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COAST SURVEY.

LETTER

FROM

THE SECRETARY OF THE TREASURY,

TRANSMITTING

The report of the Superintendent of the Coast Survey, showing the progress of that work during the year ending November, 1850.

DECEMBER 19, 1850.

Laid upon the table, and ordered to be printed.

TREASURY DEPARTMENT,
December 17, 1850.

SIR: I have the honor to submit, for the information of the House of Representatives, the accompanying report, made to the department by Professor A. D. Bacho, superintendent of the coast survey, showing the progress of said work during the year ending November, 1850. All of which is respectfully submitted.

LEBANON THOMAS CORWIN,
Secretary of the Treasury.

Hon. HOWELL COBB,
Speaker of the House of Representatives.

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Report of the Superintendent of the Coast Survey, showing the progress of the work for the year ending November, 1850.

WEBB'S STATION, ANNE ARUNDEL COUNTY, MD.,
November, 1850.

SIR: I have the honor to submit the annual report of progress of the coast survey which the regulations of the Treasury Department require, that it may be presented to the President and to Congress.

The particulars of the work are, for the most part, brought to the first of November through the reports presented to me by the assistants. After a general statement of the progress of the different parts of the survey, the estimates for the next fiscal year are given, and then the details of the work in each of the sections of the coast, including the two new ones on the Pacific. The sketches which accompany the report are of two

National Oceanic and Atmospheric Administration

Report from the Secretary of the Treasury communicating the report of the Superintendent of the Coast Survey

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classes—one intended to show the progress of the operations, and the other to communicate or put on record information of value to navigation.

A review of the advance made in the work is readily had by comparing sketches of the previous reports with those of the present. In sketches sufficed to show the year's progress, and the operation of the eight States; this year eleven principal and seventeen subsidiary sketches are required, and the work is in progress in the whole of the nineteen States on the Atlantic and Gulf of Mexico, and the State and Territory on the Pacific.

The plan of operations for the western coast is founded on the character of our present knowledge of it, and is intended to produce successive approximations from a preliminary hydrographic reconnaissance to a complete survey, the results being made public at each stage of progress.

The general examinations for the proper sites for light houses, and the minute surveys of the sites to determine the character of the lights, heights of the buildings, and other important particulars, are making—the former along the coast generally, the latter at the points specified in the bills making appropriations for the lights and other aids to navigation. The general surveys required for the engineer department have been directed.

The entrance to Columbia river has been surveyed, and the places for buoys designated; the sites for light-houses at Cape Disappointment, Cape Flattery, and New Dungeness, in Oregon, and in and near San Francisco bay, have been examined and reported upon, and the detailed surveys required in the latter bay are making. A hydrographic examination of the coast from the entrance to Columbia river to Monterey has been made, and a preliminary chart prepared is engraving at the office. The geographical position of Point Conception, the Flatteras of the western coast, has been determined, and the results will soon be received. A detailed account of the work executed and directed will be found under its appropriate head in sections X and XI.

The entrance to Columbia river has undergone very great changes since it was surveyed by the exploring expedition in 1841; and the discovery of the "New South Channel" by Captain White has rendered access to the river comparatively easy for vessels drawing not more than seventeen feet. It is computed that within the last eighteen months more vessels have entered this port than in all previous time, and no serious accident has occurred to any one of them. This channel has been carefully sounded out, and a preliminary survey made to above Astoria, the chart of which is reducing at the coast survey office, and will be published without delay.

The character of the coast from Monterey to the Columbia river is described by Lieutenant W. A. Bartlett in the appendix (No. 2.)

The appropriations made at the last session of Congress for the western coast will, if continued so that the work there receive no check, secure the obtaining of satisfactory results on that very important portion of our coast. The provision of a steam-vessel for the hydrography, which was made with wise liberality, will enable us to execute in one year what would require two to four years to effect less perfectly with a sailing-vessel, or less economically, in the same time, with several sailing-vessels.

The triangulations on the Atlantic coast, to which all the other parts

of the work are attached, extend unbroken from Casco bay, in Maine, to Cedar island, on the coast of Virginia—1,200 miles, measuring along the sides of the triangles; then with an interval of about one hundred and twenty miles to Hatteras inlet, in North Carolina. They have made progress on the coast of South Carolina, Georgia, and Florida; extend from Mobile bay, Alabama, to Lake Borgne, Louisiana, covering Mississippi sound, and have been commenced in Texas. The other land operations and the hydrography are kept as closely up with the triangulation as is practicable. The computation, reduction, drawing, and engraving, are also arranged with a view to keep pace with the field and water work; and the modification of plan and increase of force which experience shows to be necessary to carry out this principle, are made as occasion permits. When the back work which had accumulated in 1844 is all published, and the field work and hydrography have reached their greatest extension, so as to present a constant instead of an increasing supply of results each year, it will be comparatively easy to realize the idea of keeping the publication up with the survey. *Fifty-five* maps and charts, besides preliminary sketches derived from the new work, are already in the hands of the draughtsmen and engravers, or have been published.

Hydrographic notices have been published by authority of the Treasury Department, or distributed within the past year, in relation to the following localities and subjects important to the navigating interests of our country:

1. Hatteras shoals, North Carolina.
2. Hatteras inlet, North Carolina.
3. St. Helena sound, South Carolina.
4. St. Andrew's shoals, Georgia.
5. Surveying marks on the Florida reef.
6. General description of the Florida keys.
7. Shoals off Cape Canaveral, Florida.
8. Sailing directions for the western coast from Monterey to the Columbia river.
9. Hydrographic notices of the western coast within the same limits.
10. Notes on the south channel of Columbia river.

The statements relating to these subjects are also given in the appendix to the present report. Sketches of the following portions of the coast, chiefly of localities where dangers or facilities to navigation have been found, have been published from time to time, as the results were received, and sent to insurance offices, and for gratuitous distribution to the agents for the coast survey charts. They are now appended to this report:

1. Sketch of Nantucket shoals, as far as surveyed to 1849.
2. Changes in Sandy Hook.
3. Preliminary chart of seacoast of Delaware and Maryland.
4. Sketch of Beaufort harbor, North Carolina, from reconnaissance.
5. Sketch of Hatteras inlet, from reconnaissance.
6. Preliminary chart of Hatteras shoals.
7. Sketch of St. Andrew's shoals, from reconnaissance.
8. Sketch of shoals off Cape Canaveral, from reconnaissance.

The chart of the reconnaissance of the western coast, from Monterey to the mouth of the Columbia, will be published in about three weeks.

The following reports in relation to lights, beacons, buoys, &c., will be found in the appendix:

1. In relation to buoys in Massachusetts bay and the Vineyard sound.
2. In relation to buoys in New York harbor.
3. On lights and buoys required in the Chesapeake north of the Potomac.
4. On beacons in Albemarle and Pamlico sounds.
5. In reference to buoys for Hatteras shoals.
6. Beacons for Florida reef.
7. On a light-house for Sea Horse key, Florida.
8. System of beacons, &c., for Mobile bay, near the city and entrance.
9. Buoys for Cat and Ship Island harbors.
10. Light houses and fog signals for San Francisco bay.
11. Light-house at Cape Hancock, or Disappointment, Columbia river entrance.
12. Light-houses for Cape Flattery and New Dungenness, Oregon.

Scarcely any portion of our coast has been thoroughly surveyed which has not yielded important discoveries. The broken ground off Nantucket has proved different in extent and character from what was previously supposed. Davis's shoal on the south, Davis's bank on the east, McBlair's shoals on the north, were, with many minor dangers, previously quite unknown; indeed, the discovery of Davis's shoal was received at first by many seafaring men with suspicion, which would have been removed at too heavy a cost, had the fine steamer which touched upon it in 1849 been lost there, or the gallant line-of-battle ship returning from a long foreign cruise, which struck, been sacrificed upon it. Gedney's channel, at the entrance of the great commercial port of New York, and Blake's channel in Delaware bay, were actually buoyed out before their existence was generally admitted. The discovery of twenty-one feet of water on Mobile entrance bar, by Lieutenant Patterson, has effected already important changes in the commerce of that city. Saint Andrew's shoals, on the coast of Georgia; the Hetzel shoal, off Cape Canaveral; the new channel into Key West, by Lieutenant John Rodgers, have been discoveries of value. The existence of Hatteras cove and Hatteras inlet, first publicly announced to navigators by Lieutenant Mallitt, may almost be ranked with them. The delineation of the shoal of the seacoast of Maryland, by Lieutenant Lee; those off Cape Hatteras, by Lieutenant Jenkins, so entirely different in distance from the shore, in extent, and even in most cases in the depth of water supposed to exist upon them, from the data previously furnished by the best authorities, belong to the same class. Such results, though among the most striking of those which the survey yields, are not more useful than the accurate delineation of the harbors, bays, and seacoast which the ordinary operations are continually furnishing to navigators.

Some of the differences observed between the recent surveys and those on which former charts were founded, are no doubt the results of actual changes; but there are no facts which prove that any important channel has been obliterated without being replaced by another, or has diminished in depth. The portions of our coast which really do change will be made known in the course of the survey, and the permanent marks furnished by the land work will permit re-examinations to be made whenever required, at a very small expense and by ordinary nautical means.

It is sometimes forgotten, that though the land work yields no discov-

eries, it is the basis of the whole, and that without it the results on the water would be uncertain in their character. The positions on the water can only be determined by reference to fixed points upon the land, and the places of these on the surface of the earth must be given by the operations of geodesy. Without the land work a geodetic survey, such as was planned by Jefferson, Gallatin, and Hassler, and such as has been well declared, within the year, to be the only survey admissible in the present state of science, would dwindle into a nautical reconnaissance. Nearly or quite four fifths of the whole work, and two thirds to three-fourths of the out-door work, is on the land—the appropriate work of landsmen, of trained scientific men, and of such only. When a pursuit is, in the highest sense of the word, a profession, it is ever true that devotion to it unfits the man for a different profession.

The extent of shore-line of the coast is the most unexceptionable datum by which to determine the progress of the work from year to year, and its relative economy. If the survey had been commenced in each section at the same time, there would have been no difficulty, in the course of three or four years from the beginning, in collecting sufficient statistics to answer such questions, and to determine conclusively the length of time required for the survey of the whole coast. The difficulty of giving an approximate estimate now, results from the very different stages of progress of the different sections. I have nevertheless attempted these conjectures from year to year, and kept the records to be checked by the following year's experience. As sections V, VI, and IX, have not been under survey long enough to furnish reliable data, I do not propose now to dwell upon these statistics, but in a general way to show what has been gained in time and economy by conducting the work on its present scale. In 1841 and 1849 the relative proportion of shore line determined, including seacoast and rivers to the head of tide, was as one to three and four-tenths ($1 : 3.4$), while the cost was as one to one and nine tenths, ($1 : 1.91$); exhibiting a relative economy of one and three-quarters to one, ($1.76 : 1$) or of one hundred to sixty; or a gain of nearly forty per cent., and a diminution in the time of completion to less than one-third.

The extent of shore line determined in the topography, is a proper guide to such an estimate; for, if some of the operations, as the hydrography and publication, follow it, others, such as the triangulation and astronomical work, precede it.

If the hydrography be taken as the test, it appears that the number of square miles of in-shore work, and the number of soundings in and off-shore, have been nearly tripled from 1841 to 1849—the average of the ratios of area and number of soundings being as one to two and five-tenths.

I have heretofore compared the actual cost per square mile of this mode of surveying with that of the public lands; (see report of 1848, Ex. Doc. No. 1 Senate, and Ex. Doc. No. 13 House of Representatives;) and the Secretary of the Treasury has instituted a similar comparison, in reference to foreign surveys of the same class. Having re-examined the data on which my estimates were founded, and the reports of assistant R. D. Cutts, in relation to the matter, I find my previous conclusions confirmed, as to the economy of this method of surveying. The only difficulty, and that by no means an insurmountable one, in applying this method to the

public lands of our new territory on the western coast, would be the organization of a body of surveyors competent to execute the details.

Before leaving this part of my subject, I may be permitted to state that the coast of Texas, added to our Union in 1845, would require one year for the entire force of the coast survey to complete, according to the statistics gathered in other sections; and that the coast of California and Oregon would require between two and three years of the application of the same entire force. The survey of Texas was commenced in 1846, and will be made to keep pace with that of the other sections; and California and Oregon will constitute two sections, in which the parties may alternate during different seasons. As far as the maps now in our possession may be relied upon, the shore line of Oregon, its rivers to the head of tide, and its bays and sounds, has an extent of 2,018 miles, and that of the State of California of 1,647 miles. I will explain further on the course proposed, in order to meet the exigencies of the survey of the western coast.

The reorganization of the coast survey, under legislative authority, in 1843, embodied all the experience obtained up to that date, both of trials which had succeeded and of others which had failed; it confirmed and gave the force of law to the union in one corps, which had gradually grown up, of civilians, officers of the army, and officers of the navy, serving under a neutral department, under which alone they could be united—namely, that having control of matters relating to commerce and navigation. It is easy to see that without a permanent nucleus for such a work, the objects and aims must be wavering and unsteady, the methods wanting in uniformity from year to year and from party to party, and the results heterogeneous in kind and in form. Confusion and waste would result from such an organization, and the survey would in time be abandoned. The scientific parts of such a work require diligent study and devotion to mathematical and physical science, to grasp them in their various bearings; and it is not too much to say, that, unless such a work came up to the demands of science and scientific men of the country, it could not long stand. That the theoretical knowledge acquired at the Military Academy should be reduced to practice in the survey, by those officers of the army who have an inclination to similar pursuits, to its advantage as well as to their own, will readily be seen; and up to the point where details would interfere with the duties of the arm to which the officer belongs, Congress has conferred upon the work a right to seek his services. The War Department judges whether they can be granted or not.

The law of 1843 very properly limited the services of officers of the navy to the hydrographic parts of the work—the portions which have a professional bearing, and towards which the inclination of a nautical man may turn with professional pride. Experience has fully shown the advantages of this organization in general. The tendency resulting from the variable elements (the army and navy,) is nevertheless at times to lessen the results produced, by the necessity for turning aside from actual work to give instruction, and from the loss of the experience acquired at the expense of the survey by the removal of officers—caused, no doubt, by the exigencies of their proper service, and yet reacting severely upon the survey. The experience and knowledge of Humphreys, Johnstone, and Prince, of the army, and of Davis, Patterson, and Porter, of the

navy, cannot readily be replaced; a detail may be filled, but the knowledge immediately available is not supplied.

The injunction of the law to employ as many officers of the army and navy as practicable in the coast survey, I have never lost sight of. On the breaking out of the Mexican war, five staff and nine line officers were upon the work. The number of hydrographic parties has been increased from two in 1843 to eight in 1850.

At the close of the war I again applied, through the Treasury Department, for the renewal of army details, and repeated the application when there was a probability that the ground of refusal might no longer exist. On the detachment of Captain Humphreys an application was made for the detail of officers of the corps of topographical engineers, and asking that at least the vacancies caused by former detachments might be filled; (appendix No. 2 *bis*.) In reply to the Secretary of the Treasury, the Secretary of War stated that it was not in his power to comply with the request, (appendix No. 2 *bis*.) and transmitted a forcible letter from Colonel Abert, showing that every member of his corps was employed. "In fact," replies Col. Abert, "it is not in my power to meet the demands of officers in command for the assistants they require, on which account, and on account of other duties, numbers of civil engineers have to be employed in the execution of surveys." When the Chief Engineer, General Totten, applied through the Secretary of War to the Treasury Department for assistance from the coast survey in making the surveys required for the sites of fortifications by the joint commission of army and navy officers, (appendix No. 3,) I deemed it a most favorable opportunity to urge the detail of officers of the corps of engineers, and the application was accordingly made to the Secretary of War. The Secretary of the Treasury, (appendix No. 3,) while manifesting the disposition to meet the views of the War Department as far as practicable, by giving authority for the surveys on the western coast, urged upon its favorable consideration my application for the detail desired. That nothing but an urgent demand for officers for their military duties caused this application to be declined, must be obvious. When my last application for line officers was refused, the War Department stated that staff officers would, if practicable, be assigned to the survey. Now that this was found impracticable I renewed the application for line officers, which has been favorably considered by the War Department, and five officers have been detailed for the service.

The increase in the number of officers of the navy attached to the coast survey has in like manner been carried as far as the Navy Department has found it possible to make the details. Such has been the demand for officers for the more immediate duties of the naval service, that those engaged in hydrographic reductions in the office were generally detached from the survey; the hydrographic parties were diminished to one-half, or less than one-half, their numbers on coming to the office to reduce their work; and finally the additional officers required for the Texas section this winter could not be procured when applied for, the Navy Department stating that in the present condition of the service, two passed midshipmen, junior to the master who had been ordered, and who stands near the head of the list of passed midshipmen, cannot be detailed, (appendix No. 5.) Owing to the same exigencies, the vessel for that section still remains (December 10) without her complement of officers.

So great have been the exigencies of the naval service, that more than

one-half of the officers attached to the coast survey a year since have been changed. The chiefs of parties feel sensibly the impediment to the progress of the work under their charge, which this rotation produces, and which no exertion of theirs can compensate. With officers and a crew more or less entirely new to the business of surveying, a portion of each season must be spent in teaching instead of working. The present organization affords a school of practice for the young officers of the navy, and, as such, is valuable to the country. It must be obvious, however, that in point of economy and expedition the plan of employing persons regularly trained to the occupation, keeping them steadily at the work, and giving them a compensation proportioned to their knowledge, skill, and industry, would be preferable. The statistics of the relative economy of the different parts of the work as at present conducted, confirm this view of the subject.

The regular progress of the work according to the plan submitted in successive years, and approved, requires the entire appropriation asked for in this report. The sum for the coast of the Atlantic and Gulf of Mexico is less than the general appropriation of last year, when it was necessary to ask an amount in the deficiency bill for the western coast. That for the Florida reefs and keys is the same at which it was originally fixed by the Senate of the United States; and that for the western coast is the sum appropriated at the last session, less the cost of a steamer included in the former appropriation. With the sums now asked, and which after examination have received the sanction of the Secretary of the Treasury, the work laid out can be done, but not with less. Economy and rapidity in obtaining results, the completion of the survey in a reasonable period, are all concerned in keeping the appropriations at their present rate.

In my report of last year I gave a summary of the progress of the coast survey up to that time, (Executive Document No. 5, Senate, 31st Congress, 1st session,) and therefore at present confine myself to a statement of the additional work executed within the past year in the different sections.

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island*—Six land parties and two hydrographic parties have been at work during part of the season in this section; one of the land parties having two instruments employed, and one of the hydrographic parties two vessels—constituting what we term double parties. Astronomical observations have, besides, been kept up at two points in the section, and the first part of the chronometer expedition, for difference of longitude between the United States and Europe, has been brought to a close. The requisite magnetic observations for charts of Newburyport, Portsmouth, mouth of Saco river, and Richmond's Island harbor, have been made. The secondary triangulation of the coast of New Hampshire and Maine has been extended, and a special survey of Richmond's Island harbor—a harbor of refuge at the entrance of Casco bay—has been made. The topography of Salem harbor and its vicinity has been completed, and that of Cape Ann has been carried eastward nearly to Gloucester harbor; that of Cape Cod has employed one party during a brief part of the season; that of Richmond's Island harbor and the approaches has been completed. The hydrography of Nantucket shoals, including a re-examination of Davis's south shoal, and the filling up of work of previous years, has been continued; that of Muskeget channel (entrance to Vineyard sound) has

been completed; work between No Man's Land and Block island, and previous lines of in-shore soundings, has been executed for the off-shore chart. The tides and currents in the passages between Buzzard's bay and Martha's Vineyard sound, and in the sound itself, have been observed. The computations have generally kept up with the field-work of the previous year. The drawing and engraving of the following maps and charts in this section have been in progress: Boston harbor, map and duplicate for the city of Boston and the State of Massachusetts; Boston harbor on the publication scale; Wellfleet harbor, (Massachusetts bay;) Muskeget channel and its approaches; the general coast chart, eastern series No. 1.

During the year Hyannis harbor, the revised sketch of Nantucket shoals, and a new edition of the chart of New Bedford harbor, all belonging to this section, have been published.

SECTION II. In this section, coast of *Connecticut, New York, New Jersey, Pennsylvania*, and part of *Delaware*, the chief body of the field-work of which is finished, parties have been employed as occasion served in revising the topography at the mouth of Connecticut river, at Hart and City island, and at Hell Gate; and in a resurvey of Sandy Hook, to take account of its changes. A triangulation party during part of the season was employed in furnishing points on the south side of Long Island for the sounding party engaged in the revision of the hydrography outside. Minute surveys were made of Prince's and Diamond reefs, and models of these rocks and of the Hell Gate passage were moulded in clay for the inspection of the Committee on Commerce of Congress. The drawing and engraving of the following named sheets have been in progress: Long Island sound, western sheet; off-shore sheet from Gay Head to Cape Henlopen; south side of Long Island, Nos. 1 and 2; mouth of Connecticut river; Hart and City island; Hell Gate, and Sandy Hook. There have been finished within the year a map of changes at Sandy Hook, a new engraving of the entrance to Delaware bay, and a new edition of the map of New York bay and harbor on the small scale, and of the anchorages of Cawkins' and Sheffield islands. Besides, the charts for the atlas of Long Island sound have been electrotyped.

SECTION III. *Coast of Delaware, Maryland, and part of Virginia.*—There have been seven parties at work in this section during the whole season—one executing primary triangulation; two topography, one being a double party; one hydrography, being a double party—with a steamer and a sailing vessel. The connexion of the primary triangulation of the coast with the Washington Observatory and Capitol is completed, and the necessary astronomical work nearly done. The triangulation of the Chesapeake and that of the outer or seacoast has advanced to within less than two seasons' work of the capes, (Wolf Trap and Cedar island, Virginia.) The topography of the shores of the Chesapeake and outside is nearly up with the last season's triangulation, (mouth of Rappahannock and Sandy Point inside, and Chincoteague bay outside.) The hydrography of the outside has reached the middle part of Chincoteague bay, (Lonesome Hill station,) and that of the bay extends to the mouth of the Rappahannock. Seaton telegraph station at Washington has been connected with the neighboring triangulation points, and observations for latitude and azimuth have been made at it. It has been connected by telegraph with Charleston. Considerable improvements have been made in

the apparatus for recording the telegraph signals for difference of longitude. The drawing and engraving of the map of the northern part of Chesapeake bay, and of Baltimore harbor and the Patuxent, have been in progress, and the preliminary chart of the seacoast of Delaware and Maryland has been completed within the year.

SECTION IV. In this section, including the coast of part of *Virginia* and of *North Carolina*, five parties have been employed—three during the whole and two during part of the season. The base line on Bodie's island has been connected with the main triangulation of Albemarle sound; a tertiary triangulation has been carried south to Cape Hatteras, and one for furnishing hydrographic points still further south to Pilot hill. This work will extend south of Hatteras inlet before December. The hydrography of Albemarle sound proper and of the Alligator river is completed. Oregon, New, and Hatteras inlets have been re-examined. Hatteras shoals and cove have been surveyed, and off-shore work between the capes of the Chesapeake and Cape Hatteras has been done. Beaufort inner and outer harbors have been in part surveyed.

The information which the preliminary sketch of Hatteras shoals gives, will be of the highest importance to the navigator.

The drawings of Albemarle sound, No. 1, of Hatteras shoals, of Hatteras cove, Hatteras inlet, and of Beaufort harbor, are in progress or completed, and preliminary charts of three of these localities accompany this report. Sketches of the reconnaissances were made and published as soon as engraved. The map of the Pasquotank has been engraved and published.

Work in the Gulf Stream in this and the next section has been executed, but, in consequence of the employment of the party on Hatteras shoals until late in the season, is limited in amount.

SECTION V. *Coast of South Carolina and Georgia*.—Four parties have been at work in this section; one during part of the season only. A base line on Edisto island has been measured, the latitude of one of the extremities and the azimuth of the line have been determined, and the triangulation to rest on it has been commenced. The astronomical station at Charleston has been kept up, and has been connected with Seaton station, Washington, for difference of longitude. A secondary triangulation has been carried over North Edisto inlet. A preliminary base has been measured near Savannah, and the river has been triangulated from the head of Hutchinson's island to Elba island, below Fort Jackson. The work of triangulation has prepared for at least one topographical party for the coming season. The hydrography of Charleston harbor has been nearly completed. A reconnaissance for a shoal reported off St. Helena sound was made. The drawing of the land work of Charleston harbor has been finished, and the engraving will soon be commenced.

SECTION VI. *Coast of Florida*.—Four parties have been employed in this section—one in reconnaissance, one in astronomical observations and secondary triangulation, one in topography, and one in hydrography. The reconnaissance for the base lines on Key Biscayne and near Cape Sable is completed, and for the triangulation generally across Key Biscayne bay, Card's and Barnes's sound, and the reef and keys to Boca Grande. A plan has been submitted for connecting the Tortugas with the keys. A reconnaissance has been in part made of Cedar keys and

the vicinity. The triangulations of Key West, Bahia Honda, and part of Key Biscayne bay, each resting on a preliminary base, have been completed. Astronomical and magnetic observations have been made at Key Biscayne. The topography of Key West and of the adjacent keys has also been completed. The hydrography of Key West harbor, and its approaches beyond the limits of the reef to the south, has been nearly finished. Reconnaissances of St. Andrew's shoals and of Cape Canaveral shoals have been made, and preliminary charts have been engraved. The chart of Key West is in the hands of a draughtsman for reduction.

SECTION VIII. *Coast of Alabama, Mississippi, and Louisiana.*—Four parties have been engaged in this section—two during part of the season, and one during only a short time. The hydrographic party commenced their work very late, the steam vessel belonging to the survey having been taken for other service of the government. This deranged my plans; and rendered a part of the land operations impracticable. The secondary triangulation of the Mobile delta has been completed, and the connexion at Mobile entrance made. The secondary triangulation of Lake Borgne has also made some progress. The topography of the shores of Mobile bay has been completed. The hydrography of Mobile bay has been nearly finished, and that of the delta entirely so. The drawing of Mobile entrance has been completed, and is in part engraved. The map of Cat and Ship island harbors, (double sheet) has been engraved and published. The drawings of the two sheets of Mobile bay are in progress.

SECTION IX. *Coast of Texas.*—Three parties have been at work during the chief part of the season. The triangulation has been extended by one down West bay, to include the new base line, of which a preliminary measurement has been made. The topography of Galveston lower bay and of part of the upper has been executed. The hydrography of the entrance and approaches has been nearly done. The reduced chart of the entrance will be in progress before the 1st of December.

SECTIONS X AND XI. *Coast of Oregon and California.*—The hydrographic party in this section has completed a preliminary survey of the entrance to Columbia river, and a general reconnaissance of the coast between Columbia river and Monterey, besides examining the sites for light-houses at Cape Disappointment, Cape Flattery, and New Dungeness, in Oregon, and on the Farallones de los Frailes, Fort Point, and Alcatraz island, San Francisco bay. The land and hydrographic party made a survey of Mare Island straits for the joint commission, and the geographical party now there has completed the determination of the latitude and longitude of Point Conception. These results have been received through Lieutenant W. A. Bartlett, U. S. N., detached for the purpose, and arrangements have been made for their speedy reduction and engraving.

While the steamer, provided for in the recent appropriation, is constructing, it is proposed to make such alterations in one of those now used in the survey as to adapt her to the purpose, and to send her at once to the western coast, which will save some four months of the next surveying season.

The sites for light-houses, positions for beacons, buoys, &c., will be examined in connexion with their other work by these parties, and report will be made at once to the Secretary of the Treasury.

A year will develop the full effect of this organization, and, if the appropriation is continued on the same scale, I propose to visit the parties and to make on the spot such modifications as a personal examination of the coast may show to be advantageous.

During the past year the field-work or reductions of the results of the survey have been in full activity, or nearly so, in eight of the nine sections on the Atlantic and Gulf of Mexico. The same scale is provided by recent appropriations for the western coast.

In the estimates for the next fiscal year I propose to continue the work on the eastern coast on its present scale, merely, as that sanctioned repeatedly by the Executive and Congress, and to ask for the western coast the same sum furnished by the appropriation for this year, less the cost of the steamer directed to be provided, and which, from information derived from the experience of the past, is not more than adequate to secure a desirable progress.

In regard to the cost of the work on the eastern side of the United States, it has been heretofore shown that, compared with the surveys of other countries and our own land surveys, it is moderate; and that, compared with work on a smaller scale, it is economical. The fact should be constantly kept in view that the extent of coast is limited, and that economy of time and means are both concerned in pushing the survey as rapidly as possible to completion. It is a work of limited extent, and the means laid out upon it bring it just so much nearer to an end. The division of labor which the present scale permits is an economy, and so is the transfer parties from north to south, and the reverse, as the season is most suitable for work.

The estimates, as usual, suppose the aid now derived from the War and Navy Departments to be continued.

ESTIMATE FOR THE FISCAL YEAR 1851-'52.

Rent, fuel, postage; materials for drawing, engraving, and printing; carpenter's work and materials; instrument maker's work and materials; blank books, stationery, printing, and ruling forms; binding; transportation of instruments, maps and charts, and miscellaneous office expenses; purchase of new instruments, books, maps, and charts - \$15,000

SECTION I. Field work.—To extend the primary triangulation in *Maine* eastward, and to make the reconnaissance and astronomical and magnetic observations connected with it; to extend the secondary triangulation of the coast of *Maine* to the eastward to *Portland*; to continue the topography of the western shore of *Massachusetts bay*, and of the eastern and northern shores of *Cape Ann*; to commence that of *Casco bay* (*Portland harbor*); to complete the hydrography south of *Marttha's Vineyard* and *Nantucket*, and to continue that of *Nantucket shoals* and of the ocean near *Nantucket*; to complete that of *Nidem* and *Gloucester* harbors, *Massachusetts*, and of *Portland harbor*, *Maine*; to complete the observations of tides and currents in the *Vineyard sound*, and to commence those in *Nantucket sound*, including the cost of ordinary repairs to steam ves-

sel and engine, of fuel, and of the hire of a vessel to aid in the soundings. *Office-work.*—To make the reductions and computations for the section; to complete the drawing of the general coast chart No. 2, from *Cuttyhunk* to *Cape Pogue*; to commence that of No. 3; to continue the drawing of charts of *Salem* and *Gloucester* harbors; to continue the engraving of the chart of *Boston harbor*; to complete that of *Wellfleet harbor*, of *Mukeget channel*, and of *Bass river*—will require . . . \$35,000

SECTION II. *To continue the verification and filling up of parts of the hydrography in-shore and off-shore; for work of revision in the section; to commence the engraving of the middle sheet of Long Island, south side; to complete the engraving of the off-shore chart from Gay Head to Cape Henlopen*—will require about . . . 9,000

SECTION III. *Field-work.*—To continue the triangulation of the Chesapeake south to the Capes of Virginia; that of the outer shore to *Matchapungo* inlet; to make the astronomical and magnetic observations required; the tertiary triangulation of part of the *Potomac* or of *James river*; to continue the topography of both shores of the Chesapeake, to the vicinity of *Point-no-Point* and *Bowdin's Point*, and of the outer shore to *Matomkia bay*; to continue the hydrography of the outside to the parallel of *Chincoteague inlet* nearly, and of the *Chesapeake* south of the present limit, including the ordinary repairs merely, and the fuel for a steam vessel and the hire of a tender for the outside work. *Office-work.*—To make the computations and reductions required by the work of the section; to complete the drawing of a third sheet of the *Chesapeake bay* and to commence a fourth; to complete the engraving of the first sheet and to continue that of the second—will require . . . 32,000

SECTION IV. *Field-work.*—To continue the triangulation of *Currituck* sound north, towards the junction with Section III; to extend that of *Pamlico* sound and of the ocean shore from *Hatteras* inlet to *Acrucoke* inlet; to make the necessary astronomical and magnetic observations in connexion; to continue the topography of the shore of *Currituck*, *Roanoke* and *Pamlico* sounds; to complete the hydrography of *Croatan* and *Roanoke* sounds, of *Oregon* and *New* inlets; to continue that of *Currituck* sound, and to commence that of *Pamlico* sound; to complete the hydrography of *Hatteras* and *Wimble* shoals, of *Hatteras* inlet, and to continue that of the shore between *Hatteras* and *Nag's Head*, including the current repairs and maintenance of a steam vessel for the outside work. *Office-work.*—To complete the drawing of the second sheet of *Albemarle sound* and its rivers, and to continue the engraving of the first sheet; to draw and engrave charts of *Hatteras cove* and inlet—will require . . . 25,000

SECTION V. *Coast of South Carolina and Georgia.*—To continue the secondary triangulation northward and eastward, connecting *Kiawah*, *Polly* and *Morris* islands with *John* and *James* islands, and these with the main, and to extend it up the *Wando* river, and westward and southward down *Broad* river, across *Port Royal* entrance and the passages between *Hilton Head* island and the adjacent islands and main; to execute a portion of

the main triangulation in the same section and to make the astronomical and magnetic observations connected with it ; to execute the topography of the shores of *St. Helena* sound and of its rivers, and of the *Hunting* and *Port Royal* islands ; the hydrography of *St. Helena* sound, and to complete that of the *seacoast* between it and Charleston harbor. *Office work.*—To make the computations required in this section ; to continue the engraving of the chart of *Charleston harbor* and the approaches ; to make the drawing of the harbor of refuge of *North Edisto*—will require \$22,000

SECTION VI. Reefs, keys, and coast of Florida. See estimate for special appropriation as provided for the two years last past.

SECTION VIII. *Field-work.*—To continue the primary triangulation of the outer coast of Louisiana, and to make the necessary astronomical and magnetic observations connected with it ; to complete the triangulation of *Pontchartrain*, and to continue the secondary triangulation south of the *Chauveau islands* towards the mouth of the *Mississippi* ; to continue the topography of the shores of *Lake Borgne* and *Pontchartrain* ; to continue the hydrography of *Mississippi sound* and the outer coast of *Alabama*, *Mississippi* and *Louisiana*, south of *Dauphin*, *Horn*, *Petit-Bois*, *Cut* and *Ship* islands. *Office work.*—To make the necessary calculations and reductions of the work of the section ; to complete the drawing of the second sheet of *Mobile bay* and of the second general coast sheet, embracing part of *Mississippi sound* ; to complete the engraving of one sheet of *Mobile bay*, and to commence that of the first general coast sheet—will require about 22,000

SECTION IX. Coast of Texas. *Field-work.*—To continue the main and secondary triangulation southward and westward towards the *Brazos* ; to make necessary astronomical and magnetic observations connected with it ; to complete the topography of *Galveston bay*, and to commence that of *West bay* ; to complete the general hydrography of the seacoast from *Galveston* towards the *Brazos*. *Office work.*—To complete the drawing and commence the engraving of the map of *Galveston bay*, and to complete the engraving of the chart of the entrance—will require 20,000

SECTIONS X AND XI. *Western Coast.*—See estimate provided for, as last year, by special appropriation.

Total, exclusive of Florida reefs and keys, and of the western coast 180,000

SECTION VI. To continue the survey of the Florida reefs and keys, viz : *Field work.*—To complete the triangulation of *Key Biscayne bay* and *Card's sound*, and westward from *Key West* to *Boca Grande* ; to make the necessary astronomical and magnetic observations connected with it ; to measure the bases on *Key Biscayne* and *Cape Sable* ; to extend the topography of the Florida reef from *Key Biscayne* to *Carysfort reef*. *Office work.*—To make the computations and reductions required by the work of this section ; the drawing of *Key Biscayne* and chart of adjacent parts of the *Florida reef* ; to complete the engraving of *Key West harbor* and its approaches—will require 30,000

SECTIONS X AND XI. For continuing the survey of the coast of Oregon and California 150,000

The work there to include continuation of determining geographical positions of leading points on the coast; of a general reconnaissance of the coast; of the survey of *Columbia* river to *Port Vancouver*; of the *Willamette*, to *Oregon City*; commencement of the survey of *Puget's sound*; continuation of the surveys of *Humboldt* or *Trinity bay*, of *Bodega*, *San Francisco bay* in part, *Monterey*, *Santa Barbara*, *Santa Barbara sound*, (commenced,) of *San Diego bay*, and including such examinations as may be required for light-houses, beacons, buoys, &c.

The appropriations of the past year were:

1. General appropriation for the survey of the coast . . . \$186,000
2. For the Florida reefs, keys, and coast . . . 30,000
3. For the western coast, including the cost of a steam vessel 190,000

SECTION I.—FROM PASSAMAQUODDY BAY TO POINT JUDITH, INCLUDING THE COAST OF MAINE, NEW HAMPSHIRE, MASSACHUSETTS, AND RHODE ISLAND.—(Sketch A.)

The work has made good progress in this section, though, as the usual appropriation was not made at the beginning of the fiscal year, a change in the details of arrangements was indispensable. I endeavored so to direct the operations as to keep up those most immediately important, supplying the others, upon which future work would be based, as early as practicable, and adding parties towards the close of the season to make up for the deficiency in the beginning.

In the month of August I visited the parties at work in this section, or met the chiefs of the parties, and received reports of their progress, directing such modifications in the work as circumstances required. The complete survey of Richmond's Island harbor of refuge was thus arranged, in order to make up for the necessary absence of the primary party from this section. I also examined an astronomical station in Maine, to be prepared to occupy it, if means were furnished, before the advance of the season rendered it inexpedient to commence new work at the east.

This section contains so large a proportion of off-shore hydrography and of difficult in-shore work, and the season during which hydrography is practicable is so brief, that an additional hydrographic party should be employed. At the same time, the difficulty of obtaining officers for even the existing hydrographic parties is so great, that it will, probably, be necessary to employ one or more of those at work at the south, after the close of the season there, in this section. This has the disadvantage that the office work, which is as much a part of the hydrography as the observing, falls behind, and if the chiefs of parties are detached from the work, is necessarily left in an unfinished condition.

The detailed statement which follows shows the results which may be thus generally given: Some progress has been made in reconnaissance; the secondary triangulation of Massachusetts and New Hampshire have been connected with each other and with the primary stations, and the work extended over the coast of New Hampshire to beyond the Kennebunk, Maine, and over Richmond's Island harbor and approaches in Maine; the topography of Marblehead, Salem, and Beverly harbors, in Massachusetts, and of Richmond's Island harbor, in Maine, has been completed, and that of Cape Cod has made some progress.

The hydrography has been kept on the full scale, two parties having been employed, except during a brief period at the beginning of the season, and one of the parties provided with a steamer and two sailing vessels. The hydrography of the Nantucket shoals has been continued, and important advances made in it; the approaches to Muskeget channel have been sounded out, so as to complete the work for the chart which is in progress of engraving; the space between Gay Head and Block island, to the junction with former work, has been filled up for the off-shore chart; additional soundings have been made in the approaches to Wellsfleet harbor, for the chart of that harbor, which is in preparation; the sounding out of Salem and Beverly harbors has been completed, and that of the approaches commenced. A preliminary chart of the ocean near Nantucket, embracing the work up to the close of 1849, and showing the discoveries made by Lieutenants Comdring Davis and McBlair, is appended to this report. (Sketch A, No. 3.)

Tidal and current observations have been made at the western entrance to the Vineyard sound, in Buzzard's bay, and the Vineyard sound on opposite sides of the Elizabeth islands, and in the passages from the sound to the bay. Richmond's Island harbor, near Portland, Maine, and its approaches, has been sounded out, and tidal and current observations made there. Views have been taken for the general coast chart, eastern series, No. 1.

Improved arrangements have been made for ascertaining the difference of longitude between the stations on our coast and Europe, by connecting Cambridge and Liverpool observatories, by the interchange of chronometers, and one series of results has been completed. Astronomical observations have been continued for the use of the survey at Nantucket. The contribution from Harvard observatory has also been kept up. Magnetic observations for harbor charts have been made along the coast from Newburyport to Portland.

Nine maps and sketches have been in progress of drawing or engraving, from work of this section. The important sketch of Nantucket shoals (sketch A, No. 1) has been drawn and engraved anew.

Reconnaissance.—The directions in regard to reconnaissance it was found desirable not to carry out, for reasons already alluded to. Assistant C. O. Boutelle, however, took advantage of a favorable opportunity to determine a doubtful point in regard to the visibility of Ragged mountain, Maine, from Cape Small, which required the measurement of approximate angles from Sebattis, as well as observations from Cape Small. Mr. Boutelle also visited Cape Small and Richmond's Island harbor with me, and gave me the advantage of his local information in the arrangements for the survey of the latter.

Difference of longitude, &c.; magnetic observations.—The transportation of chronometers for difference of longitude between Cambridge Observatory, Massachusetts, and Liverpool Observatory, England, was continued under the immediate charge of W. C. Bond, esq.; director of the Cambridge Observatory. The observations at Liverpool were due to the kindness of Mr. Hartnup, director of the observatory there. The first series was brought to a close this year; and preparations are making for a second series, to begin next spring, in which we will be able to render available all the experience acquired in the past, and all the suggestions which arise from a discussion of the first results. In his report to me

Mr. Bond says: "The first mean result derived from one hundred and seventy-five chronometers, after the application of certain probable errors and weights, is found to be 4h. 44m. 30.1s. This may safely be considered as not one second in error. But on the comparison of a considerable number of outward and homeward passages, I find that the eastern passages give a greater difference of longitude than the western; and this too uniformly, to be the result of accidental errors of the chronometers." Further details on this interesting point will be found in appendix No. 6.

The coast survey was indebted to Messrs. Bond & Son, of Boston, for the gratuitous use of the greater part of the chronometers employed in the expedition; also, to E. & G. W. Blunt, of New York, for the use of part of the others at merely a nominal rate of compensation.

The observations of moon culminations, and of transits of moon culminating stars, contributed this year to our list by W. C. Bond, esq., have been 65, and of occultations 52.

The magnetic observations along the coast of this section for the harbor charts, continued last year by Professor Keely, were assigned, on his expressing an unwillingness to resume them, to assistant Julius E. Hilgard, who observed at Plumb island, near Newburyport, Kittery point, near Portsmouth, Fletcher's neck, near Saco entrance, and Richmond's island, near Casco bay.

The following is a statement of the number of observations made:

	Declination.	Magnetic dip.	Horizontal intensity.
Plumb island - - -	3 sets.	3 sets.	2 sets.
Kittery point - - -	5 "	4 "	2 "
Fletcher's neck - - -	3 "	3 "	3 "
Richmond's island - - -	3 "	3 "	2 "

The instruments used were a declinometer by Jones, No. 20, and a 9-inch dip circle by Barrow, with compound microscopes.

Secondary triangulation.—Two secondary triangulation parties have been employed—one during the whole season, and the other during the chief part of it. The party of Capt. T. J. Cram, United States topographical engineers, assistant in the coast survey, has extended the triangulation of the coast of New Hampshire and Maine eastward, and up to the 29th of October had passed the Kennebec. (Sketch A.) The work includes Portsmouth harbor and its approaches, the Isles of Shoals, the connexion with Mr. Boutelle's work, in Massachusetts, and with my primary triangulation, and the coast of New Hampshire and Maine to "Summit Station." Thirteen stations were occupied, from which observations were made on 156 points, including 78 light houses, beacons, buoys, steeples, and towers. The number of angles measured is 2,772, by 8,924 single observations, on 47 days, by a 12 inch repeating theodolite of Simms, (C. S. No. 18.)

The computations required from Capt. Cram's field-work of last year were made before the opening of the past season.

The plan submitted by assistant C. O. Boutelle for the triangulation of Richmond's Island harbor and its approaches, and connecting it with the main and secondary work of the coast, and of Casco bay, is shown in sketch A, No. 2, and realizes entirely the conditions of such work, as well in the way in which the sides of the main triangles are reduced, as in the determination of the secondary triangles, and in the number of

points furnished for the plane-table work. The work was commenced by setting signals on the 21st of August, and between the 28th of August and the 25th of September 11 stations were occupied, and 176 angles measured on 173 objects, by 1,246 observations, with an 8-inch Gambey theodolite, (C. S. No. 24.) Twenty-one vertical angles were also measured for height, by 202 observations, with the same instrument, and these were referred to the mean level of the sea through the height of Bramhall's hill, which was determined by a spirit-level, kindly loaned to Mr. Boutelle by John Anderson, esq., chief engineer of the Portland and Kennebeck railroad.

The work has been duplicated, the first computations made, and the points furnished to the topographical party. The party of Mr. Boutelle proceeded next to complete the connexion between the secondary triangulations of Massachusetts and New Hampshire, on which work they are now (October 28th) engaged, to proceed in a few weeks to section V. Mr. G. A. Fairfield has assisted Mr. Boutelle in the field-work during the season, and Mr. Fairfield and Mr. J. W. Gregorie have been engaged in computations, under his direction, of work of this and the previous season.

Mr. Boutelle calls my attention to the necessity for a survey of Newburyport harbor, on the ground that no good chart exists of the mouth of the Merrimack river, and that the commerce of Newburyport is greater than that of any other port between Salem and Portsmouth.

Topography.—From October 10, 1849, to December 25, the party of assistant H. L. Whiting were in the field near Salem and Boston, and surveyed an area of thirteen square miles, and thirty miles of shore-line. Mr. Whiting was assisted by Messrs. Wampler and Harrison. At the close of the season sub-assistant Wampler took charge of a plane-table party in Section IX, and Mr. Harrison was employed in computing until detailed for duty on the western coast, in May last. Mr. Whiting proceeded to the mouth of the Connecticut river, and executed in turn the surveys, of which a notice will be found in section II. During part of the past season Mr. Whiting has been assisted by sub assistant Wampler, and Messrs. S. C. McCorkle and R. M. Bache.

The work has extended eastward towards Gloucester harbor and the vicinities of Marblehead; Salem and Beverly have been completed. (Sketch A, sheets Nos. 34, 35, and 36.) The area embraced is 23 square miles; the shore-line extends 33 miles. On closing here for the season, Mr. Wampler will resume the survey of Galveston bay. The drawing has been finished as far as practicable, in order to be prepared for this transfer.

2. The party of assistant J. B. Glück was, during a brief portion of the season, engaged in bringing up his work on Cape Cod, in which he was assisted by sub-assistant J. H. Adams. He reports an area of about eight square miles as completed. Mr. Glück's party is now engaged on the Patapsco.

From June to October Mr. Glück was in charge of the drawing department of the office.

Hydrography.—The party of Lieutenant Commanding Chas. H. McBlair, United States Navy, assistant in the coast survey, has continued the survey of the shoals near Nantucket. (Sketch A.) The steamer Bibb, the schooner Gallatin, commanded by Lieutenant J. N. Maffitt, and a

hired vessel, serving chiefly as a floating station, have been engaged in the work. From the 9th of July to the 22d of August the party was employed on the Nantucket shoals. The outline, extent and depth of water of the Great Rip shoal, and its approaches, were determined, and some lines run to the southward, and southward and westward of Davis's new south shoal, important as affecting the question of the existence of other shoals to the south of Davis's, of which, thus far, there is no indication. Between this date and the 6th of September the soundings required to complete the hydrography of Muskeget channel and its approaches were made. The party next took up the soundings between Gay Head and Block island, for the off shore chart, and finished the part of the work requiring close sounding, extending about twelve miles south of Gay Head; and westward to a junction with the former hydrography in this region, and two off shore lines of about thirty miles each, commencing also the work between the islands of No Man's Land and Martha's Vineyard. The Gallatin was then detached to execute some supplementary hydrography in Boston harbor, and to prepare for taking her place in section V. Lieutenant Commanding McBlair, in the steamer Bibb, proceeded to Wellfleet harbor for supplementary work on the chart preparing for engraving, which was accomplished; and the inner harbor of Salem was sounded out, and the approaches commenced, when the advance of the season rendered it desirable to close the operations.

Lieutenant Commanding McBlair presents the following statistics of his work:

	Nantucket shoals.	Muskeget channel.	Off Gay Head.	Off-shore work.	Wellfleet harbor.	Salem and Beverly harbors.
Area.....	164	70	300	-	-	25
Lines of soundings, extent	216	230	217	95		
Number of soundings.....	3,019	3,155	1,900	91	717	3,614

The area closely sounded has covered an area of 559 square miles, and the number of soundings taken, generally at considerable depth, is 12,499.

The very various character of this work prevents a strict comparison being made between it and the work of sailing vessels; but, after making due allowances, I conclude that in amount the work has been rather more than double that which could have been performed under sails in the same time.

Lieutenant Commanding McBlair remarks: "The season generally was very unfavorable to hydrographic operations in the localities in which we were employed. During the months of July and August the weather was alternately foggy or boisterous, entirely defeating every effort to continue

the survey of the shoals. The few suitable days we had in September we employed in the Muskeget channel and Gay Head hydrography."

Buoys are recommended to be placed, one on a spit reaching from Fox's Point, Nashawena island (Elizabeth islands,) and two on Billingsgate shoal, in Massachusetts bay. (Appendix No. 7.)

After completing the hydrography assigned to his party on the south shore of Long Island, Lieutenant Commanding Maxwell Woodhull, United States navy, assistant in the coast survey, proceeded in the schooner Nautilus to establish tidal stations at the Elizabeth islands for investigating the tides and currents of the part of Buzzard's bay, and of the Vineyard sound, which are here connected by the different passages between the islands, and especially between the two passages principally used by coasters. (See sketch A.) The work was commenced last year by Lieutenant Commanding Goldsborough, but owing to the advance of the season my instructions could not be fully carried out, and renewed observations over a larger period were shown, by the discussion which I made of the results, to be necessary. Lieutenant Commanding Woodhull established three tidal stations on the Buzzard's bay side, and three on the Vineyard sound side, and continued the observations of the time and height of high and low water, day and night, for two lunations. The simultaneous hourly observations which I had directed at the stations were unavoidably omitted.

Eight current stations were occupied for the general examination of the currents in the Vineyard sound, Buzzard's bay, and their approaches. The stations are numbered 15, 16, 17, 18, 19, 20.

Leaving a portion of his party under command of Lieutenant Barnet, in the schooner Nautilus, to continue these observations, Lieutenant Commanding Woodhull proceeded to execute the hydrography of Richmond Island harbor of refuge, Casco bay, Maine, which the citizens of Portland had earnestly requested might be made. The harbor has been very minutely sounded out, and the approaches included in the survey. The work covers an area of eight square miles; the number of soundings taken were 6,000, and of miles run in sounding 100. Arrangements have been made by which the chart of this work will be at once reduced and prepared for engraving.

Lieutenant Commanding Woodhull acknowledges the indebtedness of the survey to Major Robert Anderson, United States Army, for facilities extended to the work.

Returning to the Vineyard sound, on the completion of the tidal and current observations before referred to, the operations of this party for the season were closed.

During the summer Lieutenant Commanding Woodhull gave the necessary opportunities to assistant John Farley to take the views of the coast off the entrance to Narragansett bay and Buzzard's bay, and the Vineyard sound, required for the general coast chart, eastern series, No. 1, now engraving.

SECTION II.—FROM POINT JUDITH TO CAPE HENLOPEN, INCLUDING THE COAST OF CONNECTICUT, NEW YORK, PENNSYLVANIA, AND PART OF DELAWARE.—(Sketch B.)

The office work of this section has steadily advanced, and the supplementary field work has occupied the time of parties which could occasionally be spared from other sections. The report of Professor Pendleton in regard to the progress of the sand of the south shore of Long Island inwards, and of assistant H. L. Whiting in regard to the progress of Sandy Hook, have been considered of sufficient importance to give them almost entire in the appendix, (Nos. 8 and 9.)

1. The triangulation to determine hydrographic points necessary for the revision work on the south side of Long Island was made by Professor A. G. Pendleton, United States Navy, assistant in the coast survey, temporarily attached to Lieutenant Commanding Woodhull's party for this purpose. Subsequently Professor Pendleton assisted in observing from one of the shore stations, on the schooner Nautilus, while engaged in sounding. After completing this work he was attached to the party of Lieutenant Commanding Jenkins, to assist in the work on the Hatteras shoals and in the Gulf Stream. While on Long Island he had an opportunity of observing the progress of the sand along the coast, and of ascertaining the local traditions in regard to its encroachment on the arable land. His statements in the appendix, (No. 8,) taken in connexion with those of assistant H. L. Whiting, (appendix No. 9,) in regard to the practicability of controlling such movements will be found of practical interest to the farmers on the south side of Long Island.

2. Professor Kendall, of Philadelphia, has reported from the High School Observatory, for the use of the coast survey, sixty transits of one limb of the moon, one hundred and eighty five of moon culminating stars, thirty-four immersions and seven emersions of stars, "including three occultations of Aldebaran, in each of which both phases were successfully observed, one immersion of Regulus, and the occultation of Jupiter of February 26th, on which occasion the times of the four contacts were noted."

Professor Kendall was assisted by Passed Midshipman S. L. Phelps, United States Navy, on coast survey service, who was preparing to join the expedition under charge of Lieutenant Gilliss, United States Navy, in Chili; and since his departure, by Mr. Andrew Mason. The reduction of all the observations made up to 1849 has been completed, and the work of the last two years is promised early in 1851.

3. An examination of the topography of the entrance to Connecticut river, by Captain A. A. Humphreys, having shown that, in consequence of changes and other circumstances, a resurvey was necessary, assistant H. L. Whiting proceeded there in January last, and, favored by excellent weather, finished the work before the close of the month.

The survey extends from Lynn ferry to Cornfield point on the west, and from Stony river to Saybrook point on the east; covering an area of thirteen square miles, and determining thirty miles of shore-line.

4. Mr. Whiting next reviewed the topographical sheet of Hart and City islands, so as to bring the work up to the present date for the harbor chart in course of engraving.

5. Mr. Whiting also traced the shore-line of Sandy Hook, to ascertain the changes in that important locality. The result is represented on

sketch B, No. 2, which shows the results of various surveys from 1778 to the present date. During the past two years the chief change will be found to consist in a motion of the northern extremity of the Hook to the westward. The views of Mr. Whiting in regard to the changes at Sandy Hook are given in the appendix, No. 9. A cause for the motion of the sand, different from that which he supposes, has been pointed out by General Totten, of the corps of engineers, and by Mr. Palmer, of London.

6. The revision of the hydrography on the south side of Long Island, for the western sheet of the chart of that part of the coast, was continued during part of the season by Lieutenant Commanding Maxwell Woodhull, United States Navy, assistant in the coast survey, in the schooner *Nautilus*. The work of Lieutenant Commanding Woodhull extends from Ketchikanneck to Neapeague, (see sketch B.) The area resurveyed was about 345 miles; the number of miles run in sounding, 560; and the number of soundings made, 5,500. A series of tidal observations were made for one lunation at Fire Island inlet.

During last winter Lieutenant Commanding Woodhull sounded minutely over Princes's and Diamond reefs, in the harbor of New York, and caused models of them to be made for the use of the Committee on Commerce of the House of Representatives. The importance of this examination, and of presenting its results in so plain a form, will fully appear from the report of Lieutenant Commanding Woodhull, (appendix No. 10,) and the memorial of the Chamber of Commerce, (appendix No. 11.)

8. A similar model was made, under the immediate direction of Lieutenant Commanding Woodhull, of the intricate passages and numerous obstructions of Hell Gate, and copied for the Chamber of Commerce of New York, at the expense of the Hon. James G. King.

9. The drawing of thirty-one maps and sketches belonging to this section has been finished, and the engraving of thirty is in progress or has been completed. The atlas of the harbors of Long Island sound will be completed by the charts of the mouth of Connecticut river and of City island, which are engraving. The off-shore chart has received important modifications tending to increase its value, and is constantly in the engraver's hands. The details of this part of the work will be found under the head of office work.

10. The study of the specimens of the bottom, and their classification, has been continued by L. F. Pourtales, esq., who has compared also the specimens with the corresponding designations on the off-shore chart. The scientific conclusions reached in this examination were among the most important results communicated at the meeting of the American Association for the Advancement of Science, at Charleston, in March last. The distribution occurring according to depth is practically less valuable to the navigator than if it depended on special locality.

11. The plan heretofore adopted of obtaining the orthography of names for our charts, in a form having authority, has been continued in the case of the three sheets of the south side of Long Island, the names upon which—182 in number—have been examined by the Hon. H. C. Murphy, of Brooklyn, to whose valuable labors we were before indebted for similar work in reference to the eastern and middle sheets of the chart of Long Island sound.

12. The coast survey has been called upon during the past year to continue the work on the Hudson river, and the call has been coupled with

a very liberal offer on the part of Isaac Newton, esq., president of the People's line of steamboats, of the use of the boats of the company for the transportation of the parties. (Appendix No. 12.)

13. During last winter, after closing his duties in Section I, assistant George Davidson made an elaborate series of observations at Philadelphia for determining the constants of the magnets, used with declinometer No. 22 of Jones, including the moment of inertia of the bar, and correction for temperature of the magnet.

SECTION III.—FROM CAPE HENLOPEN TO CAPE HENRY, INCLUDING THE COAST OF DELAWARE, MARYLAND, AND PART OF VIRGINIA.—(Sketch C.)

Six parties have been employed in this section during the season generally. The astronomical observations found necessary at the primary stations, connecting the Capitol with the coast, have been brought nearly to completion; the telegraphic operations from Washington station for difference of longitude have been continued; the primary triangulation has advanced to Winter harbor, Virginia, between the Rappahannock and York rivers—that across to Washington is completed; the secondary triangulation of the outer coast has reached Cedar island, Virginia, within less than forty-five miles of Cape Charles. The hydrography has advanced nearly to the limits of the triangulation of last year—on the Western shore of Virginia to the Rappahannock, on the Eastern shore to Sandy point, (mouth of Occahannock,) and on the ocean side to Chincoteague bay.

The hydrography has advanced outside to Lonesome hill, and in the bay to Windmill point and Nandua creek. The topographical party on the bay shore has had two plane-tables at work. The hydrographic party has employed a steam vessel and a sailing vessel, and during part of the season a second sailing vessel as a tender.

The estimate made in my report of last year in regard to the progress of the different parts of the survey of this section is entirely realized—the main triangulation being, however, in advance of the secondary work of the ocean coast. The steamer Walker, hitherto considered the most efficient of the steam vessels used in the survey, was transferred for outside work to the hydrographic party at the beginning of the season, and used until the party came inside.

Less than two seasons more will finish the primary triangulation to the Capes of Virginia. Further effort will be made to press on the outside hydrography.

When the triangulation has reached the capes, it will be practicable to employ an additional hydrographic party with advantage—the expenditure in the section not being increased, as a triangulation party will be dispensed with.

A valuable series of sailing directions for the bay north of the Potomac has been compiled by Lieutenant Commanding S. P. Lee, from former notes, from the charts, and from recent examination, and a report made of deficiencies in lights and buoys within the same limits, to which I beg leave to call the attention of the department. (Appendix No. 14.) The colors of the buoys are given in conformity with the law passed at the last session of Congress.

The engraving of the chart of Baltimore harbor and the Patapsco in

two sheets, and of the upper sheet of the Chesapeake bay, is in progress, and the drawing of the second sheet has been commenced.

A preliminary sketch of the seacoast of Delaware and Maryland will be appended to this report. (Sketch C, No. 2.)

Astronomical and magnetic observations and primary triangulation.—The fact having been fully established that the local attraction at an astronomical station modifies essentially the determinations, and that these stations must hence be multiplied, I have chosen the past season, when the business of the survey necessarily detained me in this section, to occupy three stations of the triangulation for connecting the Capitol and observatory with the Chesapeake base (sketch C) for astronomical observations, and to complete the triangulation itself. These stations were occupied between the 19th of June and 3d of December, and the following observations were made:

For horizontal angles, 710 observations on 13 stations, with the thirty-six inch (Troughton & Simms) theodolite, (C. S. No. 1.)

For azimuth and connexion of the work with the triangulation, 556 observations were made with the same instrument. The stars observed were, Polaris, Delta and Lambda Ursæ Minoris, generally near their greatest elongation, but in some cases by azimuths at equal intervals of time before and after culmination.

For latitude, 1,017 observations of 24 standard and 167 catalogue stars, with the zenith sector by Troughton & Simms, (C. S. No. 1.)

For time, in connexion with the foregoing, 320 observations on 40 stars, paired as high and low stars, with a forty-eight-inch transit instrument by Troughton & Simms, (C. S. No. 4.) The magnetic observations consisted of 216, on 13 different days, for magnetic declination; 11 sets, including both deflections and vibrations, for horizontal intensity, with the declinometer by Jones, No. 22, (C. S. No. 1,) on 11 different days; 9 sets for magnetic dip, on 9 days, with a ten-inch dip circle by Ganabey.

A meteorological register was kept at all the stations, in which 348 observations of the barometer, and 348 of the wet and dry-bulb thermometer, were recorded.

The method of azimuths by observations at equal intervals before and after culmination of a circumpolar star, gave excellent results—the time being well ascertained. The computations required are quite brief.

The mean value of the divisions of the micrometer used with the zenith sector was determined at one of the stations by 1,364 measures on the divisions of the limb of the instrument. The same stars were, as far as practicable, used for latitude at the different stations, so that the difference of latitude would result directly, and the places of the stars be corrected by the average of the season's results. As many of those used last year at Marriott's and at Mount Independence as the difference of season or of latitude would permit, were also taken into the observations. As many standard stars from the Nautical Almanac as were included in the hours of observation, were also introduced for comparison.

The observations for horizontal angles were made by myself, and in my absence from Hill's station by Captain A. A. Humphreys, United States topographical engineers, assistant in the coast survey. Those for azimuth generally by me, and occasionally by sub assistant George W. Dean. Those for latitude and time, and the magnetic observations,

by sub-assistant George W. Dean. The meteorological register was kept by Mr. Edward Goodfellow.

During the season, several of the younger employes of the coast survey were engaged in my camp, and under my immediate direction, in computations of tidal and other observations, and in learning to make the various observations which were in progress.

The reconnaissance of the line between Webb's and Hill's stations was brought to a successful completion during the winter by Mr. Thomas McDonnell, under my direction, and the line was opened so as to give an important verification by the second diagonal of a quadrilateral. (See sketch C.)

During the winter sub-assistant George W. Dean, with the aid of Mr. John Rockwell, revised the computations of the previous season's work, and made the necessary duplicates of the books. Mr. Dean also made a complete discussion of the latitude observations, and a comparison of the results with the zenith telescope and zenith sector, and was very useful in directing the details of the tidal diagrams and computations making under my charge.

Astronomical and telegraphic observations.—The observations for differences of longitude by telegraph, and for connecting Seaton station at Washington with the primary stations around it, have been in charge of assistant Sears C. Walker, aided by sub-assistant L. P. Pourtales.

The importance of Cincinnati as an intermediate station between Washington and New Orleans, by the western telegraph route, induced a repetition of the observations with Professor Mitchel on three nights in October and November. The meteorological circumstances, however, were not favorable, and but few signals could be transmitted and registered.

On the 5th of February, a perfect telegraphic connexion was made between Washington and Charleston, South Carolina. The thermometer at Washington was 10° Fahrenheit, and at Charleston 23° Fahrenheit, and the insulation of the wires excellent. Professor Lewis R. Gibbs was in charge of the operations at Charleston, assisted in the telegraph part by L. W. Caldwell, esq. Assistant C. O. Boutelle and myself were also present. The times of transits of a full series of zenith stars were telegraphed between Professor Gibbs's observatory and the Seaton station, and recorded on the register of both stations. The instruments were all well adjusted, and all necessary precautions taken to insure satisfactory results. Signals were also exchanged on the 11th and 12th of February, but the results were not so satisfactory as those on the 5th.

The fact that a signal made at one station is not received at the same instant of absolute time at another, but requires a measurable time for its transmission, having been fully proved by Mr. Walker, the investigation of this time is an important element in our telegraph work. The interval which he considers as due to the time required for the galvanic influence to propagate itself through the telegraph wires, or through the ground from one station to another, requires, to render it measurable with any considerable accuracy, that the stations should be very distant. By the junction of the telegraph lines from Washington to Pittsburg, (Pennsylvania;) Pittsburg to Louisville, (Kentucky;) and Louisville to St. Louis, (Missouri,) for which we are indebted to the liberal and obliging managers, Mr. Walker succeeded, on the evening of the 4th of February, in transmitting signals from the Seaton station to St. Louis, and in pro-

curing their record on the registers of the four telegraph offices above named.

The length of the wire constituting the telegraph line was one thousand and forty-five miles, and the shortest distance through the ground seven hundred and forty-two miles, between the two stations. The temperature of the air was zero of Fahrenheit at Pittsburg and the other western cities, and 8° at Washington. The sky was clear, the wind northeast, and the ground covered with snow. The insulation of the line was admirable. A brief account of this very successful experiment is given in the appendix, No. 13, as extracted from Mr. Walker's report.

A most interesting experiment was made on the same subject by the chemical telegraph line, (North American Telegraph Company,) a notice of which, with some particulars of the progress of the telegraph art and of the inquiry in regard to the velocity of transmission of the telegraphic signals, will be found in the article of the appendix just referred to.

2. The horizontal angles between the meridian mark and the three stations visible from the Seaton station, have been measured by sub-assistant L. F. Pourtales, who has also made a series of observations for latitude with a zenith telescope by Wurdeman (C. S. No. 5,) and one by Simms (C. S. No. 1,) using the same stars which were observed at Marriott's station by my party last year.

As, by the telegraphic connexion in longitude, observations of moon culminations and occultations at places thus joined with the coast stations become directly available for differences of longitude from Europe, I have requested Professor Mitchel, of Cincinnati, to furnish for use the results of his observations during the past year, which have been as follows: moon culminations, 23; transits of moon culminating stars, 75; of time stars, 31; for deviation, 44; for collimation, 23. The transits over twenty-five wires were observed.

Professor Mitchel also observed, by his own method, the differences of declination of the stars and in determining the latitude at Marriott's, and before referred to, the observations on a single wire amounting to between 2,500 and 3,000.

The report of the computations, under Mr. Walker's charge, will be given under the head of office-work.

Triangulation.—The primary triangulation of the shores of the Chesapeake, and the secondary connected with it, in charge of assistant Edmund Blunt, has advanced to Wolf Trap station, (sketch C,) though the season has been unfavorable to its progress. After the date of my last report, and before closing operations for the season, Mr. Blunt occupied four primary and seven secondary stations, measuring ninety-three angles by 1,452 observations.

The area of the work was about 150 square miles. During the present season, between June and November, three primary stations were occupied, and fifty angles measured by 1,002 observations. The area of the work was about 260 square miles. The same instrument, a twelve-inch repeating theodolite, by Simms, (C. S. No. 11,) was used in both cases. Mr. Blunt was assisted, during part of August and September, by sub-assistant S. A. Gilbert. From the progress of this work it is plain that the triangulation of the Chesapeake will be completed in less than two seasons. An average season's work on the Chesapeake covers an area of about four hundred square miles, and less than seven hundred and fifty remain to be executed, including Mob Jack bay and the entrance to York river, and Hampton

Roads and the entrance to James river, as well as the main bay. The triangulation from the head of the Chesapeake to the capes will furnish the length of an arc of the meridian of more than two degrees and a half, measured with but moderate deviation, on each side of the central meridian.

This part of the bay is better represented in its general distances and directions on the ordinary maps, than higher up, but the accuracy is by no means what is required. The distance from Windmill point to Sandy point, on the State map of Virginia, is given as 19.8 miles, while Mr. Blunt's work shows it to be 18.5.

Secondary triangulation.—The secondary triangulation of the outer coast of Maryland and Virginia has been continued during the past season by assistant John Farley; and between the date of my last report and September 1st, the work extended thirty-three miles from Pope's island, Maryland, to Cedar island, Virginia, (sketch C,) covering an area of 152 square miles. Sixteen stations were occupied, and 66 angles measured by 1,410 observations with an eight-inch Gambey theodolite, (C. S. No. 19.) The party of Mr. Farley is still in the field, having resumed work early in October. During the latter part of August and in September he was employed in taking views for the eastern series, chart No. 1. At the average rate of progress of this work, two full seasons will carry it to Cape Charles, where it will meet the primary triangulation. The difficulty of crossing the peninsula without expensive cutting has hitherto prevented a junction of the two triangulations, which was desirable.

Topography.—1. A double topographical party has been engaged on the eastern and western shores of the Chesapeake, under the charge of assistant R. D. Cutts. The temporary charge of the office having been assigned to Mr. Cutts soon after his return from Galveston, the immediate direction of the party has been, during the season, with Mr. John Seib, who, in conjunction with Mr. S. A. Wainwright, has carried on the work. Up to October 1st, the shore-line on sheets Nos. 40, 41, 42, 43, and 44, (sketch C,) had been executed, and a considerable portion of the interior; the shore-line being furnished to the hydrographic party when completed. This includes the western shore from Smith's point light-house to Windmill point, at the mouth of the Rappahannock; the eastern shore from Scott's Hall to Sandy point and Tangier and Watts island. The extent of shore-line surveyed is 308 miles, and the area 35, the disproportion being caused by the necessity for urging forward with the shore line for the hydrography, which, in the bay, presses closely on the topography.

The office-work of this party consisted in putting in ink the topography of last year, and was executed by Messrs. Seib and Wainwright before taking the field.

2 Since the date of my last report, assistant George D. Wise has been employed in revising his work on the Patapsco, in the office-work required by the surveying of the previous season, and in completing the topography of sheets Nos. 40 and 41, on the seacoast, (sketch C.) The shore-line and the greater part of the topography is completed to Lonesome Hill station, four miles from Assateague light-house. The work includes an area of 66 miles, a shore-line of 191 miles, and a distance along the coast of 22 miles.

Mr. Wise is now finishing his drawings, preparatory to field-work in section V.

Hydrography.—The hydrographic party in charge of Lieutenant Commanding S. P. Lee, United States Navy, assistant in the coast survey, has completed on the seacoast of Maryland and Virginia the work from North Birch Station (sketch C) to Lonesome hill, extending seaward thirteen miles in an east-southeast direction, besides filling up some details just north of this. Up to the first of October, the party had also executed the work near the shores of the Chesapeake shown in the sketch, and extending from Smith's point to Windmill point on the western shore, and from Shark's station to Nandua creek on the eastern shore. They are still engaged in this portion of the bay.

The party had the use of the coast survey steamer "Walker," on her return from the Gulf of Mexico, from the close of June to the latter part of September, when she was retransferred to Lieutenant Commanding Alden; then of the steamer *Legaré*, which had undergone repairs, including the replacing of her propeller by a new one, from the 7th of October to the close of the season. The brig *Washington*, Lieutenant Commanding B. F. Sands, United States navy, has been also attached to the same party during the season, and a tender—first the coast survey schooner *Bancroft*, and then the schooner *George M. Bucho*—has been used in the outside work.

The following statistics are given by Lieutenant Commanding Lee, in his report, as the work done up to October 1st.

The bay work was done in boats. The angles for the seacoast work were observed from tripods on shore and from the steamer.

	Seacoast work.	Bay work.
Area sounded out - - - -	272 sq. miles.	112 sq. miles.
Number of soundings made -	22, 029	31, 717
Number of angles taken for hydrographic positions - - - -	3, 449	1, 157
Length of lines run in sounding -	1, 115 naut. miles.	518 naut. mls.

The following additional work in the bay was reported by Lieutenant Commanding Lee up to November 21st inclusive. Square miles of area, 163; number of soundings made, 15,611; number of angles taken, 1,558; length of lines run in sounding, 163 miles. Two tidal stations were occupied during the work. Lieutenant Commanding Lee intimates that five or six days will be required to complete the section bounding by last year's line on the north, a line from Windmill point signal to Nandua signal on the south, besides the time required to renew the signals.

SECTION IV.—FROM CAPE HENRY TO CAPE FEAR, INCLUDING THE COAST OF THE STATE OF NORTH CAROLINA.—(Sketch D.)

The secondary triangulation on the north is within fifty miles of Cape Henry, and will serve in its progress as a reconnaissance for the main work in the difficult part of the coast, between the upper part of Currituck sound and the capes of Virginia. On the south the tertiary triangulation is within about twenty miles of Ocracoke inlet. The work has made good progress during the past year, though it has necessarily taken a different turn from what was proposed. The illness of the three chiefs heretofore in charge of the land operations in this section—assistants W.

M. Boyce, J. J. S. Hassler, and A. W. Longfellow—has rendered necessary a series of temporary details for supplying their places in such a way as to keep the more important parts of the work moving steadily forward.

The outside hydrography, from the failure in efficiency last year of the steamer *Jefferson*, being somewhat behind its anticipated progress, two hydrographic parties have been kept at work during the past season with as brief intervals and as little detention by other work as possible. The land work has been successfully directed towards keeping those two parties in points, tertiary triangulations being made when the main work could not be supplied in time to be hereafter verified and checked by the more accurate determinations of the primary triangulation. The connexion of the primary triangulation with the base line on Bodie's island, unavoidably left incomplete in the previous year, and so desirable from the exposed condition of that base, has been secured. A tertiary triangulation has been extended to below Hatteras light-house, and a subsidiary set of triangles carried along the beach, furnishing hydrographic points, to Pilot hill, near Hatteras inlet. The Hatteras triangulation has enabled a hydrographic party to make a complete survey of Hatteras shoals (see appendix, No. 15, and sketch D, No. 4) and of Hatteras cove, a reconnaissance of which was given in my report of last year. A new reconnaissance of Hatteras inlet has been made to determine its changes, (see appendix, No. 16, and sketch D, No. 3,) and a re-examination since the severe storms of July and September. The hydrography of the Wimble shoals, north of Hatteras, has been commenced. The hydrography inside of Albemarle and Croatan sounds has been continued, Albemarle sound being now completed, except a small portion near the head. All the entrance and the North river has been sounded out this year.

The reconnaissance, by Lieutenant Commanding Maslitt, of Beaufort harbor, North Carolina, induced a request from a portion of the citizens for a complete survey, and I accordingly detailed a party for the triangulation; a notice of which, and of the additional hydrography, will be given in the details of the different operations. (See sketch D, No. 5.)

The chart of the Pasquotank river, and sketches of Hatteras Inlet and of Beaufort harbor reconnaissances, have been engraved and published. The drawing of one sheet of Albemarle sound has made considerable progress.

Arrangements are making for connecting, by telegraph and chronometer, one of the triangulation points in this section with Seaton station, at Washington. Two triangulation parties are at work—one combining also plane-table work with triangulation, and one hydrographic party inside. The outside work of hydrography cannot, of course, be done in the winter season.

Primary triangulation.—The connexion of the triangulation with the base was made by Captain A. A. Humphreys, United States topographical engineers, assistant in the coast survey, by erecting high signals at Roanoke marshes and Mann's point, (see sketch D,) and occupying at these points stations elevated thirty-five feet above the ground. The signals at the astronomical station and S. base were also re-erected. 196 angles were measured; two stations occupied; six observed upon; and the area amounts to forty-eight square miles. The observations were made with a ten-inch Gambey theodolite, (C. S. No. 15.)

Secondary triangulation.—A detached triangulation of Beaufort harbor

was made by sub-assistant C. P. Bolles, in order to enable the hydrography of the harbor to be completed. The work includes both the approaches, outer and inner harbor, (see sketch D, No. 5,) resting on a preliminary base of about a mile and a half long, measured with a chain on the beach of Schackleford's banks. In the early part of the work (in June) Mr. Bolles had the assistance of the revenue-cutter "Crawford," Captain Coste; but the vessel, being needed for other service, was detached by the Treasury Department, and the work was prosecuted by the ordinary resources of the survey to its completion in July. The area embraced is about twenty square miles, over which twenty-nine triangles are thrown. Seven stations were occupied, at which twenty-seven angles were measured by 378 repetitions with a six-inch Gambey theodolite, (C. S. No. 29,) and 147 angles observed on 34 objects, 24 of which were temporary signals for running the shore line, and objects for the topography and hydrography. The shore-line of the harbor was also traced by Mr. Bolles.

Tertiary triangulation.—In my report of last year I explained the reasons which induced the organization of a party for this work, and the keeping it in the field during the season when the parties were generally withdrawn from the section. I also gave the progress of the work towards Hatteras to the date of December 1st. In January, sub-assistant J. Hewston, jr., resigned his position in the coast survey, and Alexander S. Wadsworth, jr., who had been his assistant, was detailed to continue the work, which he carried as far as Hatteras light-house early in the month of April, (sketch D.) The stations were carefully marked, so that the blowing down of signals, which is a common occurrence on that boisterous coast, would not cause a loss of the points. The further progress of the work to the southward involving considerable difficulty, Captain Humphreys was requested to go over the ground with Mr. Wadsworth, and to report upon the matter, and also to verify the work by repeating certain parts of it. The result of the reconnaissance, and of Mr. Wadsworth's subsequent explorations, was entirely satisfactory as to the practicability of proceeding with the work; but showed that, for the immediate purpose of furnishing hydrographic points south of Hatteras for the survey of the Diamond shoal, it would be necessary to make a small triangulation along the beach. This was subsequently executed by Mr. Wadsworth, the work being carried to Bare hill, just north of Hatteras inlet. In regard to the result of Captain Humphreys' verification of the tertiary work, it is proper to state that he reported "the plan to be the best the ground would admit of, and the angles to have been measured with care and accuracy."

Mr. Wadsworth's observations were copied in duplicate, and computed before resuming his work in the field. During the summer he was occupied in continuing the reduction, under my immediate direction, of the tidal observations at Mobile point, and in acquiring some practice in astronomical work.

Topography.—During his absence from the field, assistant J. J. S. Hassler completed the drawing of sheets Nos. 9 and 13, including North river, Currituck neck, Currituck sound, the Banks, Kitty Hawk bay, &c., (sketch D,) Duvant's island, and down Albemarle sound to Croatan sound; also Nos. 12 and 14, including Roanoke sound, the Banks to Nag's Head, and the head of Roanoke island, to the limits of the triangulation.

Hydrography.—The steamer Jefferson, Lieutenant Commanding Thornton A. Jenkins, having been rendered tolerably efficient by the application of a part of the appropriation made for repairs of steam vessels, left Norfolk on the 20th of July, for the survey of Hatteras shoals and cove, and the continuation of the exploration of the Gulf Stream. The day after, meeting the Benjamin Carver, of Sears' point, Maine, which had been injured in the violent gales of July 16th and 18th, she towed her into port. The work on Hatteras shoals (sketch D, No. 6) was successfully accomplished by the close of September, when the vessel returned to Baltimore to take in coal. In passing out and in from the capes of Virginia, six lines of deep-sea soundings, shown in sketch D, No. 6, extending 429 miles, and furnishing 211 soundings, at depths from five to one hundred and ninety-five fathoms, were run. Forty-two specimens of bottom were preserved. In the examination of the Hatteras shoals, 232 lines of soundings were run, 10,397 soundings taken, 1,618 angles measured; and 25 specimens of the bottom obtained. The area sounded out is 68.32 square miles. The positions of the vessel were determined by observers on shore—one at Cape Hatteras light-house, and the other one on an elevated tripod at Bare hill. In sounding out Hatteras cove, 5,104 casts of the lead were made, and 478 angles taken for position.

The interesting report of Lieutenant Commanding Jenkins, on the Hatteras shoals, will be found in the appendix, No. 15. In it he states that the survey "has developed a dangerous shoal of limited extent, which has on it a depth of only 9 feet at mean low water. This shoal forms the southern and eastern limit to Hatteras outer shoals, the light-house bearing north 37° west (true,) distant about $9\frac{1}{2}$ statute miles or $8\frac{1}{2}$ nautical miles. Within the distance of one third of a mile to north-east, and round to southeast, from the shoalest spot, there is 13 and 14 fathoms water; and within the distance of three-fourths of a mile from southeast to southwest, there is 7 and 8 fathoms water. Outside of these depths, at the distance of from $1\frac{1}{2}$ to 2 miles from north, round by east, to south, there is less water (9, 10, 11 and 12 fathoms) than there is at the distance of one-third of a mile from the shoal." Lieutenant Jenkins recommends a bell-buoy to be placed on or near this shoal, (appendix No. 15 *bis*.)

The report of Lieutenant Commanding Jenkins has been published for the benefit of navigators, and the chart of Hatteras shoals is now reduced and engraving at the coast survey office, (sketch D, No. 4.) The chart of Hatteras cove, of which a reconnaissance was published with my report of last year, will be speedily engraved.

I have attempted for some two seasons past to obtain observations which would settle the question of the amount of uncertainty to which ocean soundings were liable under different circumstances of depth, roughness of water, and the like, and devised several plans for the purpose, which Lieutenant Commanding Jenkins has successfully executed. The first trial was of the errors shown by repeatedly throwing the lead from the sounding stand of the vessel at anchor in rough water: this gave in five fathoms water, and ten casts of the lead, 1 foot 5 inches for the difference between the highest and lowest recorded numbers, and for the probable error of one cast 0.08 of a foot. "The sounding line was marked in fathoms and feet, and the fractions of the foot estimated by the leadsmen. In smooth water the casts run, as might be expected, the same throughout."

"Running a line from the vessel to a point on shore by time, and returning direct from the point to the vessel—the sea being rough, the line marked to feet—the soundings paired within an occasional fraction of a foot, the depth being from two to five fathoms." I find the probable error from these results to be 0.40 foot for one cast.

"In running a line of soundings between Hatteras outer shoals and the Diamond shoal, of about a mile in length, over a previously run line, the soundings being reduced to mean low water, showed an agreement in every instance within the fraction of a fathom, never differing more than one fourth of a fathom; the casts recorded in the sounding book differing less, the excess never being greater than from one to two feet in deep water." The probable error of one cast thus shown is 0.70 foot. These results admit of considerable extension, and are of practical importance, inasmuch as they decide what degree of accuracy must be arrived at in observing the tides for the correction of soundings—a problem eminently worthy of the solution of the hydrographer.

As the "Jefferson" is an iron steamer, observations of local attraction are of special importance. These were elaborately made by Lieutenant Commanding Jenkins, and though exhibiting small discrepancies, not yet explained, under different circumstances of stowage, &c., they generally concurred in showing a difference of less than four degrees when heading towards opposite points of the compass. In examining the records deposited in the coast survey office by Captain Frazer, of the United States revenue marine, of experiments made by Mr. A. D. Frye in adjusting the compasses of the iron revenue steamers, I find the same conclusion given in them in regard to the steamer Jefferson. As far as I am aware, such a case has not been before noticed.

On returning from his last cruise, early in November, Lieutenant Commanding Jenkins commenced the preparation of the steamer Jefferson for repairs and alterations, previous to sending her to sections X and XI. My inquiries had distinctly proved that a suitable steamer could not be built and sent round to the western coast in time to use the next surveying season there; and after an examination by Lieutenants Commanding Alden and Jenkins, of the Jefferson, (appendix No. 17,) their report of her adaptation to the work, of the proper means of accomplishing the object, and the approval by the Treasury Department, the alterations of the steamer were directed, and have been vigorously pushed to completion. It is confidently expected that this vessel will be on her way to the western coast early this winter, so as to reach Cape Horn at the best season for passing it, and to arrive in San Francisco in time to use the season for surveying.

2. The hydrography of Albemarle sound from the line, Wade's bluff, Pear Tree point, (sketch D,) to Powell's point, Haulover, and of Alligator river, within the limits shown by the sketch, except about sixteen square miles at the entrance, was completed last autumn by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey. The area included is about 160 square miles, the number of soundings taken was 41,451, the number of miles run in sounding 674, and the number of angles measured 2,429.

3. This work was taken up in the spring by Lieutenant Commanding Richard Wainwright, United States Navy, assistant in the coast survey, who completed the hydrography of Albemarle sound from the limits just

described (sketch D) to a line from Powell's point to the northern extremity of Roanoke island, then passed down the Croatan sound to the line Sand point to Fleetwood nearly. The North river was also sounded by the same party to the limits of the topography: 15,810 soundings were taken during the work, and 1,386 angles measured for hydrographic positions.

Lieutenant Commanding Wainwright's report contains the following recommendation in regard to a buoy: "I would respectfully recommend a buoy for Fulcus shoal, in Croatan sound, as it has only from four to six feet water on it, and it is directly in the way of vessels passing to and from the inlets to the different ports north of Croatan sound."

The position of the shoal is approximately marked on sketch D.

This party also made a reconnaissance of Hatteras and Oregon inlets. The report in relation to the former was published in July last, (appendix No. 16;) an engraved sketch is appended to this report, (sketch D, No. 3,) which has been published and sent to the agents for the coast survey maps for gratuitous distribution, and to the principal insurance offices. Subsequent examinations after the July and September gales, by Lieutenant Commanding Jenkins, exhibited no remarkable changes in this inlet.

The party of Lieutenant Commanding Wainwright completed the office work at the close of October, and resumed the soundings at the points where the hydrography of the previous season closed.

SECTION V.—FROM CAPE FEAR TO THE ST. MARY'S RIVER, INCLUDING THE COAST OF THE STATES OF SOUTH CAROLINA AND GEORGIA.—(Sketch E.)

The field and hydrographic operations in this section have been the following:

1. The measurement of a base line on Edisto island, upon which the main triangulation of this section is to rest.
2. Astronomical and magnetic observations at one extremity of the base line, and a commencement of the primary triangulation.
3. The connexion of Charleston and Washington, for difference of longitude, by telegraph.
4. Continuation of the astronomical observations at Charleston Observatory station.
5. The secondary triangulation of North Edisto inlet (harbor of refuge) and connexion with the base.
6. The measurement of a preliminary base near the city of Savannah, and the triangulation of the river from Hutchinson's island to Elba island.
7. Continuation of the hydrography of Charleston harbor and bar, nearly to completion.
8. Examination for a shoal reported off St. Helena sound.
9. Hydrographic reconnaissance of St. Andrew's shoal, off the entrance of St. Andrew's sound.

In the office the computations relating to the work just stated have been in progress, the topography of the chart of Charleston has been reduced, and the drawing placed in the hands of the engraver. A second tracing of the map of the city of Charleston has been furnished, on the application of the Hon. Isaac E. Holmes.

In March last I visited this section and examined carefully the progress of the hydrography, conferring with members of the committee of the

Chamber of Commerce in reference to the developments made on Charleston bar.

There seems to be no doubt that Lieutenant Commanding Maffitt has discovered a new channel across the bar, through which the same depth of water can be carried as through the main ship channel, more direct for vessels coming from the eastward and northward, but narrow, interrupted by bumps, and not straight. When proper sea-marks are placed for this channel, it may be used.

A comparison of the remains of the old marks for entering the main ship channel with the new, shows that it has moved to the southward, a fact which the old charts also confirm. The depth remains nearly or quite unchanged as far as the old data enable us to judge. The materials of the bar are all from seaward, or from the coast, and not from the rivers.

The notice of the reconnaissance of the shoal off St. Andrew's sound will be found of importance to navigation, especially to steam-vessels which run quite near the coast.

Measurement of a base line.—The reconnaissance for a base line for this section was made in 1848, by assistant James S. Williams, and the line located on Edisto island, passing from a point on the plantation of John P. Townsend, esq., near North Edisto river, southward and westward to a point on the "estate of Eddings," near Spanish Mount and the South Edisto river—(see sketch E.) The location was examined and confirmed by me in April, 1849. It avoids all the creeks which intersect Edisto island, and admits of easy connexion, north and south, with the chain of triangles, and of taking at once a point west of it on "Little Edisto," (plantation of Governor Aiken,) at the full distance for the sides of the primary triangles. The line runs chiefly through cotton and corn-fields, on dry and firm land, secure from any encroachment of the sea. Its profile is favorable, the undulations being gentle. The mean level of the line above the sea is six and a half feet, and the difference between the highest and lowest points, which are nearly five miles apart, is eight feet.

The preliminary arrangements for measuring were commenced as early in December as the progress of the season permitted, by assistant C. O. Boutelle, who aligned the base anew, establishing at suitable intervals marks of reference, measured the length approximately with a chain, and prepared the site for easy measurement by grading. The methods already described in my report of last year, as applied at the base at Bodie's island, North Carolina, were used in these operations.

The base was measured with the apparatus devised by me, and described in previous reports, which is of invariable length at different temperatures and while the temperature is changing. Before commencing the measurement, and after completing it, a series of comparisons of the base bars with the standard iron bar were made. The comparing apparatus consisted of two granite pillars for supporting the bars, sunk in the ground about two feet, at a distance from each other equal to the length of the standard bar, and protected from the effect of vibration in the ground by being cased in wooden boxes. In making the comparisons, the knife edge at the end of the bars rested against an abutting screw, fixed firmly in the granite, while the agate plane at the other end acted upon the arm of a bent lever, which turned a mirror. The stand for the reading telescope and scale was erected at a distance of twenty feet, in a

line perpendicular to the line of the bars. The temperature in the standard bar was ascertained by several thermometers attached to it, and was caused to vary very slowly by covering it with a wooden case, from which the ends only of the bar projected. Observations were made, too, at rising and falling temperatures, so as to counteract each other's errors. The standard bar and the measuring bars being alternately placed between the posts, the difference of length was read off on the scale reflected by the mirror—the value of the divisions of which was carefully determined. One hundred and five observations were made on five different days, for the purpose of comparison at temperatures ranging from 32° to 63° Fahr.

The measurement was commenced on the 3d, and completed on the 18th of January; the actual measurement occupying thirteen days, being interrupted by bad weather only parts of two days during that period. The greatest distance passed over in one day was 1,122 metres (about $\frac{3}{4}$ of a mile) in 9 $\frac{1}{2}$ hours; the least, 412 metres in 6 hours. As compared with the measurement of Bodie's island base, the average number of tubes measured per day was as 137.5 to 180.5; one fourth of the difference in favor of Bodie's island base being produced by the greater length of the working day, and the remaining three-fourths by the character of the ground—a hard sand-beach being much more favorable to rapid movement than land in a high state of cultivation. Of the whole number of tubes measured at Edisto, a correction for inclination or depression was required for one-half, while at Bodie's island scarcely one-sixth required correction. In all, 1,787 tubes were measured, giving a length for the base of about six and two-thirds miles.

In commencing the measurement from the east end of the base, the knife-edge of the tube No. 1 was brought over the point, marking the terminus by means of two transits plumbd over drill-holes in copper bolts at distances of 50 and 48 metres north and south of the line. The tube was then aligned by one of the transits, centred over a drill-hole in a copper bolt to the east of the terminus at a distance of 50 metres. Three large wooden pegs were set in the ground at the close of each day's work, and the ends of the tubes projected by the aid of the sectors upon copper nails driven into the pegs. The western end of the base was temporarily secured by wooden pegs with copper nails, marked by drill-holes, and placed on a line at right angles to the base. The monuments for marking the ends permanently were then placed carefully in position—each end of the base being marked by a copper bolt inserted in a stone pillar buried three feet six inches below the surface of the ground. Each stone is in the axis of an earthen cone, the centre of which also marks the terminus. A wooden platform over the cone, separated from it by a layer of earth, and having an opening in the centre to prevent pressure on the top of the post or cone, supports the heavy stones for the foundation of the monument; in the upper one of which is drilled a hole for a copper bolt, having a point marked upon it corresponding to that below. At distances corresponding to every 268th tube, the nearest measure to an English mile, stones were placed in the ground, and marks made on a copper bolt inserted in the top. For ascertaining the probable error of measurement, a portion of the line was selected as about an average in regard to slope, character of ground, &c.; and upon this a length of 45 tubes was measured twice, making in all about one-third of a mile. The probable accidental error of measurement for the whole base, as thus de-

terminated, did not exceed one tenth of an inch. This is of course much less than other known sources of error, and there may be constant errors which absorb this accidental error entirely. It nevertheless is an important datum in determining the practical value of the base apparatus.

I was assisted in the measurement by assistant C. O. Boutelle, who conducted the chief part of the operations for marking the points, placing the monuments, and the like, and by sub-assistant C. P. Bolles and Messrs. G. A. Fairfield, E. Goodfellow, and Thomas McDonnell, and during part of the time by Mr. J. W. Gregorie. Mr. J. Clark, of the office of weights and measures, attended to arrange the comparing instruments, and to make incidental repairs.

Astronomical and magnetic observations.—The east end of the Edisto base was occupied as an astronomical station by sub-assistant George Davidson, aided by Mr. John Rockwell, the party being under the immediate direction of assistant C. O. Boutelle. Between the 7th of March and the 16th of April observations for latitude were made, and incidentally for longitude. For latitude, 608 observations were made with zenith telescope No. 3, upon 54 sets, comprising 115 stars; four determinations of the value of the micrometer were made by observations of Polaris at the lower culmination, and three sets of determinations of the value of the level; 143 observations were made for time by transit No. 5, C. S., in connexion with the foregoing, and four transits of the moon and moon culminating stars were observed.

The magnetic declination was determined by observations on four different days of the maximum and minimum declination with declinometer No. 22, C. S., by Jones; the horizontal intensity by four sets of observations; the dip by three sets. The pivots of one of the dipping needles were tested by observations in planes at right-angles. Three determinations of the moment of inertia of the magnet used in vibration were made. The declination at the north end of Edisto base was $2^{\circ} 45'$ E. At the close of these observations, Messrs Davidson and Rockwell returned to Washington to prepare for work in sections X and XI—the coast of Oregon and California. The final computations have been made by the party of Mr. Boutelle.

The observations of moon culminations and occultations by Professor Lewis R. Gibbes have been continued at the Charleston Observatory; 144 transits of the moon and of moon-culminating stars have been observed during the year, and 115 transits for time and deviation.

Professor Gibbes has also taken part, as directing the operations at his observatory, in the telegraphic determinations of the difference of longitude of Washington and Charleston. The observations of the 5th of February last year gave for the difference of longitude of the Seaton station and Professor Gibbes's observatory $11m. 45.16s$.

We propose, at the opening of the present season, to determine the latitude of a point in the triangulation of the Savannah river and the azimuth of one of the lines, as also the difference of longitude between Charleston and Savannah, by the electro-magnetic telegraph. The connexion by telegraph of a point in Georgia with Seaton station, which may enable us to push through the determinations of the difference of longitude of New Orleans and Washington, is under consideration.

Triangulation, (see sketch E.)—One station has been occupied in connexion with the primary triangulation, but not finally; the secondary

triangulation of North Edisto entrance has been made—(sketch E, No. 2.) The Savannah river has been triangulated from the head of Hutchinson's island to Elba island, below Fort Jackson—(sketch E, No. 3.) The system recommended by Mr. Boutelle for this section is, to cause the secondary triangulation to precede the primary and serve as a reconnaissance for it, and as affording suitable data for opening the lines of the primary work.

The *triangulation* of North Edisto inlet and river (sketch E, No. 2) is connected immediately with the Edisto base. It has been made by assistant C. O. Boutelle, assisted by Messrs. G. A. Fairfield and J. W. Gregoria, and the observations were made with an eight-inch Gambey theodolite, (No. 24, U. S.) The extension of this work at the beginning of the season about to open will, with what has already been done, furnish work for a topographical party which it is intended to detail in December.

The triangulation of the Savannah river (sketch E, No. 3) rests upon a preliminary base, measured on the Union Ferry causeway, near the city of Savannah, by assistant C. O. Boutelle, assisted by sub-assistant C. P. Bolles. The base was measured with wooden rods, compared with a standard bar; the ends were marked on the stone posts placed in the ground, and were transferred to signals at a short distance on the plantation of Dr. Scrivans—(sketch E, No. 3.) The length of the base was about one mile and a quarter, which was measured in three days.

The triangulation was executed by sub-assistant C. P. Bolles between the 2d and 30th of April; it includes eight stations, at which 1,663 observations were made with a six-inch Gambey theodolite, (U. S. No. 29.) A topographical party will be sent soon after the opening of the season to make a plane-table survey on the basis of this triangulation, and the hydrography will, if practicable, follow in the course of the season. On closing the work in this section, assistant C. O. Boutelle proceeded to section I, and was engaged in field-work there, and in directing the computation of the foregoing results, and of those which had accumulated from the previous work of his party in sections IV and V.

Mr. Bolles made a triangulation of Beaufort harbor, North Carolina, and then joined assistant Boutelle in computing.

Hydrography.—Lieutenant Commanding J. N. Masfuit, United States navy, assistant in the coast survey, has continued the hydrography of Charleston harbor, and of its approaches, making all the progress which the stormy character of the season would permit. The inner harbor has been almost entirely sounded, from Craft's Signal on the Ashley river, and Oyster Point on the Cooper, to the bar, inclusive. Particular attention has been given to the bar, the soundings extending on an average of six miles from the shore-line. The space surveyed comprises an area of eighty-three square miles, in which 35 current stations were occupied; 225 specimens of bottom, and 45,360 casts of the lead, were taken; and 2,580 angles observed. A short distance to the southward and westward of the "Swash channel," a channel of 11 feet has been found. It is proper to state that this channel is circuitous, but if properly buoyed it may be used for towing out and in, entering with certain winds. Subsequent attention will, however, be directed to this point. The previous surveys of the Charleston bar have not been sufficiently close to admit of comparison with this, so that there are no recorded data for determining

the progressive changes in the various channels. The oldest pilots, however, and other persons long resident on this part of the coast, assert that the bar has been continually working to the southward. The beacon for entering the main ship channel is 400 yards further to the southward and westward now than it was eighteen years ago, showing a very material change in the channel in that direction, and sustaining the opinion expressed above. I found by taking specimens of the water on the bar at different stages of the tides and at various depths, that those taken on the flood tide were filled with marine sediment, while those taken on the ebb came up clear. This would seem to indicate that the bar deposits, when stirred up and borne along by the flood, are deposited on the change of tide.

In passing the coast off the light boat in St. Helena sound, the steamer Georgia, Lieutenant D. D. Porter commanding, struck what was supposed to be a shoal, the direction of which was observed, and distance from the light boat estimated. I directed Lieutenant Commanding Moffitt to examine this locality, which he did without finding shoal water, the sea being so rough during the continuance of his search that he is of opinion that a seventeen-foot spot must have been shown by breakers upon it. His letter is given in the appendix to this report, No. 18.

A hydrographic reconnaissance of St. Andrew's shoals was made by Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey, as he passed to section VI last winter. The steamer Hetzel touched on a shoal having but eight feet water upon it, not laid down on the charts, at the entrance of St. Andrew's sound, the light-house bearing west-northwest distant about eight miles.

Upon the same shoals the English ship Jane had about two months before been totally lost. My report to the Secretary of the Treasury, containing the determinations of Lieutenant Commanding Rodgers and his sailing directions for entering St. Andrew's sound, will be found in the appendix, No. 19. The sketch of his reconnaissance was published in August last, and is now annexed to this report—(sketch B, No. 4.)

SECTION VI.—FROM THE ST. MARY'S RIVER TO ST. JOSEPH'S BAY, COAST OF FLORIDA, AND INCLUDING THE FLORIDA REEF AND KEYS.—(Sketch F.).

The work in this section has made considerable progress, including in it one of the most important and dangerous parts of the coast of the United States. I have heretofore proposed (Ex. Doc. No. 30, Senate, 30th Congress, 2d session) to carry on the work on double its present scale, so as to insure its speedy completion. When the reefs and keys have been surveyed, the section might be left to the ordinary progress provided for in the present rate of annual appropriation. Within the period of five years up to January, 1870, the annual value of the vessels and cargoes wrecked on this coast was nearly *one million of dollars*; the salvage alone amounting annually, on the average, to nearly one hundred thousand dollars, and the expenses to nearly one hundred and fifty thousand dollars. The entire loss resulting from defective information would be saved by the completion of the survey, besides that from the deficiency of lights, beacons, and buoys, which would be necessarily supplied when the proper positions for them were pointed out. The present rate of appropriation permits the nearly constant employment of four parties; the hydrographic party having a steam-vessel. By a double appropri-

ation a force might be employed rendering certain the completion of the survey of the reefs and keys in three years.

During the past year the reconnaissance of the Florida reef, keys, and adjacent main has been completed (sketch F) from Key Biscayne (Cape Florida) to the Tortugas; an astronomical and magnetic station has been occupied, and a preliminary base measured, on Key Biscayne; the triangulation has been carried across Key Biscayne bay southward and westward to Soldier key; the topography of Key West and the adjacent islands, including part of the Mangrove keys, has been executed; the hydrography of Key West harbor and its approaches from the southward has been completed, and the drawing of the chart is in progress. A reconnaissance of Cedar keys, on the western coast of Florida, has been commenced, and a recommendation for a light house, of which the necessity was already proved, will be found in connexion with the notice of the hydrography. A hydrographic reconnaissance of Cape Canaveral shoals (sketch F, No. 2) has been made and the chart engraved.

The work of this year indicates a channel with six fathoms water in it, two and a half miles to the eastward of the "old ship channel." If further examination confirms this discovery of Lieutenant Commanding John Rodgers, it will place his name near that of his father on the chart of Key West.

The surveying signals placed upon the Florida reef have proved incidentally of considerable value to navigation. Assistant Gerdes, in his report, makes the following statement in regard to them: "The surveying signals upon the reef have already proved the means of preventing many vessels from running ashore. More than a dozen instances of this kind are known and spoken of at Key West. How much more effectual would large, distinct, and permanent signals or beacons be, if placed at known distances and regular intervals of say six or eight miles, in providing safety for the mariner, swept by the rapid and variable currents, in stormy weather, into dangerous proximity to the reefs." This recommendation is well worthy the attention of the department. A list of the signals referred to has been already published, and is given in the appendix, No. 20. A gratifying confirmation of the statement in regard to their usefulness was communicated to me by Joseph S. Fay, esq., one of the most enterprising merchants of Savannah.

The question of the mode of increase of this reef is one of great importance to navigation, and should be investigated by a naturalist competent to grapple with difficult problems in his science. The descriptions of the character of the reef given by ordinary observers differ very much.

Reconnaissance.—In January, 1849, the reconnaissance of the Florida keys and reef, and of the main from the head of Key Biscayne bay to Cape Sable, was commenced by assistant F. H. Gerdes, and was completed in June, 1850, from Cape Florida to the Tortugas, including the examination of the sites for two bases—(sketch F.) A triangulation connecting the keys and main and the keys and reef has been proposed by him, the figures of the main series of triangles fulfilling the necessary conditions, and the sides being between eight and eleven miles in length. In like manner, the reef will be connected with the keys, screw-pile signals being erected on the reef and determined from the station points on the keys. A scheme of triangulation for the Tortugas islands was also reported by Mr. Gerdes, and two modes suggested for connecting

them with the Marquesas; which, in turn, are determined from the Mangrove keys; thus bringing the Tortugas into the general system of triangulation. When this triangulation is complete, and the astronomical positions of a sufficient number of its points ascertained, it will be very easy to prolong the meridians of the Florida land surveys to the keys, if desired.

The whole reconnaissance covers an area of 2,700 square miles, or about 150 miles in length by an average of 18 miles in breadth. The main stations are 95 in number, to be determined by 104 principal or subsidiary triangles. Twenty-nine hydrographic points are furnished on the Florida reef, to be determined by from 65 to 70 triangles. The reconnaissance of the last season covered an area of about 750 square miles. With the preliminary measurement of Key Biscayne base, assistance to the triangulation party in Key Biscayne bay, and a re examination of Cape Florida for a base line, it is a very full amount of work for the period of between five and six months, without considering that during a part of that time Mr. Gerdes was suffering from ill health.

The base at Cape Florida (sketch F, No. 3) is well situated for commencing the part of the survey which ranks next in importance to the local work at and near Key West, and that of Cape Sable (sketch F, No. 4) is nearly central with respect to the triangulation eastward and westward of it—(sketch F.) A plane-table survey has been requested by Mr. Gerdes of Key Biscayne, in order to determine the best site for the Cape Florida base; after which it will be located, and the ground will be prepared for the measurement. The general character of the two sites will be seen by referring to sketches F No. 3, and F No. 4.

A length of rather more than four miles can be had conveniently at Cape Florida, and of about three and a half miles at Cape Sable, which may be increased to four miles if necessary. Both bases are readily connected with the triangulation.

The scheme of triangulation is shown in sketch F. The description of the keys and reef which accompanied it in Mr. Gerdes's report cannot fail to be useful to navigators and others, and I have therefore placed it in the appendix to this report—(appendix No. 23.) Most of the stations to be used will require to be elevated above the ground, and many of the signals are placed in from two to five feet water. Mr. Gerdes proposes to use the mangrove wood in all positions of exposure to the sea, and finds that though it is attacked by the worm, (teredo,) unless in situations where there is considerable current, yet it lasts nearly twice as long as pine timber under the same circumstances. For the reef he urges the use of the screw-pile (Alexander Mitchell's,) and has proposed several different forms adapted to different kinds of bottom. The material of the pile is to be cast-iron, and the upper part to be tubular, so as to admit the insertion of a pole of mangrove or the connexion of a second tube with the first. These piles are easily inserted by a simple boring machine, consisting of a wrought-iron rod with an augur like termination, kept vertical by a tripod and turned by a windlass, or by a Spanish windlass, connected suitably with the pile itself. The coast survey is indebted to I. W. P. Lewis, esq., the agent for Mitchell's patent, for much information on this subject.

The triangulation of the Tortugas in Mr. Gerdes's design rests upon a local base on Loggerhead key, unless the connexion is previously made with the general scheme. The reconnaissance covers from 60 to 70

square miles, including eleven islands, the relative positions of which are to be determined by sixteen triangles, and some twenty hydrographic points.

I have heretofore referred to the difficulty of obtaining precise information as to the best season for the various operations of the survey on different parts of the coast, arising chiefly from the fact that very suitable and even pleasant weather for ordinary purposes is not at all adapted to our work, on land especially, where the lines of sight are long, as in the main triangulation. Mr. Gerdes's experience thus far in section VI induces him to point out part of November, the whole of December, January, February, April, May, and part of June, as the best months for triangulation; and the same months, taking March instead of June, for the topography.

Learning that the existence of the channel laid down by Gauld, running from Bahia Honda northwestward, and entering the Bay of Florida between Spanish and Harbor keys, was doubted, Mr. Gerdes took occasion to investigate the matter, and found that eight feet water (a greater depth than is laid down by Gauld) could certainly be carried through this channel. A coasting vessel of less than this draught may cross from the gulf into the bay, exchanging the rough sea and rapid current of the one for the smooth and still water of the other.

Astronomical and magnetic observations.—Observations for latitude and azimuth and of moon culminations for longitude were made at Cape Florida station, by assistant J. E. Hilgard, in December and January. The observations for time, and of culminations of the moon and moon culminating stars, were made with a forty-six inch transit of Troughton & Simms, (C. S. No. 6,) for azimuth with a six inch Gambey, (C. S. No. 13,) and for latitude with a forty-seven inch zenith telescope, (C. S. No. 1.) Sixteen complete sets of observations on Polaris were made for azimuth, the image reflected from mercury being used in conjunction with direct observations as a substitute for readings on the riding level, and the positions being arranged in sets of nine and seven repetitions, so as to avoid using the same parts of the limb repeatedly.

The reductions of the moon culminations have, in connexion with corresponding observations at other stations, already proved of value.

The magnetic observations at Cape Florida station were as follows: of maxima and minima of declination for three days, with a portable declinometer by Jones, (C. S. No. 20;) four sets for magnetic dip, with a twelve-inch Barrow circle, (C. S. No. 4;) two sets of vibrations and deflections for horizontal intensity, and two for the moment of inertia, with the apparatus attached to the declinometer.

Preliminary base, triangulation, &c.—The preliminary measurement of a base on Key Biscayne was made in December, 1849, by assistants F. H. Gerdes and J. E. Hilgard. The site of the base was the shore of the "Big Bend," (see sketch F;) the measurement being made on a broken line of five different directions, and reduced by the angles determined between the directions. The ends of the reduced base are marked by stone monuments. Its length is about three miles and one-eighth.

The lines were measured by wooden rods, shod with brass nearly four metres in length, supported at each end by a wooden trestle, the flexure resulting from this position of the rod and the inclination being measured and allowed for. One rod was used at a time, the ends being placed by fine lines drawn upon the top of the trestle, which was covered with tin-

plate for this purpose. The second rod was used for an independent measurement of parts of the base, where a confirmation of the first measurement was considered necessary. The whole time employed was equivalent to five and a quarter days of ten hours each. The angles between the directions were measured by a six-inch Gambey theodolite, (C. S. No. 13.)

The triangulation resting on this base extends from the mouth of the Miami to Soldier key, across Key Biscayne bay and Card's sound. It was commenced by assistant J. E. Hilgard, and continued by assistant H. L. Whiting. The results of the former assistant are as follows: Forty-five signals were put up, embracing all the points required from Bear Cut, Miami river, (sketch F,) southward to Card's sound. Seven stations were occupied, at which 210 angles (of six repetitions each) were measured with a six inch Gambey theodolite, (C. S. No. 13,) and twenty-seven stations were observed upon. The work covers an area of 120 square miles.

Two additional stations were occupied by assistant H. L. Whiting, at which forty angles were measured by 1,044 observations with the same theodolite before referred to.

Topography.—Assistant J. H. Adams has executed the topography of the vicinity of Cape Canaveral, and of Key West and the adjacent keys, as shown on sketch F, sheets numbered 19 and 20. The area of the latter survey is ninety square miles, and the shore line thirty-nine miles in extent. The work was done in April, May, and June. Mr. Adams left New York in the coast survey steamer Hetzel, to repair to section VI, and was detained by the wreck of that vessel, and the subsequent difficulty of finding conveyance to Key West, until the middle of March. The work was closed on the 8th of July, and after finishing the drawings, Mr. Adams joined the party of assistant J. B. Glück at Cape Cod. The topography of this section will be resumed at once.

Hydrography.—The repairs of the coast survey steamer Hetzel, and alterations necessary to fit her for a hydrographic party, were made in the autumn of last year; the delay in procuring men prevented her from leaving New York until the beginning of the new year. The first duty assigned to Lieutenant Commanding John Rodgers, chief of this hydrographic party, was the reconnaissance of the shoals off Cape Canaveral, which had been reported by Captain Coste, of the revenue marine, and by Lieutenant Schenck, United States navy, commanding the steamer Ohio. While engaged in this work the Hetzel was driven ashore, in consequence of the parting of a chain by the setting in of a southeasterly swell. The persevering exertions of her commander, officers, and crew succeeded in rescuing the vessel from this perilous position, and, though leaking very badly, in taking her to Indian river, and finally to Key West; when, after some repairs, she was sent, under the command of Lieutenant Wilmer Shields, United States navy, to Mobile, and finally to New Orleans, to be hauled up and thoroughly refitted. The difficulties of this party were great, and their exertions in overcoming them extraordinary. No officer with whom I consulted in regard to the probability of getting the Hetzel off, gave the least encouragement to the idea that it was possible, and the steamboats passing Cape Canaveral reported her as irretrievably lost. In the appendix (No. 22) will be found extracts from the official correspondence in relation to the matter, with my letter of thanks to the officers and crew of the vessel. When it is considered

that no common effort was necessary to preserve this valuable vessel to the survey, and that the loss of her would have seriously crippled the work, the reason for bringing forward prominently these exertions will, it is hoped, be appreciated. In pursuance of my instructions, the schooner *Petrel*, in use by one of the land parties in section VI, was turned over to Lieutenant Commanding Rodgers during the absence of the *Hetzel*, and in her chiefly the hydrography of Key West harbor and its approaches was executed. The work covers an area of 336 square miles; the number of soundings made was 29,909; the number of miles run in sounding, 962; and the number of angles observed for the position of hydrographic points, 1,282.

The approaches from the south side are completed. On the hydrography of this region, Lieutenant Commanding Rodgers remarks: "Isolated coral rocks, with deep water around them, are numerous inside the Florida reef, and are only found to exist by running over the precise spot where they occur. The work already done, which I estimate at two-thirds of the whole quantity necessary to complete the chart, has pointed out fifty such spots, but it is probable that a few remain undiscovered. It is evident that such a formation demands the utmost patience in delineating it."

The report of Lieutenant Commanding Rodgers contains the following statement in regard to the new channel before adverted to: "Two and a half miles to the eastward of the 'old ship channel' we discovered one with six fathoms water in it. So many soundings have been taken in this channel as to render it improbable that the further examinations which I propose to make will show less depth than thirty-six feet."

The importance of the passage at Boca Grande, twelve miles west of Sand key, (sketch F,) from the Florida gulf into the Gulf of Mexico, for vessels bound to ports in the Gulf of Mexico, especially in the season of calms and light winds, and when the current of the Gulf Stream is strong, is pointed out by Lieutenant Commanding Rodgers, and his suggestion for its complete survey will be embraced in my instructions for the coming season.

After closing his work near Key West, Lieutenant Commanding Rodgers completed the reconnaissance of Cape Canaveral shoals, the notice of which will be found in the appendix, No. 24, and the chart of which is contained in sketch F, No. 2.

The work done by the party of Lieutenant Commanding Rodgers near Cumberland island, Georgia, (St. Andrew's shoals,) has already been spoken of in connexion with section V.

A reconnaissance of Cedar keys was commenced by Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, near the close of the season. His report contains a recommendation for the construction of a light-house on Sea Horse key. (Appendix No. 21.)

SECTION VIII.—FROM MOBILE BAY TO VERMILLION BAY, INCLUDING THE COAST OF ALABAMA, MISSISSIPPI, AND PART OF LOUISIANA.—(Sketch H.)

The weather during this season has been more favorable than during the last, and had we been able to use the whole season, very excellent progress would have been made. The delay in procuring men for the steamer "*Walker*," and the unauthorized use of that vessel in other

service, prevented the beginning of the hydrographic operations until March, and necessarily deranged my plans for work in the section; the land-work being already in advance of the hydrography. Lieutenant Carlile P. Patterson, who has so greatly distinguished himself in the hydrography of this section, and who has had charge of it from the beginning, was at his own request relieved from duty on the coast survey to take charge of one of the mail steamers on the western coast. All the experience which he had acquired in the survey, and those excellent qualities which study and experience had matured, were thus lost to the work—happily, however, still to be used in an extended sphere for the benefit of the country. His successor, Lieutenant James Alden, has done all which vigor and industry could do, to contend against the disadvantageous circumstances in which he was placed, and has well employed the limited time at his disposal.

The triangulation has made some progress—the secondary work having advanced into Lake Berne, and the connexion of the triangulation in Mobile bay with the outer coast east of it having been made. The topography has advanced satisfactorily, the whole of the shores of Mobile bay and of the delta having been completed. The hydrography of the delta has been executed, and the portions of Mobile bay left unfinished from previous years have been very nearly completed. Tidal observations have been kept up at Mobile point. The discussion of the tidal observations at Cat island has led to results of decided interest, and will be more particularly noticed in the account of the hydrography of this section. The drawing of Mobile entrance has been completed, and the engraving is in progress. The drawing of the two sheets of Mobile bay has been commenced. The engraving of the chart of Cat and Ship islands (double sheet) has been completed, and the chart has been published.

The depth of 20½ feet in the channel into Mobile bay, discovered by Lieutenant Patterson, is maintained; indeed, in most cases, a somewhat greater depth may be carried in. On the chart of Captain Romans, bearing date 1770, the depth of water on Mobile bar is given at fifteen feet. Successive surveys have shown a gradual increase, and it remains now to be ascertained whether natural causes will still further augment this depth or render it stationary.

Primary triangulation.—The triangulation in this section being considerably in advance of the hydrography, the services of assistant F. H. Gerdes, who is in charge of the primary work, have been chiefly directed to the important survey of the Florida reefs and keys, (section VI.) Mr. Gerdes has, however, occupied one station of the primary chain, (Bellefontaine, sketch H,) and has visited others to secure the station points.

Secondary triangulation.—This work was under the charge of assistant C. M. Eakin from December to the date of the acceptance of his resignation, on the 15th April; and from the 28th of April to the close of the season, under that of sub assistant S. A. Gilbert.

The triangulation of Mobile bay was completed by Mr. Eakin, and the connexion of the lines in Bonsecour bay with gulf shore made—(see sketch H.) In February Mr. Eakin's party was transferred to the western part of Mississippi sound, and the erection of signals was commenced, carrying the survey into Lake Berne.

Between the 28th of April and 30th of May, Mr. Gilbert occupied ten stations of the secondary and tertiary series, measuring twenty-seven angles

by fifty-six series of twelve, and thirteen sets of six repetitions, with the ten inch repeating theodolite of Pistor & Martins, (C. S. No. 27.) The area embraced is 180 square miles.

The remarkable change which has taken place in the water of the western part of Mississippi sound, in consequence of the crevasse in the banks of the Mississippi river, and which if continued must cause corresponding changes in the land and in the joint productions of land and water, is thus described by Mr. Gilbert in his report dated July 26, 1850:

"Within a short time the character of the water in this part of the sound has changed from salt to fresh as far east as Biloxi and Ship island, owing to a crevasse through which the Mississippi water runs into Lake Ponchartrain, and thence into the sound. All the shell-fish in which this region formerly abounded have been killed. Should the crevasse continue open, the probabilities are, that the character of this region will be materially changed."

After the computations connected with his work were finished, Mr. Gilbert joined the party of assistant Edmund Blunt in the Chesapeake. He is now under instructions to return to this section at the opening of the season.

Topography.—The topographical party of assistant W. E. Greenwell completed during the season, from December to June, sheets Nos. 13, 14, and 15, the first left unfinished from last year, and commenced sheet No. 16, (sketch II.) This topography completes the land-work of Mobile bay, its entrance and approaches, and the delta near Mobile city. It includes an area of 74 square miles and an extent of shore-line of 216 miles, besides the survey of the city of Mobile on the scale of $\frac{1}{10000}$. The topography of the delta on the western shore was carried about five miles above the city of Mobile, taking in the head of Spanish river, and on the eastern shore as far as Blakely. The following remarks of Mr. Greenwell on the topography of the shores of Mobile bay, and of the vicinity the city, will be found of interest:

"The country about Mobile is a slightly undulating plain, presenting the same even surface as that seen along the west shore of Mobile bay. The delta, as previously mentioned, is an extensive marsh, but the fast land on the east side rises bold and abrupt, with steep banks from twenty to forty feet, thickly covered with pine, oak and magnolia, with but here and there a settlement. It is singular how very different in character are the two upper shores of the bay; one presenting a low, smooth, even surface—the other a broken, hilly country."

Mr. Greenwell's observations in regard to the advantage of the use of a vessel by his party for shelter, as well as transportation, confirm the general experience of our parties south of the capes of the Delaware. In his report of July 20 he observes:

"The use of vessels on the southern coast, particularly, has the double advantage of combining facility of action with continued good health; for whilst all around (on the islands particularly) were suffering during the summer from fevers, we on board, though much exposed, all escaped."

Mr. William M. Johnson was assigned as aid in this party, and served throughout the season, taking charge of the party during a brief absence of Mr. Greenwell.

Hydrography.—The party in charge of Lieutenant Commanding Alden executed sheets Nos. 9 and 10, (sketch II,) including the delta of Mobile river, from near the parallel of Choctaw light to a line from the head of

Spanish river to Blakely, and part of sheet No. 8, left unfinished in the previous work. The area covered was 126 square miles; the number of soundings made, 25,096; the number of miles run in sounding, 536; and the number of angles observed in determining hydrographic positions, 2,025. Eleven temporary tide stations were occupied, and the observations made are referred to permanent bench-marks at Mobile and at Big Point Clear.

Lieutenant Commanding Alden acknowledges the services of Mr. Gustavus Wurdeman, in charge of hourly tidal observations at Mobile point.

The recommendations made by Lieutenant C. P. Patterson in regard to beacons and buoys remaining generally unacted on, and being renewed by his successor, I have placed them again in the appendix to the present report, (Nos. 25, 26, and 27.) Lieutenant Commanding Alden remarks: "My opportunities for judging, from personal observation, of what is required in regard to beacons and buoys in Mobile bay, are rather limited, owing to our short stay there—still we seldom moved without feeling the want of them, and I am satisfied that all that my predecessor (Lieutenant Commanding Patterson) recommended in that particular ought to be attended to. The absolute necessity for other marks and safeguards than those now in use at the entrance of the bay, must be apparent to any one who visits that place. I would, therefore, suggest that the attention of the department be again called to the subject, in order that the plan proposed, and so ably set forth by Lieutenant Patterson, may be carried out as soon as practicable."

After closing his work in this section, Lieutenant Commanding Alden proceeded to Cedar keys, Florida, and thence to Key West and Norfolk, when the steamer Walker was turned over to Lieutenant Commanding Lee, to be used temporarily in the hydrography of the outer coast of Maryland and Virginia.

Tidal observations were made at Cat island during the year 1848 every hour of the day and night. The preliminary discussion of them by Lieutenant C. P. Patterson showed that there were peculiarities to be investigated, and that close study of the subject was necessary. I have taken up the subject formally, and have it under discussion. The tides are of the remarkable class having one high and one low water only in twenty-four (lunar) hours as a general rule, like those observed long ago at Tonquin, discussed by Halley and Newton, and those more recently observed at Petropavlofsk, in Kamtschatka, and discussed by Mr. Whewell. It would be out of place in this report to say more than that the results admit of a complete solution, so that by adopting appropriate forms of reduction, tables for predicting the tides may be made. These tides depend probably upon the interference of the diurnal inequality (or twelve hour tide) wave with the semi-diurnal (or six hour tide) wave; at all events may be represented by such an hypothesis, and their variation may be traced in time and in height by following out the laws known to regulate the two component tide waves.

The days on which single or double tides may be expected, and their probable height, may be anticipated. The effect of a particular force and direction of the wind may also be allowed for, in a general way, as disturbing the regular tides.

I must be permitted to observe that the rigid scrutiny to which the observations have been subjected has tested in the most complete manner

the faithfulness of the observers, Mr. Gustavus Wurdeman and Mr. R. T. Bassett, who deserve great praise for the close attention and unwearied perseverance with which they discharged their duty.

SECTION IX.—FROM VERMILION BAY TO THE BOUNDARY, INCLUDING THE COAST OF PART OF LOUISIANA AND OF TEXAS.

The triangulation has advanced towards the head of East bay, and along West bay seventeen miles west of the city of Galveston. The topography of about half of Galveston upper and lower bays is completed, including both sides of the entrance. The hydrography of the approaches to Galveston harbor, and of the entrance and bar, is nearly completed, so as to furnish materials for the projected chart. Three parties have been employed for the greater part of the season in this work.

The coast survey has sustained in this section a loss which cannot soon be supplied. The death of assistant R. H. Fauntleroy, in Galveston, while preparing to take the field in discharge of his duties, cannot be too strongly deplored. The circumstances attending it, its suddenness, and the separation from his family, involved it in additional gloom. (Appendix, No. 28.) He was a man of science, equal to any occasion or emergency of his profession; conscientious in the discharge of every duty, zealous and laborious; when in control, mild, patient, unassuming, always ready to give credit; avoiding offence; full of knowledge, yet avoiding unnecessary display; combining in a remarkable degree a practical turn of mind with entire soundness of theoretical views, and great ingenuity in the discussion of theoretical questions; devoted to his business, of which he made his pleasure. His loss is felt by all those who had sustained official and personal relations with him, as that of a dear friend. The expressions of regard by his former associates attest in the strongest manner his very high worth. (Appendix, No. 29.)

1. *Primary and secondary triangulation.*—Upon the lamented decease of assistant R. H. Fauntleroy, the temporary charge of this work devolved upon sub-assistant S. A. Gilbert, who executed the task thus unexpectedly thrown upon him with much judgment. Assistant R. D. Cutts, to whom the operations were assigned, reached Galveston on the 11th of February and remained in charge until the close of the season, breaking up his party on the 31st of May, and proceeding to take charge of a plane-table party in section III, on the Chesapeake. On the 17th of April Mr. Gilbert was detached to take charge of the triangulation of Mississippi sound and Lake Borgne, and his duties were assigned to Mr. Augustus S. Rodgers.

The site for a *base line* on Galveston island, determined by assistant Fauntleroy, was examined by assistant Cutts, who confirmed the location and made the preliminary measurement on the 13th and 14th of May. The site was upon level prairie ground, and generally dry except during the rainy season. The base was measured with an iron wire two hundred metres in length and one-thirteenth of an inch in diameter, laid upon the ground and stretched with a uniform spring tension at the time of marking the position of the end. The length of the wire was frequently compared, during the measurement, with a distance of two hundred metres, laid off with suitable precautions by two standard four metre bars, and the last length of two hundred metres was measured by the same standards. Account was taken of the temperature during the measure-

ment. The alignment was made in the usual way by stakes at intervals, and the wire kept in a line between them by the eye. The position of the mark at the end of the two-hundred-metre wire was recorded as each length was noted on a small wooden platform firmly planted in the ground beneath the end of the wire. The ends of the base were permanently marked. The length of the line was about seven miles and seven-eighths.

The whole operation, as detailed in a special report by Mr. Cutts, was conducted with skill and judgment.

The progress of the *triangulation* is shown in sketch I. Joining that of the previous year, on the lines Bolivar Point-Dollar Point and Bolivar Point-Edwards' Point, it extends westward, the primary points being on the seacoast and on the prairies, and the secondary on the seacoast and West bay. The secondary triangulation of East bay was also continued eastward, from the line Parr's Grove-Smith's Point. The area embraced in the survey is 206 square miles, and the number of stations occupied 10, of which three are primary, six secondary, and one tertiary; seventy-six angles were measured by twenty-eight hundred observations. The triangles close, generally, within a limit of two seconds of arc. In some cases each of the three angles was measured by a different assistant.

The signals were erected by Mr. Gilbert, and after his leaving the party by Mr. Rodgers. Two stations were occupied by each of the gentlemen named. The observations at the other points were made by Mr. Cutts personally.

In his report Mr. Cutts remarks: "The season has been unfavorable; mists and haze prevailed during the months of February and March, and during April the wind blew almost a gale for half the month; in May the atmosphere was rendered clear and favorable in consequence of repeated heavy rains and thunder storms. Other obstacles to rapid progress have had this season to be encountered, such as transportation by land, shallow water, and the new feature of lines of sight over the level prairie. Even under the most favorable circumstances, and notwithstanding the elevation of the instrument, the signals, when visible at all, could only be observed upon for a very short time, either morning or evening, in consequence of the troubled and rolling stratum of atmosphere lying immediately over the level prairie."

The elevation of the instrument varied according to circumstances from 15 feet to 34 feet, two portable scaffolds having been made, one for primary and the other for secondary work.

The longest line observed upon was fourteen miles and three-quarters in length.

2. *Topography*.—The topographical party of sub assistant J. M. Wampler was employed in this section from February until June. The date of beginning his work was fixed by that of the arrival of the small vessel assigned him as the means of transportation, and of closing by the appropriation available for the section. The plane table sheets embraced in his survey are numbered 1, 2, 3, 4, and 6, (sketch I,) of which 3 and 6 were completed. They include the entrance to the harbor—which was first undertaken to furnish points for the hydrographic party engaged in soundings, necessary for the chart of the entrance and bar—the city of Galveston, Red Fish bar, the western side of Galveston upper and lower bays, and both sides of the upper bay near the mouth of San Jacinto river. The area surveyed is 99 square miles, and the extent of shore line 166 miles.

The services of Mr. Andrew Hussey, in taking the schooner *George M. Bache* to this section, from Alexandria, and the schooner *Nymph*, from Pensacola, to be used by the land parties in Galveston bay, deserve acknowledgment in this place.

3. *Hydrography*.—The hydrographic party, in charge of Lieutenant Commanding Augustus S. Baldwin, United States Navy, assistant in the Coast Survey, was organized as early as men could be procured for the purpose. They left the capes of the Delaware in the schooner *Morris*, on the 15th of March; after a stormy passage, reached Galveston on the 15th of April; and were occupied in the hydrography of the entrance and bar until the 13th of June. The limits of the hydrographic sheet are shown on sketch 1. It includes an area of 29 square miles, in which 20,910 soundings were taken, the distance run being 450 miles. It is proposed to commence the reduction of the entrance chart as soon as the working sheet is completed.

SECTIONS X AND XI.

The coast of California and Oregon.

The officers despatched to this coast in 1849 have met with great difficulties, arising from the high rate of wages and subsistence there, and their consequences. It was not possible to keep the hands together with the means usually deemed adequate for the support of similar parties. The hydrographic party, under Lieutenant Commanding W. P. McArthur, have, however, succeeded in obtaining results, notwithstanding the formidable obstacles to be overcome—obstacles which would have daunted less persevering spirits than these officers. The general reconnaissance of the coast from Monterey to the mouth of the Columbia river, and the preliminary survey of Columbia river, have been executed under circumstances which render them doubly creditable to all engaged in the work. The liberal appropriations made at the last session of Congress, and the providing of a steamer for the hydrographic work, will give facilities for its prosecution which will encourage those engaged in it to renewed exertions, and will produce a proportionate return.

Finding it impossible to retain hands in the land parties without exceeding the expenditures authorized, I accepted the services of four of the younger officers of the survey, (George Davidson, A. M. Harrison, James S. Lawson, and John Rockwell,) who undertook for one year to do any duty, however hard or manual, incident to the survey on the western coast. The party was placed under the charge of sub-assistant George Davidson, and set out for California in May last, repairing, on their arrival, to Point Conception—one of the worst-determined and most dangerous points, in reference to navigation, on our western coast. The new appropriations have enabled me to divide this party into two—one for geographical purposes, the other for plane-table surveys—placing at the head of each party one of the officers who had undertaken this enterprise under the adverse circumstances prevailing in this section.

Assistant R. D. Cutts, aided by Mr. Augustus S. Rodgers, has been detached to replace assistant James S. Williams; withdrawn at his own request; and an effective organization has been given to the party, for pur-

poses of both triangulation and topographical work, from the new appropriation.

With the four parties under the charge of Lieutenant Commanding McArthur, of assistant Cutts, (double party,) of assistant Davidson, and of sub-assistant Harrison, I can promise a very full return of results, should the appropriation be steadily kept up to the scale adopted at the last session of Congress, and required by the circumstances of the country, and by the rapid development of its commerce.

The following results have been furnished within the past year:

1. A report of Lieutenant Commanding McArthur on the light-houses necessary for San Francisco bay and its approaches, (appendix No. 30,) with a detailed report from Lieutenant Washington A. Bartlett, recommending a sea-light of the first order on the South Farallon de los Frailes, twenty-eight miles S. 68° W. (true) from Fort Point; an entrance-light on the hill in the rear of Fort Point; and a harbor light on Alcatraz island. These recommendations have been acted upon, and appropriations have been made for the lights. The minute surveys for their location have been directed, and will be soon received.

2. A survey of Mare Island straits, San Pablo bay, made by assistant James S. Williams, and Lieutenant Commanding W. P. McArthur, for the joint commission.

3. A general reconnaissance of the coast from Monterey, in California, to the mouth of Columbia river, with a chart and hydrographic notes by Lieutenant Commanding W. P. McArthur.

This chart was made in the schooner Ewing, during the passage northward in April last and return southward in August, both trips being made with special reference to this object. The chart is now engraving, and will, it is believed, be ready for publication in three weeks from the first of December. As it has been made with greater attention to minuteness than those of previous navigators, so it is deemed proper to publish it, as one step in advance in the knowledge of this part of our western coast. The report of Lieutenant Commanding McArthur (appendix No. 31) shows the manner in which the data were obtained, and gives a useful table of approximate latitudes and longitudes, the latter being based upon the longitudes of San Francisco bay and Columbia river entrance determined by Captain Charles Wilkes, of the United States exploring expedition.

The reconnaissance chart is accompanied by valuable sailing directions, for the limits embraced within it, for steam and sailing vessels, which will finally be engraved upon the sheets themselves, but, to expedite the publication, will be printed first in a separate sheet of letter press, (appendix No. 32.)

The hydrographic notices (appendix No. 33) include a detailed description of the Farallones de los Frailes, and of the entrance to Bel river, Humboldt river, the Klamath, Rogue river, the Coquille, Kowes, the Umpqua, and Yaquina.

4. A preliminary survey of the Columbia river from the entrance to Tongue point, above Astoria, (sketch K.)

On the changes which have taken place in the entrance to the river, Lieutenant Commanding McArthur remarks:

“When comparing our chart with that of the exploring expedition, the changes of the channels and shoals at the mouth of the Columbia river will be found to be numerous and considerable. Sand island is nearly a mile further to the westward now than it was in 1840-’41. The north

channel seems to be gradually filling up, whilst the new south channel is becoming both larger and deeper. This change will go on until some violent storm will throw up the sand again, and upon subsiding leave the water of the river to find a new channel.

"I have examined all the charts that have been made of the Columbia river from the time of its discovery to the present, and find that there have been continued changes going on, *but at all times has there been a good deep channel* at the mouth of this river. To these changes in the channel is to be attributed the great dread which navigators have had of the Columbia.

"There is now a good pilot at the mouth of the Columbia, and I have recommended a light-house on Cape Disappointment, and five buoys to be placed in such a manner as best to point out the channel. I would also recommend that these be placed under the superintendence of the pilot, who will always know when any change in the channel takes place, and can move the buoys to such positions as he might think best. By this means the dangers and delays attending the navigation of the Columbia would be vastly diminished.

"The greatly increasing commerce of Oregon demands that these improvements be made immediately—the more especially since the Columbia is the most important portion of Oregon for the pursuits of commerce.

"After crossing the bar, there is a good unobstructed channel for ships up as far as Astoria, beyond which Tongue Point bar presents quite a serious obstacle to vessels drawing sixteen or even fifteen feet of water. The channel over this bar is very crooked and shallow; vessels seldom pass it without delay. Once beyond Tongue Point bar, vessels can easily go up the Columbia as far as Fort Vancouver, on the Columbia, and Portland, on the Willamette river. I am of the opinion, however, that the time is at hand when the navigation of the Columbia river will be conducted by steam-vessels as far down as Astoria."

An additional appropriation for the light-house at Cape Hancock, or Disappointment, and for *twelve* can-buoys for this river, was made at the last session of Congress. A contract for the buoys has been made. Six of them will be delivered in time to send out by the middle of December, and instructions have been sent to Lieutenant Commanding McArthur in regard to placing them.

In a report in relation to the draught of vessels capable of passing into the Columbia river by the south channel, (appendix No. 36,) Lieutenant Washington A. Bartlett remarks:

"I have to state that our late survey of that channel, and my personal experience in passing over the south bar in vessels of deep draught, show conclusively that vessels drawing seventeen feet can be taken over the south bar at $\frac{1}{2}$ flood or $\frac{1}{2}$ ebb without the least risk of touching; and twenty feet can pass at high water."

5. A report from Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, on the light-house on Cape Hancock, or Disappointment.

This report recommends a sea-light of the first order to be placed on top of the cliff at the cape, in a tower forty feet in height.—(Appendix No. 34.)

"The summit of the sea cliffs (which are not covered by the forest) is the proper position for locating the light-house, say about 50 to 100 feet to the westward of 'Broom Station,' as given on our triangulation of the

river. Should the tower be placed there, it will show the light from the lantern around three-fourths of the horizon, without the necessity of felling the trees to the northward."

"In this position, the base of the tower will be about 250 feet above high-water mark; and should the tower be raised 40 feet to the deck of the lantern—and in my opinion it should not be less—on a base of 16 feet in diameter, it will be a prominent landmark for making the cape in the daytime."

6. A report from Lieutenant Commanding McArthur on the light houses at New Dungenness and Cape Flattery, Oregon.—(Appendix No. 35.)

A light of the first order is recommended for each of these points—the Cape Flattery light to be placed on Tatooschea island, adjoining the cape on the northwest.

Of the roadstead of New Dungenness Lieutenant Commanding McArthur says: "I have carefully examined the roadstead of New Dungenness, and find it to be safe and capacious. The holding-ground is excellent, and it is well protected from all winds except those from the northeast, a quarter from which it seldom or never blows so hard as to endanger shipping. The ingress and egress are remarkably convenient."

The remarks appended to this report in regard to the trade of Oregon, and to the cutting of timber from the public lands, are of interest. I extract the former, referring to the appendix No. 35 for the latter:

"Traffic is very much on the increase in Oregon; and while it must be admitted that the great increase has been on the Columbia river, yet it has also much improved in the sound. Lumber has become an extensive article of export, and it is quite probable that there is no country on the face of the globe where it is so abundant, so good, and so convenient."

7. Sketch of scheme of triangulation for San Francisco bay, by assistant James S. Williams.—(Sketch J.)

8. Assistant George Davidson has been engaged in determining the latitude and longitude of Point Conception, and the magnetic variation there, with the assistance of Mr. John Rockwell; and sub-assistant A. M. Harrison, aided by Mr. James S. Lawson and Mr. John Rockwell, has made a topographical survey of the same cape for locating a light-house. The results of this work will probably be received by the next arrival, as by the last advices it was completed.

The course which it is proposed to take in surveying the western coast, and to execute which the necessary appropriations are asked, is: To determine the geographical positions of the prominent points, correcting existing charts by them and by intermediate reconnaissances, and using them as points in the final survey. To make such surveys of harbors and anchorages, of sounds, of bays, and of portions of the coast, as may be most immediately useful, taking up first the parts necessary for the establishment of light-houses, beacons, buoys, and other aids to navigation, using the methods of the coast survey, and establishing such permanent marks as will enable us to bring together these detached parts into a complete survey of the coast. To publish the successive approximations which we make, so that, whenever we have better materials than those already existing for charts, they may be given to the navigator, without waiting for the best results which we can produce. In this spirit, the reconnaissance of the coast, now preparing for publication, will be followed by a similar one south from Monterey; the sites for the light-house provided for in California, now under examination, will be reported upon;

the preliminary survey of Columbia river entrance, now reducing, will be published, and the examination carried up the river to Port Vancouver, and up the Willamette; the portions of San Francisco bay, the surveys of which are required by the Engineer department, and for light-house purposes, will be first taken up, to be followed by a complete survey of that and of the adjacent bays, after less known portions of the coast have been embraced in the work.

The greater part of the coast is singularly favorable to the operations of a geodetic survey.

OFFICE WORK.

The changes in the organization of the office to which I referred as necessary in my report of last year have been gradually introduced by Brevet Major I. I. Stevens, of the Corps of Engineers, now the assistant in charge, under whom they have been made in a highly satisfactory manner. The chief departments of the office have been each placed in charge of a capable assistant, who is responsible immediately to the assistant in charge of the whole office for the details in his department. This arrangement tends to order, method, and accuracy in the details, and enables the assistant in charge effectively to supervise the several departments, which would be impossible, now that the results have become numerous, if he attended personally to the details of any single one. The views of Major Stevens in regard to the organization and wants of the office are contained in the extracts from his report in the appendix No. 37.

Since the date of my last report, Captain A. A. Humphreys, of the Topographical Engineers, has been detached from the coast survey. His services through a period of six years were of so distinguished a character as to merit richly the notice of the government. The coast survey being made by law a service for the army officer, it follows, as a consequence, that any rewards for distinguished merit that he may receive from the performance of civil duty should be bestowed, when such merit is shown in connexion with this work. The practice of the government has been so to reward distinguished civil service by officers of the army. With these views, I have heretofore urgently presented the case of Captain A. A. Humphreys to the department, deeming him entitled to a brevet for his distinguished service in connexion with this work, and now beg leave most earnestly to renew my recommendation.

The details of the office work, from the report of the assistant in charge, Brevet Major Isaac I. Stevens, will be given under the heads of—1. Computing; 2. Drawing; 3. Engraving; 4. Electrotyping; 5. Printing; 6. Publishing; 7. Instrument-making.

As an introduction to these details—which I deem it important to give, because they secure to each one employed due credit for his portion of the labor—I present an outline of some of the various matters subsequently discussed, including in it a notice of the special computations for longitude, and others which are not made immediately in connexion with the office.

It is not always kept in view that the results of the coast survey are published from the annual appropriations, which is not usual in works of this kind. The sums required for the publication of maps and charts thus go to swell the amount apparently required for surveys. By connecting the appropriations for field work and publication, the amount can be dis-

tributed so as to assign a due proportion to each during the current year; but in comparing the expenditure with other works, somewhat similar in kind, the connexion should be considered.

I have from time to time recommended in my reports the publication of the observations made. This, in my judgment, should be made annually—the publication keeping pace with the field work. If means are not furnished for such publications, when the survey is completed, the business of publishing must be commenced under considerable disadvantages. I am aware that this postponement of publication of observations has in a great degree been sanctioned by the practice of similar works abroad; but, after fully considering all the reasons in its favor, I remain of the opinion that the course heretofore recommended is the proper one for this work.

The special computations for longitude, made under the immediate direction of assistant S. C. Walker, have been as follows: Professor Pendleton, United States navy, on coast survey service, has resumed the reduction of the coast survey series of moon culminations, commencing in 1849 where Lieutenant Gilliss had closed, viz: January 1, 1844, and has extended them to the beginning of the year 1846.

Professor Pendleton has also reduced the transit observations made at Key West in 1849, and calculated the longitude of that place from the moon culminations observed there with the corresponding sets at Seaton station; recomputed the longitude of Stevenson's point, North Carolina, from the chronometer observations in 1848; besides incidental work in connexion with the office.

Professor Yulee has carefully compared together the results obtained by Lieutenant Gilliss, United States navy, and Professor Loomis, from the moon culminations observed at Hudson, Ohio, and at other stations and observatories, American and European. Where differences occur, triplicate computations are made by Professor Yulee. This work is nearly completed, and will place the longitude of the Hudson station, as compared with Europe, on a firm basis.

The telegraph connexion of Hudson with Philadelphia by the coast survey in 1849, made by the aid of Professors Loomis and Kendall, will render the highly valuable series of observations made by Professor Loomis, at Hudson, directly available for the longitude of the cardinal points of the survey.

No progress has been made in the last year in reducing the extensive series of occultations of the coast survey. These have been accumulating of late, by the labors of Mr. Downes, under the encouragement afforded by the Secretary of the Smithsonian Institution and the superintendent of the Nautical Almanac. Robert Treat Paine, esq., still continues his valuable series of amateur announcements of occultations.

Occultations.—We expect in due course to receive from the superintendent of the Nautical Almanac the means of comparing our observations of occultations directly with the lunar theory as perfected by the labors of Plana, Airy, Hansen, and Peirce, and with Airy's twelve-year catalogue of the stars, when we may resume the subject with better prospects of success.

The field work of 1847, having been submitted to duplicate computations, was reported upon last year. That of 1848, between Cambridge, Massachusetts, and the station in Stuyvesant's Garden, New York, has been completed in duplicate. The observations between Philadelphia

and Cincinnati are in process of reduction. The field work of 1849 and 1850 is in process of reduction.

In the course of the year, the observations on the velocity of transmission of signals through the telegraph lines have been submitted to Doctor B. A. Gould, of Cambridge, and to R. Culmann, of the Bavarian engineers, for independent discussion, and their results were presented to the American Association for the Advancement of Science at their late meeting in New Haven.

The following lists show the maps published within the year, those which are now engraving, those of which the drawing is completed, and those of which the drawing is in progress. The increase in the number of maps and sketches engraven and drawn is considerable, and will in another year show a corresponding increase in the number published. From these lists are excluded the editions of maps published within the year from plates previously engraved, and the maps drawn and tracings made for the records of the survey, or for communication to public bodies and to individuals, under the authority of the Treasury Department.

Maps and sketches published—

Maps.—1. Cawkin's and Sheffield's Island harbors, Long Island sound, (2d edition); 2. Pasquotank river, Albemarle sound; 3. Cat and Ship Island harbor, Mississippi sound; 4. Hyannis harbor, coast of Massachusetts; 5. Entrance of Delaware bay. *Sketches.*—6. Beaufort harbor, coast of North Carolina; 7. Sandy Hook changes; 8. St. Andrew's shoals.

Maps and sketches engraving—

1. South side Long Island No. 1; 2. Off-shore chart from Gay Head to Cape Henlopen; 3. Patapsco river and Baltimore harbor and approaches; 4. Long Island sound No. 1, from New Haven to New York; 5. Chesapeake bay No. 1, from the head of the bay to the Patapsco river; 6. Eastern series No. 1, Point Judith to Cuttyhunk; 7. Sachem's Head and City Island harbor, Long Island sound; 8. South side Long Island No. 2; 9. Muskeget channel; 10. Mobile entrance; 11. Hell Gate; 12. Mouth of the Connecticut river; 13. Seacoast of Maryland and Delaware; 14. Cape Canaveral; 15. Hatteras inlet; 16. Hatteras shoals; 17. 26 sketches showing the progress of the survey for the annual report.

Maps and sketches of which the drawing has been completed—

1. Map of Boston harbor, scale $\frac{1}{100,000}$, commissioners' copy; 2. Map of Boston harbor, scale $\frac{1}{100,000}$, commissioners' copy; 3. Chart of Muskeget channel; 4. Eastern series No. 1; 5. South side Long Island No. 1; 6. South side Long Island No. 2; 7. Map of Hell Gate; 8. Map of Mobile entrance; 9. Mouth of the Connecticut river; 10. Topography of Charleston harbor; 11. Sketch of Nantucket shoals; 12. Sketch of Canaveral shoals; 13. Sketch of St. Andrew's shoals; 14. Sketch of Maryland and Delaware seacoast; 15. Sketch of Beaufort harbor; 16. Sketch of Sandy Hook changes; 17. Sketch of Hatteras shoals.

The following drawings are in hands—

1. Chesapeake bay No. 1, nearly finished; 2. Chesapeake bay No. 2, just commenced; 3. Topography of the Patapsco as far as the field work admits; 4. The topography of Boston harbor, (for engraving); 5. The topography of the general coast chart; 6. Map of Mobile bay No. 1; 7. Map of Mobile bay No. 2; 8. Map of Albemarle sound No. 1; 9. Map of Wellfleet harbor, nearly ready; 10. Map of Hart and City islands, nearly completed; 11. Map of Key West harbor, just commenced.

Materials will soon be received at the office for the drawings of Richmond's island harbor of refuge, of Hatteras cove, and of Hatteras inlet, (complete surveys,) of the hydrography of Charleston harbor, and of the entrance to Galveston bay, which will at once be placed in the hands of the draughtsmen. Arrangements have been made to publish with despatch the results recently received (November 25) from the western coast, consisting of a chart of the entrance to Columbia river, and of a general reconnaissance of the coast from Columbia river to Monterey.

COMPUTING.—Eugene Nulty, esq., has computed magnetic observations in section IV; observations for latitude and azimuth at stations Sand Key and Cape Florida, in section VI; and observations for latitude at Mount Independence, section I.

John Downes, esq., has computed observations for latitude at Nantucket.

Assistant Theo. W. Werner has computed the secondary triangulation of assistant C. O. Boutelle, in the vicinity of Charleston harbor, 1849; the secondary triangulation of assistant J. E. Hilgard in section VI, 1849; the secondary triangulation of assistant C. O. Boutelle in section I, 1849; the magnetic observations of Mr. J. S. Ruth in sections I and II, 1848; the tertiary triangulation of Bodie's island and Cape Hatteras, section IV, by assistant A. W. Longfellow, Mr. J. Hewston, jr., and Mr. A. S. Wadsworth; the primary and secondary triangulation of assistant F. H. Gerdes in section VIII, 1846, '47, and '48; the primary and secondary triangulation of assistant E. Blunt in Chesapeake bay, 1849; the primary and secondary triangulation of assistant R. D. Cutts in section IX, 1849; the secondary triangulation of Captain T. J. Cram, Topographical Engineers, in section I; the secondary triangulation of assistant John Farley in section III, 1849; the secondary triangulation of sub-assistant C. P. Bolles in Beaufort harbor, section IV, 1849; the primary and secondary triangulation of assistant W. M. Boyce in section IV, 1849; and has arranged, and in part recomputed, a set of projection tables of a new form.

Assistant J. E. Hilgard returned to the office in April, and, before taking the field in August, recomputed the main triangulation in Delaware bay, and discussed the astronomical observations at stations Deakynce, Cape May, and Cape Henlopen; reduced the triangulation of Long Island sound from Point Judith to Tashua, and the horizontal angles at seven stations of the main triangulation in section II, by the method of least squares, in which he was assisted by J. C. Tennent, esq.; computed the conditional equations of the main triangulation from the Fire island base to Mount Rose, Stony Hill, section II; and directed the office computations generally. After returning to the office in September, Mr. Hilgard has had charge of the computing department, and has, besides, made various investigations, under the immediate direction of the superintendent.

G. Rumpf, esq., has made a recomputation of Captain T. J. Cram's triangulation on Cape Cod, and of assistant R. H. Fauntleroy's triangulation in Galveston bay; has reduced, by least squares, the horizontal angles at eight stations of the primary triangulation in section II, and the conditional equations from the Fire island base to the side Harrow-Round Hill, under the immediate direction of assistant J. E. Hilgard; has recomputed the triangle sides of the triangulation of Long Island sound; has recomputed the observations of the latitude of Nantucket by Polaris; and has prepared, with the assistance of J. C. Tennent, esq., a register of the geographical positions of all the geodetic points of the coast

survey, arranged according to sections, and supplied with indices. In connexion with the latter work, many recomputations were performed; and Mr. Rumpf has, besides, furnished such miscellaneous computations as were required for the use of the office.

C. A. Schott, esq., joined the office, from Lieutenant Commanding Alden's party, on July 18. He has since been engaged upon reducing, by the method of least squares, the horizontal angles of stations Patuceawa and Mount Independence, section I, Marriott's, section III, and at eight stations of the primary triangulation in section II; in reducing the condensation II; in computing azimuths at Mount Independence, section I; and tional equations from Round Hill-Harrow to Stony Hill-Mount Rose, in recomputing azimuths at Sand key and Cape Florida, and latitude at Cape Florida, section VI.

2. DRAWING.—Assistant W. M. C. Fairfax, besides the charge of the engraving through the year, had charge of the drawing from November 1st 1849, to June 18, 1850, when, at his own request, he was relieved, and assistant J. B. Glück placed in charge. Mr. Glück continued in charge until September, when he resumed his work in the field, and his place was supplied by assistant M. J. McClery, who is now in temporary charge of the department.

Assistant M. J. McClery, besides the charge of the drawing from September 12 to the present time, has also previously had charge of the drawing and engraving during several unavoidable absences of the assistants directing them. He has been engaged upon the reduction and drawing of the topography of No. 1 of the Chesapeake bay map, scale 1:100,000, and has commenced No. 2 of the same series. He has also continued the Patuxent map as far as the condition of the plane-table sheet would admit. Much of his time has been occupied in the verification of drawings and projections.

Joseph Welsh, esq., has been engaged upon the reduction and drawing of the topography of the Boston harbor map, scale 1:100,000, which is now in a very advanced state; has made additional reductions to, and drawn the topography of, eastern series No. 1, Long Island Sound No. 1, and also the general coast chart, scale 1:100,000, besides tracings and other miscellaneous drawings.

J. Robertson, esq., was engaged upon the drawing of the Boston harbor map, scale 1:100,000, for the commissioners of the State of Massachusetts, until the beginning of May, and was engaged on the reduction and drawing of the topography of Wellfleet harbor map, scale 1:100,000, and the hydrography of City Island harbor map, scale 1:100,000, up to the 17th June, when he resigned his position.

Charles Mahon, esq., has completed the map of Hell Gate, scale 1:100,000; has reduced and drawn the hydrography of the Boston harbor map, scale 1:100,000, in part; and has also commenced the reduction and drawing of the topography of sheets Nos. 1 and 2, Mobile bay and approaches, scale 1:100,000, besides projections and miscellaneous drawings.

Wm. Luce, esq., has been engaged upon the reduction and drawing of the topography of Albemarle sound map No. 1, scale 1:100,000, and miscellaneous drawings and tracings. Mr. L. has also, from time to time, been in charge of the electrotyping department.

J. J. Ricketts, esq., has completed the reduction and drawing of the topography and hydrography of the map of Mobile entrance, scale 1:100,000; also the hydrography of the map of Wellfleet harbor, scale 1:100,000; and

and City island, scale $\frac{1}{250,000}$; and the map of the mouth of the Connecticut river, scale $\frac{1}{250,000}$. He has nearly finished the reduction of the hydrography of Mobile bay No. 1, and has also reduced and drawn additional hydrography to the following maps, viz: the general coast chart, scale $\frac{1}{250,000}$; south side of Long island No. 1, scale $\frac{1}{250,000}$; Chesapeake bay No. 1, scale $\frac{1}{250,000}$; and eastern series No. 1, scale $\frac{1}{250,000}$; besides projects and other miscellaneous drawings.

A. Boschke, esq., has reduced and drawn the topography of the maps of Muskeget channel, scale $\frac{1}{250,000}$; Charleston harbor, scale $\frac{1}{250,000}$; mouth of the Connecticut river, scale $\frac{1}{250,000}$; and has commenced the map of Key West harbor, scale $\frac{1}{250,000}$. He has also reduced and drawn the mouth of the Connecticut river and Hart and City islands (resurveys) on a scale of $\frac{1}{250,000}$; for the map of Long Island sound No. 1, and a sketch of Nantucket shoals, scale $\frac{1}{250,000}$; besides making projects, projections on copper, and some miscellaneous drawings and tracings.

A. Fornaro, esq., has been engaged in preparing the annual report sketches, making projections for the history maps of topography and triangulation, besides miscellaneous drawings and tracings. Mr. F. has also copied the tables of L. M. Z. for the use of the survey.

J. Lambert, esq., joined the office in June, and has been engaged principally in drawing the topography of Wellfleet harbor map, scale $\frac{1}{250,000}$; and reducing and drawing additional topography to the general coast chart, scale $\frac{1}{250,000}$. He has also been engaged in making tracings, diagrams, and other miscellaneous drawings.

Eugene Hesse, esq., was engaged until the beginning of April preparing the annual report sketches, making projections for the history maps, besides miscellaneous drawings; at which time he left the survey.

J. C. Tennent, esq., joined the office in September; has reduced and drawn the plane-table sheets of sections IV and VIII on the assemblage maps, besides miscellaneous drawings and tracings.

G. Farquhar, esq., joined the office in August; has reduced and drawn the chart of Canaveral shoals, scale $\frac{1}{250,000}$; has also been engaged in reducing the plane-table sheets of section I on the assemblage map, and plotting the triangulation in section IV on the diagram map. Mr. F. left the office to join the hydrographic party of Lieutenant Commanding R. Wainwright in October.

J. R. P. Mecklin, esq., joined the office in September, and has been engaged reducing the plane-table sheets of section III on the assemblage map. He has also plotted the hydrography of Hatteras shoals, scale $\frac{1}{250,000}$.

Hydrography.—Passed Midshipman Somerville Nicholson, United States navy, was engaged upon tidal reductions until he took the field in July last.

The drawings required by the hydrographic results of each season are made by the parties who executed the work afloat, and therefore do not come into the details of office work.

3. *ENGRAVING.*—Assistant W. M. C. Fairfax has had charge of the engraving. The engraving of the maps of the lower sheet of Delaware bay and river, by F. Dankworth, O. A. Lawson, J. Knight, and W. Smith; of New Bedford, (third electrotypes copy, with important additions and improvements,) by J. Knight, O. A. Lawson; of Cawkin's and Sheffield's Island harbors, (electrotypes copy No. 2, restored, much worn in printing,) by J. Knight and S. T. Pettit; of Pasquotank, by O. A. Lawson, W. Smith, and S. T. Pettit; of Cat and Ship Island harbors, by J. Knight

and W. Smith, (so far as regards completion of lettering;) Hyannis harbor, (as to views, lettering, &c.,) by O. A. Lawson, W. Smith, and S. T. Pettit; and of New York harbor, (electrotype copy No. 1, with views attached,) by O. A. Lawson,—have been completed.

The engraving of the map of the general chart of the coast, scale 1:100,000, has been continued by F. Dankworth, O. A. Lawson, J. Knight, and W. Smith. The engraving of the western sheet of Long Island sound has been continued by S. Siebert and J. Knight; of No. 1, Chesapeake bay, by F. Dankworth, O. A. Lawson, and W. Smith; of No. 1, eastern series, by A. Rollé and J. Knight; of Boston harbor, by A. Rollé and J. Knight; of No. 1, south side of Long Island, (western sheet,) by O. A. Lawson and J. Knight; of Sachem's Head and City Island harbors, by R. T. Knight and S. T. Pettit; and of No. 2, south side of Long Island, by O. A. Lawson, W. Smith, S. T. Pettit, and R. T. Knight. The engraving of Muskeget channel has been commenced by S. T. Pettit and R. T. Knight; of Mobile entrance, by W. Smith, S. T. Pettit, and R. T. Knight; of Hell Gate, by A. Rollé, J. Knight, and G. McCoy. The sketch charts of Davis's south shoal, &c., Beaufort harbor, North Carolina; Sandy Hook channels; St. Andrew's shoals; Cape Canaveral shoals; and the seacoast of Delaware and Maryland, have been engraved in the office by S. T. Pettit, W. Smith, R. T. Knight, and Henry M. Knight, apprentice.

The sketches accompanying the annual report have also been engraved in the office by W. Smith, S. T. Pettit, R. T. Knight, H. M. Knight, E. F. Woodward, and J. V. N. Throop, (the latter by contract.)

4. ELECTROTYPING.—Under the skillful direction of Mr. Mathiot, the following engraved plates have been reproduced, viz: 1. Part No. 1. Delaware bay and river; 2. No. 2. Delaware bay and river; 3. Sheffield's and Cawkin's island, (2 made;) 4. New Bedford, (2 made;) 5. Nantucket; 6. Upper sheet of Delaware bay and river; 7. New York bay and harbor, 1:100,000; 8. No. 1. South side Long Island; 9. Alto of Patapsco; 10. Union Delaware bay and river, (2 made;) 11. Pasquotank; 12. Hyannis; 13. Cat and Ship island; 14. Black Rock and Bridgeport; 15. Mouth of Chester river; 16. Captain's islands, east and west; 17. Huntingdon bay; 18. Annapolis harbor; 19. Oyster bay; 20. Holmes's Hole and Tarpaulin cove; 21. Edgartown harbor; 22. New London.

In his report on the office, Major Stevens remarks as follows upon Mr. Mathiot's process: "His method has been very successful; it consists in washing the plate with an alcoholic solution of iodine, and exposing it to the action of a strong light, before placing it on the battery. In no case was there any marked adhesion between the copper deposited by the electrotype process and the original plates. The lower plate of the Delaware, lost by adhesion in 1848, and re-engraved in four parts, was in April reproduced with complete success."

The mode adopted was to secure the four parts by screws to a copper plate in their proper relative positions, and filling in with copper filings the intermediate spaces, made exceedingly small by a very careful and close filing of the edges of contact. The metal formed was equally good throughout, and there remained only some days' labor of an engraver to unite the parts. Two plates were made, only one of which has been prepared for the printer. I consider this conclusive as to the practicability of cutting up plates in the engraving, distributing the parts to several engravers, and reproducing the whole in the electrotyping process.

Mr. Mathiot has likewise directed a portion of his time to repairs of in-

struments; and, with the labor-saving facilities which have been introduced by him in the management of the electrotyping, it is hoped the ensuing year that he will devote one-half his time to making deep-sea thermometers and to miscellaneous work.

5. **PRINTING.**—Since the first of November, 1849, there have been printed 1,152 sheets of Delaware bay and river, (the map consists of three sheets,) 25 copies of the small map of New York bay and harbor, 775 of harbors of Cat and Ship island, 800 of Pasquotank, 800 of Hyannis harbor, 500 of the mouth of Chester river, 405 of the harbor of New Bedford, 195 of the harbor of Nantucket, 50 of New Haven harbor—making in all 4,702 sheets.

Besides these, there were 746 copies from finished and unfinished plates printed, 591 from the sketch plates, 300 copies of Hatteras inlet, 300 of Cape Hatteras, 300 of Bull's bay, 300 of St. Andrew's shoals, 300 of Beaufort harbor, 300 of Nantucket shoals, 50 of Davis's south shoal, 569 circular protractors and diagrams, scales of shade, and proofs of the plates in the engravers' hands.

6. **PUBLISHING.**—At the date of the last report, 26 sheets of coast survey maps had been published; since then, three sheets have been added—making the number now published 29. This is in addition to replacing the lower sheet of Delaware bay, lost in electrotyping.

Since November, 1849, there have been distributed, by direction of the Treasury Department, and for use in the survey, 360 sheets of the large map of New York bay and harbor, 61 copies of the small map of New York bay and harbor, 60 copies of New Bedford, 60 copies of Annapolis, 60 copies of New Haven, 60 copies of Little Egg harbor, 63 copies of New London harbor, 63 copies of Holmes's Hole and Tarpaulin cove, 63 copies of Oyster bay, 62 copies of the harbors of Black Rock and Bridgeport, 63 copies of Edgartown harbor, 412 copies of Nantucket harbor, 412 copies of the harbors of Cawkin's and Sheffield's islands, 513 copies of the mouth of Chester river, 543 copies of Huntington bay, 513 copies of Captain's island, east and west. The whole number of sheets distributed is 3,428.

There have been turned over to the disbursing officer of the coast survey, to be placed with agents for sale, 911 sheets of Delaware bay and river, 180 copies of New Bedford, 90 of Fisher's Island sound, 63 of Annapolis, 294 of New Haven, 43 of Little Egg harbor, 83 of Oyster bay, 473 of Edgartown, 88 of Black Rock and Bridgeport, 200 of mouth of Chester river, 214 of Pasquotank, 74 of Hyannis, 200 of Cat and Ship island—being in all 2,913 sheets of maps.

7. **INSTRUMENT MAKING AND REPAIRS.**—The alterations, repairs, dividing, and cleaning required by the instruments of the field and office parties generally have been made, during the past year, under the direction of Joseph Saxton, esq.

Besides these, alterations, &c., have been made to the zenith sector; a 30-inch theodolite has been repaired and additions made to it; a telegraph register made; a 6-inch vertical circle altered into a theodolite; theodolites repaired and altered; metre chains made; heliotropes repaired and adjusted; drawing instruments repaired, and iron plummets made.

Respectfully submitted by

A. D. BACHE,

Superintendent U. S. Coast Survey.

To the Hon. THOMAS CORWIN,

Secretary of the Treasury.

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1. Distribution of the parties of the coast survey upon the coast of the United States, during the surveying season, in different parts of the coast, from November, 1849, to November, 1850.

2. Report of the landmarks of the coast of Oregon from Point Adams to the boundary of Oregon and California, by Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey.

2 *bis*. Letter of the superintendent of the coast survey, applying for the detail of officers of the corps of Topographical Engineers, with the reply of the Secretary of the Treasury, enclosing a copy of a letter from the Secretary of War.

3. Correspondence in relation to surveys of portions of San Francisco bay, required by the Engineer department for the joint commission.

4. Letter of the Secretary of War to the Secretary of the Treasury, declining the detail of officers of the corps of Engineers for coast-survey service, and enclosing a letter of the Chief Engineer, stating the reasons why the detail cannot be made.

5. Letter of the Secretary of the Navy to the Secretary of the Treasury, relating to the detail of officers for the hydrographic party, in section IX, coast of Texas.

6. Extract from the report of W. C. Bond, esq., director of the Cambridge Observatory, to the Superintendent of the coast survey, in relation to difference of longitude between Cambridge and Liverpool Observatories.

7. Recommendation in reference to buoys in the Vineyard sound and Massachusetts bay, by Lieutenant Commanding Charles H. McBlair, United States navy, assistant in the coast survey.

8. Extracts from the report of Professor A. G. Pendleton, United States navy, assistant in the coast survey, to the Superintendent, in regard to the encroachment of the sea on the land on the south side of Long Island.

9. Report of H. L. Whiting, esq., assistant United States coast survey, to the superintendent, on the progress of Sandy Hook from 1848 to 1850.

10. Extracts from the report of Lieutenant Commanding Woodhull, United States navy, to the superintendent, in relation to Prince's and Diamond reefs, New York harbor.

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12. Letter of Isaac Newton, esq., president of the People's Line of steamboats, to the Superintendent coast survey, offering use of line for party surveying Hudson river.

13. Extracts from the report of S. C. Walker, esq., assistant United States coast survey, to the Superintendent, on the telegraphic operations and computations under his charge.

14. Abstract of the report of Lieutenant Commanding S. P. Leo, United States navy, assistant in the coast survey, to the Superintendent,

on lights, buoys, &c., in the Chesapeake, from the Potomac to the head of the bay.

15. Report of the Superintendent of the coast survey to the Secretary of the Treasury, on Hatteras shoals, with report of Lieutenant Commanding Thornton A. Jenkins, United States navy, assistant, &c.

15 bis. Report of Lieutenant Commanding Thornton A. Jenkins to Professor A. D. Bache, recommending a bell-beacon and buoy to be placed on Hatteras shoals.

16. Report of the Superintendent coast survey to the Secretary of the Treasury, in relation to changes in Hatteras inlet, North Carolina.

17. Report of Lieutenants Commanding James Alden and Thornton A. Jenkins, in regard to fitness of steamer Jefferson for hydrographic party on western coast, &c.

18. Letter of Lieutenant Commanding J. N. Massitt, United States navy, assistant coast survey, to the Superintendent, in relation to his examination in the vicinity of St. Helena sound, coast of South Carolina.

19. Report of the Superintendent United States coast survey to the Secretary of the Treasury, on the reconnaissance of St. Andrew's shoals, coast of Georgia, by Lieutenant Commanding John Rodgers, United States navy, assistant coast survey.

20. Notice of surveying marks on the Florida reef, in a letter from the Superintendent of the coast survey to the Secretary of the Treasury.

21. Extract from a letter from Lieutenant Commanding James Alden, United States navy, assistant coast survey, to the Superintendent, in relation to a light house on Seahorse key, Florida.

22. Letters and reports relating to the stranding of the steamer Hetzel near Cape Canaveral, and her subsequent relief, &c.

23. Extract from the report of assistant F. H. Gerdes to the superintendent coast survey, on the reconnaissance of the Florida keys, &c.

24. Report of the Superintendent coast survey to the Secretary of the Treasury, on the reconnaissance of Cape Canaveral shoals, Florida, by Lieutenant Commanding John Rodgers, United States navy, assistant coast survey.

25. Report by Lieutenant Commanding C. P. Patterson, United States navy, assistant coast survey, to the Superintendent, on beacons and buoys in Mobile bay.

26. Report by Lieutenant Commanding C. P. Patterson, on buoys and beacons at the entrance to Mobile bay.

27. Report by Lieutenant Commanding C. P. Patterson, on buoys for Cat and Ship Island harbors.

28. Extract from a letter of S. A. Gilbert, esq., sub assistant coast survey, to the Superintendent, communicating the decease of assistant R. H. Fauntleroy, at Galveston, Texas.

29. Resolutions in relation to the decease of assistant R. H. Fauntleroy, by the officers of the party of the Superintendent.

Letter of assistant F. H. Gerdes, transmitting to the Superintendent the resolutions of the officers employed in Florida, in relation to the decease of assistant R. H. Fauntleroy.

30. Report of Lieutenant Commanding W. P. McArthur, United States navy, assistant coast survey, to the Superintendent, enclosing a report of Lieutenant Washington A. Bartlett, United States navy, on the lights necessary for San Francisco bay and its approaches.

31. Report accompanying a reconnaissance chart of the western coast of the United States from Monterey, California, to the mouth of Columbia river, Oregon, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

32. Sailing directions for the western coast of the United States from Monterey to Columbia river, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

33. Hydrographic notice of the western coast of the United States from Monterey to Columbia river, islands and rivers, by Lieutenant Commanding W. P. McArthur, United States navy, assistant coast survey.

34. Report of Lieutenant Washington A. Bartlett, United States navy, assistant coast survey, to the Superintendent, in relation to a light-house at Cape Hapecock or Disappointment, entrance to Columbia river.

35. Report of Lieutenant Commanding W. P. McArthur, United States navy, assistant coast survey, in relation to lights at Cape Flattery and New Dungeness, Oregon.

36. Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, in relation to the draught of vessels which can pass through the south channel into Columbia river.

37. Extracts from the report of Brevet Major Isaac I. Stevens, Corps of Engineers, assistant, in charge of the coast survey office, to the Superintendent.

38. List of maps engraved and engraving at the coast survey office.

39. Statistics of the coast survey to January, 1850.

APPENDIX No. 1.

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Distribution of the parties of the coast survey upon the coast of the United States, during the surveying seasons, in the different parts of the coast, from November, 1849, to November, 1850.

No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
1.	Passamaquoddy bay to Point Judith, including the coast of Maine, New Hampshire, Massachusetts, and Rhode Island.	1	Reconnaissance.....	A. D. Bache, superintendent; C. O. Boutelle, assistant.	Preparation of stations, examination of work to be done at Richmond's island harbor of refuge, part of season.
		2	Magnetic observations ...	J. E. Hilgard, assistant.....	Magnetic variation, &c., for harbor charts from Newburyport, Mass., to Richmond's island, Me.
		3	Secondary triangulation ..	Captain T. J. Cram, United States topographical engineers, assistant.	Secondary triangulation from boundary of Massachusetts and New Hampshire to beyond Kennebunk, Me.
		4	Do.....	C. O. Boutelle, assistant, and G. A. Fairfield.	Junction with Captain Cram's work completed; triangulation of Richmond's island harbor and approaches made and connected with general primary triangulation.
		5	Topography.....	H. L. Whiting, assistant; J. M. Wampler, sub-assistant; and R. M. Bache. (Triple party.)	From near Beverly, Mass., eastward, Marblehead harbor, and vicinity of Salem.
		8	Do.....	J. B. Glück, assistant; J. H. Adams, sub-assistant.	Topography near Cape Cod, part of season only.
		9	Hydrography.....	A. D. Bache, superintendent. Lieutenant Command'g Chas. H. McBlair, United States navy, assistant; Lieutenant Commanding J. N. Maffitt, United States navy, assistant. (Double party.)	Inspection of progress of parties. Nantucket shoals, Muskeget channel, completed; off-shore work between Gey Head and No Man's Land, and Block island, Wellfleet harbor, Cape Cod, Salem, and Beverly harbors.

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II.	Point Judith to Cape Henlopen, including the coast of Connecticut, N. York, New Jersey, Pennsylvania, and Delaware.	11	Do.....	Lieutenant Command'g Maxwell Woodhull, U. States navy, assistant.	Tidal and current observations in Martha's Vineyard sound and Buzzard's bay, hydrography of Richmond's Island harbor of refuge, Casco bay, Maine, and approaches.
			Views.....	John Farley, assistant.....	Views of entrance to Narragansett and Buzzard's bays, &c., for coast chart, eastern series, No. 1, part of season.
		1	Magnetic observations ...	George Davidson, sub-assistant.	Determination of constants of magnetic instruments in early part of year.
		2	Auxiliary triangulation...	Professor A. G. Pendleton, United States navy.	Triangulation in connexion with verification work of hydrography, south side of Long Island, part of season.
		3	Topography	H. L. Whiting, assistant.....	Topography of mouth of Connecticut river and of City island; resurveyed shore-line of Sandy Hook, (for progress of the Hook,) part of season.
III.	Cape Henlopen to Cape Henry, including the coast of Delaware, Maryland, and Virginia.	4	Hydrography.....	Lieutenant Command'g Maxwell Woodhull, U. States navy, assistant.	Verification work on south side of Long Island, from Ketchikanneck to Neapeague; examination of Prince's and Diamond reef, &c., New York harbor, part of season.
			Do.....	L. F. Pourtales, sub-assistant.	Examination of specimens of bottom of sea in section II.
		1	Primary triangulation and secondary triangulation.	Edmund Blunt, assistant; S. A. Gilbert, sub-assistant.	Continuation of triangulation of Chesapeake to Wolftrap station; Mr. Gilbert assistant from August to close of September.
		2	Primary triangulation and astronomical and magnetic observations.	A. D. Bache, superintendent; George W. Dean, sub-assistant.	Continuation of triangulation from Chesapeake to capital and observatory, Washington; astronomical and magnetic observations at three stations.
			Reconnaissance.....	A. D. Bache, superintendent; Thomas McDonnell.	Line from Webb's to Hill's opened, &c., early part of season.
		3	Triangulation and astronomical work.	S. C. Walker, assistant; L. F. Pourtales, sub-assistant.	Triangulation and astronomical observations at Seaton station; telegraphic operations for difference of longitude of Charleston and Washington, &c.
		4	Secondary triangulation ..	John Farley, assistant.....	Continuation of triangulation of outer side of Eastern Shore peninsula, from work of last year, to Cedar Island, Virginia.
		5	Topography.....	R. D. Cutts, assistant, in charge; work executed by John Seib and S. A. Wainwright. (Double party.)	Eastern shore of Maryland; western shore of Virginia, between the Potomac and Rappahannock.

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No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
III.	Cape Henlopen to Cape Henry, &c.—Continued.	7	Topography	George D. Wise, assistant....	Examination of Patapsco; topography of outer shore of peninsula of Eastern Shore to Lonesome Hill, Virginia.
			Do.....	J. B. Glück, assistant.....	Verification work on Patapsco, part of season.
			Do.....	Captain A. A. Humphreys, United States topographical engineers, assistant.	Inspection of work on Patapsco.
IV.	Cape Henry to Cape Fear, coast of part of Virginia and North Carolina.	8	Hydrography	Lieutenant Commanding S. P. Lee, United States navy, assistant; Lieut. Command'g B. F. Sands. (Double party.)	Hydrography of outer coast from Green Run, Maryland, to Lonesome Hill, Virginia; hydrography of Chesapeake, from work of last year, to line Windmill Point, Nantux Cr.; sailing directions for Chesapeake, &c.; list of buoys, &c., for bay north of Potomac.
		1	Main and secondary triangulation.	Captain A. A. Humphreys, United States topographical engineers, assistant.	Base on Bodie's island, connected with main triangulation; verification of tertiary triangulation of ocean shore towards Hatteras, part of season.
		2	Secondary and tertiary triangulation and topography.	J. J. S. Hassler, assistant....	Secondary triangulation of Currituck sound and tertiary of Chowan, Cushee, and Roanoke rivers continued; drawings completed of topography of Albemarle sound, &c.
		3	Tertiary triangulation....	J. Hewston, sub-assistant, and A. S. Wadsworth, jr.	From Bodie's island base, south, to near Hatteras inlet.
		4	Tertiary triangulation and topography.	C. P. Bolles, sub-assistant....	Triangulation of Beaufort harbor made and shoreline traced.
		5	Hydrography.....	Lieut. Command'g Thornton A. Jenkins, United States navy, assistant.	Off shore soundings (deep sea) from capes of the Chesapeake to Cape Hatteras; hydrography of Hatteras shoals and cove; examination of Hatteras inlet, gulf stream; work in this and section V.

V.	Cape Fear to the St. Mary's river, coast of South Carolina and Georgia.	6	Do.....	Lieut. Command'g Richard Wainwright, United States navy, assistant.	Hydrography of Albemarle and Croatan sounds, of Alligator and North rivers; reconnaissance of Hatteras inlet.
		7	Do.....	Lieutenant Commanding J. N. Maffitt, United States navy, assistant.	Hydrographic reconnaissance of Beaufort harbor, North Carolina.
		1	Measurement of base....	A. D. Bache, superintendent; C. O. Boutelle, assistant; and C. P. Bolles, sub-assistant.	Measurement of base on Edisto island completed.
		2	Main and secondary triangulation, and astronomical and magnetic observations.	C. O. Boutelle, assistant; Geo. Davidson, sub-assistant.	Astronomical and magnetic observations at north end of Edisto base connected with main triangulation commenced; secondary triangulation of North Edisto inlet made.
		3	Secondary triangulation..	C. O. Boutelle, assistant; C. P. Bolles, sub-assistant.	Measurement of preliminary base near Savannah; secondary triangulation from north end of Hutchinson's island to Eiba island, Savannah river.
VI.	St. Mary's river to St. Joseph's, coast of Florida.	4	Hydrography.....	Lieutenant Commanding J. N. Maffitt, United States navy, assistant.	Hydrography of Charleston harbor and approaches; reconnaissance off St. Helena sound.
			Do	Lieutenant Commanding John Rodgers, United States navy, assistant.	Reconnaissance of St. Andrew's shoals.
		1	Reconnaissance.....	A. D. Bache, superintendent.. F. H. Gorde, assistant.....	Inspection of progress of work. Reconnaissance of Florida Keys and of part of the main from Cape Florida to the Tortugas completed; preliminary base near Cape Florida measured; reconnaissance for base near Cape Sable made; reconnaissance near Cedar Keys commenced.
		2	Astronomical and magnetic observations, and secondary triangulation.	J. E. Hilgard, assistant.....	Observations for latitude and azimuth; magnetic declination, &c., at Key Biscayne; preliminary base near Cape Florida measured; triangulation of Key Biscayne bay and of Florida reef adjacent commenced, (part of season.)
		3	Secondary triangulation and topography.	H. L. Whiting, assistant; and J. H. Adams, sub-assistant. (Double party.)	Triangulation near Key Biscayne continued; topography of Key West and of adjacent keys executed.
		5	Hydrography.....	Lieutenant Commanding John Rodgers, United States navy, assistant.	Reconnaissance of Cape Canaveral shoals executed; hydrography of Key West harbor and approaches nearly completed.

APPENDIX No. 1—Continued.

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No. of sections of survey.	Limits included in several sections.	No. of parties in section.	Operations.	Persons conducting the operations.	Localities of the several operations.
VI.	St. Mary's river, &c.—Con..	6	Hydrography.....	Lieutenant Command'g James Alden, United States navy, assistant.	Reconnaissance of Cedar Keys; recommendation for a light-house.
VIII.	Mobile bay to Vermilion bay, coast of Alabama, Mississippi, and part of Louisiana.	1	Primary and secondary triangulation.	F. H. Gerdes, assistant.....	Primary triangulation continued to Chandeleur island, (part of season.)
		2	Secondary triangulation..	C. M. Eakin, assistant; S. A. Gilbert, sub-assistant.	Triangulation of part of Mobile delta; connexion of Mobile bay and outer coast made; of Mississippi sound and adjacent bays continued westward into Lake Borgne.
		3	Topography.....	W. E. Greenwell, assistant...	Topography of west shore of Mobile bay and of delta completed; of north shore of Mississippi sound continued westward of Pascagoula.
		4	Hydrography.....	Lieutenant Command'g James Alden, United States navy, assistant.	Hydrography of Mobile delta completed; of Mobile bay nearly completed.
IX.	Vermilion bay to the boundary—part of Louisiana and Texas.	1	Main and secondary triangulation.	R. D. Cutts, assistant; S. A. Gilbert, sub-assistant. James S. Williams, assistant; Spencer C. McCorkle, sub-assistant.	Main and secondary triangulation continued westward and southward from Galveston bay; preliminary base on Galveston island measured; triangulation of East bay continued. Under instructions to continue foregoing work.
		2	Topography.....	J. M. Wampler, sub-assistant.	Topography of Galveston lower bay completed, and of western shore of upper bay.
		3	Hydrography.....	Lieutenant Command'g A. S. Baldwin, United States navy, assistant.	Hydrography of approaches to Galveston harbor nearly completed.

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X & XI.	Western coast of the United States, Oregon, and California.	1	Reconnaissance, main and secondary triangulation, and topography.	R. D. Cutts, assistant; Augustus S. Rodgers, aid.	Under instructions to make minute surveys of sites for light-houses in San Francisco bay; to make general surveys required by engineer department in same bay; to execute land-work of harbors of Bodega, Monterey, Santa Barbara and San Diego, in California, and of Columbia river (to Fort Vancouver) in connexion with general survey of coast in Oregon; and to unite in general reconnaissance from San Francisco to San Diego. Latitude and longitude of Point Concepcion. Under instructions to determine those of Monterey, of southern entrance to Santa Barbara sound, of Trinity bay, straits of Puer, &c. Under instructions to execute topography of sites of light-houses at Monterey, Point Concepcion, and San Diego; topography in connexion with work of other parties. Hydrography of Mare island straits, San Pablo bay; reconnaissance for sites of light-houses at Cape Disappointment and New Dungeness; preliminary survey of entrance to Columbia river, and determination of places for buoys; general reconnaissance of coast from Columbia river to Monterey; report of sites for light-houses at entrance to San Francisco bay and harbor; under instructions to examine sites for light-houses at Monterey, Point Concepcion, and San Diego, and to unite in foregoing operations.
		2	Geographical determinations.	George Davidson, assistant; and John Rockwell.	
		3	Topography	A. M. Harrison, sub-assistant; and James S. Lawson.	
		4	Hydrography	Lieutenant Commanding W. P. McArthur, United States navy, assistant.	

APPENDIX No. 2.

Report of the landmarks of the coast of Oregon from Point Adams to the boundary of Oregon and California, by Lieutenant W. A. Bartlett, United States navy, assistant in the coast survey.

WASHINGTON, December 11, 1850.

SIR: The coast of Oregon from Point Adams (the south point of the Columbia river) to the parallel of 42° north, or the boundary of Oregon and California, will be better understood by the following classification and description:

1. The section of coast from the Columbia to the Kowes river, at Cape Arago.

2. From Cape Arago to the line of 42° north of Cape St. George. This entire line of coast, when seen from a distance of ten leagues or more at sea, presents the appearance of a high and precipitous shore, densely timbered—an unbroken line of forest: which, perhaps, may account for the very imperfect and incorrect descriptions heretofore given, when it has been stated to be “an iron bound and inhospitable coast.”

A nearer approach and examination of the section from Point Adams to Cape Arago shows that the prevailing character of this part of the coast is sand.

Throughout this extent—a distance of 165 miles—132 miles is a sand beach, and only 33 miles of rocky cliffs where the ocean touches the shore.

The cliffs or rocky promontories result from the prolongation of the spurs from the coast mountains, or that ridge of high lands which stretch along the coast, at varied distances from the shore, separating the interior table-lands from the shores, except through the valleys which reach the sea-shore.

The whole country is densely wooded, whether high or low, the principal tree being a fir of heavy growth, occasionally found intermixed with pine, alders, and other trees.

From Cape Arago to the line of 42° , or for a distance of eighty-five miles southward, there are only about fifteen miles of sand beach—there being a very marked difference in the coast to the northward and southward of Cape Arago, the coast to the southward being higher or lower cliffs as the coast hills approach to or recede from the coast.

From latitude 42° to $42^{\circ} 30'$, the hills are at some points bald, or only timbered on one side of their peaks. In this region, where the coast range recedes from the shore, there are very pretty coast prairies, covered with a rich soil and grasses, presenting very tempting sites for habitation. There the Indians have taken advantage of these sunny spots, and their villages line the banks of the small streams which flow from the mountains.

Coast of California.—To the south of Cape St. George the shore line is principally composed of high, rocky cliffs, regular in character, with rolling and only partially timbered peaks until we reach Trinidad bay, where the whole country is again densely wooded. Here again we have a sand beach of near forty miles in extent.

From Mendocino to San Francisco, the coast rises higher in varied shapes of peaks or rolling hills, partially covered with oak and redwood timber. A rich growth of oak and a fertile soil characterize this portion of the coast.

Nearly every danger to navigation on this coast, 600 miles in extent, shows itself above water.

Very truly, your obedient servant,

WASHINGTON A. BARTLETT,

Lieutenant U. S. N., Assistant Coast Survey.

Professor A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 2 bis.

Letter of the Superintendent of the coast survey, applying for the detail of officers of the Corps of Topographical Engineers, with the reply of the Secretary of the Treasury, enclosing a copy of a letter from the Secretary of War.

1. Letter from A. D. Bache, Superintendent of coast survey, to Secretary of Treasury.
2. Letter from Secretary of Treasury to A. D. Bache, Superintendent of coast survey.
3. Letter from Secretary of War to Secretary of Treasury.
4. Letter from Colonel Abert to Secretary of War.

No. (1.)

HILL'S STATION, October 3, 1850.

SIR: Within the past three years, three officers of the Corps of Topographical Engineers have been relieved from service on the coast survey, without being replaced. I have been made aware, by personal communication with Colonel Abert, that the exigencies of his service did not permit the details which I desired, and have therefore foreborne to make applications which must be declined. The wants of the coast survey are, however, now so pressing, that I have no choice but to request that you will make application to the Secretary of War for the services of four officers of Topographical Engineers, including one to replace Captain Humphreys, who has recently been detached by order of the Secretary of War.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey..

Hon. THOMAS CORWIN,

Secretary of the Treasury.

No. (2.)

TREASURY DEPARTMENT,
October 25, 1850.

SIR: I transmit herewith a copy of a letter, dated the 24th instant, from the Secretary of War, with accompanying report from Colonel

Abert, chief of Topographical Engineers, on the subject of the application made to the War Department for detail of officers of the Topographical Corps, upon coast survey service. For the reasons stated, it will be seen that no officer can at this time be detailed for the survey.

Very respectfully, your obedient servant,

THOMAS CORWIN,
Secretary of the Treasury.

Professor A. D. BACHE,
Superintendent United States Coast Survey.

No. (3.)

WAR DEPARTMENT,
October 24, 1850.

SIR: I have the honor to enclose to you the report of Colonel Abert, chief of Topographical Engineers, upon your application of the 7th instant for four officers of said corps for the coast survey service.

I regret that, for the reasons assigned by Colonel Abert, it will be out of my power to comply with your request at this time; but so soon as it can conveniently with the duties of the corps be done, the application shall receive the prompt action of the department.

Very respectfully, your obedient servant,

G. M. CONRAD,
Secretary of War.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

No. (4.)

BUREAU OF TOPOGRAPHICAL ENGINEERS.

SIR: In reference to the application of the superintendent of the coast survey, through the Treasury Department, for the services of four officers of this corps, I have the honor to submit the following report:

The corps consists of—

- 1 colonel,
- 1 lieutenant colonel,
- 4 majors,
- 10 captains,
- 10 first lieutenants,
- 10 second lieutenants,
- 5 brevet second lieutenants, attached:

In all, 41 officers of all grades. The following detailed exhibition of their positions and duties is given that the honorable Secretary may fully understand the case:

1. The colonel, in charge of the bureau.
2. The lieutenant colonel, in charge of the survey of the lakes, with two lieutenants as assistants.

3. Major (Brevet Lieutenant Colonel) Long, in charge of the improvement of the western rivers and the building of certain marine hospitals.

4. Major Bache, with one assistant, in charge of all the harbor improvements on Delaware river and bay, with the construction of the light-house on Brandywine shoals, and with the erection of a beacon upon a shoal off Nantucket, Massachusetts.

5. Major (Brevet Lieutenant Colonel) J. D. Graham, in charge of the restoration of the maps of the northeastern boundary, with one lieutenant as assistant.

6. Major (Brevet Lieutenant Colonel) Turnbull, an assistant to the bureau, in special charge of certain light-house constructions and of the construction of certain marine hospitals.

7. Captain Canfield, in charge of the construction of the light-house on the Waquoit shoal, straits of Michilimackinac.

8. Captain (Brevet Colonel) G. W. Hughes, with one lieutenant as assistant, in charge of the survey and examinations in reference to the supply of water for the city of Washington.

10. Captain T. J. Cram, on the coast survey.

11. Captain (Brevet Lieutenant Colonel) McClellan, on the survey of the Mexican boundary, under the Department of the Interior, with two lieutenants. Brevet Major Emory, on the same duty, closing up survey from Pacific to Colorado.

12. Captain Stansbury and one lieutenant, now out on the survey of the Salt lake and vicinity.

13. Captain (Brevet Major) Linnard, superintending the construction of the light house on Carysfoot reef, Florida.

14. Captain (Brevet Colonel) J. E. Johnstone, with five lieutenants as assistants, engaged on the surveys and examinations in Texas, and between the Mississippi and the Rio Grande.

15. Captain Thomas J. Lee, an assistant to the bureau.

16. Captain A. A. Humphreys, just relieved from the coast survey, required, with two lieutenants as assistants, for surveys on the Mississippi.

17. Lieutenant Simpson and one assistant, at Santa Fe, on surveys and examinations in that vicinity.

18. First Lieutenant (Brevet Captain) Sitgreaves, reducing map from the Mississippi to the Pacific. This map was compiled at the bureau, under a resolution of the Senate, and is now being reduced under a resolution from the same authority.

19. First Lieutenant Woodruff, on the survey of an Indian boundary, under application from the Bureau of Indian Affairs.

20. First Lieutenant Palmer, on sick leave.

21. First Lieutenant Webster, in charge of works on west shore of Lake Michigan; also superintending the erection of a light-house at Chicago, and also at the mouth of the Calumet; also superintending the construction of a marine hospital at Chicago.

22. Two lieutenants, Derby and Williamson, on duty with the troops in California.

23. Two lieutenants, Franklin and Peck, on duty at the Military Academy.

From the foregoing expositions, the Hon. Secretary will perceive that, of the 41 officers of the corps, there are now two under the Department of State, five under the Department of the Interior, two at the Military

Academy, one on sick leave—making ten in all, and leaving but thirty-one for the surveys and other duties of the bureau; and from the exposition of these last duties, it will be seen that it is not possible, without serious injury to the public duties of the bureau, to withdraw one from these. In fact, it is not in my power to meet the demands of officers in command for the assistants they require—on which account, and on account of other duties, numbers of civil engineers have to be employed in the execution of surveys.

From these considerations, the Hon. Secretary will perceive that I am obliged to report against complying with the application of Professor Bache.

The most in my power to recommend is that the application be approved, on the condition that it should be complied with whenever the same can be done without injury to the duties of the bureau.

Respectfully, sir, your obedient servant,

J. J. ABERT,

Colonel Corps Topographical Engineers.

Hon. C. M. CONRAD,

Secretary of War.

APPENDIX No. 3.

Correspondence in relation to surveys of portions of San Francisco bay required by the Engineer department for the joint commission.

1st. Letter of the Secretary of the Treasury to the superintendent of the coast survey, enclosing copy of communication from the War Department, in relation to surveys required by joint commission of army and navy officers on western coast.

2d. Letter from the Secretary of War to the Secretary of the Treasury, enclosed in the foregoing.

3d. Extracts from the letter of the Chief Engineer, General Totten, to the Secretary of War, in relation to the same surveys.

4th. Reply of superintendent of coast survey to the Secretary of the Treasury, in relation to surveys, and requesting the detail of officers of engineers in making them.

No. (1.)

TREASURY DEPARTMENT, *October 14, 1850.*

SIR: I transmit herewith a copy of a communication from the War Department, dated the 12th instant, with enclosures, in reference to surveys needed by that department for defensive works "at certain indicated positions in California," and, in the absence of any funds at the disposal of that department applicable to the object, suggesting whether the surveys referred to do not probably fall within the scope of the operations of the coast survey, and hence may be executed at an early period by the parties engaged upon that work.

I have to request to be furnished with a report of your views on the subject. Be pleased to return the enclosures with your answer.

Very respectfully, your obedient servant,

THOMAS CORWIN,
Secretary of the Treasury.

Professor A. D. BACHE,
Superintendent U. S. Coast Survey, Washington, D. C.

No. (2.)

WAR DEPARTMENT, *Washington, October 12, 1850.*

SIR: The joint board of engineers and naval officers now engaged in the selection of sites for defensive works on the Pacific coast have applied to this department to have surveys made of certain positions indicated by them. There being, however, no funds at the disposal of the department applicable to this object, the Chief Engineer, in a communication herewith transmitted, representing the importance of the early completion of these surveys, suggests that they will probably fall within the scope of the operations of the coast survey, and may be executed at an early period by the aid of the parties engaged upon that work. Concurring in the views of the Chief Engineer, I have the honor to request that such aid as can be afforded through your department may be given to the accomplishment of these important surveys, in the manner indicated by the communication of the Chief Engineer and the accompanying papers, herewith transmitted.

Very respectfully, your obedient servant,

WM. A. GRAHAM,
Acting Secretary of War.

Honorable THOMAS CORWIN,
Secretary of the Treasury.

No. (3.)

ENGINEER DEPARTMENT, *Washington, October 11, 1850.*

SIR: Having been informed that the Topographical Bureau has no funds with which to execute the surveys on the coast of the Pacific called for by the joint board of engineers and naval officers, and being impressed with the necessity of completing these surveys, in order to a commencement, at the earliest day practicable, of defensive works on the important positions selected by the joint board, I have to suggest that application be made to the Secretary of the Treasury for aid in the matter, through the operations about to be undertaken, as I understand, on the same portion of that coast, under the Superintendent of the coast survey.

It is probable that the surveys called for by the joint board would, at any rate, fall within the early operations of the coast survey, as they embrace headlands and anchorages most important to be accurately known to navigators—being the two shores of the entrance to San Francisco

bay, the deep water of the mid portion of that great bay, and one side of the entrance to the straits of Carquines. Surveys in relation to sites of light houses, which are understood to be comprised within the objects of the coast-surveying parties, would be certain to embrace some, if not all, the grounds specified in the call of the joint board. It is possible, moreover, that, though some of these surveys may not form a part of the work designed by the superintendent to be the first taken in hand, he may nevertheless find it practicable to introduce them without injury, delay, or inconvenience to the general interests of the coast survey; and I feel assured, from a most obliging disposition often manifested, and from several instances in which prompt and very important aid has been rendered to the system of coast defence by the Superintendent of the coast survey, that the suggestion now made, if sanctioned by the Honorable Secretary of the Treasury, will be received with a sincere desire to contribute to the important end in view, (by no one better understood than by him,) and, if permitted by paramount obligations of his own system of surveys on the coast, will be carried out promptly, and in the best manner.

The extract from the report of the joint board transmitted herewith indicates four separate surveys—namely: 1st. A survey of the south shore of the entrance into San Francisco bay; 2d. A survey of the north shore of the same entrance; 3d. Soundings of this entrance, and of all the channels leading from the sea to San Francisco and San Pablo bays; and 4th. A survey of Mare island and of ground on the east side of Mare island straits. Two sketches, also, herewith, show the general limits of the above-mentioned surveys, as marked in red lines by the joint board.

As some of the particulars necessarily comprised in surveys made for the study of defensive works are peculiar, I may here add a few words thereon.

I have the honor to be, very respectfully, sir, your obedient servant,

JOS. G. TOTTEN,

Brevet Brigadier General, and Chief Engineer.

Honorable C. M. CONRAD,

Secretary of War, Washington, D. C.

No. (4.)

COAST SURVEY STATION,

Webb's Hill, October 22, 1850.

SIR: I have the honor to acknowledge the receipt of your letter of October 14, enclosing a communication from the War Department, in relation to surveys needed by that department for defensive works at certain indicated positions in California, suggesting that these surveys probably fall within the scope of the operations of the coast survey, and may be executed at an early period by its parties, and asking my views on the subject.

The surveys referred to are of two classes—general and minute; and the former falls altogether within the scope of the operations of the coast survey. The instructions already given to the parties on the western coast in regard to surveys for the sites for light-houses include a part of the work required by the Engineer Department; and the whole of the general

surveys may be made without interfering materially with the plan marked out for the survey of the coast. The time of its execution must depend upon the progress of the season, the period at which instructions reach the parties, and of their completion of work in regard to sites for light-houses, which is embraced in previous instructions. The parties are on the ground, however, and I do not anticipate any extraordinary delay.

With an earnest desire to render the operations of the coast survey as useful as possible to the government, and acknowledging my indebtedness to the Chief Engineer for the favorable opinion which he expresses of the coast survey, I would suggest to the Honorable Secretary of the Treasury that this opportunity of rendering service should not be lost.

I would respectfully recommend that authority be given to me to issue such instructions as will insure the execution of the general surveys required by the Engineer department, and referred to in the letter of the Honorable Secretary of War of October 12, at the earliest date practicable.

It would much expediate this work, and insure its completion at an earlier date, if one or more officers of the Corps of Engineers could be detailed for service on the coast survey during its execution, especially if one of those now on the western coast might be available for the purpose.

I therefore further request that application may be made to the honorable Secretary of War for such a detail, if the officers can be spared from more pressing duties.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Honorable THOMAS CORWIN,

Secretary of the Treasury.

APPENDIX No. 4.

Letter of the Secretary of War to the Secretary of the Treasury, declining the detail of officers of the Corps of Engineers for coast survey service, and enclosing a letter of the Chief Engineer, stating the reasons why the detail cannot be made.

DECEMBER 6, 1850.

Sir: In answer to your letter of the 22d of October, enclosing one from the superintendent of the coast survey, asking for a detail of officers of engineers to assist in that survey, I regret to say that it will be out of the power of the department to order it.

With this I enclose a copy of General Totten's report upon the application made by you for a detail from his corps, which will, I trust, satisfactorily explain why your request cannot be complied with.

With great respect, your obedient servant,

G. M. CONRAD,

Secretary of War.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

ENGINEER DEPARTMENT,
Washington, December 5, 1850.

SIR: I am much gratified to find, by the letter, under date of October 22, from the Superintendent of the coast survey to the Secretary of the Treasury, and the action thereon of the Honorable Secretary, (this day referred to this office,) that the surveys called for by the joint board of naval and engineer officers will receive the early attention of the parties of the coast survey now engaged, or about to be engaged, on the coast of California.

Greatly desirous of assisting in a work in which the system of defence is so much concerned, I regret being obliged to add, in relation to the request for a detail of officers of engineers to assist in these surveys, that the present occupations of the officers of the corps make it impracticable to comply with this request, there being a heavy and serious deficiency in the number of officers for the duties now resting upon them.

None of the officers engaged in the joint board can, with any propriety, be detached therefrom when they are about to enter on their general report; and the only other officer of engineers now on the Pacific shore (Captain Halleck) is under the orders of the commanding general there, and not within the call of the Engineer Department.

Very respectfully, your most obedient servant,

JOS. G. TOTTEN,
Brevet Brig. Gen., and Chief Engineer.

HON. C. M. CONRAD,
Secretary of War.

APPENDIX No. 5.

Letter of the Secretary of the Navy to the Secretary of the Treasury, relating to the detail of officers for the hydrographic party in section IX, coast of Texas.

NAVY DEPARTMENT,
November 2, 1850.

SIR: I have the honor to acknowledge the receipt of your letter of the 31st ultimo, with its enclosures.

The commandant of the navy-yard at Philadelphia has been directed to order a crew to be shipped for the surveying schooner Morris, to be selected by Lieutenant Commanding A. S. Baldwin, attached to the coast survey, and commanding that vessel.

Passed Midshipman James R. Spotts has been ordered to the Morris as her master; but, in the present condition of the service, two passed midshipmen junior to him cannot be detailed for that vessel to make up her complement. It is suggested that, as some of the surveying parties are about laying up their vessels for the winter, the complement of the Morris may be filled by a transfer of two passed midshipmen already attached to the coast survey.

I am, very respectfully, your obedient servant,

C. M. CONRAD,
Acting Secretary of the Navy.

HON. THOMAS CORWIN,
Secretary of the Treasury.

APPENDIX No. 6.

Extract from the report of W. C. Bond, esq., director of the Cambridge Observatory, to the superintendent of the coast survey, in relation to the difference of longitude between Cambridge and Liverpool Observatories:

CAMBRIDGE, October 28, 1850.

DEAR SIR: I have delivered to assistant Sears C. Walker copies of all the observations, comparisons, and computations resulting from my operations in ascertaining chronometrically the difference of longitude between Greenwich Observatory and this station, during the years 1849 and 1850.

I shall not occupy your time in recapitulating in this place the details of the work, as you have them at your command. It may be sufficient to say that the final mean result derived from one hundred and seventy-five chronometers, after the application of certain probable errors and weights, is found to be 4h. 44m. 30.1s. This may safely be considered as not one second in error. But on the comparison of a considerable number of outward and homeward passages, I find that eastern passages give a greater difference of longitude than western, and this, too, uniformly to be the result of accidental errors of the chronometers.

For the purpose of investigating this discrepancy, I selected one hundred and nineteen cases, such as required no extraordinary weights to be applied in the reduction, and obtained the following:

17. L. to Camb. 4h. 44m. 39.90s.	17. C. to L. 30.61s. max.	30.25s.
38. L. to Camb. 29.74	17. C. to L. 30.31	29.92
25. L. to Camb. 27.48	25. C. to L. 33.32	30.40
39. L. to Camb. 27.83	39. C. to L. 33.98	30.90
Mean acc'g to weights 28.75	32.59	30.48

The personal equations of Mr. Harcup and myself, we have satisfactorily proved, do not amount to one-tenth of a second. I am, therefore, extremely anxious to pursue, and have no doubt that the source of this difference may be ascertained. In order, however, to accomplish this object, we must admit none but the best chronometers on trial, and let them be accompanied by some one who is familiar with their construction and tendencies.

With sincere respect and regard, I remain, dear sir, yours, truly,
W. C. BOND.

Professor A. D. BACHE.

APPENDIX No. 7.

Recommendation in relation to buoys of Lieutenant Commanding Charles H. McBlair, United States navy, assistant in the coast survey, in a report to the superintendent.

U. S. SURVEYING STEAMER BIRD,
Salem, October 23, 1850.

SIR: I would respectfully suggest that two buoys be placed on Billingsgate shoal—one on the southwestern extremity, and the other about half

the distance between that point and the island. They will serve as valuable guides to vessels bound to the anchorage under the lee of the shoal.

Though not lying within the field of work occupied by the party, it is perhaps proper for me also to recommend that a buoy be placed on the extremity of a shoal or spit reaching from Fox's point, Nashawena island. This sand spit lies immediately at the southern extremity of Quicks's Hole, one of the great highways leading into Buzzard's bay, through which large numbers of vessels are constantly passing. It takes its name from a vessel that was stranded upon it—a circumstance in itself suggestive of the necessity of guarding others against a similar casualty.

I am, respectfully,

C. H. McBLAIR,
Assistant Coast Survey.

Professor A. D. BACHE,
Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 8.

Extracts from the report of Professor A. G. Pendleton, United States navy, assistant in the coast survey, to the Superintendent, in regard to the encroachment of the sea on the land on the south side of Long island.

WASHINGTON, D. C., August 2, 1850.

Sir: * * * I was afterwards directed by Lieutenant Commanding Woodhull to act in conjunction with Lieutenant Preble, as an observer on the vessels from the stations on shore; and, as I boarded with the farmers residing in the immediate vicinity of the beach, I had opportunities of conversing with them about the changes to which the shore was liable, and had undergone during their own recollections and those of their fathers.

Some of them informed me that the beach and sand hills encroached with the ocean upon the land, as was evidenced to them by the diminution of their meadows and arable land, by their being covered with sand, and the discovery, at times, of the tracks of wagons in a peat formation on the ocean side of the sand hills, which could only be accounted for upon the supposition that they were the traces of old roads that were once in the meadows on the north side of the hills. In a place somewhere between Fire island and Ketchikannek, I was told that a considerable number of cedars were left by the movement of the sands on the ocean side of the hills, after having been buried for some unknown length of time. These cedars must have grown in the meadows, being covered and finally uncovered again, by the continuation of the same causes, when the meadows became exposed to the action of the surf. The surface of the peat is broken up into small fragments, and may frequently be seen on various parts of the shore, where it is left by the tide, after nearly all the earthy parts are dissolved out of it, leaving the tangled network of roots, &c., as the only remains of the meadows that can be found.

But, while the above seems to be the progress of the water upon the land during a long interval of time, there seem also to be smaller changes

effected in the beach, by the various winds and currents of a more temporary nature, but which frequently causes the water-line to advance or recede, as the case may be, a distance of from 200 to 300 feet in the course of two or three weeks of stormy weather.

From the above facts and suppositions I would expect, in the general, deeper water in the same places at present than formerly; but about the same depth at the same distance from the beach, as the sea acting on the sand would probably carve out for itself the same form of bed in all its course of encroachment on the land.

I am, very respectfully, your obedient servant,

A. G. PENDLETON,
Professor Mathematics, U. S. N.

Professor BACHE,
Superintendent U. S. Coast Survey.

APPENDIX No. 9.

Report of H. L. Whiting, esq., assistant United States coast survey, to the Superintendent, on the progress of Sandy Hook, from 1848 to 1850.

WASHINGTON, D. C., March 25, 1850.

DEAR SIR: I transmit herewith a report of my survey of Sandy Hook, together with such information as I was able to obtain concerning the action and effect of tides, winds, and breakers, during heavy storms, &c., upon the beach and shoals.

Some are of opinion that the principal cause of the changes at Sandy Hook is from the wind. I think, however, it has very little influence as a first cause in effecting these changes. The sand seems first to be thrown up by the heavy seas, during storms, &c. After it becomes dry, it will always continue to be carried away by the winds, to nearly the level of high water, or until the surface exposed is sufficiently damp to prevent its rising with the wind.

I believe the construction of wind hedges or fences, to break the force of the wind, on exposed places, has often been successful in preserving sand and loose soil. Mr. Lewis, of Lynn, has effectually preserved, in this manner, the long beach to Nahant, which has now become so high that the sea never breaks over it.

At Sandy Hook, wherever there are obstructions to the wind, among the cedars, &c., sand hills are formed and the beach is preserved. If hedges were set in other places and parts of the Hook, in reference to the prevailing winds, I believe that almost any action could be caused, and the beach either formed or carried away, as was desired. The sea and tide, however, are by far the most powerful agents, and I think will defy all artificial constructions. Any storm at sea causes the swell to roll in from the southeast, and the sea breaks upon the shore obliquely from this direction. The flood tide setting from south to north carries the sand, which is thrown up and mixed with the surf, from the plain where it may have been formerly deposited, and thus causes a constant shifting of the outside of the beach from as far south as the Ocean House to the point of the Hook. This same action of the sea, breaking obliquely upon the

shore, with a tide running nearly in the same direction, is observable on the extremity of Cape Cod. The sea seems to wash away the beach in particular places, forming a cove in the shore, with a deposite of sand to leeward, or below the cove; both of these formations will gradually work in the direction of the tide until they disappear at the point of the cape. This is very obvious at Sandy Hook; the Shrewsbury inlet usually breaks through within half a mile of the Ocean House, and works to the northward until it reaches the wider part of the Hook, caused by the cedars, &c., where it closes, as in the case of last winter. The ship *North America* (the wreck of which is now nearly due east from the Highland lights) went ashore, some eight or ten years ago, in the middle of the inlet, as it then was; it is now at least a mile to the south of where the inlet last closed. It is probable, in a few years, or in case of any heavy storm, that a new inlet will break through the beach within a mile, or thereabout, of the Ocean House.

I am of opinion, however, that this could be prevented, if desired, by the wind hedges to which I have alluded. The inlet is finally opened more by the ebb tide out of Shrewsbury river, after a storm has made a break through the beach, than by the action of the sea from the outside.

There is also now forming, some 100 yards off the shore, a shoal or ridge of sand, extending for a mile and more, off the narrowest part of the beach; this is nearly parallel with the shore, and in some places dry at low water. From what I can learn from persons residing near the shore, who have observed the action and effect of storms, I think this shoal may eventually be thrown higher and nearer the shore, until it becomes part of the beach itself, in which case no inlet will be likely to break through the beach for many years.

I remain, sir, very respectfully, yours,

HENRY L. WHITING.

Professor A. D. BACHE,

Superintendent United States Coast Survey,

Washington, D. C.

APPENDIX No. 10.

Extracts from the report of Lieutenant Commanding Woodhull, U. S. Navy, in relation to Prince's and Diamond reefs, New York harbor.

WASHINGTON, January 18, 1850.

SIR: On receipt of your instructions I proceeded to New York, which place I reached on the 5th, and commenced making my arrangements immediately. The collector of the port extended every facility to me in his power, and the only obstacle I encountered in the speedy performance of the work was the incessant bad weather. Notwithstanding, I succeeded in the examination and soundings, agreeable to your orders.

I commenced with Prince's or Middle reef, (the name it is commonly known by,) and sounded till I found the shoalest point, upon which I placed a spar buoy. I then placed small buoys on the four extremities of it. By these means I was enabled to obtain a pretty fair knowledge of its extent and form. I find, on running my lines and soundings with great

care, two summits, on one of which was $10\frac{1}{2}$ and on the other $9\frac{1}{2}$ feet of water at extreme low water. This reef is about 140 feet long, and averages about 50 feet in width, and projects above the surface of the river bottom some 12 or 15 feet, not including the two summits above mentioned, which jut up from the body of the reef some 5 or 6 feet. I measured the distance of the reef from the nearest pier, and found it to be 360 feet.

While surveying, the ship *New London* ran on the Diamond reef and received some damage. Although you did not direct its examination, I thought it proper, under the circumstances, to include it in my present work, and accordingly sounded every part of it and accurately determined its shoalest point, which I have marked by a spar buoy, which I recommended should be kept as I have placed it, until the rock is removed.

I addressed a letter to Mr. Maxwell on the subject, recommending his keeping the buoys as I had placed them, which suggestion he promised to comply with. This reef is situated about midway between the north dock, Governor's island, and the South ferry, foot of Whitehall street. The current on the ebb tide sets directly on it, which has been the cause of many accidents. It is of irregular shape, about 80 feet long and 30 or 40 wide, and has an average projection above the river bottom of 8 to 13 feet. I sounded it out carefully; its shoalest part has at extreme low water about 16 feet upon it.

This, as also the Prince's reef, is immediately in the way of all vessels bound in or out of the East river, and should be removed.

Yours, respectfully,

MAXWELL WOODHULL,

Lieut. Com'r U. S. Navy, Assist. U. S. Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 11.

Memorial of the Chamber of Commerce of New York to the Senate and Representatives of the United States.

The memorial of the Chamber of Commerce of New York respectfully represents: That the natural advantages and favorable position of New York necessarily constitute this port the great mart of commerce as well as the common centre for the trade of the nation. The vast increase in this trade, and the constant increase in the number of vessels, both great and small, that require the use of the waters of the harbor, would seem to present a strong claim to the favorable consideration of Congress for the requisite appropriation to remove those obstructions that interfere with the convenience and security of that extended navigation in which all classes and all interests are directly or indirectly concerned.

The outlet to the ocean by way of the East river and the passages of Hell Gate is probably required and used by as great a number of vessels of all descriptions, though mostly at present of moderate size, as that of almost any other in the world; yet do the dangers of that passage remain a standing reproach to the enterprise and improvements of the age. A moderate expenditure would remove the difficulty by blowing up the rocks

that obstruct the channel, and thus make that hitherto dangerous strait not only safe for the myriads of schooners, sloops and steamers that are now daily compelled, when waiting for the tide, to encounter the delay and risk occasioned by the entrance to the channel, but that entrance might be made entirely secure for merchant ships of any draught, as well as for ships of war of the largest class.

The opening of that channel would also afford to our public marine the important advantage to be derived from the harbor at Throg's Point, capable of containing in safety the largest fleet, in a position to be enabled to take advantage of an outlet to the ocean either by way of Sandy Hook or of Long Island sound.

The rocks in the harbor that require removal consist of those at and near Hell Gate and those off the Battery, with Diamond reef and Prince's reef; most, if not all of which, as the Chamber is advised, have been surveyed by the coast survey, whose scientific labors have been productive of so much benefit to the commercial interests of the country.

In order to show more plainly the dangers to which our navigation is exposed by these obstructions, the Chamber respectfully craves the reference of your honorable body to the annexed chart, on which is laid down the exact position of the two reefs alluded to, by which it will be seen that the distance in a straight line from Diamond to Prince's reef is only 1,600 feet, and the passage between them is the ordinary channel through which all ships now pass when going in or out of the East river, the principal basin of our harbor. The Chamber would also beg leave to report, that the services of a steam cutter, of approved model and great power and speed, are often required, particularly during the winter, to give aid and succor to vessels off our coast, and occasionally to render them assistance when ashore near the entrance of our harbor.

An appropriation is accordingly earnestly and respectfully solicited, sufficient for the accomplishment of these objects, so absolutely necessary for the security of our marine, and so essential to the prosecution of our increasing commerce, the success of which is indissolubly connected with the general prosperity of the country.

JAMES D. P. OGDEN,
GEORGE W. BLUNT,
SIMEON BALDWIN,
Committee.

APPENDIX No. 12.

Letter of Isaac Newton, esq., President of the People's Line of steamboats on the Hudson river, to the Superintendent of the Coast Survey.

NEW YORK, October 14, 1850.

SIR: The owners of steamers and tow-boats navigating the North river are extremely anxious that your surveys of that river should be commenced at as early a period as possible.

Having understood that you propose to detail Mr. Edmund Blunt for that duty, which would be extremely acceptable to all concerned in the navigation of the river, I would offer the free use of the steamers com-

posing the "People's Line" to Mr. Blant and his party during the time required for the survey.

Respectfully yours, &c.,

I. NEWTON.

Professor BACHE,
Superintendent Coast Survey.

APPENDIX No. 13.

Extract from the report of S. C. Walker, esq., assistant United States coast survey, to the Superintendent, on the telegraphic operations and the computations in his charge.

I.—EXPERIMENTS FOR GALVANIC WAVE TIME BETWEEN WASHINGTON AND ST. LOUIS.

Standing orders were left in January, February, March and April to work with the aid of the several telegraph companies, by junction at their respective termini, through as long circuits as possible by the chemical and mechanical methods.

Although the Seaton station was in readiness during this period, yet there were only three nights in which the instrumental and meteorological circumstances and the personal arrangements admitted of experiments on extensive lines. Among these the work of the 4th of February holds a prominent place, from the favorable concurrence of all these particulars.

Owing to the kindness of Mr. D. Brooks, the chief operator on the Pittsburg and Louisville, and of Mr. Stager, of Cincinnati, and of Mr. E. Calton, on the Washington and Pittsburg line, we were able on that night to effect a junction directly between Seaton station and St. Louis, through a distance of 1,045 miles of iron wire, and of 742 miles of ground, between these termini. The temperature was at 0° Fahrenheit from Pittsburg to St. Louis, and at 5° at Washington. The sky was clear, and the wind northeast. The snow, on the average more than twelve inches deep, afforded so perfect an insulation, that Washington, Pittsburg, Cincinnati, Louisville, and St. Louis, could each during the same second receive the writing of all without change of adjustment. The presence of Mr. R. Kuhn of the Bavarian engineers, of Dr. B. A. Gould, of Professors Hubbard and Coffin, added interest to the experiment. The operations were divided into stages of ten minutes each, during which the Saxton clock at the Seaton station graduated the time scales on the Morse registering fillets at all the stations, and arbitrary dots or signals were given at one station and received at all the others. Thus Pittsburg, Cincinnati, Louisville and St. Louis were alternately made the stations for these ten-minute terms of arbitrary signals, which were printed on all the registers every three seconds. In one ten-minute term between Washington and Pittsburg, the Seaton battery, of fifty Grove's pint cups, was between the stations on the short junction of 300 miles through the ground. In the other term the battery was on the long junction, or zinc pole, through the ground to St. Louis. It can hardly be expected that the coast survey will be

able, for some time to come, to meet with another combination of circumstances so favorable as this.

II.—ATTEMPTED EXPERIMENTS ON WAVE TIME THROUGH DIFFERENT CONDUCTORS.

An arrangement was made with Major B. B. French, president of the Morse line to New York, to use the four wires of that line for an experiment on galvanic wave time, in which two registers, placed side by side, should in reality be separated by a circuit of iron wire 700 miles long on each pole. During the period from January to June no single occasion presented itself in which all four lines were in good working condition, so that our hopes in this respect were not realized.

III.—EXPERIMENTS WITH THE CHEMICAL TELEGRAPH LINE.

An arrangement has also been made with Henry J. Rogers, esq., superintendent of the Bain Chemical line, (the North American Telegraph Company,) to work by the chemical method, but without success, owing to difficulties of insulation over the Hudson river; accordingly, we did not succeed in our experiment with chemical imprints till the 5th of July, when, by the courtesy of Marshall Lefferts, esq., president of the Merchants' line of chemical telegraphs, the experiment was made between Boston and New York, on a circuit of 225 miles of wire and 187 miles of ground. We were frustrated in our efforts to work from New York to Buffalo, by the impossibility, in the actual state of the art, of making the double record by the chemical process at the two termini. The battery of 60 Grove's cups, required to work a chemical line of a thousand miles circuit, causes a burning of the paper at the battery station, where the short duplicate circuit is used and the writing is made.

An ingenious experiment has recently been performed by Mr. Bain, which obviates the difficulty just mentioned. This consists in dipping the two poles of the short circuit into a plate of water, and gradually bringing them nearer to each other till the resistance on the short and long circuit, both of which pass through the battery, is the same. The discoloration of the paper by the galvanic current from the present or from the remote battery is then the same. It is proper also, in this connexion, to invite your attention to an ingenious contrivance of Mr. Westbrook, chief operator on the North American Telegraph Company's line, by which the residual current, not destroyed by the remote electrotonic from imperfect intervening insulations, is carried onward through a branch circuit, without affecting the chemical registering disk, a slight waning of the galvanic current, causing a perfect electrotonic at the receiving station, and forcing the current into the short branch or multiple circuit, so as not to interfere with a still remoter receiving station. The two contrivances of Messrs. Bain and Westbrook—the one for tapping the circuit at the writing station, the other for diverting it through a supernumerary circuit at the receiving station—give to the chemical method the same universality of application as that of the mechanical method. The chemical lines of any length may now write at any one station and receive at all the others; moreover, the batteries may now be equalized along the line, instead of expending their whole force at the writing terminus. It is also proper to

mention an important invention of Mr. Westbrook, of the electro-metallic mode of recording, which surpasses all others in distinctness and legibility.

As the obstacles in the way of the telegraph operations for longitude by the chemical method are now removed by the ingenuity of Messrs. Bain and Westbrook, and as the lines, mechanical and chemical, in all directions from Washington, have been generously placed at the disposal of the coast survey without charge, after commercial business hours, the prospect of success in our very remote telegraph connexions is much increased.

IV.—PROGRESS OF THE RESEARCHES ON THE VELOCITY OF THE GALVANIC CURRENT.

The physical researches on the velocity of the galvanic current, made in 1849 and 1850, have been concluded for the present.

All the experiments of the coast survey, on this subject, concur in showing a velocity of the propagation of the galvanic waves of about 15,400 miles per second in the iron wires of the American telegraph lines. These experiments have been made on lines extending from Seaton station north to Cambridge, Massachusetts, on a circuit of 1,021 miles; west to St. Louis on a circuit of 1,787 miles; and south to Charleston, South Carolina, on a circuit of 1,157 miles. They have been made in all varieties of temperature, and in all degrees of excellence of insulation of the lines. They have been made with the chemical and mechanical registers. The results of the electrotonic comparisons on the Morse registers, and of both kinds on the chemical registers, are so uniform in their indications of this velocity, and the number of single comparisons made and measured is so numerous (exceeding ten thousand single results,) that it will require a strong accumulation of counter evidence, of which none has yet appeared, to impair confidence in the general character of our conclusions.

The entire experience of the coast survey up to this time cannot be reconciled with a velocity of galvanic waves in the ground greater than *two-thirds* of the velocity in the iron wires. Perhaps the proportion is even smaller. The subject is reserved for future investigation, in which the proportion of ground and wire circuit shall be changed at pleasure on the same evening.

The work of February 4, 1850, between Washington and St. Louis, indicates that no change in the wave time between two stations is produced by the presence or absence of a powerful battery of 50 Grove's cups on the iron wire between them, in the shortest junction route.

In our experiments of February 4, 1850, a phenomenon was noticed, indicating an apparent crossing of the waves on the two poles of the telegraph circuit. The clock at Seaton station was on the platinum pole, and graduated the registers at all the stations with dots or pauses of the galvanic current, of one-tenth of a second in length. The other nine-tenths of the second were, as usual, exhibited on the scale as a line of continuous action of the current.

Now, when the operation at a station distant some 800 miles made arbitrary signals in the following order, viz: dot, line, dot, all of the length of one-tenth of a second, and so timed that the line corresponded in absolute date to that of the Seaton clock pause, this apparent crossing took place. Thus: let us call A, B, and C the operator's successive dot,

line, and pause; and A', the Seaton clock pause: then the Seaton station Morse register exhibits these four signals in the order A and A' coincident; and forming a single pause, followed by B and C. The signal station register (Louisville, for instance) exhibits first A and B, then C and A' coincident, and forming a single pause. This phenomenon was exhibited in more than 100 instances, in the case of the Louisville and St. Louis signals, on the 4th of February, 1850. In other cases, where the middle line at the western stations did not correspond to the absolute date of the Seaton clock pause, since the mechanical register could not imprint both pause and signal at the same time, it appears to have followed the laws of mechanics and to have obeyed the influence of the resultant of the forces, caused by the simultaneous influence of the line or current on the zinc pole, and the pause on the platinum pole, combined with the acquired armature momentum. This interference of the waves sometimes registered a line on the scale for the western signal, when the eastern would have given a pause. Sometimes the two effects neutralized each other, and the armature remained for a fifth part of a second motionless, exhibiting on the register either a continuous line or pause. This circumstance of the apparent crossing of the waves, and of their apparent interference, as indicated on the registers, affords ground for interesting physical researches on the interference of the galvanic waves which go out to meet each other on the two poles of the telegraphic circuits.

The subject has already been alluded to in your brief communication to the Charleston meeting of the American Association. Some discussion has arisen, at the August meeting in New Haven, whether the analogy of the crossing and interference of waves of sound, light, heat, &c., applies to the galvanic waves in consequence of the existence of a re-entering circuit, while the other waves are propagated in a right line through space. But may we not conceive that for a short portion of the telegraphic circuit the action of the galvanic medium, whatever it may be, is similar to that of the medium of light and heat, and to that of the air, as the known medium of sound?

The progress of invention in regard to the mechanical registers, in the last year, has been very remarkable. The defect of all the registers in use heretofore, has been the uncertainty of the time of a revolution of the registering apparatus, whether by cylinder, disk, or drawing rollers. Although the approximate portions of the graduated scale were very nearly equal; yet the accumulation even of the small discrepancies became manifest in the course of a few minutes. Professor O. M. Mitchel's revolving disk, with the Munich centrifugal fly, revolving in a conical box for its governor, had, in 1849, approached nearer to perfection than any of the registering machines on which our experiments had been made.

Mr. Saxton's fly, enclosed in a vessel of quicksilver, gave a very good performance in graduating the recording sheet, rolled round the revolving cylinder.

All these methods, however, were liable to the objection which I have mentioned, that they did not guard against the cumulative error.

It was obvious that the pendulum alone afforded an effectual safeguard against this cumulation error; but the difficult point was to derive from it a uniform rotary or rectilinear motion.

This difficulty has been in a great degree obviated by a machine called the spring governor, which is the joint invention of Mr. Wm. Cranch

Bond and his sons, Messrs. George P. and Richard Bond. It consists in the application of a spring, like the mainspring of a watch, (having, however, only one coil,) which takes motion from the primary train moved by a pendulum, and communicates it to a secondary train, controlled by a centrifugal fly. A cylinder on a delicate axis on friction rollers is made to rotate by this secondary train. The pen which graduates the sheet rolled round the cylinder, is moved by an independent train and weight. The cylinder, controlled in the single seconds by the centrifugal fly, and in the long periods by the pendulum, performs its revolutions with all the accuracy of a clock in its measurement of time. The cylinder revolves once in a minute, so that the enveloping sheet has sixty seconds on a line. It has sixty lines on a sheet. By stamping the 0's, 5's, and 10's of seconds on the top, and of minutes on the left margin, the eye seizes instantly the correct reading of the minute and second. The fraction to the tenth of a second may be estimated by the eye, or it may be read off to the hundredth of a second by a glass or horn scale, graduated to suit the intervals. In a perfect register the scale of seconds should be straight and vertical from the top to the bottom of the sheet. In the sheet now before me the maximum deviations of this line from a straight vertical line are not more than one-tenth of a second, and the discrepancies of any single second's length from that of the average scale quite insensible. The Messrs. Bond deserve the highest commendation for this useful invention, which seems to have removed the only obstacle in the way of the practice of registering and of reading off the dates of observations from the printed scales.

APPENDIX No. 14.

Abstract of the report of Lieutenant Commanding Lee, U. S. N., assistant in the coast survey, to the Superintendent, on lights, buoys, &c., in the Chesapeake, from the Potomac river to the head of the bay.

The following recommendations in regard to lights and buoys are made by Lieutenant Commanding S. P. Lee, U. S. N., assistant in the coast survey, in the hydrographic notes relating to Chesapeake bay, between the mouth of the Potomac and the head of the bay. The reasons for the recommendations are given briefly from the notes.

1.—Lights; *a*, light-houses; *b*, light-boats.

The color for the buoys, which is given, is determined by the rule that in passing up the bay, buoys on the right or starboard hand are painted red, those on the left or port hand are black, and the same for the rivers.

Light houses—*a*.—1. A harbor light on the flat at Drum point, mouth of the Patuxent river.

"The mouth of the Patuxent is one of the most frequented harbors of the bay, and the proposed light would not only be a safe guide for bay-craft, but for sea-going vessels, with or without pilots."

Light-boats—*b*.—1. A light-boat to mark the west side of "the seven feet knoll" on the east side of the narrow Swash channel by the Bodkin

(mouth of the Patapsco river.) This channel is the nearest and most convenient to and from Baltimore for light-draught vessels bound south of the Patapsco. The soundings are such that at night the lead is not efficient as a guide; and in thick weather, the wind blowing from the northeast, the buoy which marks the "knoll" not being visible, vessels caught off the Bodkin must lay to until daylight, often losing their deck loads.

11. Buoys.—1. Spar-buoy (painted black) to mark the northern and eastern end of the shoal making out from Smith's Point light.

"This shoal cannot be approached by the lead, as the soundings rapidly change from 42 to 13 feet, and from 34 to 11 feet."

2. Spar-buoy (painted black) to the northward and eastward of Hull's neck to mark the sudden change in the depth from 36 to 18 feet which occurs here.

3. Spar-buoy (painted red) to mark the western edge of Sheep's Head shoal, Point Lookout harbor.

On Sheep's Head shoal, W. $\frac{1}{4}$ N., $\frac{1}{2}$ of a mile from Point Lookout light-house, there are 9 feet of water at ordinary low water. In high northwest winds there are but 6 or 7 feet. The steamboat Columbia struck and was injured upon this shoal.

4. Spar-buoy (painted red) to mark the southern point of the spit making out south from Point Lookout light.

This spit makes out nearly a mile to the south of the light-house, where there are 17 feet of water.

5. A spar-buoy (painted black) to mark the eastern edge of the shoal making into the bay to the northward and eastward of Point Lookout light-house.

6. A spar-buoy (painted black) to mark Sheep's Head rock off Point-no-Point, bearing E. by N. $\frac{1}{2}$ N. from the dwelling-house on the point, $1\frac{1}{2}$ mile distant.

There are 20 feet water on the rock, 27 feet around it, and a shoal adjacent making from the shore.

7. A spar-buoy (painted black) to mark the bar off Little Coyo point. This bar makes out nearly a mile from the shore, where there are 16 feet water, Cove Point light bearing N. by W. $\frac{1}{4}$ W., distant 2 miles.

8. Spar-buoy (painted black) to mark the northern edge of the shoal from Hog island, mouth of the Patuxent river. This shoal makes out from the shore about $\frac{1}{2}$ mile to the northward, where the depth changes suddenly from 12 feet on the shoal to 42 feet in the channel.

9, 10. Spar-buoys (painted red) to mark the SE. and E. edge of the shoal, from Sandy point, Patuxent river.

This shoal extends $\frac{1}{2}$ mile SSE. $\frac{1}{2}$ E. from Sandy point, where the depth changes suddenly from 8 feet on the shoal to 32 feet in the channel. From the house on Sandy point the shoal makes out half way to Drum point, where there are four feet of water.

11. A spar-buoy (painted black) to mark the eastern edge of Hawk's Nest shoal, Patuxent river. This shoal or flat makes out from the north point of Cuckold's creek, nearly half way across the river, where the depth changes suddenly from 7 feet on the shoal to 36 feet in the channel.

12. Spar-buoy (painted red) to mark the shoal or flat from Helen's creek, Patuxent river. This flat extends more than a third of the dis-

tance across the river in a southwest direction, where the depth changes suddenly from three feet on the shoal to 42 feet in the channel.

13, 14. A buoy (painted red) to mark the western, and one (painted red) to mark the southwest edge of the shoal west of Kedge's strait.

This dangerous shoal extends about half-way across the bay. The soundings change abruptly on the western edge in one place, from 10½ fathoms in the channel to 18 feet at ordinary low water, where ships have grounded in fresh NW. winds.

15, 16, 17. Three or more spar-buoys (painted red) to mark the western edge of the shoal or flat extending westward from Hooper's and Barren islands.

The western edge of the flat SW. from Richland point, and west of Hooper's and Barren islands and Meebin's neck, is generally abrupt; west of Barren island the soundings change suddenly from 27 fathoms to 15 feet.

18. Spar-buoy (painted black) to mark the extremity of the flat of the south end of Hooper's island, in the direction of the light-boat in Hooper's strait. The depth changes abruptly at the extremity of the flat in this direction.

19. Spar buoy (painted black) to mark the eastern edge of the shoal off Holland's point. This shoal makes off NE. about 1½ mile, and E. 1½ mile. Here it is abrupt, the depth changing from 11 and 14 to 25 and 28 feet in the channel.

20, 21. Spar-buoys (painted black) to mark the northeastern and southeastern points of the shoal from the "Sisters." On the northeastern edge of the shoal, which makes out from the "Sisters," the depth changes suddenly from 9 and 14 to 36 feet in the channel.

22. A spar-buoy (painted black) to mark the extremity of the shoal from Thomas's point light-house.

On this shoal, E. by S. $\frac{1}{2}$ S, 1½ mile distant from Thomas's point light, the depth changes suddenly from 8 to 42 feet in the channel.

23, 24. A spar-buoy, (painted red,) entrance of South river, to mark the end of the spit which makes off to the southward and westward from Marshy point, mouth of South river. Another buoy, (painted black,) to mark the edge of the flat making off the opposite side of the river.

25, 26, 27. Entrance of West river a spar-buoy, (painted red,) to mark the eastern side of the flat making off from Dutchman's point, and one (painted black) to mark the western edge of the shoal on the opposite side of the channel.

A spar-buoy (painted black) to mark the point of the flat off Saunders' point.

28. A spar-buoy (painted red) on the western edge of the flat making off from the eastern shore, near Tilghman's point. On this flat, W. by S., 2½ miles distant from the windmill, which is 1½ mile north of Tilghman's point, the depth changes suddenly from 15 feet to 30 feet.

29. Spar-buoy (painted red) to mark the shoal west of Poplar island. On this shoal the depth changes suddenly from nine feet to ten fathoms in the channel.

30. Spar-buoy (painted red) on the southwestern edge of the flat off Kent island.

This flat makes off nearly a mile west and southwest from Kent Island

station, where it is abrupt; the depth changing suddenly from six feet on the flat to 54 feet in the channel:

31. Entrance to Eastern bay, spar-buoy (painted red) on the western point of the shoal off the northern point of Poplar island. This shoal extends into Eastern bay, $1\frac{1}{2}$ mile NE. by N. from the point of Poplar island, with 12 feet water on its edge.

32. Spar buoy (painted black) on the southeastern edge of the shoal from Kent island. This shoal extends nearly a mile SSE. from Kent island, where the depth changes suddenly from 17 feet to 54 feet in the channel.

APPENDIX No. 15.

Report of the Superintendent of the Coast Survey to the Secretary of the Treasury on Hatteras shoals, with a report of Lieutenant Commanding Jenkins, United States navy.

COAST SURVEY STATION, November 5, 1850.

SIR: I have the honor to communicate the following extract from the report of Lieutenant Commanding Jenkins, United States navy, assistant in the coast survey, on the Hatteras shoals, in the hydrography of which he has been engaged during the past season, and would respectfully request authority to publish the same.

A preliminary chart of the shoal is in progress at the office, and will be speedily engraved and distributed.

"The survey of the shoals in the vicinity of Cape Hatteras, which has just been completed by the hydrographic party under my command, has developed a dangerous shoal of limited extent, having on it a depth of only nine feet at mean low water.

"This dangerous spot forms the southern and eastern limit to 'Hatteras outer shoals,' the light house bearing from it north 37° west, (true,) distant about $9\frac{1}{2}$ statute or $8\frac{1}{2}$ nautical miles.

"Within the distance of one third of a mile to northeast, and around to southeast, from the shoalest spot, there are 13 and 14 fathoms water, and within the distance of three-fourths of a mile from southeast to southwest there are seven and eight fathoms water. Outside of these depths, at the distance of one and a half to two miles, from north around by east to south, there is less water (9, 10, 11, and 12 fathoms) than there is at the distance of one-third of a mile from the shoal. To the southward and westward of the shoal the soundings are more regular, and change gradually to seven fathoms at the distance of about half a mile from it.

"In approaching Hatteras shoals from the northward and eastward, vessels should not be run into less than 15 fathoms water; and in approaching them from the southward and westward, they should not be run into less than 11 or 12 fathoms water. The lead will not serve as a safe guide to the mariner at night, or in bad weather, in approaching these shoals nearer than as above specified."

Very respectfully, yours,

A. D. BACHE,

Superintendent U. S. Coast Survey.

HON. THOMAS CORWIN,
Secretary of the Treasury.

APPENDIX No. 15 bis.

Report of Lieutenant Commanding Thornton A. Jenkins to Professor A. D. Bache, recommending a bell-beacon and buoy to be placed on Hatteras shoals.

UNITED STATES COAST SURVEY STEAMER JEFFERSON,
Philadelphia, November 11, 1850.

SIR: I deem it my duty to call the attention of the proper authorities, through you, to the great importance of having a proper mark placed on or near the nine-foot shoal which has been developed by the recent survey, by the hydrographic party under my command, of the shoals in the immediate vicinity of Cape Hatteras. Navigators who, from any cause, find themselves near these shoals in bad weather, especially at night, have no guide by which to extricate themselves from their perilous situation.

The present aids to navigation in this vicinity are not commensurate to its wants; and I take leave to recommend that they may be increased, at least to the extent of having a suitable and effective mark placed on the most dangerous point of these shoals.

Having well considered this subject, and weighed in my own mind the various and numerous difficulties to be overcome in the accomplishment of an object of so much importance to the interests of navigation, I have arrived at the conclusion that a floating bell-beacon, properly placed and safely moored, will prove to be the most effective if not the only practicable means by which the mariner can be warned of his approach to danger, and be guided clear of it.

The proposed bell-beacon would resemble a large boat, sharp at either end, constructed wholly of sheet-iron over a wrought-iron (T or L iron) frame, with proper braces for a mooring shackle, and for sustaining the gallows for the heavy bell which it would be designed to carry. It should be constructed to prevent leakage, with the additional precaution of having a longitudinal and transverse bulkhead of heavy iron, and each of the apartments to be supplied with a pump-well, to be secured by screw-caps. The deck should be of sheet-iron, rising sufficiently to the centre to insure the immediate return of any water which might come over it in bad weather. The model of this floating beacon should be such as is best calculated to increase the motion, compatible with a proper stability, which the ordinary heaving of the sea would impart to it. This motion would be sufficient to cause a properly-poised bell to ring at intervals approximating to regularity. A well-toned, sonorous bell of proper weight for a vessel of forty feet in length would give warning in stormy weather, in fogs and hazy weather, under the most unfavorable circumstances, probably to the distance of three miles, and under favorable circumstances to the distance of seven miles.

During the day, when objects could be seen at any distance, this object would subserve all the purposes of any sea-mark, in addition to the ringing of the bell. It would serve to guide navigators by the shortest line clear of the "Hatteras outer shoals," or those familiar with the locality through the four and a half fathoms channel which lies between the "Diamond" and "Outer shoals."

This beacon can be safely moored by Mitchell's screw-moorings, or by

mushroom anchors. To guard against accidents, it will be necessary for an inspector to visit it and sound the wells two or three times a year, and, if necessary, pump out each of the four apartments, although it is believed a beacon of this description, properly built, would seldom require the pumps.

I should be happy to furnish drawings and specifications for such a structure as I propose, should the suggestion be considered of sufficient importance to warrant its being recommended for adoption.

In connexion with "Hatteras shoals," I have also to recommend that a large buoy may be placed on the shoalest part of the "Diamond shoal," to serve as a guide to coasting vessels in running between that shoal and the spit which extends from Cape Hatteras point.

I am, very respectfully, your obedient servant,

THORNTON A. JENKINS,

Lieut. Commanding, and Assistant U. S. Coast Survey.

Professor A. D. BACHE,

Superintendent United States Coast Survey.

APPENDIX No. 16.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury, in relation to changes in Hatteras inlet, North Carolina.

COAST SURVEY STATION,

July 27, 1850.

SIR: I have the honor to transmit a report by Lieutenant Commanding R. Wainwright, United States navy, assistant in the coast survey, on the changes at the inlet south of Cape Hatteras, re-examined by my direction, and would respectfully request authority to publish the report for the benefit of navigators. The chart of the new reconnaissance will be engraved and published as early as practicable.

Very respectfully, yours,

A. D. BACHE,

Superintendent United States Coast Survey.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

UNITED STATES COAST SURVEY OFFICE,

Washington, July 26, 1850.

SIR: I have the honor to report that, in obedience to your instructions, I made a re-examination of Hatteras inlet in June last, and found many changes from the reconnaissance of the previous year.

The entrance between the outer breakers has shifted more to the north and east, and nearer the beach. The east point has washed away, and made more to the north and east in Pamlico sound. The west point has made more out into the inlet towards the north and east. There is between the outer breaker from ten to twenty feet at mean low water, and

twelve feet can be carried up to a good anchorage inside of sand spits. Six feet can be carried over the bulkhead into Pamlico sound.

A sluice has opened to the northward of the east point of the inlet, which makes a good harbor for small vessels. I would not recommend buoys to be placed in the inlet, as it is not in a permanent condition; and they might therefore mislead if any change should occur. For this reason, as well as that the tide runs so strong that vessels are in danger of being swept upon the numerous sand spits or shoals, I would advise all vessels unacquainted with the inlet to take a pilot, who may be obtained by hoisting their flag at the fore.

I would recommend a buoy to be placed on Long shoal, in Pamlico sound, to prevent vessels touching on it, and as a good guide in making for the bulkhead from the Sound side.

A sketch of the reconnaissance is in progress.

Respectfully, yours,

R. WAINWRIGHT,
Assistant Coast Survey.

Professor A. D. BACHE,
Superintendent United States Coast Survey.

APPENDIX No. 17.

Report of Lieutenants Commanding James Alden and Thornton A. Jenkins in regard to fitness of steamer Jefferson for hydrographic party on western coast.

UNITED STATES COAST SURVEY STEAMER JEFFERSON,
Baltimore, October 17, 1850.

SIR: We have respectfully to report, in compliance with your instructions of the 15th inst., on the points contained therein, viz:

1. That the steamer Walker is not adapted to hydrographic service on the western coast as an efficient steam vessel.

2. That the Jefferson may be rendered fit for that service, and may be sent safely under sails to her destination.

3. To prepare the Jefferson to proceed with expedition to the Pacific, it will be necessary to have the wheel-houses and wheels taken down, and the parts so fitted as to enable the engineer's crew on board to replace them in the space of three to four weeks' time.

4. It will be necessary to convert the Jefferson into a barque; her fore and mainmasts occupying the same positions as at present, and a small mizzenmast placed just forward of the cabin bulk-head to carry a spanker. The fore and mainmasts and spars to be of the proper dimensions of a sailing vessel of her tonnage.

5. To make the Jefferson an efficient steamer surveying vessel, there will be required new boilers, new bilge, and force pumps, and the necessary connexions to be made to the new boilers.

6. It will require from six to seven weeks to construct the boilers, and from three to four weeks to put them in their places and fit the proper connexions.

7. The Jefferson can be masted and rigged in a month from the time the order may be given, if attended to by a competent and zealous officer.

8. It is believed the engines can be thoroughly overhauled and put in complete order for any service connected with hydrography, embracing the recommendations of the engineers herewith appended, for

the sum of	-	-	-	-	-	\$1,500 00
Probable cost of boilers	-	-	-	-	-	8,000 00

Amount	-	-	-	-	-	9,500 00
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9. The whole amount for preparing the Jefferson for the voyage around Cape Horn may be assumed at about	-	-	-	-	-	4,000 00
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Making the total expense	-	-	-	-	-	13,500 00
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10. We would call your attention to the estimates, &c., appended, upon which we have been compelled to rely in a great measure.

11. The crew can dismantle the vessel, after reaching her destination, in about three days.

12. To get her ready for steaming, it will require about four weeks' work by her engineers and firemen.

13. The carpenter of the vessel could replace the wheel-houses in a few days, the materials being prepared here for doing so.

Very respectfully submitted.

THORNTON A. JENKINS,

Lieutenant Commanding and Assistant Coast Survey.

JAMES ALDEN,

Lieutenant Commanding and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 18.

Letter of Lieutenant Commanding J. N. Maffitt, United States navy, assistant in the coast survey, to the Superintendent, in relation to his examination in the vicinity of St. Helena sound, coast of South Carolina.

UNITED STATES SCHOONER GALLATIN,

Charleston, April 12, 1850.

DEAR SIR: I returned from a cruise to the southward some six days ago; having, during my absence, made a diligent search for the shoal reported by Captain Porter of the steamer Georgia. March 29th, with the tender I started from St. Helena bar, the light-boat bearing north by west, and run south by east fourteen miles; kept three leads going on board this vessel, and one on board of the tender.

The soundings deepened regularly from $4\frac{1}{2}$ fathoms to 9 and 10. I then run several close traverses back, increasing them in the position assigned to the shoal. The wind was fresh from the northward and eastward, with quite a heavy sea running—sufficient to have formed breakers on a seventeen feet spot. For 12 hours this search was continued, only discontinued by bad weather coming on, which drove me into Savannah—crossing the

bar on the 30th in a heavy gale. I am of the opinion that no seventeen-foot shoal exists in the position assigned by Captain Porter. His reports that at the moment of striking, heavy pieces of timber floated by; and as large timber rafts are frequently driven to sea from St. Helena sound, it is not impossible that the Georgia may have struck on one of them.

I am, very respectfully, your obedient servant,

J. N. MAFFITT,

Lieutenant Commanding and Assistant U. S. Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 19.

Report of the Superintendent of the United States coast survey to the Secretary of the Treasury on the reconnaissance of St. Andrew's shoals, coast of Georgia, by Lieutenant Commanding John Rodgers, U. S. N., assistant in the coast survey.

COAST SURVEY STATION,
August 9, 1850.

Sir: I beg leave to report that the sketch of the reconnaissance of St. Andrew's shoals, at the entrance of St. Andrew's sound, Georgia, by Lieutenant Commanding John Rodgers, U. S. N., assistant in the coast survey, has been engraved and is nearly ready for publication at the coast survey office, and for gratuitous distribution by the agents for our maps to navigators and others.

On her passage southward last winter the coast survey steamer "Hetzl" touched lightly on part of this shoal, St. Andrew's light-house bearing nearly WNW., and distant about eight miles; the vessel was going carefully at the time; the position being taken by bearings and soundings frequently. The English ship "Jane," of about seven hundred tons burden, bound for Savannah, fell to leeward, and in beating up struck upon these shoals in broad daylight, bilged, and went to pieces.

The following sailing directions and notes are given by Lieutenant Commanding Rodgers for entering St. Andrew's sound:

SAILING DIRECTIONS.

To run in by the buoy.—Keep in not less than six fathoms water until light-house bears by compass W. by N. $\frac{1}{4}$ N., then steer for the light-house until the buoy comes in sight. Keep it and the light-house in range until up with the buoy, which should be passed close to either side. Then steer NW. by W. $\frac{1}{4}$ W. until the light-house bears WSW. Haul in for the anchorage under the NW. end of Little Cumberland island, and anchor where convenient.

To run in by the compass.—Keep in not less than six fathoms water until the light-house bears as above, W. by N. $\frac{1}{4}$ N., then steer for the

* The buoy is said to be insecurely moored. High water near Cumberland light-house in St. Andrew's sound, 7 h. 55 m., at full and change. The only spring-tide observed rose 7 feet.

light-house. When the south point of Jekyll island bears NW. $\frac{1}{2}$ W., steer NW. by W. $\frac{1}{4}$ W. until the light-house bears WSW. Then haul in for the anchorage under the NW. end of Little Cumberland island, and anchor where convenient.

I respectfully request authority to publish this report.

Very respectfully, yours, &c.,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,

Secretary of the Treasury.

APPENDIX No. 20.

Notice of surveying marks on the Florida reef, in a letter from the Superintendent of the coast survey to the Secretary of the Treasury.

COAST SURVEY OFFICE,

Washington, May 16, 1850.

SIR: In surveying the Florida coast, it has been found desirable and practicable to place signals upon the reefs. As these will serve as important marks to show these dangers, and, unless removed by accident or design, are likely to be permanent for some considerable time, I am of opinion that it would subserve the interests of navigation to give notice of their position and character, and I would respectfully request authority to give publicity to the notice.

Assistant Gerdes informs me that the steamers Ohio and Georgia have both already found the marks useful to them.

1. A signal pole on *Turtle reef*, bearing southeast from Caesar's creek, twelve feet above the water, with braces six feet from the base, on the top a tin cone; the upper half painted red, the lower white.

2. A signal on the *Pacific reef*, east-southeast from Caesar's creek, of the same dimensions; the upper part of the cone painted white, the lower part red.

3. On *Ajax reef*, bearing east by north from Caesar's creek, of the same dimensions; the upper half of the cone red, the lower white.

4. On *Long reef*, bearing east of Elliott's Key, also of the same dimensions; the upper part of the cone painted white, the lower part red.

Two beacons of similar dimensions were also put up on the *Triumph reef* and on the *Fourcy rocks*; but, by some accident or design, they were lately removed. Arrangements, however, have been made to have them replaced during the first calm weather, and their bearings and characters will be as follows:

Triumph reef, east of Ragged Keys; cone painted red above, and white below.

Fourcy rocks, S. $\frac{1}{2}$ W. from Soldier's Key; cone painted white above, and red below.

It was attempted to place a signal or beacon on *Ledbury reef*, but it was found impracticable.

The following large signals and beacons were put up last year and recently:

Sombrero key, 36 feet high; barrel; braces 25 feet long.

Love key, 38 feet high; barrel; braces 22 feet long; leans somewhat to the east.

West Sambo, 35 feet high; barrel; braces 25 feet long.

Sand key, (astronomical station,) 36 feet high; barrel; braces 26 feet long; the sides recently boarded up by Lieutenant Rodgers.

Eastern dry rocks, near Sand Key triangle point; 18 feet poles.

Western dry rocks, near Sand key, 18 feet poles.

Middle Ground, also near Sand Key triangle point; 22 feet poles; the east and west sides boarded up.

Very respectfully yours,

A. D. BACHE,

Superintendent of the United States Coast Survey.

Hon. W. M. MEREDITH,

Secretary of the Treasury.

APPENDIX No. 21.

Extract from a letter from Lieutenant Commanding James Alden, United States navy, assistant in the coast survey, to the Superintendent, in relation to a light-house on Sea-horse key, Florida.

COAST SURVEY STEAMER WALKER,

Pensacola, May 27, 1850.

There is a long and very dangerous shoal extending out some eight or ten miles from Sea horse key, (the outer one of the keys of this group,) in a southwest by south direction, and I am told that vessels bound to the northward, during the prevalence of northers, frequently anchor under it for protection. This shoal is laid down on most of the charts, but to make it more available as a harbor of refuge, as well as to warn vessels of their proximity to danger, I am of opinion that a light should be placed, as soon as practicable, on Sea-horse key.

With great respect, I am, sir, your obedient servant,

JAMES ALDEN,

Lieutenant Commanding, and Assistant U. S. Coast Survey.

Professor A. D. BACHE,

Superintendent Coast Survey.

APPENDIX No. 22.

Letters and reports relating to the stranding of the steamer Hetzel, near Cape Canaveral, and her subsequent relief, &c.

1. Letter of Lieutenant Commanding John Rodgers, United States navy, assistant coast survey, communicating to the Superintendent the circumstances of the stranding of the Hetzel, with reply of Superintendent

2. Abstract of log of steamer Hetzel from February 9 to February 28,

1850, with extract from report of Lieutenant Commanding Rodgers, from Indian river.

3. Letter of the superintendent to Lieutenant Commanding John Rodgers, March 28, 1850, in regard to the stranding of the Hetzel, and her subsequent relief, returning thanks to the officers and crew for their exertions, and especially to Lieutenant W. Shields, Acting Master W. G. Temple, and Second Assistant Engineer Thomas Killpatrick, named by Lieutenant Commanding Rodgers in his report.

4. Report of Lieutenant Wilmer Shields to Lieutenant Commanding Rodgers in regard to repairs found necessary to hull, boilers, and engine of steamer Hetzel, and made under his direction at New Orleans. Extract from the letter of Lieutenant Commanding Rodgers enclosing the foregoing, and returning thanks to Lieutenant Shields.

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No. (1.)

U. S. STEAMER HETZEL,
Cape Canaveral, February 14, 1850.

DEAR SIR: I regret to inform you that the Hetzel was driven ashore upon the beach of this place, on the night of 7th instant, at half-past 11 o'clock.

The wind at the time was moderate from the southeast—so moderate that I did not have up steam. A light swell came on, and another anchor was let go; immediately afterwards the principal chain parted and we dragged the other anchor to the shore; a gale subsequently arose and forced us high upon the beach.

When the chain gave way the water was already hot in the boiler from previous use; the fires were immediately lighted, but too late for any useful purpose.

No one was hurt, and everything was safely landed.

Fortunately for myself, in hauling in the part of the chain which remained we recovered the broken link; it was welded only about one-sixth of its diameter.

In looking at the event it may seem that steam should have been upon the vessel—to ordinary discretion it was not needed.

With lighted fires, but without using the engine, I had ridden by the same chain to stronger winds and greater swells.

I knew that this particular service was dangerous; I was most anxious to finish it quickly, yet I was not willing to consume the fuel I had allotted to it, without apparent necessity.

Every dangerous service supposes that a certain amount of risk is to be encountered; and where an ordinary degree of faith in his means is necessary to carrying out his instructions, until his means shall seem insufficient, the officer is bound to give that faith. To have kept up steam without apparent cause would have consumed the fuel in guarding against accident; it would have left none for service; it would have been a practical nullification of your instructions to me.

I was out on deck a short time before the accident to look at the weather. Soon after Lieutenant Shields came to me and reported a slight well, and asked whether he should let go the other anchor; I said yes.

He returned to the deck and had obeyed the order, when the principal chain gave way. The remaining anchor was a very slight one; it proved unable to hold us.

We were in the best anchorage, ready to get up fires at any moment; we could have had steam in half an hour before a gale, with common warning, could have arisen. The chain appeared to be a good one; it was my duty to suppose it so, unless cause should arise to think otherwise. The master had examined it on the day of our arrival here, and found no flaws. We had rode to it in worse weather. I had reason to think the chain a good one—it proved bad. Whether we shall get off remains uncertain.

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant Commanding, and Assistant Coast Survey.

To A. D. BACHE, I.L. D.,

Superintendent Coast Survey.

COAST SURVEY OFFICE,
Washington, February 26, 1850.

DEAR SIR: Your two letters of February 14, announcing that the Hetzel had been driven ashore, have been received. As I am not yet without hope that you may get the steamer off, I shall wait for the next mail with much anxiety. It is a great relief to hear that no lives have been lost, or injury sustained, by officers and men under such trying circumstances. I rely upon you, of course, to make such arrangements as will best secure the preservation of the movable property, should the vessel be lost; or to take steps for removing the engine and parts belonging, if it can be profitably done. Also to take such measures in regard to disposing of the hull as may be most economical. If I hear that you pursue your intention of coming to Charleston, I shall send one of the sailing vessels of the coast survey to meet you there, that you may pursue your season's work.

Remember me to your officers. Under all circumstances I shall take such steps as seem best to preserve all concerned from unjust censure, and to give you such means of continuing your work as are in my power.

Yours truly,

A. D. BACHE,

Superintendent United States Coast Survey.

Lieut. Com. JOHN RODGERS, U. S. N.,

Assistant Coast Survey.

No. (2.)

CAPE CANAVERAL, February 9, 1850.

From 4 to 6, fresh breezes from the southward and eastward, with cloudy weather; at 5 p. m., came to off the light-house with starboard anchor in 2½ fathoms water, and veered to 40 fathoms starboard cable. From 6 to 8, fresh breezes from the southward and eastward, and cloudy.

From 8 to midnight, moderate winds from the southward and eastward, with thick weather; at 11h. 40 m. let go the port anchor, parted the starboard cable; started fires immediately, but before steam could be got the vessel dragged the port anchor into the beach, where she beat high up with the wind, tide and surf. From midnight to 4 a. m., fresh breezes from the southward and eastward, and cloudy. From 4 to 8, fresh breezes from the southward and eastward, and cloudy; high and dry on the beach; commenced getting stores, provisions, &c., out of the ship. From 8 to meridian, fresh southeast winds and rainy; employed in getting everything out of the vessel and in building tents on shore.

February 10.—Commences with heavy southeast gale and rain; employed in getting everything out of the vessel; a heavy surf beating against the vessel. From 4 to 6, wind shifted to the southwest, and partially clear; parted the two bow hawsers; the vessel swung round, doing herself much damage; weather moderate, wind southwest, rain and mist; hawsers run out to shore; commenced sweeping for anchor; pumping out vessel. From 4 to 8, moderate southwest winds, and cloudy; employed at the pumps, and in sweeping for the anchor; hove in the cable, and with it the broken link, which was welded only about one-sixth of its diameter; caught the lost anchor of another vessel; repairing engine.

February 11.—Wind southwest, light, raining and cloudy to midnight; then west, light and clear; pumping vessel out; anchor planted outside of breakers; kedge run out; steam got up; pumping.

February 12.—Wind west, light and clear; pumping and sweeping for anchor. At high water, vessel hove ahead about half her length by steam and anchors; another anchor found by sweeping; used it to back kedge; parted one hawser and stranded another in attempting to get off.

February 13.—Northeast wind and cloudy, freshening to gale; rain; hawser run out to kedge and anchor; pumping vessel; hove vessel about two lengths ahead by steam and hawsers, when one hawser parted; bottom of furnace fell out, vessel sagged into the beach; heavy sea; repairing furnaces; sea breaking entirely over vessel.

February 14.—Wind southwest, moderate; rain and cloudy; showers; pumping out vessel; tide ebbed and flowed through the vessel's hold.

February 15.—Wind southwest, fresh, cloudy and showers; wind west and southwest, fresh, clear; pumping out vessel; hove the vessel upright. Steamer Monmouth (belonging to Quartermaster's department, United States army) came in and anchored; received hawser from Monmouth; Monmouth weighed Hetzel's anchor, and planted it ahead of the vessel.

February 16.—Wind west, fresh, light; clear; northwest, light, clear; pumps kept vessel dry; hawser from Monmouth run out to last found anchor.

February 17.—Wind northwest; northwest and southwest; clear, pleasant; rigged and raised pair of shears; unstepped the foremast and got it over the bows, and placed purchases upon it to assist in getting the steamer off; rigged a derrick out of the foremast and got it upright under the bows; dug the sand from about the vessel; attempt to get the vessel off ineffectual; pumps kept vessel free of water.

February 18.—Wind southwest and northwest, light; clear, calm; southeast, moderate, clouds; a line to Indian river fixed preparatory to cutting a road; removing iron, &c., from vessel; water casks taken out

to place under bottom of vessel; pumping; another ineffectual attempt to get off at high water.

February 19.—Southwest, light, cloudy, and clear; northwest, moderate, clear; pumping; digging away sand; got a heave on the hawser without moving vessel; lifted small bower and carried further out; got a pull of the hawser; vessel appeared to move a little.

February 20.—Wind northwest, west and north, light, weather pleasant; pumping; heaving off; got up steam and worked engine; as the vessel began to break ground the water gained on the pumps, and finally put out the fires; preparation to caulk.

February 21.—Wind light, southeast and south; weather clear and pleasant; pumped vessel dry; caulked inside.

February 22.—Southeast, light, clear, pleasant; pumping, bailing, and caulking; vessel moved; leaking so badly that further attempt to move her was postponed; caulking.

February 23.—Wind southeast and south, light, calm and pleasant; north, light, clear and pleasant. Pumping and caulking; repairing larboard pump; heaving off at high water, between midnight and 4 a. m.

February 24.—Northwest and north, light, clear and calm; southeast, light, clear. Caulking inside. At 3 p. m. began heaving vessel off with hawsers. From 4 to 6 p. m., hove up the port anchor and swung to the starboard anchor and hawser; pumping and bailing; water slowly gaining. Midnight to 4 a. m., fires got up; at 1 hour 30 minutes hove up anchor and got under weigh, standing along the beach. At 6 p. m. water gained so fast on the pumps that it was deemed expedient to beach the steamer. At 8, high and dry on the beach. Pumping and bailing; holes bored on inshore side of vessel to assist in freeing her from water.

February 25.—Wind southwest, northeast, southeast, calm; south, weather clear and pleasant. Pumping, bailing and caulking; hawser run out to shore to prevent vessel from swinging off.

February 26.—Southeast and south, clear, calm; west and northwest, moderate, clear and pleasant. Planted starboard anchor a little forward of the beam, about 75 fathoms cable out. Caulking, pumping and bailing; steam got up; cast off fasts on shore.

February 27.—Wind west, cloudy, calm and pleasant; west, light, clear. Vessel kept dry; carried out anchor and hawser on the bow to assist in hauling off; failed in attempt to get steamer off. Shifting coal, caulking and bailing.

February 28.—Wind variable, light. Vessel hove off to her anchors, 6 to 8 p. m.; bailing, 8 p. m. to midnight; hove up anchors, got the boats from shore, stood along land to Indian river. Pumping and bailing; sounded every fifteen minutes in 8 and 9 fathoms. At 7 a. m. made out land about Indian river; at 8 hours 30 minutes took a pilot and stood in over the bar of Indian river; at 9 a. m. beached the vessel for repairs.

From this time, though the vessel leaked very badly, she did not cease to be under entire control. Partial repairs were made and the steamer was taken to Key West; and thence, keeping as near the shore as convenient, to Mobile, and finally to New Orleans, where she was thoroughly repaired.

Besides the assistance received from the steamer Monmouth, belonging to the Quartermaster's department, Lieutenant Commanding Rodgers acknowledges the kindness of Captain Jordan, assistant quartermaster

United States army, at Fort Peirce, in sending for the stores of the Hetzel, lost at Cape Canaveral.

The following extract from the official report of Lieutenant Commanding Rodgers, from Indian Key, shows the part taken by his officers in assisting him to save the vessel:

* * * "We were very fortunate in getting the vessel off, after so long an exposure to the swell of the Atlantic. I am indebted to Lieutenant Shields for very valuable assistance, and very valuable suggestions; it was he who first proposed to caulk the inside planking. The services of Acting Master Temple were distinguished by zeal, energy, and efficiency. Great praise is due to both engineers, but, from his seniority of rank, more particularly to Second Assistant Engineer Killpatrick. That the crew worked hard, will appear from the log-book; but they had eminently the merit of cheerful labor, while its useful result was very doubtful."

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieut. Comd'g, and Assistant Coast Survey.

A. D. BACHE, L.L. D.,

Superintendent Coast Survey.

No. (3.)

COAST SURVEY OFFICE,

Washington, March 28, 1850.

SIR: I have deliberately and carefully examined the circumstances of the stranding of the steamer Hetzel, under your command, as detailed in your several letters and in the extracts from the log-book of the vessel, before and after the occurrence, and ending with her relief and arrival at Indian river. I am of opinion that everything was done by you, and by the officers under your command, which prudent foresight could do, to avoid accident; and that under the very trying and difficult circumstances in which you were placed, good judgment was shown in the attempts to prevent loss, in the means used to secure the property and to relieve the vessel. I wish you to accept my thanks for your energy, and congratulations for the success which has crowned it; and to communicate to your officers generally, especially to Lieutenant W. Shields, Acting Master W. G. Temple, and to Second Assistant Engineer Thomas Killpatrick, the thanks of the Survey for the zeal and ability displayed by them, and the services rendered, under circumstances calculated to discourage less persevering spirits. My thanks are also due to the crew of the Hetzel, for their seamanlike conduct.

I have already communicated with you in regard to the repairs of the Hetzel, and the general prosecution of the Florida work, in letters addressed to Key West.

Very respectfully yours,

A. D. BACHE,

Superintendent U. S. Coast Survey.

Lieut. Com. JOHN RODGERS, U. S. N.,

Assistant Coast Survey.

No. (4.)

UNITED STATES SURVEYING STEAMER HETZEL,
Key West, Florida, June 12, 1850.

SIR: in compliance with your order of April 13, I assumed the charge of this vessel, proceeded to and arrived at Mobile on the 22d, and after a detention of two days, finding it impracticable to make the necessary repairs at that place, I proceeded to New Orleans, where I arrived on the evening of the 28th, and the next morning hauled into dock. Upon examination, I found that the Hetzel's hull and frame were much strained, a number of her butts started, some of her planks almost entirely separated from the timbers, and her stern-post started; the oakum forced from her bottom and bilge seams, which were open fore and aft; a portion of her copper lost, the remainder much bruised, her keel charred and bruised in several places. The engine works, boiler, and frame were much shattered, and required and received extensive repairs. Upon consultation, I determined to do the work by day's work, as the most satisfactory mode to all concerned. The "Hetzel" was immediately stripped of her copper, seven or eight tons of sand removed from between her timbers, 900 and over feet of new three-inch plank (oak) put into her bottom, and she was completely refastened with composition spikes and bolts, her keel repaired, her bottom caulked, payed, and covered with two coats of verdigris. On her upper works, all the bulk-heads were refastened, and those that had been torn away replaced by new ones. A new berth deck was laid, new coal bunks put up, and bulk-heads got up in the main hold; and a new set of water casks. All the running rigging was renewed. A new fore-gaff and squaresail yard was purchased; the bulwarks, wheel-house, &c., repaired. In regard to the minute details of repairs upon the engine works, boiler, &c., I refer you to the report of Mr. Killpatrick, senior Engineer, which I herewith enclose. In closing, I would remark that the Hetzel is now in better condition than I have ever seen her; and by a reference to the vouchers accompanying this, you will see that very extensive repairs, requiring a large amount of labor, have been put upon her with a very limited appropriation.

Your obedient servant,

WILLIAM SHIELDS,
Lieutenant U. S. N.

JOHN RODGERS,

Lieut. Commanding U. S. Steamer Hetzel, Key West.

I enclose copies of Lieutenant Shields's report of the repairs put on the Hetzel at New Orleans, and of senior Engineer Killpatrick's to him. Lieutenant Shields deserves the greatest credit for the skill with which he repaired the vessel, and for the low price at which he effected it. There is actually less vibration to the boat, when in motion, now, than before the accident. She will need recoppering.

Your obedient servant,

JOHN RODGERS.

A. D. BACHE, LL. D.,

Superintendent Coast Survey, Washington.

APPENDIX No. 23.

Extract from the report of assistant P. H. Gerdes to the Superintendent of the Coast Survey, on the reconnaissance of the Florida Keys, &c.

I.—MAIN FROM CAPE FLORIDA TO CAPE SABLE.

The southern part of Florida, as is well known, consists chiefly of everglades, or vast and enormous water prairies. The bottom of most places where I entered the glades had a rocky foundation, and was covered only slightly with soft soil, the thickness of which did not exceed six inches, apparently of an alluvial nature. The depth of water varied from one to four feet, and the water was fresh, drinkable, and of a brownish color. Numerous hammocks or patches of elevated ground lay all over the glades, like islands in a bay; they are from one to three feet above the level of the water, thickly covered with wood, and exceedingly fertile.

Around the everglades, along the Atlantic coast, as well as on the branch of the gulf towards the Florida Keys, runs a belt of solid ground, to the extent of eight or ten miles in breadth, bordering the glades on the inside. It is generally thickly wooded. The soil is barren and stony; on some places rocky. Marshes extend for a few miles along the coast, and some hammocks and fertile spots are found at several projecting points. Among the latter the hunting grounds occupy the first place. Here cultivation has very sparsely begun, though the produce of the soil, in sugar, rice, corn, limes, oranges, olives, &c., was very rich. On the Miami river are also some small plantations, that seemed, before the late Indian outbreak, to thrive well. For five or six miles to the east from Cape Sable the country is also very productive, and here alone is open, and consists of well watered prairie land intermixed with fine groves of trees. The stony and barren tracts along the coast are covered chiefly with pine growth, and the ground, in general, is plentifully filled with arrow root bushes, called in this section by the Indian name of *coonty*. This is a product which is little used as yet, but which, I presume, will become in time a source of wealth to the land owners. The navigable streams from the glades to the Bay of Florida, with water power of generally four or five feet fall, will facilitate the manufacturing of the article. It grows in very great abundance, and is of an excellent quality, perfectly equal to the Bermuda arrow-root, and can be delivered, with large profits, for ten cents per pound, when the imported article sells here in the country for 60 or 75 cents.

Above Cape Florida there runs out of the everglades into Key Biscayne bay, a stream called the Boca Rontes; and a few miles below, the Little river, the Arch creek, and the Miami river fall into the same water, all constantly discharging the contents of the glades into the bay. Some ten or thirteen miles below the Miami, near the hunting grounds, is Little creek, and further down another small stream without a name. From here to Cape Sable the shore is uninterrupted. I ran a line of levels along the Miami, which will show the fall, and other features of the river and country.

II.—THE FLORIDA KEYS.

I will give a topographical sketch of the principal islands facing the reef channel, from Cape Florida to the Mangroves. The main land of Florida, above said cape, runs down into a sharp point, from the head of Key Biscayne bay to Narrows cut, which separates it from Virginia Key, the most northern of the Florida islands. This spit is in fact the first island itself, and ought to be counted as such. It is covered with wood, has a fine beach, and is about eight or ten miles long and one-half or one mile wide.

Virginia Key.—About three miles long and one mile wide, wooded, with a fine Atlantic beach; southern passage called Bear Cut, with four feet water.

Key Biscayne.—Southern point called Cape Florida, having a lighthouse; key five miles long, from one to two wide, with a fine Atlantic beach, and a strip of open land alongside, covered only with palmettos, &c.; the rest wooded. The southern inlet (Key Biscayne inlet) has a swash channel over the reef with ten feet water. West and southwest of the island is an excellent anchorage and harbor. From here to the Miami eight feet may be carried.

Soldier Key.—Five miles below, very small; filled with mangroves.

Rugged Keys.—Five or six in number; most of them rocky, covered with mangroves; beach on part of the east side.

Elliott's Key.—Some very good land, with timber; most of the land rocky, with mangroves; five miles long, one and a half wide.

Black Caesar's, Old Rhole's, and Angelfish Keys.—Small islands, covered with timber and mangroves; at the second, good anchorage.

Key Largo.—The largest island among the Keys; lies northeast and southwest; is twenty-five miles long, and from one to three wide. Six miles from the northeast point is a small cove called Walton's cove, (after Captain Walton of the Carysfort light-ship, who was murdered here, in the war of 1837, by the Indians,) and abreast of this is the famous Carysfort reef, with the light-ship Florida stationed there. Near this cove the island has an elevation called the Basin hill, laid down by Captain Barnet, of the British ship Thunderer, Royal Navy, as ninety feet high, but it is not nearly so elevated. About seven miles below Basin hill a creek divides the island, the point being called Sound Point. Westerly the island contains some good land of a black and yellow appearance, and said to be well calculated for the culture of pine-apples; also some timber and dogwood, and (so called) medicine wood. The land, except Basin hill, is low everywhere, and rocky, generally thickly covered with mangroves.

Rodriguez Key.—Low, rocky, very small, covered with very high mangroves—according to Captain Barnet, eighty-five feet high.

Dove Key.—Very small, rocky, wooded.

Tavernier Key.—At the west point of Key Largo; low, small, rocky, and woody. This island and Rodriguez key afford good anchorages.

Plantation Island.—Erroneously named on the charts Long island; west of Key Largo; six or seven miles long, and one and a half or two wide, low; some good soil and timber—the rest rocky and covered with mangroves.

Vermont Key.—Two miles long, rocky, and covered with mangroves.

Upper Metacumbe.—Five miles long, one mile wide; contains some good land with timber, and several slight elevations; the rest is rocky, and thickly covered with mangroves.

Tea-table Key.—Very small; covered with mangroves. The United States troops were cantoned there in 1836.

Indian Key.—Small; cleared in the Indian war by the United States troops, who built a hospital and water-tanks. A good harbor here; the channel runs east of the island.

Lignumvita Key.—About one mile in diameter, covered with mangroves.

Shell Key.—Small, rocky, low, covered with mangroves.

Lower Metacumbe.—Four or five miles in length and one wide; some good land with timber; few slight elevations; rest low, rocky, and covered with mangroves.

Jewish Bush.—On the northeast point of Long island; small, low, and rocky, full of mangroves.

Channel Keys and Couch Keys.—All very small; rocky, and covered with mangroves.

Duck Key.—Two miles long, one and a half wide; low and rocky, covered with mangroves; contained, years ago, salt-works; now, like the rest, uninhabited.

Grassy Keys and Fat Deer Keys.—A group of narrow keys a few miles long, all low, and wooded with mangroves.

Key Vacas.—A few elevated places; a little of the land is very good—the rest sandy, rocky, and covered with mangroves. Here is a settlement of some twenty houses, but only three are inhabited at present.

Boat Key and the Sisters.—The latter very small, and the former a few miles long; low and covered with mangroves.

Knight's Keys.—Small, on the western extremity of the Vacas; covered with mangroves. The key forms a shelter for anchorage, and makes a tolerable harbor. From here there is said to be a passage into the Florida bay, with seven feet water.

Pigeon and Molasses Keys.—Very small, low, and wooded.

Bahia Honda.—Several islands of this name, viz: the Little Bahia Honda, Upper Bahia Honda east, and Upper Bahia Honda west; all small, rocky, and low; the largest five miles by one. Bahia Honda forms a good harbor—the best on the reef, (except Key West,) with 3 or 4 fathoms of water. A channel leads from here to the northwest, entering the bay between Spanish and North Harbor keys. It contains, at low water, eight or nine feet. I sounded it, as its existence was strongly and positively contradicted, and had the satisfaction to find the above result, which was certified at the time by the pilot.

Pine Islands.—This group is situated west of Bahia Honda, and east of Boca Chica, and contains more than 220 islands of different sizes. The soil of most of them is of a similar strong substance, covered with mangroves and some timber, amongst which pine wood is found more plentifully than on any other islands. There are a few natural elevations on the southern extremity of the keys, and these, viz: the Sally Bunces and Saddle bluffs, are of great use to the triangulation.

Boca Chica Keys commence eastward at the termination of the Pine keys, and end westward with *Cayo Hueso* or *Key West*. They are of the same kind as the Pine islands—level, stony, covered with wood, chiefly

mangroves; they are more than 200 in number. The town of Key West, on the island of the same name, is very thriving; has a good harbor, a great many stores and warehouses, three (so named) observatories, (look-outs for vessels and shipwrecks,) four churches, a court house, and more than 3,500 inhabitants, who have considerable commercial intercourse with New York, Havana, and New Orleans.

Mangroves.—A dozen small islands west of Key West—low, level, stony, and wooded with mangroves.

Marquesas.—A like number and of the same description. Boca Grande is the largest—six or seven miles long.

Here end the Florida keys; and the following group of islands, called the Dry Tortugas, are separated by a space of 35 or 40 miles—half of which (the western part) is safely navigable, while the eastern part contains very dangerous quicksands. The Tortugas I have not yet visited.

III.—THE FLORIDA REEF.

The reef, as stated before, runs nearly parallel with the southern extremity of the Florida keys, at a distance of from four to six miles from the same; is one or two miles wide, one hundred and thirty miles long, and consists of shoals and ledges of sand rocks and corals. On the most dangerous parts of the reef there are only a few feet of water; in many places the reef is bare; between such ledges, however, many good passages across are found. The following are the names of some of the more dangerous places on the reef:

1. Water Witch shoal, abreast of Key Biscayne; quicksands; three or four feet water.
2. Sambos; quicksand knolls off Cape Florida; three or four feet water.
3. Powey rocks, (Soldier Key reef;) rocky ledge off Soldier key; two or three feet water.
4. Ledbury reef, off North Ragged Key point; four feet; rocky.
5. Triumph reef, off Sand's cut; few feet; rocky.
6. Long reef, off Elliott's key; rocky; few feet.
7. Ajax reef, off Caesar's creek; few feet; rocky.
8. Pacific reef, off Caesar's creek; few feet; rocky.
9. Long shoals; off Key Largo, north point; few feet; sandy.
10. Carysfort reef; long rocky ledge off Key Largo; very dangerous; rocky or coral points; light-ship Florida is stationed here.
11. Pickle reef, off Rodriguez key; three feet water; rocky.
12. Crocus reef, off Plantation key; five feet water; rocky.
13. Alligator reef, off Indian key; from one to two miles in extent; two or three feet water; sharp rocks and very dangerous.
14. Tennessee reef, off Long key; 5 feet water; rocky.
15. Collins's Patches, off Duck key; rocky; few feet water.
16. Sombrero, off Vacas keys; dry island; one or two acres in surface; rocky around.
17. Love key, off Bahia Honda; dry island; a few acres in surface; rocky around.
18. American shoals, off the Saddle bluffs; one or two feet water; very sharp rocks.

19. Washerwoman; two or three miles closer in shore than American shoal; three feet water; rocky.
 20. Pelican shoal, off Sally Bunces; rocky and dangerous.
 21. East Sambo, off Boca Chica; dry key; one or two acres surface.
 22. Middle Sambo, off Boca Chica; dry key; one or two acres surface.
 23. West Sambo, off Boca Chica; dry key; one or two acres surface.
- Around and between the three Sambos it is rocky and very dangerous.
24. Sand key, off Key West; small island of sand and corals several acres in extent. Formerly it had a light-house; at present a light ship anchored near for the same purpose. Astronomical station.
 25. Rock island, one mile east of Sand key; rocky and dry.
 26. Dry rocks, a mile or two west of Sand key; very dangerous.
 27. Middle Ground, Sandy island, northwest of Sand key; its vicinity dangerous.

APPENDIX No. 24.

Report of the Superintendent of the United States Coast Survey to the Secretary of the Treasury on the reconnaissance of Cape Canaveral shoals, Florida, by Lieutenant Commanding John Rodgers, United States navy, assistant in the coast survey. [Sketch F. No. 2.]

COAST SURVEY OFFICE,
Washington, August 14, 1850.

SIR: I have the honor to enclose a report of Lieutenant Commanding John Rodgers, United States navy, assistant United States coast survey, upon a reconnaissance of Cape Canaveral shoals, Florida; and request authority to publish the same.

Very respectfully, yours,

A. D. BACHE,
Superintendent U. S. Coast Survey.

Hon. THOMAS CORWIN,
Secretary of the Treasury.

UNITED STATES COAST SURVEY OFFICE,
Washington, August 9, 1850.

SIR: I have the honor to report that, in obedience to your instructions, I have made a reconnaissance of Cape Canaveral shoals.

Bearing from the light-house by compass NE. by N., and distant from it eleven and three-quarters nautical miles, there is a shoal with fifteen feet water on it at low tide; and there is one with eight feet water on it at low tide, eleven and a quarter miles from the light house, and bearing from it NNE. $\frac{1}{4}$ E.

These shoals, distant from one another one and a half mile, and bearing from each other E. by S. and N. by W., are the extremities of a bank with three, four, and five fathoms water on it.

With the eye elevated twenty-six feet above the sea, the land could not be seen from them in a clear day; and the light-house was only faintly visible.

These shoals are the more dangerous, because deep water surrounds the bank on which they lie.

In bad weather, breakers point out their place; but with a smooth sea no indication of their existence is given.

A shoal runs out from the light-house very nearly five miles in a SE. $\frac{1}{2}$ E. direction. Separated from this, by a channel one mile wide and four fathoms deep, is a small shoal with eleven feet water on it at low tide; it bears SE. by E. $\frac{1}{2}$ E. from the light-house, and is six and a quarter miles distant from it. Between the light-house and southeast shoal is a beach channel with six feet water in it at low tide.

Though there are deep channels between the outer shoals and the light-house, there are numerous shoal spots which render the navigation through them dangerous to large vessels.

Vessels wishing to lie under the cape, in northerly or westerly winds, should bring the light-house to bear NE., and anchor in fifteen or seventeen feet water, about one-third of a mile from the beach.

DIRECTIONS FOR THE BEACH CHANNEL.

Bring the light-house to bear WSW. and run for it. Keep the south end of the stable roof in a range with the middle of the light-house, until within one hundred and fifty yards of the beach. Then steer south and pass the cape.

At low tide the depth of water in the channel is six feet. Especial care must be taken to guard against the current, which was found to set strongly to the northward. The light house and stable are so close together, that the range must be closely watched.

Very respectfully, your obedient servant,

JOHN RODGERS,

Lieutenant Commanding and Assistant Coast Survey.

A. D. BACHE, L.L. D.,

Superintendent Coast Survey.

APPENDIX No. 25.

Reports by Lieutenant Commanding C. P. Patterson, U. S. N., assistant in the coast survey, to the Superintendent, on beacons and buoys on Dog river bar, and in Choctaw Pass, head of Mobile bay.

U. S. COAST SURVEY STEAMER WALKER.

SIR: The following report respecting the locations, &c., of beacons for the channels over Dog river bar and through Choctaw pass, at the head of Mobile bay, and through which all the trade of Mobile passes, is respectfully submitted:

1. A beacon at the south end of Dog river bar channel, in the position of what is now called Lower Stake, on the west edge of the channel, with Choctaw light-house bearing north 7° west, distant 2.45 miles.

2. A beacon at the angle where the channel changes its direction from north $19^{\circ} 30'$ east to north, in the position of what is now called *Wreck stake*, on the west side of the channel, with Choctaw light-house bearing north $21^{\circ} 30'$ west, distant 1.61 mile.

3. A beacon at the angle where the direction of the channel changes from north to north 58° west into Choctaw pass, in the position of what is now called *Tucker's Stake*, on the west side, at the southeast end of Choctaw pass, with Choctaw light-house bearing north 61° west, distant 0.65 mile.

4. A beacon on the side of the channel leading to the mouths of Spanish and Tensaw rivers, in the position of what is now called *Tucker's Stake*, with Choctaw light-house bearing north 63° west, distant 1.1 mile, and in a line with the range through Choctaw pass.

5. A beacon on the east side of the same channel, in the position of what is now called *Fowler's Stake*, bearing from beacon 4 south $58^{\circ} 30'$ east, distant 0.4 mile, so that beacon 4 or beacon 5 shall lead through Choctaw pass, and the channel leading to Spanish and Tensaw rivers between them.

These beacons should all be substantially built and lighted. I would suggest beacon 4 white, and beacon 5 red; each beacon to be painted the color of its own light. As there is liability of vessels running into and against the beacons, they should be protected by spring fenders. Should these beacons be built, the light-house on Choctaw point could be discontinued, and the expense of keeping up the beacons would be but the difference between their annual expense and that of the light-house.

Arrangements could be made with the pilots of Dog river bar, for a small compensation, to keep these lights up. At present the channels are marked by wide stakes and small bushes, which, during the hazy weather of the business season, are constantly hid. The sameness of the country gives no landmarks, and the narrowness of the channels (which are partly dug) renders it impossible to use them with ease without the assistance of these stakes, which should be superseded by properly lighted beacons. The want of lights in these channels is the cause of great detention to the vessels used in taking merchandise to and from the ships in the lower bay. The consequence is expense incurred and much valuable time lost. I would respectfully call the attention of the department to these beacons, that they may be erected at as early a date as possible.

Very respectfully, yours,

C. P. PATTERSON,

Lieut. Commanding and Assistant U. S. Coast Survey.

Professor A. D. BACHE,

Superintendent U. S. Coast Survey, Washington.

APPENDIX No. 26.

Report on buoys and beacons at the entrance to Mobile bay.

Sir: The following report upon the location, &c., for buoys and beacons for the entrance to Mobile bay, is respectfully submitted:

BUOYS.

1. A buoy, or, far better, a boat-buoy, with a heavy bell, just outside the bar, in eight and three-quarters fathoms, soft bottom, with Sand island light-house bearing north 22° west, and distant from the bar a mile. A buoy is necessary at this place at all times, but much more so during the thick, hazy, and foggy weather prevailing nearly through the most active season, when a bell would be of great benefit.

2. A buoy off the south end of West bank, in twenty-five feet water, with Sand island light-house bearing south $11^{\circ} 30'$ west, distant 1.78 mile, on a range of Mobile light-house, on West Umbrella Tree.

3. A buoy off the north end of West bank, in forty-eight feet water, with buoy 2 bearing south $11^{\circ} 30'$ west, in range with Sand island light-house, distant 1.68 mile, and Mobile light-house bearing south $55^{\circ} 30'$ east, distant 1 mile. The line joining buoys Nos. 2 and 3 will clear West bank.

4. A buoy off the southwest end of Middle Ground, in twenty-five feet water, with Mobile light-house bearing south $28^{\circ} 30'$ east, distant 1.66 mile.

5. A buoy on the northeast edge of West bank, opposite to the southwest end of the Middle Ground, with buoy 4 bearing south $42^{\circ} 30'$ east, distant 1.82 mile. The line joining buoys Nos. 3 and 5 will clear the northeast edge of West bank.

6. A buoy on the twelve-feet spot (the northeast end) of the Middle Ground.

7. A buoy on the southwest point of the Spit, in nine feet water.

These buoys should be large, of such construction as to be seen some distance; of such form and so colored as to be known when seen in foggy weather, and to point out on which side they are to be passed. The system adopted for this purpose should be based upon the principles proposed by the late Lieutenant G. M. Bache, United States navy, in a report upon the buoys of Long Island sound.

BEACONS—ENTRANCE TO MOBILE BAY.

1. A beacon on Sand island, with the light-house bearing north 22° west, distant 245 feet. To cross the bar with beacon on the light-house.

2. A beacon on Sand island, with light-house bearing south 83° west, distant 145 feet; and beacon 1 bearing south 11° west, distant 250 feet, so that beacon 2, in range on beacon 1, shall clear the West bank.

3. A beacon on Revenue Point, the south end of East bank. This beacon would bear nearly the same relation to this entrance that the "Romer beacon" bears to that of New York.

4. A beacon on Mobile Point, with the light-house bearing south 34° east, distant 140 feet, near the water, and on the range of the black barrel over the chimney of the frame house on middle of light-house; to lead through the channel between the southwest point of the Middle Ground and northeast edge of West bank.

5. A beacon on Mobile Point, with the light-house bearing north $46^{\circ} 30'$ east, distant — feet; and beacon 4 bearing north $16^{\circ} 30'$ east, distant 240 feet; so that beacon 5, on beacon 4, shall clear East bank, and beacon 5, on light-house, shall lead into the east end of Sand island channel.

I would propose that beacons 1 and 4 have red lights, and beacons 2 and 5 white lights. Flashing and fixed white lights would do better, but are more expensive. It would not be necessary to light beacon 3, but it would be an advantage.

It would not be required to see these beacons more than $3\frac{1}{2}$ miles; therefore arcs of single reflectors (or better, the argand burner, with a single wick) would be sufficient; and they need not be over 12 or 15 feet in height, made strongly of rough wood.

Beacons 2, 3 and 5 should be black; beacon 2, because it would show against the sky, and to distinguish it from beacon 1, (as in red and white lights, flashed, &c.) beacon 3, because it shows against the sky; beacon 5, because it shows against the sky, and to distinguish it from beacon 4. Red would probably be a better color than black. Beacon 1 should be black (or red) on the southeast side, as it would show against the white of Sand island light-house, and white on the north side, to distinguish it from beacon 2. Beacon 4 should be white, as it would show against the green glacis of the fort, and to distinguish it from beacon 5.

These beacons could be re-erected and kept lighted at a small expense, and no additional assistance would be required to the light-house keepers to keep them up. A buoy on the northwest end of the northwest Pelican shoal, and a beacon on Dolphin island, so placed that a bearing on it would be the course into Pelican pass from outside, would be very useful to the mail steamboats between New Orleans and Mobile during the winter months, when the north winds prevail, and the water is too low for them to use Grant's pass, the inside route.

At present, the marks for this entrance are very inferior; those for the West bank can scarcely be called such at all; and the mark leading through between the Middle Grounds and northeast edge of West bank is of the rudest kind, small, and during hazy weather can scarcely be seen, except with the sun to the westward. In foggy or thick weather, though knowing themselves off the bar from the soundings and bottom, yet these cannot give their position with sufficient accuracy to allow the pilots to cross the bar, which a bell-buoy would enable them to do with great ease. The entrance to this bay, through which passes a yearly commerce of twenty millions, has no other marks or safeguards than the two light-houses, which are very inferior to the third order of French lights.

I would therefore respectfully urge the great necessity of calling the early attention of the department to these buoys and beacons.

I will merely state, that during the past year \$40,000 worth of property has been lost on or near the bar, and \$20,000 and upwards paid for salvage; and this, in the opinion of all, for the want of good marks to clear the dangers.

These amounts I will forward as soon as they are obtained from the agent of the underwriters at Mobile, who promised to forward them to me. The precise amount of loss and salvage, however, is over \$60,000.

Very respectfully, your obedient servant,

C. P. PATTERSON,

Lieutenant Commanding and Assistant Coast Survey.

Professor A. D. BACRE,

Superintendent United States Coast Survey.

APPENDIX No. 27.

Report on buoys for Cat and Ship Island harbors.

COAST SURVEY OFFICE,

Washington, August 20, 1849.

Sir: The following report upon the locations, &c., of buoys for Cat and Ship island harbors is respectfully submitted:

1. A buoy just outside of Ship island bar, in twenty-three feet water, hard sandy bottom, with the west end of Ship island bearing north 53° east. To cross the bar in that course.

2. A buoy off the east end of Spadefish shoal, (off North spit of Cat island,) in sixteen feet water, soft bottom, with Cat island light-house just on with north point of North spit.

3. A buoy on the northeast edge of Cat island bar, in eighteen feet water, with west end of Ship island bearing north 66° east, distant six miles, south end of South spit of Cat island bearing north 71° west, distant two and a half miles, and Sand Hill bearing north 5° west.

4. A buoy at the southeast end of Cat island channel, in eighteen feet water, soft bottom, with south end of South spit bearing north $11^{\circ} 30'$ west, distant one and a half mile; so that a course of south 71° west, distant two and one-fifth miles between buoys 3 and 4, shall lead through the channel over the bar.

5. A buoy on the north side of Cat island channel, near the northwest end of the Mud-hole, eighteen feet water, hard bottom, with the south point of South spit bearing north 73° east, distant one and one-third mile, and Cat island light-house bearing north 36° west, distant four miles.

6. A buoy off Potato Hill, with Cat island light-house bearing north 5° west, distant two and a half miles. This buoy should be placed off the southwest point of Potato Hill, in eighteen feet water.

7. A buoy off the east end of Pistol shoal, in eighteen feet water, with Cat island light-house bearing north 24° west, distant two and two-thirds miles, and the northwest point of Isle au Pied bearing south 42° east, distant one and two thirds mile.

8. A buoy off the north edge of Pistol shoal, in sixteen feet water, with Cat island light-house bearing north 52° east, distant three miles; and buoy No. 7 bearing south 71° east, distant one and a half mile.

9. A buoy off the west end of Pistol shoal, in eighteen feet water, with Cat island light-house bearing north 59° east, distant four and a half miles; and buoy No. 8 bearing north 70° east, distant one and a half mile.

The want of landmarks makes the necessity of so great a number of buoys.

The increasing commerce of the coast will in time demand greater facilities for navigation, in several beacons and an increased number of buoys; but the buoys named above are deemed sufficient for present purposes.

The importance of the channel south of Cat island, through which a large portion of the smaller trade to and from New Orleans must pass, and

of Ship island harbor, as one of refuge, will be strongly felt as this trade increases, which it is rapidly doing.

Very respectfully yours,

C. P. PATTERSON,

Lieutenant Commanding and Assistant Coast Survey.

Professor A. D. BACHE,

Superintendent Coast Survey.

APPENDIX No. 28.

Extract from a letter of S. A. Gilbert, esq., sub-assistant United States coast survey, to the Superintendent, announcing the decease of assistant R. H. Fauntleroy, at Galveston, Texas.

GALVESTON, TEXAS, December 15, 1849.

DEAR SIR: In pursuance of your instructions and directions from Mr. Fauntleroy, I joined his party on the 6th instant at New Orleans. On the 9th instant we left New Orleans in the steamer Galveston, and arrived here on the 12th, having had a very rough and uncomfortable passage.

On the morning of the 13th Mr. Fauntleroy was taken very sick, and sent for a physician—Doctor Taylor—who pronounced the disease to be cholera; two other physicians were called in likewise, but neither their skill nor the devoted attention of his numerous friends, who were gathered around him, could arrest the progress of the disease. Mr. Fauntleroy expired about four o'clock on the same afternoon, within thirteen hours after the first symptoms appeared.

APPENDIX No. 29.

Resolutions in relation to the decease of assistant R. H. Fauntleroy, by the officers of the party of the Superintendent.

CAMP NEAR EDISTO BASE, January —, 1850.

The undersigned, officers of the coast survey, have learned with heart-felt regret of the decease of their associate, R. H. Fauntleroy, assistant in the survey, while in the discharge of his duty in Texas, on the 13th ultimo.

They desire to express their sense of his great merit as a man of science, as a skilful observer, as an officer devoted zealously and successfully to the discharge of every duty in the work; as one whose loss to the government and to the survey cannot be replaced. They offer to his family their sincere condolence in this most afflictive bereavement, and ask that they, with the other associates of this excellent husband, father, and brother, may be permitted to unite in erecting a monument, as a testimonial of their esteem and affection for him while living, and their sincere regret for him when dead.

A. D. BACHE,
CHARLES O. BOUTELLE,
CHARLES P. BOLLES.

Letter of assistant F. H. Gerdes, transmitting to the Superintendent the resolutions of the officers employed in Florida, in relation to the decease of assistant R. H. Fauntleroy.

MOBILE, ALABAMA, January —, 1850.

DEAR SIR: Enclosed I transmit to you two copies of resolutions passed to express our feelings at the sudden death of our dear and lamented friend, Robert H. Fauntleroy.

His long association with us in the southern sections of the coast survey had endeared him very much to our hearts, and his loss will never be forgotten by us.

Very respectfully, your most obedient servant,

F. H. GERDES,

In behalf of the Assistants in Sections VI and VIII,

U. S. Coast Survey.

Professor A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

Resolutions in relation to the decease of assistant R. H. Fauntleroy, by the officers employed in Florida, his former associates.

At a meeting of the assistants in the coast survey, employed on the Gulf of Mexico, the following resolutions were adopted:

1. *Resolved*, That we deeply deplore the loss of our late friend and associate, R. H. Fauntleroy, by whose sudden death, in the fulness of manhood and activity, his country has been deprived of, an able and energetic servant, and science of an ardent votary and profound thinker. We who have known him intimately, lament the loss of the truest and kindest heart; of his calm judgment and ever-ready sympathy: we mourn for the man, the scholar, and the friend.

2. *Resolved*, That a badge of black crape be worn by us for thirty days, as a token of our regard for the memory of the departed.

3. *Resolved*, That copies of these resolutions be transmitted to the superintendent of the coast survey, and to the afflicted family of our lamented friend.

F. H. GERDES.

J. E. HILGARD.

KEY WEST, FLA., January 18, 1850.

APPENDIX No. 30.

Report of Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey, to the Superintendent, enclosing a report of Lieutenant Washington A. Bartlett, United States navy, on the lights necessary for San Francisco bay and its approaches.

UNITED STATES SURVEYING SCHOONER EWING,

San Francisco, March 31, 1850.

DEAR SIR: I have the honor to lay before you a copy of a letter from Lieutenant W. A. Bartlett, United States navy, expressing his views on

the subject of light houses, their situation and class, necessary to facilitate navigation in and at the mouth of this harbor.

You will see by my report, dated 29th instant, that I recommended three lights, placed as Lieutenant Bartlett has recommended; but since he has gone into details, and as he has cruised considerably in these waters, I cannot do less for his judgment and experience than to lay his letter before you, stating at the same time, that I fully concur in his views.

Respectfully and truly yours,

WM. P. McARTHUR,

Lieutenant Commanding, and Assistant Coast Survey.

To Professor A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

UNITED STATES SURVEYING SCHOONER EWING,
San Francisco, March 31, 1850.

DEAR SIR: My experience in and about the bay of San Francisco, since June, 1846, induces me to lay before you, for the information of the department at Washington, my views on the character and arrangements of lights necessary to be adopted for the safety of the vast fleet of shipping entering and leaving this port.

1st. A revolving light of the *first power* on the south "Farrallon de los Frayles," which island bears southwest by west (compass) and distant twenty-eight miles from the fort at the mouth of the harbor.

On this island should also be placed a heavy fog-bell.

2d. A fixed *white* light, of a power not less than the light on Sandy Hook, to be placed on the height in the rear of the fort, at the entrance of the harbor.

3d. A red beacon light, visible for four leagues, to be placed on Alcatraz island, within the harbor.

The first-named light, on the "Farrallon de los Frayles," is of prime necessity, in order to enable vessels to approach the coast boldly and with safety, as this cluster of rocky islets and sunken rocks lies in the "fair way" to the harbor, and only six leagues south 3° east from "Punta de los Reyes," the most western land near San Francisco.

A fog-bell is necessary in consequence of the density of the fogs which prevail off the coast for a considerable portion of the year, and the difficulty of getting astronomical observations in a smoky haze when there is no fog.

For the same reasons I would recommend that one or two thirty-two pounder guns be placed near the light-house to respond to vessels which may fire guns, in order to learn their positions. This system of communication is practised at Monterey, between the "Redoubt" and ships of the squadron, (when in the fog off that port,) with the best results.

The fixed light on the height in the rear of the fort of San Francisco will point out the entrance of the harbor when vessels have lost sight of the light on the Farrallon, and enable them to correct their bearings (which are always more or less affected by tides and currents in the outer bay,) before reaching the bar. By this time the beacon light on Alcatraz island (being red) will give a sure leading mark for crossing the bar in

the best water, avoiding the reef of Boneta point, and enabling a ship to keep on the proper line of sailing at any time when the state of the tide and wind permits her to proceed.

The beacon-light on Alcatraz is also absolutely necessary to the safety of shipping and steamers navigating within the bay in the night, and will give all necessary leading marks to clear "Blossom rock" and "Southampton shoal."

As the South Farrallon has an eminence at each extremity, (being about one mile in length,) on which a tower can be placed, the base of which will be at least one hundred and fifty feet above water, the height of the tower below the lantern need not exceed fifty feet; (visible 18.7 miles.)

Towers of fifty feet in height below the lantern will also be sufficient for both the other lights, as the base of the tower on the hill in the rear of the fort will be at least 200 feet above water, and that on Alcatraz 80 to 100 feet.

It would appear proper to remark, that inasmuch as these towers, with their lanterns and apparatus, must be prepared and shipped from the Atlantic coast, the most economical and durable material should be used. Boiler-plate iron would seem to be the very best for the purpose, while the framing and stair cases should also be made of the same imperishable material.

Respectfully submitted by your obedient servant,

WASHN. A. BARTLETT,

Lieutenant U. S. Navy, and U. S. Coast Survey.

Lieut. Com. WM. P. McARTHUR, U. S. N.,
Assistant United States Coast Survey.

APPENDIX No. 31.

Report accompanying a reconnaissance chart of the western coast of the United States, from Monterey, California, to the mouth of the Columbia river, Oregon, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

UNITED STATES SURVEYING SCHOONER EWING,
Bay of San Francisco, September 25, 1850.

SIR: In laying before you our chart of reconnaissance of the northwest coast, embraced between the parallels of $36^{\circ} 36'$ north and $46^{\circ} 17'$ north, including Monterey and the mouth of the Columbia river, I beg to state the manner in which this reconnaissance was made.

Assuming the longitude of San Francisco and the mouth of the Columbia river, as determined by Captain Charles Wilkes, United States navy, to be correct, with our chronometers well adjusted, and their rates well established, we sailed from this place on the 3d of April last.

The directions given were as follows, viz:

1st. The vessel to be kept as close to the shore as her safety would permit, and to come to anchor with the kedge at sunset when the weather was favorable.

2d. Boats to be sent to occupy headlands and islands, and bearings to be carefully observed with an azimuth compass.

3d. Soundings to be frequently made, and the depth of water and character of the bottom carefully noted.

4th. The position of the vessel to be ascertained and plotted on the chart every four hours, and oftener when necessary; cross bearings to be observed upon all headlands, islands, bays, rivers, &c., at all material changes of position throughout the day.

5th. The directions and velocity of the currents to be observed whenever the vessel came to anchor.

6th. The variations of the magnetic needle to be ascertained whenever good observations could be made.

7th. The surface temperature of the water, the temperature of the air, and the barometer, to be observed every four hours of the day and night.

8th. Views of the principal headlands to be taken.

The foregoing directions were adhered to as closely as circumstances would permit.

After leaving San Francisco, we commenced working along the coast to the northward, and in three days of very favorable weather we succeeded in carrying on satisfactory operations as far as Fort Ross, (an old Russian establishment in the latitude of $28^{\circ} 33'$ north, and longitude $123^{\circ} 17'$ west.) The weather then became foggy, and we shaped a course clear of the land, and stood to the northward under easy sail. The weather continued unfavorable until we had nearly reached the latitude of Cape Mendocino. It then became fair, and we were enabled to determine with accuracy the latitude and longitude of this great promontory; after succeeding in which, we proceeded to reconnoitre the coast to the northward.

Between Cape Mendocino and Trinity Head two rivers were discovered; one called Bel river, nine feet water on the bar, and 150 yards in width, and draining a beautiful valley, which seems to extend to the southward and eastward. The other and more important entrance was discovered by Captain Ottinger. It debouches from a lagoon of 18 miles in length; the mouth is one-half a mile in width, and has three fathoms water on the bar. This is called by Captain Ottinger Humboldt Harbor. After examining the currents we proceeded to Trinity Head, came to anchor, and determined its latitude and longitude; soundings were also obtained as we went along the coast. After leaving Trinity Head we encountered a gale of wind, which blowing us off the shore, we saw no more of the coast until we reached the Columbia river.

We left the Columbia river on the 7th of August, and again commenced our reconnaissance—the wind variable and light, the weather clear, and sea smooth. We cruised along from one to three miles from the shore, and our chart will show the latitudes and longitudes of the points, headlands, rivers, reefs, indentations, and soundings, as we proceeded to the southward. A table of these headlands, &c., will be annexed to this, as well as a description of each river.

We succeeded in connecting our work at Trinity Head, the point to which we carried our reconnaissance on our way north, and continued our work to the southward until we were driven off the coast about twenty miles to the southward of Cape Mendocino. We hove-to and made the land the following day at noon, and were so successful as to connect our work again at Fort Ross. Thus you will perceive the whole coast

from Monterey to the Columbia river has been examined, except about thirty miles lying between Port Ross and Cape Mendocino.

After fully considering all facts in connexion with this reconnaissance, I do not hesitate to say that the limits of error of all important points, as well as nearly the whole coast, may be safely asserted to be within one mile in longitude and half a mile in latitude. The scale was adopted with a view to the convenience to navigators. The whole work seems to be so satisfactory as to cause me to believe it to be much better than any published chart. The rapidly increasing commerce and navigation along the whole coast induces me to urge that this chart be published at once.

I am, respectfully and truly, yours,

WM. P. McARTHUR,

Lieut. Commanding, and Assistant U. S. Coast Survey

Professor A. D. BAORE,

Superintendent United States Coast Survey,

Washington, D. C.

Table of latitudes and longitudes of the ports, rivers, islands, reefs, capes, &c., from Monterey to the Columbia river.

	Latitude.		Longitude.	
	Deg.	min.	Deg.	min.
Point Pinos, Monterey.....	36	37½	121	58
Point Santa Cruz.....	36	56	122	6½
Point Año Nuevo.....	37	12	122	23
Point San Pedro.....	37	34	122	28
Point Lobos.....	37	46½	122	27
Fort Point (entrance to San Francisco).....	37	48	122	28
Point Boneta.....	37	50		
South Farrallon.....	37	37	123	00
Northwest Farrallon.....	37	45	123	8
Punta de los Reyes.....	38	1½	123	2½
Point Torrales.....	38	15	123	2½
Bodega Head and anchorage.....	38	19	123	5
Fort Ross.....	38	33	123	16½
Blunt's Reef (off Mendocino).....	40	27	124	29½
Cape Mendocino.....	40	27	124	27
False Mendocino.....	40	31	124	26
Eel river (entrance).....	40	39½	124	17
Table bluff.....	40	43	124	13
Humboldt harbor (entrance).....	40	51	124	8
Trinidad bay (anchorage).....	41	5½	124	5
Trinidad city.....	41	6	124	5
North Turtle (off Trinity Head).....	41	12	124	12½
Red wood creek.....	41	18½	124	7
Redding's rock (200 feet high, 6 miles off shore).....	41	23	124	16
Klamath river (entrance).....	41	34	124	1½
Port St. George (anchorage).....	41	43	124	4
Cape St. George.....	41	47	124	7
The northwestern extremity of St. George reef or islets.....	41	51	124	13
Pelican bay (Indian village anchorage).....	41	55	124	4
Rogue's river.....	42	25½	124	21
Rogue's river reef (southern extremity).....	42	27½	124	28
Ewing harbor (anchorage).....	42	44	124	21
Cape Oxford or Blanco.....	42	55	124	26½
Extremity of Oxford reef or rocky islets.....	42	49	124	32
Coquille river.....	43	12½	124	16
Cape Arago.....	43	27	124	17
Kowee river (entrance).....	43	28	124	10
Umpqua river and head.....	43	44	124	9
Cape Perpetua (south bluff).....	44	11	124	1
Cape Perpetua (north bluff).....	44	16½	124	1
Extremity of islets of Cape Foulweather.....	44	42½	123	59½
Cape Foulweather.....	44	45	123	57
Nekoa river (entrance).....	44	57	123	53
Yaquina river (entrance).....	45	6	123	54
Cape Look ut.....	45	23	123	55½
Killamook river.....	45	32	123	53
False Killamook Head.....	45	46½	123	59
Killamook Head.....	45	54	123	59
Point Adams.....	46	13	123	57½
Cape Hancock or Disappointment.....	46	16	124	1½

Respectfully submitted:

WASHINGTON A. BARTLETT,
Lieutenant United States Navy, Assistant Coast Survey.

APPENDIX No. 32.

Sailing directions for the western coast of the United States from Monterey to Columbia river, by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

Previous to giving sailing directions for this part of our coast, I propose to notice the character of the winds at different seasons, with their effects upon the sea and currents.

From March to October the prevailing wind along the coast, and for many miles to the westward, is fresh from the northwest, being freshest from 10 A. M. to 2 P. M., and not unfrequently falling light during the night. During this season of the year, the northwest wind blows with almost the regularity of a trade-wind. During the months of August and September fogs prevail to a great extent, and impede and endanger navigation materially.

During the part of the year above mentioned there are no heavy gales of wind, and little or no rain.

These winds cause a current of about one-half a knot per hour along the coast, setting to the southward.

From October to March the wind is variable, both with regard to velocity and direction. During this season heavy gales occur from the southeast, south, and southwest, generally accompanied by protracted rain, and causing a very heavy sea and swell along the coast.

The current during this season sets generally to the northward, varying in velocity with the strength of the wind.

These facts being known, it is now to be considered how directions should be given which would be most useful to navigation.

Sailing vessels bound to the northward from Monterey or any more northern port, during the summer season, should stand well off shore, not too close hauled, until about 300 miles from the land, when they will be beyond the influence of the southerly current, and in a situation to take advantage of a slant of wind which frequently occurs from west north-west. They would do well not to approach the land, unless favored by the wind so as to enable them to lay their course, or nearly so, until up with the latitude of the destined port.

Steamers should follow the coast from point to point as nearly as possible, always keeping within fifteen miles of the land. They will by this means shorten the distance and frequently avoid the strong northwest winds, as often they will find it quite calm close in with the shore when there is a strong wind to seaward.

Vessels bound to the northward in the winter season should keep as close along the land as practicable, and take every advantage of all southerly winds to make latitude. They should always endeavor to make the land at least twenty or thirty miles to the southward of the destined harbor.

Navigators bound to the southward should keep the coast in sight, and take advantage of either tack upon which the most latitude may be made, always making the land to the northward of the port in summer, and to the southward in the winter season.

WM. P. McARTHUR,
Lieut. Commanding, and Assistant Coast Survey.

APPENDIX No. 33.

Hydrographic notice of the western coast of the United States, from Monterey to Columbia river, (islands and rivers) by Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey.

THE FARRALLONES DE LOS FRAYLES.

There are no islands, properly so called, between Monterey and the mouth of the Columbia river. Those most deserving the name are the "Farrallones," a group of detached islets off the harbor of San Francisco.

They lie in a northwest and southeast direction from each other, and form two groups, the northwestern and southeastern. The distance from the extreme northwestern to the extreme southeastern islets is twelve miles. In the whole group there are seven which appear above water. The southeast islet is the largest of the group, and is distant from the fort at the mouth of the harbor twenty-eight miles, and bears from the fort south 68° west (true.) This islet is about 150 or 200 feet high, and on the southeast side there is an anchorage in 11 fathoms water, hard (probably rocky) bottom; it is tolerably sheltered from the northwest wind and sea.

In order to distinguish between the northwest and southeast groups it is only necessary to observe that the northwest group shows three rocks, of about the same size, lying nearly east and west from each other, nearly a mile apart, and sending off a reef to the eastward of about one mile in extent.

About one-third the distance from the southeast Farrallon there is 41 fathoms water—sand and mud. The soundings gradually diminish until up with the bar off the mouth of the harbor. The deepest water on the bar is 7 fathoms, (hard sandy bottom,) and the best range for crossing the bar is to have the Fort point and Alcatraz island in range.

I consider that the southeast Farrallon is an important landmark in making the harbor of San Francisco, and have already recommended that a light-house be placed on it.

The situations of the remaining rocks, islets, and reefs are sufficiently defined on the reconnaissance chart.

RIVERS.

The mouths of the important rivers between San Francisco and the Columbia are perhaps sufficiently well defined on the reconnaissance chart as far as latitude and longitude are concerned.

Eel river.—There is nine feet water on the bar at the mouth of this river. The entrance is very narrow, and the swell so high generally as to render it difficult and dangerous for sailing vessels. Steamers enter and depart without difficulty.

Humboldt river.—The entrance to this bay is half a mile in width between the breakers. There is eighteen feet water on the bar at mean low water.

The Klamath.—On the bar of this river there is seventeen feet water at mean low water. The channel is so narrow and the current so strong,

that I deem it unsafe for sailing vessels. Steamers are required, to make this river useful.

Rogue's river.—This river has ten feet water on the bar at the mouth at mean low water, but is too narrow for sailing vessels, as there is scarcely room to turn in the channel.

The Coquille river is not available for anything larger than small boats and canoes.

The Koonce.—This river was not closely examined; but, to judge by appearances at the mouth, I do not hesitate to express the opinion that it will be found to be available and very useful for steamers.

The Umpqua.—I crossed the bar of this river in the second cutter, in fourteen feet water, and passed into three fathoms on the inside of the bar, the rollers breaking at the time all the way across the channel. The channel, in my opinion, is practicable for steamers, but dangerous for sailing vessels, unless under very favorable circumstances.

The remaining rivers to the northward can only be entered by small boats, except perhaps the Yaquina, which might be entered by vessels of a larger class.

In making my report with regard to the navigation of these rivers, I beg leave to be considered as only giving my *opinion*, unless in case where I mention particularly the depth of water; then, of course, I speak authoritatively. I would recommend, however, an early and detailed examination of all, and for this purpose a steamer is *indispensable*.

All of which is respectfully submitted by your obedient servant,

WM. P. McARTHUR,

Lieutenant Commanding, and Assistant Coast Survey.

Prof. A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 34.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, to the Superintendent, in relation to a light-house at Cape Hancock, or Disappointment, entrance to Columbia river.

WASHINGTON, November 29, 1850.

SIR: In answer to your inquiries as to the character of the light-house which should be erected at Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, and for information as to the locality on which it should be placed, &c.—

I have the honor to state that Cape Hancock, or Disappointment, at the mouth of the Columbia river, Oregon Territory, where it is proposed by a late act of Congress to erect the principal light-house for that river, is a bold cliff of columnar basalt, rising perpendicularly from the sea to variable heights of from 200 to 300 feet, terminating in unequal rolling summits covered with a rich and fertile soil.

These summits vary also in width from ten to fifty feet at the apex, whence they slope by a quick descent to the northward; the northern or inshore face of the hills being covered by a dense growth of gigantic pine, alder, and other trees, with a thick growth of vines, "salmon berry," and other shrubbery.

The summit of the sea cliffs (which are not covered by the forest) is the proper position for locating the light-house—say within two to four hundred yards to the westward of "Broom station," as given on our triangulation of the river. Should the tower be placed there, it will show the light from the lantern around three fourths of the horizon without the necessity of felling the trees to the northward.

In this position the base of the tower will be about 250 feet above high-water mark; and should the tower be raised 40 feet to the deck of the lantern, (and in my opinion it should not be less,) on a base of 16 feet in diameter, it will be a prominent landmark for making the cape in the day-time.

The lantern or light which is to be placed on the tower should be of a power not less than the best light on Navesink; in other words, a marine light of the first power.

The tower should be constructed of fire proof materials, and no wood whatever should be admitted into the construction of the building, as there is at all times much danger of the forest being fired to the northward, which in such a case would inevitably destroy the building.

From the cove in Baker's bay, where the materials would be landed, the distance is about 1,000 yards by a path now greatly obstructed by huge trees which have fallen across it. It must ever be a difficult matter to transport any great amount of bulk or weight to the summit; a good road must first be made. Whether the tower is constructed of wood, iron, or brick, the materials must be transported in small parcels.

When such a tower as I have contemplated is lighted up by a light of the first power, it will be clearly visible for a distance of 9 leagues at sea from the northwest, by the west and southwest, to the south, and by the east for the entire width of the river, and for the same distance up the Columbia.

A light on Cape Hancock, or Disappointment, will be of vast importance to the rapidly increasing commerce of Oregon, as it will enable all vessels to approach the coast boldly, and then to maintain their positions on pilot ground until daylight, when they will at once be taken into port by the highly intelligent pilots now fully established there.

Very respectfully, sir, I have the honor to be, your obedient servant,

WASHINGTON A. BARTLETT,

Lieutenant United States Navy, Assistant Coast Survey.

To Professor A. D. BACHE,

Superintendent United States Coast Survey.

APPENDIX No. 35.

Report of Lieutenant Commanding W. P. McArthur, United States navy, assistant in the coast survey, to the Superintendent, in relation to lights at Cape Flattery and New Dungeness, Oregon.

UNITED STATES SURVEYING SCHOONER EWING,

San Francisco, September 25, 1850.

DEAR SIR: The portion of your instructions relating to the investigation of the necessity or otherwise of light-houses at Cape Flattery and New Dungeness has been attended to, and I beg to report as follows:

I have carefully examined the roadstead of NewDungenness, and find it to be safe and capacious. The holding-ground is excellent, and it is well protected from all winds except those from the northeast, a quarter from which it seldom or never blows so hard as to endanger shipping.

The ingress and egress are remarkably convenient.

A point two and one-fourth miles in length extends from the main land, and completely shelters the anchorages from the strong and prevalent northwest winds. This point is quite low and narrow, and not discernible at night. On the extremity of this point I would recommend a light-house of the first power to be built; the shaft to be not less than 80 feet in height. Thus situated, it would guard navigators against the Spit, as well as point out the anchorages. The entrance is entirely clear; but as the profile of the bottom is so precipitous, I would advise navigators to come to anchor in not less than 10 or 13 fathoms water.

A light-house is much needed also at Cape Flattery, and I would recommend that it be situated on "Tatoochie island," a small island, almost touching the northwest extremity of Cape Flattery.

To vessels bound from seaward a light-house on this island would be of much assistance. It would enable them to enter the straits when the absence of a light would frequently compel them to remain at sea until day-light. Once inside the straits, vessels are comparatively secure.

The advantage of having the light-house situated on the island instead of on the extremity of the cape is, that it would serve as a guide to vessels seeking Neap or Scarborough's harbor—a small but secure harbor of refuge about four miles inside the straits. Strong contrary currents will cause navigators to seek this little harbor quite frequently.

Traffic is very much on the increase in Oregon; and while it must be admitted that the great increase has been on the Columbia river, yet it has also much improved on the sound. Lumber has become an extensive article of export; and it is quite probable that there is no country on the face of the globe where it is so abundant, so good, and so convenient.

It seems to me that the government should be informed that ships are continually arriving at different points of the sound to obtain spars and lumber; (they of course take the best and most convenient;) and it might be deemed advisable on the part of the government to take means to arrest these depredations. I had occasion to witness them, and was called upon by General John Adair, the collector for the district of Oregon, to assist him in enforcing the revenue laws, and arrest even foreign vessels from smuggling and cutting our timber. (See his report on the subject to the honorable Secretary of the Treasury.)

I am, very respectfully and truly, yours,

WILLIAM P. McARTHUR,

Lieut. Commanding and Assistant U. S. Coast Survey.

Professor A. D. BACHE,

Superintendent U. S. Coast Survey, Washington, D. C.

APPENDIX No. 36.

Report of Lieutenant Washington A. Bartlett, United States navy, assistant in the coast survey, in relation to the draught of vessels which can enter the south channel, Columbia river entrance, Oregon.

WASHINGTON, November 30, 1850.

SIR: In answer to your inquiries as to the draught for vessels which may at any time be carried into the Columbia river by the new south channel, &c., I have to state that our late survey of that channel, and my personal experience in passing over the south bar in vessels of deep draught, show conclusively that vessels drawing seventeen feet can be taken over the south bar at $\frac{1}{2}$ flood $\frac{3}{4}$ ebb, without the least risk of touching, and twenty feet can pass at high water.

In making the preceding statement, it is proper to say that I have fully considered the "drop" which a vessel makes when in the swell of the bar, which is, however, much less in the south than in the old north channel, when the wind is in the usual northwestern quarter.

In the winter or spring seasons, when the wind is in the south or southwest quarter, there is a lively breaker on the south bar, at which time it will be smoothest on the north bar; and this southerly wind being then fair for the north channel, there is no occasion to take the south bar in *southerly winds going in*; yet with a moderate draught in a *sailing vessel* the south channel is ever safest in coming out, although the wind may be "dead on" to the bar; the bar being so short and quickly passed, that it is not necessary to tack in shoal water.

The United States steamer Massachusetts and United States sloop-of-war Palmouth, each drawing 17 feet water, have passed the bar of the south channel into the Columbia river since our survey was made.

In addition, I would state that my experience at the mouth of the Columbia has convinced me that the south channel is the practicable commercial channel of that river for certainty and safety, with the additional advantage of accomplishing the passage to or from the river without waiting for a particular wind. Ships frequently pass the bar inward in fifteen minutes after receiving their pilot, and outward in thirty minutes after getting their anchors.

A disabled ship, that can be sailed so as to have good steerage-way, can pass over the south bar in safety when it would be impossible to get her in by the north channel.

From the 18th of April to the 5th of August, 1850, there was no day that the south channel was not practicable for vessels, and was in daily use.

I crossed the bar (south channel) in the pilot boat "Mary Taylor" during the "heaviest bar" that occurred within the above named period, beating out with the wind dead ahead.

The principal pilot of the bar is Captain White, late pilot of New York harbor; he is very intelligent and competent to his duties, and no accident has occurred at the mouth of the Columbia since September, 1849, when he commenced his duties as pilot.

The commerce of the Columbia river, the great artery of the fertile valleys of the Columbia and its tributaries, is rapidly increasing; the Pacific Mail Steamship Company's steamers now proceed to Astoria and return to

San Francisco with the monthly mails; a small steamer has been built at Astoria, and is now employed in the river trade; a second steamer was on the stocks when we left the river.

Regular lines of sailing and steam-propeller vessels are also established between San Francisco and the various towns on the Columbia; also to Nisqually and other points in Puget's Sound.

For further particulars, I have the honor to refer you to my report of June last.

Very truly, your obedient servant,

WASHINGTON A. BARTLETT,

Lieut. U. S. Navy, Assistant Coast Survey.

Professor A. D. BACHE,

Superintendent U. S. Coast Survey.

APPENDIX No. 37.

Extracts from the report of Brevet Major Isaac I. Stevens, corps of engineers, assistant in charge of the coast survey office, to the Superintendent.

OFFICE COAST SURVEY, WASHINGTON, D. C.,

November 11, 1850.

DEAR SIR: In submitting my annual report of office work, I beg leave to premise the following observations as to the organization of the work:

The office is essentially, in all its parts, one of record, from the correspondence and results sent in by parties in the field to the charts distributed for the benefit of commerce and navigation. The finished hydrographical and topographical sheets, the reductions therefrom, the engraving, and printing, are simply intermediate steps. The same remark applies to the observations—astronomical, geodetic, magnetic, and tidal. They undergo various computations, revisions, and comparisons, before results can be furnished for the charts. All these must be carefully preserved and registered.

It is some years after a survey has been commenced before all parts of the office-work are in full operation. A large increase of field-work is not, therefore, felt at once; and it is not till the appropriations have reached their maximum for about three years, that the corresponding office-work becomes fully developed and established.

On your assuming the charge of the survey in 1844, the appropriations were comparatively small, and the office-work limited. The work was, however, acknowledged to be a national one. All parts of the coast were interested in its extension, and soon the system was introduced of operating in distant sections, and carrying the benefits of the survey simultaneously to the different parts of our extended coast. Then the field-work necessarily experienced a great expansion. Great exertions were required suitably to enlarge the scientific corps.

The increase of office-work had been seriously felt for some two years before my assuming the charge of the office. The necessity of a further distribution of duties by providing assistants to supervise the different branches of the office had been admitted, and was adverted to in your

last annual report. The indefatigable exertions of my predecessor, Capt. Humphreys, and his unusual familiarity with all the parts, both in general and in detail, of field and office-work, prevented those embarrassments which, in less skilful and experienced hands, must necessarily have ensued:

On entering upon my duties, I saw at once that my only hope of filling the situation with satisfaction to the survey, and to myself, was in at once applying my exertions to enlarging and adapting the organization of the office to the increasing wants of the survey. The office-work would necessarily increase two or three years without any additional increase of field-work. But it was manifest that the field-work of the survey itself must increase, and thus involve a still greater increase of office-work. I had no other qualification for the position than some little administrative experience, derived from my appropriate duties as an engineer in our fortifications. I was entirely unacquainted with the details of my new duties, and I felt as though I was substantially entering upon a new profession.

These views, early communicated to you, were favorably received, and measures were taken to secure the services of additional assistants. The success has been marked. The department of engraving had been under the supervision of assistant W. M. C. Fairfax for several years, but the departments of drawing and computing have only been separately organized since my connexion with the survey. Under the direction of assistants McClery and Hilgard, it gives me pleasure to report that we are now reaping all the advantages that we expected from their separate organization.

Some other changes and improvements have been made in the office. The publication and distribution of the maps, and the care of the archives, have been placed again immediately under the direction of the assistant in charge of the office. The clerical duties have been subdivided, and the clerical force has been increased. One clerk has charge of the distribution of maps, of the superintendence of the rooms, and of the returns and records of the office; a second has charge of the correspondence, a third of the archives of the survey.

All the geographical data of the survey have been collected and indexed. Some changes have been made in the system of registry of the land-work of the survey. The volumes of observation are to be permanently bound, and considerable progress has already been made in this duty. By the old system, the register, being made at intervals, was sometimes one to two years behindhand. By the new, it will be kept up to date. All observations and computations are to be bound and registered immediately on being turned in to the office.

Much remains, however, to be done. Additional efficiency must be given to the engraving department by an increase of the corps of engravers, and by more system in classifying work. The drawing department, as it is now advancing, will be in one year up to the wants of the survey. The younger members are rapidly acquiring skill and efficiency.

The hydrographic records require revision and improved methods of registry. With the force now in the office, I hope to be able to accomplish this the ensuing winter. But an assistant in charge of hydrography, who shall supervise the records, and examine the work of parties, reporting deficiencies, errors, &c., is much needed. An officer thoroughly acquainted with all parts of the hydrographic work, could relieve both

the superintendent and assistant in charge of many onerous duties. He could prepare statements of the progress of work, the details growing out of instructions to parties, provide for deficiencies, and insure that all the methods in use were thoroughly understood, and practically carried out.

There is much work to be done in the computing department. Many general discussions are yet to be made, and much duplicating of work. The preliminary computations for current work have been kept up, so no delay will occur to other branches of the survey.

I append a list of the coast survey maps engraved up to this date, of maps engraving, (appendix No. 38,) the statistics of the work in 1849, with the result of the additions to the several quantities heretofore given, up to the first of January, 1849—(appendix No. 39.) This table brings the statistics of the work up to January, 1850.

APPENDIX No. 38.

List of coast survey maps engraved.

No. 1.	New York bay and harbor and approaches.....	78655
2.	...Do.....do.....do.....do.....No. 1.....	78655
3.	...Do.....do.....do.....do.....No. 2.....	
4.	...Do.....do.....do.....do.....No. 3.....	
5.	...Do.....do.....do.....do.....No. 4.....	
6.	...Do.....do.....do.....do.....No. 5.....	
7.	...Do.....do.....do.....do.....No. 6.....	
8.	Map of Delaware bay and river and approaches, No. 1	78655
9.	Map of Delaware bay and river and approaches, 2d engraved plate, No. 1.....	
10.	Map of Delaware bay and harbor and approaches, No. 2	
11.	....Do.....do.....do.....do.....No. 3	78655
12.	The harbor of New Bedford	
13.	The harbor of New London	
14.	Fisher's Island sound	78655
15.	Holmes's Hole and Tarpaulin Cove harbors	78655
16.	Oyster For Syosset bay.....	78655
17.	Little Egg Harbor.....	78655
18.	Harbor of Annapolis	78655
19.	New Haven harbor.....	78655
20.	Harbor of Edgartown	78655
21.	Harbors of Black Rock and Bridgeport.....	78655
22.	Huntington bay.....	78655
23.	Nantucket harbor	78655
24.	Harbors of Shellfield and Catkin's islands.....	78655
25.	Mouth of Chester river	78655
26.	Harbors of Captain's islands, east and west.....	78655
27.	Long Island sound, sheet No. 2.....	78655
28.	....Do.....do.....No. 3.....	78655
29.	Sketch chart of Nantucket shoals.....	78655
30.	....Do.....Buttermilk channel, New York harbor..	78655
31.	....Do.....Cape Hatteras cove.....	78655

No. 32. Sketch chart of Cape Hatteras inlet.....	200000
33. ....Do.....Bull's bay harbor.....	200000
34. Re-engraving lower sheet of the Delaware.....	200000
35. Pasquotank river.....	200000
36. Cat and Ship islands harbors.....	200000
37. Harbor of Hyannis.....	200000
38. Sketch chart Beaufort harbor, North Carolina.....	200000
39. ....Do....St. Andrew's shoals, Georgia.....	200000
40. Sketch chart of Nantucket shoals, re-engraved and enlarged.....	200000
41. Hatteras inlet, from resurvey.....	200000
42. Cape Canaveral shoals.....	200000
43. Seacoast Maryland and Delaware.....	200000

Maps engraving.

No. 1. General chart of the coast.....	200000
2. No. 1, Long Island sound.....	200000
3. No. 1, Chesapeake bay.....	200000
4. No. 1, south side Long Island.....	200000
5. No. 2, south side Long Island.....	200000
6. No. 1, eastern series.....	200000
7. Boston harbor.....	200000
8. Sachem's head and City island.....	200000
9. Muskeget channel.....	200000
10. Mobile entrance.....	200000
11. Hell Gate.....	200000
12. 18 annual sketches for annual report 1850, various scales.	200000

APPENDIX No. 39.

Results of the coast survey at different periods, from 1844 to 1850.

Results.	From 1844 to 1849.	For 1849.	Total from beginning of survey.
Reconnaissance, area in square miles.....	22,544	10,139	51,366
Reconnaissance parties, number of.....	9	7	16
Base lines.....do.....	4	1	6
Preliminary base lines.....do.....	3	3	8
Base lines, length of in miles.....	19	9½	28½
Triangulation, area in square miles.....	19,309	4,091	38,333
Extent of coast line.....	405	143	864
Extent of shore line, reckoning bays, sounds, &c....	4,211	620	8,046
Horizontal angles stations, number of.....		204	.....
Vertical angles stations.....do.....	34	18	59
Triangulation parties.....do.....		21	.....
Astronomical stations.....do.....	47	9	70
Latitude stations.....do.....	20	4	24
Azimuth stations.....do.....	22	4	26
Longitude stations.....do.....	8	1	9
Latitude stations.....do.....		1	.....
Longitude stations.....do.....		5	.....
Astronomical parties.....do.....		10	.....
Magnetic stations.....do.....	88	11	109
Magnetic parties.....do.....	15	8	23
Meteorological stations.....do.....	8	3	11
Meteorological parties.....do.....	7	2	9
Topography, area in square miles.....	2,755	35,191	930,891
Length of shore line in miles.....	4,055	94,980	1,102,080
Length of roads in miles.....		264	.....
Topographical parties, number of.....	60	11	71
Hydrography, area in square miles.....	15,086	1,111.3	25,620.3
Hydrography, number of soundings.....	950,202	265,824	2,024,173
Gulf stream, number of soundings for temperature..	1,410	None.	1,410
Gulf stream, number of fathoms of line.....	139,747	None.	139,747
Specimens of bottom, number of.....	4,098	286	4,884
Hydrographical parties.....do.....	32	9	41
Current stations.....do.....	160	28	188
Tidal stations.....do.....	40	32	85
Tidal parties.....do.....	14	12	26
Total number of manuscript maps.....	295	42	663
Of these manuscript maps, number prepared in office being reduced, &c.....	123	7	159
Original topographical maps, number of.....	100	20	280
Containing sheets.....do.....	131	24	453
Original charts.....do.....	72	12	187
Duplicates (charts).....do.....		3	37
Containing sheets.....do.....	160	28	424
Records triangulation, bases, &c., number of vols..	233	38	370
Astronomical observations, &c.....do.....	140	28	185
Astronomical differences of longitude.....do.....	66	41	107
Computations, geodetic.....do.....	138	41	258
Computations, astronomical.....do.....	138	10	154
Magnetic observations.....do.....	37	3	44
Magnetic computations.....do.....	15	6	21
Geodetic books, duplicates.....do.....	128	19	174
Meteorological books.....do.....	7	3	10
Meteorological books, duplicates.....do.....	3		3
Original hydrographical books, sound- ings, and angles.....do.....	380	134	693
Duplicates of same.....do.....	32	12	71
Hydrographic books, tidal and current observations, and tidal reductions.....do.....	158	63	229

APPENDIX No. 39—Continued.

Results.	From 1814 to 1849.	For 1849.	Total from beginning of survey.
Total of records.....	1,475	395	2,318
Engraved plates of maps.....number of....	24	11	40
Engraved plates electrotyped.....do.....	8	6	14
Published maps.....do.....	21	9	30
Printed sheets of maps.....do.....	24,249	15,162	39,411
Printed sheets of maps distributed.....do.....	7,678	1,848	9,526
Printed sheets of maps, sale agents.....do.....	12,979	1,506	14,485
Volumes in library.....	655	95	750
Instruments, value of.....	\$149,513	\$6,326	\$157,839

Coast survey office, 1849.

Number of assistants in charge of office.....	1
Number of computers in the office.....	2
Number of computers out of the office.....	2
Number of assistants in charge of drawing department.....	1
Number of draughtsmen in coast survey office.....	8
Number of hydrographic draughtsmen in coast survey office.....	2
Number of assistants in charge of engraving department.....	1
Number of engravers in the coast survey office.....	9
Number of engravers out of the coast survey office.....	2
Number of electrotypers.....	1
Number of printers.....	2
Number of assistant printers.....	1
Number of laborers.....	1
Maps, number of sheets published.....	9
Maps, number of sheets printed.....	15,162
Chiefs of instrument shop.....	1
Number of hands in instrument shop.....	4

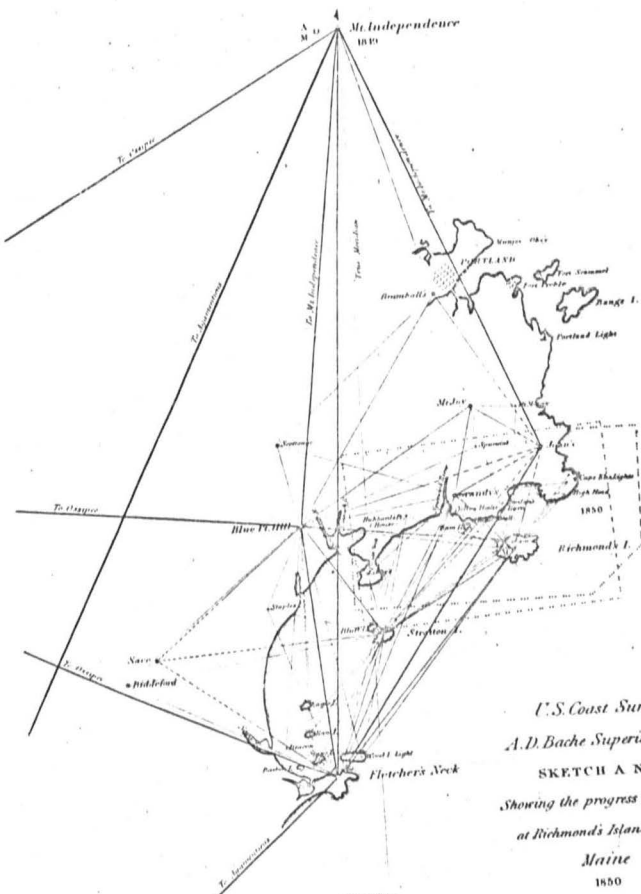


SKETCH A.

Showing the present work in Section N° 1

Unoccupied Station

at Cape Cod



U.S. Coast Survey
A.D. Bache Superintendent
 SKETCH A NO. 2
 Showing the progress of the Survey
 at Richmond's Island Harbor

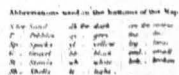
Maine

1850

Scale 1/10000

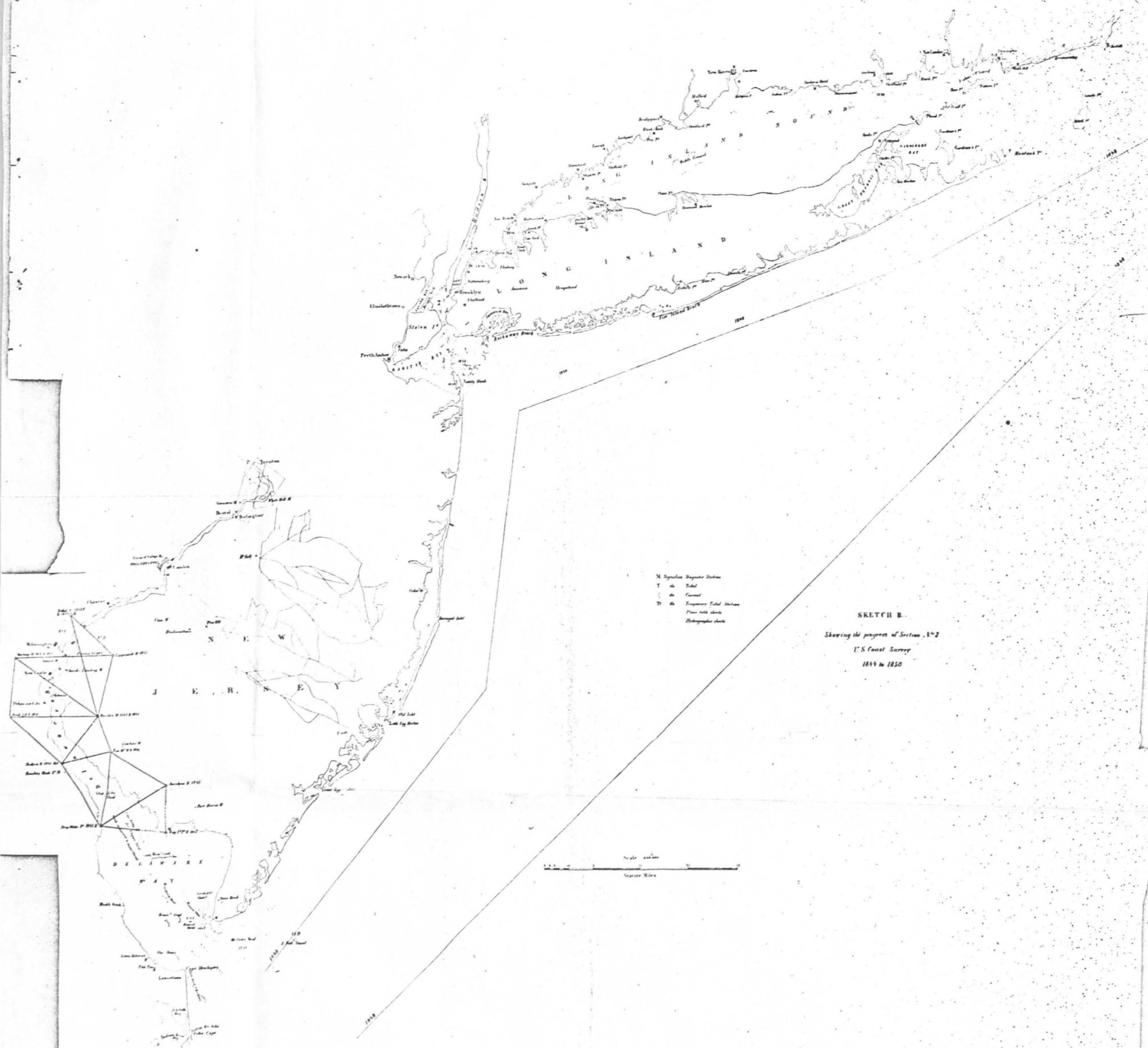
—————	Signifies line between primary occupied stations.
—————	————— subsidiary " "
—————	————— secondary " "
—————	————— compound triangulation stations.
—————	————— unoccupied do.
—————	limits of plane-table sheets.
—————	————— of hydrographic sheets.
—————	Tidal station.
—————	Magnetic station.

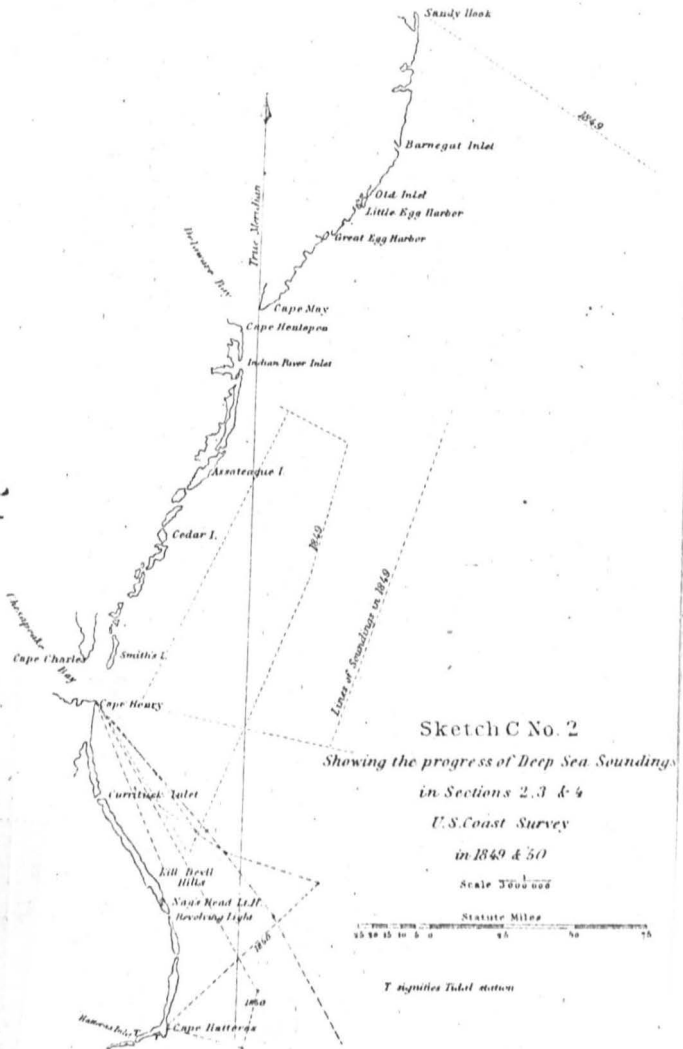
by the Hydrographic party under the command of
Lieutenant CHAS. H. DAVIS, U. S. Navy
in 1856, 1857 & 1858
and of Lieut. CHAS. Mc. BLAIR, U. S. Navy
in 1859
A. D. Bache, Superintendent

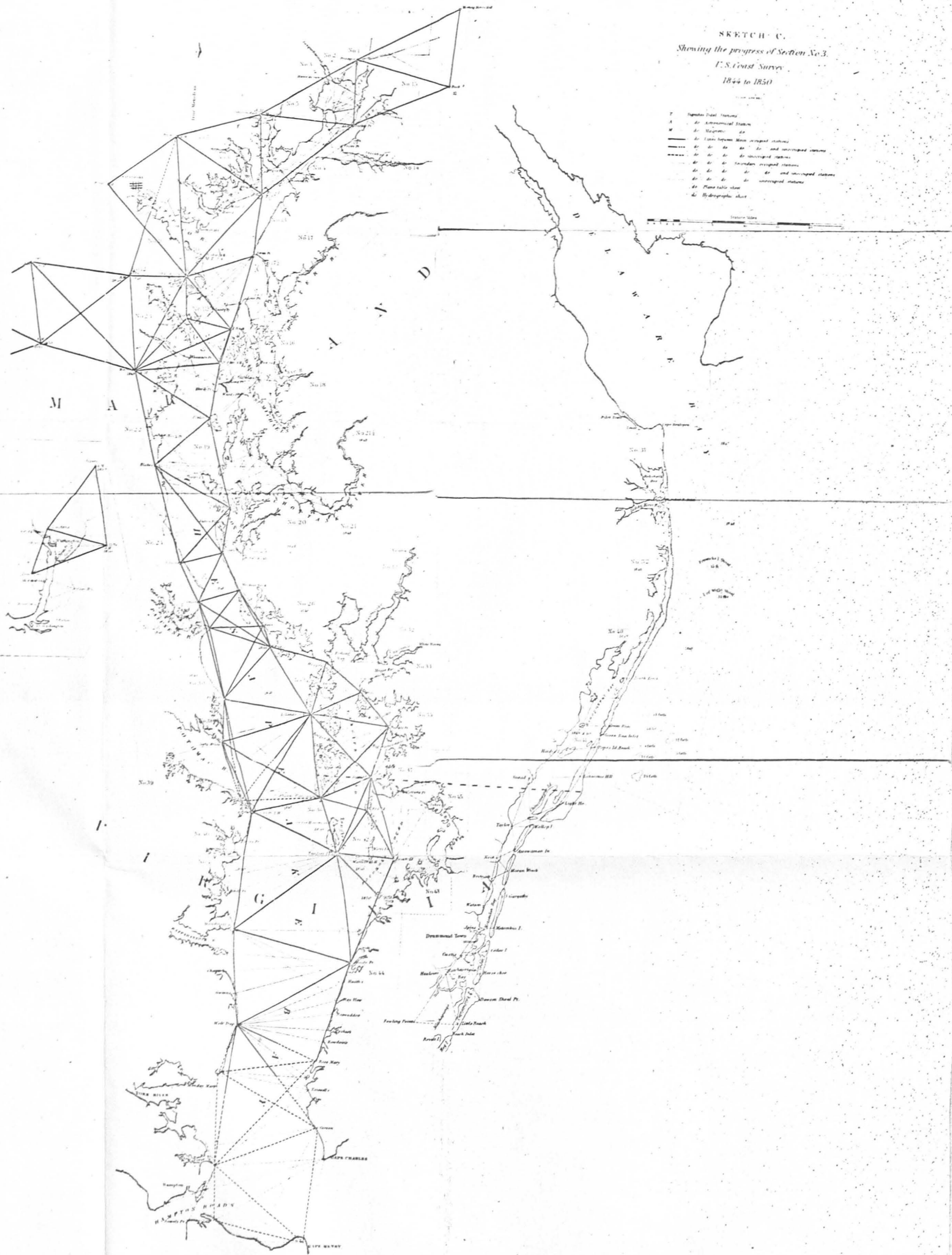


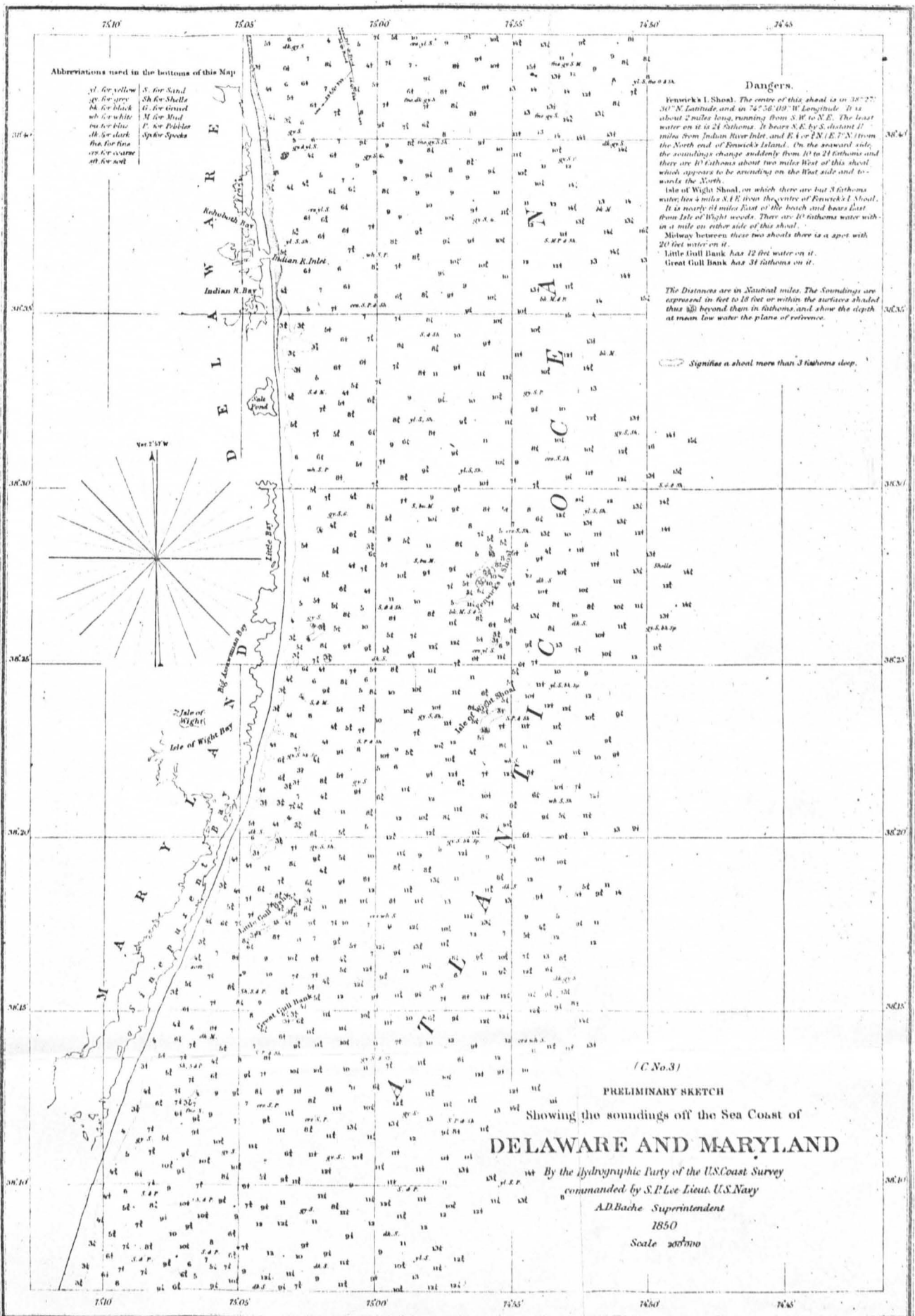
Statute Work

Handled With









Abbreviations used in the bottoms of this Map

yl. for yellow
gr. for grey
bk. for black
wh. for white
br. for blue
dk. for dark
fne. for fine
cr. for coarse
sh. for shell
M. for mud
P. for pebbles
S. for specks

Dangers.

Fenwick's Shoal. The centre of this shoal is in 38° 27' 30" N. Latitude and in 74° 54' 00" W. Longitude. It is about 2 miles long, running from S.W. to N.E. The least water on it is 24 fathoms. It bears S.E. by S. distant 11 miles from Indian River Inlet, and E. by N. (E.T.N.) from the North end of Fenwick's Island. On the seaward side, the soundings change suddenly from 10 to 24 fathoms and there are 10 fathoms about two miles West of this shoal, which appears to be ascending on the West side and towards the North.
Isle of Wight Shoal, on which there are but 3 fathoms water, lies 4 miles S.E. from the centre of Fenwick's Shoal. It is nearly 1/2 mile East of the beach and bears East from Isle of Wight woods. There are 10 fathoms water within a mile on either side of this shoal.
Midway between these two shoals there is a spot with 20 feet water on it.
Little Gull Bank has 12 feet water on it.
Great Gull Bank has 31 fathoms on it.

The Distances are in Nautical miles. The Soundings are expressed in feet to 10 feet or within the surfaces shaded thus 10 beyond them in fathoms, and show the depth at mean low water the plane of reference.

Signifies a shoal more than 3 fathoms deep.

(C No. 3)

PRELIMINARY SKETCH

Showing the soundings off the Sea Coast of

DELAWARE AND MARYLAND

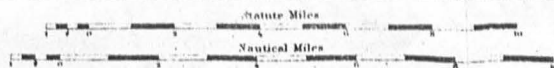
By the Hydrographic Party of the U.S. Coast Survey

commanded by S.P. Lee Lieut. U.S. Navy

A.D. Bache Superintendent

1850

Scale 1:100,000



D. No. 31

U.S. Coast Survey

A.D. Baché Superintendent

RECONNOISSANCE OF

HATTERAS INLET

Harbor of Refuge

COAST OF NORTH CAROLINA

By the Hydrographic party under the command of
R. Wainwright Lieut. U.S. Navy & Attd. U.S. Coast Survey

Published in 1850

Scale 30,000

SAILING DIRECTIONS

Hatteras Inlet bears W 20° S. 10 m. S.E. 12 miles from Cape Hatteras Lt. H. It is easily known by a remarkably round hammock covered with trees on the East side of the entrance.

The breakers seldom extend entirely across the entrance but at nearly all times make on each side and between them lies the channel.

The Bay should be approached from the Northward and Eastward. Keep in from 2 to 5 fathoms water along the breakers until up with the opening. The course is to W. N. E. a mile until getting into from 20 to 25 fms. then the course up to N. N. W. 1/2 N. a mile passing to the Westward of the breakers off the Eastern point of the Inlet to the anchorage just inside of the sand spit, which are here at low water and show at all times distinctly.

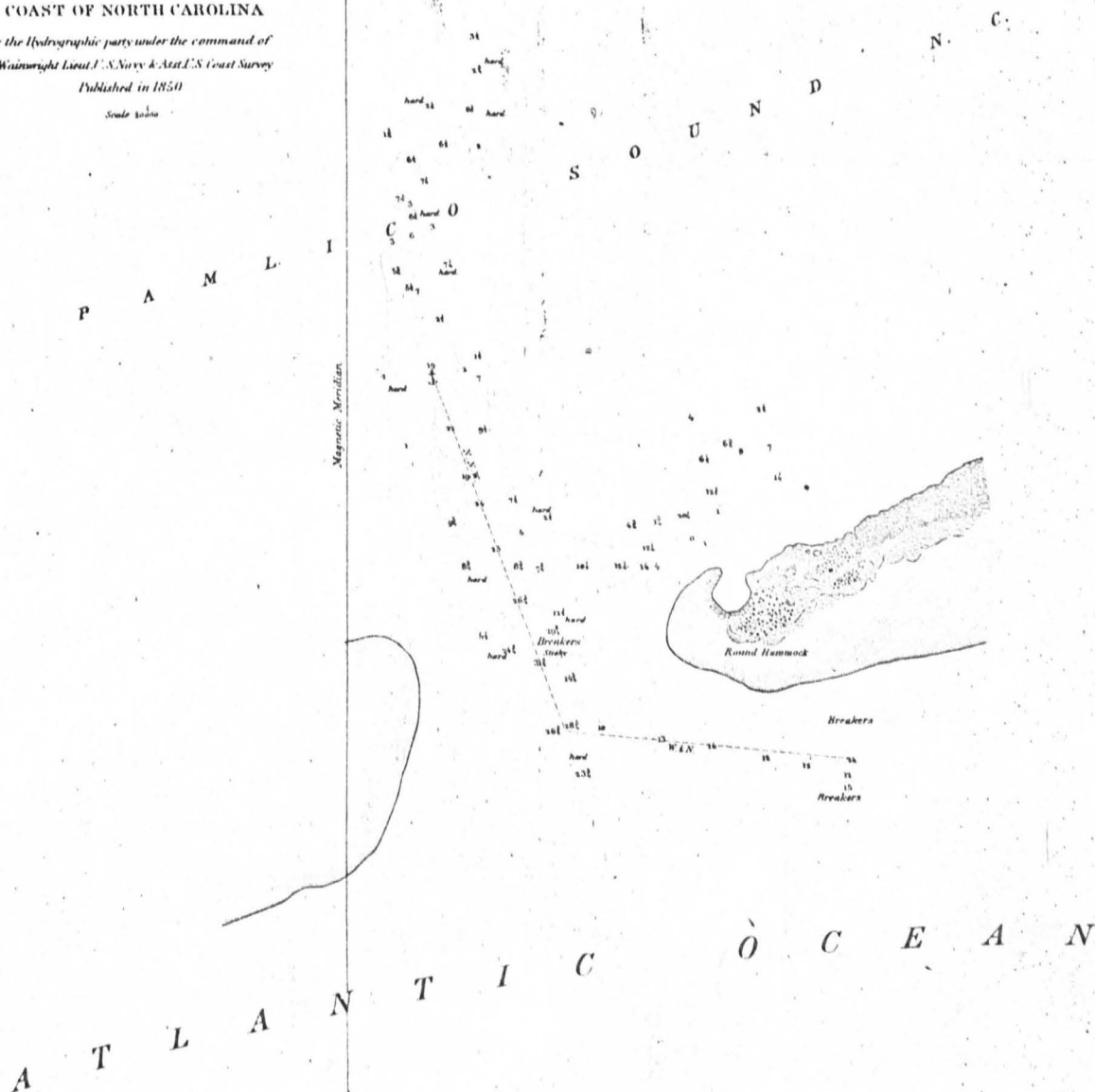
The anchorage is marked on the sketch.

Note: The above are the courses for running in but as the channel is very narrow great precaution should be taken by sounding.

The soundings are expressed in fms and are reduced to low water.

The Courses and Bearings are Magnetic.

The distances are in nautical miles.



SAILING DIRECTIONS.

(D No. 4)

PRELIMINARY SKETCH OF

HATTERAS SHOALS

By the Hydrographic Party of the U.S. Coast Survey
under the command of

T. A. Jenkins Lt. U.S. Navy and Assist. U.S.C.S.

A. D. Bache Superintendent

1850

Scale 1250000

Cape Hatteras Light bears N 37° E distant about 8½ nautical miles from the South Eastern edge of the 11th or Outer Shoals.

To clear the Outer Shoals in approaching them from the S and E, being the Light House to bear W in 12 to 15 fathoms water when run S keeping in not less than 10 fathoms water until the Lt. H. bears N 37° E when any course South of that may be steered with ease.

In coming from the N and N.W. keep in not less than 10 fathoms water until the Lt. H. bears N 37° E when any course S of that may be steered.

In bad weather and especially at night do not approach the Outer Shoals nearer than 15 fathoms water from the N.E. and E, and 12 to 15 fathoms from the S.W. and S. It is necessary to watch the bearing of the Lt. H. and keep as long going in beating around, or between the shoals, as approaching the shoals at night or in bad weather if the Lt. H. has not been seen before night, it will not be prudent to run the S.

At 10 or 11 fathoms water may be found to the N.E. of a shoal, in going outside of them from the S.E. and W. do not approach the land to the S.E. of the Cape nearer than 8½ to 10 miles.

To pass between the Diamond and Outer Shoals, from N.E. and E, being the Lt. H. to bear W in 10 to 8 fathoms water about ¼ mile from it and run S until the water shoals to 7 or 6 fathoms and the Lt. H. bearing N 37° E, when run S.W. carrying not less than 4 fathoms through the channel and deepening gradually to the South Western edge of it until in 7 or 8 fathoms with the Lt. H. bearing N. In approaching this channel from the N.E. and W. being the Lt. H. to bear N 37° E, 6 to 7 fathoms water about ¼ mile distant from it and run N.E. until in 8 to 9 fathoms water and the Lt. H. bearing N 37° E when the Shoals will be cleared.

To pass between the Diamond and Cape Hatteras Spit from the N.E. and E, being the Lt. H. to bear S 37° E, W 1° E or 2 fathoms water ½ mile distant and steer N 37° E giving the end of the Spit and back to a berth of 1 mile the shoals concern not less than 10 fathoms will be found. When the Lt. H. bears N in 3 to 6 fathoms water low ground will be cleared and when the Lt. H. bears N 37° E, 6 to 7 fathoms water the Spit will be cleared and the anchorage the Cove open.

To pass between the Diamond and the Spit from the S.E. and W. being the Lt. H. to bear N 37° E, 5 fathoms water 2 miles from the Spit and Point and run S. until in 8 to 9 fathoms water when the Shoals will be cleared.

To enter the Cove from the S.E. and W. being the Lt. H. to bear N 37° E, 2 to 3 fathoms water and run N.E. 1 mile without 1 of a mile from the S. Shoal and the Point of the Cape bearing about E 37° E in 5 to 4 fathoms water. The bottom is hard mud with an occasional small spot of blue mud. The currents in or out to the south of the Shoals have a velocity of 3 to 5 knots per hour and are greatly influenced in direction and force by the winds. The surface water of the Gulf Stream extends to within a short distance of the Outer Shoals for sometime after a continuation of Northwesterly and Easterly winds.

The Currents and Bearings are True and the Distances are in Nautical miles. The Soundings are expressed in feet to 10 fathoms or within 10 fathoms and in fathoms beyond them to 100 fathoms and show the depth of mean low water the plane of reference. The dotted surface around low water mark represent the bottom within the respective depths of 6, 12 and 18 feet.

Current time and Fall of tides at Hatteras time

Mean do. do. 5.3 P.M.
Low do. do. 3.3 P.M.
High do. do. 2.2 P.M.

Abbreviations used in the bottoms of this Map

M. for Mud. S. for Sand. Sh. for Shells. bl. for blue. gy. for grey. bk. for broken. wh. for white.

Statute Miles

Natural Miles

U. S. Coast Survey

A.D. BACHE, *Superintendent*

Sketch D. No. 5

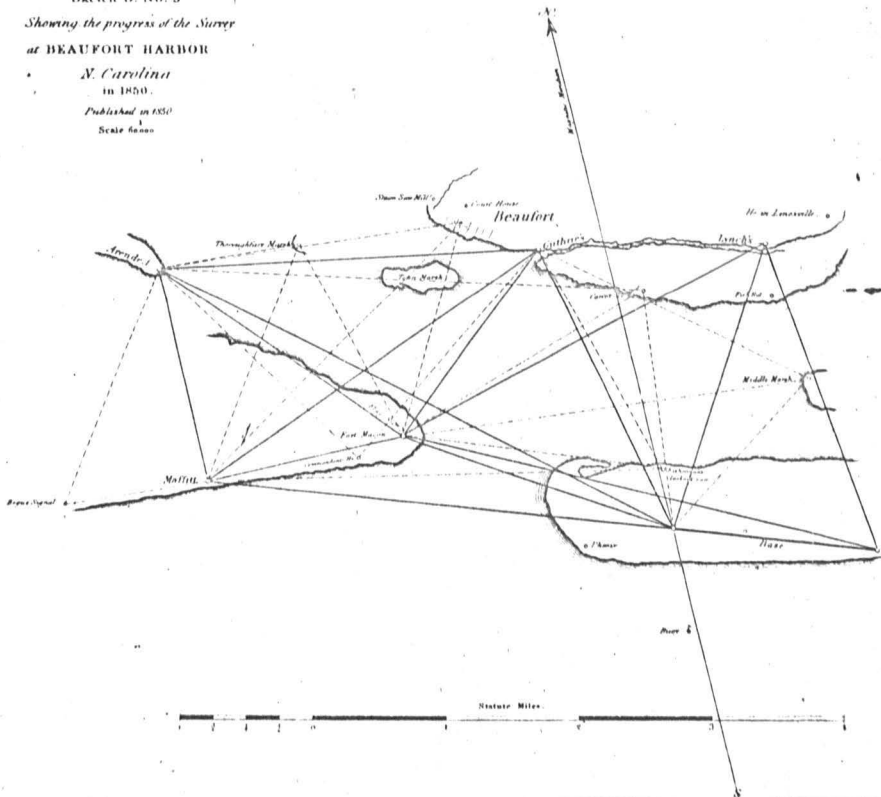
Showing the progress of the Survey
at BEAUFORT HARBOR

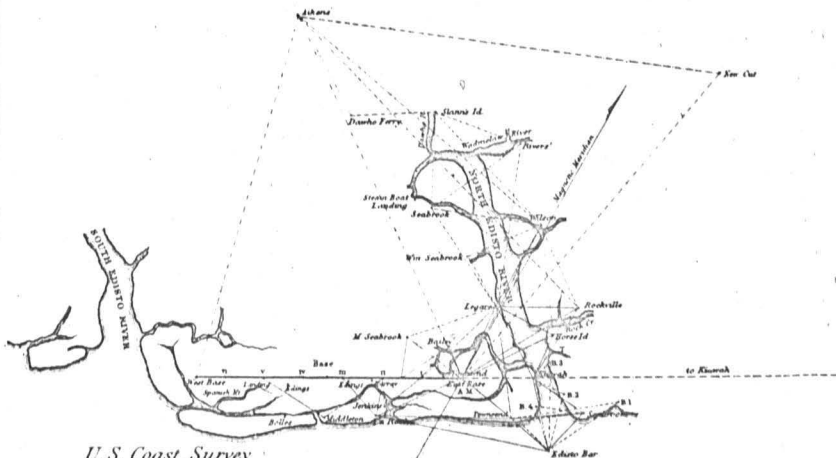
N. Carolina

in 1850.

Published in 1851

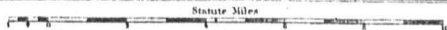
Scale 60000





U. S. Coast Survey
 A.D. Bache Superintendent
 SKETCH E No. 2
 Showing the progress of the Survey
 at N. Edisto River and Entrance
 South Carolina
 1850

Scale 200000



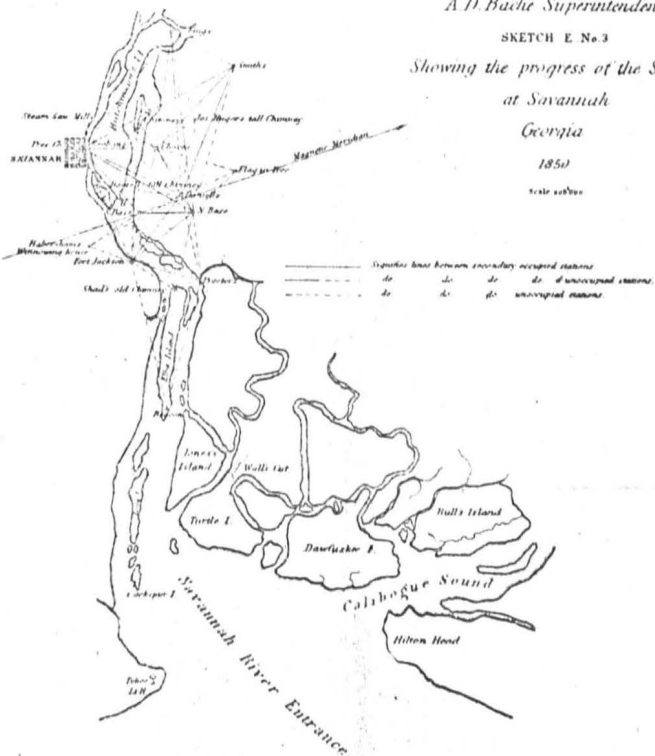
U.S. Coast Survey
A. D. Bache Superintendent

SKETCH E No 3

Showing the progress of the Survey
at Savannah
Georgia

1850

Scale 1:50,000

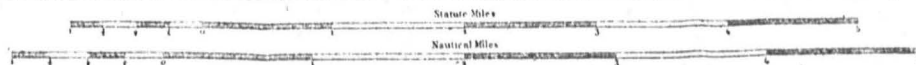
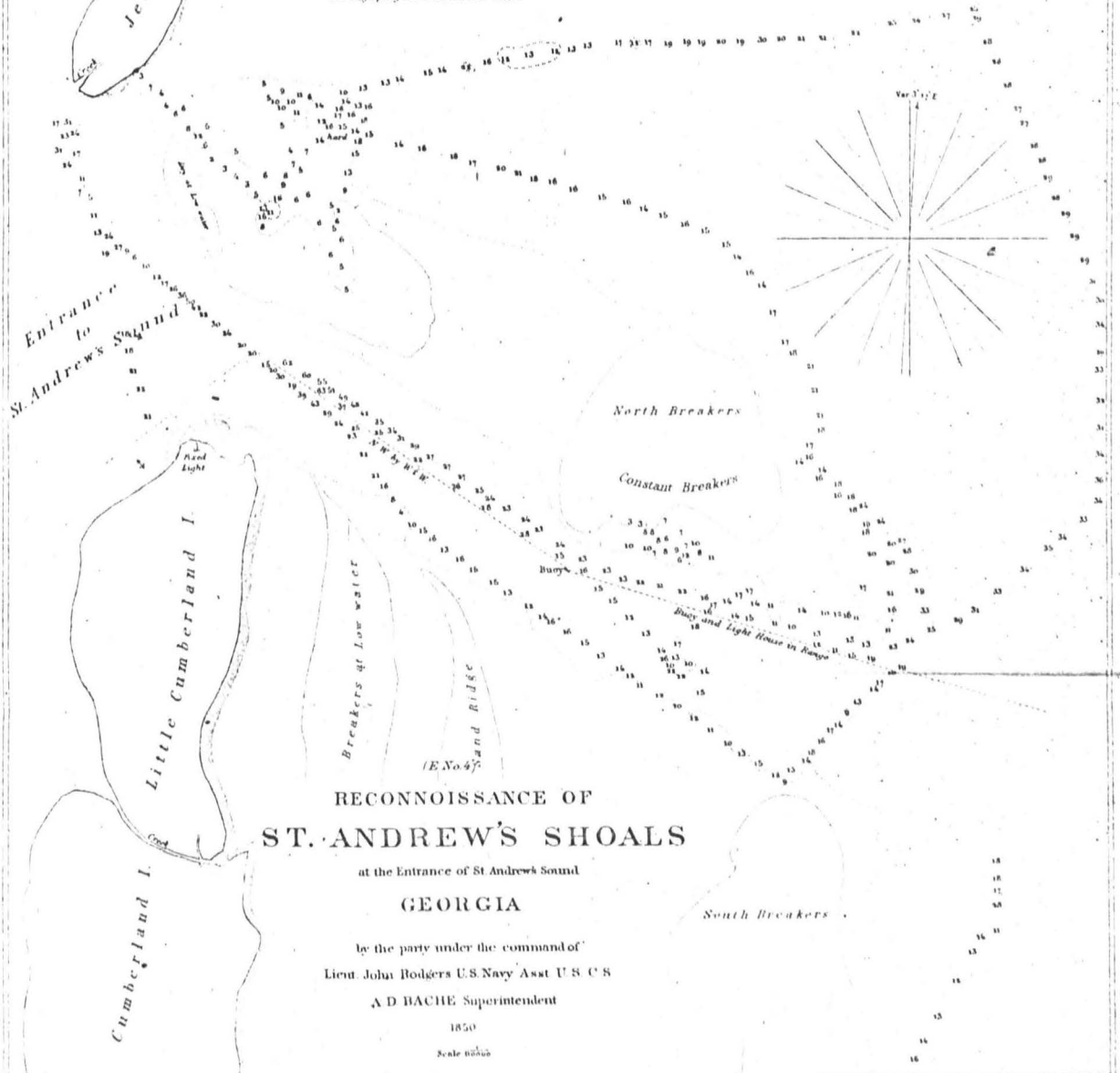


SAILING DIRECTIONS.

To run in by the Bore, keep in not less than 6 fathoms water until the Lt. H. bears by compass W by N. E. then steer for the Lt. House until the Bore comes in sight keep it and the Lt. House bearing up with the line, which should be passed close to either side. Then Steer N. W. by W. E. until the Lt. House bears W by N. then in for the anchorage under the N. W. end of Little Cumberland I. and anchor where convenient. To run in by compass, keep in not less than 6 fathoms water until the Lt. House bears by above W by N. E. then steer for the Lt. House. When the South Pt. of Jekyll I. bears N. W. by W. steer N. W. by W. E. until the Lt. H. bears W by N. E. then haul in for the anchorage under the N. W. end of Little Cumberland I. and anchor where convenient.

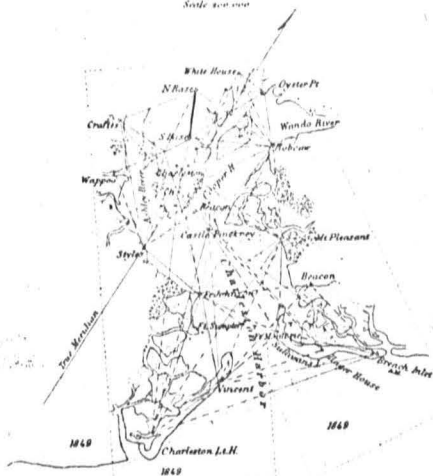
The Soundings are in fathoms and are reduced to Low water.
Note the buoy is said to be inaccurately moored, and it is proposed to move it.

High water near Cumberland Lt. H. in St. Andrews Sound 7555 at full and change.
The only Spring Tide observed rose 7 feet.



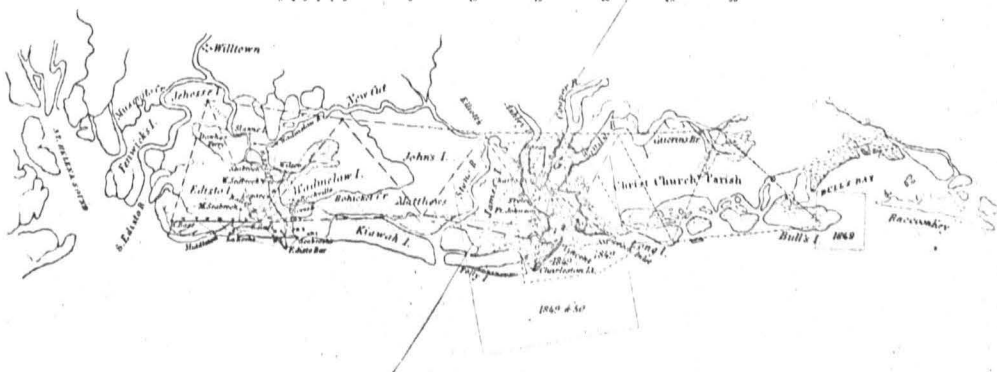
Signed by R.H. Knight Apprentice

Sketch E bis
Showing work in Charleston Harbor
1849

Scythris sp. nov.

Sketch E
Showing the progress of Section N^o 5
U.S. Coast Survey
1847 to 1850

Scale 0 to 100



Significance lines equal

 Δ Δ *As observed*

do not observe

da Hydrographic sheet

46 *T. G. S. Smith et al.*

de Tidal Station

A. Astronomical Station

de Moringa *de*

4

Nautical Miles

U.S. Coast Survey
A. D. Bache Superintendent

SKETCH P. N^o 3
Proposed Base at Cape Sable

FLORIDA

1850

Scale Nautical



U. S. Coast Survey
A. D. Bache Superintendent

SKETCH F. No. 1
Proposed Base at Cape Florida

1850

Scale: 10000

To Elliott Sound

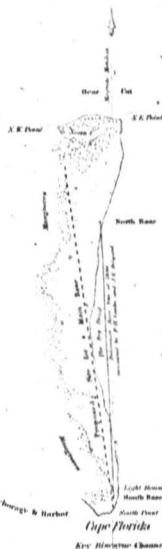
To Elliott Sound

Ambergris Bay Harbor

Cape Florida

Key Biscayne Channel

Scale: 10000

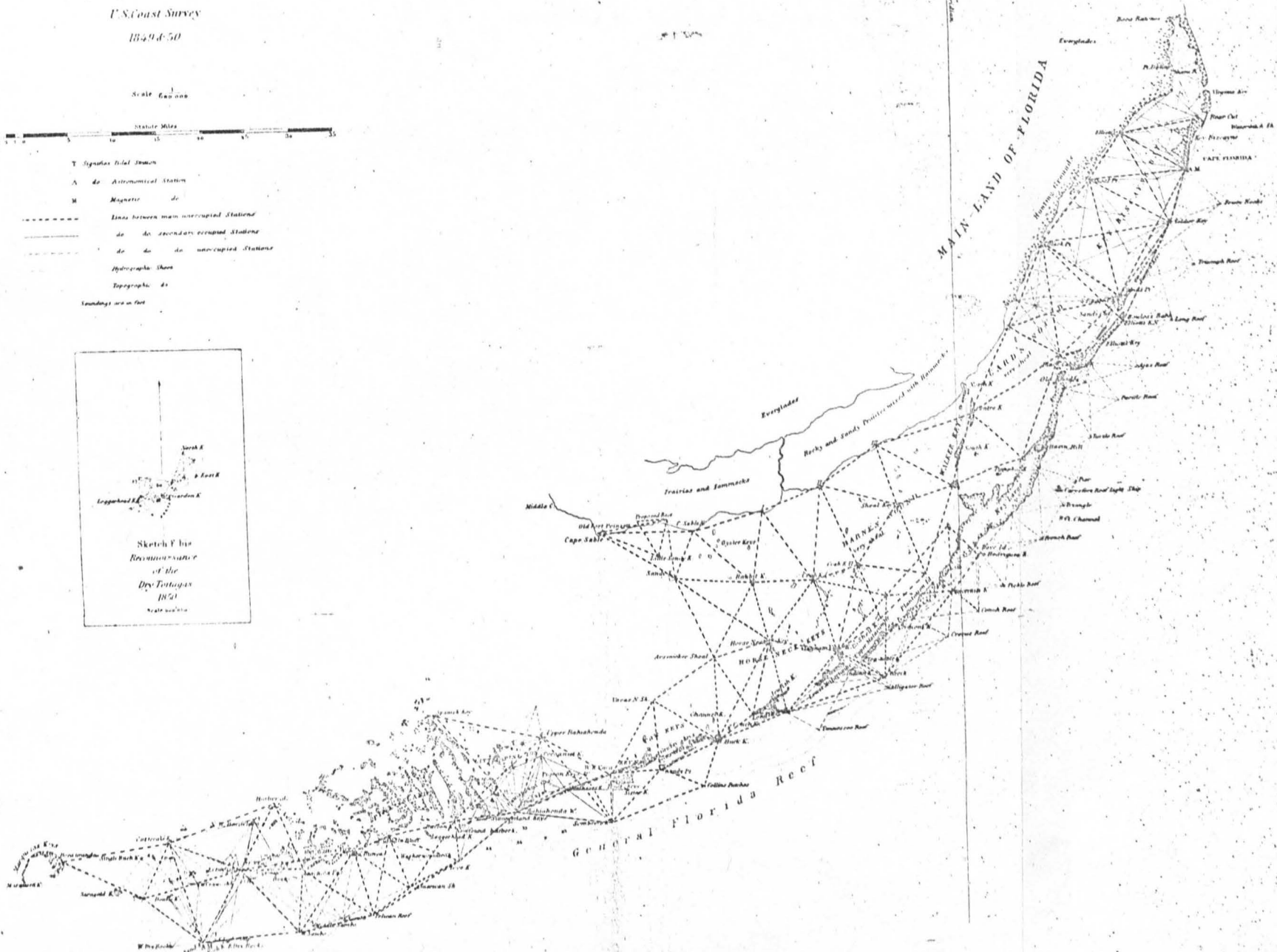


A T L A N T I C O C E A N

Scale 600 000

Statute Miles

Sketch of the
River Tottogay
 of the
Dry Tortugas
 1874
 Scale 1000 feet



SKETCH G

Showing the progress in Section No. 7.

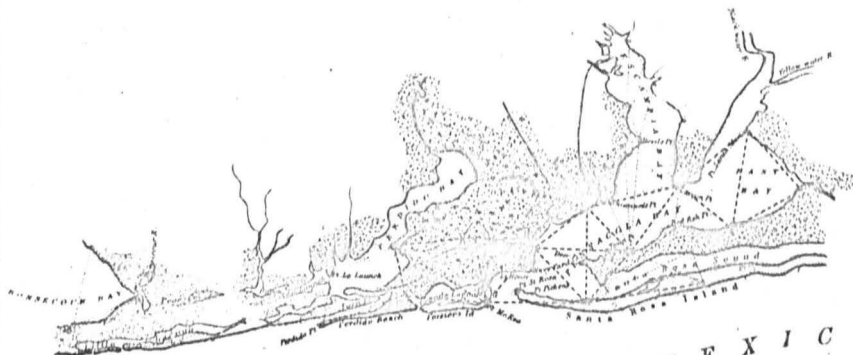
U. S. Coast Survey

in the year 1849

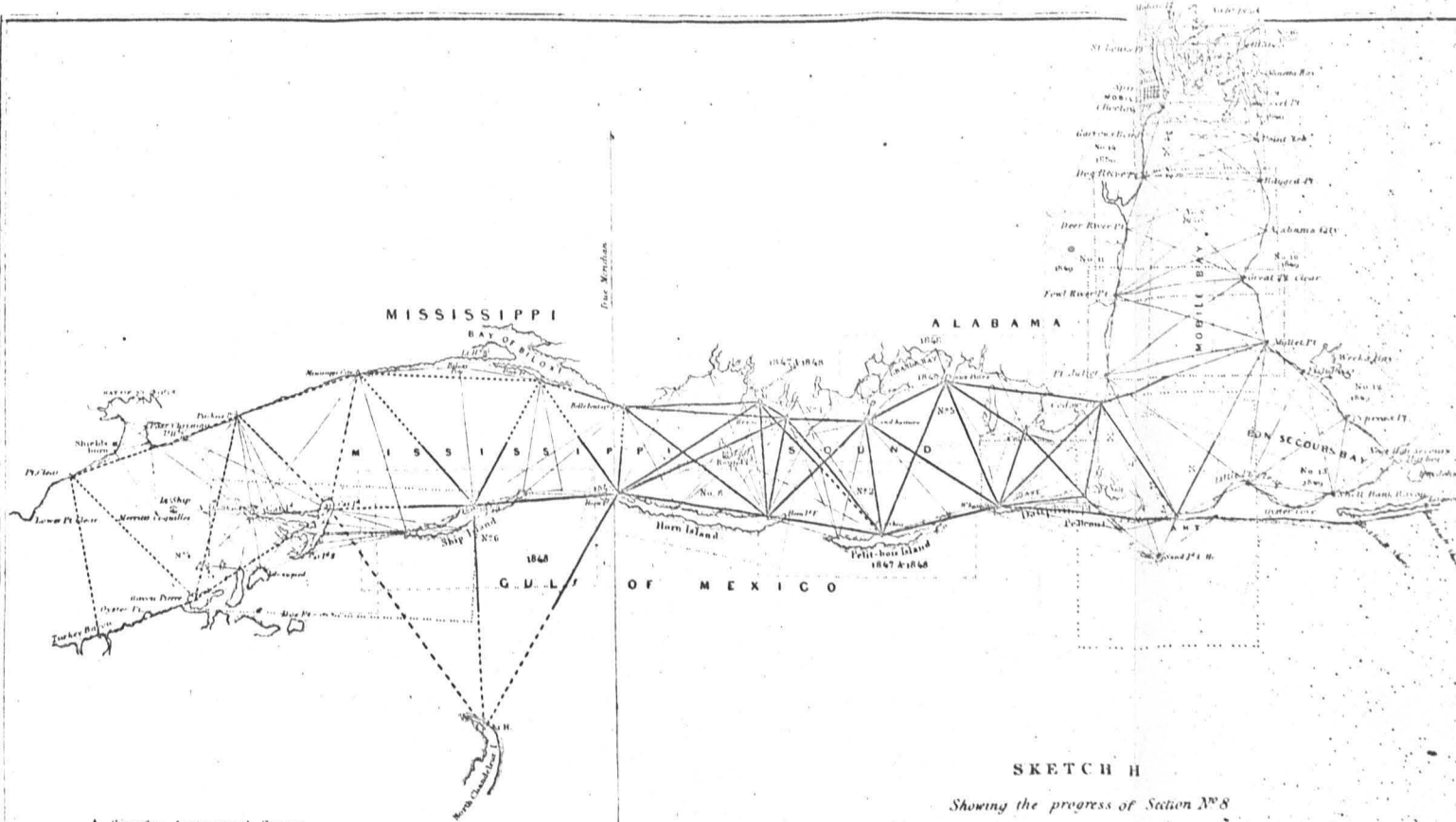
*Reconnaissance of Pensacola and Perdido Bays
and plan of Triangulation*

Scale 1:100,000

Statute Miles



G U L F O F M E X I C O



A Signifies Astronomical Station.

M " " Magnetic Station.

X " " Current Station.

T " " Tidal Station.

— Lines between primary occupied stations

— do do occupied & unoccupied stations

— do do unoccupied & secondary occupied stations

— Lines between primary unoccupied stations

— do do secondary occupied

— do do occupied & unoccupied stations

— do do unoccupied stations

Epigraphical Shores

Hydrographical do

SKETCH H

Showing the progress of Section No. 8

U. S. Coast Survey,

from 1846 to 50

Scale 600,000

Statute Miles.



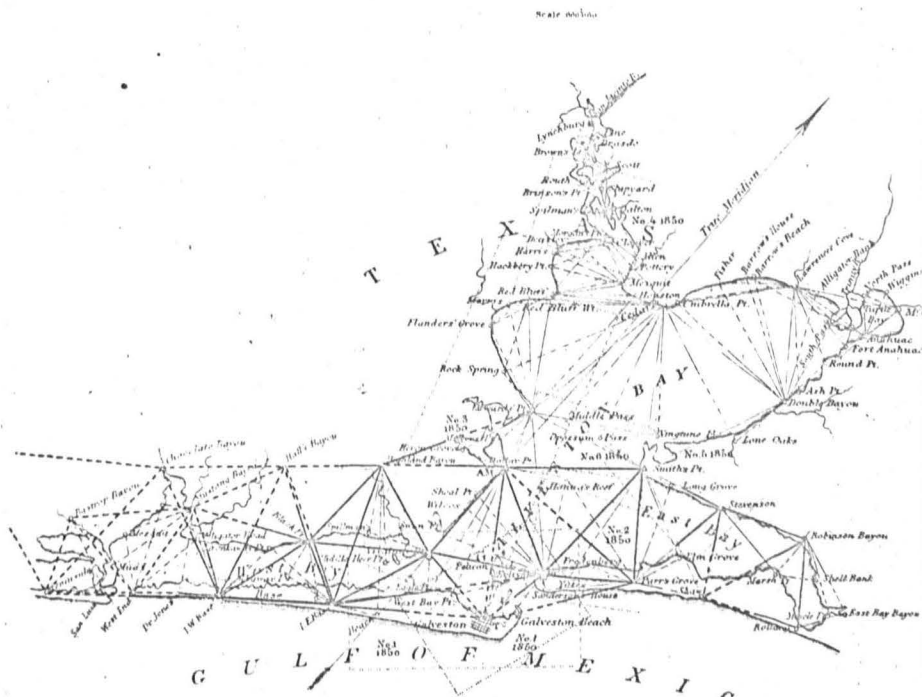
SKETCH I

Showing the progress in Section No. 9

U. S. Coast Survey

1848 to '50

Published in 1850



- Lines between main unoccupied Stations.
 ——— Lines between main occupied Stations.
 - - - - - do do do do & unoccupied Stations.
 — · — · — do do secondary occupied Stations.
 - - - - - do do do do & unoccupied Stations.
 - · - · - do between secondary unoccupied do.

A Signifies Astronomical Station.

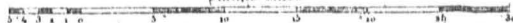
M " Magnetic do

T " Tidal do

Signifies Topographical and Shore

do Hydrographical do

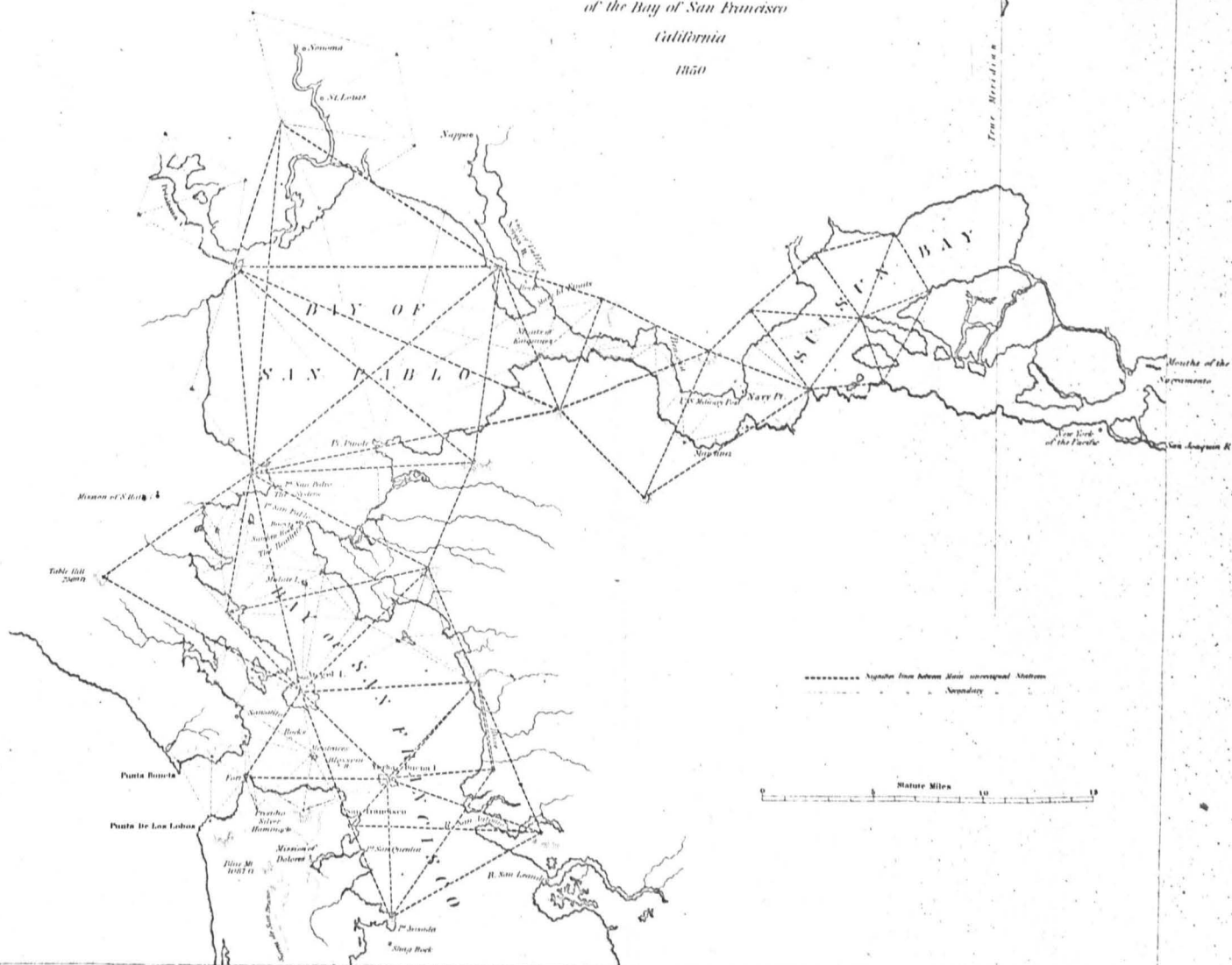
Statute Miles



SKETCH 1

California

1850



Cape Hancock
Disappointment

Columbia River

Killamook Head

Cape Lookout

Yaguenna

Nobai R.

Cape Bulwath

Alaga R.

Cape Propetia

Campagna R.

Cape Arago

Kowas R.

Cochelle R.

Cape Oxford or Blanco

Boring R.

Bay of R.

Pelican Bay

Pl. St. George

Kalanianth N.

Red Rock

Trinidad Bay

Humboldt Harbor

Trinidad City

Union Town

Cape Mendocino

Rock

Point

Fort Ross

Bodega Bay

Petaluma River

Drake's Point

St. Francis

San Francisco

Palma Nueva

Bay of Monterey

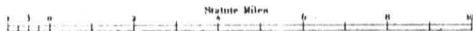
Monterey

Point

U.S. Coast Survey
A.D. Bache Superintendent

SKETCH J NO. 2

Reconnaissance of the
Western Coast of the United States
From Monterey to the Columbia River



Variation $21^{\circ} 40' E.$

U. S. Coast Survey
A. D. Bache Superintendent
 SKETCH K
 PRELIMINARY SURVEY OF THE
MOUTH OF THE COLUMBIA RIVER

OREGON TERRITORY

By the Hydrographic party

Under the command of

W. P. McArthur Lieut. U. S. Navy & Assist. U. S. Coast Survey

1850

Scale 1:10000

PACIFIC OCEAN

*Cape Hancock
or Disappointment*

The soundings are in feet

BAKER'S BAY

Middle Channel
Line of Soundings
South Channel
Line of Soundings

Pr. Adams

Chinook Pt.

Columbia River

Barre at Low Water

Barre at Low Water

Tongue Pt.

Astoria

YONGE'S BAY

Youngs Bay