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HOUSE OF REPRESENTATIVES.

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REPORT  
OF  
THE SUPERINTENDENT  
OF THE  
COAST SURVEY,  
SHOWING  
THE PROGRESS OF THE SURVEY  
DURING  
THE YEAR 1864.

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1866.

# REPORT.

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CAMBRIDGE, MASS., *October 26, 1864.*

SIR: I have the honor to submit, in conformity with the law and regulations of the Treasury Department, the following report on the progress made in the survey of the coast of the United States during the surveying year, which will end with the present month.

The general progress in the work under my superintendence has been summed up from time to time in previous reports. It is not now needful to recapitulate in detail, as our parties on southern sections of the coast are yet employed in local surveys to facilitate military operations, or for the use of blockading squadrons, in accordance with the policy adopted by the department at the outset of the rebellion. The large manuscript map, prepared under act of Congress of March 3, 1853, and as directed by the act, presented annually since that date, shows the progress up to the present time. In a general way the progress is shown also by the small engraved sketch (No. 37) which accompanies this report.

A brief statement of the work of the present year will be given to show the adaptation of the survey in all parts of its organization to the present requirements of the government service.

The war has not essentially changed the distribution of the working parties. About the same number as were heretofore assigned to duty on the southern coast has been in surveying service with the national forces in the rebellious States. Four parties have acted under the orders of Admiral Lee; three, with as many vessels, under Admiral Dahlgren, and two under Admiral Porter.

For the military service in Eastern Virginia and Maryland six parties were employed during parts of the season; in West Virginia three parties, at Knoxville two parties, at Nashville two, at Chattanooga five; previous to and during the movement on the rebel works at Missionary Ridge; two parties accompanied the army in Louisiana and Texas, and one was attached to the Florida tax commission.

From the several officers in whose commands the parties were associated warm acknowledgments have been reiterated as to the importance of the services rendered, and their bearing on the success of military and naval operations. The body of the report will contain, as usual, notices of the work in detail. Very brief mention will here be made of the localities and nature of this class of operations, and after it mention of the advance made in the regular progress of the survey of the coast.

## SERVICE WITH ARMIES AND BLOCKADING SQUADRONS.

The survey has been kept in full co-operation with the blockading squadrons, and with the armies of the Union, as heretofore. In the vicinity of Baltimore the survey of ground connected with the defences has been continued by Sub-Assistant Iardella, and during part of the season by Assistant C. M. Bache. The topography of the approaches to the capital has been further extended beyond the northeast boundary of the District of Columbia, by Sub-Assistant Ferguson. A minute topographical survey has been made of Arlington Heights by Messrs. Hergesheimer and McMath for the War Department, and special determinations for the effective use of heavy artillery at Washington, New York, and Boston, by Assistant Schott. Sub-Assistant Donn is now engaged in surveying the approaches to the fords of the Potomac above and below Harper's Ferry. In West Virginia the latitude and longitude have been determined at eleven military posts by Assistant Dean and Sub-Assistant Mosman, and the magnetic variation at most of them by Mr. S. H. Lyman. At Clarksburg, Virginia, Mr. Lindenkohl assisted in compiling the military map of West Virginia, and computed the latitude of numerous points from the sextant observations of the late Lieutenant J. R. Meigs, formerly chief engineer of the department. Sub-Assistant Rockwell, before making a plane-table survey of Strawberry Plains and of the city of Knoxville and its defensive works, in which duty he was associated with Mr. R. H. Talcott, was engaged in similar service at Sewall's Point, Virginia. Assistant West, after reconnaissance duty, which terminated with the battle of Missionary Ridge, Tennessee, was in the same way employed at Bermuda Hundred, Virginia. Sub-Assistants Dorr and Donn made plane-table surveys of the environs and defences of Nashville and of Chattanooga, Tennessee, previous to the repulse of the enemy in

the south approach to that city; and Mr. Donn, in conjunction with Mr. Marindin, afterwards rendered similar service for the army near Petersburg, Virginia. Sub-Assistant Boyd has made a complete survey of the battle-field of Chickamauga, Georgia, and is now under orders to rejoin the army at Chattanooga.

In connexion with the North Atlantic blockading squadron, Mr. Strausz, and subsequently Mr. Cordell, have made resurveys of the bar and channel into Beaufort harbor, North Carolina. The last-named officer sounded the harbor, and the entire channel which leads from Beaufort through the straits and through Core sound, marking also its course by buoys and stakes. The same parties reset the buoys between the bar and Fort Macon to conform to the changes found by the resurveys. Mr. Strausz also made a resurvey of Hatteras inlet, and sounded out a stretch of six miles of the Neuse river below New Berne, marking the channels in both localities by buoys. The triangulation of the Neuse river was at the same time continued by Assistant Fairfield. Sub-Assistant Halter made a triangulation and shore line survey of Croatan sound, and of Roanoke river, North Carolina, above and below Plymouth. These waters were thoroughly sounded by Sub-Assistant Bradford, and the channel through the latter was marked by spar-buoys. He has since sounded Trents' Reach, in James river, Virginia, and is now engaged in the survey of Bogue sound. A careful reconnaissance of the Cape Lookout shoals has been made by Lieutenant Commander Phelps with the surveying steamer Corwin.

Attached to the South Atlantic blockading squadron, and for service also with the military forces, three parties with the surveying steamer Vixen, and schooners Bailey and Caswell, were assigned. Assistant Boutelle, besides the complete development of the channels at present leading into Charleston harbor, in which also Assistant Edwards was engaged during part of the season, reset the buoys, and prepared new sailing directions. Under his direction Folly river and Light-house inlet have been sounded by Sub-Assistant Webber; the hydrography of Wassaw sound has been continued, and a resurvey made of the bar and channel of the St. John's river to a point near Mayport Mills. As heretofore, his party in the Vixen, in charge of Acting Master Platt, performed the pilot service required for the vessels of the South Atlantic squadron. Sub-Assistant Dennis made surveys for defensive works at Pilatka, Florida, extended the survey of the St. John's river above Jacksonville, and during the military movements in that vicinity made a reconnaissance of the roads leading towards St. Augustine, Picolata, and Mayport Mills. At Port Royal he surveyed Bay Point and Land's End for naval purposes, and on Morris and Folly islands surveyed the shore lines of the inland passage between Light-house inlet and Folly river. Mr. McMath was on service with the United States tax commissioners for Florida, at Fernandina and at St. Augustine. He also furnished for military use a copy of the county map, showing the interior of Florida beyond Jacksonville.

In the military department of the Gulf, Assistant Oltmanns served on the staff of Major General Franklin, and made surveys along the route of the 19th army corps, including the environs of Vermilionville Opelousas, Washington, and Franklin, Louisiana. Sub-Assistant Hosmer was present with the army detachment at Aransas Pass, Texas, and located the position of the rebel works on a map, after determining the changes that had taken place in the depth of water on the bar of that pass. He performed similar duty at Pass Cavallo, traced and marked the changes which had occurred at the eastern end of Matagorda island, and buoyed the channel into McHenry bayou. After joining the staff of Brigadier General Grover, in January, Mr. Hosmer made surveys at Madisonville and Morganza, Louisiana, and at Fort Adams, Mississippi. Both of these officers accompanied the army of Major General Banks through the Red river campaign.

On the Mississippi river, and for the use of the squadron under Admiral Porter, Assistant Gerdes made a topographical survey of Grand Gulf and its vicinity, and sounded the channel abreast of that post. This was followed by a reconnaissance which included the shore and channel of about fifty miles of the course of the Mississippi, between Rodney and Vicksburg. He made also a minute survey of the Ohio river and its shores from Mound City to Cairo, Illinois, with soundings relative to inquiries concerning a navy yard site. Sub-Assistant Fendall assisted in this important survey, and was afterwards on duty with the gunboats which passed up Red river to act in concert with the land forces.

The transfer of some of these parties from one locality to another, as service required, has been noticed in the abstract just given; the transfer of others therein mentioned for prosecuting the usual work of the survey will appear in the short summary which follows.

#### GENERAL STATEMENT OF PROGRESS.

In connexion with the following summary, it should be borne in mind that many of the operations referred to under the preceding head have added to the material requisite for the usual publications of the survey.

In the northern sections of the Atlantic coast the regular operations of the survey have been continued, and the parties here enumerated are now at work: Sub-Assistant Dennis, in the topography of the lower part of Passamaquoddy bay, Maine; Assistant Fairfield, in coast triangulation near Mount Desert island; and Assistant McCorkle, in similar duty in Penobscot river, near Bangor; Sub-Assistant Dorr, in the topography of islands at the entrance of Penobscot bay; Sub-Assistant Ferguson, at the entrance of St. George's river, Maine; Assistant West, on the shores of Boothbay, Maine; Mr. McMath, on the east side of the Sheepscot river; Assistant Adams is completing plane-table work on the shores of the water passages which enter the Kennebec, near Bath, Maine; Assistant R. M. Bache, on the shores of the Kennebec, above Bath; and Sub-Assistant Longfellow, on the survey of islands on the east side of Casco bay. Sub-Assistant Webber has sounded the St. George's river, Maine, and its approaches; Mr. Strausz, the waters of Quohog bay, Maine; and Lieutenant Commander Phelps has extended the hydrography eastward of the approaches to Portland entrance. Assistant Mitchell has examined the known dangers to navigation in Eastport harbor and Muscle Ridge channel, (Penobscot bay,) and indicated the position of desirable aids to navigation. He has also continued work connected with the special survey of Boston harbor for the United States commissioners. The detailed survey of the shores of Narragansett bay is in progress by Assistant Harrison and Sub-Assistant Hosmer. On the coast of Connecticut the work of connecting the primary base lines in Sections I and II has been continued by my own party, and Assistant Blunt has extended the triangulation which connects the primary work with points on the Hudson river. The detailed topography of the shores of the Hudson has been extended by Assistant Whiting near Sing-Sing and Haverstraw. The hydrography near Sandy Hook has been re-examined by Assistant Mitchell, the results, as heretofore, having reference to the labors of the engineer department. Assistant C. M. Bache has been engaged at the highlands of Navesink, New Jersey. The work of verification on the coast of New Jersey has been extended by Assistant Farley to include Absecom inlet; the shores of Absecom harbor have been resurveyed by Mr. H. W. Bache, and the hydrography of the approaches and of the inlet executed by Lieutenant Commander Phelps. Assistant Mitchell made a special examination relative to the effect of the ice drift in the Delaware river during the winter of 1863-'64 for the Navy Department.

Tidal observations have been kept up at the permanent stations, at Eastport and Portland, Maine, Charlestown, Massachusetts, in New York harbor, and at Old Point Comfort; and magnetic observations at Eastport and Key West.

On the Pacific coast of the United States the triangulation along the Santa Barbara channel and between Monterey bay and San Francisco has been continued, and that of Suisun bay is in progress. The topography and in-shore hydrography between Point San Pedro and Tunitas creek have been completed, and a resurvey has been made of Mare Island strait, including the approaches to the navy yard.

The great enhancement of prices during the present year has unavoidably been felt in our operations. It is, however, a matter of gratification that the results here sketched compare favorably with those of the preceding years of the war. On the Pacific coast only has the progress of the work been sensibly retarded by the effect of the basis of currency in use there.

In office-work numerous direct calls have been met from generals and naval officers for tracings on the full scale of such sheets of the Coast Survey as were applicable to their purposes; these have been very generally found available in siege operations and in blockading service. Copies of maps for immediate use have in all cases been furnished to the naval and military commanders, to whose forces the parties have been attached. The tangible evidence of utility thus presented to a class of minds eminently practical has continued to elicit the warm commendation which marked our first connexion with the military and naval forces of the government at the outset of the war.

Of the regular charts of the Coast Survey nearly thirty-seven thousand copies have been distributed during the past year. In this aggregate are included twenty-three thousand copies which were supplied to the navy.

The compilation of maps for use in the armies and to illustrate their operations has been continued, and the several sheets include, on a uniform scale, by far the greater part of the area of the States in rebellion. The region embraced in the great campaign of Major General Sherman beyond Chattanooga was mapped at the office at his request, and by diligent exertion the sheets intended for the use of his army were completed and forwarded before the opening of the campaign.

The call from public officers in the civil and military service for this class of information has become general. Of all kinds, (excluding charts,) seventeen thousand copies have been distributed or sold during the year, the sales, as heretofore, reimbursing for the publication.

The descriptive memoirs of the southern coast, which were prepared at the outbreak of the rebellion, and intended for the exclusive use of naval and military commanders, retain their interest, and have been supplied, as heretofore, when calls were made for them.

#### OFFICE-WORK.

SECTION I. Sheet No. I, of a general chart of the Atlantic coast of the United States, scale 1:1,200,000, (Cape Sable to Sandy Hook,) has been drawn and engraved; a new edition of Nantucket shoals, with additions, has been prepared, and Rockland harbor, as a preliminary chart, has been completed. The drawing and engraving of coast charts No. 7, (Muscongus bay to Portland,) No. 8, (Seguin island to Kennebunkport,) No. 10, (Cape Ann to Plymouth,) No. 11, (Plymouth to Hyannis,) have been continued; progress has been made in the engraving of the charts of Kennebec and Sheepscot rivers, Barnstable harbor and Newport harbor. The drawing of Eastport harbor and approaches, and the drawing and engraving of a new edition of Boston harbor, embracing the resurvey for the harbor commission, have been commenced.

SECTION II. The drawing and engraving of a preliminary chart of Hudson river, sheet No. 3, (from Poughkeepsie to Troy,) have been completed; that of the finished chart of Hudson river, sheet No. 1, (from New York to Haverstraw,) and of coast chart No. 21, New York bay and harbor, (finished topography,) have been continued; and the drawing of a chart of Absecom inlet has been commenced.

SECTION III. A chart of Hampton Roads and Elizabeth river has been engraved. Progress has been made in the drawing and engraving of coast chart No. 28, (Cape May to Isle of Wight;) coast chart No. 29, (Isle of Wight to Chincoteague inlet;) Potomac river, sheet No. 1, (from the river entrance to Piney Point;) and Potomac river, No. 4, (from Indian Head to Little Falls.) The drawing of the general chart of Chesapeake and Delaware bays has been continued; that of a map of the approaches to Baltimore for military purposes has been commenced; additions have been made to the lithographic map of Virginia and southeastern Virginia; and a map of part of Virginia and North Carolina, on a scale of ten miles to the inch, has been drawn and engraved on stone.

SECTION IV. A preliminary chart of Cape Lookout shoals has been drawn and engraved; the drawing of additional surveys on coast charts Nos. 40 and 41, (Albemarle sound;) and a preliminary chart of the mouths of Roanoke river has been completed and the engraving commenced. Progress has been made in the engraving of coast chart No. 48, (Cape Fear and approaches,) and a tinted lithographic edition of the same has been printed for the use of the navy. New editions of the entrances to Beaufort harbor and Hatteras inlet, from resurveys, have been published.

SECTION V. The drawing and engraving of coast chart No. 53 (from Rattlesnake shoals to St. Helena sound) have been continued; and work on No. 54 (from St. Helena sound to Ossabaw sound) has been commenced. Progress has been made in the drawing and engraving of St. Helena sound, Port Royal sound, Beaufort river, South Carolina, and the inland passage from St. Helena to Port Royal sound through Harbor river, Stony river, and Station creek; and in the engraving of Wassaw sound, with the inland passage from Port Royal sound to Tybee Roads, through Skull creek and Calibogue sound. A new edition in tint of Charleston harbor, showing the resurvey of the bar, and a sketch of Light-house inlet, have been prepared. A military map of parts of Georgia and South Carolina has been drawn and engraved on stone.

SECTION VI. The engraving of the Atlantic coast, sheet No. 4, (Mosquito inlet to Key West, including the Bahama banks,) of the western end of Florida reefs, including Tortugas islands, of a new edition of Key West harbor, and of additions to general coast chart No. X, (straits of Florida,) has been completed. Progress has been made in the drawing and engraving of coast chart No. 69, (Florida reefs, from the Elbow to Matecumbe key,) and of No. 70, (Long key to Newfound Harbor key.) A preliminary chart of the main entrance to Charlotte harbor, Florida, has been commenced, and a military map of the northern part of Florida has been drawn and engraved on stone.

SECTIONS VII, VIII, and IX. A general chart of the Gulf coast, from Key West to the Rio Grande, has been drawn and engraved; the engraving of coast chart No. 100 (Point au Fer to Marsh island, Louisiana) has been continued, and additions have been made to coast chart No. 108, (Matagorda and Lavacca bays, Texas.) A new edition of Mobile bay and approaches has been prepared in tint; maps of the approaches to Vicksburg and Grand Gulf, Mississippi; and of the Mississippi river and its shores from Rodney to Palmyra bend; and military maps, embracing the States of Mississippi, Alabama, and part of Georgia, on a scale of ten miles to the inch, have been drawn and engraved.

SECTIONS X and XI. The drawing and engraving of Tomales bay, as a finished chart, and of Half Moon

bay, as a preliminary chart, have been completed. Progress has been made in the drawing and engraving of Bodega bay, upper part of San Francisco bay, and chart of the Pacific coast from Point Pinos to Bodega Head. A new edition has been prepared of Washington sound, with additions and corrections, and additions have been made to the other plates previously engraved.

#### MAPS AND CHARTS.

In the regular progress of the work of publication, many of the early sketches and preliminary editions of charts, issued to make the information obtained by the survey available to the public as soon as practicable, are superseded by or absorbed in the more finished charts, which are prepared as the information accumulates, especially those which embrace the whole coast in a connected series, on a scale of  $\frac{1}{800000}$ . This process must be kept in mind when following the reported advance of various maps and charts from year to year, and in comparing the catalogue of charts (Appendix No. 10) now issued by the Coast Survey Office to the government vessels, or sold to the commercial marine, with annual statements of plates engraved. Thus a chart of an important locality will be first published with the bare shore-line, soundings, channel curves, and sailing directions—an incomplete form—but still containing the information most important for the navigator. While an electrotype copy of this plate is used for printing, the engraving of the original is continued; the shoals are made conspicuous by sanding; other hydrographic details are added as they are developed by the survey; and the outlines of the topography are engraved, bringing the map to a second stage, in which it is again issued, superseding the first, but still remaining a preliminary edition. This also is printed from electrotype copies, while the original is receiving the finished representation of topography, as hills, woods, fields, marsh, &c., together with views, and all requisite notes and tables, so as to form at length the finished map, which alone is retained in the catalogue.

Seventy-four sheets have been worked upon in the drawing division within the past year. Fourteen of this number were first-class maps and charts of large size; eight first-class, and twenty-four preliminary harbor charts and sketches; twelve sheets were intended for engraving on stone, or for photographic reduction, and sixteen were progress sketches. Fifty-six sheets have been completed, and eighteen are in progress. Of the hydrographic sheets completed, two are large charts of the coast series, and twenty-six harbor charts, most of which were for issue in preliminary form.

In the engraving division two first-class maps and charts have been completed within the year. Eight plates of second-class charts and sketches have also been engraved, and two diagrams. Nine preliminary editions have been engraved preparatory to their final completion. Twenty-three plates are now in progress, of which five were commenced within the year. This gives a total of twenty-four plates completed, and twenty-three in progress, or forty-seven plates worked upon during the year.

All the details in regard to the production and distribution of maps and charts will be found in the report of the assistant in charge of the office. (Appendix No. 10.)

The following is a list of charts arranged in geographical order which are either the result of the present season's work, or, having been heretofore prepared, have not yet appeared in any annual report, for reasons of public policy, although issued to public vessels. Such of this number as it may be deemed expedient to publish at the time will appear with this report, as will some others which have not heretofore been published in any annual report in the present finished state, viz: the three sheets of Long Island sound, and the upper three sheets of Chesapeake bay, together with the necessary sketches, to illustrate the progress of the survey:

Eastport harbor, Maine.

Rockport and Camden harbors, Maine.

St. George's river, Maine.

Kennebec and Sheepscot rivers, with Boothbay harbor, Maine.

Lynn harbor, Massachusetts, resurvey of 1864.

Boston bay and approaches, coast chart No. 1, (preliminary edition.)

Bristol bay, Rhode Island.

Newport harbor, Rhode Island.

Absecom inlet, New Jersey.

Potomac river, sheet No. 1, from the entrance to Piney Point.

Potomac river, sheet No. 2, from Piney Point to Lower Cedar Point.

Potomac river, sheet No. 3, from Lower Cedar Point to Indian Head.

Potomac river, sheet No. 4, from Indian Head to Little Falls.

James and Appomattox rivers, from City Point to Richmond and Petersburg.  
 Albemarle sound, eastern part, coast chart No. 40, (new edition.)  
 Albemarle sound, western part, coast chart No. 41, (new edition.)  
 Mouths of Roanoke river, North Carolina.  
 Core sound, North Carolina.  
 Cape Lookout shoals, North Carolina.  
 Cape Fear and approaches, with the river to Wilmington, North Carolina, coast chart No. 48.  
 Charleston bar, resurvey of 1864.  
 Light-house inlet, and inland passage to Folly river, South Carolina.  
 Stono inlet, South Carolina.  
 Coast of South Carolina, from Rattlesnake shoals to St. Helena sound, coast chart No. 53.  
 Coast of South Carolina and Georgia, from St. Helena sound to Ossabaw sound, coast chart No. 54.  
 Beaufort river, Station creek, Story and Harbor rivers, with inland passage between Port Royal and St. Helena sounds, South Carolina.  
 Port Royal entrance, South Carolina, survey of 1863.  
 Calibogue sound and Skull creek, forming the inland passage between Tybee roads and Port Royal sound, South Carolina.  
 Wassaw sound, with Wilmington and Tybee rivers, Georgia.  
 Ossabaw sound, Georgia.  
 Sapelo sound, Georgia.  
 Altamaha sound, Georgia.  
 St. Simon's sound, Georgia.  
 Charlotte harbor, Florida.  
 Mississippi river, reconnaissance from Rodney to Palmyra bend, Mississippi.  
 Ohio river, from Mound City to Cairo.  
 Western coast of the United States, from San Diego to Point Reyes.  
 Western coast of the United States, from San Francisco to Umpquah river.  
 Western coast of the United States, north of Umpquah river.  
 Pacific coast, from Point Pinos to Bodega Head.  
 San Francisco bay, upper part.  
 A list is given, at the close, of such of these charts and others that are intended to accompany this report.

#### ESTIMATES.

The estimates here submitted are designed to carry forward the work required on the eastern part of the Atlantic coast, and to provide for the progress which may be feasible on the southern part and in the Gulf; to continue the work on the Pacific coast, and to provide for the assignment of special parties as heretofore, with the concurrence of the department, for service with the fleets and armies.

The estimates for progress on the Atlantic, Gulf coast, Florida reefs, and western coast of the United States, are given, as usual, in separate items, and are exclusive of the aid formerly, but not now, extended for the work, by the detail of officers of the army and navy.

#### *Estimates in detail.*

For general expenses of all the sections, namely, rent, fuel, materials for drawing, engraving, and printing, and for transportation of instruments, maps, and charts; for miscellaneous office expenses, and for the purchase of new instruments, books, maps, and charts..... \$19, 000

#### SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.* FIELD-WORK.—

To continue the triangulation of *Passamaquoddy bay*, and to extend it so as to include the northeastern boundary along the *St. Croix river*; to complete the secondary triangulation of the coast of Maine east of *Mount Desert island*; to continue the topography of *Passamaquoddy bay* and its dependencies; to complete that of *Prospect harbor*, and commence that of *Goldsborough bay*, (coast of Maine;) to continue that of the islands at the entrance of *Penobscot bay*, and the western shore of the bay above *Camden*, and that of the adjacent shores of *Muscongus sound*; to complete the topography of the *Damariscotta river*, and of the eastern shore of the *Sheepscot river*, and to complete the survey of the eastern shores of *Casco bay*; to continue the detailed

- survey of the shores and islands of *Narragansett bay*; to continue off-shore soundings along the coast of Maine, and the hydrography of *Passamaquoddy bay*, *Frenchman's bay*, and approaches of *Penobscot bay*, and *Goldsborough, Prospect and Winter harbors*; to continue tidal and magnetic observations at Portland, and tidal observations in the progress of the hydrography.
- OFFICE-WORK.—To make the computations required for and reductions from the field observations; to continue the drawing of coast chart No. 1, *Passamaquoddy bay*; to continue the drawing and engraving of coast chart No. 6, approaches of *Penobscot bay*; of No. 7, *Pemaquid Point to Cape Elizabeth*; of No. 8, *approaches to Casco bay*; of No. 10, coast of Massachusetts, from *Cape Ann to Plymouth*, and of No. 14, *Narragansett bay and approaches*; to continue the drawing and engraving of general coast chart No. 1, *Quoddy Head, Me., to Cape Cod, Mass.*; to complete the drawing and engraving of charts of *Eastport harbor and Rockland harbor*; to continue the drawing and engraving of *Winter harbor, Rockport, and Camden harbors, and Tennant's harbor*; and of *Herring Gut and St. George's river and approaches*; of the *Damariscotta river* and of *New Meadow harbor*; and to complete the drawing and engraving of charts of the *Sheepscot river, Me.*, of *Newport harbor*, and of *Providence river, R. I.*, and to engrave the resurvey of *Boston harbor*, will require..... \$62, 000
- SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.* FIELD-WORK.—To complete the observations required for connecting the *Epping base*, in Section I, with the *Fire Island base*, in Section II; to continue the triangulation of *Connecticut river*, between *Higganum and Hartford*, and that of the *Thames river*, above *New London*; to continue verification work on the *coast of New Jersey*, south of *Absecon inlet*; to continue the topography of the shores of the *Connecticut and Thames rivers*, and the detailed survey of the shores of the *Hudson*, above *Haverstraw*; to execute such supplementary hydrography as may be required in *New York bay and Delaware bay*; to continue the tidal observations. OFFICE-WORK.—To make the computations and reductions; to continue the engraving of coast chart No. 21, *New York harbor*, and its approaches, (new edition;) and to commence the drawing and engraving of coast chart No. 22, from *Sandy Hook to Barnegat*; to continue the drawing and engraving of sheet No. 2, of the chart of *Hudson river*, (from *Haverstraw to Poughkeepsie*;) and of a chart of the *Connecticut river*: and to complete the engraving of coast chart No. 28, from *Cape May, N. J., to Isle of Wight, Del.*, will require..... 17, 500
- SECTION III. *Coast of part of Delaware and that of Maryland, and part of Virginia.* FIELD-WORK.—To continue astronomical and magnetic observations in the section, and secure the stations of the triangulation; to make extensions of the triangulation for including the detached plane-table surveys in the vicinity of *Washington city*; to complete the topography near *Washington*, required for defensive purposes, and continue that of the eastern shore of *Virginia*; to make such detailed surveys as may be necessary at points on the *Potomac, Rappahannock, and James rivers*; and to continue the off-shore hydrography and tidal observations in the section. OFFICE-WORK.—To make the computations from field-work; to draw maps of the approaches to *Baltimore and Washington*; to continue the engraving of coast chart No. 29, (from *Isle of Wight, Del., to Chincoteague, Va.*;) and of No. 30, from *Chincoteague to Great Machipongo inlet, Va.*; to continue the engraving of coast chart No. 30 bis, (*Chesapeake entrance*;) and general coast chart No. IV, (*approaches to Delaware and Chesapeake bays*;) and to commence the drawing and engraving of a chart of *James river, from Newport News to City Point*, will require..... 14, 500
- SECTION IV. *Coast of part of Virginia and part of North Carolina.* FIELD-WORK.—To complete, if practicable, the primary triangulation of *Pamlico sound*, and make the requisite astronomical and magnetic observations; to continue the triangulation of *Pamlico river*; to continue the triangulation and commence the topography of the shores of *Neuse river*; to complete the topography of the outer coast of *North Carolina*, between *Hatteras inlet and Core sound*; to continue the in-shore and off-shore hydrography in the vicinity of *Cape Lookout*; and to execute that of *Pamlico river*, and such other soundings as may be required in the waters of *Pamlico or Albemarle sounds*; to make observations of the tides and currents. OFFICE-WORK.—To make the computations and reductions; to commence the drawing and engraving of general coast chart No. V, from *Cape Henry to Cape Lookout*; to continue the

engraving of coast chart No. 38, (from <i>Currituck, Va.</i> , to <i>New inlet, N. C.</i> ;) and of coast charts Nos. 46 and 47, (from <i>Cape Lookout</i> to <i>Barren inlet</i> ;) and the drawing and engraving of a chart of the <i>Neuse river</i> ; and to complete the engraving of coast chart No. 48, <i>Cape Fear and approaches</i> , will require.....	\$15,000
SECTION V. <i>Coast of part of North Carolina and that of South Carolina and Georgia.</i> FIELD-WORK.—To execute such triangulation and topography as may be practicable in places not yet embraced in the survey; to execute the hydrography that may be required, and additional soundings in the shifting bars in this section, with tidal observations. OFFICE-WORK.—To continue the engraving of coast chart No. 53, (from <i>Rattlesnake shoal</i> to <i>St. Helena sound, S. C.</i> ;) to continue the drawing and engraving of No. 54, (from <i>Fripp's inlet, S. C.</i> , to <i>Ossabaw sound, Ga.</i> ;) to continue the drawing of No. 57, (from <i>Sapelo sound</i> to <i>St. Andrew's sound, Ga.</i> ;) and that of general coast chart No. VII, (from <i>Winyah bay, S. C.</i> , to <i>St. John's river, Fla.</i> ;) and continue the engraving of the last-named chart; the resurvey of <i>Charleston harbor</i> entrance, and the drawing and engraving of the <i>inland passage</i> between <i>St. Helena</i> and <i>Port Royal sounds, S. C.</i> , and of <i>Wassaw sound, Ga.</i> , will require.....	17,000
SECTION VI. <i>Coast keys and reefs of Florida.</i> —(See estimates of appropriation for these special objects.)	
SECTIONS VII, VIII, and IX. <i>Part of the western and northern coast of Florida and the coast of Alabama, Mississippi, Louisiana, and Texas.</i> FIELD-WORK.—To execute such triangulation, topography, and hydrography, in continuation of the surveys in these sections, as may be practicable, and such special surveys as may be required for public service. OFFICE-WORK.—To continue the computations and reductions of previous field-work; to continue the engraving of coast charts Nos. 84 and 85, (western coast of Florida from <i>Ocilla river</i> to <i>Cape St. Blas</i> ;) the drawing of No. 96, ( <i>delta of the Mississippi</i> ;) and that of general coast chart No. XIV, (northeastern coast of the <i>Gulf of Mexico</i> ;) to continue the engraving of the last-named chart, and to commence the engraving of general coast chart No. XVI, (western coast of the <i>Gulf of Mexico</i> ;) will require.....	36,000
Total for the Atlantic coast and Gulf of Mexico.....	\$181,000

The estimates for the Florida coast, keys, and reefs, and for the western coast of the United States, (California, Oregon, and Washington Territory,) are intended to provide for the following purposes:

SECTION VI. <i>Coast, keys, and reefs of Florida.</i> FIELD-WORK.—To continue, if practicable, the survey of the eastern coast of the peninsula south of the present limit at <i>Matanzas inlet</i> , or north of <i>Indian river</i> ; to complete the triangulation of keys inside of the Florida reefs and between <i>Chatham bay</i> and <i>Cape Sable</i> ; to continue the topography of those in <i>Chatham bay</i> , and complete that of <i>Charlotte harbor</i> ; to complete the hydrography of the approaches to that harbor, and run off-shore lines of soundings from the reef and from the coast of this section; to continue magnetic observations at <i>Key West</i> , and such tidal observations as may be requisite. OFFICE-WORK.—To compute the results of field-work; to complete the drawing and engraving of coast charts Nos. 69 and 70, ( <i>Florida reefs</i> , from the <i>Elbow</i> to <i>Newfound Harbor keys</i> ;) and general coast chart No. X, ( <i>Florida reefs</i> , from <i>Key Biscayne</i> to the <i>Marquesas</i> ;) and to continue the drawing and engraving of a chart of the approaches to <i>Charlotte harbor</i> , will require.....	\$11,000
SECTION X. <i>Coast of California.</i> FIELD-WORK.—To continue the coast triangulation southward of the <i>San Pedro base</i> , or northward of <i>Santa Barbara</i> , and the work for connecting the <i>Santa Barbara</i> islands by triangulation with the coast of California; to continue the triangulation northward from <i>Bodega</i> , and to execute that of <i>Suisun bay</i> ; to continue the topography of the islands in <i>Santa Barbara channel</i> , that of the shore of <i>Bahia Ona</i> , that of the coast north of <i>Bodega Head</i> , and to complete that of <i>Suisun bay</i> ; to complete the hydrography of <i>Suisun bay</i> ; to run off-shore lines of soundings from the principal headlands of the section; to extend the in-shore hydrography northward of <i>Bodega</i> , and re-examine bars subject to change in <i>San Pablo bay</i> ; to continue tidal observations at <i>San Diego</i> and <i>San Francisco</i> . OFFICE-WORK.—To make the computations from field-work; to complete the drawing and engraving of a chart of <i>Half-moon bay</i> , the engraving of the resurvey of <i>Mare Island straits</i> , and of the upper sheet of <i>San Francisco bay</i> , and of a chart of <i>Suisun bay</i> ; to continue the drawing and engraving of a	

general coast chart of the Pacific, (from *San Diego to Point Conception*,) and of a chart of *San Francisco bay*, to be issued in one sheet.

Also, for the operations in—

SECTION XI. *Coast of Oregon and that of Washington Territory.* FIELD-WORK.—To make the astronomical and magnetic observations required in this section, or in Section X; to continue the triangulation of *Washington sound* in connexion with former work, and to make such plane-table surveys in continuation of previous work as may be practicable; to continue the hydrography in *Admiralty inlet*, or execute soundings in such special localities of *Oregon or Washington Territories* as may be called for by public interests; to continue tidal observations at Astoria, and make such as may be required by the hydrography. OFFICE WORK.—To continue the computations of field-work; to continue the drawing and engraving of surveys, as far as now made, for charts of *Koos bay, Gray's harbor, Washington sound, Admiralty inlet, and Puget's sound*, will require ..... \$100, 000

The two small items following are in terms and amount the same as were asked for last year, and the third one is diminished in amount in consequence of a less number of steamers in use:  
 For publishing the observations made in the progress of the survey of the coast of the United States, per act of March 3, 1843 ..... 4, 000  
 For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853..... 4, 000  
 For pay and rations of engineers for three steamers to be used in the hydrography of the Coast Survey, and no longer supplied by the Navy Department..... 6, 000

The amounts thus estimated for the fiscal year 1865-'66, and the appropriations for the present year, are here given in parallel columns.

Object.	Estimates for fiscal year 1865-'66.	Appropriated for fiscal year 1864-'65.
For survey of the Atlantic and Gulf coasts of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843.....	\$181, 000	\$178, 000
For continuing the survey of the western coast of the United States, including compensation of civilians engaged in the work, per act of September 30, 1850.....	100, 000	100, 000
For continuing the survey of the Florida reefs and keys, including compensation of civilians engaged in the work, per act of March 3, 1849.....	11, 000	11, 000
For publishing the observations made in the progress of the survey of the coast of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843.....	4, 000	4, 000
For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853..	4, 000	4, 000
For pay and rations of engineers for three steamers used in the hydrography of the Coast Survey, no longer supplied by the Navy Department.....	6, 000	*9, 000
Total.....	306, 000	306, 000

\* Formerly included in estimates of the Navy Department.

DEVELOPMENTS AND DISCOVERIES.

Under this head are included the special results of hydrographic operations, and in some cases of the topography. The particular localities in which developments were made by the hydrographic parties within the present year are stated below. The items are supplementary to the general list given in Appendix No. 4, in which the previous developments and discoveries made in the progress of the survey are arranged in geographical order.

1. Determination of the position of Birch Point ledge, with eleven feet of water in it, in Wiscasset bay and of a rock with only four feet, near Clou's ledge, in Sheepscot river, Maine.
2. White Head ground, about eight miles to the eastward of Cape Elizabeth, Maine, developed in its general direction.
3. A rock in the entrance of New Bedford harbor, Massachusetts, determined in position.

4. Development of Round shoal, with eleven feet at mean low water, outside of the four-fathom curve off Absecom inlet, New Jersey.
5. Hatteras inlet. The character and extent of recent changes in the depth of water determined by resurvey.
6. Three separate shoals developed by reconnaissance to the south and eastward of Cape Lookout, North Carolina.
7. Beaufort harbor, North Carolina, re-examined, and its hydrographic changes determined.
8. Two new channels developed, leading into Charleston harbor, South Carolina, resulting from changes in the direction of the former channels and shoaling in the Lawford channel.
9. Hydrographic changes determined at the bar and in the channel of St. John's river, Florida.
10. Mare Island strait resurveyed, and changes developed in the vicinity of the navy yard.
11. Special examination of the flat in San Pablo bay, between San Pablo and Pinole Point.

#### SPECIAL SURVEYS.

The physical survey of Boston harbor has been continued under my direction by Assistant Henry Mitchell. Most of the work of the present season was confined to the tabulation and arrangement of data needed by the commission, authorized to advise in regard to the preservation of the harbor. The commission, as stated in previous reports, consisted of the late Chief Engineer, General Joseph G. Totten, Admiral C. H. Davis, and myself. The expenditures for the work, as heretofore, have been defrayed by the city authorities of Boston.

At the request of the Navy Department a special examination was made in the course of last winter as to the effect of floating ice in two localities of the Delaware river, which had been under consideration as sites for a navy yard.

Numerous surveys which might be noticed under this head, being specially called for by generals in command of armies in the field, will be mentioned under the heads of sections in the report corresponding to the localities of the work.

#### TIDE TABLES FOR MARINERS.

The tide tables for the use of navigators are given in a revised form in Appendix No. 8. In addition to the usual number printed with the annual report, one thousand copies were prepared in pamphlet form during the first year of the war. These have been distributed from the Coast Survey office or from the Naval Observatory for the use of government vessels.

The mean interval between the time of the moon's transit and the time of high water at Old Point Comfort is corrected in the tables of this year from the latest observations.

A report on the field and office work connected with tidal stations is given in Appendix No. 9, and the office occupation of the tidal division in Appendix No. 10. With the former is included a general description of the peculiarities observed in the tides at Tahiti, the largest of the Society islands in the South Pacific ocean.

#### INFORMATION FURNISHED.

A list showing special items of information furnished from the office during the year is given in Appendix No. 2. While calls arising in the ordinary course of enterprise have been lessened, those connected with military and naval operations have largely increased. Besides the items given in the list, numerous applications belonging to the same general class, but more local in character, have been answered at the office.

The regulation of the department requiring acknowledgment in the title of any publication embodying information procured from the Coast Survey office has been strictly observed.

In addition to the matter usually given under this head, assistance has been rendered to the artillery department of the army for the determination of ranges of ricochet gunnery with fifteen-inch and twenty-inch guns. The experiments were made under the direction of General A. P. Howe, inspector of artillery United States army, and the operations for measuring the ranges of each impact of the projectile are stated at length in the Appendix, Nos. 21 and 22, by Assistant Schott. He also furnished a set of equations determining the trajectory of ricochet shot, and applied them in practice to illustrate their use. Mr. Schott visited two batteries on the Potomac, three forts in New York harbor, and one in Boston harbor, where the necessary measurements were taken. At each of these places temporary frameworks were erected, and the range lines were marked for given lines of fire.

## GEOGRAPHICAL POSITIONS.

In Appendix No. 15 the publication of geographical positions is resumed in part, in continuation of similar lists given biennially in my report for 1859 and preceding years. The register of positions on the southern coast is still reserved in the office. The total number of positions thus far given in latitude and longitude deduced from the triangulation is eight thousand two hundred and seventeen. Any small differences between the publications since the year 1851 are due to the effect of later and accumulated material, geodetic and astronomical, which has been brought to bear on the results.

## GEODESY.

The geodetic connexion of the Epping base line with the primary triangulation passing through the eastern States, offers so instructive an example of the process of reduction followed in the computations of the Coast Survey, and of the application of the method of least squares, that I have given in full Assistant Schott's report on the subject, in Appendix No. 14; that paper may be regarded as an extension of Appendix No. 33 S, in my annual report for 1854. It exhibits the combination of resulting angles from measures of directions and from measures of angles by repetition, and assigns the relative weights to the results. The residuals in the sum of the angles of the triangles are shown, and proper weights are given to the conditional equations depending upon the closing of the triangles as well as (primarily) upon the probable errors of the measured directions or angles. The thirty-five normal equations were solved by the indirect method of elimination.

The report by Mr. Schott concludes with a statement of the resulting angles and computations of the sides of the triangles.

It is proper to remark that the length used for the Epping base in this report, though very nearly so, is not the final length, which can be deduced only from certain comparisons that remain to be made.

## LONGITUDE.

The computations for the longitude of American stations from the European meridian, by Pleiades occultations, have been continued under the direction of Professor Benjamin Peirce, of Harvard, according to the comprehensive plan developed by him, and before alluded to in my annual reports. His remarks (Appendix No. 11) give such promise of agreement in results as will justify the expectations founded on the adoption of the method.

The computations of differences of longitude between American stations, determined heretofore by the telegraphic method, have been continued by Dr. B. A. Gould. In addition to the results formerly reported, the longitudes of Raleigh, N. C., Wilmington, N. C., and Columbia, S. C., have been definitely settled, giving a total of twelve stations determined in longitude south of Washington. The report of Dr. Gould is given in Appendix No. 12.

The telegraphic difference of longitude between New York and Washington, deduced some years ago without the advantage of recent improvements in instruments, is somewhat uncertain. There is also a small geodetic difference which enters into that determination. It is, therefore, desirable that the telegraphic method should be again applied for a new determination of the difference of longitude between the two cities.

The list of fundamental star places, used in longitude determinations, has been submitted to a new discussion, and the declinations of the time star list have also been determined.

The investigation of the diurnal motion in azimuth of the transit instruments has been continued, and new results found strongly confirmatory of previous inferences. This subject is receiving attention in other quarters. Hereafter it must be brought into the determination of star places in order to obtain the best results practicable.

## MAGNETISM.

The series of papers containing a discussion of the magnetic observations made at Girard College, Philadelphia, from 1840 to 1845, contained in some of the preceding annual reports, is brought to a close this year by the insertion of the last three parts, Nos. X, XI, and XII, contained in the Appendix, Nos. 16, 17, and 18. To facilitate the reference to the separate parts, I herewith give an abstract of the headings and general contents:

SECTION I.—Part I—Coast Survey report, 1859, Appendix No. 22—Investigation of the eleven (or ten) year period in the amplitude of the solar-diurnal variation, and of the disturbances of the magnetic declination. Part II—Coast Survey report, 1860, Appendix No. 23—The solar-diurnal variation in the magnetic declination and its annual inequality. Part III—Coast Survey report, 1860, Appendix No. 24—Influence of the moon on the magnetic declination.

SECTION II.—Part IV—Coast Survey report, 1862, Appendix No. 15—Investigation of the eleven (or ten) year period, and of the disturbances of the horizontal component of the magnetic force. Part V—Coast Survey report, 1862, Appendix No. 16—Solar-diurnal variation and annual inequality of the horizontal component of the magnetic force. Part VI—Coast Survey report, 1862, Appendix No. 17—Lunar influence on the magnetic horizontal force.

SECTION III.—Part IV—Coast Survey report, 1863, Appendix No. 19—Investigation of the eleven (or ten) year period, and of the disturbances of the vertical force; with appendix on the effect of the aurora borealis on the magnetic declination and on the horizontal and vertical force. Part VIII—Coast Survey report, 1863, Appendix No. 20—Solar-diurnal variation and annual inequality of the vertical component of the magnetic force. Part IX—Coast Survey report, 1863, Appendix No. 21—Lunar influence on the magnetic vertical force, the inclination and total force.

SECTION IV—Part X—Coast Survey report, 1864, Appendix No. 16—Analysis of the disturbances of the dip and total force. Part XI—Coast Survey report, 1864, Appendix No. 17—Solar-diurnal variation and annual inequality of the inclination and total force. Part XII—Coast Survey report, 1864, Appendix No. 18—Discussion of the magnetic inclination and table of absolute values of the declination, inclination, and intensity between 1841 and 1845.

I proceed to a more detailed account of the contents of the three parts contained in this volume:

Part X (Appendix No. 16) analyzes the disturbances of the dip and total force. The instrumental quantities given are the differential readings of the horizontal and vertical components of the magnetic force expressed in scale divisions, and corrected for progressive change and effect of changes of temperature. Each entry was marked as a disturbance that differed as much as, or more than,  $\pm 30$  scale divisions from the normal of the vertical force, and as much as, or more than,  $\pm 33$  scale divisions from the normal of the horizontal force, and was transcribed and converted into its equivalent part of the respective force. When but one of the components was disturbed, the contemporaneous value of the other component was also inserted; a chronological table of the disturbances of the two components was thus formed, and the corresponding values of differences from the normal dip, (expressed in minutes of arc,) and from the total force, (in parts of that force,) were computed by their well-known geometrical relations. By an extended use of the criterion  $\pm 1/1$  was recognized as the limit, beyond which the disturbed values of the dip commence, and  $\pm 0.00094$  parts of the force as the corresponding limit of the total force disturbances. There remained, then, for discussion 1,446 disturbances of the dip. The first two tables contain the aggregate amount and number of disturbances of the dip for each month, divided into those which increase and those which decrease the dip; also the resulting monthly ratios and laws of progression. The next two tables exhibit the changes due to the eleven-year period, in the aggregate amount and number of disturbances, for increasing and decreasing values. The diurnal inequality of the disturbances is next shown for the aggregate amount and number, and the law of progression is exhibited for both, increasing and decreasing inclination, together with the average diurnal effect. The hours of maxima and minima, and the degree of correspondence or divergence in each case, are pointed out. Disturbances increasing the dip, upon the whole, preponderate. A table of disturbances, distributed according to their size, concludes this part of the inquiry. The disturbances, 1,470 in number, of the total force are next taken up and treated in precisely the same manner as those of the dip, and their annual and diurnal distribution, and change for the eleven-year period, are shown by means of ratios. This part concludes with tables of the average diurnal effect, and of the distribution of the disturbances of the total force according to their size. Whenever practicable, comparisons of these rather intricate laws of the disturbances with corresponding ones, deduced from the Toronto observations, are instituted and commented upon.

Part XI (Appendix No. 17) treats of the solar diurnal and annual inequality of the dip and total force. The combination of the two experimental components to form the dip and total force was effected as follows: Owing to the eleven-year inequality contemporaneous readings only, of the two parts, can be admitted for combination. The observations of the horizontal force from July, 1840, to July, 1841, are therefore here omitted. By means of a preceding paper (Part V) a table was made out of hourly values (expressed in scale divisions, corrected for progressive and temperature changes, and freed from the larger disturbances) of the horizontal force; each value was compared with its corresponding monthly normal, and the difference converted into parts of the force. The same was done with respect to the vertical force, by means of numbers, given in Part VIII. The differential values, expressed in minutes of arc, for the dip, and in parts of the force for the total force, were then computed by the formulæ, connecting these elements with their components. The semi-annual inequality of the dip, found by comparison of the summer and winter means with the annual means,

has its turning epochs about the middle of April and October.  $5\frac{1}{2}$  a. m., 1 p. m., 3 p. m., and 7 p. m. are hours of no semi-annual change; greatest change at 10 a. m.; secondary change at 6 p. m.; range  $0.51$  and  $0.18$  respectively. The diurnal inequality of the dip is shown analytically and graphically for each month, also for the summer and winter half year, and for the whole year. The general character of the last curve shows a maximum about 11 a. m., and a minimum about 5 a. m., with a range of  $1.2$ . In summer these epochs occur earlier, range  $1.5$ , and in winter later, range  $1.0$ . There is also a secondary maximum and minimum. The diurnal range of the dip is greatest about the time of the equinoxes, less in winter, greater in summer. The afternoon minimum disappears about the time of the equinoxes, and is best marked about the time of the solstices. Principal epochs of the normal dip, when best marked, are *7h. 22m.* a. m. in summer, *8h. 33m.* a. m. in winter, and *7h. 50m.* a. m. for the whole year. The semi-annual inequality of the total force has its turning epoch about the 4th of April and 12th of September. 6 a. m. and 7 p. m. are hours of no semi-annual range; greatest change about 2 a. m. and 4 p. m.; range  $0.00037$  and  $0.00033$  parts of the force. The diurnal inequality of the total force consists of a single crested curve, on the average, during the year, but in winter it assumes a double progression. The principal maximum in summer occurs about 2 p. m., and in winter one hour and a half earlier; the principal minimum in summer occurs about 10 p. m., and in winter two hours earlier. Summer range nearly  $0.0009$ ; winter range nearly  $0.0004$  parts of the force. The hours  $6\frac{1}{2}$  a. m. in summer and  $7\frac{1}{2}$  a. m. in winter are epochs of normal total force. The paper concludes with an attempt to deduce the annual inequality of the dip and total force, and is illustrated with several diagrams. (Sketch No. 38.)

Part XII (Appendix No. 18) contains the results and discussion of the observations for dip, obtained with a Robinson dip circle, the same instrument which was employed in the magnetic survey of Pennsylvania and adjacent States. The series commence in January, 1842, and terminate in July, 1844; the observations were made weekly. There are, however, some breaks. Needle No. 1 was employed, with but a few exceptional cases, throughout the series; the casual results by three other needles have been referred, by comparison, to this standard needle. The monthly and annual mean dips are tabulated, the latter indicating an annual decrease of  $1.2$ . There is also a collection of dip results, taken at Philadelphia, compiled from various sources, and properly arranged. By grouping these the secular change of the dip is expressed by a formula involving the time and square of the time. A comparison of the observed and computed dips assigns a probable error of  $\pm 4/8$  to each represented value. The minimum dip occurs about January, 1840. The discussion closes with a table of magnetic constants for five epochs, and for the mean epoch January, 1843, of the declination, the dip, and the horizontal, vertical, and total force. A comprehensive index of all the parts is added to Appendix No. 18.

With these papers is presented one containing results of magnetic observations in the United States by the late Professor J. N. Nicollet, between 1832 and 1836, made out from the manuscript record by Assistant Charles A. Schott, under my immediate direction, and at my own expense. These results, though partly incomplete and not of an accuracy attainable by methods and instruments now in use, may, it is thought, be of use in investigating the secular change. The paper is given in Appendix No. 19. The observations had never been published, and the value of the results are enhanced because of the comparatively early period of the observations and the occupation of some localities not visited by other magnetists. It contains the magnetic horizontal force at nine stations, in Maryland, Missouri, Tennessee, Georgia, South Carolina, Mississippi, Alabama, and Minnesota; and the inclination at sixteen stations in the States just mentioned, and including also Kentucky, North Carolina, Louisiana, and Florida; also the declination at one station in Virginia. Some of the results were compared with such later ones as could be found in records by other observers.

#### AIDS TO NAVIGATION.

The results of a special examination made at the request of the Light-house Board, with reference to aids needed for navigation in Passamaquoddy bay and Penobscot bay, are given in Appendix No. 23. In the list which follows it (Appendix No. 24) a statement is given of the buoys set or replaced by parties while working on various parts of the coast. Acting Assistant Cordell has served during the entire season as inspector for the fifth district, and in the adjoining southern district close attention has been given to the light-house service by Assistant Boutelle.

#### TEN YEARS' INDEX.

The consolidated alphabetical index given with this report was prepared by Sub-Assistant F. F. Nes. It comprises references to the material of all the annual reports of the survey since the year 1853.