike	19,150	1,940	300	23	6,800	424						
Striped bass	750	60	220	17	700	55	1,550	124				
Suckers	1,500	45										
Terrapin									293	$350		
Total	184,690	7,686	12,960	552	58,300	2,997	10,825	414	293	350	52,100	2,710

Species.	Kent.		Queen Anne.		Somerset.		Talbot.		Wicomico.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Value.
Alewives	27,640	$206	5,900	$74	4,300	$57			12,850	$203	50,690	$540
Black bass											1,250	95
Carp	4,660	101	1,050	40			100	$4	325	7	10,850	372
Cat-fish	24,300	618	11,300	344	9,200	228	395	11	12,365	568	158,470	5,189
Croakers					2,150	42			1,050	18	3,200	60
Drum									100	2	100	2
Eels	18,550	429	1,430	60					1,250	69	30,880	924
Flounders							175	9	600	30	775	39
Gizzard shad									200	5	200	5
Mullet	1,125	19	800	6	2,500	30	200	3	340	8	8,015	135
Perch, white	11,885	521	4,150	153	3,400	156	1,400	75	7,625	511	93,660	5,116
Perch, yellow	80,100	2,057	10,800	396			950	34	1,970	67	196,450	6,355
Pike	1,650	136	300	23	75	5			375	32	28,650	2,583
Shad	550	26	350	14	1,350	59			3,365	165	5,615	264
Squeteague					50	2			360	9	410	11
Striped bass	5,750	442	2,250	164	4,300	303	670	41	10,335	861	26,525	2,067
Suckers									100	2	1,600	47
Sun-fish			100	2					670	5	770	7
Terrapin					75	50					368	400
Total	175,710	4,555	38,430	1,276	27,400	932	3,890	177	53,880	2,562	618,478	24,211

Table showing, by counties, the trammel-net catch in the shore fisheries of Maryland in 1901.

Species.	Anne Arund l.		Baltimore.		Cecil.		Harford.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Black bass					200	$16			200	$16
Blue-fish	200	$10							200	10
Carp	160	5					10,300	$309	10,460	314
Cat-fish	100	5			500	37	200	16	800	58
Eels	90	3							90	3
Gizzard shad	110	5							110	5
Mullet					150	4	2,100	63	2,250	67
Perch, white	550	33	75	$5	200	15			825	53
Perch, yellow	200	10			100	4			300	14
Pike					2,900	220	1,000	30	3,900	250
Striped bass	120	10	50	4	400	40	29,950	4,196	30,520	4,250
Sun-fish	250	5							250	5
Total	1,780	86	125	9	4,450	336	43,550	4,614	49,905	5,045

Table showing, by counties, the pound-net, trap-net, and weir catch in the shore fisheries of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	949,892	$5,355	50,000	$150	435,800	$4,566	10,900	$218
Blue-fish					2,300	119		
Butter-fish					200	10		
Carp	1,875	57	500	15	19,770	609	420	6
Cat-fish	1,050	52	3,000	70	7,850	253	3,950	38
Croakers	300	15			18,950	414		
Drum					1,300	13		
Eels	7,040	260	300	10	3,450	115		
Flounders	450	22			9,490	334		
Harvest-fish					300	10		
Hickory shad	1,275	38			2,890	74		
Mullet							300	4
Perch, white	12,270	686	700	35	16,750	956	8,150	276
Perch, yellow	4,275	213	9,050	272	350	10	2,645	68
Pike	200	20	800	80	200	16		
Shad	128,052	5,504	6,400	160	59,700	2,967	2,050	77
Sheepshead					150	12		
Spanish mackerel					100	12		
Spots					1,000	28		
Squeteague	475	23			5,850	224		
Striped bass	22,102	1,769	710	50	38,100	3,221	2,400	95
Terrapin	30	22						
Total	1,129,286	14,036	71,460	842	624,500	13,963	30,815	782

Species.	Cecil.		Charles.		Dorchester.		Kent.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	2,430,000	$10,445	754,800	$1,365	390,700	$3,854	461,200	$2,319
Alewives, salted							44,400	552
Black bass			2,250	189				
Blue-fish			5,300	253				
Butter-fish					100	3		
Carp			7,400	176	720	23	3,700	61
Cat-fish	5,250	210	40,143	1,200	25,895	798	24,600	670
Croakers					49,700	714		
Drum					1,900	28		
Eels			2,485	76	1,540	64	18,150	443
Flounders			3,650	110	2,270	100		
Gizzard shad					4,400	94		
Menhaden					6,800	12		
Mullet					1,900	48	3,500	92
Perch, white	7,300	292	55,705	3,156	15,920	754	17,300	948
Perch, yellow			9,005	328	5,670	184	10,100	376
Pike			4,150	208	7,325	520	1,160	95
Shad	38,300	1,186	75,200	2,347	163,580	8,126	29,050	1,271
Spots					14,600	158	100	3
Squeteague			5,800	259	3,660	136	200	7
Striped bass	1,600	155	112,582	9,028	25,535	1,817	52,065	4,077
Sturgeon			150	13	1,690	108		
Caviar			30	15	130	65		
Suckers			2,520	50	1,170	22		
Sun-fish					600	8	900	13
Other fish					200	1		
Total	2,482,450	12,288	1,081,170	21,773	726,005	17,637	666,425	10,927

Table showing, by counties, the pound-net, trap-net, and weir catch in the shore fisheries of Maryland in 1901—Continued.

Species.	Prince George.		Queen Anne.		St. Mary.		Somerset.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	76,000	$420	122,550	$1,086	377,800	$2,490	80,400	$905
Blue-fish			2,200	88	4,475	200	700	35
Butter-fish					12,000	363	3,200	49
Carp	250	12	2,100	57	2,250	45		
Cat-fish	3,100	76	5,250	104	500	11	6,975	195
Croakers			9,000	210	17,750	534	120,985	675
Drum					500	5	19,500	346
Eels	325	8	10,500	393	200	6	300	9
Flounders			2,800	117	2,080	52	1,925	39
Harvest-fish					500	15	12,000	85
Hickory shad					4,150	97		
Menhaden							55,600	71
Mullet			400	10				
Perch, white	2,700	180	2,925	151	2,025	99	1,740	41
Perch, yellow	125	7	8,700	155				
Pike	30	2	150	10				
Pompano							140	14
Shad	4,350	143	14,100	750	73,925	3,309	20,900	1,083
Sheepshead					200	15		
Spanish mackerel					415	59	540	64
Spots					700	25	210	10
Squeteague			940	45	25,420	992	21,950	655
Striped bass	3,720	277	15,650	1,222	27,635	2,936	1,437	135
Sturgeon					1,500	115	1,100	59
Caviar					80	60		
Other fish							400	2
Total	90,600	1,125	192,165	4,398	554,105	11,428	350,002	4,462

Species.	Talbot.		Wicomico.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	707,400	$7,548	96,300	$1,015	27,600	$213	6,971,342	$44,949
Alewives, salted							44,400	552
Black bass							2,250	189
Blue-fish	600	30			1,960	98	17,535	823
Bonito					250	10	250	10
Butter-fish					443,200	11,080	458,700	11,505
Carp	500	16					39,485	1,077
Cat-fish	11,200	310	4,875	155			143,638	4,142
Cero					500	10	500	10
Cod					600	12	600	12
Croakers	32,800	713	4,600	89	33,770	518	287,855	3,882
Drum	200	1			26,250	105	49,650	498
Eels			250	12			44,540	1,396
Flounders	5,470	220	310	13	19,600	490	48,045	1,497
Gizzard shad	100	4	1,200	25			5,700	123
Harvest-fish							12,800	110
Hickory shad							8,315	209
King-fish					5,400	810	5,400	810
Mackerel					1,800	180	1,800	180
Menhaden							62,400	83
Mullet							6,100	154
Perch, white	6,900	360	2,250	130			152,635	8,064
Perch, yellow	2,200	65	200	7			47,320	1,685
Pike							14,015	951
Pompano							140	14
Scup					28,650	859	28,650	859
Shad	851,000	17,875	41,600	2,100	1,995	113	1,010,202	47,011
Sheepshead					1,000	25	1,350	52
Spanish mackerel					400	60	1,465	175
Spots					4,500	135	21,110	359
Squeteague	1,730	50	9,400	375	852,520	21,358	927,945	24,124
Striped bass	30,350	2,174	2,585	194			336,371	27,150
Sturgeon					2,940	119	7,380	414
Caviar					85	46	325	186
Suckers			100	2			3,790	74
Sun-fish					500	20	2,000	41
Other fish							600	3
Terrapin							30	22
Total	1,150,450	29,366	163,670	4,117	1,453,520	36,251	10,766,623	183,395

Table showing, by counties, the bow-net catch in the shore fisheries of Maryland in 1901.

Species.	Somerset.		Wicomico.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives					435	$6	435	$6
Carp			40	$2			40	2
Cat-fish			375	20			375	20
Perch, white			300	24			300	24
Shad	10,000	$575			57,961	2,442	67,961	3,017
Striped bass			140	14			140	14
Total	10,000	575	855	60	58,396	2,448	69,251	3,083

Table showing the catch by minor apparatus in the shore fisheries of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.		Dorchester.		Kent.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Carp							300	$11				
Perch, white							70	5				
Crabs, soft	124,520	$10,704			60,000	$2,250			149,700	$6,835	2,900	$175
Shrimp			728	$708								
Terrapin									142	160		
Frogs			130	50								
Total	124,520	10,704	858	758	60,000	2,250	370	16	149,842	6,995	2,900	175

Species.	Queen Anne.		St. Mary.		Somerset.		Talbot.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.
Carp	500	$30							800	$41
Cat-fish	350	12							350	12
Perch, white									70	5
Perch, yellow	80	4							80	4
Crabs, soft	10,400	685	5,025	$419	1,052,070	$49,378	5,433	$340	1,410,048	70,786
Shrimp									728	708
Oysters, natural rock					7,000	500			7,000	500
Terrapin					75	50			217	210
Frogs									130	50
Total	11,330	731	5,025	419	1,059,145	49,928	5,433	340	1,419,423	72,316

Table showing, by counties, the line catch in the shore fisheries of Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.		Caroline.		Charles.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Cat-fish							9,600	$287		
Crabs, hard	1,162,565	$8,794	480	$12	181,333	$884			210,000	$2,100
Crabs, soft	267	27	288	58	266	1				
Total	1,162,832	8,821	768	70	181,599	885	9,600	287	210,000	2,100

Species.	Dorchester.		Kent.		Queen Anne.		St. Mary.		Talbot.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Cat-fish	3,400	$250	10,700	$318	900	$25				
Perch, white			100	3						
Perch, yellow			200	5						
Striped bass			100	3	2,000	180				
Crabs, hard	1,664,333	18,337	391,333	2,535	691,166	4,908	197,500	$1,975	3,771,517	$28,753
Crabs, soft	136,466	5,940	8,000	700	6,800	360			92,333	2,078
Total	1,804,199	24,527	410,433	3,564	700,866	5,473	197,500	1,975	3,863,850	30,831

Table showing the line catch in the shore fisheries of Maryland in 1901—Continued.

Species.	Somerset.		Wicomico.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Blue-fish	660	$26			8,900	$440	9,560	$466
Cat-fish			21,550	$1,229			46,150	2,109
Croakers	1,300	13			7,200	182	8,500	195
Drum	3,700	70					3,700	70
Flounders	160	4			1,650	62	1,810	66
King-fish	65	5					65	5
Perch, white	500	7					600	10
Perch, yellow							200	5
Scup					4,000	160	4,000	160
Sea bass					50,800	2,540	50,800	2,540
Spots	600	13					600	13
Squeteague	23,950	695			35,880	980	59,830	1,675
Striped bass							2,100	183
Crabs, hard	714,900	11,761	784,000	5,040	1,666	50	9,770,793	85,149
Crabs, soft	24,000	1,300					268,420	10,464
Turtles	300	15	4,350	180			4,650	195
Total	770,135	13,909	809,900	6,449	110,096	4,414	10,231,778	103,805

Table showing, by counties, the catch of eels by pots and spears in Maryland in 1901.

Counties.	Eels, fresh.		Eels, salted.		Eels, smoked.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Dorchester	57,440	$2,621					57,440	$2,621
Talbot	3,000	100					3,000	100
Total	60,440	2,721					60,440	2,721
Shore fisheries:								
Baltimore	3,600	108			1,000	$120	4,600	228
Calvert	13,600	459					13,600	459
Cecil	8,000	400					8,000	400
Charles	1,300	26					1,300	26
Dorchester	21,700	678			100	8	21,800	686
Harford	23,400	936					23,400	936
Kent	27,300	672	1,700	$50			29,000	722
Queen Anne	13,850	420					13,850	420
St. Mary	2,900	185					2,900	185
Somerset	17,400	870					17,400	870
Wicomico	3,200	140	500	10			3,700	150
Worcester	28,360	1,174					28,360	1,174
Total	164,610	6,068	2,200	60	1,100	128	167,910	6,256
Total vessel and shore	225,050	8,789	2,200	60	1,100	128	228,350	8,977

Table showing, by counties, the catch by dredges and scrapes in Maryland in 1901.

Species.	Anne Arundel.		Baltimore.		Calvert.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:						
Oysters, natural rock	100,807	$9,535	2,297,050	$229,515	270,550	$23,200
Shore fisheries:						
Oysters, natural rock	18,200	1,925			127,400	12,510
Total, vessel and shore	119,007	11,460	2,297,050	229,515	397,950	35,710

Species.	Charles.		Dorchester.		Queen Anne.		St. Mary.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Oysters, natural rock	11,200	$640	3,355,240	$259,514	5,250	$300	43,400	$3,130
Crabs, soft			86,333	4,030				
Total	11,200	640	3,441,573	263,544	5,250	300	43,400	3,130
Shore fisheries:								
Oysters, natural rock	35,000	2,000	1,271,025	93,105			152,250	11,425
Oysters, private beds			3,500	250				
Crabs, soft			146,500	6,720				
Total	35,000	2,000	1,421,025	100,075			152,250	11,425
Total, vessel and shore	46,200	2,640	4,862,598	363,619	5,250	300	195,650	14,555

Table showing the catch by dredges and scrapes in Maryland in 1901—Continued.

Species.	Somerset.		Talbot.		Wicomico.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Oysters, natural rock..	3,652,677	$324,738	957,222	$74,798	65,975	$5,400	10,759,371	$930,770
Oysters, private beds..	7,000	500	....	....	....	....	7,000	500
Crabs, soft	68,033	2,959	....	....	....	....	154,366	6,989
Total.............	3,727,710	328,197	957,222	74,798	65,975	5,400	10,920,737	938,259
Shore fisheries:								
Oysters, natural rock .	1,384,992	104,183	186,375	13,478	20,300	1,450	3,195,542	240,076
Oysters, private beds..	....	....	....	....	....	....	3,500	250
Crabs, hard	54,000	735	....	....	....	....	54,000	735
Crabs, soft	2,224,129	100,300	600	35	....	....	2,371,229	107,055
Total.............	3,663,121	205,218	186,975	13,513	20,300	1,450	5,624,271	348,116
Total, vessel and shore...........	7,390,831	533,415	1,144,197	88,311	86,275	6,850	16,545,008	1,286,375

Table showing, by counties, the catch by tongs and nippers in Maryland in 1901.

Species.	Anne Arundel.		Calvert.		Charles.		Dorchester.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Oysters, natural rock..	2,800	$275	75,355	$6,285	....	....	9,800	$650
Shore fisheries:								
Oysters, natural rock..	4,276,895	339,023	1,232,385	105,405	397,075	$24,700	3,134,425	212,755
Oysters, private beds..	....	....	55,720	5,300	25,900	2,400	570,850	48,832
Terrapin	72	99	....	....	....	....	....	....
Total.............	4,276,967	339,122	1,288,105	110,705	422,975	27,100	3,705,275	261,587
Total, vessel and shore...........	4,279,767	339,397	1,363,460	116,990	422,975	27,100	3,715,075	262,237

Species.	Kent.		Queen Anne.		St. Mary.		Somerset.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Oysters, natural rock..	....	....	....	....	1,400	$80	....	....
Shore fisheries:								
Oysters, natural rock..	2,878,050	$168,930	2,465,449	$144,842	1,783,600	125,375	1,503,460	$119,265
Oysters, private beds..	10,500	1,458	....	....	....	....	604,800	56,240
Clams	....	....	....	....	....	....	72,600	10,884
Total.............	2,888,550	170,388	2,465,449	144,842	1,783,600	125,375	2,180,860	186,389
Total, vessel and shore...........	2,888,550	170,388	2,465,449	144,842	1,785,000	125,455	2,180,860	186,389

Species.	Talbot.		Wicomico.		Worcester.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:								
Oysters, natural rock..	1,750	$150	....	....	....	....	91,105	$7,440
Shore fisheries:								
Oysters, natural rock..	2,772,700	184,450	1,781,780	$127,270	19,880	$1,473	22,245,699	1,553,488
Oysters, private beds..	2,100	150	1,162,700	78,245	1,057,140	105,869	3,489,710	298,494
Clams	....	....	....	....	35,000	3,500	107,600	14,384
Terrapin	....	....	....	....	....	....	72	99
Total.............	2,774,800	184,600	2,944,480	205,515	1,112,020	110,842	25,843,081	1,866,465
Total, vessel and shore...........	2,776,550	184,750	2,944,480	205,515	1,112,020	110,842	25,934,186	1,873,905

The following table shows the extent and value of the oyster fishery of Maryland during the season of 1900–1901:

Table showing, by counties, the extent of the oyster fishery of Maryland for the season of 1900–1901.

Items.	Anne Arundel.		Baltimore.		Calvert.		Charles.		Dorchester.	
	No.	Value.	No.	Value.	No.	Value.	No.	Val.	No.	Value.
Persons employed:										
On vessels fishing	61		1,257		209		6		1,789	
On vessels transporting	127		243		82		12		148	
In shore or boat fisheries	1,932				1,095		349		2,120	
Shoresmen	290		7,936		5		16		990	
Total	2,410		9,436		1,391		383		5,058	
Vessels fishing	13	$5,750	146	$82,450	43	$22,300	1	$400	330	$153,115
Tonnage	119		3,550		356		9		2,590	
Outfit		1,525		58,005		6,935		275		50,667
Vessels transporting	57	35,800	68	95,350	24	28,050	4	1,950	45	55,850
Tonnage	902		2,683		712		91		1,163	
Outfit		5,571		15,470		4,015		630		7,134
Boats	791	57,735			463	28,145	173	5,760	1,206	87,245
Apparatus—vessel fisheries:										
Dredges	30	557	584	7,085	149	2,075	2	80	1,291	19,458
Tongs	9	54			28	344			13	85
Apparatus—shore fisheries:										
Dredges	16	255			94	1,470	4	100	924	7,964
Tongs, etc.	1,585	12,362			663	4,597	332	1,224	2,193	13,896
Shore and accessory property		25,500		1,726,440				1,150		60,413
Cash capital		19,500		1,901,350				600		91,350
Total investment		164,609		3,886,150		97,931		12,169		547,177
Products.	Bush.	Value.	Bush.	Value.	Bush.	Value.	Bush.	Val.	Bush.	Value.
Vessel fisheries:										
Dredge catch (natural rock)	14,401	$9,535	328,150	$229,515	38,650	$23,200	1,600	$640	479,320	$259,514
Tong catch (natural rock)	400	275			10,765	6,285			1,400	650
Total, vessel catch	14,801	9,810	328,150	229,515	49,415	29,485	1,600	640	480,720	260,164
Shore fisheries:										
Dredge catch (natural rock)	2,600	1,925			18,200	12,510	5,000	2,000	[a]182,075	93,355
Tong catch (natural rock)	610,985	339,023			176,055	105,405	56,725	24,700	447,775	212,755
Tong catch (private beds)					7,960	5,300	3,700	2,400	81,550	48,832
Total, shore catch	613,585	340,948			202,215	123,215	65,425	29,100	711,400	354,942
Total, vessel and shore catch	628,386	350,758	328,150	229,515	251,630	152,700	67,025	29,740	1,192,120	615,106

[a] Includes 500 bushels, valued at $250, taken from private beds.

NOTE.—A few oysters were taken in the shore fisheries by nippers, and in one locality some were taken by scoop nets, but the apparatus and catch are combined under tongs.

Table showing, by counties, the extent of the oyster fishery of Maryland for the season of 1900-1901—Continued.

Items.	Kent.		Queen Anne.		St. Mary.		Somerset.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Persons employed:								
On vessels fishing	....	....	2	....	36	....	1,885	....
On vessels transporting	69	....	36	....	69	....	155	....
In shore or boat fisheries	999	....	1,217	....	1,059	....	2,064	....
Shoresmen	....	....	....	....	....	....	1,252	....
Total	1,068	....	1,255	....	1,164	....	5,356	....
Vessels fishing	....	....	1	$100	6	$2,600	335	$188,215
Tonnage	....	....	6	....	45	....	3,347	....
Outfit	....	....	....	85	....	1,195	....	57,608
Vessels transporting	32	$18,050	16	10,900	23	14,100	50	56,425
Tonnage	640	....	191	....	390	....	1,313	....
Outfit	....	3,345	....	2,290	....	3,045	....	7,506
Boats	500	32,910	609	32,335	550	33,325	1,054	97,925
Apparatus—vessel fisheries:								
Dredges	....	....	4	20	14	265	1,208	18,180
Tongs	....	....	....	....	1	14	....	....
Apparatus—shore fisheries:								
Dredges	....	....	....	....	75	393	932	9,096
Tongs, etc.	1,044	8,435	2,255	11,245	975	5,028	1,473	8,988
Shore and accessory property	....	1,950	....	....	....	....	....	63,618
Cash capital	....	....	....	....	....	....	....	102,800
Total investment	....	64,690	....	56,975	....	59,965	....	610,361

Products.	Bush.	Value.	Bush.	Value.	Bush.	Value.	Bush.	Value.
Vessel fisheries:								
Dredge catch (natural rock)	....	....	750	$300	6,200	$3,130	522,811	a$325,238
Tong catch (natural rock)	....	....	....	....	200	80	....	....
Total vessel catch	....	....	750	300	6,400	3,210	522,811	325,238
Shore fisheries:								
Dredge catch (natural rock)	....	....	....	....	21,750	11,425	197,856	104,183
Tong catch (natural rock)	411,150	$168,930	352,207	144,842	254,800	125,375	215,780	119,765
Tong catch (private beds)	1,500	1,458	....	....	....	....	86,400	56,240
Total shore catch	412,650	170,388	352,207	144,842	276,550	136,800	500,036	280,188
Total vessel and shore catch	412,650	170,388	352,957	145,142	282,950	140,010	1,022,847	605,426

a Includes 1,000 bushels, valued at $500, taken from private beds.

Table showing, by counties, the extent of the oyster fishery of Maryland for the season of 1900–1901—Continued.

Items.	Talbot.		Wicomico.		Worcester.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Persons employed:								
On vessels fishing	364		40				5,649	
On vessels transporting	70		55		37		1,103	
In shore or boat fisheries	1,461		761		236		13,293	
Shoresmen	765		223		15		11,498	
Total	2,660		1,079		288		31,543	
Vessels fishing	65	$36,400	7	$3,275			947	$494,605
Tonnage	664		51				10,637	
Outfit		10,962		940				188,197
Vessels transporting	27	20,125	18	20,550	15	$13,550	379	370,700
Tonnage	480		395		269		9,229	
Outfit		4,260		2,720		822		56,808
Boats	792	51,530	184	19,650	226	8,312	6,548	454,872
Apparatus—vessel fisheries:								
Dredges	260	3,660	28	350			3,570	51,730
Tongs	3	15					54	512
Apparatus—shore fisheries:								
Dredges	120	1,138	18	160			2,183	20,576
Tongs, etc	2,302	11,478	761	4,850	231	1,158	13,914	83,261
Shore and accessory property		40,035		3,900		12,700		1,935,706
Cash capital		36,000		10,000				2,161,600
Total investment		215,603		66,395		36,542		5,818,567
Products.	**Bush.**	**Value.**	**Bush.**	**Value.**	**Bush.**	**Value.**	**Bush.**	**Value.**
Vessel fisheries:								
Dredge catch (natural rock)	136,746	$74,798	9,425	$5,400			1,538,053	$931,270
Tong catch (natural rock)	250	150					13,015	7,440
Total vessel catch	136,996	74,948	9,425	5,400			1,551,068	938,710
Shore fisheries:								
Dredge catch (natural rock)	26,625	13,478	2,900	1,450			457,006	240,326
Tong catch (natural rock)	396,100	184,450	254,540	127,270	2,840	$1,473	3,178,957	1,553,988
Tong catch (private beds)	300	150	166,100	78,245	151,020	105,869	498,530	298,494
Total shore catch	423,025	198,078	423,540	206,965	153,860	107,342	4,134,493	2,092,808
Total vessel and shore catch	560,021	273,026	432,965	212,365	153,860	107,342	5,685,561	3,031,518

The following is a summary of the crab fishery of Maryland in 1901:

Table showing, by counties, the extent of the crab fishery of Maryland in 1901.

Items.	Anne Arundel.		Baltimore.		Calvert.		Charles.		Dorchester.	
	No.	Value.	No.	Val.	No.	Val.	No.	Val.	No.	Value.
Persons engaged:										
Soft crabbers	157		32		100				435	
Hard crabbers	96		2		36		18		242	
Shoresmen	123		16		3				65	
On vessels transporting crabs									1	
Total *a*	376		50		139		18		743	
Vessels soft crabbing									35	$12,625
Tonnage									224	
Outfit										800
Vessels transporting crabs									1	100
Tonnage									8	
Outfit										10
Boats, soft crabbing	134	$1,559	16	$160	70	$560			296	10,485
Boats, hard crabbing	96	2,089	1	14	36	330	18	$144	214	3,105
Total *a*	230	3,648	17	174	106	890	18	144	510	13,590

a Exclusive of duplication.

Table showing, by counties, the extent of the crab fishery of Maryland in 1901—Continued.

Items.	Anne Arundel.		Baltimore.		Calvert.		Charles.		Dorchester.	
	No.	Value.	No.	Val.	No.	Val.	No.	Val.	No.	Value.
Apparatus used in soft crabbing:										
Scrapes									337	$1,141
Scoop nets	157	$83			100	$20			298	104
Seines	35	105	16	$432						
Apparatus used in hard crabbing:										
Trot lines	40	470	2	1	36	131	18	$45	227	810
Shore and accessory property		4,905		1,042		428				445
Cash capital		1,400				300				3,090
Total investment		10,611		1,649		1,769		189		19,180
Soft-crab catch by—										
Scrapes									698,500	10,750
Scoop nets	373,560	10,704			180,000	2,250			449,100	6,835
Seines	139,440	3,704	48,000	1,200						
Trot lines[a]	800	27	864	58	798	1			409,398	5,940
Total	513,800	14,435	48,864	1,258	180,798	2,251			1,556,998	23,525
Hard-crab catch by trot lines	3,487,695	8,794	1,440	12	543,999	884	630,000	2,100	4,992,999	18,337
Total catch, soft and hard crabs	4,001,495	23,229	50,304	1,270	724,797	3,135	630,000	2,100	6,549,997	41,862

Items.	Kent.		Queen Anne.		St. Mary.		Somerset.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Persons engaged:								
Soft crabbers	26		39		20		2,164	
Hard crabbers	115		93		60		89	
Shoresmen							250	
On vessels transporting crabs							20	
Total[b]	135		129		80		2,462	
Vessels, soft crabbing							20	$7,375
Tonnage							113	
Outfit								500
Vessels transporting crabs							12	3,500
Tonnage							80	
Outfit								300
Boats soft crabbing	13	$135	25	$198	15	$140	2,340	92,555
Boats hard crabbing	105	1,045	93	558	60	590	90	1,045
Total[b]	112	1,120	115	735	75	730	2,430	93,600
Apparatus used in soft crabbing:								
Scrapes							2,492	9,097
Scoop nets	23	4	35	10	50	13	1,443	562
Seines	12	38	17	89				
Apparatus used in hard crabbing:								
Trot lines	105	303	93	197	60	147	90	294
Shore and accessory property		115		80		30		27,414
Cash capital								81,150
Total investment		1,580		1,111		920		212,117
Soft-crab catch by—								
Scrapes							6,876,486	103,259
Scoop nets	8,700	175	31,200	685	15,075	419	3,156,210	49,378
Seines	20,120	430	66,498	1,425				
Trot lines[a]	24,000	700	20,400	360			72,000	1,300
Total	52,820	1,305	118,098	2,470	15,075	419	10,104,696	153,937
Hard-crab catch by trot lines	1,174,000	2,535	2,073,498	4,908	592,500	1,975	2,306,700	12,496
Total catch soft and hard crabs	1,226,820	3,840	2,191,596	7,378	607,575	2,394	12,411,396	166,433

[a] These lines are used primarily for hard crabs, the soft or shedding crabs being taken with the hard crabs as "doublers."

[b] Exclusive of duplication.

Table showing, by counties, the extent of the crab fishery of Maryland in 1901—Continued.

Items.	Talbot.		Wicomico.		Worcester.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Persons engaged:								
Soft crabbers	34						3,007	
Hard crabbers	403		72		2		1,228	
Shoresmen	615		158				1,230	
On vessels transporting crabs			2				23	
Total[a]	1,022		232		2		5,388	
Vessels soft crabbing							55	$20,000
Tonnage							337	
Outfit								1,300
Vessels transporting crabs			1	$400			14	4,000
Tonnage			5				93	
Outfit				10				320
Boats soft crabbing	17	$760					2,926	106,552
Boats hard crabbing	393	10,684	72	502	2	$20	1,180	20,126
Total[a]	395	10,694	72	502	2	20	4,082	125,847
Apparatus used in soft crabbing:								
Scrapes	2	9					2,831	10,247
Scoop nets	30	16					2,136	811
Seines	15	37					95	701
Apparatus used in hard crabbing:								
Trot lines	393	1,929	72	143	2	4	1,138	4,474
Shore and accessory property		29,250		4,320				68,029
Cash capital		15,925		10,000				111,865
Total investment		57,859		14,965		24		321,974
Soft-crab catch by—								
Scrapes	1,800	35					7,576,786	114,044
Scoop nets	16,299	340					4,230,144	70,786
Seines	24,498	510					298,556	7,269
Trot lines[b]	277,000	2,078					805,260	10,464
Total	319,597	2,963					12,910,746	202,563
Hard-crab catch by trot lines	11,314,550	28,753	2,352,000	5,040	4,998	50	[c]29,474,379	85,884
Total catch, soft and hard crabs	11,634,147	31,716	2,352,000	5,040	4,998	50	42,385,125	288,447

[a] Exclusive of duplication.
[b] These lines are used primarily for hard crabs, the soft or shedding crabs being taken with the hard crabs as "doublers."
[c] Includes 95,000 hard crabs, valued at $235, taken in crab scrapes, and 67,000 hard crabs, valued at $500, taken while dredging for oysters.

THE WHOLESALE FISHERY TRADE.

In the quantity of oysters handled Baltimore ranks first not only in the State, but in the entire country. This is largely due to its accessibility from the oyster grounds and its transportation facilities. So important is the shucking and packing trade of Baltimore that during the oyster season the leading railroads send out daily trains, several cars in length, loaded entirely with shucked oysters, which are widely distributed throughout the Western States. Many dealers, however, are finding it cheaper to have their oysters shucked in small towns contiguous to the oyster-grounds and shipped to Baltimore by steamer. This is also the case with firms engaged in the crab-meat industry. While Baltimore handles the larger portion of the State's oyster catch, owing to direct connection of towns on the eastern shore of the State with New York and Philadelphia, these two cities receive large shipments of fish, the demand being greater and the prices higher in many cases than in Baltimore.

The burning of oyster shells for lime is an industry of some importance in Baltimore, the product being used largely as a fertilizer. The use of crushed and ground shells as a food for fowls is also growing. Owing to the lessening quantity and higher prices of oysters the canning industry of this city is decreasing in value, several large firms having moved to other States. Next to Baltimore the largest quantities of oysters are handled at Cambridge, Crisfield, and Oxford, many shucking houses being located at these places. Crisfield still continues to be the most important crab-shipping point in the United States and, together with Deal Island, handles practically the entire soft-crab catch of the State. On account of the small capital necessary, the number of crab firms at Crisfield is increasing yearly and is no doubt responsible for the low prices received by the fishermen, as these firms, in their endeavors to get contracts with commission houses in the larger cities, are compelled to underbid competitors in fixing prices for the following season.

Hard crabs are handled principally at Oxford, St. Michaels and vicinity, Tilghman Island, and Cambridge. With the exception of the latter, these places handle the crab meat almost entirely.

The following table shows by localities the number and value of establishments, cash capital employed, and number of persons engaged in the wholesale fishery trade of Maryland in 1901:

Table showing the wholesale fishery trade of Maryland in 1901.

Localities.	Establishments.		Cash capital.	Number of persons engaged.
	No.	Value.		
Annapolis	6	$26,735	$19,800	375
Baltimore	104	1,795,940	1,968,350	7,972
St. Michaels, Claiborne, and Royal Oak	8	12,605	10,800	241
Tilghman Island	6	8,685	9,100	218
Oxford and Bellevue	16	31,048	20,875	591
Crisfield, Lawsonia, and Ewell	43	80,793	114,600	814
Deal Island and Chance	13	6,940	4,550	126
Fairmount and Oriole	9	11,800	14,700	243
Marion and Hopewell	6	9,780	13,400	205
Tulls Corner and Shelltown	2	3,825	3,500	104
Cambridge and Secretary	30	60,527	91,340	1,003
Holland Island and Elliott	2	905	1,000	20
Wingate and Vienna	2	865	1,000	20
Havre de Grace and Perryville	3	4,900	3,000	28
Bivalve and Tyaskin	4	3,970	14,500	287
Whitehaven and Nanticoke	2	2,250	5,500	94
Solomons and Benedict	2	878	900	17
Total	258	2,061,946	2,296,915	12,358

FISHERIES OF VIRGINIA.

The fisheries of Virginia, as compared with those of the other Middle Atlantic States, ranked first in the quantity of products in 1901.

The last two canvasses (1897 and 1901) of the fisheries of this State by the United States Fish Commission present some interesting comparisons. The total capital invested in shore property, vessels, fishing apparatus, and cash capital in 1897 amounted to $2,891,536, and in 1901 to $3,633,104, an increase of $741,568. The number of fishermen and shore employees in 1897 was 28,277, and in 1901, 29,325, an increase of 1,048. Of the employees in 1901, 5,565 were on vessels, 18,492 on small boats in shore fisheries, and 5,268 in wholesale fish markets, menhaden factories, and oyster canneries.

The products in 1901 as compared with 1897 show an increase of 861,599 bushels in the quantity and of $881,773 in the value of the oyster catch. In the other fishery products there has been an increase of 94,158,216 pounds and of $552,113. The total yield and value of the oyster fishery in 1897 was 7,023,848 bushels, of $2,041,683 value; in 1901, 7,885,447 bushels, of $2,923,456 value. The fishery products, exclusive of oysters, in 1897 amounted to 228,827,013 pounds, of $1,137,815 value; in 1901, to 322,985,229 pounds, of $1,689,928 value.

The greater part of the fish are caught by pound nets, gill nets, and haul seines, in each of which, since 1897, there has been a material increase in number. Pound nets have increased from 1,250 to 1,590, gill nets from 9,307 to 10,437, and haul seines from 107 to 257.

Alewives, one of the most abundant food species, have increased in both the quantity and value of the catch, which was 13,689,510 pounds in 1897, valued at $70,841, and 13,913,444 pounds in 1901, valued at $115,424. There was an increase of 905,690 pounds in the squeteague taken and of $38,026 in the value.

The shad catch is an important feature of the fisheries of Virginia, the most of it being taken in pound nets, of which many are owned and worked by planters who farm near the fishing-grounds. The farmer fishermen take up their pound nets at the close of the shad season. The shad catch of 1901 shows a large decrease from that of 1897, which is accounted for by the unusually cold and backward spring. The season at its best is short, and in 1901 the fish were late in arriving, after which much time was lost from the weather being unfavorable for fishing. The shad catch in 1897 amounted to 11,529,474 pounds, valued at $304,448, and in 1901 to 6,972,212 pounds, valued at $366,203, a decrease of 4,557,262 pounds in quantity and an increase of $38,245 in value, the better price received by the fishermen in 1901 more than compensating for the reduced catch. The shad in 1901 were extra large and of fine quality, and found a ready market at the seaside resorts, as well as in the northern markets, the demand being steady and prices satisfactory.

Crabs continue plentiful, with an increasing demand for those shipped alive, for cooked meat picked from the shell and shipped in bulk, and for that hermetically sealed in tin cans, the latter being distributed as far as the Pacific coast. The crab catch in 1897 amounted to 6,399,514 pounds, valued at $68,245, and in 1901 to 7,401,701 pounds, of $118,835 value, an increase of 1,002,187 pounds and of $50,590.

Oysters comprise more than three-fifths of the value of the fisheries of Virginia. The oyster season from September 1900 to May 1901 was the most successful for many years. The yield of the oyster fishery of Virginia in 1891 was 6,074,025 bushels, of $2,524,348 value; in 1897, 7,023,848 bushels, of $2,041,683 value; and in 1901, 7,885,447 bushels, of $2,923,357 value. The product of market oysters in 1901 was 2,991,144 bushels from natural rock or native beds and 3,076,525 bushels from private beds, and of seed oysters 1,817,778 bushels were taken from their native beds and replanted on private beds.

Yearly the area of native oyster grounds decreases, as a result of overworking the beds and the abandonment of those that have become unproductive. As soon as a bed is depleted of oysters it is available for rent by any citizen at $1 per acre per year. This has proved of much benefit to the State, both on account of the revenue derived and in the reestablishment of beds upon a commercial basis. Grounds once noted for an abundance of fine oysters were, from overworking, cleaned of oysters and abandoned, after which they were leased from the State by private parties who prepared and reseeded the grounds, watched and cared for them until they equaled or exceeded their former abundance. Others leased land up the rivers on bottoms that had never been known to have an oyster on them; seed oysters were planted on these grounds, and new areas of good oyster beds resulted.

In some cases leased lands have been used only for a short bedding of market oysters that had been taken from their native beds. This gave the owner protection during the few months the oysters remained on the private beds and fattened. In case of an overstocked market with much reduced prices, many cargoes are returned and planted on private beds. These oysters having been counted as from natural beds were not again counted from private beds, which accounts in some cases for the entire absence or very small quantity of oysters from private beds in counties that are known to have leased oyster lands.

ENDLESS-CHAIN SCRAPER USED IN OYSTER-SHUCKING ESTABLISHMENTS.

Oysters are brought in vessels from the oyster beds to the plants of the wholesale dealers and there unloaded into storerooms adjoining the shucking rooms on the wharf. From the latter they are carried to the shucking benches. Shucking benches extend the entire length of the long, low building, some 100 to 200 feet long, there often being several of the tables with an aisle between. Each of these long tables has partitions dividing it into stalls just large enough for the oyster opener to work to advantage. The opener picks up an oyster from the pile before him, placing its edge on an upright pin, and with a small hammer breaks off the tip end, then inserting his oyster knife with a quick motion, flips off the top shell which drops down a spout by his side; another quick motion with the knife and the oyster is thrown from the shell into a measure, the shell following the first one down the spout. From the chute the shells fall into an oval-shaped trough that extends under the entire length of the long table. An endless chain passes over the trough to which, every 2 or 3 feet, is attached an iron scraper that scrapes the shells as they fall from the hands of the opener. Arriving at the end of the table, the shells fall into another trough running at right angles, which is also provided with an endless chain with scrapers that passes on outside of the building and up an incline of 50 feet in height, out on an extended arm some 50 feet, around which it returns and continues its endless course. The extended arm at the top is provided with openings through which a continuous stream of shells falls so long as the 150 openers are at work. When one pile of shells reaches up to the 50-foot level the first opening is closed, the shells falling through the next opening, starting another pile from the ground. The endless chain is 1,000 feet long and is driven by a 45-horsepower steam engine. This appliance was first used in the oyster industry during the season of 1899 and 1900, removing 125,000 bushels of shells.

In the season of 1900-1901, 190,000 bushels of shells represented the bulk of the season's work of opened oysters by one firm. At the close of the season these shells were all removed and scattered over the private oyster beds of the firm, for the spat or young oysters to catch on soon after hatching out.

For many years the removal of the large amount of shells was quite a tax on the business. Shells were gladly given away to anyone who would remove them. Then as they came more in demand for road building, the filling of low lands, for making lime, and other purposes, a small price of 1 cent or less a bushel was paid. As the leasing of land for oyster culture increased, the shells came largely in demand for planting on oyster beds and were so used for several years, the price advancing to 2 cents a bushel. During the years of depression their use was discontinued. With the return of more prosperous years and a large increase of private beds, an active demand for shells to plant called for nearly all the supply, at prices ranging from 3 to 4 cents a bushel, adding many thousands of dollars to the receipts of the dealers.

FISHING WATERS AND SEASONS.

The State of Virginia is bountifully supplied with waters that produce many species of food fish. Beginning on the south near the State line of North Carolina, pound nets and haul seines are used all along the beach to Cape Henry and in the Chesapeake Bay and Potomac River, as well as on the eastern shore of Virginia in Accomac and Northampton counties. Pound nets are set in the early spring as soon as the weather will permit, but most of them are taken up when the run of shad is passed. A few are again fished for a short time in the fall, and others are fished all the season from March to November, the length of seasons depending on weather conditions. Much time and property are often lost from unfavorable weather. Haul seines are used during the same time mentioned for pound nets. These are worked by hand, horses, and in a few cases by steam.

The several navigable streams, including the Nansemond, James, York, Rappahannock, and Potomac rivers, with their numerous branches, creeks, and bays, are nearly all fished, more or less, for shad, and but very little except during the shad season. For a long time the rivers have no doubt been overfished, being lined with stake gill nets, haul seines, and a few other appliances of capture. So few of the local species remain that it does not pay the fishermen to follow the business after the run of shad is over. Citizens living along the upper tide waters now report very few, if any, shad seen in these waters, which formerly were so plentifully supplied with them. The same conditions obtain as to alewives and all other migratory fish.

It has been noted that the fishery products of Virginia for 1901 show quite an increase over those of 1897. This may be partly accounted for by an increased quantity of fishing apparatus in the waters of Chesapeake Bay and the near shore waters of the Atlantic Ocean. The number of pound nets increases every year, and they are placed farther from shore in deeper water.

While the river fisheries have to a large extent become exhausted, or at least unprofitable, their place has been filled by the planting of oysters on private beds. A large portion of the beds of the rivers before mentioned are now leased from the State and planted with oysters as far up as the waters are at all suitable. Much of this oyster ground was never known to have had an oyster on it, while other sections were abandoned oyster beds. Nearly all of these private oyster beds have proved financially successful, except when excessive rains have freshened the water and covered the oyster beds with silt, killing thousands of bushels of oysters. The two eastern counties of Virginia—Northampton and Accomac—have almost continuous shore lines of fishing-grounds in the waters of Chesapeake Bay and the Atlantic Ocean. The representative catches of this district embrace menhaden, blue-fish, alewives, crabs, and oysters, with smaller quantities of several other species.

The three tables which follow show the number of persons employed, the number and value of vessels, boats, and apparatus of capture, the value of shore and accessory property, the amount of cash capital, and the quantity and value of products in the fisheries of Virginia in 1901.

Persons employed.

How engaged.	No.
In vessel fisheries	4,430
On vessels transporting	1,135
In shore or boat fisheries	18,492
Shoresmen	5,268
Total	29,325

Table of apparatus and capital.

Items.	No.	Value.	Items.	No.	Value.
Vessels fishing	702	$529,588	Apparatus—shore fisheries:		
Tonnage	8,245		Seines	257	$41,135
Outfit		241,106	Pound nets	1,590	313,616
Vessels transporting	384	276,320	Gill nets	10,437	50,035
Tonnage	7,338		Fyke nets	729	7,444
Outfit		50,317	Lines		3,579
Boats	12,174	589,757	Eel pots and spears	579	585
Shore and accessory property		869,624	Weirs and slat traps	15	500
Cash capital		647,000	Oyster dredges	526	7,341
Apparatus—vessel fisheries:			Oyster tongs	9,478	42,488
Seines	54	37,395	Crab scrapes	933	2,256
Oyster dredges	435	9,315	Clam tongs, rakes, etc	1,976	5,574
Oyster tongs	1,687	7,318	Minor apparatus		255
Clam tongs, rakes, etc	359	556	Total		3,633,104

Table of products.

Species.	Lbs.	Value.	Species.	Lbs.	Value.
Alewives, fresh	13,633,444	$110,524	Shad	6,972,212	$366,203
Alewives, salted	280,000	4,900	Sheepshead	8,430	348
Black bass	199,439	16,735	Spanish mackerel	520,142	44,017
Blue-fish	755,085	25,609	Spots	806,827	24,306
Bonito	14,160	537	Squeteague	7,431,496	127,993
Butter-fish	1,071,860	28,551	Striped bass	527,507	45,177
Carp	127,930	2,940	Sturgeon	183,023	12,161
Cat-fish	820,325	23,560	Caviar	18,318	10,204
Crevalle	468,791	13,533	Suckers	48,165	927
Cod	100	4	Sun-fish	4,000	95
Croakers	3,937,168	53,493	Tarpon	75	1
Drum	228,172	2,707	Whiting	600	12
Eels	105,815	4,430	Crabs, hard	a6,113,277	52,863
Flounders	209,394	6,253	Crabs, soft	b1,288,424	65,972
Gizzard shad	5,250	100	Prawn	2,850	142
Hickory shad	448,600	11,427	Terrapin	5,130	1,444
Hog-fish	44,892	3,586	Turtles	56,897	1,444
King-fish	91,122	3,436	Frogs	15,377	1,283
Menhaden	273,493,709	433,109	Clams, hard	c1,764,680	134,777
Moon-fish	70,400	2,161	Market oysters, natural rock.	d20,938,008	1,145,169
Mullet	190,700	5,420			
Perch, white	731,925	32,582	Market oysters, private beds.	e21,535,675	1,476,746
Perch, yellow	158,939	4,472			
Pike	32,103	2,848	Seed oysters, natural rock	f12,724,446	301,541
Pompano	96,186	7,549			
Sea bass	2,200	´93	Total	378,183,358	4,613,384

a 18,339,831 in number.
b 3,865,272 in number.
c 220,585 bushels.
d 2,991,144 bushels.
e 3,076,525 bushels.
f 1,817,778 bushels.

The hard and soft crabs, clams, and oysters above shown in pounds are given by number and bushels in the following table:

Products.	No.	Value.
Crabs, hard	18,339,831	$52,863
Crabs, soft	3,865,272	65,972
Clams ... bushels	220,585	134,777
Market oysters, natural rocks ... do	2,991,144	1,145,169
Market oysters, private beds ... do	3,076,525	1,476,746
Seed oysters, natural rocks ... do	1,817,778	301,541

STATISTICS BY COUNTIES.

In 1897 the fisheries of Virginia were carried on in 34 counties, but since that time they have ceased to be of commercial importance in Dinwiddie and Hanover counties. The following tables give detailed statistics of the fisheries of each county for the year 1901:

Table showing the number of persons employed in the fisheries of Virginia in 1901.

Counties.	In vessel fisheries.	On vessels transporting.	In shore or boat fisheries.	Shoresmen.	Total.
Accomac	1,234	129	2,615	447	4,425
Alexandria		45	120		165
Caroline			16		16
Charles City			248		248
Chesterfield			86		86
Elizabeth City	79	63	501	516	1,159
Essex	6	10	297	30	343
Fairfax			165	10	175
Gloucester	346	73	967	84	1,470
Henrico			146		146
Isle of Wight	141	7	299		447
James City		4	80		84
King and Queen		3	264		267
King George	8		252	2	262
King William	110	62	256	234	662
Lancaster	405	89	1,773	837	3,104
Mathews	30	111	1,639		1,780
Middlesex	53	121	1,639	52	1,865
Nansemond	228	21	403	124	776
New Kent			271		271
Norfolk	628	106	718	1,959	3,411
Northampton	236	88	829	370	1,523
Northumberland	518	49	1,226	350	2,143
Princess Anne			585	52	637
Prince George			128		128
Prince William		2	135	5	142
Richmond	4	24	476	25	529
Stafford		3	151	10	164
Surry			43		43
Warwick	100	27	346		473
Westmoreland	151	12	394	31	588
York	153	86	1,424	130	1,793
Total	4,430	1,135	18,492	5,268	29,325

Table showing, by counties, the vessels, boats, apparatus, and shore property employed in the fisheries of Virginia in 1901.

Items.	Accomac.		Alexandria.		Caroline.		Charles City.		Chesterfield.		Elizabeth City.	
	No.	Value.	No.	Value.	No.	Val.	No.	Value.	No.	Val.	No.	Value.
Vessels fishing	163	$110,021									13	$18,500
Tonnage	1,677										171	
Outfit		38,280										6,345
Vessels transporting	42	40,350	16	$7,100							15	9,200
Tonnage	799		173								374	
Outfit		4,146		2,350								3,375
Boats	2,927	187,585	70	2,135	13	$130	146	$1,851	37	$795	272	14,410
Apparatus—vessel fisheries:												
Seines	10	5,645										
Oyster dredges	262	4,485									22	795
Oyster tongs	294	1,494									42	168
Clam tongs, rakes, etc	294	504										
Apparatus—shore fisheries:												
Seines	33	1,115	4	800	1	20	5	1,825	6	300	2	300
Pound nets	128	20,140			9	900					103	30,150
Gill nets	21	251	47	3,255	5	100	143	3,701	48	1,365	1	30
Fyke nets	3	35	72	720								
Lines		118						10				800
Eel pots and spears	16	10										
Oyster dredges	330	5,219										
Oyster tongs	1,647	8,469									213	962
Crab scrapes	933	2,256										
Clam tongs, rakes, etc	1,273	4,129										
Minor apparatus		30										
Shore and accessory property		74,815		565		50		1,825		525		71,165
Cash capital		63,300										61,000
Total		572,397		16,925		1,200		9,212		2,985		217,200

Vessels, boats, apparatus, etc., of the fisheries of Virginia in 1901—Continued.

Items.	Essex.		Fairfax.		Gloucester.		Henrico.		Isle of Wight.		James City.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Val.
Vessels fishing					74	$27,875			35	$11,175		
Tonnage					768				346			
Outfit						16,925				9,065		
Vessels transporting	4	$1,625			27	18,500			3	900	1	$600
Tonnage	66				615				45		31	
Outfit		475				3,455				325		200
Boats	196	4,275	61	$3,633	688	25,516	73	$1,619	130	3,860	47	1,004
Apparatus—vessel fisheries:												
Oyster dredges					2	100						
Oyster tongs					228	912			94	376		
Apparatus—shore fisheries:												
Seines	1	200	4	8,450					2	100	1	20
Pound nets	37	3,575	40	4,900	172	34,400					2	200
Gill nets	875	1,601	17	1,020	540	810	97	2,300	2,480	5,532	724	1,936
Fyke nets	8	80	55	1,075	116	1,160	100	200	24	276	40	400
Lines		14				180				39		34
Eel pots and spears	78	110							50	50	100	100
Weirs and slat traps							6	120				
Oyster tongs	199	696			784	2,836			140	560	20	80
Shore and accessory property		2,790		3,860		4,500		375		2,150		380
Total		15,441		22,938		137,169		4,614		34,408		4,954

Items.	Nansemond.		New Kent.		Norfolk.		Northampton.		Northumberland.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	50	$24,300			112	$38,775	43	$41,817	57	$126,550
Tonnage	486				1,115		465		1,215	
Outfit		13,360				39,830		17,028		38,432
Vessels transporting	10	6,250			38	30,200	37	27,170	15	10,700
Tonnage	100				678		462		362	
Outfit		1,065				5,360		3,471		1,930
Boats	189	4,435	164	$2,484	339	14,750	685	29,004	791	36,765
Apparatus—vessel fisheries:										
Seines							6	5,650	20	13,700
Oyster dredges									91	1,585
Oyster tongs	152	608			431	1,780	105	458		
Clam tongs, rakes, etc							65	52		
Apparatus—shore fisheries:										
Seines	1	200	5	1,170	6	6,300	4	565	1	175
Pound nets	5	200			23	15,725	16	11,600	299	67,951
Gill nets	16	112	525	3,384	569	1,895				
Fyke nets	6	120	16	160			1	10		
Lines		10		15		291		298		89
Eel pots and spears									100	75
Weirs and slat traps	2	30								
Oyster dredges									86	832
Oyster tongs	206	824	28	112	326	1,304	352	1,534	664	2,077
Clam tongs, rakes, etc					15	60	219	172		
Minor apparatus		60				16		16		45
Shore and accessory property		10,550		965		300,060		91,314		85,800
Cash capital		9,000				194,000		38,900		53,800
Total		71,124		8,290		650,296		269,069		440,506

Items.	Princess Anne.		Prince George.		Prince William.		Richmond.		Stafford.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing							1	$300		
Tonnage							14			
Outfit								150		
Vessels transporting					1	$300	8	5,700	1	$300
Tonnage					8		165		6	
Outfit						100		975		150
Boats	345	$4,515	63	$1,020	45	2,219	277	6,590	63	2,480
Apparatus—vessel fisheries:										
Oyster tongs							4	16		
Apparatus—shore fisheries:										
Seines	126	5,070	1	75	10	4,225			10	3,675
Pound nets	13	16,200			11	1,225	94	9,050	78	4,660
Gill nets	210	6,840	73	2,381	9	600	2,060	3,193	6	500
Fyke nets					25	500			67	660
Lines		230		5		3				
Eel pots and spears	240	240								
Oyster tongs	125	375					289	1,164		
Minor apparatus				15						10
Shore and accessory property		9,050		500		1,660		4,065		2,960
Total		42,520		3,996		10,832		31,203		15,395

Vessels, boats, apparatus, etc., of the fisheries of Virginia in 1901—Continued.

Items.	King George.		King and Queen.		King William.		Lancaster.		Mathews.		Middlesex.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing	2	$350			13	$6,000	28	$86,300	5	$1,950	10	$2,900
Tonnage	12				179		772		50		91	
Outfit		320				7,300		29,951		1,155		2,595
Vessels transporting			1	$1,500	22	19,250	29	17,850	35	18,775	84	85,700
Tonnage			30		442		516		799		974	
Outfit				150		3,050		3,425		4,650		5,600
Boats	117	6,138	99	4,600	139	1,640	1,026	64,720	916	51,735	1,058	58,035
Apparatus—vessel fisheries:												
Seines							16	11,400			2	1,000
Oyster dredges	4	170										
Oyster tongs					92	368	36	272	10	88	22	120
Apparatus—shore fisheries:												
Seines	4	1,750	1	200	2	350	6	1,650	10	50	6	1,950
Pound nets	102	11,175					138	26,375	189	32,750	44	7,390
Gill nets	23	620	64	1,280	378	3,794						
Fyke nets	30	318			106	1,060						
Lines		1				133		182		160		140
Weirs and slat traps					7	350						
Oyster dredges	11	440									2	24
Oyster tongs	60	210	115	700	12	48	889	3,916	802	4,843	1,114	5,846
Clam tongs, rakes, etc									40	120		
Minor apparatus								34		6		18
Shore and accessory property		1,555		1,100		16,670		155,530		2,625		12,690
Cash capital						46,000		73,000				5,000
Total		23,047		9,530		106,013		474,605		118,907		134,008

Items.	Surry.		Warwick.		Westmoreland.		York.		Total.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Vessels fishing			20	$5,800	27	$11,650	49	$15,325	702	$529,588
Tonnage			258		210		416		8,245	
Outfit				5,090		5,435		9,845		241,106
Vessels transporting			9	3,150	4	2,500	32	18,700	384	276,320
Tonnage			117		58		518		7,338	
Outfit				1,260		500		4,305		50,317
Boats	23	$345	173	4,315	189	11,809	813	40,345	12,174	589,757
Apparatus—vessel fisheries:										
Seines									54	37,395
Oyster dredges					54	2,180			435	9,315
Oyster tongs			70	280			107	428	1,687	7,318
Clam tongs, rakes, etc									359	556
Apparatus—shore fisheries:										
Seines					5	600			257	41,135
Pound nets					57	6,250	30	8,800	1,590	313,616
Gill nets	731	2,185	750	1,125	22	135	3	90	10,437	50,035
Fyke nets			8	80	17	170	35	420	729	7,444
Lines				20		52		755		3,579
Eel pots and spears									579	585
Weirs and slat traps									15	500
Oyster dredges					97	826			526	7,341
Oyster tongs			235	940	188	636	1,120	4,356	9,478	42,488
Crab scrapes									933	2,256
Clam tongs, rakes, etc							429	1,093	1,976	5,574
Minor apparatus								5		255
Shore and accessory property		300		1,350		1,505		6,375		869,624
Cash capital						3,000				547,000
Total		2,830		23,410		47,248		110,842		3,633,104

Table showing, by counties, the products of the fisheries of Virginia in 1901.

Species.	Accomac.		Alexandria.		Caroline.		Charles City.		Chesterfield.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	477,270	$3,200	38,000	$202	56,500	$565	149,362	$1,724	138,000	$2,070
Black bass	1,050	105	9,914	804			5,500	390	18,000	1,440
Blue-fish	79,940	3,921								
Bonito	3,640	207								
Butter-fish	17,005	351								
Carp, German			1,500	30			4,250	125	30,000	900
Cat-fish	750	30	27,200	689	1,000	20	17,100	641	6,000	240
Cod	100	4								
Croakers	128,465	2,543								
Drum	93,670	744								
Eels	3,600	147	1,000	30						
Flounders	30,735	899								
Hickory shad							4,500	150		
King-fish	27,750	962								
Menhaden	41,828,700	77,461								
Mullet	60,400	1,704								
Perch, white	4,190	141	7,900	395	2,250	122	10,342	712	1,800	108
Perch, yellow			20,500	435			10,467	300	1,760	35
Pike			2,050	183						
Pompano	51,985	4,077								
Sea bass	2,200	93								
Shad	104,539	5,103	289,080	7,401	7,425	297	299,256	17,528	72,100	4,120
Sheepshead	1,200	73								
Spanish mackerel	68,625	5,968								
Spots	17,405	762								
Squeteague	505,065	13,711								
Striped bass	5,145	340	10,916	1,045	900	72	20,795	1,248		
Sturgeon	8,115	774					6,840	832		
Caviar							556	318		
Suckers			3,500	52			3,800	66		
Crabs, hard	80,000	530								
Crabs, soft	1,093,784	46,848								
Terrapin	1,230	794								
Turtles							1,025	51		
Frogs							700	125		
Clams, hard	1,073,520	99,439								
Market oysters, from natural rock	2,930,333	175,663								
Market oysters, from private beds	3,320,205	266,008								
Seed oysters, from natural rock	2,579,290	71,896								
Total	54,599,906	784,498	411,560	11,266	68,075	1,076	533,993	24,210	267,660	8,913

Species.	Isle of Wight.		James City.		King George.		King and Queen.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh			19,055	$190	1,144,000	$5,959	7,500	$75
Blue-fish					900	36		
Carp, German	800	$12			1,100	17		
Cat-fish	9,975	333	43,800	1,425	120,850	3,115	3,000	75
Croakers	41,050	698	600	12				
Eels	2,500	125	5,400	270	700	21		
Flounders	2,800	54			11,850	331		
Gizzard shad	5,250	100						
Perch, white	4,475	261	7,625	686	73,766	4,353	1,500	90
Perch, yellow					4,000	130		
Pike					1,300	65		
Shad	121,812	6,463	70,596	4,346	162,849	5,259	93,000	4,650
Spots	8,550	177						
Squeteague	36,800	1,183	15,000	450	1,000	40		
Striped bass	4,500	355	15,150	1,818	126,059	12,399	500	50
Sturgeon	6,900	516	10,750	860				
Caviar	880	513	600	336				
Turtles			1,092	54	1,200	65		
Frogs			917	163				
Market oysters, from natural rock	794,199	39,808			147,700	8,620	21,000	1,500
Market oysters, from private beds	525,000	30,000	133,000	9,500			448,000	35,200
Seed oysters, from natural rock	1,219,946	26,188						
Total	2,780,437	106,736	323,585	20,110	1,796,774	40,410	574,500	41,640

Table showing, by counties, the products of the fisheries of Virginia in 1901—Continued.

Species.	Elizabeth City.		Essex.		Fairfax.		Gloucester.		Henrico.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.
Alewives, fresh	258,934	$3,435	219,360	$2,231	1,590,671	$10,086	344,000	$5,160	285,000	$6,225
Black bass					21,225	2,040				
Blue-fish	382,375	11,471								
Bonito	400	12								
Butter-fish	145,100	4,353	17,300	413			172,000	5,160		
Carp, German	1,200	36			13,375	275	25,000	250		
Cat-fish			37,650	954	49,135	1,407	56,000	1,680	35,000	1,450
Crevalle	100,561	3,009					103,200	3,098		
Croakers	888,563	13,680					412,800	4,128		
Drum	16,350	155					34,400	344		
Eels			24,100	1,160	1,680	50	6,000	210		
Flounders	65,564	1,967					10,000	300		
Hickory shad	78,300	1,839					68,800	1,376		
Hog-fish	30,300	2,130								
King-fish	3,500	140								
Menhaden	1,464,825	2,930					344,000	688		
Moon-fish	66,400	2,057								
Mullet	22,800	466								
Perch, white	39,600	1,916	6,310	253	26,970	1,370	60,000	3,600	23,000	1,380
Perch, yellow			125	5	23,450	657				
Pike					4,787	397				
Pompano	13,870	991					10,000	700		
Shad	272,507	18,703	87,385	3,513	151,049	5,023	527,250	35,150	72,450	4,140
Spanish mackerel	53,352	4,497					172,000	13,760		
Spots	102,082	2,041								
Squeteague	1,818,031	28,133	18,825	385			206,400	3,096		
Striped bass	1,534	92	9,290	537	31,248	3,261	26,200	2,994		
Sturgeon	29,558	2,142					7,500	450		
Caviar	3,653	2,207					910	546		
Suckers			165	5	8,350	137				
Whiting	600	12								
Crabs, hard	1,044,330	5,937					177,000	1,770		
Turtles	12,525	236					5,000	100		
Frogs			12,400	750						
Clams, hard	42,664	3,520					50,984	4,093		
Market oysters, from natural rock	250,110	14,292	122,220	7,384			818,300	44,304		
Market oysters, from private beds	2,660,000	149,040	634,837	45,345			759,500	47,200		
Seed oysters, from natural rock	963,830	27,538	7,000	200			1,163,400	26,730		
Total	10,833,418	308,977	1,196,967	63,135	1,921,940	24,703	5,560,644	206,887	415,450	13,195

Species.	King William.		Lancaster.		Mathews.		Middlesex.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	145,850	$1,459	230,000	$1,725	811,500	$4,403	299,600	$2,796
Blue-fish			6,500	455	9,380	369		
Butter-fish			109,500	2,310	37,400	752	77,950	1,252
Carp, German	5,015	100						
Cat-fish	181,200	4,580	5,600	168				
Crevalle	2,720	81						
Croakers	3,850	67	75,600	756	68,500	805	25,800	508
Drum			7,560	76				
Eels	3,800	76	3,500	140				
Flounders	3,310	102	3,140	94				
Hickory shad					83,750	2,680		
Menhaden			84,902,190	131,175	135,000	140	3,194,500	3,826
Mullet					2,500	50		
Perch, white	5,860	352						
Perch, yellow			3,000	60				
Shad	269,064	14,381	470,225	26,765	818,455	46,776	150,325	7,978
Spanish mackerel			33,800	2,704	875	139	3,150	252
Spots			2,500	125				
Squeteague	31,800	954	246,500	4,520	143,250	3,135	96,250	2,647
Striped bass	7,500	751	3,400	198	7,200	576	80,000	1,800
Sturgeon	625	44	6,475	389	23,800	714	1,800	126
Caviar	75	45	1,200	720	900	360	130	78
Suckers	9,250	139						
Crabs, hard	133,650	1,337	292,280	4,041	218,751	3,280	100,831	1,537
Crabs, soft			96,000	9,950	4,000	800	6,800	510
Terrapin					150	100		
Turtles					10,000	200		
Clams, hard					196,000	1,400		
Market oysters, from natural rock			1,787,800	102,160	2,044,350	114,120	2,168,600	123,970
Market oysters, from private beds	385,000	32,000	1,551,200	109,300	585,550	47,590	1,379,000	98,500
Seed oysters, from natural rock	546,000	11,700	55,300	1,975			2,800	100
Total	1,734,069	68,168	89,893,270	399,806	5,201,311	227,889	7,537,536	245,880

Table showing, by counties, the products of the fisheries of Virginia in 1901—Continued.

Species.	Nansemond.		New Kent.		Norfolk.		Northampton.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	2,000	$80	354,633	$3,244	84,280	$1,032	27,000	$42
Black bass			200	10				
Blue-fish					54,850	1,750	81,370	1,383
Bonito							5,310	159
Butter-fish					198,850	5,930	21,200	510
Carp, German	400	16	640	13	600	18		
Cat-fish	1,400	57	12,600	345				
Crevalle			320	10	122,650	3,680	18,650	405
Croakers	16,500	260	400	8	432,500	6,625	114,175	2,282
Drum					24,500	245	40,450	1,015
Eels			320	7			240	12
Flounders			160	5	25,950	973	5,950	165
Hog-fish					11,200	1,120	860	82
King-fish					7,950	276	5,410	498
Menhaden					440,000	840	25,880,800	43,136
Moon-fish							2,000	44
Mullet					80,000	2,300		
Perch, white	1,700	102	1,120	83	17,800	506		
Perch, yellow			790	47				
Pompano							7,315	741
Shad	36,750	2,475	292,969	16,782	131,290	8,491	12,510	720
Sheepshead							340	32
Spanish mackerel					5,300	586	72,425	7,304
Spots					213,200	7,044	42,955	1,344
Squeteague	5,800	105	4,800	192	1,047,410	18,548	997,380	12,415
Striped bass	2,300	184	1,000	100			15,260	1,098
Sturgeon					14,205	1,022	2,580	129
Caviar					755	484	70	35
Suckers	6,000	180	800	12				
Tarpon					75	1		
Crabs, hard			1,200	12	1,090,625	10,375	1,509,000	9,159
Crabs, soft					2,400	420		
Turtles			2,900	145	400	8		
Frogs			1,150	205				
Clams, hard					32,000	3,000	202,160	11,371
Market oysters, from natural rock	1,352,456	68,698			3,483,620	174,806	715,540	32,317
Market oysters, from private beds	546,000	29,699	154,000	12,100	1,692,005	109,197	3,981,978	245,817
Seed oysters, from natural rock	1,181,600	25,920			672,700	17,920	1,464,470	29,464
Total	3,152,906	127,726	830,002	33,320	9,887,115	377,197	35,177,898	401,679

Species.	Stafford.		Surry.		Warwick.		Westmoreland.		York.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	940,408	$6,375					584,756	$2,934		
Alewives, salted	280,000	4,900								
Black bass	76,150	7,547								
Blue-fish	800	82					1,990	78	54,800	$1,644
Butter-fish									27,000	810
Carp	21,700	540					6,000	90		
Cat-fish	75,625	2,366			3,000	$100	62,240	1,929		
Crevalle									20,800	624
Croakers					21,945	665			739,200	11,334
Drum									900	15
Eels							700	23		
Flounders							5,645	184	3,000	90
Menhaden									240,000	480
Mullet									15,000	600
Perch, white	33,710	1,686			550	50	90,970	4,805		
Perch, yellow	48,350	1,712					14,100	423		
Pike	19,225	1,821					600	30		
Shad	23,280	651	66,815	$3,580	34,650	2,310	57,546	1,762	58,040	3,536
Spots					1,875	75	700	21	8,800	176
Squeteague	1,000	40			8,580	260	3,500	140	278,600	4,342
Striped bass	27,050	2,246			400	50	108,060	8,633	8,000	180
Sturgeon			10,800	756					8,700	609
Caviar			800	400					1,500	900
Suckers	8,750	175								
Sun-fish							4,000	95		
Crabs, hard							134,200	1,779	662,580	5,478
Crabs, soft									2,500	200
Terrapin									1,750	450
Turtles	800	50					675	40	1,000	20
Clams, hard									167,352	11,954
Market oysters, from natural rock					226,240	14,034	802,830	47,923	1,850,450	93,140
Market oysters, from private beds					350,000	18,850			1,274,000	75,050
Seed oysters, natural rock					1,049,860	22,497			1,783,250	38,213
Total	1,556,848	30,141	78,415	4,736	1,607,100	58,891	1,878,512	70,889	7,197,222	249,845

Table showing, by counties, the products of the fisheries of Virginia in 1901—Continued.

Species.	Northumberland.		Princess Anne.		Prince George.		Prince William.		Richmond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives, fresh	4,315,000	$36,700	11,915	$185	16,800	$198	766,800	$5,126	315,250	$3,153
Black bass			44,000	2,200	8,000	240	20,400	1,959		
Blue-fish	56,300	2,152	75,880	2,318						
Bonito			4,810	159						
Butter-fish	55,300	903	193,255	5,807						
Carp, German					5,000	150	11,350	368		
Cat-fish					1,000	40	32,300	968	37,900	948
Crevalle			99,890	2,626						
Croakers	34,200	186	933,520	8,936						
Drum			10,342	113						
Eels	7,000	350	22,000	880			2,800	84	20,475	845
Flounders	27,300	819	14,490	270						
Hickory shad	213,250	5,382								
Hog-fish			2,532	254						
King-fish			46,512	1,560						
Menhaden	115,055,034	172,383	8,750	50						
Moon-fish			2,000	60						
Mullet			10,000	300						
Perch, white			292,137	8,750	300	18	17,300	798	750	45
Perch, yellow			19,250	193	312	6	12,610	462	225	7
Pike							4,141	352		
Pompano			13,016	1,040						
Shad	1,712,000	83,075	84,550	6,600	156,750	8,802	50,800	1,395	219,895	8,428
Sheepshead	850	60	6,040	183						
Spanish mackerel	8,735	785	101,880	8,022						
Spot	6,500	325	407,260	12,216						
Squeteague	408,580	7,001	1,471,925	24,996					85,000	1,700
Striped bass	35,000	2,500	6,450	447			20,800	1,721	7,850	482
Sturgeon	28,230	1,571	11,465	899	4,680	328				
Caviar	5,089	2,542	850	510	350	210				
Suckers							7,800	156	250	5
Crabs, hard	316,830	4,812	352,000	2,816						
Crabs, soft	82,940	7,744								
Prawn			2,850	142						
Terrapin					2,000	100				
Turtles	9,200	184	6,080	61	1,000	50	4,000	180		
Frogs					210	40				
Market oysters, from natural rock	1,281,140	73,358							141,120	9,072
Market oysters, from private beds	85,400	6,100	157,500	45,000					913,500	65,250
Seed oysters, from natural rock			14,000	500					21,000	750
Total	123,743,878	408,932	4,427,149	138,093	191,402	10,182	951,101	13,569	1,763,215	90,685

Number and value of shad taken in the fisheries of Virginia in 1901.

County.	No.	Value.	County.	No.	Value.
Accomac	29,868	$5,103	Middlesex	42,950	$7,978
Alexandria	72,270	7,401	Nansemond	10,500	2,475
Caroline	2,475	297	New Kent	97,223	16,782
Charles City	87,702	17,528	Norfolk	40,280	8,491
Chesterfield	20,600	4,120	Northampton	8,574	720
Elizabeth City	89,539	18,703	Northumberland	462,500	83,075
Essex	26,210	3,513	Princess Anne	24,621	6,600
Fairfax	38,707	5,023	Prince George	45,000	8,802
Gloucester	175,750	35,150	Prince William	12,700	1,395
Henrico	20,700	4,140	Richmond	62,827	8,428
Isle of Wight	35,400	6,463	Stafford	5,820	651
James City	21,731	4,346	Surry	19,090	3,580
King and Queen	26,571	4,650	Warwick	9,900	2,310
King George	42,009	5,259	Westmoreland	14,456	1,762
King William	89,688	14,381	York	15,154	3,536
Lancaster	134,350	26,765			
Mathews	233,845	46,776	Total	a 2,014,010	366,203

a 6,972,212 pounds.

THE PRODUCTS BY APPARATUS.

The products of the vessel fisheries of this State amounted to 277,812,456 pounds, valued at $1,080,475, and those of the shore fisheries to 100,370,902 pounds, valued at $3,532,909. The yield of the vessel fisheries consisted of menhaden with purse seines, 262,877,262 pounds, $417,765; oysters with dredges and tongs, 14,749,490 pounds, or 2,107,070 bushels, $644,169; and hard clams with tongs, etc., 185,704 pounds, or 23,213 bushels, $18,541. In the shore fisheries a greater variety of apparatus was employed and the products comprised upward of thirty different species. Seines secured 9,987,821 pounds, $122,774; gill nets, 3,204,111 pounds, $133,171; pound nets, 34,620,083 pounds, $673,789; slat traps and weirs, 84,780 pounds, $2,559; fyke nets, 668,837 pounds, $28,453; lines, 8,415,124 pounds, $105,894; eel pots and spears, 47,700 pounds, $2,132; minor apparatus, 320,103 pounds, $25,976; dredges and tongs, 40,488,639 pounds, or 5,778,377 bushels of oysters, $2,279,287; clam tongs, hoes, and rakes, 1,578,976 pounds, or 197,372 bushels of clams, $116,236; and crab scrapes, 994,728 pounds, or 2,996,184 soft crabs in number, $42,638.

The following tables show, by counties and species, the quantity and value of products taken with each form of apparatus in the vessel and shore fisheries of Virginia in 1901:

Table showing, by counties, the yield of the seine fisheries in Virginia in 1901.

Species.	Accomac.		Alexandria.		Caroline.		Charles City.		Chesterfield.		Elizabeth City.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Vessel fisheries:												
Menhaden	40,077,900	$75,038										
Shore fisheries:												
Alewives, fresh	800	12			25,000	$250	139,500	$1,625	36,000	$540		
Black bass			9,214	$734			5,000	350	18,000	1,440		
Carp							2,250	45	30,000	900		
Cat-fish			16,875	483			17,100	641	6,000	240		
Croakers	8,150	220										
Drum	1,200	18										
Flounders	10,250	267										
Hickory shad							4,500	150				
King-fish	4,150	149										
Mullet	36,800	1,034									1,800	$46
Perch, white	1,100	43	3,400	170			10,342	712	1,800	108		
Perch, yellow			13,150	288			10,467	300	1,760	35		
Pike			1,050	83								
Sea bass	500	20										
Shad	513	32					26,606	1,495	18,900	1,080		
Spots	6,905	290									3,000	60
Squeteague	119,480	3,347									1,000	60
Striped bass	300	18	10,916	1,045			20,795	1,248				
Suckers							3,300	66				
Total	190,148	5,450	54,605	2,803	25,000	250	239,860	6,632	112,460	4,343	5,800	166
Grand total	40,268,048	80,488	54,605	2,803	25,000	250	239,860	6,632	112,460	4,343	5,800	166

Species.	Essex.		Fairfax.		Isle of Wight.		James City.		King George.		King and Queen.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Shore fisheries:												
Alewives, fresh	10,000	$100	1,204,671	$7,529			10,000	$100	28,000	$140		
Black bass			10,800	1,060								
Blue-fish									900	36		
Carp			5,425	109	800	$12						
Cat-fish	2,500	50	18,955	506	2,400	84			52,750	1,056	3,000	$75
Croakers					2,500	37						
Flounders					1,875	37						
Gizzard shad					5,250	100						
Perch, white	2,000	80	5,510	300	1,000	50			20,100	1,005	1,500	90
Perch, yellow			10,400	216					2,000	70		
Pike			850	68								
Shad	15,000	500	47,274	1,891					2,875	87	1,500	75
Squeteague					3,650	109			1,000	40		
Striped bass	3,000	150	16,568	1,939					58,600	6,470	500	50
Total	32,500	880	1,320,453	13,618	17,475	429	10,000	100	166,225	8,904	6,500	290

Table showing, by counties, the yield of the seine fisheries in Virginia in 1901—Continued.

Species.	King William.		Lancaster.		Mathews.		Middlesex.		Nansemond.	
	Lbs.	Val.	Lbs.	Value.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Vessel fisheries:										
Menhaden			81,402,194	$127,520			2,000,000	$2,000		
Shore fisheries:										
Alewives, fresh	111,000	$1,110								
Carp	775	15								
Cat-fish	18,000	450								
Croakers									5,000	$50
Menhaden			3,066,666	3,220			1,194,500	1,826		
Mullet					2,500	$50				
Perch, white	2,900	174							300	18
Perch, yellow			3,000	60						
Shad	7,650	410							10,500	650
Squeteague			22,500	790					1,200	18
Striped bass	625	63	600	30					500	40
Suckers	2,200	33							6,000	180
Total	143,150	2,255	3,092,766	4,100	2,500	50	1,194,500	1,826	23,500	956
Grand total	143,150	2,255	84,494,960	131,620	2,500	50	3,194,500	3,826	23,500	956

Species.	New Kent.		Norfolk.		Northampton.		Northumberland.		Princess Anne.	
	Lbs.	Val.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Val.
Vessel fisheries:										
Menhaden					25,858,800	$43,098	113,538,368	$170,109		
Shore fisheries:										
Alewives, fresh	328,502	$2,985	780	$9						
Black bass	200	10							44,000	$2,200
Blue-fish			8,000	240	120	6	24,000	720	1,000	40
Cat-fish	3,000	105								
Croakers			160,000	3,100					182,500	1,250
Flounders			3,400	161	350	11			2,500	50
Hog-fish			10,000	1,000						
King-fish			1,000	30	1,310	123				
Mullet			10,000	200					8,000	240
Perch, white	800	64	15,900	468					290,250	8,707
Perch, yellow	790	47							19,250	193
Shad	9,354	604								
Spanish mackerel							400	60		
Spots			104,700	3,269	6,115	187			149,000	4,470
Squeteague			77,260	2,125	46,080	1,389			86,000	3,680
Striped bass	200	20			15,260	1,098				
Total	342,846	3,833	391,040	10,602	69,235	2,814	24,400	780	782,500	20,830
Grand total	342,846	3,833	391,040	10,602	25,928,035	45,912	113,562,768	170,889	782,500	20,830

Species.	Prince George.		Prince William.		Stafford.		Westmoreland.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:										
Menhaden									262,877,262	$417,765
Shore fisheries:										
Alewives, fresh	6,000	$90	500,000	$3,125	580,000	$3,925			2,980,253	21,538
Alewives, salted					280,000	4,900			280,000	4,900
Black bass	3,000	240	11,990	1,140	28,000	2,792			130,204	9,966
Blue-fish					800	32	1,850	$72	36,670	1,146
Carp	5,000	150	8,750	290	2,000	60	5,500	82	60,500	1,663
Cat-fish	1,000	40	25,300	758	26,525	767	21,500	645	214,905	5,900
Croakers									358,150	4,657
Drum									1,200	18
Flounders									18,375	526
Gizzard shad									5,250	100
Hickory shad									4,500	150
Hog-fish									10,000	1,000
King-fish									6,460	302
Menhaden									4,261,166	5,046
Mullet									59,100	1,570
Perch, white	300	18	10,650	465	19,950	998	37,500	1,875	425,302	15,845
Perch, yellow	312	6	7,860	272	10,600	358	14,100	423	93,689	2,268
Pike			2,466	185	2,675	224			7,041	560
Sea bass									500	20
Shad	3,150	180	27,200	680	12,480	327			183,002	8,011
Spanish mackerel									400	60
Spots							700	21	270,420	8,297
Squeteague					1,000	40	2,600	104	361,770	11,702
Striped bass			16,400	1,331	21,850	1,726	28,000	2,240	194,114	17,468
Suckers			3,000	60	6,350	127			20,850	466
Sun-fish							4,000	95	4,000	95
Total	18,762	724	613,616	8,306	992,230	16,276	115,750	5,557	9,987,821	122,774
Grand total	18,762	724	613,616	8,306	992,230	16,276	115,750	5,557	272,865,083	540,539

Table showing, by counties, the yield of the gill-net fisheries of Virginia in 1901.

Species.	Accomac.		Alexandria.		Caroline.		Charles City.		Chesterfield.		Elizabeth City.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives			38,000	$202			9,862	$99	102,000	$1,530		
Black bass							500	40				
Blue-fish	1,200	$72										
Carp							2,000	80				
King-fish	300	11										
Mullet	23,600	670									20,000	$400
Shad			289,080	7,401	4,500	$180	272,650	16,033	53,200	3,040		
Spots	600	30										
Squeteague	4,000	120									400	24
Sturgeon							6,840	832				
Caviar							556	318				
Total	29,700	903	327,080	7,603	4,500	180	292,408	17,402	155,200	4,570	20,400	424

Species.	Essex.		Fairfax.		Gloucester.		Henrico.		Isle of Wight.		James City.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives	3,000	$30					265,000	$5,725			9,055	$90
Shad	48,835	2,014	91,200	$2,736	11,250	$750	72,450	4,140	121,812	$6,463	66,096	4,046
Sturgeon									6,900	516	10,750	860
Caviar									880	513	600	336
Total	51,835	2,044	91,200	2,736	11,250	750	337,450	9,865	129,592	7,492	86,501	5,332

Species.	King George.		King and Queen.		King William.		Nansemond.		New Kent.		Norfolk.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives			7,500	$75	18,500	$185			24,931	$249		
Croakers											50,000	$650
Flounders											3,000	150
Mullet											68,000	2,040
Shad	33,763	$1,284	91,500	4,575	258,234	13,759	9,275	$662	283,135	16,146	55,800	3,965
Spots											24,000	1,500
Squeteague											43,500	815
Sturgeon					625	44						
Caviar					75	45						
Total	33,763	1,284	99,000	4,650	277,434	14,033	9,275	662	308,066	16,395	244,300	9,120

Species.	Princess Anne.		Prince George.		Prince William.		Richmond.		Stafford.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives			10,800	$108	116,000	$870			64,000	$480
Shad	24,500	$1,950	153,600	8,622	23,600	715	141,512	$6,065	10,800	324
Sturgeon			4,680	328						
Caviar			350	210						
Total	24,500	1,950	169,430	9,268	139,600	1,585	141,512	6,065	74,800	804

Species.	Surry.		Warwick.		Westmoreland.		York.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives									668,648	$9,643
Black bass									500	40
Blue-fish							7,200	$216	8,400	288
Carp									2,000	80
Croakers							3,000	45	53,000	695
Flounders									3,000	150
King-fish									300	11
Mullet							15,000	600	126,600	3,710
Shad	66,815	$3,580	33,750	$2,250	2,550	$99			2,219,907	110,799
Spots							1,800	36	26,400	1,566
Squeteague							3,600	72	51,500	1,031
Sturgeon	10,800	756							40,595	3,336
Caviar	800	400							3,261	1,822
Total	78,415	4,736	33,750	2,250	2,550	99	30,600	969	3,204,111	133,171

Table showing, by counties, the yield of the pound-net fisheries of Virginia in 1901.

Species.	Accomac.		Caroline.		Elizabeth City.		Essex.		Gloucester.	
	Lbs.	Value.	Lbs.	Val.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	476,270	$3,185	31,500	$315	258,934	$3,435	206,360	$2,101	344,000	$5,160
Black bass	1,050	105								
Blue-fish	77,290	3,804			42,895	1,287				
Bonito	3,640	207			400	12				
Butter-fish	17,005	351			145,100	4,353	17,300	413	172,000	5,160
Carp					1,200	36				
Cat-fish	750	30	1,000	20			32,750	844		
Crevalle					100,561	3,009			103,200	3,098
Croakers	88,665	1,669			677,563	10,499			412,800	4,128
Drum	58,320	459			6,550	67			34,400	344
Eels							16,900	800		
Flounders	17,955	554			25,564	767			10,000	300
Hickory shad					78,300	1,839			68,800	1,376
Hog-fish					300	30				
King-fish					3,500	140				
Menhaden	1,750,800	2,423			1,464,825	2,930			344,000	688
Moon-fish					66,400	2,057				
Mullet					1,000	20				
Perch, white	690	28	2,250	122	3,600	116	4,310	173		
Perch, yellow							125	5		
Pompano	51,985	4,077			13,870	991			10,000	700
Shad	104,026	5,071	2,925	117	272,507	18,703	23,550	999	516,000	34,400
Sheepshead	600	47								
Spanish mackerel	68,625	5,968			53,352	4,497			172,000	13,760
Spots	6,100	247			19,082	381				
Squeteague	250,535	6,531			1,448,631	22,529	18,825	385	206,400	3,096
Striped bass	4,545	298	900	72	1,534	92	4,940	306	3,000	210
Sturgeon	8,115	774			29,558	2,142			7,500	450
Caviar					3,653	2,207			910	546
Suckers							165	5		
Whiting					600	12				
Turtles					12,525	236			5,000	100
Total	2,986,966	35,828	38,575	646	4,732,004	82,387	325,225	6,031	2,410,010	73,516

Species.	Fairfax.		James City.		King George.		Lancaster.		Mathews.		Middlesex.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives	386,000	$2,557			1,116,000	$5,819	230,000	$1,725	811,500	$4,403	299,600	$2,796
Black bass	3,800	380										
Blue-fish							6,500	455	9,380	369		
Butter-fish							109,500	2,310	37,400	752	77,950	1,252
Carp	4,150	83										
Cat-fish	14,800	440	3,000	$105	63,600	1,924	5,600	168				
Croakers							75,600	756	68,500	805	25,800	508
Drum							7,560	76				
Eels							3,500	140				
Flounders					11,350	331	3,140	94				
Hickory shad									83,750	2,680		
Menhaden							433,330	435	135,000	140		
Perch, white	14,350	717			48,466	3,064						
Perch, yellow	5,400	192			2,000	60						
Pike	2,300	184										
Shad	12,575	396			126,211	3,888	470,225	26,765	818,455	46,776	150,325	7,978
Spanish mackerel							33,800	2,704	875	139	3,150	252
Spots							2,500	125				
Squeteague			12,500	375			224,000	3,730	143,250	3,135	96,250	2,647
Striped bass	8,880	830	7,350	882	67,259	5,913	2,800	168	7,200	576	30,000	1,800
Sturgeon							6,475	389	23,800	714	1,800	126
Caviar							1,200	720	900	360	130	78
Suckers	3,000	45										
Turtles									10,000	200		
Total	455,255	5,824	22,850	1,362	1,434,886	20,999	1,615,730	40,760	2,150,010	61,049	685,005	17,437

Table showing, by counties, the yield of the pound-net fisheries of Virginia—Continued.

Species.	Nansemond.		Prince William.		Richmond.		Stafford.		Westmoreland.		York.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Alewives	1,000	$10	150,800	$1,131	315,250	$3,163	296,408	$1,970	584,756	$2,934		
Black bass			2,160	194			40,750	4,025				
Blue-fish									140	6	7,600	$228
Butter-fish											27,000	810
Carp			1,100	33			16,250	411				
Cat-fish	200	7	2,000	60	37,900	948	38,400	1,278	39,090	1,234		
Crevalle											20,800	624
Croakers	2,000	20									538,000	8,125
Drum											900	15
Eels					20,475	845			200	8		
Flounders									5,645	184	400	12
Menhaden											240,000	480
Perch, white	1,100	66	4,550	228	750	45	13,760	688	50,970	2,805		
Perch, yellow			1,000	40	225	7	27,850	1,114				
Pike			500	50			14,850	1,461				
Shad	5,950	400			78,383	2,363			54,996	1,663	52,800	3,520
Squeteague	1,000	15			85,000	1,700			900	36	122,000	1,850
Striped bass	1,800	144	1,900	190	7,850	482	5,200	520	80,060	6,393		
Sturgeon											8,700	609
Caviar											1,500	900
Suckers					250	5						
Turtles											1,000	20
Total	13,050	662	164,010	1,926	546,083	9,548	453,468	11,467	816,757	16,263	1,020,700	17,193

Species.	Norfolk.		Northampton.		Northumberland.		Princess Anne.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	83,500	$1,023	27,000	$42	4,315,000	$36,700	11,915	$185	9,945,793	$78,644
Black bass									47,760	4,704
Blue-fish	46,850	1,510	21,600	972	28,800	1,292	74,880	2,278	315,935	12,201
Bonito			5,310	159			4,810	159	14,160	537
Butter-fish	198,850	5,930	21,200	510	50,300	803	193,255	5,807	1,066,860	28,451
Carp	600	18							23,300	581
Cat-fish									239,090	7,058
Crevalle	122,650	3,680	18,650	405			99,890	2,626	465,751	13,442
Croakers	172,500	2,375	42,175	442	31,200	156	725,020	7,426	2,859,823	36,909
Drum	24,500	245	10,450	115			10,342	113	153,022	1,434
Eels									41,075	1,793
Flounders	19,550	662	6,600	154	27,300	819	11,990	220	138,494	4,097
Hickory shad					213,250	5,882			444,100	11,277
Hog-fish	1,200	120	860	82			1,032	104	3,392	336
King-fish	6,950	246	3,100	290			46,512	1,560	60,062	2,236
Menhaden	440,000	840	22,000	88	1,516,666	2,274	8,750	50	6,355,371	10,298
Moon-fish			2,000	44			2,000	60	70,400	2,161
Mullet	2,000	60					2,000	60	5,000	140
Perch, white	1,900	38					1,887	43	148,583	8,133
Perch, yellow									36,600	1,418
Pike									17,650	1,695
Pompano			7,315	741			13,016	1,040	96,186	7,549
Shad	75,490	4,526	12,510	720	1,712,000	83,075	60,050	4,650	4,548,978	246,010
Sheepshead			340	32	850	60	6,040	183	7,830	322
Spanish mackerel	5,300	586	72,425	7,304	8,335	725	101,880	8,022	519,742	43,957
Spots	84,500	2,275	16,840	407	6,500	325	248,260	7,446	383,782	11,206
Squeteague	883,650	14,963	863,700	8,396	405,980	6,897	1,365,925	21,016	6,128,546	97,301
Striped bass					35,000	2,500	3,950	297	274,168	21,673
Sturgeon	14,205	1,022	2,580	129	28,230	1,571	11,465	899	142,428	8,825
Caviar	755	484	70	35	5,089	2,542	850	510	15,057	8,382
Suckers									3,415	55
Tarpon	75	1							75	1
Whiting									600	12
Prawn							2,850	142	2,850	142
Turtles	400	8			9,200	184	6,080	61	44,205	809
Total	2,185,425	40,612	1,155,725	21,017	8,393,700	145,305	3,014,649	64,957	34,620,083	673,789

Table showing, by counties, the yield of the fyke-net fisheries of Virginia in 1901.

Species.	Accomac.		Alexandria.		Essex.		Fairfax.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	200	$3						
Black bass			700	$70			6,625	$600
Carp			1,500	30			3,800	83
Cat-fish			10,325	206	1,600	$40	15,380	461
Eels			1,000	30			1,680	50
Flounders	1,000	22						
Perch, white	100	4	4,500	225			7,110	353
Perch, yellow			7,350	147			7,650	249
Pike			1,000	100			1,637	145
Sea bass	400	22						
Squeteague	150	6						
Striped bass	300	24			1,350	81	5,800	492
Suckers			3,500	52			5,350	92
Total	2,150	81	29,875	860	2,950	121	55,032	2,525

Species.	Gloucester.		Henrico.		Isle of Wight.		James City.		Nansemond.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Carp	25,000	$250								
Cat-fish	56,000	1,680	30,000	$1,200	5,075	$161	30,000	$1,050	1,000	$40
Croakers					5,050	69			6,500	130
Eels	6,000	210								
Flounders					925	17				
Perch, white	60,000	3,600	15,000	900	3,475	211	7,625	686		
Shad							4,500	300	3,850	250
Squeteague					2,500	75	2,500	75	2,600	52
Striped bass	23,200	2,784			4,500	355	7,500	900		
Total	170,200	8,524	45,000	2,100	21,525	888	52,125	3,011	13,950	472

Species.	Northampton.		Prince William.		Stafford.		Warwick.		Westmoreland.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Black bass			6,250	$625	7,400	$730				
Carp			1,500	45	3,450	69			500	$8
Cat-fish			5,000	150	10,700	321	3,000	$100	1,650	50
Eels	240	$12	2,800	84					500	15
Perch, white			2,100	105			550	50	2,500	125
Perch, yellow			3,750	150	9,900	240				
Pike			1,175	117	1,700	136			600	30
Shad							900	60		
Striped bass			2,500	200			400	50		
Suckers			4,800	96	2,400	48				
Turtles									675	40
Total	240	12	29,875	1,572	35,550	1,544	4,850	260	6,425	268

Species.	New Kent.		King George.		King William.		York.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	1,200	$12			7,950	$80			9,350	$95
Black bass									20,975	2,025
Carp	640	13	1,100	$17	4,240	85			41,730	600
Cat-fish	9,600	240	4,500	135	63,600	1,590			247,430	7,424
Crevalle	320	10			2,160	65			2,480	75
Croakers	400	8			2,650	53	8,200	$164	22,800	424
Eels	320	7	700	21	2,120	43			15,360	472
Flounders	160	5			1,710	52	2,600	78	6,395	174
Perch, white	320	19	5,200	284	2,120	127			110,600	6,689
Perch, yellow									28,650	786
Pike			1,300	65					7,412	593
Sea bass									400	22
Shad	480	32			3,180	212	240	16	13,150	870
Spots							1,000	20	1,000	20
Squeteague	4,800	192			31,800	954	7,000	140	51,350	1,494
Striped bass	800	80	200	16	5,300	530	3,000	180	54,850	5,692
Suckers	800	12			5,300	80			22,150	380
Crabs, hard	1,200	12			8,650	87			9,850	99
Turtles			480	29					1,155	69
Terrapin							1,750	450	1,750	450
Total	21,040	642	13,480	567	140,780	3,958	23,790	1,048	668,837	28,453

Table showing, by counties, the catch of the weir and slat trap fisheries of Virginia in 1901.

Species.	Henrico.		King William.		Nansemond.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Alewives	20,000	$500	8,400	$84			28,400	$584
Carp					400	$16	400	16
Cat-fish	5,000	250	33,600	840	200	10	38,800	1,100
Crevalle			560	16			560	16
Croakers			700	14			700	14
Eels			1,680	33			1,680	33
Flounders			1,600	50			1,600	50
Perch, white	8,000	480	840	51	300	18	9,140	549
Shad					175	13	175	13
Striped bass			1,575	158			1,575	158
Suckers			1,750	26			1,750	26
Total	33,000	1,230	50,705	1,272	1,075	57	84,780	2,559

Table showing, by counties, the yield of the line fisheries of Virginia in 1901.

Species.	Accomac.		Charles City.		Elizabeth City.		Essex.		Gloucester.		Isle of Wight.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Blue-fish	1,450	$45			339,480	$10,184						
Cat-fish							800	$20			2,500	$88
Cod	100	4										
Croakers	31,650	654			211,000	3,181					33,500	592
Drum	34,150	267			9,800	88						
Flounders	1,530	56			40,000	1,200						
Hog-fish					30,000	2,100						
King-fish	23,300	802										
Perch, white	2,300	66			36,000	1,800						
Sea bass	1,300	51										
Sheepshead	600	26										
Spots	3,800	195			80,000	1,600					3,550	177
Squeteague	130,900	3,707			368,000	5,520					30,650	999
Crabs, hard	80,000	580			1,044,330	5,937			177,000	$1,770		
Turtles			1,025	$51								
Frogs			700	125								
Total	311,080	6,403	1,725	176	2,158,610	31,610	800	20	177,000	1,770	70,200	1,856

Species.	James City.		King George.		King William.		Lancaster.		Mathews.		Middlesex.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Cat-fish	10,800	$270			66,000	$1,700						
Croakers	600	12										
Striped bass	300	36										
Crabs, hard					125,000	1,250	292,280	$4,041	218,751	$3,280	100,831	$1,537
Turtles	1,092	54	720	$36								
Total	12,792	372	720	36	191,000	2,950	292,280	4,041	218,751	3,280	100,831	1,537

Species.	Nansemond.		New Kent.		*Norfolk.*		*Northampton.*		Northumberland.		Princess Anne.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.
Blue-fish							9,650	$405	3,500	$140		
Butter-fish									5,000	100		
Croakers	3,000	$60			50,000	$500	72,000	1,840	3,000	30	26,000	$260
Drum							30,000	900				
Hog-fish											1,500	150
King-fish							1,000	85				
Spots							20,000	750			10,000	300
Squeteague	1,000	20			43,000	645	87,600	2,630	2,600	101	20,000	300
Striped bass											2,500	150
Crabs, hard					1,090,625	10,375	1,509,000	9,159	316,830	4,812	352,000	2,816
Turtles			2,900	$145								
Frogs			450	80								
Total	4,000	80	3,350	225	1,183,625	11,520	1,729,250	15,769	330,930	5,186	412,000	3,976

Table showing, by counties, the yield of the line fisheries of Virginia in 1901—Continued.

Species.	Prince George.		Prince William.		Warwick.		Westmoreland		York.		Total.	
	Lbs.	Val.	Lbs.	Val.	Lbs.	Val.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Blue-fish									40,000	$1,200	394,080	$11,974
Butter-fish											5,000	100
Cat-fish											80,100	2,078
Cod											100	4
Croakers					21,945	$665			190,000	3,000	642,695	10,794
Drum											73,950	1,255
Flounders											41,530	1,256
Hog-fish											31,500	2,250
King-fish											24,300	887
Perch, white											38,300	1,866
Sea bass											1,300	51
Sheepshead											600	26
Spots					1,875	75			6,000	120	125,225	3,217
Squeteague					8,580	260			146,000	2,280	838,330	16,465
Striped bass											2,800	186
Crabs, hard							134,200	$1,779	662,580	5,478	6,103,427	52,764
Turtles	1,000	$50	4,000	$180							10,737	516
Frogs											1,150	205
Total	1,000	50	4,000	180	32,400	1,000	134,200	1,779	1,044,580	12,078	8,415,124	105,894

Table showing, by counties, the yield by eel pots, spears, and other minor apparatus in the fisheries of Virginia in 1901.

Apparatus and counties.	Alewives.		Terrapin.		Turtles.		Frogs.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Minor apparatus:								
Accomac			1,230	$794				
Essex							12,400	$750
James City							917	163
Mathews			150	100				
Nansemond	1,000	$20						
New Kent							700	125
Prince George			2,000	100			210	40
Stafford					800	$50		
Total	1,000	20	3,380	994	800	50	14,227	1,078

Apparatus and counties.	Eels.		Shad.		Crabs, soft.		Total.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Eel pots and spears:								
Accomac	3,600	$147					3,600	$147
Essex	7,200	360					7,200	360
Isle of Wight	2,500	125					2,500	125
James City	5,400	270					5,400	270
Northumberland	7,000	350					7,000	350
Princess Anne	22,000	880					22,000	880
	47,700	2,132					47,700	2,132
Minor apparatus:								
Accomac					99,056	$4,210	100,286	5,004
Essex							12,400	750
James City							917	163
Lancaster					96,000	9,950	96,000	9,950
Mathews					4,000	300	4,150	400
Middlesex					6,800	510	6,800	510
Nansemond			7,000	$500			8,000	520
New Kent							700	125
Norfolk					2,400	420	2,400	420
Northumberland					82,940	7,744	82,940	7,744
Prince George							2,210	140
Stafford							800	50
York					2,500	200	2,500	200
Total			7,000	500	293,696	23,334	320,103	25,976
Grand total	47,700	2,132	7,000	500	293,696	23,334	367,803	28,108

Table showing the catch by oyster dredges and tongs in the fisheries of Virginia in 1901.

Counties.	Oyster tongs.					
	Market oysters from natural rock.		Market oysters from private beds.		Seed oysters from natural rock.	
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:						
Accomac	129,878	$6,934	857,437	$69,395	773,626	$21,756
Elizabeth City					213,500	6,100
Essex					7,000	200
Gloucester	234,150	11,659			648,900	14,205
Isle of Wight	416,199	20,908			533,946	11,438
King William					546,000	11,700
Lancaster	113,050	6,460				
Mathews	59,500	3,200				
Middlesex	53,200	3,090			2,800	100
Nansemond	245,000	13,325			1,181,600	25,920
Norfolk	2,485,700	124,910			672,700	17,920
Northampton	164,577	7,433	915,859	56,538	336,826	6,776
Richmond					21,000	750
Warwick	50,400	2,730			346,500	7,425
York	459,200	23,340			470,750	10,088
Total	4,410,854	223,989	1,773,296	125,933	5,755,148	134,378
Shore fisheries:						
Accomac	1,507,443	90,317	2,462,768	196,613	1,805,664	50,140
Elizabeth City	250,110	14,292	980,000	56,800	750,330	21,438
Essex	122,220	7,384	634,837	45,345		
Gloucester	573,650	32,120	759,500	47,200	514,500	12,525
Isle of Wight	378,000	18,900	525,000	30,000	686,000	14,700
James City			133,000	9,500		
King George	98,000	5,600				
King and Queen	21,000	1,500	448,000	35,200		
King William			385,000	32,000		
Lancaster	1,674,750	95,700	1,551,200	109,300	55,300	1,975
Mathews	1,984,850	110,920	585,550	47,590		
Middlesex	2,115,400	120,880	1,323,000	94,500		
Nansemond	1,107,456	55,373	a 546,000	29,699		
New Kent			164,000	12,100		
Norfolk	997,920	49,896	1,692,005	109,197		
Northampton	550,963	24,884	3,066,119	189,279	1,127,644	22,688
Northumberland	754,320	43,104	85,400	6,100		
Princess Anne			157,500	45,000	14,000	500
Richmond	141,120	9,072	913,500	65,250		
Warwick	175,840	11,304	350,000	18,850	703,360	15,072
Westmoreland	311,850	18,510				
York	1,391,250	69,800	1,274,000	75,050	1,312,500	28,125
Total	14,156,142	779,556	18,026,379	1,254,573	6,969,298	167,163
Grand total	18,566,996	1,003,545	19,799,675	1,380,506	12,724,446	301,541

Counties.	Oyster dredges.				Total.	
	Market oysters from natural rock.		Market oysters from private beds.			
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:						
Accomac	647,542	$38,497			2,408,483	$136,582
Elizabeth City			1,680,000	$92,240	1,893,500	98,340
Essex					7,000	200
Gloucester	10,500	525			893,550	26,389
Isle of Wight					950,145	32,346
King George	16,800	1,080			16,800	1,080
King William					546,000	11,700
Lancaster					113,050	6,460
Mathews					59,500	3,200
Middlesex					56,000	3,190
Nansemond					1,426,600	39,245
Norfolk					3,158,400	142,830
Northampton					1,417,262	70,747
Northumberland	220,220	12,734			220,220	12,734
Richmond					21,000	750
Warwick					396,900	10,155
Westmoreland	235,130	14,793			235,130	14,793
York					929,950	33,428
Total	1,130,192	67,629	1,680,000	92,240	14,749,490	644,169

a Includes 12,000 bushels (84,000 pounds) of seed oysters valued at $1,799 taken from private beds.

Table showing the catch by oyster dredges and tongs in the fisheries of Virginia in 1901—Continued.

Counties.	Oyster dredges.				Total.	
	Market oysters from natural rock.		Market oysters from private beds.			
	Lbs.	Value.	Lbs.	Value.	Lbs.	Value.
Shore fisheries:						
Accomac	645,470	$39,915			6,421,345	$376,985
Elizabeth City					1,980,440	92,530
Essex					757,057	52,729
Gloucester					1,847,650	91,845
Isle of Wight					1,589,000	63,600
James City					133,000	9,500
King George	32,900	1,940			130,900	7,540
King and Queen					469,000	36,700
King William					385,000	32,000
Lancaster					3,281,250	206,975
Mathews					2,570,400	158,510
Middlesex			56,000	$4,000	3,494,400	219,380
Nansemond					1,653,456	85,072
New Kent					154,000	12,100
Norfolk					2,689,925	159,093
Northampton					4,744,726	236,851
Northumberland	306,600	17,520			1,146,320	66,724
Princess Anne					171,500	45,500
Richmond					1,054,620	74,322
Warwick					1,229,200	45,226
Westmoreland	255,850	14,620			567,700	33,130
York					3,977,750	172,975
Total	1,240,820	73,995	56,000	4,000	40,448,639	2,279,287
Grand total	2,371,012	141,624	1,736,000	96,240	55,198,129	2,923,456

The following supplementary table presents in bushels, instead of pounds, the quantity and value of oysters taken from public and private areas in each county of Virginia in 1901:

Counties.	Market oysters from natural rock.		Market oysters from private beds.		Seed oysters from natural rock.		Total.	
	Bush.	Value.	Bush.	Value.	Bush.	Value.	Bush.	Value.
Accomac	418,619	$175,663	474,315	$266,008	368,470	$71,896	1,261,404	$513,567
Elizabeth City	35,730	14,292	380,000	149,040	137,690	27,538	553,420	190,870
Essex	17,460	7,384	90,691	45,345	1,000	200	109,151	52,929
Gloucester	116,900	44,304	108,500	47,200	166,200	26,730	391,600	118,234
Isle of Wight	113,457	39,808	75,000	30,000	174,278	26,138	362,735	95,946
James City			19,000	9,500			19,000	9,500
King George	21,100	8,620					21,100	8,620
King and Queen	3,000	1,500	64,000	35,200			67,000	36,700
King William			55,000	32,000	78,000	11,700	133,000	43,700
Lancaster	255,400	102,160	221,600	109,300	7,900	1,975	484,900	213,435
Mathews	292,050	114,120	83,650	47,590			375,700	161,710
Middlesex	309,800	123,970	197,000	98,500	400	100	507,200	222,570
Nansemond	193,208	68,698	78,000	29,699	168,800	25,920	440,008	124,317
New Kent			22,000	12,100			22,000	12,100
Norfolk	497,660	174,806	241,715	109,197	96,100	17,920	835,475	301,923
Northampton	102,220	32,317	568,854	245,817	209,210	29,464	880,284	307,598
Northumberland	183,020	73,358	12,200	6,100			195,220	79,458
Princess Anne			22,500	45,000	2,000	500	24,500	45,500
Richmond	20,160	9,072	130,500	65,250	3,000	750	153,660	75,072
Warwick	32,320	14,034	50,000	18,850	149,980	22,497	232,300	55,381
Westmoreland	114,690	47,923					114,690	47,923
York	264,350	93,140	182,000	75,050	254,750	38,213	701,100	206,403
Total	2,991,144	1,145,169	3,076,525	1,476,746	1,817,778	301,541	7,885,447	2,923,456

Table showing, by counties, the catch by clam tongs, hoes and rakes, and crab scrapes in the fisheries of Virginia in 1901.

Fisheries and counties.	Clam tongs, hoes and rakes.		Crab scrapes.	
	Clams, hard.		Crabs, soft.	
	Lbs.	Value.	Lbs.	Value.
Vessel fisheries:				
Accomac	139,208	$15,926		
Northampton	46,496	2,615		
Total	185,704	18,541		
Shore fisheries:				
Accomac	[a] 934,312	83,513	994,728	$42,638
Elizabeth City	42,664	3,520		
Gloucester	50,984	4,093		
Mathews	196,000	1,400		
Norfolk	32,000	3,000		
Northampton	155,664	8,756		
York	167,352	11,954		
Total	1,578,976	116,236	994,728	42,638
Grand total	1,764,680	134,777	994,728	42,638

[a] Includes 20 bushels (200 lbs.) soft clams, valued at $20

MENHADEN FISHERY.

The menhaden fisheries, with one less factory than in 1897, show a gain of $455,693 in the value of products in 1901, the value being $362,032 in 1897 and $817,725 in 1901. This large gain may in part be accounted for by the higher prices received for the products and in part by the increased catch of 115,504,331 menhaden, the catch of 1897 numbering 263,203,000 fish and that of 1901 378,727,331 fish. During the past few years factories have been extensively enlarged and improved and new and improved machinery has been introduced. The increase in steamers was 7, in purse seines 15, and in vessel and shore employees 407. Menhaden were found fairly plentiful, and the season on the whole was a satisfactory one.

The manufactured products of the menhaden fisheries amounted to 21,130 tons of dry scrap, 10,591 tons of acidulated scrap, and 723,215 gallons of oil. This business gives employment on vessels and in factories to 1,577 persons, the factory employees receiving $92,308 in wages during 1901.

Table showing the extent of the menhaden industry of Virginia in 1901.

Items.	No.	Value.	Items.	No.	Value.
Factories	15	$271,025	Steam vessels fishing	21	$256,000
Cash capital		121,450	Tonnage	1,753	
Wages paid factory employees		92,308	Outfit		64,580
			Sail vesssels fishing	17	17,600
Persons in factories	661		Tonnage	435	
Persons on vessels	916		Outfit		12,565
Menhaden utilized	378,727,331	392,715	Sail vessels transporting	18	19,850
Tons of dry scrap	21,130	517,872	Tonnage	524	
Tons of acidulated and crude scrap	10,591	135,388	Outfit		2,170
Gallons of oil made	723,215	164,465	Seines (total length, 42,636 feet)	52	36,395

WHOLESALE FISHERY TRADE.

The wholesale trade in fishery products of the State was represented by 80 firms in 1901 and 56 in 1897, a gain of 24. Of the 80 firms, 67 were engaged in the oyster business, most of them, more or less extensively, from the planting of seed oysters to the gathering, opening, and distribution of the marketable crop to all sections of the country. This branch of business shows many changes and improvements and has increased considerably in importance.

The wholesale trade in food-fish is carried on by a comparatively small number of firms. The fresh fish are handled chiefly during the early spring runs of migratory fish, the season being much earlier than for the same species in northern waters. This early spring catch has a wide range of distribution. The only cured fish marketed are salted alewives.

The total number of employees in the wholesale firms was 4,132, the larger portion of whom were engaged in the opening of oysters. The wholesale firms paid in 1901 $701,807 in wages, most of which went to oystermen for their eight months' work.

Reference has been made to an endless-chain scraper for removing oyster shells from the shucking rooms. This device is employed by Messrs. J. S. Darling & Son, of Hampton, one of the largest firms in Virginia, and has resulted in saving much time, labor, and expense. The old and expensive method of removing shells by shovels and wheelbarrows is still practiced by all of the other firms.

Table showing the persons and capital in the wholesale fishery trade of Virginia in 1901.

Localities.	Establishments.		Cash capital.	Number of persons engaged.	Wages paid.
	No.	Value.			
Lewisetta, Whealton, Kinsale, and Mundays Point	7	$21,000	$31,800	551	$86,650
West Point	5	15,500	46,000	234	45,600
Hampton	6	65,000	61,000	510	66,575
Suffolk	3	9,000	9,000	124	9,900
Portsmouth and Berkley	4	62,440	38,000	513	105,425
Norfolk	20	229,500	156,000	1,404	318,100
Irvington and Weems Wharf	3	3,100	8,000	123	20,000
Cape Charles, Brighton, Cobbs Landing, and Brownsville	7	10,200	11,100	130	9,980
Willis Wharf, Bridgetown, and Franktown	5	5,350	7,800	184	7,320
Chesconessex, Dreka, Mappsville, Saxis, and Lemont	9	8,000	20,600	148	9,447
Watchapreague, Messongo, and Wisharts Point	4	3,600	8,000	85	6,210
Chincoteague and Franklin City	5	10,250	20,500	116	14,850
Tangier Island	2	1,000	2,750	10	1,750
Total	80	443,940	420,550	4,132	701,807

SUPPLEMENT TO LIST OF PUBLICATIONS OF THE UNITED STATES FISH COMMISSION AVAILABLE FOR DISTRIBUTION.

Of the publications available for distribution on December 1, 1901, the following pamphlets are now out of print and can not be furnished: Nos. 165, 166, 222, 223, 224, 290, 320, 345, 397.

Besides the publications enumerated in the list of December 1, 1901, the following have been issued and are available for distribution:

BOUND VOLUMES.

Designation.	For the year—	Published.	Pages.	Plates.
Annual Report:				
Part XXVII	1901	1902	VI+844	37
Annual Bulletin:				
Vol. XX, *first part*	1900	1902	XV+524	52, 17+IV+XXXVIII
Vol. XX, second part	1900	1902	VIII+416	A+XII
Vol. XXI	1901	1902	VII+476	22, XLIV+A

PAMPHLETS.

Serial No.

481. Report of the Commissioner for the year ending June 30, 1901, including the reports of divisions of fish-culture, scientific inquiry, and fisheries, by George M. Bowers. Report for 1901, pp. 1–170, plates 1–5. 1902.
482. Publications of the United States Commission of Fish and Fisheries available for distribution on December 1, 1901. Report for 1901, pp. 177–192. 1902.
483. Notes on the fishes and mollusks of Lake Chautauqua, New York, by B. W. Evermann and E. L. Goldsborough. Report for 1901, pp. 169–175. 1902.
484. The foraminifera of Porto Rico, by James M. Flint. Bulletin for 1900, pp. 415, 416. 1901.
485. Description of a new species of blenny from Japan, by Hugh M. Smith. Bulletin for 1901, pp. 93, 94. 1902.
486. List of species of fishes known to occur in the Great Lakes or their connecting waters, by Barton Warren Evermann. Bulletin for 1901, pp. 95, 96. 1902.
487. Preservation of fishery products by drying and dry-salting, by Charles H. Stevenson. Bulletin for 1898, pp. 389–424. 1902.
488. Preparation of fish eggs for food, by Charles H. Stevenson. Bulletin for 1898, pp. 541–548. 1902.
489. Refrigeration, or preservation by low temperature, by Charles H. Stevenson. Bulletin for 1898, pp. 358–388. 1902.
490. Preservation of fishery products by smoking, by Charles H. Stevenson. Bulletin for 1898, pp. 474–506. 1902.
491. Notes on the tagging of four thousand adult cod at Woods Hole, Mass., by Hugh M. Smith. Report for 1901, pp. 193–208. 1902.
492. Notes on the silversides of the genus *Menidia* of the east coast of the United States, with descriptions of two new subspecies, by W. C. Kendall. Report for 1901, pp. 241–267. 1902.
493. Note on the Scotch methods of smoking haddocks, by Hugh M. Smith. Report for 1901, pp. 269–271. 1902.
494. Notes on the fishes of Lake Ontario. An annotated list of the fishes known to occur in Lake Champlain and its tributary waters. An annotated list of the fishes known to occur in the St. Lawrence River, by B. W. Evermann and W. C. Kendall. Report for 1901, pp. 209–240. 1902.

495. A report on fishes collected in Mexico and Central America, with notes and descriptions of five new species, by B. W. Evermann and E. L. Goldsborough. Bulletin for 1901, pp. 137–159. 1902.
496. The organic constituents of the scales of fish, by E. H. Green and R. W. Tower. Bulletin for 1901, pp. 97–102. 1902.
497. The reactions of copepods to various stimuli and the bearing of this on daily depth migrations, by G. H. Parker. Bulletin for 1901, pp. 103–123. 1902.
498. The gas in the swim-bladder of fishes. Biliary calculi in the squeteague, by R. W. Tower. Bulletin for 1901, pp. 125–135, plate XXI. 1902.
499. Description of a new species of shad (*Alosa ohiensis*), with notes on other food-fishes of the Ohio River, by Barton Warren Evermann. Report for 1901, pp. 273–288. 1902.
500. The reproductive period in the lobster, by Francis H. Herrick. Bulletin for 1901, pp. 161–166. 1902.
501. Notes on five food-fishes of Lake Buhi, Luzon, Philippine Islands, by Hugh M. Smith. Bulletin for 1901, pp. 167–171, plate 22. 1902.
502. Marine protozoa from Woods Hole, by Gary N. Calkins. Bulletin for 1901, pp. 413–468. 1902.
503. Notes on a species of barnacle (*Dichelaspis*) parasitic on the gills of edible crabs, by Robert E. Coker. Bulletin for 1901, pp. 399–412. 1902.
504. The fishes and fisheries of the Hawaiian Islands. A preliminary report, by D. S. Jordan and B. W. Evermann. Commercial fisheries of the Hawaiian Islands, by J. N. Cobb. Report for 1901, pp. 353–499, plates 21–27. 1902.
505. Notes on the fisheries of the Pacific Coast in 1899, by William A. Wilcox. Report for 1901, pp. 501–574, plates 28, 29. 1902.
506. Statistics of fisheries of the Great Lakes. Report for 1901, pp. 575–657. 1902.
507. Statistics of the fisheries of the Mississippi River and tributaries. Report for 1901, pp. 659–740. 1902.
508. The Pan-American Exposition. Report of representative of the U. S. Fish Commission, by W. de C. Ravenel. Report for 1901, pp. 289–351, pls. 6–20. 1902.
509. Notes on the boats, apparatus, and fishing methods employed by the natives of the South Sea Islands, and the results of fishing trials by the *Albatross*, by A. B. Alexander. Report for 1901, pp. 741–829, plates 30–37. 1902.
510. The salmon and salmon fisheries of Alaska. Report of the Alaskan salmon investigations of the United States Fish Commission steamer *Albatross* in 1900 and 1901, by Jefferson F. Moser. Bulletin for 1901, pp. 173–398 and 399–401, plates I–XLIV, plate A, and charts A, B. 1902.
511. Observations on the herring fisheries of England, Scotland, and Holland, by Hugh M. Smith. Bulletin for 1902, pp. 1–16, plates 1 and 2. 1903.
512. Japanese oyster culture, by Bashford Dean. Bulletin for 1902, pp. 17–37, plates 3–7. 1903.
513. The habits and culture of the black bass, by Dwight Lydell. Bulletin for 1902, pp. 39–44, plate 8. 1903.
514. Hearing and allied senses in fishes, by G. H. Parker. Bulletin for 1902, pp. 45–64, plate 9. 1903.
515. Natural history of the quinnat salmon. A report on investigations in the Sacramento River, 1896–1901, by Cloudsley Rutter. Bulletin for 1902, pp. 65–141, plates 10–18. 1903.
516. Notes on fishes from streams and lakes of northeastern California not tributary to the Sacramento Basin, by Cloudsley Rutter. Bulletin for 1902, pp. 145–148. 1903.
517. Breeding habits of the yellow cat-fish, by Hugh M. Smith and L. G. Harron. Bulletin for 1902, pp. 151–154. 1903.
518. The destruction of trout fry by hydra, by A. E. Beardsley. Bulletin for 1902, pp. 157–160. 1903.
519. Artificial propagation of the salmons of the Pacific coast. Revised edition of Fish Manual, pp. 1–15, plates 3–10. 1903.
520. Artificial propagation of the lake trout, grayling, and white-fish. Revised edition of Fish Manual, pp. 91–120, plates 30–39. 1903.
521. Artificial propagation of the shad and pike perch. Revised edition of Fish Manual, pp. 121–145 and 165–179, plates 40–46 and 51–52. 1903.
522. Artificial propagation of marine species of fishes. Revised edition of Fish Manual, pp. 195–238, plates 54–63. 1903.
523. Descriptions of new genera and species of fishes from the Hawaiian Islands, by D. S. Jordan and B. W. Evermann. Bulletin for 1902, pp. 161–208. 1903.
524. Report of the Commissioner for the year ending June 30, 1902, including the reports of divisions of fish culture, scientific inquiry, and fisheries, by George M. Bowers. Report for 1902, pp. 1–160, plates 1–5. 1903.

The following are in press and will soon be available:

525. Descriptions of a new genus and two new species of fishes from the Hawaiian Islands, by David Starr Jordan and Barton Warren Evermann. Bulletin for 1902, pp. 209-210. 1903.
526. The fresh-water fishes of western Cuba, by Carl H. Eigenmann. Bulletin for 1902, pp. 211-236, plates 19-21. 1903.
527. The organ and sense of taste in fishes, by C. Judson Herrick. Bulletin for 1902, pp. 237-272. 1903.
528. Rotatoria of the United States. II.—A monograph of the *Rattulidæ*, by H. S. Jennings. Bulletin for 1902, pp. 273-352, plates I-XV. 1903.
529. The plankton algæ of Lake Erie, with special reference to the *Chlorophyceæ*, by Julia W. Snow. Bulletin for 1902, pp. 369-394, plates I-IV. 1903.
530. Description of a new species of darter from Tippecanoe Lake, by William J. Moenkhaus. Bulletin for 1902, pp. 395-398. 1903.
531. Notes on some fresh-water fishes from Maine, by W. C. Kendall. Bulletin for 1902, pp. 353-368. 1903.
532. Habits of some of the commercial cat-fishes, by W. C. Kendall. Bulletin for 1902, pp. 399-409. 1903.
533. A more complete description of *Bacterium truttæ*, by M. C. Marsh. Bulletin for 1902, pp. 411-416, plates I and II. 1903.
534. Report on collections of fishes made in the Hawaiian Islands, with descriptions of new species, by Oliver P. Jenkins. Bulletin for 1902, pp. 417-511, plates I-IV. 1903.
535. The sponge fishery of Florida in 1900, by J. N. Cobb. Report for 1902, pp. 161-175, plates 6-9. 1903.
536. Aquatic products in arts and industries, by C. H. Stevenson. Report for 1902, pp. 177-279, plates 10-25. 1903.
537. The utilization of the skins of aquatic animals, by C. H. Stevenson. Report for 1902, pp. 281-352, plates 26-38. 1903.
538. List of the common names of the basses and sun-fishes, by Hugh M. Smith. Report for 1902, pp. 353-366. 1903.
539. The fisheries and fish trade of Porto Rico, by W. A. Wilcox. Report for 1902, pp. 367-395. 1903.
540. Statistics of the fisheries of the Middle Atlantic States. Report for 1902, pp. 433-540. 1903.
541. Records of dredging and other collecting stations of the U. S. Fish Commission steamer *Albatross* in 1901 and 1902. Report for 1902, pp. 397-432. 1903.
542. Isopods collected at the Hawaiian Islands by the U. S. Fish Commission steamer *Albatross*, by Harriet Richardson, Ph. D. Bulletin for 1903, pp. 47-54. 1903.
543. Birds of Laysan and the Leeward Islands, Hawaiian group, by Walter K. Fisher. Bulletin for 1903, pp. 1-39, plates 1-10. 1903.
544. Notes on a porpoise of the genus *Prodelphinus* from the Hawaiian Islands, by Frederick W. True. Bulletin for 1903, pp. 41-45, plates 1 and 2. 1903.

WASHINGTON, D. C., *June 30, 1903.*

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INDEX.

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