

LETTER

FROM

THE SECRETARY OF THE TREASURY,

TRANSMITTING

The report of the Superintendent of the Coast Survey, showing the progress of that work.

DECEMBER 17, 1845.

Read, and laid upon the table; and 250 extra copies ordered to be printed for the office of the coast survey.

TREASURY DEPARTMENT,
December 15, 1845.

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. Bache, Superintendent of Coast Survey, showing the progress of said work during the year ending November, 1845. All which is respectfully submitted.

R. J. WALKER,
Secretary of the Treasury.

HON. JOHN W. DAVIS,
Speaker of the House of Representatives.

Report of the Superintendent of the Coast Survey, showing the progress of the work during the year ending November, 1845.

COAST SURVEY STATION,
Bodies Island, N. C., November 29, 1845.

SIR: I have the honor to present the report of the progress and state of the survey of the coast, required by the regulations, in order that it may be "laid before the President and Congress."

The report contains, 1st, a brief statement of the work executed by the different parties in the field; 2d, of the office work, including the preparation, engraving, and publication of maps and charts resulting from the survey; and 3d, a sketch of the work proposed for the ensuing year, with an estimate of the cost of execution.

In the statement of the work done, I have endeavored to be sufficiently minute, to enable the President and Congress to judge whether the pro-

gress for the past year has been satisfactory, either in reference to that of former years or to the sum appropriated and expended.

In regard to the estimate for the next fiscal year, I would bespeak for it in advance a favorable consideration; it has been made carefully and after due knowledge of the requirements of the different parties, and a careful study of the operations which can be carried on to the greatest advantage in the course of the year.

Any diminution of the sum there asked must involve a decrease in the amount of work which is practicable, and thus postpone the realizing of the results of the survey on some portion of the coast, and the ultimate completion of the work. Operations are proposed which may certainly be accomplished with the present scientific force, or with a very moderate addition to it. The number of parties which may be employed advantageously in their execution is stated. The actual expenses of such parties are taken as the basis of the estimate—expenses which are limited as far as is consistent with the due progress of the work—so that no party shall consist of more officers or men, or be supplied with more equipage, than is absolutely necessary. The estimates for computing, reducing, drawing, engraving, and printing, are regulated in a similar way. To place these estimates upon a lower scale would be, in the case of field parties, to risk the cessation of operations during the working season, and thus to incur the expense of salaries without corresponding progress in the work.

It is sometimes supposed that salaried officers alone constitute the working parties of the survey. It is true that the scientific chief of each party is the essential person by whom the results are obtained, and who works with his hands as well as his head; but there are also purely manual operations to be performed, requiring in each of the land parties the employment of at least from four to six, and in some cases ten and twelve men. The number of persons therefore necessarily employed in the mechanical operations of the survey is very considerable.

The increase of the appropriation for the year 1845-'46 has enabled me to commence operations effectively in two additional southern sections—one in *North Carolina* and one on the *Gulf of Mexico*. This is a measure of economy, since it gives employment in the field during periods of the year when the parties cannot be employed to the north, and as it advances the work towards completion. It is of public utility, because it must give, at an early day, charts of a portion of our coast but little known and dangerous to the navigator.

Should the estimate which I furnish be adopted, the work will be extended from these centres, and a new southern centre be established in *South Carolina* or *Georgia*, from which in turn to extend the survey to meet the other parts of the work.

The estimate furnishes means for carrying on the survey of the coast effectively in the following named States: *New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina or Georgia, Florida, Alabama, Mississippi, and Louisiana*; in all, sixteen States. In some of them the work is nearly finished, in others far advanced, and in others new centres are to be occupied, from which the survey may be extended until the parts unite.

The southern coast must be surveyed by frequent bases connected

generally by intermediate triangulations. There is no objection to the establishment of these centres, which will finally be connected by a chain of triangles. The results thus procured are of course approximate until the connexions are made, but they are practically useful, and in the absence of more complete ones, (to be finally supplied by the coast survey,) they may save the loss of many valuable lives and of much property. During the past year the survey in *North Carolina*, and in *Alabama*, *Mississippi*, and *Louisiana*, has been actually begun, establishing two new centres, the northern one of which will be connected in three or four years with the chain of triangles down the Chesapeake, and thus with the whole coast survey from Maine to North Carolina. The sum which I ask for field work was repeatedly granted when the survey extended over but one of the five sections in which it is now executing.

The additional sum voted by Congress last year for reducing, engraving, and publishing part of the work of former years, has secured the publication, within the year, of no less than seven engraved sheets, and the preparation, by computations, reductions, and drawings, of others for engraving. Besides these, charts of two harbors surveyed during the past year are engraving, and will probably be finished before next February.

The work promised to be executed within the period embraced in this report has been actually done, and I may, therefore, claim confidence in the promises now made for the ensuing year. The amount of work done in the field and office has been greater in proportion, than the increase in the appropriation of last year on that which preceded it. Upon a general review, that increase of work cannot be taken at less than one-third, and the additional means exceeded those of the former year, including a balance of the year next preceding, but one-sixth. If the report were carried to the close of the fiscal year, it would probably present a greater proportionate gain.

The direction of Congress, that officers of the army and navy should as far as practicable be employed upon the work, has been faithfully executed, and an additional number in both services has been asked for within the present year. The frequent changes necessarily occurring in these parties, from the prior claims of professional services upon the officers, put a limit to their advantageous employment, and thus determine their due proportion to the more permanent civil parties.

The following is a summary of the work done since November, 1844, the date of my last report:

In the eastern section.—The primary triangulation has been extended to Cape Ann and across the northern boundary of Massachusetts, one station observed on being in New Hampshire. The verification base, on the Providence and Boston railroad, has been connected with the primary triangulation. The secondary triangulation has been carried to the peninsula of Cape Cod. The topography of the shores of Buzzard's bay, the Elizabeth islands, and Martha's Vineyard has been nearly completed. The hydrography includes Buzzard's bay and part of the Vineyard sound. Additional observations for differences of longitude from Europe have been procured at Cambridge, Portland, and Nantucket. The work of this section has been within the limits of the States of Rhode Island and Massachusetts.

In the middle section.—The primary triangulation of Mr. Hassler has

been connected with the main triangulation in Delaware bay, and carried across the neck between the Delaware and Chesapeake bays. A reconnaissance, for connecting the work on the Delaware with that on the coast of New Jersey, is in progress. Astronomical observations have been made at one of the Delaware stations.

Magnetic observations have been made in the harbors of Long Island sound. The off-shore work has been continued, and the special examination of the Gulf stream has been commenced. Observations for the set and drift of the tides have been made in New York bay and harbor, in the East river, and in Long Island sound. Additional soundings have been made in the East river and in Long Island sound. This work is generally within the limits of Connecticut, New York, New Jersey, Pennsylvania, and Delaware.

Southern Section No. I.—The Kent island base has been connected with the primary triangulation of Mr. Hassler, and the primary triangulation has been carried south of Kent island. A reconnaissance for a triangulation to connect the work on the bay with the capitol and naval observatory, and for verifying the work on the Potomac river, has been completed. Also, additional astronomical and magnetic observations have been made. A secondary triangulation of the streams emptying into the Chesapeake, north of Kent island, and of part of the bay, has been completed. The secondary triangulation of the bay, south of Kent island, has made considerable progress. The topography of the shores of the bay, of the Patapsco river, and of other streams flowing into the Chesapeake, north of Kent island, is more than three-fourths done. The hydrography of the Patapsco and of the approaches to it is completed, and that of the bay north of Kent island is nearly finished. This work is generally in the States of Delaware, Maryland, and Virginia.

Southern section No. II.—The operations connected with the measurement of the base line on Bodies Island, North Carolina, and the triangulation of Albemarle sound, have been commenced.

Southern section No. III.—A reconnaissance of the coast of Alabama, Mississippi, and part of Louisiana has been made, and the triangulation and astronomical observations on Mississippi sound will be commenced as soon as the season permits.

The following maps and charts have been published within the year, or will be ready for publication before the first of February next: a map of New York bay and harbor, on a scale of $\frac{1}{80000}$; two sheets of the large map of New York bay and harbor, scale $\frac{1}{30000}$, completing this map of six sheets; a chart of Fisher's Island sound; one sheet of the entrance of Long Island sound from the eastward; one sheet of Delaware bay and river; New Bedford harbor, surveyed in 1844; Annapolis harbor and the Severn river, surveyed in 1844. The engraving of a sheet of the southern coast of Long island is nearly done.

The engraving of the following is nearly completed. A second sheet of Delaware bay and river, and chart of the harbor of New London.

I now proceed to give a more particular account of the progress of the work, avoiding, however, scientific details as far as practicable.

In accordance with the plan adopted in my last report, the operations of the survey will be classified under the heads of—

1. The primary triangulations and astronomical and other observations connected with them.

2. The secondary triangulations, and others connected with them.
3. The topography.
4. The hydrography.
5. The office work, including—

First. The calculations of the survey.

Second. The drawing of maps and charts.

Third. The engraving, printing, and publishing of the maps and charts.

Fourth. The making and repairs of instruments.

The progress of the field operations will be described in the different geographical sections of the country to which the survey has extended, beginning northward and eastward. These include—

I. The eastern section. From Narragansett bay, eastward and northward, to Massachusetts bay; in the States of Rhode Island and Massachusetts.

II. Middle section. From Narragansett bay to New York bay, and thence to the capes of the Delaware, including, also, Delaware bay and river; in the States of Connecticut, New York, Pennsylvania, New Jersey, and Delaware.

III. Southern section No. I. Chesapeake bay, &c.; in the States of Delaware, Maryland, and Virginia.

IV. Southern section No. II. Coast of North Carolina, in the State of North Carolina.

V. Southern section No. III. Coast of the Gulf of Mexico; in the States of Alabama, Mississippi, and Louisiana.

I. EASTERN SECTION.

From Narragansett bay, eastward and northward, to Massachusetts bay.

If any incentive to exertion had been required in this section of the work during the past season, it must have been found in the accidents occurring within the knowledge of the different parties, from a want of information in regard to the dangers of this part of the coast. In the Vineyard sound a ship prepared for a whaling voyage to the Pacific struck, in good weather and with a fine and fair breeze, upon a shoal off Holmes' Hole, and this vessel had not entirely been released from peril, to be taken into harbor to refit, when a heavily loaded schooner struck near the same spot. The injury to the first of these vessels would have paid for the operations of the survey in this quarter more than twice over. The ship *Centurion*, lost on Nantucket south shoal during the summer for want of knowledge of the extent of the shoal and of the set and drift of the tides near and upon it, was insured for a sum beyond the whole appropriation for the field work of the year. These are only a part of the accidents which occurred in this region during the summer, the least dangerous portion of the year. There passed through the Vineyard sound within the last three years, (as appears from an interesting letter from William Mitchell, of Nantucket, appended to this report, appendix, No. IV,) four hundred and forty seven ships, three thousand six hundred and sixty-four brigs, twenty-three thousand two hundred and sixty-two schooners, and nine thousand seven hundred and seven sloops; or a total of thirty-seven thousand and eighty vessels. The sound through which this trade is carried on in these vessels has many dangerous shoals, the limits of which are not defined on the existing charts. The pilots know the chan-

nels, but not the configuration of the bottom generally, and, besides this, a vessel is often without a pilot when danger is nearest. The coast survey will soon be able to supply the want of a good chart in this quarter.

1. *The primary triangulation* in this section has been carried from Narragansett bay eastward across Buzzard's bay, the Vineyard sound, and the sound between Nantucket and Cape Cod; then northward across Cape Cod and Massachusetts bays, where it meets the same work carried northward from Narragansett bay, and stretches to the hills which are near the northern boundary of Massachusetts, and into New Hampshire.

The diagram (sketch A) gives a sufficiently correct idea of the character of the triangulation, and of its connexion with the geographical features of the country. It rests upon the base measured by assistant Blunt, on the Boston and Providence railroad, as shown by the dotted lines in the diagram. It is connected with the main triangulation, and carried eastward, as indicated by the lighter full lines, the line McSparran—Quaker Hill being common to the two triangulations. Passing eastward, it gives a suitable base (Cuttyhunk—Indian hill) for the secondary triangulation; determines an important point (Cuttyhunk) at the entrance of Buzzard's bay and the Vineyard sound, a point on Martha's Vineyard, a point on the island of Nantucket, one on the ridge of Cape Cod, near Barnstable, one near the extremity of Cape Cod, one at Manomet point, near Plymouth; furnishes the base Manomet—Provincetown, for the secondary work; determines a station (Blue hill) overlooking Boston harbor, a point (Thompson's hill) near Cape Ann, and other stations suitable for carrying the work along the coast of New Hampshire and Maine.

The character of the country, in proceeding northward and eastward from Massachusetts, admits of a triangulation with sides of very considerable length, tending to accuracy in the scientific results, and to economy and rapidity in the practical ones. At the same time, by adopting intermediate points, a series of triangles is formed, furnishing, directly or by easy subsidiary operations, frequent bases for the secondary work, in addition to the constant checks presented by the positions of the primary points themselves. Thus, for example, the quadrilateral formed by Blue hill, Wachusett, and Thompson's hill in Massachusetts, and Unkonoonuc mountain in New Hampshire, has sides of from thirty to fifty-eight miles, one of these being immediately in the direction of the coast, and the stations at the other extremities overlooking the whole coast and country adjacent to it, to the northward and eastward, while by the intermediate station of Holt's hill a chain of lesser triangles is carried forward, of which the angular points overlook the adjacent waters and islands. In the case used for illustration, the stations Blue hill and Prospect hill overlook Boston harbor, its islands, and dependencies. The larger triangulation is marked on the diagram by the broader full lines, and the minor one by the narrower lines.

This part of the work will be connected immediately with the observatory at Harvard University, Cambridge, and when completed will render directly available the accurate determinations for the longitude and latitude of that point, which have been the accumulation of many years of the labors of the Cambridge and Boston astronomers, and are especially valuable to the survey in reference to the difference of longitude between this and European observatories. The triangle Blue hill, Prospect hill, Harvard observatory, makes this connexion.

Seven stations, marked 1845 in the sketch, were occupied this year between the 6th of May and the 19th of October, when the party was transferred to North Carolina. Those stations, upon which observations were made without occupying them, are marked (u). The stations at Nantucket and Provincetown were not occupied, because they are not used in carrying the work forward, and the results, with the instrument employed, proved, by the test of summing the angles in the triangles of which all three of the angles were measured, that a due degree of accuracy in the positions of those points was attainable without the necessity for measuring the third angle for verification.

The work especially intended for testing the main triangulation, by joining it with the base of verification through Pocasset station, was shown in the sketch accompanying the report of 1844, and has on that account been omitted in the one now presented.

The number of points observed upon has been as follows: primary stations 41; from the station first occupied 7; from the second 6; from the third 4; from the fourth 5; from the fifth 4; from the sixth 7; from the seventh 8; other stations and objects observed upon from the seven stations, 16. The number of angles measured was 55, and the number of observations used in their measurement was 4,436.

The area of the polygon covered by the season's work is 2,840 square miles. In making this estimate, the area of the triangles, of which two angles only have been measured, has been estimated at two-thirds of its real extent, and those where one angle only has yet been measured at one-third. Work has been prepared for a secondary triangulation party for at least two years.

Astronomical observations were made at four of the stations: Great Meadow hill, between Providence, Rhode Island, and Taunton, Massachusetts; Indian hill on Martha's vineyard; Shootflying hill, near Barnstable; and Blue hill, near Boston. At the first, the eclipse of the sun of May 6th, and the transit of Mercury on May 8th, were observed, the local time being carefully obtained. At the others, observations for latitude and azimuth were made, requiring of course the determination of local time as an auxiliary. The number of observations for time was 1,125; for latitude, 6,362; for azimuth, 937. The azimuths were obtained, as during last year, by the elongations of the pole star.

Vertical angles for the heights of the stations were measured at all the stations upon nearly all of the others in sight, so that reciprocal angles have been measured from most of the stations occupied in 1844 and 1845. One of the heights above the level of the sea was also measured by the barometer.

Magnetic observations were made at five primary stations, and, in addition, at a secondary station near New Bedford, the last named observations being required for the chart of that harbor now preparing for publication. The observations were as follows: of variation or declination, 269; of dip, 264; and of absolute horizontal intensity, 90.

A meteorological journal, recording twice a day the temperature and moisture of the air, the direction and force of the wind, the character of the clouds, and proportion of sky covered, and once a day the pressure of the air, was kept at all the stations but three. The number of observations was, of the thermometer, 154; hygrometer, 154; barometer and attached thermometer, 82; other observations, 451.

The instruments employed were as follows : the Troughton and Simms theodolite of three feet diameter, for measuring the horizontal angles of the triangles and the azimuths; the two feet vertical circle, originally accompanying the theodolite and the six inch Gambey theodolite for the vertical angles; a thirty-two inch transit kindly loaned by Major Graham, of the United States topographical engineers, and a twenty inch transit, for which we are indebted to S. C. Walker, Esq., of Philadelphia, for time; the two feet Troughton and Simms circle, and the six inch Gambey theodolite for latitude; a set of Riddell's portable magnetic instruments by Jones, of London, for variation and horizontal intensity; a dip circle by Patten, of Washington, and Hassler barometers.

The Troughton and Simms two feet repeating circle has not been used in the survey for many years, and the trials made with it in the summer of 1844 showed many important defects in the instrument. Some of these were remedied by Mr. William Würdeman, mechanic in the Coast Survey office, during the summer of 1844, so that on further trial in the autumn the results were sufficiently encouraging to induce further changes, and the construction of a stand (in part of the materials of one formerly used,) expressly for the instrument. Further changes were made last spring and summer, and the instrument has rewarded the labor expended upon it, and promises, with comparatively slight additions, to become available for the work.

The measurements of horizontal angles of the triangles, the observations for azimuth, a small part of the observations for height and for time, and the observations of the eclipse and transit in May, were made by myself personally. The observations for time and for latitude were generally made by Lieutenant Thomas J. Lee, of the United States topographical engineers, assistant in the party; and the vertical angles generally were measured, and a part of the observations for time taken by assistant Charles O. Boutelle. The reconnaissance for the work was made under my immediate direction by assistant C. O. Boutelle, at such times during the season as he could be spared from duties in camp. In September the reconnaissance was carried across the northern part of Massachusetts into New Hampshire, and a range of stations beyond those represented in the sketch selected, carrying forward the triangulation very satisfactorily.

During the early part of the season, astronomical and magnetic observations were made by Lieutenant Lee on the Chesapeake, the notice of which will be found in another part of this report.

The assistants of my party were occupied during the last winter in calculating the observations of the previous season.

The astronomical observations already made in this quarter, at points connected by the triangulation, bring seven neighboring local determinations of latitude and azimuth to bear in establishing the position of any one of the station points, or the direction of the lines joining them, for the map of this part of the coast now in preparation.

In addition, the geographical position of Nantucket will be determined by a continuous series of observations, which will be communicated for the use of the survey. These were commenced this season by Professor Elias Loomis, of the University of New York, who has communicated the results of observations of moon culminations, and for latitude, made during parts of July and August. They will be continued by William Mitchell,

Esq., of Nantucket, who will probably add prime vertical observations for the latitude to those in the meridian, and will observe the occultations computed by R. T. Paine, Esq., of Boston, as well as moon culminations with the almanac stars. The instruments used this summer for this purpose were a two feet transit belonging to Mr. Mitchell, and the West Point Troughton circle, loaned to the coast survey by the engineer department on the recommendation of Professor Bartlett. A transit for use on the prime vertical has been kindly loaned by Professor T. H. Perry, United States navy. Besides the importance of this station in a nautical point of view, it is of high practical and scientific interest, from occupying the southern extremity of an arc of the meridian passing near Portland, in Maine, the determination of the length of which will furnish the essential elements for the final computation of the work in this quarter, and the data for the figure of this portion of the earth's surface.

2. The connexion of the base line measured last year, upon the Boston and Providence railroad, by assistant Edmund Blunt, with the primary triangulation, was this year completed; the *angles at the extremities of the base* having been measured by Mr. Blunt, with the twelve inch Simms theodolite.

The peculiar position of this line, parts of which are in the trough formed by the cuttings of the railroad, rendered the measurement tedious, from the variable and considerable effects of lateral refraction. No pains were spared in rendering it as perfect as possible, and the test by the sum of the angles in the triangles, part of which had been measured by me and part by Mr. Blunt, proved both sets of results to be satisfactory.

3. *The secondary triangulation* in this section of the survey has been carried eastward to include the Vineyard sound and the island of Martha's Vineyard, the sound between Nantucket and the main, (Nantucket sound,) the island of Nantucket, the main between Buzzard's bay and Massachusetts bay, and part of Cape Cod. The most westerly station occupied was Falmouth, near the eastern shore of Buzzard's bay. The most easterly station was Sancoty head, and the most northerly was Hyannis. The stations observed upon extend as far east as Sancoty head, and as far west as Mishiaum point. The work was retarded considerably during the months of July and August, in consequence of the long lines included in it, across the shoal water between Nantucket and the main; and the thickly wooded country between Falmouth and Sandwich, on Cape Cod bay, which it was deemed desirable to cross, offered at a later date considerable obstacle to rapid progress. The amount of work has, however, notwithstanding the detentions, been satisfactory. The area embraced in the work is 818 square miles, and the survey of the parts of it immediately adjacent to the coast will occupy two topographical parties more than one season. A diagram of the triangulation is given upon sketch A.

The reconnaissance for this work, and the triangulation itself, have been made by assistant C. M. Eakin, assisted by Mr. James E. Shiras. The party commenced their field operations on the 10th of May, and closed them on the 13th of October. The number of stations occupied was 17; the number of objects observed upon was 244, viz: 177 stations, 26 light-houses, 30 spires, 6 telegraphs, 3 lightboats, and 2 beacons; and the number of angles measured was 4,392.

Assistant Eakin was occupied during the last winter in the computa-

tion of the work of the previous season, in making duplicates of the calculations, a diagram of the triangulation, descriptions of the stations, and in completing the drawing of a sheet containing a topographical survey formerly made by him.

4. *The topographical work* in this section has included the head of Buzzard's bay, the eastern shore of the bay, the Elizabeth islands, and part of Martha's Vineyard island. It has covered an area of one hundred and seventy-eight square miles, determined one hundred and thirty-two miles of shore line, and one hundred and seventy-one miles of roads. This is a considerable increase on the work of last year in the same quarter.

Two sheets, marked Nos. 2 and 3 on sketch A, have been surveyed by assistant W. M. Boyce, assisted by Lieutenant H. C. Pratt, of the United States army. The area of the two is about ninety-three square miles, and they include more than one hundred and forty miles of shore line, sixty-six miles of roads, and thirty-two miles of shore line of ponds. The coast embraced in them is rugged and broken, with alternations of rocky, sandy, and marshy shores. The face of the country is undulating and irregular, with but little wood upon it, and requiring much labor to represent it accurately. The season has been generally favorable for work, but high winds and fogs have prevailed at times, during which the use of the plane table is difficult; at such times the compass and chain have been used with good effect in advancing the work.

This party was not able to take the field until the beginning of June, owing to circumstances not necessary to be detailed here, but by great diligence the amount of work done has been satisfactory. Through the liberal views taken by the Hon. Secretary of the Navy, in reference to the progress of the coast survey, and under authority of the act of Congress of 1807, the party has had the use of the schooner *Wave* belonging to the United States navy, and the facility thus afforded must be enumerated among the reasons for the amount of work done. The party was transferred to Neapeague beach, on the eastern end of Long island, for the survey of an unfinished space there, on the 20th of October, and to Philadelphia, for the measurements of the wharves, &c., left unfinished there, about the middle of November.

Assistant Boyce was engaged last winter in the office, in putting in ink the topographical work of the preceding season.

Three sheets, marked No. 1, No. 1½, and No. 4 on sketch A, have been surveyed by assistant H. L. Whiting; aided by Mr. W. E. Greenwell. The area included in these is about eighty-five square miles, and one hundred and five miles in length of roads and one hundred miles of shore line are laid down upon them. The work on the main was done between the 8th of May and the close of September, and about the 1st of October the party was removed to Martha's Vineyard island, remaining in the field until the latter part of November. The face of the country on the main has already been described, and that on the Vineyard upon the immediate shore is similar; the country embraced in the interior of the sheet is, on the contrary, level, and covered with woods of scrub oak, interspersed with pines.

The sickness of Mr. Whiting during one part of the season, and of a number of his party at another, has in a degree retarded the work, but

the progress has, notwithstanding, been satisfactory, and the amount of work done considerably exceeds that of the last year.

During the winter Mr. Whiting was occupied in the office in finishing the drawings of his sheets of the previous season, and in reducing for publication the map of New Bedford harbor, the style of the execution of which was very satisfactory. He also assisted in preparing the projections of the plane table sheets of the season.

It appears that, in general, from the beginning of May to the middle of November may be profitably used in this region for the topographical surveys.

The shore line determined by these parties has been furnished to the hydrographical party working in their vicinity.

5. *The soundings* in Buzzard's bay have been completed, and considerable progress made in those of the Vineyard sound, by the party under the command of Lieutenant commanding George S. Blake, United States navy, in charge of the surveying schooner Gallatin. Some supplementary work off the coast of Rhode Island has also been completed for the chart of the entrance to Long Island sound, now preparing for publication. Other observations have been made in Long Island sound by this party, belonging to the next section of the work. Preparations for the season's work were begun on the 23d of April, and the work itself on the 7th of May, continuing until the close of October.

The limits of the sounding sheets are shown by the dotted lines on sketch A, the sheets being five in number. The work of this season will afford means for the immediate publication of charts of two important harbors of refuge on the Vineyard sound, Tarpaulin Cove on the south-east side of Naushon, and Holmes' Hole on the north side of Martha's Vineyard. Combined with the work of last year, it gives the greater part of the hydrography for a chart extending from Point Judith to Cape Pogue, and embracing the entrances to Narragansett bay, and the whole of Buzzard's bay, and the Vineyard sound. The materials for this chart, from the astronomical and geodetic observations, the topography and hydrography, will be collected immediately so as to commence the chart at the earliest possible date, leaving the remaining part of the hydrography to be completed while the chart is in progress. One of the most interesting parts of this will be the determination of the velocity and set of the tides in the Vineyard sound—a subject of not less practical importance than scientific interest.

The area included in the work is about 350 square miles; but the statement of it hardly gives an idea of the work done, as searching for detached rocks occupied much time, and was of paramount importance. Lieutenant commanding Blake's efforts in this search have been rewarded by the discovery of three rocks, very dangerous while their positions were unknown or unmarked, but which are rendered comparatively harmless when known and marked. The positions of these rocks are thus described in his report:

"A dangerous rock, having but fifteen feet water upon it, was discovered northwesterly a mile and a half from Cuttyhunk light-house, with very deep water in all directions immediately around it. This danger lies very much in the way of ships bound to and from New Bedford, many of which, when loaded, draw from sixteen to eighteen feet. Another very dangerous rock has been discovered about a mile and three-quarters southwest-

erly from Mishaum point, also very near the main channel into New Bedford. The Gallatin draws but $9\frac{1}{2}$ feet, and her larboard bilge struck heavily upon this rock, the lead on the starboard side giving at the time a quarter less four, and deepening immediately to six and seven fathoms.

* * * * *

At the request of the collector of New Bedford, I have recently indicated the proper position for a buoy near this danger."

"A very dangerous single rock, having but ten feet of water upon it at low water, was found in mid-channel off the harbor of Mattapoissett, a whaling port on Buzzard's bay, second in importance to New Bedford."

"In regard to the rocks off Cuttyhunk and Mishaum, I am informed by experienced Vineyard pilots, that although dangers were generally believed to exist in the vicinities named, the precise situations of them were not known. In regard to the one off Mattapoissett, I am informed that nothing has heretofore been known of it. A very dangerous ledge was found off Ragged Neck, near the head of the bay, a quarter of a mile *within* which is a buoy, and which I am likewise assured was entirely unknown before."

A more technical description of the positions of the rocks off Cuttyhunk and Mishaum point, and of the ledge off Scraggy Neck, will be found in the appendix, (No. I.)

Besides the occasional observations for the tides at different points, for the reduction of the soundings, regular observations for the times of high and low water, and the height of the tide, have been kept up during the whole season at Point Judith and Newport.

The views required for illustrating the sailing directions, and desirable for entering New Bedford harbor, were prepared this season by assistant John Farley, under the advice and with the co-operation of Lieutenant commanding Blake.

During the last winter the unfinished reduction of the work of this party for the previous season, which was, however, small in amount, was completed. It consisted chiefly of the reduction of observations of tides and currents and the copying of journals.

The hydrography of New Bedford harbor was reduced for publication, and a copy made of the original chart on the working scale; a general reduction of the season's work was also made on the publication scale. The sailing directions, and other unfinished parts of the New Bedford chart, have since been supplied, and the work has been put into the hands of the engraver.

My attention has been repeatedly called by Lieutenant commanding Blake to the necessity for thorough repairs to the schooner Gallatin—repairs which are entirely beyond the limits of expenditure permitted by the ordinary appropriation for the coast survey. In his report at the close of the season, he says: "The vessel is nearly thirteen years old, has never received a thorough repair, and is now in such a state that the mere patching, which is constantly needed to preserve her efficiency, is extravagant. Her frame is believed to be sound, though it cannot continue so long if the repairs named in the estimate are not attended to."

As it is impossible, without serious diminution in the quantity of work, to furnish these thorough repairs, I have felt it my duty to call the attention of the Treasury Department to the subject in a separate communication, believing that the vessels belonging to the survey should be put in

thorough order before another season's work, and that a special appropriation should be asked from Congress for that purpose.

Another subject of importance to the progress of the hydrography of the coast survey, referred to in the law for its reorganization, and in regard to which no advance whatever has been made or can be made without aid from Congress, is thus referred to in Lieutenant commanding Blake's report:

"In regard to the use of steam vessels in the survey, upon which you request my views, I would observe, that the employment of such vessels, of *suitable construction and equipment*, would in my opinion conduce very much to accuracy, despatch, and economy. To accuracy, because the rate of running would be more uniform than that of sailing vessels; the lines of soundings could be run with more system, and a vast amount of useless labor thereby be avoided. To despatch, because in light winds and calms, which prevail much upon our coast in summer time, where sailing vessels can do little or nothing, steamers could work with perfect success. They could also work with much more success, under all circumstances, than sailing vessels, being independent, in a great measure, of the direction of the wind and of tides. To economy, because a very much greater amount of work could be performed by a steamer in a given time, than by a sailing vessel, and with fewer men. I am convinced, in short, that steamers are as much to be preferred for surveying as for any other purpose whatever. It is proper to add, that I speak from experience on this subject, steamers having occasionally been attached for short intervals to my command."

6. My attention has been repeatedly called this summer to certain dangerous obstacles to navigation off the coast of Massachusetts, requiring but little time to determine their places. Lieutenant commanding Davis brought these before me particularly, at a time when the surveying brig Washington, under his command, was necessarily waiting the repairs of instruments required for his work. A rough or approximate determination of such dangers is certainly better than none, and public utility sometimes requires that ideas of precision should be sacrificed to secure other objects. The determinations can by no means replace the accurate ones which will be made in the course of the coast survey, but they will be useful to navigators, in the absence of them. I directed, therefore, Lieutenant commanding Davis to make the search suggested by him for a ledge of rocks off Brandt point, Massachusetts bay, and the shoal to the west of George's bank. The rock, or rather ledge, is about three-quarters of a mile E. N. E. of Phillips' ledge, which has a buoy upon it, and has but eight feet of water on two different spots at low water, spring tides. It lies in the track of vessels bound into and having a fair wind for Plymouth and the lower part of Barnstable bay, and of coasting vessels beating in Massachusetts bay. An extract from a letter of Lieutenant commanding Davis in the appendix, (No. II,) gives the approximate position of this ledge, which is known to the fishermen from the adjacent shore as "Howland's ledge." It should undoubtedly have a buoy to mark it, as several vessels are reported to have struck upon it, and the buoy on Phillips' ledge tends to give false assurances of safety to the eastward of it.

The season has not permitted a thorough exploration of the shoal west of George's, known as Clark's bank, but a line of soundings, &c. has been run upon it, and an early opportunity will be taken to examine it further.

Soundings were made by Lieutenant commanding Davis in ten fathoms, upon a bank not laid down upon the charts, in about latitude $41^{\circ} 17'$, longitude $68^{\circ} 36'$, or about sixty miles southeast of Nantucket. This bank, it is believed, was not before known, and the credit of its discovery may be claimed for the coast survey.

7. The work of triangulation conducted by me personally being in this section of the survey, I was enabled at intervals when changing stations to visit the different parties employed in this quarter, in some cases to inspect the results of their work, and in others both the results and operations.

II. MIDDLE SECTION.

1. *From Narragansett bay to New York bay, and thence to the capes of the Delaware.* 2. *Delaware river and bay, and south of cape Henlopen.*

1. The connexion of the *primary triangulation* of Mr. Hassler at its southern end, with the main triangulation across Delaware bay, by assistant Blunt, was made only by secondary triangles. The bay triangulation is remarkable for the beautiful symmetry of its triangles, while the connecting triangles, however allowable in secondary work, were not suitable for the important purpose of making a junction with a triangulation like that of Delaware bay. This triangulation has, besides, assumed a new degree of importance, since it has been decided to carry the primary triangulation across to the Chesapeake, and not down the Delaware bay. The directions sanctioned by the Treasury Department in the spring of 1844 referred to the importance of a revision of this part of the work, but time was not found during that year to execute it. It was accordingly made the first duty of assistant Blunt on the opening of the present season. The reconnaissance was commenced in May, and was carried through under many obstacles, and a suitable triangulation determined upon and executed by the beginning of September.

The triangulation is shown in sketch B, where the stations are marked B, 1845. They are six in number, three in Delaware and three in New Jersey, with a seventh in New Jersey observed upon but not occupied. The number of angles measured was 17, and the number of observations made 530.

At three of the stations tripods of timber were erected, varying in height from 30 to 45 feet. The instrument was placed upon the top of the tripod, and the observer stood upon a scaffold entirely detached from the tripod. The legs of the tripod were stiffened by braces passing to the ground, forming lesser tripods, and by horizontal ties. It might be supposed that the warping and twisting of the timber of which the tripods were made, under the action of the sun and moisture, would sensibly affect the observations made from them, but this does not appear to have been the case. The probable errors of the separate observations deduced at the stations where the tripods were used, are not quite so great as of those at the other stations. Nor do the triangles containing two of the angles measured from the tripods and one from the ground, compare disadvantageously, in the error of the sum of their angles, with those in which one angle only was measured from the tripod and two from the ground. These facts; if farther experience should verify them; will have an im-

portant bearing in facilitating the triangulation in the southern sections of the survey.

The angles of the triangles were measured with the twelve inch theodolite of Simms.

S. V. Talcott, assistant in the party of Mr. Blunt, resigned his position in the coast survey just after the opening of the season, and Mr. J. P. Bolles was temporarily attached to the party to assist Mr. Blunt.

Observations for azimuth and latitude were made by assistant Blunt at one of the Delaware stations, marked Deakyne in the sketch, in the months of October and November. The observations for azimuth were taken by the elongations of the pole star, the Simms theodolite being used for measuring the angles with the elongation mark. The observations for latitude were made with the six inch Gambey theodolite.

2. *The primary triangulation* for connecting Mr. Hassler's work with the base of verification on Kent island was in part in this section, but chiefly in the next, where it will be described.

3. The work of triangulation in this section is nearly complete. The only matter of importance which remains, is the verification of the work on the eastern coast of New Jersey. It is very desirable, if practicable, to connect this work with the primary triangulation which was carried across the State of New Jersey to the river Delaware, and southward to near Delaware bay. A *reconnaissance* to examine the practicability of such a junction was commenced in the early part of September, by Lieut. Henry Prince, of the United States army. The examination is a difficult one, and nothing positive can yet be known as to its results, the intention being, if possible, to set at rest the question under review.

4. *The magnetic observations* in this section, to be communicated for the use of the survey by Professor Renwick, of Columbia college, New York, have been continued. The charts of the harbors on Long Island sound, now in progress, require accurate observations of the variation of the needle, and advantage has been taken of the necessity for procuring these results to obtain at the same time, and without additional expense, others interesting to science. The observations of this season have included the variation (declination) dip, and horizontal intensity at Stonington, Connecticut; Greenport, Long island, New York; Saybrook and Bridgeport, Connecticut; of variation and horizontal intensity at New London and Sachem's head, Connecticut; Drowned meadow and Sand's point, Long island, New York; of variation at New Haven and Milford, Connecticut; and Black rock, New York.

The instruments used were Riddell's portable magnetometer, by Jones, of London, and a dip circle, by Barrow, of London, successor to Robinson. Professor Renwick was assisted by Henry Renwick, Esq.

5. *The topographical work* in this section is nearly completed. An omission on the northeastern extremity of Long island has been supplied by assistant W. M. Boyce; one on the Delaware by assistant J. J. S. Hassler. The local data for the plan of the city of Philadelphia, and especially for the wharves, having been found conflicting, and not accordant in total distances with the determinations of the survey, it was necessary to make the measurements required for the coast survey map, and these were executed, on returning from the field in the eastern section, by assistant W. M. Boyce.

The topography of the coast immediately south of cape Henlopen, the

triangulation for which was made in 1844, was executed by assistant J. J. S. Hassler, between the middle of September and the close of November. The shore line near cape Henlopen, which was reported to have undergone changes, was also resurveyed. The work extends south to Indian river, and completes the data necessary for the chart of the approaches and entrance to Delaware bay, which is now in the course of engraving.

6. *The off-shore work* of this season, which was chiefly in this section, included the commencement of an examination of the gulf stream. A thorough exploration of the gulf stream is necessary to furnish information upon one of the most important parts of the hydrography of the North American coast. To ascertain its limits at and below the surface, the direction and rate of the current, its temperature at the surface and at different depths, the soundings in and near it, the character of the bottom and other important particulars, with the influence of the seasons and prevailing winds, will require much labor and great zeal and intelligence on the part of those charged with the execution of the work. The high temperature at and near the surface of this body of water enables the navigator to recognise his position on reaching it, when bound for the United States, and is one of the important uses made of this stream. Various causes interfere with the constancy of the indications, as belonging to particular positions, and these should be investigated carefully, so as to give certainty in regard to the practical conclusions or rules that must be furnished to the navigator.

This work is not without risk, and was unavoidably delayed by the repairs required by the surveying brig Washington before it could be employed in such service. It was not possible to make these repairs from the remnant of the small appropriation for the survey in 1844-'45; but as soon as the new appropriation was available, the Washington was put in charge of Lieut. Com. Charles H. Davis, U. S. N., and made ready for the service. The preparations were completed and the vessel left New York on the 20th of July. The means of observing were necessarily tentative, experiment being required to test the value of the methods suggested in the instructions; the duties, too, were in a great measure new to the officers. The zeal and ability of Lieut. Com. Davis have supplied the place of experience in the modes of observation; and the methods themselves have been remarkably successful in his hands—having realized at the very first attempt some most interesting results.

This is not the place to discuss those results; and, indeed, it would be premature to ground conclusions upon the few observations already reported; but the obvious utility of the facts developed, connecting, as they do, temperatures and soundings together, and the efficacy of the means employed, as proved by the verification of known laws of the transmission of heat by conduction through a fluid warmed at or near the upper surface, are too remarkable not to give great encouragement in prosecuting the work.

Lieut. Com. Davis returned, for the repairs of certain of his instruments and for essential changes in others, in September, and in the beginning of October again proceeded to the gulf stream, returning at the close of the month. In this second exploration, bottom was reached in 1,300 fathoms, and a specimen brought up. The number of observations for temperature, at and below the surface, made during the season, is 813. The number of soundings, including the work in the sound and off

Brandt point, is 2,354. 95 specimens of bottom, and 26 specimens of water at various depths, have been preserved.

The surveying brig Washington requires considerable repairs and alterations to render her thoroughly effective, and the estimate by her commander will be included in a special report to the Treasury Department.

The views entertained by Lieutenant commanding Davis in regard to the use of steam-vessels in the hydrographic part of the coast survey, are expressed in the following extract from one of his reports to me :

“ I believe that the present expense of this purchase would be amply repaid by the greater amount of work they would perform. Their superiority to sailing vessels in sounding, both in rapidity and certainty, makes the argument in favor of their employment to be this—that with them the coast of the United States can be surveyed in one half the time consumed by the present means.”

The fact cannot be too often presented, that there is a certain determinate extent of coast to be surveyed. The more rapidly it is surveyed the more economically can the work be done, and the sooner will its fruits be enjoyed.

7. The party of Lieutenant commanding Davis was occupied during part of October in supplementary work of *sounding* at the eastern entrance of Long Island sound. As other duties did not permit the completion of this work, Lieutenant Carlile P. Patterson, of the United States navy, who had been engaged in the reduction of this part of the survey in the office at Washington, was requested to report to Lieutenant commanding Davis for the completion of this work. A small vessel was hired at New London for the purpose, and the work occupied Lieutenant Patterson during the month of October, after which he took charge of the schooner Phenix, loaned to the survey by the Navy Department, to proceed to the Gulf of Mexico.

8. A series of *tidal observations* for the establishment of the port of New London, Connecticut, with observations of the *set and velocity of tides* in Fisher's Island sound, have been made by Lieutenant John N. Maffitt, United States navy, under the immediate direction of Lieutenant commanding George S. Blake. The stations at which the observations were made are marked in sketch C, No. 1. The results will be immediately reduced, and the computations required be made by an officer of this party at the office in Washington. The observations of currents are projected on diagrams, which facilitate the scrutiny of the results, and render practical deductions from them comparatively easy. In a difficult navigation like that of Fisher's Island sound, a chart of which is now publishing, sailing directions must be very imperfect, unless they take into consideration the set and drift of the tide.

Lieutenant commanding Blake in his report acknowledges his obligation to the collector of the port of New London, Charles F. Lester, esq., for the facilities afforded by him for carrying on this work.

9. The unfinished observations of *the tides and currents in New York bay and harbor*, were resumed on the 16th of May, by Lieutenant commanding Davis, then in charge of the surveying schooner Vanderbilt; to these were added observations of the remarkable and dangerous currents at Hell Gate, at the entrance of the East river and Long Island sound. Nothing less thorough than a series of observations, by which the motion of the water should be traced from one end of this passage to

the other, seemed admissible; and it was necessary that this should be done at different times of tide, and under different circumstances of wind. This duty was executed by Lieutenant commanding Davis with great ability. Nine stations for the observations of currents (shown in sketch C, No. 2) were occupied in this dangerous passage, and *five* tide stations, two on the East river and three on the Long Island sound, part of the passage. Subsequently, two of the extreme stations were connected by a line of levels run from one to the other by Lieutenant commanding Davis, and simultaneous observations of the rise and fall of the tides made at them by Lieutenant commanding J. R. Goldsborough. The result of these observations is to show clearly upon a chart the direction taken by the water at ebb and flood tide—its rate of motion, not only in the principal current, but in the minor currents; to show how advantage may be taken of the parting of these currents to pass in a particular direction in reference to the dangerous obstacles of this passage, and how to avoid being carried by them in unsafe directions. The examination of the effects of winds, and the connexion of the observations with the figure and dimensions of the passage, remain yet to be made. A chart representing these results will accompany the western sheet of Long Island sound.

The number of stations selected for observations of currents in New York bay and harbor, was twenty-eight; of these, twenty-one were occupied in 1844 by the party under the immediate direction of Lieutenant commanding Davis, and the observations made at them in calm times. The work of this season has been to occupy the remainder of these stations in calms, and to ascertain the effect of the prevalence of particular winds in modifying the observed set and drift of the tides. In connexion with these observations, the rise and fall of the tide were observed at Sandy Hook and at Governor's island, and in addition at or near the localities of the observations of currents. Meteorological observations accompanied those on the tides at the regular stations. The stations are shown in sketch C, No. 2.

The seven stations remaining from 1844 were occupied by Lieutenant commanding J. R. Goldsborough, United States navy, in the surveying schooner Vanderbilt, and under the immediate direction of Lieutenant commanding Davis; and the observations have since been continued by the officer first named, who has availed himself of the prevalence of different winds to advance this part of the work. The observations were continued until about the middle of October, when the Vanderbilt was temporarily required in aid of the arrangements for measuring the base line in North Carolina. Before this time, all the outside stations, thirteen in number, had been occupied after a storm, or long prevailing wind, and the results of ten consecutive tides at the chief stations, and of four at the minor ones, had been obtained and entered in the usual forms, and laid down upon appropriate diagrams. The simultaneous observations of tides in Hell Gate, before referred to, were made by Lieutenant commanding Goldsborough.

The self-registering tide gauge, established at Governor's island, was kept up during last winter, and has continued to work moderately well. The mechanical execution of the screw, upon which the working of the machine depends, was not sufficiently perfect for this purpose, and has caused some stoppages in the apparatus, especially as the clock had but little power. A self-registering gauge, devised by Mr. Saxton, of the office

of weights and measures, seemed so much more perfect than this, that it was determined to make trial of it before causing other gauges to be constructed. There is no doubt but that, with nicer work, the plan at present in use will answer, if Mr. Saxton's gauge does not prove so far superior as to supersede it. This gauge, when replaced by another, will be removed to Boston harbor, where the range of the tide is greater than in New York.

During the last winter the party of Lientenant commanding Davis was engaged in the office in reducing the tidal observations, made at the chief stations of the survey, entering them in the prescribed forms, determining the corrected establishments, and preparing the materials for a general discussion of the tides of our coast within the limits of the survey. This will be carried as far as may be considered necessary to the hydrography.

10. The chart showing the progressive changes at Sandy Hook, referred to in my last report, was prepared by Mr. B. Glück, draughtsman in the coast survey office, and, by authority of the Treasury Department, was sent to the Hon. J. Phillips Phœnix, member of Congress from New York city, to be laid before the chamber of commerce of that city, which has acknowledged, by a very gratifying series of resolutions, the information thus communicated.

SOUTHERN SECTION No. I.

III. *Chesapeake bay, &c.*—1. The *primary triangulation* for connecting the work of Mr. Hassler with the base of verification on Kent island, has been completed during the season by assistant James Ferguson. The whole triangulation is shown in sketch B, where the stations occupied by Mr. Ferguson are marked F, and the year of their occupation is also marked. Those of Mr. Hassler in the same sketch are marked H.

The party reached their first station, at Swan point on the Chesapeake, on the 11th of April, and the work was finished about the close of September, after which the party proceeded to North Carolina to commence the triangulation there. Mr. Ferguson was aided by assistant J. C. Neilson.

The number of stations occupied during the season was six, and one station of last year was reoccupied. The area of the polygon, embraced in the triangulation, is four hundred and eighty square miles. The sides of the triangles embraced in this year's work vary in length from about ten to twenty-two miles. The number of primary points observed upon, at the different stations, were as follows: at the first, 3; at the second, 4; at the third, 4; at the fourth, 6; at the fifth, 4; and at the sixth, 4; and at the station of last year reoccupied, 4; making in all 29 points. The number of angles measured was 24; of observations made, 2,276. When the obstacles to the work in this quarter are considered, the progress of the triangulation must be deemed satisfactory. The coincidence in the length of the line, common to Mr. Hassler's and Mr. Ferguson's triangulations, derived by the former from the Fire island base, and by the latter from the Kent island base, is very close. The data are yet insufficient for a final comparison of latitudes and azimuths.

The instrument used was the two-feet Troughton theodolite, which was repaired and improved in many respects in the office of the survey by Mr. William Würdeman, during the last winter, and was redivided on the Troughton dividing engine, which has been rendered automatic by Mr. Joseph Saxton, of the office of weights and measures. Mr. Ferguson

reports that the regraduation has apparently materially reduced the errors in the triangles measured by it, as compared with those measured before the change.

Towards the close of the season, Mr. Ferguson was directed to have a reconnaissance made for ascertaining and reporting the obstacles for connecting two stations in the primary triangulation of Mr. Hassler, near the Delaware, (Bethel and Meeting House hill, see sketch B,) either directly or by using an intermediate station suitably placed. This was executed by Mr. Neilson, whose report on file shows the obstacles which render the connexion impracticable under ordinary conditions.

The party of assistant Ferguson was engaged during the winter in making duplicates of the journals of the summer's work, and in recalculating the astronomical observations made by them.

2. It being desirable to increase the number of *astronomical stations* in this section of the survey, Lieutenant Thos. J. Lee, of the United States Topographical Engineers, assistant in my party, was directed to observe for latitude at Taylor's and Abingdon. (See sketch B.) At the same time, Lieutenant Lee made the *magnetic observations* required for the chart of Annapolis harbor, about to be published, at Taylor's, near Annapolis, and at the south end of the Kent Island base, and similar ones at three other stations. These observations were made between the 8th of May and the 6th of July, when Lieutenant Lee joined me to assist in the observations at the astronomical stations already referred to in the eastern section of the survey, having executed very satisfactorily a considerable amount of work in the brief time allowed him. The number of observations made were as follows: for latitude 2,980, and for time 336. For magnetic variation (declination) 160, for magnetic dip 216, and for total horizontal intensity 108.

The observations for latitude were made with the six-inch Gambey theodolite of the survey, and, for time, with a Hassler reflecting circle; the magnetic observations with the instruments already referred to under the head of the eastern section of the survey.

3. As mentioned in my last report, a *reconnaissance* for a triangulation to connect the coast survey stations, on or near the Chesapeake, with the Capitol, and to verify the triangulation of the Potomac river, was commenced under my immediate direction in 1844, by Lieutenant Henry Prince, of the United States army. The course taken in this laborious reconnaissance, in which Lieutenant Prince has shown much persevering industry, as well as aptitude for the work, was the following.

The country northwest of a line joining Washington and Baltimore was first examined; the Elk, Patuxent, and Montgomery ridges being explored to find intervisible points. This examination proved that the connexion in that direction could only be made by going far into the interior. Lieutenant Prince next examined the route by following heights which skirt the valley of the Potomac as far as Fort Washington, and then crossing to the Chesapeake bay, (at Herring bay), and found obstacles deemed by him very serious, if not insurmountable, by the ordinary modes of triangulating from the ground. The next exploration was in the general direction of a line joining Washington and Annapolis. The practicability of a small triangulation in this quarter was rendered very probable, but it was not of an order desirable for this particular object, and the numerous stations would have made it expensive if executed in a man-

ner suited to the purpose in view. By further examination, and the use of methods common in reconnaissance, Lieutenant Prince finally ascertained that a triangulation is very probably, if not certainly practicable, connecting a line joining two of the Chesapeake bay stations, (one to the north and the other to the south of Annapolis) with the Capitol and naval observatory, by the use of intermediate stations, and furnishing a good base for continuing the triangulation down the Potomac, to meet the work coming from the Chesapeake bay up the river, thus affording a necessary verification.

The work was continued, whenever the weather was favorable, during the last winter and spring, and was completed as far as necessary, in a preliminary reconnaissance, about the close of July.

The very detailed reports, made from time to time in regard to this work, are on file in the coast survey office.

After being temporarily attached for a short period, when the weather was not advantageous for reconnaissance to the plane-table party of assistant Whiting, Lieutenant Prince was directed to proceed with the reconnaissance already described, for connecting the primary triangulation down the Delaware with the coast of New Jersey.

4. The continuation of the *primary triangulation* of the Chesapeake southward from the Kent island base, was assigned to assistant Edmund Blunt. Duties claiming prior attention occupied him until about the 20th of November, when his party was transferred to the Chesapeake. All the progress which the season will permit will no doubt be made, and the work will be resumed as early as the opening of the spring will allow.

5. Two parties have been engaged in the *secondary and tertiary triangulations* of the Chesapeake and waters flowing into it—the one during the whole working season, and the other in a different locality, during part of July and August. The area surveyed includes the Elk, Bohemia, and Sassafras rivers, the bay from Turkey point to Legoe's point, the Gunpowder, Middle, and Back rivers, the Chester nearly to the head of navigation, and part of the bay from Kent island southward.

The *secondary triangulation* from Kent island south was made by assistant F. H. Gerdes, after his return from the southern reconnaissance, and the completion of his topographical sheet (commenced last year) between the Magothy and Patapsco rivers. The work occupied him from the 13th of July to the 28th of August, between which dates ten stations were occupied. The area of the polygon embraced in the survey is 153 square miles. The sides of the triangles vary from $2\frac{1}{2}$ to 11 mile in length—a main series of triangles for securing the requisite accuracy being carried on, besides the minor series intended specially for the use of the topographical parties. The number of stations and objects observed upon was 23, including stations, spires, windmills, and the cupolas of houses. Assistant Gerdes also filled some tertiary triangles while engaged in the topographical work between the Magothy and the Patapsco.

The angles of the secondary triangles were measured with an eighteen inch theodolite belonging to the survey, and made in the office, the limb having been redivided by Mr. Saxton with the coast survey dividing machine. This theodolite was one of a pair made from another instrument, in order to use the divided circle, but now the strong point of the instrument is considered the weakest; and the Troughton divisions, the supposed excellence of which caused the adaptation of the instrument to the

limb, are erased to give place to a more accurate series, traced in the office on the Troughton dividing engine, as improved by Mr. Saxton.

It being necessary that assistant Gerdes should leave the field to complete the drawing upon his topographical sheet, and the copies of the journal of his reconnaissance in Alabama, Mississippi, and Louisiana, before again proceeding to the Gulf of Mexico, the secondary triangulation was continued by Captain Joseph E. Johnstone, of the United States Topographical Engineers, assisted by Lieutenants R. E. Hammond and Edward Murray, of the United States army.

The *secondary triangulation*, near the head of the bay, and the streams flowing into it, and the *tertiary triangulations* in the streams, have been under the immediate direction of Captain Joseph E. Johnstone, of the United States Topographical Engineers, on coast survey service, assisted by Lieutenants C. Benjamin and J. F. Irons, of the United States army. The precarious state of the health of Captain Johnstone required that two assistants should be assigned to his party, in order to insure due progress in the work. The party took the field on the 3d of June, having been detained by the illness of Capt. Johnstone and other causes, and triangulated the Elk, Bohemia, Sassafra, Gunpowder, Middle, and Back rivers, and the bay from Turkey point to Legoe's point, as shown on sketch B, before the 3d of July, having occupied fifty-six points, chiefly tertiary points. The party then proceeded to the Chester river, carrying the triangulation from the mouth towards the head. On the 23d of July, having occupied twelve stations, it was deemed necessary by the officer in charge (Captain Johnstone being absent on account of ill health) to suspend operations on the score of the unhealthiness of the season. In August, Lieutenants Irons and Benjamin were directed by the War Department to rejoin their regiments, there being special need of their professional services.

Captain Johnstone and his assistant, Lieutenant Benjamin, were engaged during the last winter in the office of the survey in making copies of the journals of observations of the preceding season, and duplicate calculations of the work.

5. *The topography* of the shores of the Chesapeake, and of the rivers running into it, as far as the head of navigation of each, has been nearly completed, except that on three sheets, Nos. 6, 7, and 16, of sketch B, from Swan point, on the eastern shore, to the head of the bay, and from Thomas's point, Annapolis harbor, to the head of the bay. The materials for a chart of the Patapsco and Baltimore harbor will, it is confidently expected, be ready for use this winter, and the chart will at once be drawn and put into the hands of the engravers. The topography has been executed by assistants Gerdes, Hassler, Wise, and Cutts.

The unfinished work of last year, on sheets Nos. 1 and 2, at the head of Chesapeake bay and Northeast river, has been completed by assistant J. J. S. Hassler, and the survey of sheet No. 15 commenced and finished by him. The work includes Elk neck, the shores of the Elk and Bohemia rivers, and of Back creek, with a portion of the Delaware and Chesapeake canal, and the roads included within the limits of the sheets. The area surveyed is seventy-six square miles; the extent of shore line, seventy-three miles; of roads, one hundred and eighty miles; and of canal, five miles. The party took the field on the 15th of April, beginning work on the 21st. It was transferred to the neighborhood of Cape Henlopen in September. The country is reported by Mr. Hassler to be difficult to survey, being hilly and thickly wooded, and admitting

of but short sights for the plane table points. The season, too, was remarkable for excessive heat, complained of by nearly all the parties in this region.

Mr. Hassler was engaged during the last winter in drawing in ink the work on sheets Nos. 1 and 2; in supplying an omission in the topographical work on the Delaware river, and in recalculating the positions of some trigonometrical points on the upper part of the Delaware.

The topographical work on sheets Nos. 3, 5, 7, and 13 (sketch B) was assigned for execution to assistant Richard D. Cutts. No. 13, including the eastern shore from Swan point to Worton point, was first completed; then No. 3, near the head of the bay, including part of the Susquehannah river, and the towns of Havre de Grace and Port Deposit. Mr. Cutts was at work upon sheet No. 5, which includes the head of Bush river, when he was taken very ill and obliged to break up his party on the 18th of September. He was enabled to resume work early in October, and completed sheet No. 5, and will probably finish part of No. 7 before the close of the season. The area surveyed up to the 26th of September, was 51 square miles; the extent of shore line $54\frac{1}{2}$ miles, and of roads 40 miles. The party took the field on the 21st of April, and left it finally about the 20th of November.

Mr. Cutts was engaged during the last winter, in part, in revising the work done with assistant Ferguson during the previous season, and in reducing to the publication scale the chart of Annapolis harbor and the Severn river, now nearly ready for publication.

Sheets Nos. 6 and 8 (sketch B) have been completed; and considerable progress has been made in sheet No. 9, by assistant George D. Wise. The last named includes the shores of the Patapsco; No. 8 the city of Baltimore and the adjacent country. Having found it impossible to reconcile the measured distances with a printed plan of the city, Mr. Wise found it necessary to make a detailed survey, especially of the part near the water. This sheet (No. 8) covers an area of 8 square miles, and includes 10 miles of shore line, 5 miles being of wharves, 9 miles of roads, and 48 miles of streets. No. 6 covers an area of 66 square miles, and includes an extent of 102 miles of roads and 48 miles of shore line. The party of assistant Wise is still in the field, completing such parts of sheet No. 9 as are necessary to the commencement of the Patapsco river.

Assistant Wise has had a small vessel during the whole season. His party has again been exempt from sickness, so as to be able to keep the field continuously since last April.

During the last winter, Mr. Wise was occupied in reducing to a more convenient working scale a part of the previous season's work; in drawing his maps in ink, and in assisting in general duties of the office.

The topographical sheet marked No. 10, extending from Sandy point to the Patapsco, commenced by assistant Gerdes in 1844, (designated as No. 3 in the report of that year,) was completed between the 1st and 30th of June. The work done covers about 8 square miles, and includes about 20 miles in length of shore line and $2\frac{1}{2}$ of roads.

6. *The hydrography* in this section has included the soundings of the Patapsco river and the harbor of Baltimore, the approaches to the Patapsco, and part of the bay between Annapolis harbor and Kent island and Poole's island, and observations on the tides and on the direction and velocity of the currents within the same limits in the bay. It has been

executed by the party under the command of Lieutenant commanding George M. Bache, United States navy, in the surveying schooner *Nautilus*. Materials for the chart of the Patapsco are in readiness. The part of the bay marked as broken ground in Brantz's chart of the Patapsco was thoroughly examined by Lieutenant commanding Bache, but "every new line passed over some knoll that would interfere with the clear progress of large vessels." The work was commenced on the 26th of April, and closed about the beginning of December.

The subordinate officers of this party have generally been changed by the Navy Department during the season, and the two remaining from the former season have been notified that they will be soon detached. The places of the officers detached have been filled as they became vacant.

Views for the chart of Annapolis harbor (now engraving) were taken by assistant Farley, with the advice and co operation of Lieutenant commanding Bache, requiring the use of the surveying vessel a few days in the month of June.

The party was occupied during the winter in copying and reducing the work of the previous season, and in reducing for publication the soundings of Annapolis harbor and the Severn river.

The views of Lieutenant commanding Bache in regard to the use of steam vessels in sounding will be found in the following extract from his report:

"In the deep waters of the Chesapeake bay which have been gone over, the angles as well as soundings have been taken from the vessel. There are many difficulties and delays in working in a vessel under canvass. It is only with a moderate and steady breeze that the work can be laid out to advantage; frequent alterations in the force or direction of the wind are great impediments. Light airs and calms put a stop to all sounding operations, unless the stations are sufficiently near to be distinguished from the boats. On this account, I have long thought that the use of steam vessels on the off-shore and bay work would contribute to the accuracy, expedition, and convenience of the work; and, if properly managed, would prove more economical than sailing vessels for the extent of surface surveyed. In a steamer, such lines of soundings could be run as would best display the features of the bottom, without closing upon or partly running over the lines of soundings which had been previously established. This is sometimes unavoidable in working under sail, particularly when distant from the shore stations. During light weather and calms, when the sailing vessel would be comparatively idle, the steamer, going at a moderate and steady rate over smooth water, would be working to the best advantage, and with the greatest accuracy and convenience. It is evident that much more and better work of this kind can be done from a steamer than from a sailing vessel. As regards the comparative economy of the two kinds of vessels, I can only speak in more general terms. The same expenditure for outfits and renewal of sails would not be incurred; on the other hand, the expense of repairs of machinery and cost of fuel would be heavy items; but when the greater amount of work is considered, the cost of it would probably be lessened. As the triangulation progresses down the wide part of the bay, I am confident that, to keep pace with it on the water, either one or more hydrographical parties must be added to the force now here, or that steamers must be speedily introduced."

SOUTHERN SECTION No. II.

IV. *The coast of North Carolina.*—The work here has been begun by the employment of two parties as early in the autumn as the weather would permit; the one in preparations for measuring a base line, the other in the primary triangulation of Albemarle sound. The work is fairly begun, and will be followed up as vigorously as the appropriation will admit.

1. As there is no doubt but that, in surveying the southern coast of the United States, the frequent measurement of base lines will necessarily be resorted to, I have been desirous to supply an apparatus more portable than the one formerly used in the work, and combining certain other advantages. Among these are, that the length of the apparatus is invariable at different temperatures; that the bars have equal absorbent powers for heat, and are in one single piece; that they are supported so as to be stiffened laterally as well as horizontally, while capable of free motion; that they are enclosed in a way which prevents sudden changes of temperature, while the covering part of the apparatus gives stiffness; that the apparatus is supported at two points only, and is easily moveable in the different directions required for adjustment in measuring. I expected also to apply Bessel's contact apparatus in measuring, thereby to render the measurement so easy and rapid that its repetition, which is always desirable, might be made without expending too much time; but time has not sufficed for this, and I have employed the microscopes used by Mr. Hassler, with the modifications made last year by Mr. Blunt, and other changes. I have been necessarily, by the same circumstance, limited to the use of one set of bars, instead of two, which I expected to have employed to facilitate the measurement. The general conditions to be fulfilled by the apparatus, and a general description of its construction, were given to Mr. William Würdeman, mechanic to the coast survey, to fill up the details. This was satisfactorily done, and the work commenced in August last. With great effort, the apparatus was prepared for use by the 22d of November. The preliminary trials for the invariable length, and for the comparison of the length of the bars (six metres) with the standard metre of the French committee of weights and measures, were made by me personally, with the assistance of Lieutenant A. A. Humphreys and Mr. Joseph Saxton.

Before the completion of my work at Blue hill station in Massachusetts, assistant Boutelle was sent to re-examine the site for the base, a reconnaissance for which was made in 1843, by assistant J. C. Neilson, under the direction of assistant Ferguson, to determine definitely its location, to run the line, to make a series of levels so as to determine the best grades for the work, to erect signals at the extremities, to make a preliminary measurement with a chain, and in general to prepare for the final measurement of the base. These operations were nearly completed by the close of November, when I reached the site of the base, to examine the line and fix upon the terminations. The work of Mr. Boutelle had been both diligently and skilfully executed.

The very low state of water in the Dismal Swamp canal, unprecedented at this season of the year, has interposed difficulties and delays in the transmission of the apparatus; but unless the season should prove unusually unpropitious, I expect to proceed at once with the measurement of the base. The only circumstance which can cause the postponement of the

measurement until the close of winter, will be an unusually wet season, covering the sand flats, over which the line passes, with rain water. Should this occur, the triangulation from the ends of the base will be made to precede the measurement.

2. *The primary or main triangulation of Albemarle sound* was commenced early in November by assistant Ferguson, aided by assistant Neilson. A small vessel was hired for the use of the party, in order to facilitate the work. This party will probably be able to keep the field until January, and to recommence work in March; so that considerable progress may be expected within the present year.

There is no part of our coast the peculiar features of which render accurate and minute surveys more necessary than this. The broad sounds are traversed by channels in which alone the requisite draught of water for vessels even of moderate size is to be had, and these are imperfectly explored, out of the ordinary track. Any facilities of navigation which would open more readily the corn-growing region of North Carolina to a market, would add much to the wealth of the country. Accurate charts would thus, directly and indirectly, in their bearing upon the improvements required, be of great advantage to this part of the country.

It is therefore very desirable to follow up the primary work already described by employing a secondary or tertiary triangulation party, and the topographical and hydrographical parties required; and this will be done as far as the means put at our disposal will allow. It would be manifestly improper to cease working on any of the sections of the survey which have been in progress, to take up new sections, for this would prevent the fruits of the work from being soon realized; but I am sincerely anxious to diffuse the benefits of the work over a large extent of our country at a very early day, and this can be done by a small increase of the appropriation. In pressing this, I do so, not that it will benefit those engaged in the work, or will lead to the employment of others; but simply that it may benefit the agriculture, commerce, and navigation of the whole country, in which the whole country is directly interested; and that it may furnish, as fast as possible, means to prevent or diminish the waste of life and property which now annually occurs upon our coast.

SOUTHERN SECTION NO. III.

V. *Coast of the Gulf of Mexico*.—1. A reconnaissance, preliminary to the survey of this coast, was commenced in January last by assistant F. H. Gerdes, accompanied by Mr. William S. Walker. The coast between New Orleans and Mobile was thoroughly examined, and some progress made in the direction of Pensacola. The reconnaissance included the shores of Lake Pontchartrain east of the meridian of New Orleans, the shores of Lake Borgne and of Mississippi sound, the Chandeleur islands, the islands along the coast of Mississippi and Alabama, Mobile bay, the coast of Alabama from about three to five miles inland, and a part of the interior near Mississippi city and Pearl river. The distance from New Orleans to Mobile is about 160 miles, and as the general breadth of the reconnaissance was from 12 to 30 miles, it comprised an area of more than 3,000 square miles. The conclusions drawn by assistant Gerdes from his reconnaissance are the following:

"1st. That a trigonometrical survey may be extended from New Orleans to Mobile without any great difficulty.

"2d. That the coast is well situated for a series of well-shaped triangles.

"3d. That a base line of nearly 7 miles in length may be measured on Dauphin island, which may be connected with the main triangulation by triangles, the sides of which will increase gradually."

A very copious report and journal of this reconnaissance have been deposited in the office, with a scheme of the triangulation, prepared by assistant Gerdes. This includes both a main or primary and a secondary triangulation, which assistant Gerdes proposes to carry on simultaneously, and the execution of which has been assigned to him. He will leave Washington in November for the Gulf of Mexico. If my presence in Washington next spring is not needed, and the state of the coast-survey appropriation will permit, I intend to measure the base line on Dauphin island; and if not, to prepare the apparatus for as early a measurement as circumstances will allow.

Assistant Gerdes acknowledges his indebtedness for information and facilities afforded by collector Minge, of Mobile, J. McCaughan, esq., of Mississippi city; to Col. Totten, chief engineer, for the communication of maps of reconnaissance; also for information derived from the maps and charts of Col. Kearny, U. S. Topographical Engineers, and of Commander Powell and Professor Coffin, of the U. S. navy.

2. In order to facilitate the operations of the triangulating party, and to make a beginning of the hydrography by examining the operations of the tides and currents, which are very complex, Lieut. C. P. Patterson, U. S. navy, on coast-survey service, has been put in charge of the schooner *Phenix*, loaned to the survey by the Navy Department, and will proceed to this quarter as soon as his duties in Long Island sound are completed.

As showing the necessity for an early commencement of this work in relation to tides and currents, I append (appendix No. III) an extract from an interesting report of assistant Gerdes.

VI. *Determinations of differences of longitude from European observatories.*

The determination of differences of longitude of points on our coast, and of different European observatories required by the plan of re-organization of the coast survey, has advanced in the course of the past year by the communication of the following observations for the use of the survey, as well as by calculations which will be referred to in another place.

1. The solar eclipses of December 9, 1844, and of May 6, 1845, were observed, by my request, at Portland, Maine, by Lieutenant Charles H. Davis, U. S. navy. The time was obtained by a transit instrument, the use of which was kindly permitted by Mr. Senter. On the occasion of the latter eclipse, measurements were made of differences of polar distances of cusps and limbs with a wire micrometer attached to a telescope equatorially mounted, belonging to the coast survey. The internal contacts of the disk of the planet Mercury with the sun's limb, in the transit of May 8th, were also observed by Lieutenant commanding Davis.

2. W. C. Bond, esq., of Cambridge, has communicated, for the use of the coast survey, observations of the eclipse of the sun of December 9, 1844, and of May 6, 1845. In the latter case, differences of declination of the cusps and of the sun's disk were observed. Also, seven occultations

of stars by the moon between the 14th of December, 1844, and the 15th of September, 1845; ninety-five moon culminations and transits of moon culminating stars, between December 16, 1844, and September 17, 1845; and observations of the transit of Mercury of May 8, 1845, including differences of right ascension of the disk of the planet and of the sun's limb.

3. Mr. Bond has also communicated the results of the comparisons of chronometers transported by steamers between Boston and Liverpool, and a special comparison by twelve chronometers between Greenwich and Boston, and Liverpool and Boston. This latter determination gives for the difference of longitude between the observatories of Greenwich, England, and Cambridge, United States, 4 hours 44 minutes 31.69 seconds. Means having been taken to secure the obtaining of the local time at Liverpool from the observatory there the comparisons by the chronometers of the steam vessels, from their frequency, will, in time, give a body of results of the highest value. The method derives great importance from being, as compared with the determinations by astronomical observations, an independent method.

4. Professor Caswell, of Brown University, has kindly communicated his observations of the solar eclipse of May 6, and the transit of Mercury of May 8th.

5. I have already elsewhere adverted to the observations in progress at Nantucket, which will be communicated for the use of the survey, and also of the observations made by me at Great Meadow station of the eclipse of May 6, and the transit of Mercury of May 8, 1845.

6. The following observations for the longitude of the Philadelphia observatory will be communicated by Professor O. Kendall, of the central high school. They were made with the assistance of Professor Thomas H. Perry, United States navy, detailed for the purpose by the Navy Department.

"1st. A series of occultations, embracing, with two or three exceptions, all that could possibly have been observed.

"2d. A series of transits of the moon and moon culminating stars.

"3d. The observations of the transit of Mercury of May 8, consisting of the times of ingress and egress, meridian observations of Mercury, the sun, and several fundamental stars, and micrometric measures of the distances in right ascension and declination between the limbs of Mercury and the sun, amounting to about one hundred in number."

Besides these, advantage has been taken of the fine Ertel circle to make observations for determinations of latitude, which have also been recorded for the use of the coast survey.

7. Professor Perry was detached temporarily from service at Philadelphia, to make observations of occultations and of the transit of Mercury at Finley's station, near Baltimore. Two occultations were observed at Finley's in moon culminations, at Baltimore.

8. The computations made for the survey out of the office will be noticed in another place.

VII. *Office Work.*—*Calculations, drawing, engraving, instrument making, &c.*

1. The office work of the different field parties during the last winter, consisting of copying journals, calculating observations, drawing, &c.,

has been referred to in connexion with their work of the past season. During the past winter I superintended personally the work of the different parties in the office, and for all official purposes may be considered, according to the regulations of the survey, as present at that central point of the survey at all times; but the immediate charge of the operations going on under my direction is one of the most important duties which can devolve upon an assistant. Upon the efficiency of that officer depends the regular movement of the part of the establishment where the results of the work are collected and put into form to be given to the public. Having felt most forcibly the value of the services to the public, and the relief from responsibility afforded by the ability, method, assiduity, and untiring zeal of the assistant in charge, Lieutenant A. A. Humphreys, of the U. S. Topographical Engineers, I must be excused for warmly and publicly expressing my deep sense of obligation and wishes that his services might meet with the public reward which they deserve.

2. The plan of having duplicate calculations of the work admitting of them made by others than those engaged in executing the work, has been fully carried out; and in cases of disagreement, a third computation has been resorted to. The observations of the last year have nearly all been recomputed, and some of those of the present year have been begun. Assistant Theodore W. Werner, at New Haven, and Eugene Nulty, esq., at Philadelphia, have done the chief work of recomputing, and a portion of work has been referred to Professor Stephen Alexander, of Princeton. The advantages of this system are not only felt directly in the accuracy to which it leads, but in the reaction upon the modes of observations themselves by bringing independent judgments to their scrutiny.

3. The computation of recorded observations for differences of longitude of points upon our coast, and of European observatories, has been continued by Sears C. Walker, esq.

In his report of October 25, 1845, Mr. Walker gives the following summary of the computations added since his last report; "The transit of Mercury of the 8th of May, of which both phases were observed at Philadelphia, enables me to add one to class III of that report. The two partial eclipses of the sun that have occurred in the interval are of no use for purposes of longitude from Europe. Classes IV, V, VI, and VII, have been extended so far as to include all the phenomena of their kind for Philadelphia down to 1842. They have also been made to include the extensive series of observations of eclipses and occultations by Lieutenant Gilliss at the marine observatory at Washington in the years 1838 to 1842, inclusive."

Some idea of the labor of computing the occultations, the observations of which form a considerable part of the materials for Mr. Walker's computations, may be gathered from the fact, that one of the eight classes into which the work has been subdivided for ready reference requires the discussion of not less than one hundred occultations, and that a form prepared for the reduction of one of these occultations occupies four printed pages in folio.

4. In my report of last year, the advantage of publishing every year the results of the work was referred to. I had in view a publication resembling the memorial which contains an account of the operations of the great trigonometrical survey of France. Instead of delaying publication

until the close of the work, I proposed to publish annually the results of observation. I suggested there a difficulty in regard to pecuniary means; and have felt that difficulty so strongly, that the collecting of the work for such a purpose is only in part done. It will not, however, be lost sight of; and, possibly, when the volume is presented to the department to be laid before Congress, means may be appropriated for its publication at the office of the survey, or it may be printed as a congressional document.

Drawing, &c.—1. The usual maps of assemblage and record for the work of 1844 generally, which require considerable labor, have been completed. Seventeen sheets were prepared for the plane-table parties for the season's work, the meridians and parallels, triangulation points, and sides of triangles being projected upon them.

2. The following maps, charts, and sketches were drawn chiefly on the publication scale :

A map of the harbor of New Bedford, on a scale of $\frac{1}{40000}$, was reduced and drawn by assistant Whiting; the drawing of the hydrography being furnished by Lieutenant commanding George S. Blake.

A chart of Fisher's Island sound, on a scale of $\frac{1}{40000}$, was reduced and drawn by assistant B. Glück.

A map of New Haven harbor, on a scale of $\frac{1}{30000}$, has been nearly completed by assistant Glück.

The hydrography of the eastern sheet of Long Island sound, on a scale of $\frac{1}{50000}$, was reduced under the immediate direction of Lieutenant commanding Blake, by Mr. Glück.

A map showing the progressive changes at Sandy Hook was compiled from different surveys made between 1778 and 1844, and drawn by Mr. Glück. This has been furnished, as before stated, by the direction of the Treasury Department, to the Hon. J. Phillips Phœnix, and has been laid before the chamber of commerce of New York.

The sketches, exhibiting the progress of the survey during the year 1844, were also made by Mr. Glück.

The hydrography of the Delaware, from Fort Mifflin to Trenton, is in part reduced and the drawing nearly completed by Mr. Glück.

The drawing of the middle sheet of the map of Delaware bay and river has been finished by assistant W. M. Fairfax.

The drawing of the upper sheet of the same map, except the part including the city of Philadelphia, has been finished, and that of the lower sheet, containing the bay and approaches, has been begun by assistant Fairfax.

Scales of shade for representing the slopes of hills, with specimens of hills, and other topographical details, including conventional signs, and for drawings on different scales from $\frac{1}{10000}$, the usual working scale, to $\frac{1}{50000}$, the most common publication scale heretofore used, have been prepared by Mr. Fairfax, under the immediate direction of assistant Humphreys.

The map of the harbor of Annapolis and the Severn river, on a scale of $\frac{1}{50000}$, was reduced by assistant Cutts, and drawn by assistants Glück and Gerdes; the reduction of the hydrography being furnished by Lieutenant commanding George M. Bache.

Additions have been made to sheets Nos. 5 and 6 of New York bay and harbor.

A drawing to exhibit the progress of the coast survey each year since its commencement, designating the different kinds of work and by whom executed, is in progress and nearly completed, by Mr. Morven McClery, who has been also engaged in lettering maps and in miscellaneous duties of the office. Drawings for the projections of the plane table operations for the season were also made by Mr. McClery.

Various tracings and copies of maps have been made for the use of the different parties in the survey.

The verification of the maps published, by comparison with the original surveys, is made by Lieutenant Humphreys personally. This duty has included, within the past year, the verification of the small map of New York bay and harbor, of Nos. 5 and 6 of the large map of New York bay and harbor, of two sheets of the chart of Long Island sound, of one sheet of the Delaware bay and river, of Fisher's Island sound, and of the harbors of New Bedford, New London, and Annapolis.

5. Part of the officers of the party of Commander Gedney, United States navy, have been engaged (latterly under the immediate direction of Lieutenant C. P. Patterson, Commander Gedney being unavoidably absent on account of ill health) in bringing up the office work of the party. The following work has been done in the course of the year:

1. A chart has been made of the off-shore soundings of 1844, from Cape Henlopen to Block island, and southeast to the gulf stream; scale $\frac{1}{100000}$. 2. The off shore work of 1842, within the same limits, has been re-protracted on the same scale, and the soundings transferred to the chart of 1844. 3. The work of the East river and Long Island sound, from Governor's island to Throg's point, has been re-protracted; scale $\frac{1}{100000}$. 4. The work on the south coast of Long island, from inlet East (near Southampton) to Montauk point, has been re-protracted; scale $\frac{1}{100000}$. 5. The work on Great South bay, from Conkley's point (near Fire Island inlet) to Head and Horns, has been re-protracted; scale $\frac{1}{100000}$. 6. The work on the coast of New Jersey, from Sandy Hook to Barnegat inlet, has been re-protracted; scale $\frac{1}{100000}$. 7. A chart has been made of the East river, from Governor's island to Fulton ferry; scale $\frac{1}{100000}$. 8. About one half of the duplicate journals have been compared with the originals and corrected, and the journal of 1844 copied. 9. The charts have been lettered and marked. 10. A register has been made of all the hydrographical notes in the office. 11. Specimens of bottom (3,815 in number) have been put in bottles, marked, and registered.

6. Tracings and drawings have been made of different parts of the work, to answer the calls made for information for public purposes, and under the sanction of the Treasury Department. The archives have been thus rendered useful in cases which could not have been foreseen, but which nevertheless are of value to the public.

Engraving, printing, and publishing.—1. The engraving and drawing have been prosecuted with considerable activity by the aid of the additional appropriation made by Congress at their last session for the publication of the work of former years. The local charts, requiring less finish and uniformity of style than those of the sections of the coast, have been put out of the office for execution, and we shall thus have a fair trial of the contract system in its results as to accuracy, style, cost, and time. It will be found that my pledge, in the

event of this appropriation being made, to carry on the publication of the back work without interfering with that appropriate to the year, has been fully redeemed. Two sheets of the large map of New York bay and harbor, and the map of the same bay on a smaller scale, have been published; a chart of Fisher's Island sound is ready for publication; a sheet of the map of Long Island sound, and of Delaware bay and river, are nearly ready for publication; a chart of New Bedford harbor, and a chart of Annapolis harbor and the Severn river, will be out during the winter; and a second sheet of Delaware bay and river, and a chart of New London harbor, will soon follow. A sheet of the south side of Long Island is engraved as far as the materials in the office permit. The results thus produced will, I trust, induce Congress to continue the additional appropriation for the preparation of the maps and charts, until the whole of the back work has been published.

A more particular account of the several charts in the course of publication or engraving will be found below.

1. The small map of New York bay and harbor, on a scale of $\frac{1}{80000}$, which was nearly finished at the close of 1844, was published in February, 1845.

Copies of it have been distributed under act of Congress and by direction of the Treasury Department, and have been placed for sale with agents at New York, Boston, Philadelphia, Baltimore, and Washington. Arrangements will soon be completed for exposing it for sale at Charleston and New Orleans.

2. The first sheet of the southern shore of Long Island, on the scale of $\frac{1}{60000}$, reported as nearly completed in my last, has been delayed to remedy some essential defects which the verification of the hydrography made apparent.

3 and 4. Two sheets (Nos. 5 and 6) of the map of New York bay and harbor, completing the map on the scale of $\frac{1}{30000}$, which were in outline merely at the close of last year, have been completed, printed, and published. The distribution of them must be made through the members of Congress, who apply in behalf of the literary and scientific institutions, and the associations to which by law they are to be sent, the Treasury Department having no longer the privilege of franking them. Copies of these sheets were directed to be placed with the agents of sales in November.

5 and 6. The plate which contains the entrance of the sound from the eastward, and Fisher's island sound, is nearly completed. The elaborate work upon this plate and the two of Delaware bay (numbered below as 7 and 8) renders progress upon them necessarily slow. The middle sheet of the sound is in outline, and the roads and other parts of the topography have been completed. The western sheet, towards New York, is in outline upon the copper.

7 and 8. The middle part of Delaware bay and river (No. 2) will be finished by the first of February, and the upper sheet within two months after. The drawing of the lower sheet is nearly ready for the engraver, and the projection upon the copper has been prepared.

9. A chart of New London harbor will probably be engraved before the presentation of this report.

10. A chart of Fisher's island sound, on a scale of $\frac{1}{40000}$, has been en-

graved out of the office, and is nearly ready for publication, requiring the re-entering of portions of the topography.

11. A chart of the New Bedford harbor, surveyed in 1844, is in progress out of the office, and the time for its delivery was the first of December. The views and other additions to it will occupy six weeks or two months in engraving, so that it will probably be issued in February next.

12. A chart of Annapolis harbor and the Severn river, surveyed in 1844, is also in progress out of the office to be completed, with the exception of the views, by the first of December. This will speedily be published.

The engraving department has been, during the whole of this year, under the charge of assistant Farley and the general supervision of Lieutenant Humphreys, and monthly reports and proofs of the works have been regularly forwarded to me. It is manifest that great diligence has been shown by the engravers; and, in regard to the style of execution of the two principal parts of the work, the hill topography on the sound, and the woodland upon the Delaware, and sanding in Delaware bay, the style is admirable. The lettering, some of the views, and part of the sanding, approach these in excellence.

2. *Printing and publishing.*—Since the first of December, 1844, 630 copies of Nos. 1, 2, and 3, of the large map of New York bay and harbor, have been printed, and 440 of No. 4. The remaining copies of No. 4 will be printed with No. 6, the sheet which it adjoins; 861 impressions of No. 5 have been printed, and 600 copies of No. 6 will be printed before the close of December, so as to make up 600 complete copies of the six sheets—the whole map; 1,440 impressions of the map of New York bay and harbor on the smaller scale have been printed since February.

Fifty-three copies of the four sheets of the large map of New York bay and harbor have been *distributed* this year under act of Congress, including twenty-six to foreign governments; making a total number distributed of two hundred and twenty-two. One hundred and ninety-four copies of the small map of New York bay and harbor have been distributed, including 26 to foreign governments. The agents for the sale of the charts have received 250 copies of the four sheets of the large map, and 630 of the small. Before the 1st of December it is probable that 222 copies of sheets Nos. 5 and 6 of the large map will be directed and ready for distribution, and 250 copies placed with the agents for sale.

I would again respectfully solicit that authority be obtained from Congress to distribute, under the direction of the Treasury Department, an additional number of these charts, at home and abroad, to literary and scientific institutions, and associations connected with navigation, and to supply the depot of charts of the navy with the number which may be required for use by our national vessels. The cost of this distribution will be very trifling, and a great object will be answered by diffusing the information conveyed by the charts as widely as possible.

3. The instruments for nearly all the parties on the work have been cleaned and repaired in the office during the past year. The work done has included the construction of a stand for the two-feet vertical circle, and part of the changes necessary to the instrument itself, which now requires only slight additions to render it available for use. The dividing engine has had various changes made in it. A ruling machine and other tools for the engravers have been made. The three-feet theodolite has

been cleaned, the friction rollers repaired, and the mode of adjustment of the microscopes altered. The two-feet theodolite has been thoroughly repaired and the limb re-divided. Two of the theodolites for secondary triangulation have been cleaned, repaired, and the limbs re-divided. The heliotropes have been altered, and an arrangement for heliotroping attached to a two-and-a-half-feet telescope. Theodolites, telescopes, barometers, compasses, and chains, plane tables, and tools for the field parties generally, have been repaired. The parts of six full sets of drawing instruments have been nearly prepared. Four beam compasses, four pairs of proportional dividers, and other drawing tools, have been made. A compensating base apparatus has been made, with the various parts for supporting and adjusting it. This work has been executed by Mr. William Würde-man, assisted during the season generally by one instrument maker, and at pressing times by two others temporarily employed.

When the variety of work thus done is considered, it is obvious that it requires no small share of knowledge, skill, and industry for its execution.

Recently, when it was desirable to employ additional force to furnish the new base apparatus, it was found very difficult to obtain any aid, and several instrument makers, who were applied to, declined undertaking the work at all to be executed by a specified time. These facts must be allowed due weight in estimating the value of the work shop of the coast survey.

It must be obvious from this statement of work done, which exhibits much of constant yearly recurrence, that new instruments can be made, if at all, only occasionally in this work shop. The necessity for more instruments, and of a different kind from those heretofore used in the survey, is very great, and I have asked for a moderate sum in the estimate of next year for their gradual supply.

4. The *disbursements* of each party are made by the chief, and the accounts then pass into the hands of a general disbursing agent, by whom they are first audited under the regulations of the Treasury Department. They then undergo an administrative examination by the superintendent, and if they have passed these two audits, are forwarded by the general disbursing agent to the First Auditor of the Treasury. The appropriation is drawn by the general disbursing agent, who advances the sums required to the chiefs of parties on their requisition, under such restrictions as may be laid by the Department or superintendent. The success of this arrangement of finance depends essentially upon detaching the general disbursing agency from other duty in the survey, and making the officer himself stationary at Washington. The duties of general disbursing agent are performed by Samuel Hein, esq., under whose care entire order and regularity prevail in the supplies to the parties, and in the arrangement and preliminary audit of accounts.

I have thus endeavored to give a view of the work done during the year, extending from November, 1844, to November, 1845, and to assign, as far as practicable, to each one engaged in the direction of any part of it the due share of credit. The amount done proves conclusively that each one in his sphere of labor has been zealously and industriously engaged, that the different branches of the service have harmonized in the execution of their work, and that a good spirit has reigned throughout.

It must, I think, be conceded that (not to go further back than my own superintendence of the work) more has been done during the past year

by each of the parties, with the same or proportional expenditure, than was accomplished the year before, and that thus, in the aggregate, a much greater result is furnished in proportion to the means expended; more has been done, I think, in the aggregate, with the means assigned, than I promised in my report, and perhaps enough to prove that if the appropriation were increased it would go proportionably still further for the public benefit.

In conclusion, I beg leave to present a sketch of the progress which may be made in the next year, and an estimate of the means required to realize that progress.

Two new centres of operation have been added during the past year, one on the coast of North Carolina and the other in the Gulf of Mexico; to these I would add, during the coming year, a third centre on the coast of South Carolina, or Georgia, or Florida, as a reconnaissance may prove most desirable, and I would extend the work efficiently from the two new centres. This can be done without proportionally increasing the appropriation for the survey; for if the means for keeping the parties in the field for a longer period of time each year were provided, we could work to the south during the winter, and to the north during the summer; a system already in part commenced during the past year, and carried as far as the means at my disposal would allow.

Again; the enlightened co-operation of the heads of the War and Navy Departments with the Treasury Department, and the general good feeling towards the survey of the officers of the army and navy, would enable us, under the directions already issued by Congress in regard to the employment of officers of the army and navy, to organize new parties if we had the means to fit them out and supply them with laborers, transportation, vessels, and other appliances for surveying which they require. We should thus be able to make such an impression on the public, by the extension of the work and the speedy publication of its results, as would repay by a rich harvest of popular approbation the fostering care of the Executive and Congress.

The present state of the work in the different sections will admit of the following progress during the next year.

1. *Eastern section.*—The primary triangulation may be extended across the northern line of Massachusetts into New Hampshire, and some progress made upon the coast of New Hampshire. The secondary triangulation may be carried across Cape Cod and Massachusetts bays, and as far north as Plymouth. The topography of Martha's Vineyard and Nantucket may be completed, and that of the main be carried from Wood's Hole eastward to Monomoy point. The hydrography of the Vineyard sound and of the sound between Nantucket and the main (Nantucket sound) may be completed, and the dangerous shoals off Nantucket seaward be examined.

2. *Middle section.*—The triangulation on the coast of New Jersey may be verified, the magnetic observations near New York and on Long Island sound and its vicinity may be completed, and the observations of currents in New York bay, Long Island sound, and Delaware bay may be nearly or quite completed.

The important observations in the gulf stream may be continued, and the off shore soundings be extended southward as well as eastward.

3. *Southern section No. 1.*—The triangulation of the peninsula of the

eastern shore of Maryland and Virginia may be completed, and its connexion with the triangulation of the Chesapeake may perhaps be made. The primary triangulation may be extended southward along the Chesapeake, the secondary triangulation reach the Potomac and pass up towards Washington. A main triangulation may be commenced, to cross from Annapolis to Washington, connecting the capitol and naval observatory with the coast, and verifying the triangulation of the Potomac. A tertiary triangulation may be carried up the rivers of the Chesapeake to the head of navigation of each. The topography of the shores of the Chesapeake north of Kent island, the topography of Kent island, and of the shores of the Chester river, may be completed, and that south of Kent island commenced. The hydrography of the bay north of Kent island, and of the rivers flowing into it, may be completed, and that between Kent island and the Potomac be commenced and make considerable progress.

4. *Southern section No. II.*—The triangulation of Albemarle sound and of the rivers emptying into it may be nearly completed, and that of Pamlico sound may perhaps be commenced. The requisite astronomical observations at the Bodies island base and neighboring stations may be made. The topography of the shores of Albemarle sound and the hydrography of Albemarle sound be commenced.

5. *Southern section No. III.*—The measurement of a base on Dauphin island may be made, and the triangulation of Mississippi sound and of Mobile bay be carried on. The requisite astronomical and magnetic observations may be made in this quarter. The survey of the shores may be made from Dauphin island as far west as Mississippi city. The observations of tides and currents may be continued, and the soundings commenced in the same quarter.

6. *Southern section No. IV.*—A reconnaissance for a suitable base line, and to determine the character of the triangulation which is practicable, may be made on the coast of South Carolina, Georgia, and Florida, establishing a new centre of operations.

7. *Office work.*—The office work should consist, 1st, in the copying, reducing, and computing of the observations of the previous season, and in making drawings and projections of past or for future work; the arrangement of the observations of the past year for publication; the verification of calculations made by the field parties. 2d. The preparation of the materials for a map to extend from Point Judith to the east chop of Holmes's Hole, Martha's Vineyard, to include Buzzard's bay and the Vineyard sound, properly so called, and the commencement of the map itself. 3d. The reduction of the chart of the harbors of refuge of Tarpaulin cove and Holmes's Hole, on the Vineyard sound, and the engraving of the charts. 4th. The engraving of the second sheet of Long Island sound, and the drawing and engraving of the harbors of New Haven and Oyster bay. 5th. The preparation of an off-shore chart, to include the work off the coast of Delaware, New Jersey, New York, Connecticut, and Massachusetts; the commencement of the engraving of a sheet of this chart. 6th. The continuation of the drawing of the southern coast of Long Island, with a view to engraving and publication. 7th. The completion of the engraving of the upper sheet of Delaware bay and river, and the progress of the sheet representing the entrance of Delaware bay and the approaches; the drawing and engraving of a chart of Little Egg

Harbor, on the coast of New Jersey. 8th. The preparation of a chart of the Patapsco river and of Baltimore harbor, and the engraving of the chart as far as the materials may be furnished. 9th. The preparation of the materials for the commencement of a map of the upper part of the Chesapeake bay, on the publication scale, with a view to its completion as soon as all the data are furnished by the field parties, and its subsequent immediate publication. 10th. The data for a map of Albemarle sound and of Mississippi sound west of Mobile bay should be collected and arranged, so that the maps may be drawn as fast as the field-work is executed.

If the additional appropriation for preparing maps for publication, and for drawing and engraving, which was made last year, is continued, the new work and the back work, which are spoken of together in the foregoing, may be continued together; if not, one or the other of them must be cut off. That appropriation was made after an estimate had been presented to the Committee of Ways and Means showing the amount required to complete the reduction, drawing, and engraving of the work of former years, and asking for that part of the sum to expend during the past year. It will be observed that no work of this sort has been allowed to accumulate during the past year, but that publication has been made of what was complete in itself. This policy it is desirable to continue, and at the same time to publish the materials which have accumulated in past years so as to bring the publication up to the field-work.

I place the estimate for the field-work under the different sections, that it may be distinctly seen that the cutting off of a part of it involves the cutting off of some one section, or of all proportionately. It should be observed that, if there is a necessity for cutting off new work, or reducing the amount of expenditure upon the work already in progress, economy absolutely requires that the new work be not begun, the proportionate facilities for continuing the new work not being equivalent to those of continuing the old.

The cost of publishing the work of former years is included with that of the new work in the different sections.

<i>General items</i> —Current repairs of vessels at present in use in the survey, and hire of others for work generally	\$1,350
Purchase of surveying instruments, books, maps, and charts	5,570
For rent, fuel, postage, stationery, materials for drawing, engraving and printing, and for printing charts	5,000

Eastern section.—To continue the triangulations north into New Hampshire, over Cape Cod and Massachusetts bay to Plymouth; the topography from Wood's Hole to Monomoy point; the hydrography through the Vineyard sound, and to survey the shoals off the island of Nantucket, including observations of tides and currents, will require two triangulation parties, two topographical parties, the whole time of one hydrographical party, and part of the time of another \$18,000

To reduce and engrave the charts of the harbors of refuge of Holmes's Hole and Tarpaulin cove on the Vineyard sound; to calculate the data for a map from

Point Judith to the east chop of Holmes's Hole, including the entrances of Narragansett bay and the Vineyard sound proper, will require about - -

\$1,300

\$19,300

Middle section.—To verify the triangulation of the coast of New Jersey; to complete the magnetic observations near New York and in Long Island sound, &c.; to complete the observations of currents and tides in New York harbor, Long Island sound, and Delaware bay; the off-shore work off the coast of Delaware, New Jersey, New York, Connecticut, and Massachusetts, will require one triangulation party, one other party for two months, two hydrographical parties—one for the season, the other for five months

8,750

To complete the engraving of two sheets of Long Island sound, the reduction and engraving of two of Delaware bay, the drawing of the harbor maps of New Haven and Oyster bay, and their engraving, the reduction, drawing, and engraving of the off-shore chart—all belonging to the work of former years - - - - -

9,100

17,850

Southern section No. 1.—To carry the triangulation from Cape Henlopen and connect it with the Chesapeake bay work; to carry the primary and secondary triangulations down the Chesapeake, the tertiary triangulation along the water courses near it, a triangulation across to Washington and up the Potomac; to finish the topography of the shores of the Chesapeake north of Kent island, and to commence that of the shores south; to complete the hydrography of the upper part of the bay, and to commence that of the bay south of Kent island and of the adjacent rivers, will require three triangulation parties during the season, and one during part of the season; three topographical parties, two hydrographical parties -

21,500

To make the computations, reductions, and drawings, and to engrave the chart of Patapsco and Baltimore harbor; to make the computations, reductions, and drawings of the chart of the upper part of the Chesapeake, will require - - - - -

3,800

25,300

Southern section No. 2.—To commence the triangulations of Albemarle, Roanoke, and Pamlico sounds, and of the rivers emptying into them; to make the necessary astronomical and magnetic observations; to commence the topography of the sound and ocean shores, and the hydrography of the sound, will require one triangulation party during the whole season, one other during part of the season; one astronomical party; one topographical party; one hydrographical party. For each of these parties a vessel must probably be hired - - - - -

16,100

The reduction of this work and the computations connected with it, will require -	\$1,500	
	<hr/>	\$17,600
<i>Southern section No. 3.</i> —To measure a base line on Dauphin island ; to triangulate Mississippi sound and westward ; to make the astronomical and magnetic observations required ; to begin the topography of the shores and islands ; the hydrography, by observing currents and tides, and by soundings ; to continue the reconaissance eastward along the coast of Florida, will require one triangulation party, one astronomical party, one reconnoitring party, and two topographical and one hydrographical party -	17,800	
Calculations and reductions preparatory to map -	400	
	<hr/>	18,200
<i>Southern section No. 4.</i> —Reconnaissance on the coast of South Carolina, Georgia, and Florida commenced		900
Total -		<hr/> <hr/> \$111,000

The work in four of these sections is actually commenced, and to keep pace in the regular way with its progress will require all that I have asked. The estimates have been made with care, and are approved by the Treasury Department. Should the amount be diminished, the work must necessarily be diminished, and that in a greater proportion than the diminution of the appropriation ; because the work is economical just in proportion as the system of division of labor can be more fully applied to it. The only choice will then be between neglecting certain sections altogether, or the wasteful way of working in all with insufficient means. I confess the responsibility of omitting the work projected for any particular part of the country, for either the eastern, middle, or three southern sections, is one which I shrink from, and which I sincerely trust there may be no necessity for taking. If, however, the means asked are not granted, the responsibility for the progress of the survey and for the period of its completion thus passes away from me ; for it would be manifestly unjust to refuse the means stated to be necessary to advance the work, and to publish the results, and then to hold those engaged in or directing the work responsible for slow progress and the absence of publication. But I trust a different course will be taken, and that the disposition shown to push the work forward rapidly, to task to the utmost the powers of all concerned, to economize in every way short of destroying the efficiency of the work, and to publish the results as fast as they are obtained, will be responded to by the grant of the amount which, after careful examination, I pledge myself to be necessary to the due progress of the work, and to be that which can be applied to the greatest advantage during the coming fiscal year.

I ought not to close this report without saying that the scale of the survey may be still further expanded, if desired by Congress. In my last report, I showed how this expansion might take place, carrying on the work more rapidly on the coasts of the Atlantic and Gulf of Mexico, at an additional cost of about \$47,000. The foregoing estimate is based upon the continuance of the policy heretofore sanctioned by the Treasury De-

partment, and by Congress; but I am very willing to go forward more rapidly, and, if additional means are furnished for the purpose, to commence work at once in our newly acquired coast of Texas.

The extent of the line of coast within the geographical limits of the United States, for the time being, is determined by nature; and the more rapidly it is surveyed, consistently with accuracy, the more economically can the work be done—the sooner will this source of expenditure cease—the sooner will the loss of life and property, caused by ignorance of the dangers of the coast, cease—the sooner will the reproach be removed from us of being dependant almost entirely upon foreign surveys for the little knowledge we possess of our coast and harbors south of the Chesapeake, and east and north of the Vineyard sound.

Very respectfully submitted by

ALEXANDER D. BACHE,

Superintendent United States Coast Survey.

HON. R. J. WALKER,

Secretary of the Treasury.

APPENDIX NO. I.

Extract from a letter addressed by Lieutenant Commanding Blake, United States navy, coast survey service, to Professor A. D. Bache, Superintendent Coast Survey, containing a description of the position of a rock off Mishaum point, of a rock off Cuttyhunk, and of a ledge off Scraggy Neck, Buzzard's bay.

“Rock off Mishaum point, eight feet at low water. Mishaum point N. 30° E., 1½ *nautical* miles. Highest part of Pune island S. 30° E.—A black spar buoy has been recently placed S. 58° E., a little over one-third of a mile from this rock—in three fathoms at low water. The buoy is upon the eastern extremity of the ledge to which the rock belongs, and is upon the following ranges. Clarke's point light just open to the eastward of the summit of Round hill. West end of Nashawena island just open with the south part of Pune. Vessels bound into Buzzard's bay should, as they draw up with this buoy, be careful to keep to the eastward of it.

“Rock off Cuttyhunk in 15 feet at low water. Cuttyhunk light S. 37° E., 1½ *nautical* miles. Highest part of Pune N. 71° E., 2¾ *nautical* miles. The only well defined range to this rock is the southwest bluff of Nashawena, just open with the high part of Cuttyhunk, over Copecut beach.

“Entrance of Mattapoiset harbor, a rock in 10 feet at low water. Ned's point light N. 32° W.—Strawberry point just open to the northward of Angelica point.

“A similar ledge, having but six feet water upon it, lies one quarter of a mile *without* southwest buoy off Scraggy Neck, and bearing about SSW. from it.”

APPENDIX NO. II.

Extracts from a letter from Lieutenant Commanding Charles H. Davis, United States navy, surveying brig Washington, to Professor A. D. Bache, Superintendent Coast Survey, relating to the determination of Howland's reef, off Brandt point, Massachusetts bay.

“ U. S. SURVEYING BRIG WASHINGTON,
“ Provincetown, September 17, 1845.

“ DEAR SIR: Yesterday, on leaving Boston harbor, I searched for the rock off Brandt point, reported to me by one of the bay pilots, and, agreeably to your request, determined its position. On two spots there is eight feet of water only at low spring tides. This small ledge, as it proves to be, is not to be found on the charts, and is, indeed, generally unknown to pilots. * * * * *

“ Several packets are reported to have struck upon this reef during the past year. The water deepens rapidly from the shoal part to three and four fathoms (at low water) in all directions. It is situated in the track of vessels bound to Plymouth and the lower part of Barnstable bay, with a fair wind, and of all coasting vessels beating in Massachusetts bay. I waited until this morning and made a more careful determination of the ground, measuring several angles upon topographical points furnished by Mr. Borden's State map. I send a sketch showing the relative place of the ledge, which (by no means intended as an accurate survey) is sufficient to establish its position, and also the claim of the coast survey to its first determination. The following directions will serve to mark its location on the common charts:

“ Gurnet lights bearing S. $\frac{1}{4}$ ° E., distant $4\frac{1}{2}$ miles.

“ Scituate bearing NNW., distant $5\frac{1}{4}$ miles.

“ Captain's hill bearing SW.

“ Buoy, Phillip's ledge bearing WNW. $\frac{1}{4}$ W., distant $\frac{3}{4}$ of a mile.

“ High Pines ledge bearing S., distant $2\frac{1}{4}$ miles.

“ Its distance from Brandt point is $1\frac{1}{2}$ mile, and from the shore due west $1\frac{1}{2}$ mile. The bearings are magnetic. The buoy on Phillip's ledge, $\frac{3}{4}$ mile inshore, is generally supposed to mark the western limit of safety, and this increases the danger of the new ledge, and renders it more important that a buoy should be placed on it.”

APPENDIX NO. III.

Extract from a letter addressed by Ferd. H. Gerdes, assistant United States Coast Survey to Prof. A. D. Bache, Superintendent, containing remarks upon the currents in Mississippi sound, and upon the change in the magnetic variation within short distances in the Gulf of Mexico.

“ The effects of the prevailing winds, of currents, and of the great differences in the local magnetic variation, have more influence in the navigation of the Gulf of Mexico, between Mobile and the Balize, and in Lakes

Borgne and Pontchartrain, than on other parts of our coast bordering on the Atlantic ocean. The lakes are rather shallow, and only navigable for vessels of a light draught; the tide, therefore, affords frequently a great advantage, or otherwise. But this tide seems to be governed altogether by winds, and at present no system has been developed by which we may form a correct idea or even an approximation to the rise and fall. Under the head "tides and currents," I have mentioned in my report some observations which were made by myself during my presence on the coast, and have also referred to the charts of Mr. Blunt, who derived his information regarding the tides, I presume, from the surveys of Colonel Kearny and Lieutenant Powell. But those observations were necessarily confined to a limited period—Colonel Kearny's register commencing with the 13th of March and ending with the 1st of May, 1822, at Santa Rosa beach, Pensacola, and the notes of Lieutenant Powell, including from the 5th of January to the 2d of February, 1841, at Ship island.

"It appears necessary to investigate, if possible, closely into the causes of the irregularity; to observe for a long time not only the actual rise and fall, but also the direction and strength of the wind, the different formidable currents, their courses and strength, and form an idea of their origin; then I believe we may be able to establish gradually a system of conjectures bordering much nearer on truth than all our present suppositions. To make any observations of this sort, I would provisionally name Mobile point, either Ship island east or the Chandeleur island north, and the Rigolets.

"The strongest and most irregular currents which I observed, were north of the Chandeleur islands and south of Horn island and the Petit Bois. An instance of the strength I have mentioned in the above named paragraph of the report in the filling up of the Pelican channel. This is so extraordinary that it may be compared with the alterations on the Sandy Hook beach, near New York.

"The danger occasioned by this current is very great. On most places the soundings change from a considerable depth suddenly to shallow water, and the velocity of the stream sweeps many a vessel out of her reckoning, and she finds herself without the aid of light-houses, in dark nights, suddenly out of an apparently safe navigation, on bars or amongst breakers, at the mercy of the wild sea.

"Another danger for the navigation on this coast is, the irregular pointing of the needle. In short distances, the variation changes, according to records, materially enough to throw obstacles in the path of the mariner. The following notes were taken from charts:

" St. Joseph's,	Blunt's chart,	1826,	variation	6° 18' E.
" "	Lieut. Powell,	1841,	"	7° 39' "
" Mobile bay,	Blunt,	1840,	"	7° 5' "
" Balize,	Blunt,	1838,	"	10° 15' "
" Ship island,	Lieut. Powell,	1841,	"	7° 35' "
" "	J. Wheeler,	1839,	"	7° 41' "

"The Balize is on the same meridian with Ship island, and differs only 35' southward in latitude. A difference of nearly 3° in about 40 miles seems to be very large, and, if correct, may form one more objection to the use of the compass in topography.

"These observations belong properly to the hydrographical part of the survey, and were always taken simultaneously or even after the sound-

ings were made. This, however, might in future (without alluding to the past) occasion some delay in engraving the charts, as a much longer period for obtaining results will be required in the Gulf than in our eastern waters; therefore I would propose to take into consideration if we might not begin at once with such observations."

APPENDIX No. IV.

Extract from a letter addressed by William Mitchell, of Nantucket, to Professor A. D. Bache, Superintendent of the Coast Survey, containing an account of the trade through the Vineyard sound for the last three years, and of the Nantucket south shoal.

"MY DEAR FRIEND: I have at length obtained the information I desired relative to the number of vessels which annually pass through the sound. Knowing that thou wouldst prefer a modern account, I applied to the captain of the light boat, with whom it has been somewhat difficult to communicate. To his politeness I am indebted for the following particulars:

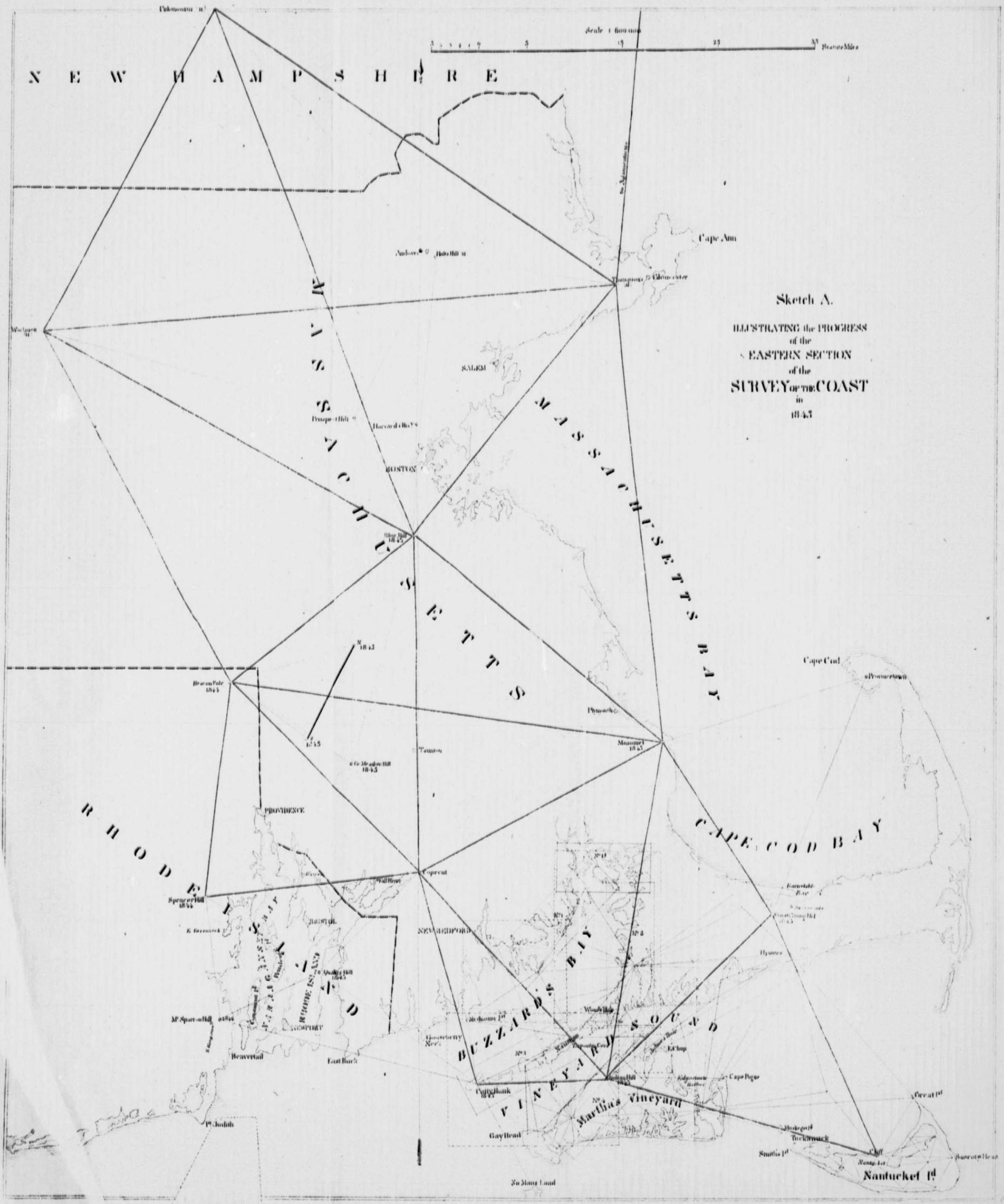
In 1842 there were	144	ships,	1,295	brigs,	7,551	schooners,	3,616	sloops.
In 1843 there were	151	"	1,194	"	8,228	"	3,525	"
In 1844 there were	152	"	1,175	"	7,483	"	2,566	"
	447	"	3,664	"	23,262	"	9,707	"

and to July, 1845, there were 122 ships, 805 brigs, 4,847 schooners, 1,796 sloops, passed Nantucket light-boat, (an immense amount of property indeed,) and yet there is no chart of this thoroughfare in existence that is worthy of the name.

"My rude angles to the ship Centurion, wrecked on the south shoal, (1845,) resulted in placing her within one hundred rods of the position of the shoal as located by modern observers. The history of this most dangerous and fatal shoal is startling. Situated in mid ocean; having, in low ebbs, scarcely a foot of water; in a region proverbial for its heavy swell; rising, at times, without a moment's warning; the dread of all mariners, and the grave of thousands; laid down in a position twenty miles in error of latitude, and confided in as late as the year 1821—such is Nantucket south shoal! The honor of giving to this shoal its true locality belongs to Captain Jonathan Colesworthy, of this place, who, on the 24th of June, 1821, made its latitude $41^{\circ} 3' 55''$, it having, in all former time, been considered to be $40^{\circ} 44'$. In looking over the documents of Captain C., I am entirely satisfied that, in the old location, there are forty fathoms of water. So strong, however, is the impression on the minds of our veteran seamen that the earlier location is the true one, that confidence is still wanting in the survey of Colesworthy, though he has always been distinguished as an accurate observer. Its new and probably true location is precisely in the track of all vessels bound to New York from Europe; and it is remarkable with what apparent recklessness vessels of the largest size (even the Atlantic steamers) dash near its parallel, from the apprehension that it is far south of them. The last

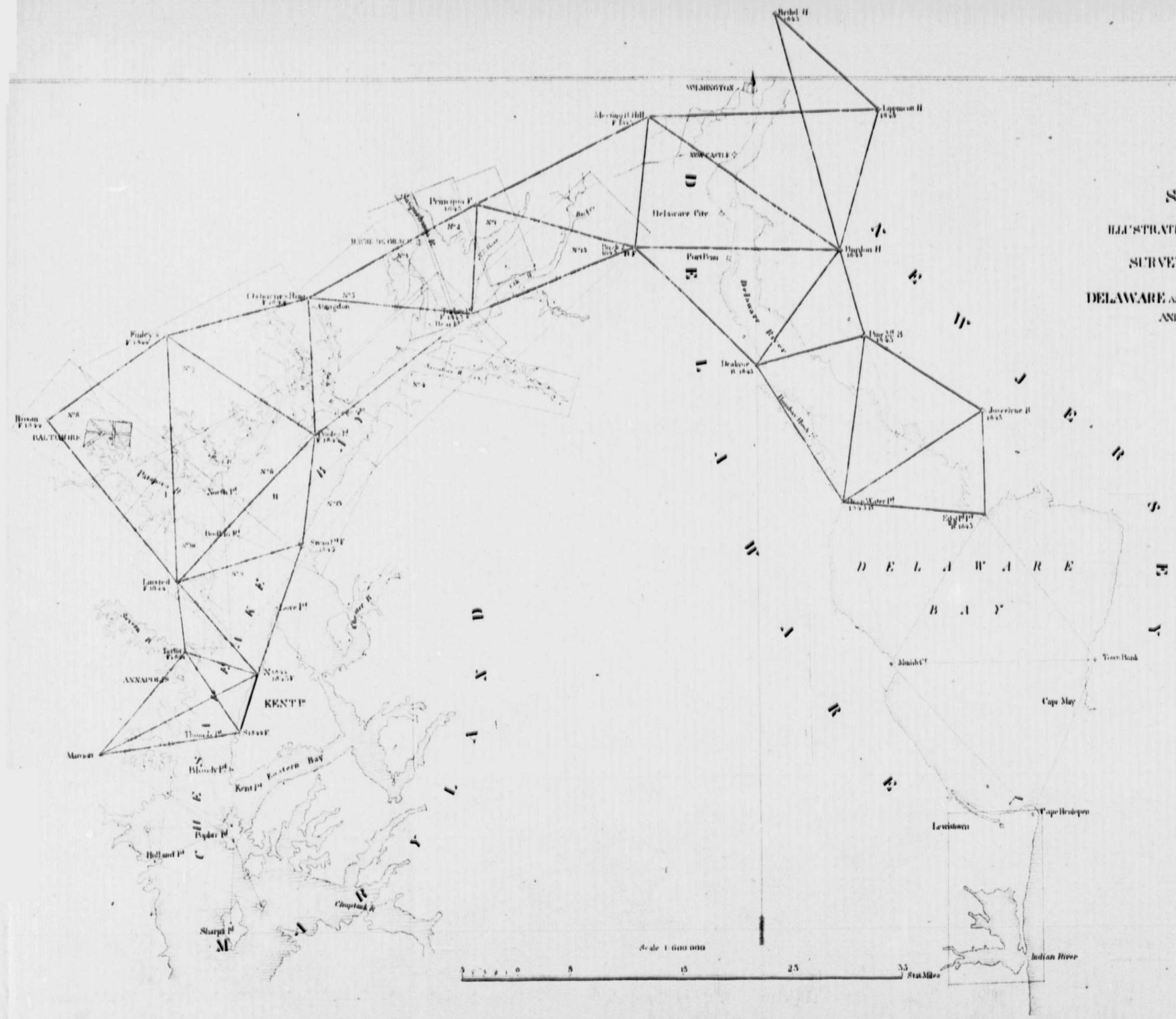
and most authentic account of the ill-fated President (so says rumor) was near Nantucket in a heavy storm, and the idea has always been prevalent here that the south shoal was her burial-ground.

“If we could have the true account of the amount of property and human life that the erroneous location of this single shoal has cost our country, not only prior to 1821, but subsequent to that period, the expense of the whole coast survey would seem a diminutive fraction. The manner in which this survey is conducted will settle this matter forever, by removing all possible doubts.”



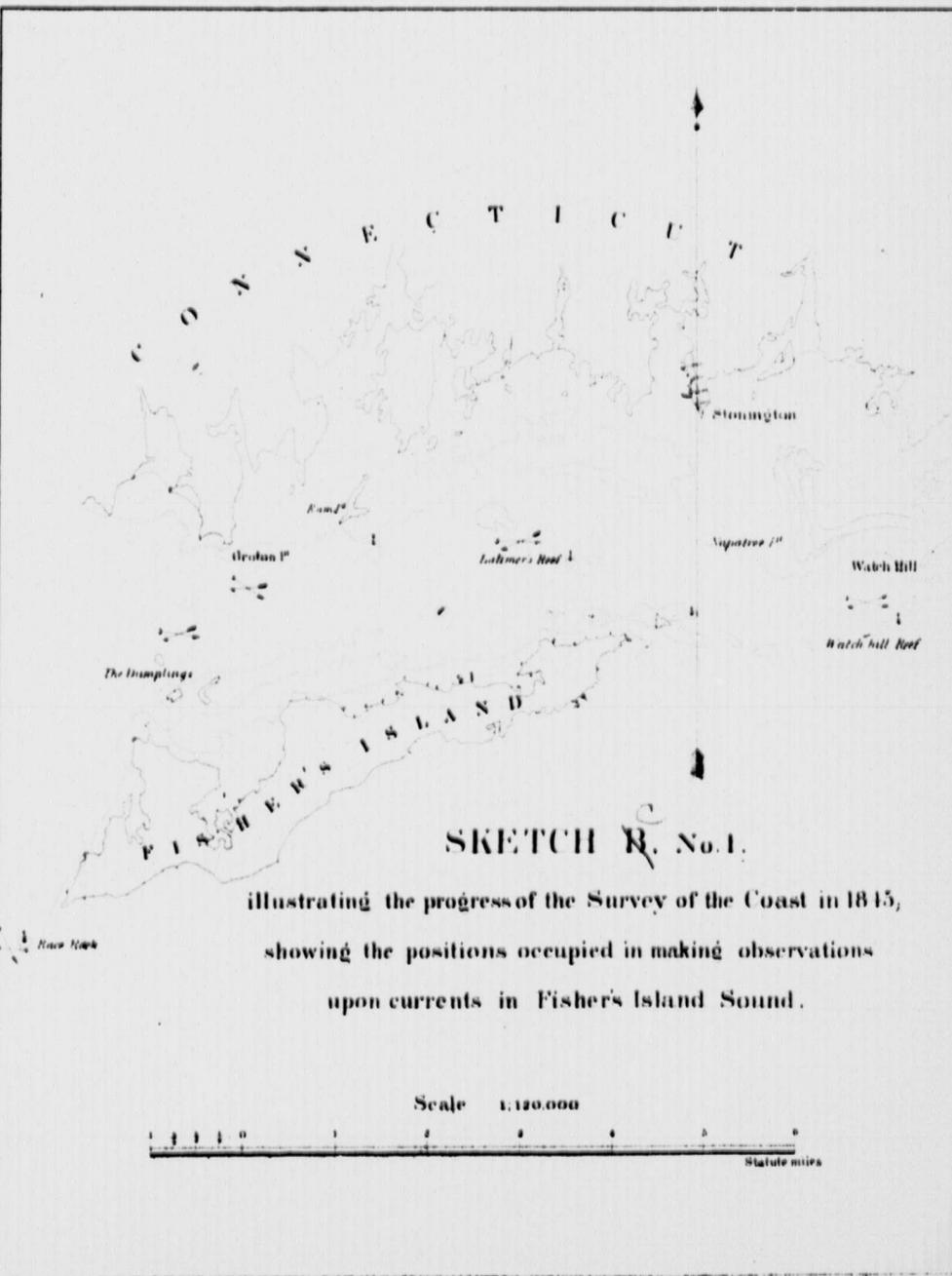
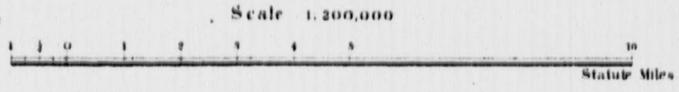
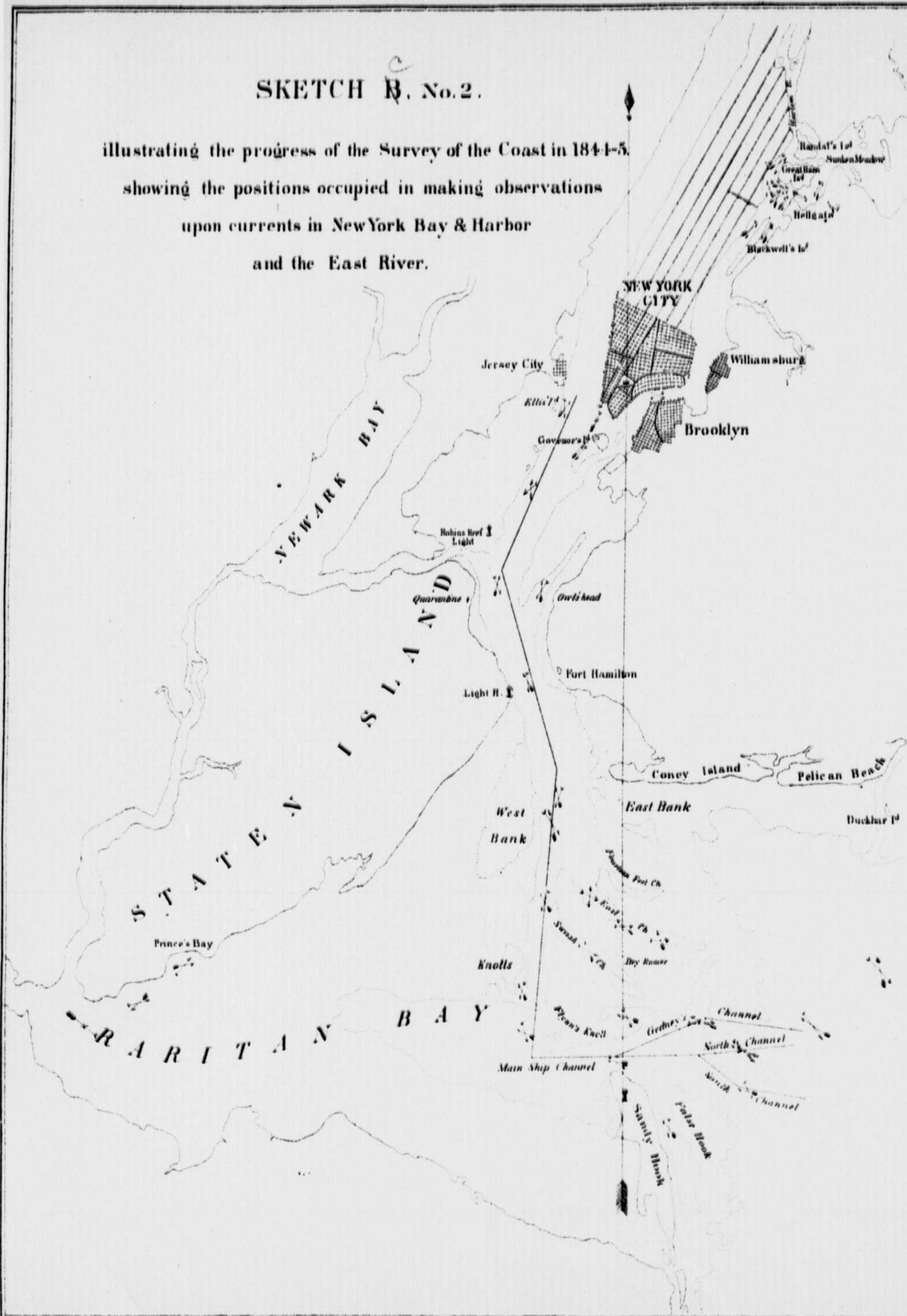
Sketch A.
 ILLUSTRATING the PROGRESS
 of the
 EASTERN SECTION
 of the
 SURVEY of the COAST
 in
 1847

Sketch B
 ILLUSTRATING the PROGRESS
 of the
 SURVEY OF THE COAST
 IN
 DELAWARE AND CHESAPEAKE BAYS
 AND VICINITY
 in
 1845



SKETCH R, No. 2.

illustrating the progress of the Survey of the Coast in 1844-5,
 showing the positions occupied in making observations
 upon currents in New York Bay & Harbor
 and the East River.



SKETCH R, No. 1.

illustrating the progress of the Survey of the Coast in 1845,
 showing the positions occupied in making observations
 upon currents in Fishers Island Sound.

