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REPORT OF THE SUPERINTENDENT

OF THE

UNITED STATES COAST SURVEY,

SHOWING

THE PROGRESS OF THE SURVEY

DURING

THE YEAR 1873.

WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1875.

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

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LETTER

FROM

THE SECRETARY OF THE TREASURY

TRANSMITTING

THE ANNUAL REPORT OF THE SUPERINTENDENT OF THE COAST SURVEY.

FEBRUARY 16, 1874.—Referred to the Committee on Commerce and ordered to be printed.

TREASURY DEPARTMENT, *February* 16, 1874.

SIR: I have the honor to transmit, for the information of the House of Representatives, a report made to this Department by Prof. Benjamin Peirce, Superintendent of the Coast Survey, stating the operations and progress in the survey of the coast during the year ending November 1, 1873.

I have the honor to be, very respectfully,

WILLIAM A. RICHARDSON,
Secretary of the Treasury.

Hon. JAMES G. BLAINE,
Speaker of the House of Representatives.

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REPORT.

COAST SURVEY OFFICE,
Washington, D. C., December 30, 1873.

SIR: I have the honor to present the following report on the progress made during the past year in the survey of the Atlantic, Gulf, and Pacific coasts of the United States. For convenient reference, the distribution of the surveying-parties is given in tabular form in Appendix No. 1, and in conformity with that, the work done in each site will be mentioned in geographical order in the body of the report.

In one or more of its branches, the survey has been in progress within the present year in each of the seaboard States of the Union, and geographical positions have been determined in several of the interior States.

The subdivision of the coast into sections marks the judicious policy of my predecessor. Under corresponding arrangements at the outset, the harbors most frequented and the coast-approaches most dangerous to foreign commerce and to the coasting-trade were first surveyed in the order of their importance, and charts issued from time to time met the immediate requirements of commerce and navigation, without waiting for the completion of work on intervening stretches of coast. It will be readily understood, however, that while thus meeting important local needs the general interests of commerce were much concerned in the development of the parts of coast intermediate between the surveys of the principal ports. For these intervals, and in advance of the issue of final charts for general purposes, the local triangulations which were first completed must be joined. It has in consequence followed that parts of the Atlantic and Gulf coast, unsettled on account of the low, swampy, and sickly character of the shores, are now occupied by parties of the survey, and, as was to be expected, many impediments are encountered in pushing the triangulation. Amongst these is the necessity of depending upon distant points for supplies required by the parties; and in some places the only fresh water to be had is brought many miles during the working-season. The great lines of triangulation along each coast are absolutely necessary, and are organic parts of the original plan of the survey. By such means more than fourteen thousand points in all have been well determined in latitude and longitude for defining the shore-lines of the adjacent oceans, bays, harbors, inlets, and river-entrances; and the triangulation itself has been checked at intervals by elaborate observations for geographical position. The general sketch (No. 1) which accompanies this report shows only the main courses of the field-work, as no map of ordinary dimensions would admit of representing, in relation to each other, all the stations which have been occupied for the coast-triangulation.

Formerly, the local data gathered in the progress of the survey of the coast, such as the topography of harbor-shores, the adjacent soundings, precise knowledge of the tidal variations deduced from long series of observations, and knowledge of the effects of the currents, were called for only by engineers and constructors at our sea-ports, or at points of consequence along the coast. But, of late years, no step has been taken to modify natural conditions, even in remote places, without recourse to data and conclusions which at least point out what should be avoided. The ill effect of encroachments upon channel-spaces relied on for the benefit of the public has been clearly demonstrated in repeated instances. If the bottom of the channel is anything but rock, the material has probably been brought by the current, and has been deposited by natural forces. These may be so exactly balanced that any contraction of the water-way, and consequent acceleration of the current, will disturb the bottom, especially if the material is soft. In other cases, the tendency of the material to remain in place may preponderate. But if in any case the material at the bottom of a commonly-used channel is moved, it is well known that bars or shoals are formed near the outlet of the channel. In a case noticed under the head of Section I, in the following report, mention will be made of the method employed for determining the limits which admit the rights of marginal owners, and at the same time preserve the accustomed route of navigation for the public benefit. At several of the northern sea-ports, questions of this kind are now pending. In fact, the conviction is general at all our ports, that, inasmuch as changes for the worse may be actually in progress without intention, it is unwise to neglect any means that may tend to maintain the facilities that now exist for commercial purposes.

It need not be explained that, excepting determinations of the latitude and longitude of the place, all the conjoined data of the survey enter into the consideration of such questions as are here alluded to. Including all the methods and processes, the outlay for the survey of the coast and harbors, and for the determination of points in the interior States, costs less than one-twentieth of one per cent. reckoned upon the coastwise commerce of the United States.

Intimate relations with the Light-House Board have been maintained as heretofore, and in that connection my personal attention has been given, as chairman of the committee on lighting, to the local details pertaining to aids for navigation on the Atlantic and Pacific coasts and on the lakes. These need not be specified, nor the bearing upon them of developments made in the progress of the survey, as the routine of interchange by established usage properly makes known to others any collateral information gathered in either branch of the public service.

Regarding the definition of the coast and harbor lines, and the development of their approaches, as for Government uses alone, a manifest special advantage inures to the seaboard States in the determination of points requisite for defining the trend of the shore-line. The main points are preserved by marks in the ground, and, by recourse to them, ultimate State surveys along the seaboard can be prosecuted at moderate expense. But the geodetic connection between the survey of the Atlantic and the survey of the Pacific coast is in itself of much general interest. Several important questions, outside of the advantage which attaches to accurate surveys of the interior, depend upon such connection. Congress has therefore wisely authorized the determination of points in such of the interior States as make provision for their topographical or geological surveys. Already, the advantage to them is generally, and soon will be universally, recognized by the interior States. In New Hampshire, where the work is well advanced, part of the outlay for determining geographical points is met by the State treasury. The sum appropriated by Congress for the work of this season was small, as will be seen by reference to the estimates which follow; but, within the year, the geodetic connection has been carried on in the States of New Hampshire, Vermont, New York, Wisconsin, and Minnesota for the northern line, in Maryland, West Virginia, Pennsylvania, Illinois, Missouri, and Colorado for the middle, and in Georgia and Alabama for the southern; the points following each other in succession at elevations most available for the determination of long lines of triangulation. In each of these States, stations have been occupied or selected, and, when the number is increased, each State will have a frame-work upon which to construct a State map. While the benefit to the State is immediate, advantage to the General Government is equally certain in the future, as explained in previous reports. In one of the old States of the Union, map-errors in regard to prominent landmarks have been detected by the work of this year; the positions as marked varying by from two to eight miles from the true positions. Similar cases have been mentioned in my previous reports. The public advantage gained by such corrections is unquestionable.

The surveying-parties were all in the field when my estimates were presented in September last for continuing work during the next fiscal year. The detailed estimates are here annexed, and with them, as illustrating the scope of the field-work, a recapitulation of the operations of the present year.

The survey has been advanced on the coast of Maine by topography and soundings on the eastern side of Mount Desert Island; by the survey of Deer Isle and the adjacent reefs, and of islands, including hydrography, near Castine and between Cape Rosier and the Fox Islands, where tidal observations have been continued; on Isle au Haut and the neighboring islands; survey of the

Penobscot shores between Winterport and Bucksport; special survey and current-observations in Fore River at Portland, and revision of shore-line at Old Orchard Beach; by the determination of magnetic elements in Maine, and of geographical points and the magnetic elements in New Hampshire; by soundings on George's Shoal; deep-sea lines northward to Cape Sable; dredgings on the fishing-banks off the coast of Massachusetts; the selection of proper sailing-courses for entering the harbors of New England; tidal observations at Boston; astronomical observations at Cambridge for determining the longitude of a point in New York; experiments on local variations in gravity; and the development of marine alterations at Nauset Beach, Monomoy Point, and the eastern approaches to Nantucket Sound; special examination and series of tidal observations at Providence, R. I.; sailing-courses for navigating from the eastward and throughout Narragansett Bay; topography of the coast west of Point Judith advanced to Quonochontaug Pond; on the coast of Connecticut, survey of the water-front of New Haven, including the harbor-shores. In the vicinity of New York, the operations include tidal and current observations, and soundings near Sandy Hook and in East River; topography of the western shore north and south of Jersey City; survey of the Raritan and Hackensack Rivers, New Jersey; determinations of latitude, longitude, azimuth, and the magnetic elements at Port Jervis, N. Y.; of the magnetic elements at Sandy Hook and New York City, and at Burlington and Rutland, in Vermont; survey of the shores, and soundings, in Lake Champlain, and selection of stations for connecting that survey with the coast-triangulation; development of the changes in shore-line and depth at Great South Bay, Long Island; the examination of station-marks on Long Island, and near Perth Amboy, N. J.; geodetic connection of Barnegat light-house with the main coast-triangulation; topography of the coast of New Jersey near Barnegat and Manahawken, including Mullica River; soundings in the upper part of Little Egg Harbor; special survey at New Castle, Del.; and shore-line survey of Schuylkill River at Philadelphia.

In the vicinity of Chesapeake Bay, the work of the year includes the shore-line survey, the hydrography, and determination of the position of aids to navigation in the approaches to Elizabeth River, Virginia; tidal observations at Fortress Monroe; tests of sailing-courses and supplementary soundings in the waters of Chesapeake Bay; magnetic observations at Washington City, D. C.; and reconnaissance for the selection of geographical points westward from Harper's Ferry. On the coast south of Cape Henry, latitude and the magnetic elements have been determined at Knott's Island, and triangulation has been extended through Currituck Sound, North Carolina; the Hatteras Shoals have been closely examined; the survey has advanced on the shores and in the waters of Pamplico Sound and its branches; also on the shores of Core Sound, and in the vicinity of Beaufort, N. C. At Cape Fear, hydrographic operations have developed the Seward Channel as it now exists, and the channel of the river up to Wilmington, N. C. Little River entrance has been surveyed, and the coast of South Carolina between it and Winyah Bay, also the North Santee and South Santee Rivers; and the sea-islands at the head of Saint Helena Sound, South Carolina, including the adjacent sea-water channels of the inland navigation. Latitude has been determined at Saint Simon's Island, Georgia.

On the Atlantic coast of Florida, the survey includes the upper part of Halifax River and the adjacent main; soundings on the Florida Reef near Garden Key, and extension of hydrography in the vicinity of the Tortugas; survey of the Gulf coast between Tampa entrance and Saint Joseph's Bay (south); and soundings in Boca Ceiga Bay. Under special arrangement, tidal observations have been continued at Saint Thomas, West Indies.

On the Gulf coast, triangulation has been advanced between Cedar Keys and Appalachee Bay, and hydrography at the approaches of Saint George's Sound, Florida; geodetic operations have been completed near Atlanta, Ga., and for the triangulation extended in that vicinity connecting-stations have been selected in Georgia and Alabama. In Chandeleur Sound, Mississippi, the hydrography has been completed; the detailed survey of the Mississippi River has been extended to the vicinity of New Orleans; geographical points have been determined in Illinois and Missouri, east and west of Saint Louis; also in Wisconsin, Minnesota, and Colorado.

On the coast of Texas, field-work has been in progress from East Bay toward Sabine Pass; triangulation at Galveston Bay has included the positions of the light-houses and beacons; and the hydrography of Espiritu Santo and San Antonio Bays has been completed.

On the Pacific coast, geographical positions have been determined in Lower California, including the station occupied in 1769 by M. Chappe de l'Autéroche for observing the transit of Venus; dangers to navigation between Cape San Lucas and San Diego have been developed, and much of the erroneous published shore-line on foreign charts of the coast of Lower California has been corrected; at several sites, the survey has advanced on the shores and on the islands of the Santa Barbara Channel, and in the vicinity of Point Conception, where also the magnetic elements have been determined; stations have been selected for triangulation between that point and Monterey Bay; intermediate operations include coast-topography near San Luis Obispo Bay, latitude and azimuth there, and at San Simeon, and magnetic observations at Point Pinos, coast-topography northward of Piedras Blancas; astronomical and magnetic observations at San Francisco, Cal.; topography of the north side of the Golden Gate, and of the sand-dunes near San Francisco; tidal and current observations and soundings in San Francisco Bay and its approaches; coast-topography north of Mendocino Bay; development of numerous rocks off Cape Mendocino; hydrography of the vicinity of Crescent City Reef; triangulation between Klamath River and False Klamath; reconnaissance for extending the survey of the coast of California to Rocky Point; and topography north of Noyo River entrance.

On the coast of Oregon, topography has been extended from Crook's Point to Cape Sebastian, and reconnaissance for the triangulation northward to Rogue River; anchorages have been developed by soundings at Chetko River entrance and Hunter's Cove; field-operations include triangulation of the Columbia River from Westport to Kalama, and observations for latitude, longitude, and azimuth at the last-named place.

In Washington Territory, work has been completed on the shores of Shoalwater Bay, and that survey has been joined with the triangulation of the Columbia River; tidal observations have been continued at Astoria, and magnetic observations repeated at Cape Disappointment; tidal observations have been commenced at Port Townshend; topographical work includes the shores of Budd's Inlet, and soundings have developed its approaches from the waters of Puget Sound.

On the coast of Alaska, besides the development of numerous harbors, anchorages, and marine characteristics, tidal observations have been recorded at Unalaska, and at Saint Paul's Island, in Behring Sea.

The preparation of a "*Coast Pilot*," or Sailing Directions, for all the harbors and coastwise navigation between Eastport, Me., and Newport, R. I., has been completed, and that work is now ready for publication. Much additional data gathered within the year will be embodied in new editions of the Sailing Directory for the Pacific Coast.

The work in the Coast Survey Office, which includes the computation of results from the field-observations, and the drawing, engraving, and publication of maps and charts, has kept pace with the operations in triangulation, topography, and hydrography. Nineteen charts, engraved on copper, have been completed within the year, and twenty-nine are in hand, exclusive of six charts issued by means of the photolithographic process, which greatly expedites the publication of new material. In the Drawing Division, sixty-three charts have been in hand. Fourteen thousand copies of copper-plate charts and fifty-three hundred of lithographic charts have been printed, and nearly as many issued to sale-agents, and to departments of the Government, chiefly the Navy and the Revenue Marine.

Tide-tables for all sea-ports of the United States for the year 1874 have been computed and issued.

The important matter of reproducing the original topographical maps of the coast, which exist only in a single manuscript copy of each, has received constant attention. Satisfactory results have been obtained by the comparatively inexpensive process of photolithography, and, in the order of their importance, these maps will be reproduced when the requisite force is available and means can be applied to that object.

In order to continue the field and office operations of the survey on a scale corresponding with the rate of progress now reported, a small increase in the two leading items of the estimate seems unavoidable, on account of continued increase in the cost of supplies required in the field-service.

For continuing work in the geodetic connection, my estimate was, for the present fiscal year, fifty thousand dollars, in view of additional demands for the determination of points within the interior States. The appropriation of thirty-six thousand in lieu of the estimated sum has not availed for the requirements of the service; two other States, Wisconsin and Kentucky, having applied within the year for the benefit intended by that item in prosecuting their geological surveys.

The determination in the interior of points in true geographical relation to the eastern and western coasts of the United States, limited as the work is to "each State of the Union which shall make requisite provision for its own topographical and geological surveys," now requires an increase of means for extending the provisions of this item in the West, and it is hoped that the increase of the estimate to sixty-five thousand dollars will enable the survey to perform all the work which may be required during the next fiscal year in the several States that are now entitled to the service.

ESTIMATES IN DETAIL.

For general expenses of all the sections, namely: Rent, fuel, materials for drawing, engraving, and map printing, and for transportation of instruments, maps, and charts, for miscellaneous office expenses, and for the purchase of new instruments, books, maps, and charts, will require $33,000

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.*—FIELD-WORK.—To continue the topography of the western shores of Passamaquoddy Bay and its estuaries, and of the coast and islands between Castine and Mount Desert; to determine the heights of the principal trigonometrical points in the section; to complete the hydrography of Penobscot Bay and River, and to continue the soundings eastward to Mount Desert; to make such additional triangulation as may be required for the topographic and hydrographic surveys; to continue the resurvey of Monomoy and Nantucket Shoals, and the offshore hydrography of this section, and make special examination for the sailing-lines for charts; to continue the tidal observations, and to make such astronomical and magnetic observations as may be required. OFFICE-WORK.—To compute results from the field-observations; to continue the drawing of charts Nos. 1 and 2, showing the approaches to the coast of Maine, between Passamaquoddy entrance and Petit Manan light-house; to continue drawing and engraving for charts Nos. 3, 4, and 6, which include Frenchman's Bay, Blue Hill Bay, the approaches of the Penobscot and the coast between Kennebec entrance and Saco; also for local charts of Mooseabec Reach, Mount Desert Island, Eggemoggin Reach, Penobscot Bay (east), Penobscot River, and the vicinity of Monomoy Shoals, will require 75,000

SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.*—FIELD-WORK.—To continue the resurvey of the north shore of Long Island Sound; to make such examinations as may be required in New York Harbor; to continue observations on the tides and currents; to extend, if practicable, the plane-table survey of Hudson River above Haverstraw; to make the requisite astronomical observations; to connect the triangulation of Hudson River with that of Lake Champlain, and to complete the topography of the shores of Barnegat Bay; and to commence the resurvey of the hydrography of Delaware Bay and River. OFFICE-WORK.—To make the computations and reductions; to complete the drawing and engraving of a chart of New Haven Harbor; to continue the engraving of chart No. 21, showing the coast between Sandy Hook and Barnegat Inlet; the drawing and engraving of Nos. 22 and 23, between Barnegat and Cape May, and to commence a new chart of Long Island Sound, will require 30,000

SECTION III. *Coast of part of Delaware, and that of Maryland, and part of Virginia.*—FIELD-WORK.—To connect the Atlantic-coast triangulation with that of Chesapeake Bay, near the boundary-line between Maryland and Virginia; to complete the detailed survey of the James River, Virginia, including the hydrography, and continue the plane-table survey of the Potomac River; to continue southward the main triangulation along the Blue Ridge parallel with the coast, including astronomical and magnetic observations; to complete the supplementary hydrography required in this section; and to continue the tidal observations. OFFICE-WORK.—To compute results from the records of field-observations; to complete the drawing and engraving of the chart of James River below City Point; and to make additions to the charts and sketches of the section, will require $35,000

SECTION IV. *Coast of part of Virginia and part of North Carolina.*—FIELD-WORK.—To continue the triangulation of Pamplico Sound and the topography of its western shores between the Roanoke marshes and Swan Quarter; to measure a base of verification and determine azimuth for the coast-triangulation south of Cape Lookout; to make the astronomical and magnetic observations requisite; to continue the off-shore hydrography of the section, and that of Pamplico Sound and its rivers. OFFICE-WORK.—To make computations from the field-data; to continue the drawing and engraving of charts Nos. 37, 39, 42, 43, 44, 45, 46, and 47, showing parts of the Atlantic coast between Cape Henry and Cape Lookout, including Pamplico Sound, will require 40,000

SECTION V. *Coast of South Carolina and Georgia.*—FIELD-WORK.—To extend northward the primary triangulation along the Blue Ridge; to continue the topographical survey southward of Cape Romain; to determine azimuth for the triangulation of the coast of South Carolina; to complete the detailed survey of the sea-islands and water-passages between Charleston and Savannah, and to make tidal observations. OFFICE-WORK.—To make computations and reductions; to continue the drawing and engraving of the general chart of the coast between Cape Romain and the Saint Mary's River, and of charts Nos. 51 and 52 between Cape Fear and Winyah Bay; and to make additions to the charts and sketches, will require 35,000

SECTION VI. *Coast, keys, and reefs of Florida.*—FIELD-WORK.—To extend southward from Cape Canaveral the triangulation, topography, and hydrography of the sea-water channels adjacent to the eastern coast of the Florida peninsula; to make the requisite astronomical observations; to continue the off-shore hydrography of the Florida peninsula, and observations on the Gulf Stream; and to complete soundings in the vicinity of the reefs and keys. OFFICE-WORK.—To reduce and compute from the field-records; to continue the drawing and engraving of the general chart of the coast from Saint Mary's River to Cape Canaveral, and of charts Nos. 58 and 59 from Cumberland Sound to Mosquito Inlet; and to make additions to the charts of the section, will require 45,000

SECTION VII. *Gulf coast of the Florida peninsula north of Tampa and coast of Western Florida.*—FIELD-WORK.—To make the astronomical and magnetic observations requisite in this section; to continue the triangulation, topography, and hydrography of Tampa Bay and of the western coast of the peninsula between Cedar Keys and Appalachee Bay; to run lines of soundings in the Gulf of Mexico, and develop the hydrography of the Gulf coast included in the field-operations. OFFICE-WORK.—To compute from the astronomical and field records; to continue the drawing and engraving of charts Nos. 79, 82, 83, 86, and 87, showing parts of the Gulf coast between Chassahowitzka River and Pensacola entrance, and of the chart of Tampa Bay, will require 45,000

SECTION VIII. *Coast of Alabama, Mississippi, and part of Louisiana.*—FIELD-WORK.—To connect the survey of the Mississippi River at New Orleans with that of Lakes Borgne and Pontchartrain; to determine geographical positions, and make the astronomical and magnetic observations required in this section; to extend the triangulation and topography westward of the Mississippi delta, and continue the hydrography of the Gulf of Mexico. OFFICE-WORK.—To make the computations required; to continue the drawing and engraving of charts Nos. 91, 92, 93, 94, and 95, showing Lake Borgne, Lake Pontchartrain, Isle au Breton Sound, and the Mississippi River between New Orleans and the Gulf of Mexico, will require...... .. 45,000

SECTION IX. *Coast of part of Louisiana and coast of Texas.*—FIELD-WORK.—To extend the triangulation and topography of the coast of Texas westward from Sabine Pass and south of Corpus Christi; to measure a base of verification, and make the astronomical and magnetic observations requisite in this section; to continue the hydrography of the approaches to the coast, and of the bays and passes. OFFICE-WORK.—To compute results from observations recorded in the field; to continue the drawing and engraving of the general chart between Galveston and Rio Grande, and of charts Nos. 109 and 110, showing Aransas Bay, Copana Bay, and Corpus Christi Bay, will require $42,000

Total for the Atlantic coast and Gulf of Mexico 425,000

The estimate for the survey of the western coast of the United States is intended to provide for the following progress:

SECTION X. *Coast of California.*—FIELD-WORK.—To make the requisite observations for latitude, longitude, azimuth, and the magnetic elements at stations along the Pacific coast of the United States; to continue off-shore soundings on the coast of California and tidal observations at San Diego; to continue the coast-triangulation and topography near San Juan Capistrano and Newport, and that of the Santa Barbara Islands; to continue the detailed survey of the coast north and south of Point Conception, also between Point Sal and San Luis Obispo, and northward of Piedras Blancas; to continue the main triangulation between Santa Barbara and Monterey, the hydrography of the western part of Santa Barbara Channel, and to make soundings between the islands; to develop the Falmouth Shoal, and the hydrographic changes in San Francisco Bay and its approaches; to continue tidal observations at the Golden Gate, and observations on the ocean-currents along the coast of California; to continue hydrographic work within the limits of field-operations; to continue the triangulation, topography, and hydrography of the coast between Mendocino City and Shelter Cove, and in the vicinity of Klamath River entrance; to complete the detailed survey between the last-named point and Crescent City, and the off-shore hydrography at Crescent City Reef. OFFICE-WORK.—To make computations from the observations recorded in the field, and additions to the general and local charts of the section; also for the operations in—

SECTION XI. *Coast of Oregon and of Washington Territory.*—FIELD-WORK.—To continue the triangulation and topography of the coast of Oregon from Mack's Arch northward toward Cape San Sebastian and Port Orford; to determine the latitude, longitude, and azimuth at stations on the coast of this section; to complete the survey between Tillamook Head and Cape Adams; to continue the survey of the Columbia River, and tidal observations at Astoria; to complete the topography between Cape Disappointment and Shoalwater Bay, and extend the detailed survey from thence along the coast of Washington Territory toward Gray's Bay; to measure a base-line and continue the triangulation of the Strait of Fuca, Puget Sound, and Washington Sound; and to develop the hydrography of harbors in Puget Sound. OFFICE-WORK.—To make the requisite computations, and to draw and engrave the results of field-work as additions to the charts and sketches of the section; also for the operations in—

SECTION XII. *Coast of Alaska.*—FIELD-WORK.—To make the requisite astronomical and magnetic observations, and to continue hydrographic researches in the vicinity of the Aleutian Islands, the Shumagins, and near the Kadiak group, with observations on the tides and currents. OFFICE-WORK.—To compute results from the recorded observations, and to draw and engrave the shore-line and soundings derived from the reconnaissance, will require $275,000

For extending the triangulation of the Coast Survey to form a geodetic connection between the Atlantic and Pacific coasts of the United States, and assisting in the State surveys 65,000

For repairs and maintenance of the complement of vessels used in the Coast Survey... $50, 000
For continuing the publication of observations made in the progress of the Coast Survey. 10, 000

The annexed table shows in parallel columns the appropriations made for the fiscal year 1873-'74 and the estimates herein submitted for the fiscal year 1874-'75:

Objects.	Estimated for fiscal year 1874-'75.	Appropriated for fiscal year 1873-'74.
For continuing the survey of the Atlantic and Gulf coast of the United States, and Lake Champlain, including compensation of civilians engaged in the work, and pay and rations of *engineers for the steamers used* in the Coast Survey, per acts of March 3, 1843, and June 12, 1858	$425, 000	$410, 000
For continuing the survey of the western coast of the United States, including compensation of civilians, and pay and rations of engineers for the steamers used in the work, per act of September 30, 1850	275, 000	260, 000
For extending the triangulation of the Coast Survey to form a geodetic connection between the Atlantic and Pacific coasts of the United States, and assisting in the State surveys, including compensation of civilians engaged in the work, per act of March 3, 1871	65, 000	30, 000
For repairs and maintenance of the complement of vessels used in the Coast Survey, per act of August 18, 1856	50, 000	50, 000
For continuing the publication of observations made in the progress of the Coast Survey, including compensation of civilians engaged in the work, *the publication to be made at the Government Printing-Office*, per act of March 3, 1869	10, 000	10, 000
Total	825, 000	760, 000

PART II.

The operations of the surveying-parties in the course of the year will now be described briefly in geographical order, beginning on the Atlantic side with the coast of Maine, and terminating with the coast of Texas. Of the western coast, mention will first be made of work between Cape San Lucas and San Diego, and from thence northward, sites will be noticed in regular order, closing with an abstract of the operations of the year along the coast of Alaska.

The work of triangulation has been prosecuted in each section of the Atlantic coast. In the difficulties to be met at some places by this branch of the service, as already mentioned, the long experience in the field of Assistant Richard D. Cutts has availed much. Instructions to the parties engaged in secondary triangulation have been based upon his careful study in each case in regard to the requirements of the service. On these parties, besides the determination of points for advancing along the coast, devolve minor duties, amongst which may be mentioned the supply of new points for occasional resurveys, made necessary by changes in the direction and depth of channels, and determinations of the positions of new light-houses, beacons, and buoys, in order that the published charts and sailing-directions may be conformable to the other aids provided for the benefit of navigation and commerce.

During the summer, Assistant Cutts served as an honorary commissioner at the National Exposition in Vienna, and there noted amongst observing-instruments of the various classes, cognate to those used in the survey of the coast, such as were presented as improvements or as affording special facilities in method or precision in observing. His views in regard to the comparative merit of instruments now employed in geodetic determinations are of much interest.

In regard to limits and details of the topographical surveys, of which abstracts will follow, I have had the experienced advice of Assistant Henry L. Whiting.

Systematic order has been held in view in pushing work to close the intervals in marginal topography occasioned by the necessarily detached order of work in the earlier surveys, for which order reasons were stated in my opening remarks. In the course of the season, Mr. Whiting visited the working-ground of most of the plane-table parties on the coast of Maine, and personally conducted special surveys at Portland and near New York, as will be stated under those heads in the abstracts which follow. He also inspected the operations of parties on the coast of New Jersey, Virginia, North Carolina, South Carolina, and Georgia. His detailed report makes gratifying mention of the accuracy and generally-improved style and finish of the plane-table sheets which have passed through his hands.

The hydrographic inspector, Capt. C. P. Patterson, though with much-impaired health, has conducted as heretofore the details of his division. After completing plans and specifications for new vessels required in the service, and arranging for the continuance of office-duties pertaining to the hydographic work of the year, he was absent from the Office during summer, with the sanction of the Treasury Department, and my own permission, accorded in the hope that by renewal of health his valuable services might be retained for the interests of the survey.

SECTION I.

ATLANTIC COAST OF MAINE, NEW HAMPSHIRE, MASSACHUSETTS, AND RHODE ISLAND, INCLUDING SEA-PORTS, BAYS, AND RIVERS. (SKETCHES NOS. 2 AND 3.)

Topography and hydrography of Mount Desert Island, Maine.—The survey of Mount Desert Island was resumed by a party under the charge of Assistant J. W. Donn early in July, and in the course of the season the eastern end was mapped by means of the plane-table from a point west of Bar Harbor around to a point westward of Seal Cove. Field-work was favored by almost uninterrupted good weather until the close of operations in October. All the islands adjacent to the eastern end of Mount Desert are included in this survey. It is estimated that the details yet outstanding can be filled in by a plane-table party before the close of another working-season.

As heretofore, Assistant Donn used the schooner *Scoresby* in this section. The soundings made by his party define the eastern sea-approaches to Mount Desert to the distance of one mile from the shore-line. Bar Harbor was sounded, Otter Cove, Seal Cove, and other indentations, and the rocks and reefs in the immediate vicinity of the eastern end of Mount Desert Island, were carefully developed. The general statistics are:

Miles of shore-line surveyed	25
Miles of roads	33
Miles of streams	44
Area of topography (square miles)	31
Miles run in sounding	235
Angles measured	2,338
Number of soundings	7,766

The party of Assistant Donn had been previously engaged in Section III, as will be stated in detail under that head. His arrangements are now complete for resuming work in that section. Mr. F. C. Donn efficiently aided in the operations of this party.

Topography of Deer Isle, Maine.—Assistant W. H. Dennis resumed plane-table work in this section on the north side of Deer Isle early in July. In continuation of the survey, he mapped the western side, including Ship Island and the shore of Penobscot Bay, to Northwest Harbor; tracing also the shore-line of Deer Isle beyond, nearly to its northern extremity. Eastward, the detailed work of this season includes the shores of Southeast Harbor, Greenlaw's Neck, Stinson's Neck, the small islands in that vicinity, and the eastern side of Deer Isle adjacent to Eggemoggin Reach. Many isolated low-water ledges are represented on the plane-table sheet. The shore-line, as usually found in this quarter, is very irregular; and the hills near it, as far as they were included within the topographical limits, are rocky and rough, though not of great height.

Mr. S. N. Ogden served acceptably as aid in this plane-table party. Field-work was continued on Deer Isle until the 28th of October, when arrangements were made for the transfer of the party to resume duty in Section V, under which head the previous work of Mr. Dennis will be mentioned. The statistics of work done this season by the party on the coast of Maine are:

Miles of shore-line traced	68
Miles of roads	35
Area of topography (square miles)	24

The site of this survey is shown on sketch No. 2.

Topography of Castine Harbor, Maine.—Having traced the shore-line of Cape Rosier district in the preceding season, Assistant A. W. Longfellow prosecuted the detailed survey during the summer, and filled in the topography of Brookville, the north end of which bounds Castine Harbor. On the north side of the harbor, some of the surface-features in the vicinity of Castine were mapped. Subassistant Joseph Hergesheimer was attached to this party, and assisted in the field and office work.

Hydrography of Castine Harbor and vicinity, Maine.—With a party in the schooner *Silliman*, and attended by the steam-launch *Sagadahoc*, Assistant Horace Anderson commenced sounding on the 23d of June at Castine Harbor. The completed sheet of this quarter includes the entire harbor and Bagaduce River. A second sheet was nearly filled with soundings made in Penobscot Bay between Cape Rosier and the Fox Islands, joining there with hydrographic work of former seasons. Some ledges within the limits of this sheet, and the approaches to several of the islands, will be specially examined in another season. All the soundings in this vicinity were referred to a bench-mark on Commercial wharf, Castine, where Mr. Anderson had set up a tide-gauge in June. The work of this party in Penobscot Bay was closed at the end of October, when Assistant Anderson proceeded to Harpswell Neck, and made additional soundings for the development of a ledge in that vicinity. He was aided in this section by Messrs. F. H. North, E. H. King, and Charles Coburn. Of work in Penobscot Bay, the general statistics are:

Miles run in sounding	685
Angles measured	5,450
Number of soundings	29,868

During the preceding winter, Assistant Anderson conducted hydrographic work in Section VII, under which head mention will be made of the occupation of his party.

Topography of Isle au Haut, Maine.—The plane-table survey of this island, in which some progress had been made in the preceding season, was continued during the summer by Subassistant J. N. McClintock, who worked with a party in the schooner *Joseph Henry*. Of three sheets returned to the Office, one contains the completed survey of Isle au Haut. Most of the surface represented is rock, but the soil between outcropping ledges supports a dense growth of pine and alder. The outlying islands, which partly fill the other two sheets, are of the same general character, having rocky, precipitous shores, long reaches of exposed granite and shale ledges, with a dense but stunted growth of pine. Eagle Island and Butler Island differ from others in the vicinity in being fertile and well cultivated. The group included in the operations of the party of Mr. McClintock this season lies between Northern Fox, Deer, and Little Deer Islands, Cape Rosier, and Islesboro'. Field-work was continued on the group until the end of October, when Mr. McClintock was assigned to special field-service in Section II. The statistics of work on the islands are:

Miles of shore-line surveyed	90
Area of topography (square miles)	14

One hundred and eighteen small-islands and ledges are already represented on the two partially-completed sheets. During the preceding winter, Subassistant McClintock was in service in Section VI. He is now making arrangements to conduct a party which has been assigned to field duty in Section IX.

Topography of Penobscot River, Maine.—At Stockton, to which point the plane-table survey had been extended last year along the western side of Penobscot Bay, the work was resumed in the middle of July by Assistant C. T. Iardella. After carefully tracing the shore-line, and contouring the peninsula known as Cape Jellison, the detailed survey of the western bank of Penobscot River was carried upwards to a point opposite to Bucksport. The water-front of that town was traced on a second plane-table sheet, as was also the outline of Orphan's Island, that forms in that vicinity the eastern side of the Penobscot. Nineteen signals were set up and determined in position.

The marginal topography on the western side of the bay was made uniform with that of previous years. As shown by the contour-lines, that shore is bounded by hills that range in height from 100 to 600 feet; all being thickly wooded with pine, ash, and birch. Field-work was continued by

Assistant Iardella until the 5th of November, when he was assigned to service in Section III. Until the close of September, he was aided by Mr. W. C. Hodgkins. The following are statistics of the topography on the Penobscot:

Miles of shore-line surveyed	36
Miles of streams	15
Miles of roads	36
Area of topography (square miles)	15½

Under the head of Section IV, notice will be made of the previous work of this party.

Topography of Penobscot River at Winterport, Me.—Above the limits of the work described under the last head, Assistant F. W. Dorr made a plane-table survey of the stretch of the river included between Indian Point and Parker's Point. The resulting topographical sheet represents both banks of the Penobscot, the town of Winterport, and the usual surface-details adjacent to the shore-line. Part of Prospect River is within the limits of this survey. Field-work was begun on the 21st of July, and was continued until the 23d of October; the last month being employed by the aid, Mr. D. B. Wainwright, in filling in details of the vicinity of Frankfort, after Assistant Dorr had been detached for special duty at the Coast Survey Office.

Except in the vicinity of Winterport, the returned plane-table sheet represents only rocky and sterile ground, of which the shore-line is either steep bluff, or low, soft marsh. Several stone-quarries are shown. At many places, the flats at low water stretch out far into the river, and are mentioned by Assistant Dorr as consisting of soft mud mixed with sawdust, which the river-current brings down from the Bangor mills.

Mr. W. W. Gilbert served in this party as temporary aid. The following are statistics of the work:

Miles of shore-line surveyed	23½
Miles of creeks and marsh	23
Miles of roads	53
Area of topography (square miles)	15

Under the head of Section IV will be described the operations of the party of Assistant Dorr during the preceding winter. The aid, Mr. Wainwright, has been assigned to service in Section VI.

Portland Harbor.—The harbor-commissioners of Portland having requested advice for locating proper harbor-limits in Fore River, the details requisite for reaching a conclusion were committed to Assistants H. L. Whiting and Henry Mitchell.

While a topographical survey, made by Assistant Hull Adams, was in progress, the currents of the river and its special hydrographic features were developed. The results were combined on a map, which showed also, besides the shore-lines, the recent structures along the shores, the encroachments, and the obstructions affecting the channel.

The current-observations, upwards of 2,600 in all, recorded in July, were designed to give the curves of equal velocities at maximum ebb and at maximum flood for the entire length of Fore River, as evidently the harbor-lines to be drawn ought to preserve the scouring force. For the most part, the bottom in Fore River is very soft mud, which by any considerable encroachment on the water *actually in motion* might be moved down into the broader and more important parts of the harbor. In advance of determining the amount of tide-water passing through each of ten sections of the stream, Mr. Mitchell computed the capacity of the channel from data afforded by the hydrographic survey of 1869. Current-observations were then made simultaneously at four or more points in each of the sections, to determine the *transverse curve of velocity*, which curve was reduced to the mean by applying a co-efficient so as to make the velocities multiplied into the depths correspond with the volume previously computed from data of the hydrographic survey. After thus reducing the ten transverse curves of velocity, it was easy to draw upon the map lines for each tenth of a nautical mile of velocity, and such lines were drawn both for ebb and flood. The results proved that the water in *actual motion* does not occupy the entire section of the channel at some points, and that at others the movement is evidently impeded by artificial encroachments. Selecting one of the sections at which velocity had been so much increased as to disturb the bottom, special observations were made, and a limit in velocity was fixed beyond which it will not be safe to encroach upon the stream there or elsewhere. The full report of Assistant Mitchell will be found in the Appendix (No. 8).

In the study of proper harbor-limits for Fore River, commercial advantage, adaptation, natural features, and the character of the shore were jointly and carefully considered; and, though the limiting lines drawn and accepted by the city government of Portland are in strict accord with the limits of velocity determined by the elaborate survey of Assistant Mitchell, it is a gratification to add that they also favor the most useful occupation of the harbor-frontage for commercial purposes. Mr. J. B. Weir served as aid in the party of Assistant Mitchell.

After the close of observations in Fore River, a map and plans showing the principles according to which the limiting lines were drawn were furnished to the harbor-commissioners.

Old Orchard Beach, Maine.—In the latter part of October, Assistant Hull Adams examined the beach above and below the mouth of Little River, across which an extended dam has been built since the completion of the survey of that vicinity. The new structure has caused a considerable change in local features. In a large basin, which now exists inside of the embankment, the water, during heavy storms, stands above the level of tide, the former outflow from Little River now passing through Jones Creek. In that quarter, an embanked road has been made to pass from Blue Point and across the marshes to the ocean-beach. These and other existing features were mapped by Assistant Adams, to be filed with the former detailed survey of this part of the coast of Maine. His party is now under instructions for topographical duty in Section IV.

Triangulation—Geodetic connection—New Hampshire.—The object and resulting benefits of this and similar schemes of triangulation in other States were referred to in my last annual report. It is, therefore, only necessary to add in this connection that the State of New Hampshire, under her law of 1872, has again contributed to this important operation by paying the expense of erecting all the tertiary signals which were put up during the past season.

In accordance with my instructions of April, Prof. E. T. Quimby resumed field-work on the 1st of May and closed on the 24th of September.

The month of May was occupied in reconnaissance for the purpose of selecting additional stations for extending the triangulation. This work proved more difficult than in previous years, and a longer time was employed in it in proportion to the number of stations established. One reason for this was the fact that the reconnaissance necessarily extended over a large part of New Hampshire and a part of Vermont. The number of main stations selected during this time was ten; but many other points were visited to determine which were the most suitable for the purpose.

Towards the close of May, the party for triangulation was organized, and occupied a station on Mount Cardigan, in the town of Orange, N. H. The observations there were completed and the party was transferred to Bean Hill during the month of June. By the 15th of July, the angles at Bean Hill were measured, and the next station in order, Prospect Mount, in the town of Holderness, was occupied. The observations at this, the third, station were finished, and the moving of the party and camp to Moosilauk Mountain was accomplished by the 5th of August. This mountain is about 5,000 feet above tide. In consequence of winds and rain, the observations at the station were not concluded until the 24th of September. During the season, Professor Quimby kept an aid and one hand constantly employed in the selection of tertiary stations and in the erection of signals, the expense of which was paid by the State. The statistics of the season are as follows:

Stations occupied	4
Signals observed upon	60
Angular measurements with 24-inch theodolite	3,000
Angular measurements with vertical circle	2,200

An examination of the scheme of triangulation proposed and partly executed (Sketch No. 3) will show the progress made, and the expansive character and usefulness of the work which has been undertaken in conformity with the intentions of Congress.

On existing maps, Professor Quimby found that many mountains in New Hampshire were misplaced; the error being in some cases as much as five miles. The character of the discrepancies has been referred to elsewhere in this report, in further illustration of the necessity for determining points in the several States in advance of any considerable outlay for geological surveys.

Magnetic observations.—The three elements of declination, dip, and intensity, were observed at Eastport, Brunswick, and Portland in Maine, and at Gorham, Littleton, and Hanover in New Hampshire, in the course of September and October, by Dr. T. C. Hilgard, acting under the immediate direction of Assistant J. E. Hilgard. The observations were as usual taken on three days at each station, and include determinations of the true meridian by observations of the sun. At Eastport and Portland, the same stations have been previously occupied and will be hereafter, for ascertaining the rate of secular change. The Brunswick station established at Bowdoin College will also serve the same purpose, as observations will be made frequently by the professors.

The results of the observations here noticed, and of others in Section II, are given in Appendix No. 16.

George's Shoal.—In the course of the summer the vicinity of this shoal, off the coast of Massachusetts, was examined by the hydrographic party of Commander J. A. Howell, U. S. N., Assistant Coast Survey, in the steamer *Bache*, with a view of determining whether or not special changes in form, position, or depth had occurred since the survey of 1835. The resulting chart, in comparison with the early sheet, shows differences in the position of shoal spots, but not such as to indicate any actual change in position; and the least depth found corresponds with that of the previous survey.

Lines of deep-sea soundings were run by the party eastward from the outer edge of George's Bank. In reference to the assumed position of "Hope Bank," the existence of which was reported in 1869 as in longitude 63° 20′ W., Commander Howell says: "The result of our soundings seems to demonstrate that there is no bank having forty-nine fathoms of water within twenty miles of the position given as that of Hope Bank." Somewhat to the eastward a specimen of bottom was obtained in 1,856 fathoms. From the same vicinity lines of soundings were run to Cape Sable, and from thence southward to the latitude of George's Bank. A heavy non-detaching lead was used, with registers for determining depth, and thermometers for temperature. The last-named instruments, as between two at the same depth, varied four degrees in temperature indication, and the registers as much as 6 per cent. in indicating depth. The off-shore soundings were made during July and August.

In September the vessel, in furtherance of the general work of the Fish Commission, was engaged in dredging on Jeffrey's Bank, Cashe's Ledge, Jeffrey's Ledge, Stellwagen's Bank, and to the northward and eastward of Cape Cod, under the direction of Dr. Packard and Professor Cooke, of the Peabody Academy of Science. Many specimens of marine fauna were procured. The defective boilers of the steamer, however, lessened the service intended in dredging. On the 8th of November the vessel reached Baltimore, and, after refitting with new boilers, will be assigned to hydrographic work in the Gulf of Mexico. Under the head of Section VI, mention will be made of previous duty done by the party of Commander Howell.

Early in September the party and vessel then in service on the coast of Maine narrowly escaped disaster. Having repaired one of the boilers of the steamer, Commander Howell sailed from Portland on the 2d, and was detained at Peak's Island in consequence of another defect. Off Manhegan Island a tube blew out of the forward boiler, and both being then disabled the vessel could not move by steam. Using sail to the best advantage, in a thick fog, a position was gained judged to be within a mile of Burnt Island, when the ship was anchored, but with increase of the gale the hawser parted soon after midnight of the 5th. Fortunately for that emergency the boiler defects had been then so far repaired as to admit of the use of steam. The vessel having drifted into seventeen fathoms, steamed slowly through the dense fog and was safely brought to anchor to the leeward of Burnt Island. When the bluff was first seen through the fog, the steamer was very near it, having but six fathoms of water under the bow and sixteen and a half fathoms under the stern.

Commander Howell was ably assisted in hydrographic duty by Lieutenants W. H. Jacques, J. W. Hagenman, E. S. Jacobs, and Richard Rush, U. S. N., and by C. A. Bradbury, Master, U. S. N.

Atlantic Coast Pilot.—Final examinations preparatory to the publication of Sailing Directions for the Atlantic Coast of the United States have been continued by Assistant J. S. Bradford. His party left Baltimore on the 3d of July, in the schooner *Palinurus*, and resumed inspection in Penobscot Bay. After testing proper lines for navigating up to Bangor, a hydrographic survey was made of Weskeag River, from its mouth to South Thomaston; and the survey of Tenant's Harbor was completed to the head of Long Cove. Several very dangerous rocks in the Muscle Ridge Channel were developed by soundings, and were located upon the chart. After finishing this work the party proceeded to Boston and commenced on the second section of the work, which extends from that port to New York. Sailing directions, prepared for all the harbors between Boston and Point Judith, include the results of a thorough examination of Vineyard and Nantucket Sounds and Buzzard's Bay, with its numerous interior harbors. Narragansett Bay was also fully examined, and many additions and corrections were made to charts of harbors between the limits named. Views of harbors, and of the approaches to them, were taken from such points as seemed most likely to render the sketches of use to mariners. These will be embodied in the forthcoming edition of the Coast Pilot. The work of preparing for publication the notes of this and previous voyages has been continued by Mr. Bradford in person.

Some of the buoys in Boston Harbor having shifted, the positions of all were determined this season under my special direction by the party in the *Palinurus*. While in the vicinity of Cape Ann, Assistant Bradford made a hydrographic survey of Milk Island Bar. The result shows that the bar has seven feet of water between Milk Island and the main land. The party remained in service on the coast of New England until the 19th of November, when the *Palinurus* proceeded to Baltimore to resume work in Chesapeake Bay, where the party is now engaged. The manuscript, in the aggregate nearly fifteen hundred pages, of the first section of the Coast Pilot, which includes the Atlantic coast, from the northeastern boundary to Boston, is now ready for the printer, and will be put in hand for publication at once. It includes accuratedescriptions of the coast, and sailing directions for every harbor between Calais and Boston. Many of the harbors were never previously described, and of many on the coast of Maine, as mentioned in my report of last year, no charts as yet exist.

On the coast of New England, Assistant Bradford was efficiently aided by Mr. John R. Barker, draughtsman, whose sketches and views of the different harbors give evidence of the veracity and fine finish which characterized all his previous drawings. After completing the examination of harbors in the Chesapeake, the party of Assistant Bradford will engage in similar duty, during the winter and ensuing spring, along the southern coast and in the Gulf of Florida.

Astronomical observations.—For determining the longitude of a point near Port Jervis, N. Y., in the boundary-line between New York and New Jersey, where an observer was stationed for the purpose in May and June, Prof. Joseph Winlock, at Cambridge Observatory, conducted the requisite exchanges of clock-signals by telegraph. Under the head of Section II further mention will be made of the operations near Port Jervis.

Pendulum experiments.—Tests for determining local variations in gravitation have always been considered as essential in geodetic surveys, but have been deferred in the operations of the Coast Survey, under the hope of improvement in the methods heretofore adopted for such experiments. Of late years, however, the subject has had renewed attention; and important improvements in the apparatus have been brought into practice.

In August last, a party under the charge of Assistant C. S. Peirce occupied a station near North Adams, Mass., in the immediate vicinity of the Hoosac Tunnel, and there recorded a series of observations. The pendulums used were single pieces of brass, swung upon steel knife-edges resting upon surfaces of agate. Inside of a glass receiver with two walls, the space between which was filled with water, the pendulums were swung *in vacuo*, and were thus protected from changes of temperature. Assistant Peirce was aided in the operations by Messrs. W. E. McClintock, H. Farquhar, and A. W. Edmunds. The first-named aid made a careful topographical survey, and determined the mountain contour within a radius of two miles from the station at which the experiments were recorded.

Chatham, Cape Cod peninsula.—The coast of the peninsula near Chatham, Mass., has been recently subjected to unusual abrasion by the waves of the sea during heavy gales. In the autumn of 1871, an inlet opened through Nauset Beach, exposing the town-front to the ocean, and elevated land near the light-houses was undermined by the action of the waves. Accompanied by Rear-

Admiral Chas. H. Davis and by Messrs. H. Mitchell, and H. L. Whiting of the Coast Survey, I personally inspected the changes which had been wrought. The mere opening of an inlet was of little moment, records showing similar instances. On our southern coast, moreover, breaks through the littoral cordon occur commonly during violent storms, and there, and elsewhere, such breaks have had no physical significance. But in this case a diminution had been observed for years of the area of Nauset Beach, and apparently the protecting barrier of sand was soon to disappear. The evident wasting away at this point was considered in connection with the reported increase of obstructions at the entrance of Nantucket Sound. Mr. Mitchell was, therefore, instructed to visit the place from time to time, and to note and report the rate of alteration. Under his immediate direction several surveys have been made by Subassistant H. L. Marindin, the last in November of this year, and the results Mr. Mitchell has included in a review of the history of this part of the coast, from the visit of Champlain; in 1606, down to the present time. That review shows that between parallels 41° 39′ and 41° 42′ the beach-area was maintained from the time of Champlain down to the year 1847, although the cordon seemed to have fallen back, much diminishing the water-way between this beach and the main sand of Chatham. Champlain's map shows a wooded island of about one hundred acres, which Mr. Mitchell identified as the one marked *Ram Island* on the Coast-Survey map, where it is represented as having an area of about thirteen acres, an elevation of twenty feet, and with an inlet in front, which exposed the island to the wear of the sea. In a lapse of twenty-one years, Minot's gale and other great storms having caused changes, the second examination by the Coast Survey showed that between the parallels named the beach had lost two hundred and thirty-nine acres, and that *Ram Island* had been entirely washed away. Except the loss of this island, however, the upland suffered but little, being protected by the strip of beach, lessened to about one-half of its former area. In November, 1871, the beach began to break up. Nearly one-third of it disappeared between 1868 and 1872, and the town front, an irregular elevated drift formation, lost so much that at some points the crest-line of the bank receded one hundred feet.

During the present year, 1873, the beach has lost twenty-eight per cent. of its area, so that now there exists between the parallels before named only about one-quarter of the area found by the Coast Survey in 1847. The main land has suffered but little in the course of the year, but liability to abrasion has been considered so imminent that buildings have been moved back.

Coincident with the wasting of Nauset Beach, a rapid extension of the peninsula of Monomoy has taken place; and the bight at its extremity, popularly known as "*The Powder Hole*," has declined from a valuable harbor of refuge to a nearly-closed lagoon, accessible only to boats. Mr. Mitchell's reports show that, in a more or less fitful way, Monomoy has been gaining to the southward since 1750; but the movement between 1802 and 1853 was only thirty feet per year, while that in the short interval from 1853 to 1856 was one hundred and thirty-eight feet a year. The yearly gain during twelve years, ending with 1868, was one hundred and fifty-seven feet.

Mr. Mitchell's observations show also that Monomoy Point curves to the westward as it advances, apparently tending to form another and larger bight which may in time become a desirable anchorage for the coasting-fleet. At present, there is no refuge for vessels in this dangerous neighborhood; and as the cost of an artificial structure would be enormous, special interest attaches to this gradual movement of the sands.

The inquiries here sketched I have connected with the hydrography of the approaches to Nantucket Sound. Subassistant Granger, whose work will be referred to under the next head, was therefore directed to act under the advice of Mr. Mitchell, so that comparisons desirable for developing the physical character of this part of the coast might be made without delay.

In the Appendix, No. 9, will be found Mr. Mitchell's second report, accompanied by Mr. Marindin's sketch, which gives the shore-lines of Chatham and Nauset Beach as they existed in the years 1606, 1847, 1868, 1872, and 1873.

Hydrography, Monomoy and Nantucket Shoals, Massachusetts.—In continuation of researches commenced last season, Subassistant F. D. Granger, with his party, in the steamer *Endeavor*, started early in July from Hyannis and made an examination of the shoal near Great Point, Nantucket. A few lines of soundings proved conclusively that what was supposed to be a permanent channel with four fathoms does not exist between the shoal and the point. The depth found was about nine feet; the passage is narrow; the tide sweeps through with great velocity, and, as the locality is subject to rapid changes, the passage is very hazardous for any vessel not entirely familiar with the currents.

A careful examination this season of the broken part of Pollock Rip showed marked changes in the narrow "rips," but the depths generally correspond with the results of soundings made last year. As the sand ridges hardly exceed thirty feet in width where the depth of water is least, doubtless they shift in position in the course of one season. Mr. Granger developed a shoal in twelve feet, and several lumps having only ten feet of water, near black can-buoy No. 1.

The hydrography of this season joins with the southern limits of work done last year. East and west the soundings include Great Round Shoal and the space between it and the Handkerchief light-vessel. The hydrography was carried southward as far as Nantucket light, and in its course a large area of broken ground was developed. Subassistant Granger found on Great Round Shoal as little as five and a half feet at mean low water, and a depth of forty feet only two hundred yards to the southward. In balancing the conflicting statements made by fishermen and others, some of which represent that parts of the shoal have been seen dry at low water, it seems probable that the position of definite soundings is subject to remarkable changes from year to year.

The northern part of Stone Horse Shoal was covered by the soundings made last year. This season the outlines and curves of depth were developed. Mr. Granger says: "Since the survey of 1857, this shoal seems to have moved somewhat to the southward and westward, leaving a number of disconnected spots of ten, eleven, and fifteen feet. There has been a gradual wearing away of the northern part, and seventeen feet of water is now found where depths were only nine and ten feet. A spot of only seven feet on the northwest part was found in 1857, but in the same approximate position eleven and fourteen feet were found this year. On the southern part there has been a decrease in depth, soundings showing only nine feet in places which are marked on the old chart as having twelve and fourteen feet. About seventy-five yards south of black can-buoy No. 3 there is now a shoal spot of eighteen feet at mean low water where the depth was four fathoms in 1857."

"Within the three-fathom curve Stone Horse Shoal and Little Round Shoal are connected. The least water (five and one-half feet) was found near the southeast part, and, as at Great Round Shoal, the depth was found to drop off suddenly into deep water at the southward."

"As was noticed last year, comparatively few vessels appeared this season in the channel between Great Point Rip and Great Round Shoal, although this channel is much wider and somewhat deeper than the northern passage. Perhaps a few miles are saved by the northern channel, but, if the southern channel were marked by light-vessels and buoys, it would be preferable to the northern channel, especially for deep-draught vessels."

Mr. Granger carefully determined the position of lights and buoys which mark the Monomoy Shoals, but these are of necessity moved, and are moored in general conformity with changes in the position of the shoals.

The two bench-marks made last year at Powder Hole Wharf were destroyed by ice in the winter. Mr. Granger repeated tidal observations for mean low water, and referred the results to two bench-marks established on the shore.

The following are statistics of the hydrographic work in this quarter:

Angles measured	8,996
Miles run in sounding	715
Number of soundings	24,168

Messrs. D. C. Hanson, D. S. Wolcott, and C. A. Ives served efficiently as aids in this party. The report for the season mentions also the acceptable service rendered by Mr. H. Barrows, of the Institute of Technology, Boston, in making observations for determining the position of the Handkerchief light-ship.

The steamer *Endeavor*, after needful repairs at New York, was assigned for service with the party of Subassistant Granger, in Section VI. His work during the preceding winter and spring will be mentioned in detail under the head of Section VIII.

Tidal observations.—The excellent series of tidal and meteorological observations made at

North Haven on the Fox Islands, off the coast of Maine, have been kept up by J. G. Spaulding, a very good observer. The self-registering gauge now used here is furnished with duplicate cylinders, and with conveniences for tabulating, so that high and low waters and the hourly ordinates are read and recorded by the observer regularly. There is also a heating-apparatus for circulating warm water through the float-box to guard against freezing. This has proved a safeguard, and no tides are wanting in the registers of this station. The curve traced is very regular, and the indications have always been that the place is remarkably well suited for a permanent tidal station.

The series of tidal and meteorological observations made at the Boston navy-yard, have been continued by Mr. H. Howland. The gauge often stopped in previous winters by ice, but has been supplied with heating-apparatus similar to that used at North Haven. Last winter no tides were lost at this station from the effects of freezing, but, owing to some defects in the float and float-box, some losses occurred. This gauge is now in good order, and is working without interruptions.

The new form of tide-gauge, with duplicate cylinder, reading-box, &c., lent to the city of Providence last summer, and put in the care of J. H. Shedd, esq., engineer of the Providence Water-Works, has been furnished for running another year. The record of observations will finally be turned over to the Coast Survey, though they were primarily undertaken for the local surveys, and the working-expenses are borne by the city.

Several short series of tidal observations have been made during the season at other places in this section by hydrographic parties. These series, after being used for the adjustment of soundings, will be reduced and compared with those made at the permanent stations.

Providence Harbor, R. I.—In the latter part of August my attention was called to some proposed restrictions in regard to water-space, and to the construction, then in progress, of a wharf or pier intended to project a thousand feet into the harbor from its eastern shore. Doubtless these changes were deemed by many residents as not likely to harm the large interests concerned in the present condition of the harbor. That view, however, was questioned by some, who doubted whether such decided encroachments could leave the harbor unimpaired. This view is warranted by the almost general belief that too much caution cannot be exercised in regard to artificial structures in our harbors, and in general none are nowadays ventured upon without careful study of their probable effect upon present and prospective interests.

At my request, Assistant Whiting, in September, examined, in a general way, the limits of the changes proposed in Providence Harbor, and reported that they were such as have been by other cities invariably made the subjects of special investigation. In conformity with this view of the pending matter the mayor and harbor committee of Providence subsequently asked for such a survey, at the cost of the city, as might furnish data for an opinion in regard to the effect of the proposed alterations. The desired survey will be made as soon as practicable in the coming spring.

SECTION II.

ATLANTIC COAST AND SEA-PORTS OF CONNECTICUT, NEW YORK, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, INCLUDING BAYS AND RIVERS; AND ALSO LAKE CHAMPLAIN. (SKETCHES NOS. 4 AND 5.)

Triangulation and topography west of Point Judith, R. I.—Under the direction of Assistant A. M. Harrison, the determination of points for continuing the plane-table survey of the coast of Rhode Island, was taken up at Green Hill in the middle of June by Mr. W. H. Stearns. Westward from Green Hill, at convenient intervals, stations were occupied between it and Watch Hill, the distance being about seventeen miles. Mr. Stearns closed observations with the theodolite at Watch Hill Bay on the 12th of August, and then was assigned for similar duty in Section I.

The topographical survey was resumed by Assistant Harrison on the 7th of August at a station about half a mile west of Cross's Mills, and was pushed westward to include Charlestown Pond and Quonochontaug Pond, with the details of roads and other features found within two miles and a half of the coast line. A series of large, shallow lagoons is shown on the plane-table sheet, as separated from the ocean by a narrow strip of sand-hills rising in some instances to the height of fifty feet. Back of these ponds the land undulates with a gradual upward slope, broken here and there by a prominent hill, but merging finally, beyond the post-road, into wooded hills, difficult of delineation. The frequent occurrence on this stretch of coast of inclosed depressions upon the slopes and among the hills, as remarked before, is a marked and interesting geological feature, and special care was taken in representing them.

Assistant Harrison was aided in this section and also in Section VI, where his party passed the preceding winter, by Mr. Bion Bradbury. Field-work was closed on the coast of Rhode Island on the 4th of November, the progress of the season being, in statistics:

Miles of shore-line surveyed	62
Miles of roads surveyed	75
Miles of creeks and ponds surveyed	58
Area of topography (square miles)	20

The party of Assistant Harrison is now in effective order for resuming work for the winter on the Atlantic coast of Florida, near Mosquito Inlet.

Survey of New Haven Harbor, Conn.—Assistant R. M. Bache resumed field-work early in the spring, and in the course of the season determined by triangulation twenty-one points in the immediate vicinity of New Haven. In June, a large part of the city-front adjoining the harbor was mapped with the plane-table. Subsequently, the western shore was surveyed as low down as Oyster Point and the eastern side of the harbor to include Fair Haven. The details, on seven topographical sheets of large scale, embrace nearly eight miles of wharf and other shore-line features. Most of the outlay for this work has been defrayed by the city authorities; and one of the plane-table parties, directed by Assistant Bache, was made up entirely of members from the graduating class of the Sheffield Scientific School, who volunteered their services, without cost to the city.

During the preceding winter and spring Assistant Bache plotted the soundings and completed the sheets of his shore-line and hydrographic survey of last year. That elaborate work includes the development of every known rock or ledge in New Haven Harbor. For the use of the city and the harbo-recommission the results have been furnished in large manuscript maps, and a duplicate showing the topography and hydrography has been prepared for the archives of the legislature of Connecticut. An extension of this survey will be prosecuted in the coming season, at the expense of the city authorities. Field-work for the present season was discontinued at the end of October.

New York Harbor.—The resurvey of New York Harbor, to which some time has been devoted, under the direction of Mr. Henry Mitchell, was not, when commenced in the year 1871, intended to include the entire port and its approaches, but only certain channels, shoals, and water-fronts, where changes for the worse had been reported by the Pilot Commissioners, and which changes had been noticed also by the Chamber of Commerce. As the work advanced, however, the necessity was seen for examining all the ground covered by the published chart which was based upon the very careful survey made about fifteen years ago. Doubtless it would have been expedient to test the former soundings at an early day, if known changes in the condition of the harbor had not been actually reported.

The examination now in progress, like the preceding survey, includes physical studies, designed to show the effects of changes both natural and artificial.

My report of last year commented upon the increase of the Jersey Flats, and mentioned the fact that deposits by tidal action no longer take place in the middle of the Flats as formerly, but rest rather on the exterior slope, thereby encroaching continually upon the deep water of the main channel. Much of the shoaling, as made manifest by the survey, is artificial, and is due to the dumping of material dredged from the city slips and elsewhere; but, exclusive of this, there is evidently much deposit brought to this locality by the streams.

Since, therefore, the Flats serve no longer as a catch-basin for sediment, but merely the subordinate purpose of a tidal reservoir, there is apparently no good reason why they should not be turned to account for docks and commercial occupation, due caution being observed in regard to the exterior limit of structures. To this end it was deemed important in the survey now in progress to determine the proper outer limit of occupation. Observations were accordingly made on the currents to admit of comparison between the transverse curves of velocities and the normal sections, the principal object being to show that the line along which no abrasion now takes place would be the safe limit of a quay-line where depths would not alter after walls are built.

Observations of like character were extended by Assistant Mitchell, and under his direction by Subassistant H. L. Marindin and Mr. J. B. Weir, up the Hudson, in connection with careful soundings in order to determine how the occupied harbor-lines of New York City and Jersey City have affected the channel, and at the same time to afford means for predicting the effects which would be consequent upon the occupation of the Jersey Flats. Changes contemplated by the New York City authorities in regard to the harbor-lines drawn after careful study by the United States Advisory Council in 1857–'58 will be kept under view in the investigation now pending.

In the East River many observations were recorded for the use of the board of commissioners on Brooklyn pier lines. There, the transverse curves of velocity were carried across the river and clearly showed the ill effect of encroachments made by the two cities upon this confined arm of the sea. There, also, landmarks established by the commission of 1857–'58 had been changed under special legislative enactments, and the commission now acting has merely to modify the old limits so as to include recent encroachments, without increasing the difficulties of navigation which were induced by the change.

Two tidal-stations and one hundred and ninety-seven current-stations were occupied by the party of Mr. Mitchell. The schooners *Caswell* and *Bowditch* were used in this service from the beginning of August until the middle of October. A synopsis of the statistics of work is appended:

Observations on currents	13,501
Angles determined	1,941
Number of soundings	4,045

Observations made late in 1872 at Gowanus Bay were, soon after their completion, discussed by Assistant Mitchell. The identification of that bay as a *fiord* is the natural result of the discussion. His demonstration (Appendix No. 10) that the Middle Ground Shoal occupies the exact position due to it under the law of dynamical equilibrium, and which, though deduced from theory, is fully confirmed as a fact by observation, is of special interest. The result shows that great harm may inure to commercial interests from such variations in shore-line as tend directly to change the conditions of this dynamical equilibrium.

The detailed hydrography done this season, under the direction of Assistant Mitchell, is thus described in the report of Assistant F. F. Nes, who prosecuted soundings with a party in the steamer Arago: "After establishing a tide-gauge at Sandy Hook, erecting and determining the positions of signals, and setting range-stakes, lines of soundings were run to develop the aproning around Sandy Hook from Government wharf to the Hook Beacon, and also about a mile down the beach."

"The hydrography of New York lower bay was then commenced and was prosecuted, as the weather favored, until the 4th of September, when observations were taken up and continued until the 19th, on the currents of East River, in conjunction with parties in the schooners *Caswell* and *Bowditch*."

In the early part of October, Assistant Nes made repeated attempts to resume soundings in the lower bay, but bad weather interfered and finally on the 11th the steamer was disabled by the giving way of the crown-sheet of her boiler.

In the East River, near the foot of Nineteenth street, on the New York side, and opposite to Green Point, the British steamer *Easby* struck on a point of rock on the 1st of August. Search was made at once, under the direction of the board of pilot commissioners, and by others, but the development proved tedious, the rock being small, though within two hundred yards of the water-line. Weather and tide favoring, in the latter part of September, Assistant Nes went to the place and by a sweep of the dredging-line found the point on which the *Easby* had struck. A buoy, furnished by Commodore Trenchard of the light-house service, was placed on the rock by the party of the steamer *Arago*. Full information in regard to the danger, and a sketch showing the depth of water in its immediate vicinity, were at the same time furnished to the pilot commissioners. In East River Mr. Nes occupied seven stations at ebb and flood for determining the current. Tides were observed at four stations between Sandy Hook and the navy-yard. The soundings as made by the party were plotted and the resulting charts were forwarded to the Office.

Assistant Nes was aided in this section by Mr. E. B. Pleasants, and, during part of July, by Mr. W. B. French, who, on being assigned to another hydrographic party, was replaced by Mr. W. T. Blunt, of the Boston Institute of Technology.

The general statistics of hydrographic work done this year in the vicinity of New York are:

Miles run in sounding	280
Angles measured	2,937
Number of soundings	10,093

During the preceding winter Assistant Nes conducted a hydrographic survey in Pamlico Sound, mention of which will be made under the head of Section IV. The steamer *Arago* has been repaired, and is now on her way with the party to resume work in that section.

In connection with the physical survey of New York Harbor, it became necessary to retrace the water-front of Jersey City from Castle Point downward, so as to include the extensive structures of the New Jersey Central Railroad Company at Communipaw and the docks and quays at Hoboken. A thorough resurvey between these limits, made in November, by Assistant H. L. Whiting, shows extensive and important changes since the year 1869. Within the last four years, part of the western side of the harbor has been occupied by some of the largest commercial depots of the country.

The extension of wharves along the water-front, between Communipaw and Castle Point, was intended to be in conformity with harbor-lines established on the New Jersey side of the channel. Mr. Whiting's recent survey does not show that any special encroachments have been made on the channel-way, although the outer faces of the piers are not as true in alignment as it would be desirable or advantageous to have them. In round numbers, the area here occupied by solid filling since 1869 amounts to about three hundred acres. Thirty-four wharves, many of them extensive structures, have been built within four years, making now a linear frontage of about five miles.

Subassistant H. M. De Wees was engaged in the survey near Jersey City, under the direction of Mr. Whiting.

Of the artificial changes developed by this examination, the effects, if any, upon the general conditions under which the harbor exists, or local effects consequent upon the changes, will be the subject of discussion hereafter.

Survey of Raritan River, N. J.—This work, which had been deferred, for reasons stated in my preceding report, was taken up by Assistant F. H. Gerdes at the end of July, and was completed on the 20th of September. The survey is represented by two plane-table sheets, one of which shows the Raritan valley and river, between Sayersville and New Brunswick; the other contains details of the survey of the South River and English Creek, which are navigable branches of the Raritan. At intervals, while the field-work was in progress, the channels of the river and its principal branches were sounded, and the data thus gathered was plotted on a hydrographic sheet to which the shore-line had been transferred.

Early in October, Assistant Gerdes proceeded to the Hackensack, and revised the survey of that river between the railroad bridges, where considerable alterations had recently been made in improvements. The soundings generally were made by Subassistant C. P. Dillaway, who conducted also the plane-table work on the branches of the Raritan, under the supervision of Assistant Gerdes. Mr. W. S. Bond was attached to the party as aid. Tides were observed at eight stations while soundings were in progress. Twenty-six signals were erected by the party in the course of the season. The general statistics of the work are:

Miles of shore-line surveyed	23
Miles of roads	28
Area of topography (square miles)	10
Signals determined in position	59
Angles measured	726
Number of soundings	8,367

The party engaged in this service was discharged on the 6th of November. Assistant Gerdes then took up the computations and other office-work pertaining to the operations of his party. Subassistant Dillaway, who was employed during the preceding winter in Section IV, has been assigned to service in Section VI.

Geodetic connection.—In March last Prof. G. M. Cook, in behalf of the State geological survey of New Jersey, requested that latitude and longitude might be determined at points along the boundary established in 1774 between that State and New York, so as to facilitate the erection of additional monuments to mark the division-line. The geographical position of the eastern end of the line, on the west bank of the Hudson, was determined by Coast Survey observers several years ago, but the western terminus on Carpenter's Point, at the confluence of the Delaware with the Neversink River, was, until the present season, known only by the approximate determination of the preceding century, when the boundary was traced.

For determining the longitude of Carpenter's Point, Assistant G. W. Dean made the usual arrangements. At his request, the Western Union Telegraph Company, by its superintendent, Gen. Thomas T. Eckert, placed one of its lines at the disposal of the observers. Prof. Joseph Winlock, director of the Cambridge Observatory, co-operated by exchanging clock-signals by telegraph during six nights with Mr. Edwin Smith, who was stationed at Port Jervis, near Carpenter's Point. The clock and instrumental corrections at that station were ascertained by Mr. Smith, from one hundred and fifty-three observations on thirty-four zenith and circumpolar stars, observed on twelve nights with the 46-inch transit, C. S. No. 5.

For latitude at Port Jervis, seventy observations were recorded, using seventeen pairs of stars, on seven nights, with zenith telescope No. 2.

Azimuth was determined with transit No. 5, by one hundred and five observations upon Polaris, at lower culmination, and ninety-one upon 32 Camelopardalis, at its upper culmination, all being referred to a meridian-mark about a mile and a half from the station. The bearing of the State line was determined by careful measurement of the angle between its direction and the meridian-mark.

Much favored by good weather at this station, the desired series of observations were satisfactorily recorded between the 24th of May and the 23d of June. In these are included careful determinations of the magnetic elements. Mr. Smith observed on three days for the magnetic declination. Two needles were used in ascertaining the dip; and horizontal magnetic intensity was determined, as usual, by recording the deflections and vibrations of a suspended magnet.

Later in the season, the party of Assistant Dean was engaged in the determination of geographical points in the interior, as will be stated more in detail under the head of Section VIII.

Reconnaissance for triangulation, Hudson River to Lake Champlain.—Reconnaissance for the connection of the survey of Lake Champlain with the triangulation of the Hudson River, near Albany, was assigned to Assistant S. C. McCorkle, after the completion of service which will be mentioned under the head of Section IX.

The line from *Perry's Peak*, in Massachusetts, to *Yellow Pine*, in New York, determined in length by Assistant Blunt in 1860, was adopted as a base, and from this a scheme was laid out by Mr. McCorkle to connect the primary triangulation of the coast with the Adirondack and Green Mountain ranges, and from the height and isolated character of the peaks to be found in these ranges the scheme admits of extension to the boundary-line, or even to the Saint Lawrence River, as well as of expansion eastward and westward to provide for future necessities. The length of the lines will vary from 18 to 70 miles, and the height of the stations above tide from 700 to 4,200 feet Points for an inner or subordinate series of triangles were also selected, by means of which a connection can be effected with the triangulation and survey of Lake Champlain. The scheme extends over the valleys of the Mohawk and Upper Hudson, and includes the region about Lake George and Schroon Lake.

The report of Assistant McCorkle describes the general character of the stations or summits selected, whether wooded or bare, and the facilities now existing for reaching them. In some cases much labor will be required to clear the stations, and in others roads must be partially opened. The people of the country traversed in the reconnaissance favored the operations of the party, and the citizens of Rutland promised to open a road to Killington Peak, the highest station of the series, when a party might be ready to occupy it.

Assistant McCorkle closed observations in this section at the end of October, and is now engaged in reconnaissance for triangulation in Section VII.

Topography of Lake Champlain.—Progress has been made in the detailed survey of the shores of Lake Champlain, by a party working with two plane-tables under the direction of Assistant H. G. Ogden. The details mapped between the middle of July and the middle of October, are on four sheets, which give all the topographical features within a mile of the water-line on the west side of the lake from Bluff Point southward to Jones's Point, and including Port Kent, Port Douglass, Valcour Island, and Willsboro' Point. On the east side of the lake, below Burlington, this survey includes the details on the eastern shore of Shelburn Bay. The mouth and part of the course of Au Sable River are represented on one of the plane-table sheets, and on all the contour of surface is indicated in the usual way by curves. The general statistics are:

Miles of shore-line traced	45
Miles of roads	69
Miles of streams	19
Area of topography (square miles)	34

Earlier in the season this party was engaged in a survey which will be mentioned in detail under the head of Section VI. Assistant Ogden has resumed field-work there, and Subassistant Andrew Braid, who aided him in work on the shores of Lake Champlain, has commenced hydrographic service with a party in Tampa Bay, Florida.

Hydrography of Lake Champlain.—Assistant Charles Junken reached Alburg, Vt., on the 12th of July, and, favored by the season, prosecuted soundings in the northeast arm of Lake Champlain until the 24th of September, when the hydrography was completed as far as the United States boundary-line. The part sounded includes McQuam Bay and Alburg Passage from the north end of Butler's Island, and also the lower end of Missisquoi Bay. Below Butler's Island the waters of the lake had been sounded in previous seasons as far to the southward as the Four Brothers. At that limit the work was resumed this season by Subassistant L. B. Wright, who extended the hydrography to the vicinity of Crown Point, essentially completing the lake hydrography. The narrow channel south of Crown Point will be developed in another season.

During the temporary absence of Assistant Junken, for service in another part of the section, the operations of his party were conducted by the aid, Mr. F. W. Ring. Subassistant Wright used the steamer *Fathomer*, and was aided by Messrs. E. H. Wyville and W. B. French. The previous occupation of Mr. Wright will be mentioned under the head of Section IX, in which quarter he is now preparing to resume work for the coming winter and spring. A synopsis of statistics returned by the two sounding-parties on Lake Champlain, shows:

Miles run in sounding	1,256
Angles measured	10,466
Number of soundings	52,517

After completing the records pertaining to the hydrography of Lake Champlain, Mr. Junken entered upon duty as draughtsman, at the Office.

Magnetic Observations.—The stations at Burlington and Rutland, in Vermont, and at Sandy Hook and in Central Park, in New York, where magnetic observations had previously been made, were re-occupied in October and November last, by Dr. T. C. Hilgard, acting under the immediate direction of Assistant J. E. Hilgard. Magnetic declination, dip, and intensity, were determined at each station by observations made on three or more days. Observations for azimuth by the sun were also made. The results are given in Appendix No. 16.

Tidal observations.—The self-registering series at Governor's Island, in New York Harbor, has been continued as usual by Mr. R. T. Bassett, an experienced observer. He also makes, as heretofore, occasional day observations, for comparison, with a box-gauge at Hamilton Avenue ferry, Brooklyn. The observations at New York, as stated in previous reports, are the bases for surveys around and near the harbor, relating to docks, bridges, tunnels, dikes, and other structures, and it is, therefore, desirable that all prospective requirements for such important uses should be fully met.

Another permanent station, at or near Sandy Hook, would be advantageous for perfecting the tidal survey of the waters connected with New York Harbor, and the establishment of a self-registering gauge for that purpose is under consideration.

Survey of Fire-Island Inlet and Great South Bay, Long Island, New York.—For developing the marked changes which have been caused in this quarter by the action of the sea, Assistant Charles Hosmer was detailed with a party, in June, to trace the shore-lines, and in general to determine the alterations in contour and depth at Fire-Island Inlet and in Great South Bay. Field operations were commenced early in July. The triangulation needful for the shore-line survey rests upon two stations of the survey made some years ago, and points determined by Mr. Hosmer and his aid, Mr. R. B. Palfrey, suffice for including about fifteen miles east and west of Great South Bay. Its north shore and indentations were surveyed from Conklin Point to a station about eleven miles eastward. The topography includes, also, seven miles of the western part of Fire Island, both sides of Fire-Island Inlet, and the islands in its vicinity. The inlet was sounded, and the body of the bay adjacent from Nicoll's Point westward to Conklin Point. This survey rests upon thirty-seven points, which were determined by occupying seventeen stations with the theodolite. The plane-table and hydrographic statistics are:

Miles of shore-line, including creeks	95
Miles of roads	49
Area of topography (*square miles*)	15½
Miles run in sounding	234
Angles measured	1,465
Casts of the lead	38,322

Assistant Hosmer discharged his party in this section at the end of October, and then resumed duty in Section V, where he had been engaged in the preceding winter, as will be mentioned in detail hereafter.

Station-marks.—The periodic inspection of station-marks of the coast triangulation at important localities, with a view to their preservation for future uses, has been continued by Assistant John Farley.

In the course of the summer, the stations *Bloomfield*, in New Jersey; *Terry* and *Montauk*, on Long Island, and those on *Shelter Island* and *Gardiner's Island*, were identified, and new marks, measurements, and descriptions were made for their further security. The stations at *Horton's Point, Mattituck*, and *Friar's Head*, on the south shore of the sound, having been located on the summits of sand-hills, in order to obtain the elevation needful for observing across the sound with the theodolite, are lost, except for ordinary local surveys. The sand-dunes have moved on gradually to the west and south, in the direction of the prevailing high winds, and the points which were occupied by the theodolite now correspond in place with the foot of the hills or dunes, but no marks are left to show the exact positions of the stations.

During the last thirty-five years, the sand-dunes on Long Island have moved at the rate of between one and two feet per annum. Of the station at *Friar's Head*, Mr. Farley reports that "the crest of the hill for the space of several acres has been blown away by winds to the depth of 30 or 40 feet, leaving an immense chasm, and destroying, consequently, every trace of the original aspect of the place."

Triangulation near Barnegat Light-house, N. J.—The object of this work has been stated in previous reports. Being nearly in the meridian of Hudson River, which is traversed by a careful triangulation as far north as Troy, and not far from the chain of primary triangles which passes through the valley of the Delaware, Barnegat has been brought into geodetic connection with the latter, so as to furnish data for determining the exact length of a considerable arc of the meridian. Subassistant F. W. Perkins took the field early in July, and in the course of the season occupied five stations. At these, by the measurement of horizontal angles, the detailed survey of the coast of New Jersey was finally connected with the main triangulation, which of necessity in this section passes southward at some distance from the sea.

Mr. J. F. Pratt served efficiently as aid in this party until the 1st of September, but, being then taken seriously ill, he was replaced by Mr. F. W. Ring.

The length of the triangle sides determined by the party varies from ten to twenty miles. Eight points were determined by angular measurements, of which the aggregate in the records is upward of two thousand. Subassistant Perkins had been previously engaged in work of which mention will be made under the head of Section VII. He is now on the way to resume duty on the Gulf coast.

Topography between Barnegat Light-House and Manahawken, N. J.—Early in July, Assistant C. M. Bache resumed field-service in this section, having been at the outset of the year engaged in duty which will be mentioned under the head of Section IV.

After tracing the coast-line to a point about eleven miles below Barnegat Light, Assistant Bache mapped the interior shore-line, the opposite side of the bay and inland, the details generally as far as the road which runs parallel with the coast between Barnegat and Manahawken. This service occupied the main party until the 25th of October. A detached party meanwhile was engaged on the shores of Mullica River with a plane-table in charge of Subassistant H. M. De Wees. The survey of that stream was resumed at the mouth of Bass River, to which the former plane-table work was carried by Assistant Bache, and was extended upward to Green Bank. Mr. De Wees included also the vicinity of Port Republic, and all the ground adjacent to the navigable part of Mullica River, which, within the limits of his survey, has a depth of about seven feet.

Subassistant H. W. Bache was attached to the party, and worked between Manahawken and Barnegat. The statistics of this season in the section are:

Miles of shore-line surveyed	210
Miles of roads	102
Area of topography (square miles)	70½

This party was employed during the preceding winter in duty which will be described under the head of Section IV. Assistant Bache is now preparing to take the field for service in Section III.

Hydrography of Little Egg Harbor, N. J.—The development of Little Egg Harbor by soundings was resumed in the middle of July, by a party under the charge of Subassistant W. J. Vinal, with the schooner *Bailey*. At all favorable intervals of weather work was steadily prosecuted until the 5th of November, at which date the detailed hydrography had been extended northward and eastward from Little Egg Harbor entrance to within a few miles of Barnegat. Further progress in that direction being impracticable, by reason of the severity of the weather, the work was discontinued for the season, it being evident that the outstanding hydrography could be more readily completed by passing the vessel through Barnegat Inlet in a future season. The work done by the party is continuous with that reported last year. A summary of the additional hydrography is appended:

Miles run in sounding	510
Angles measured	3,537
Casts of the lead	67,270

Mr. J. J. Evans served as aid in this party, and Mr. G. A. Morrison was detailed from the Office for temporary duty while the soundings were in progress. Thirty-six signals were erected by the party, and a large number of objects were determined in position, to insure accuracy in plotting the soundings.

The previous service of this party will be mentioned under the head of Section V, to which Subassistant Vinal is about to return for hydrographic duty, which will occupy his party during the present winter and ensuing spring.

Hydrography at New Castle, Del.—By means of large ice-breaking steamers, maintained by the General Government, the harbor of New Castle has in former years afforded refuge to vessels that would otherwise have been cut through in the waters of the Delaware by floating ice. Of late years, however, the shoaling of the harbor has made the use of the full complement of ice-breakers impracticable. The depth of fifteen feet between the wharves at Harmony street and Delaware street in the year 1828, was represented by only six feet in 1841, and the same place is now bare at low water.

Late in May, when the town authorities had under consideration the extension of quays into deeper water, the aid of the Coast Survey was requested, for determining such limit and direction in wharf-lines as might best preserve the depth required by shipping at New Castle.

Assistant Charles Junken, under my direction, in June, traced the shore-line of the Delaware River, adjacent to the town, and made upwards of three thousand soundings. These were plotted at once, and a copy of the resulting chart was furnished to the authorities.

In August, Assistant Henry Mitchell, accompanied by Mr. Junken, visited New Castle and made careful observation with reference to the proper limit in wharfage. The results, in the form of a chart showing the desired wharf-line, and a report descriptive of the conditions held in view in its selection, were transmitted, early in September, to John H. Rodney, esq., chairman of the town commissioners.

Through the courtesy of Colonel Kurtz, of the United States Engineers, who had charge of Government works in the Delaware, Messrs. Mitchell and Junken were furnished with manuscript charts showing the condition of New Castle Harbor in the year 1805, in 1827, in 1837, and in 1852. These, with the two Coast Survey charts of the harbor, gave a good physical history of the place for a period of nearly seventy years.

The first piers, built in 1805, now lie within the occupied frontage of the town. The extension in 1827, of *Elbow pier* and *Junction pier* outward from the wharf-front proving injurious, parts of them were removed by the Government officers in 1835, since which time, although the water again deepened, the original depth has not been regained. Piers subsequently built on the plan introduced by Major Delafield, in 1837, and intended to secure protection without creating any shoals, will, when the system is complete, give a harbor of refuge, with ample depth for shipping, at New Castle. In recent years, however, the decrease in depth of water was plainly due to the erection of a coal-wharf 690 feet long, which projects far out into the stream. The structure, by throwing the water-front and part of the harbor into the dead angle of waves and currents, moved the low-water line, at an average, fifty feet further from the town, and at one place, as much as two hundred and fifty feet, at the same time decreasing the depth at many points by five feet; and at some the consequent decrease in depth was found to be as much as eight feet. The effect of the coal-wharf was to disturb the equilibrium of the ebb and flood currents which traversed the marginal flats of this part of the Delaware River, but the wharf served also to catch all mud which the natural interchange of currents set in motion.

Careful examination proved, however, that the wharf might have extended 400 feet from the shore, without producing the injury which was caused by making it 690 feet long; and that the removal now of 290 feet from the outer end of the wharf would not, all of it, be of equal value in the restoration of the former good depth of water. A quay-line was therefore recommended restricting the extension of ordinary wharves, and suggesting the removal of 160 feet of the outer extremity of the coal-wharf.

Shore-line survey of Schuylkill River, Pennsylvania.—After closing work for the season on the shores of Lake Champlain, and before proceeding to Section VI, where his party is now engaged, Assistant H. G. Ogden traced the shore-lines of the Schuylkill River from its mouth, at League Island, and upward as far as Fairmount, at Philadelphia. Mr. R. B. Palfrey aided in this survey. The stretch of river is represented on two sheets, which show an aggregate of nearly nine miles of wharf-line in a total shore-line of about thirty-one miles. In general the levee-lines were taken as the water-limits, Mr. Ogden observing that the grass at high tide was in water, at some places, several feet deep.

This work was closed on the 27th of November. After sending the results to the Office, Assistant Ogden proceeded to Section VI. Mr. Palfrey, at the same time, joined a field party in Section IV.

SECTION III.

ATLANTIC COAST AND BAYS OF MARYLAND AND VIRGINIA, INCLUDING SEA-PORTS AND RIVERS.

(SKETCH No. 6.)

Triangulation, Hampton Roads, and vicinity, Virginia.—The position of the light-house on Thimble Shoals, inside of Chesapeake entrance, and of others built on the Elizabeth River subsequent to the original survey of the approaches to Norfolk, not having been determined, Assistant J. W. Donn was directed to connect the light-houses on Thimble Shoal, Craney Island, Lambert Point, and that at the naval hospital with the triangulation executed in previous years. This duty was in progress at the date of my last annual report. The work consisted in measuring a number of preliminary triangles starting from bases supplied by the old triangulation.

Stations occupied	10
Angles measured	320

In the report of Assistant Donn it is mentioned that the points determined, in addition to the light-houses, were in such positions as to be of service to the hydrographic party of Acting Master Platt, U. S. N., who was then engaged in sounding the waters of Elizabeth River.

Shore-line survey of Elizabeth River, Virginia.—After determining points in the vicinity with the theodolite, Assistant Donn made a shore-line survey of the Elizabeth River and its principal branches. With a separate plane-table party, the aid, Mr. F. C. Donn, mapped the eastern branch and Tanner's Creek, while work was in progress by the main party on the southern and western tributaries. Assistant Donn traced anew the entire water-front of the cities of Norfolk and Portsmouth, and as the shore-line survey advanced, furnished points for the hydrography. The shore-line survey was completed by the 20th of February, when the party took up work on the James River. This winter a party will be detailed to fill in the topographical details for the chart of Elizabeth River. Assistant Donn and his aid traced 138 miles of shore-line and mapped six square miles of area.

Hydrography of Elizabeth River, Virginia.—For this work Acting Master Robert Platt, U. S. N., Assistant Coast Survey, with his party in the steamer *Bibb*, put up signals in September, 1872, and determined positions sufficient for the adjustment of soundings made in the following month. Subsequently other points and the entire shore-line were supplied by Assistant Donn, as already stated. Of two hydrographic sheets projected by Acting Master Platt to join at the naval hospital, one on a large scale represents Norfolk Harbor, including the navy-yard. The other sheet takes in the channel between the naval hospital and Sewall's Point. Additional sheets, filled in the course of the spring and summer, represent the branches and tributaries of Elizabeth River. The chart of soundings with accurate shore-line is now complete, leaving the topographical details adjacent to the water-line to be mapped by a party which is now on the way for that service.

Mr. J. B. Adamson served as aid in the hydrographic party.

As stated in my report of last year this service was assigned to Acting Master Platt because the steamer *Bibb* was no longer available for duty in off-shore soundings. That officer has transferred his party to the steamer *A. D. Bache*, and will be engaged during the present winter in developing the hydrography of the Gulf coast in Section VI.

The statistics of work in the hydrography of Elizabeth River are:

Miles run in sounding	638
Angles measured	5,769
Number of soundings	51,101

Topography and hydrography of James River, Virginia.—In March, Assistant Donn resumed the detailed survey of the James River, with a party in the schooner *Scoresby*. Field-work was joined at Warwick River, (Sketch No. 6,) to which point the survey had been advanced in the previous year. After completing the plane-table and hydrographic details about Warwick River, the work has continued through Burwell's Bay and up to Jamestown Island. All the tidal estuaries of the main river are included in this survey, as well as the usual margin of topography and careful soundings. In two seasons, the last closing at the end of May, Assistant Donn has advanced the final survey of the James River a distance of thirty-five miles above Newport News.

The following statistics pertain to the operations of the present season:

Miles of shore-line surveyed	110
Miles of roads	119
Miles of streams, not tidal	65
Area of topography (square miles)	60
Miles run in sounding	474
Angles measured	3,250
Number of soundings	23,143

Mr. Donn noticed that in consequence of some changes, probably unusual in the condition of James River during winter, all the buoys from point of Shoal light-house to Swan Point had been forced out of their positions.

During the summer this party was engaged in Section I, and is now about to resume field-work at Jamestown Island. Mr. F. C. Donn served as aid acceptably throughout the year.

Tidal observations.—At Fortress Monroe, the self-registering gauge, which had been removed from its old position, on account of the destruction of the wharf, and placed in a new building of the Quartermaster's Department, in accordance with General Barry's orders, worked badly on account of the frequent stoppages of its pendulum-clock by the jars of steamers in striking the wharf. It was therefore deemed best to substitute a gauge of the new form, furnished with duplicate cylinder, reading apparatus, &c., and having a clock with a balance instead of pendulum. This has been working only a short time, but seems to promise well for preserving the series of observations at this important station.

Atlantic Coast Pilot.—The work of compiling sailing-directions for the Atlantic coast, and their verification, was continued during the season by Assistant J. S. Bradford. In the schooner Palinurus he proceeded, in November, 1872, to examine Chesapeake Bay and its tributary rivers. The unusual severity of the winter very much retarded the progress of the work, the vessel being at one time held fast by ice in the harbor of Norfolk. Good progress was, however, made, and final sailing-directions have been prepared for the bay itself, and for entering the Elizabeth, Nansemond, James, York, Piankatank, Rappahannock, Potomac, West, South, Severn, and Magothy Rivers, on the west side of the bay. On the east side of the bay, the examinations include Tangier and Pocomoke Sounds, and the Annemessex, Manokin, Wicomico, Nanticoke, Little Choptank, Sassafras, and Elk Rivers. Sailing-directions for all the channels of the Patapsco up to Baltimore were also prepared.

In addition to this work, Mr. Bradford made complete surveys of Cherry-stone Inlet, and Old Plantation Creek, connecting the survey of these streams with that of the adjacent shores of the bay, and developing important changes in the channels, caused by the washing away of the Chesapeake shores in that vicinity. Work was closed for the season about the middle of June. On the 3d of July the Palinurus left Baltimore for service on the coast of Maine, mention of which has been made under the head of Section I.

Magnetic observations.—The series of observations made yearly, since 1866, for determining the magnetic declination, dip, and horizontal intensity at the station on Capitol Hill, was repeated in June of the present year by Assistant Charles A. Schott, chief of the computing division in the Coast Survey Office. Some years having elapsed since local observations were discussed, Mr. Schott renewed investigation with a view of developing the secular changes by including data not attainable until now, and even now not as far advanced in the series as could be desired. The results show that the magnetic declination in the District of Columbia will probably continue to increase for some years. Local disturbances there are known to be considerable.

Reconnaissance for triangulation in Maryland, West Virginia, and Pennsylvania.—In pursuance of instructions, Assistant A. T. Mosman, after completing the astronomical work assigned to him in Section IV, proceeded to Winchester, Va., and resumed reconnaissance for the geodetic connection where it was suspended in November, 1872. He was employed on this duty during June and July, and from September 3 to November 8. The month of August was passed in Section VII in assisting in the remeasurement of the Atlanta Base, under the charge of Assistant C. O. Boutelle.

The reconnaissance extended over the country lying between Cumberland, Oakland, and

Cheat River on the south, and Bedford and Hillsborough, Pa., to the north. Toward the close of the season a partial reconnaissance was made to the ridges, and facilities for carrying on the work from Hillsborough to the Ohio River. The scheme so far laid out extends from Harper's Ferry to the vicinity of Waynesborough, Pa., and consists mainly of quadrilaterals, the lines varying in length from fifteen to sixty-five miles. It was intended that the scheme should follow the thirty-ninth parallel, but, although the mountain-ranges on that line are somewhat the highest, the examination of the previous season showed that the restriction was impracticable. In consequence the scheme was laid out between the thirty-ninth and fortieth parallels, and has been continued to the westward within those limits. Assistant Mosman spent June and July in a thorough examination of the mountains between Cumberland, Md., and Bedford, Pa., on the east, and of those between Morgantown, in West Virginia, and Mount Pleasant, Pa., on the west. This region is unfavorable for long lines of sight, the mountain-chains being only four or five miles apart, all, moreover, running nearly parallel in a northeast and southwest direction, with no prominent peaks, and all are heavily wooded on their summits.

On the return of Assistant Mosman from Georgia, the country, as far south as Oakland, was examined in the hope of finding longer lines and better-shaped triangles by bending the chain more to the southward. The tract around Oakland, and westward to the Cheat River, was found utterly impracticable for the triangulation, for although very high, Oakland being 2,700 feet above the sea, it is a glade country filled with mountains of moderate elevation, and all heavily wooded. No prominent peaks there afford a view, in any direction, of more than ten or fifteen miles.

A reconnaissance was also made of the Laurel Mountains, north of the Cheat River, the most westerly range of the Alleghanies, but with no success, except so far as to make available the gap where the Youghiogeny breaks through the range, for connecting Ragged Mountain with the hills in the valley of the Monongahela.

Between the western line of the scheme reported and the Ohio River the country is one vast plateau, in which the streams have cut deep channels, so that the range of hills are nearly of the same height, and consequently are very unfavorable for long lines, in triangulation.

Assistant Mosman found the work very laborious. The only means of transportation was by wagon and horseback over a region which had few roads and most of them rough, and in which many of the summits were heavily wooded, so that, to avoid the expense of cutting lines of sight, the view and the approximate angles could only be obtained by climbing trees. His previous occupation will be stated under the head of Section IV.

SECTION IV.

ATLANTIC COAST AND SOUNDS OF NORTH CAROLINA, INCLUDING SEAPORTS AND RIVERS. (SKETCH No. 7.)

Latitude and magnetic elements.—At the end of March, Assistant A. T. Mosman commenced a series of observations for latitude, at a station near the north end of Knott's Island, Va. Owing to the prevalence of cloudy weather, the series desired was not completed until the 21st of April, when the party returned to Norfolk and was transferred to the mountain region for reconnaissance, as stated under the head of Section III.

The magnetic elements were determined at Knott's Island while observations for latitude were in progress. The records and field computations pertaining to this work were received at the office early in May. Ten nights were employed for the determination of latitude, and the usual number in ascertaining the magnetic declination, dip, and intensity. Similar observations were recorded by Mr. Mosman at another station in this section, as will be stated presently, and also at a station in Section V.

Triangulation, Currituck Sound, Virginia and North Carolina.—In view of the importance of the connection between the primary triangulation of the Chesapeake Bay and the Bodies' Island Base, constituting a part of the arc of the meridian from Principio to Ocracoke light-house, it was deemed advisable to continue the scheme of verification commenced by Assistant Richard D. Cutts in 1869 and described in my report for that year. Accordingly, instructions were issued to Assistant R. E. Halter to take up the work where it was left off and to obtain another comparison of distance and direction farther to the southward.

Assistant Halter reached Norfolk and organized his party early in January, but owing to ice and bad weather did not get into camp and fairly ready for work until the latter part of the month. Starting from the triangle side, *Coffee Point–Three Sisters*, shown on Sketch No. 9, the triangulation was extended down the sound, by a series of quadrilaterals, to Thoroughfare Station, where second junction was effected with the old work. The results of the comparisons were entirely satisfactory.

The progress of the work was greatly interfered with, throughout February, by the unusually cold and stormy character of the weather. The operation was completed and the party broken up by the middle of July. The following are the statistics of the work:

Signals erected	14
Stations occupied	11
Angular measurements	3,978

Assistant Halter was aided in the field by Mr. C. L. Gardner, who erected nearly all the signals and duplicated the records.

During the winter and ensuing spring, this party will be engaged on the shores of Pamplico Sound.

Hatteras Shoals.—On a shoal spot, the existence of which was generally unknown until it was developed by Acting Master Robert Platt, Assistant Coast Survey, in his thorough survey of the dangers to navigation in passing Cape Hatteras, the steamship *General Sedgwick* struck, in March last, while on a voyage to New Orleans. The official notice of the accident was accompanied with notes of the estimated position of the vessel, consistent with the supposition that the lump in question had not been traversed by either of the many sounding-lines run by the party of Acting Master Platt. In consequ n the steamer *Endeavor* was temporarily assigned to his command, and, with that vessel, in May, he subjected his previous soundings to the severest test in the reported vicinity of the shoal. An observer with a theodolite was sent to Cape Hatteras light-house, and flags were placed at the outer slough buoys, both of which, having somewhat shifted, were carefully determined in position. The *Endeavor*, then moving into the supposed position of the shoal lump on which the *General Sedgwick* had struck, found eleven and twelve fathoms. At the same time an observer, stationed by Acting Master Platt at the mast-head, had in view that small shoal and other spots of broken ground known by developments in the previous survey. The result of this examination is gratifying, as it fully confirms the confidence felt in accepting as final the chart completed last year by Acting Master Platt to show the dangers in the vicinity of the Hatteras Shoals.

Latitude.—Observations for determining latitude were repeated by Assistant Mosman at two stations on Portsmouth Island, N. C., between the middle of February and the middle of March. The stations are distant from each other rather more than half a mile, and both are connected with the base line of the triangulation of Pamplico Sound. Eight nights were employed by the party at one station and six nights at the other, with the zenith telescope No. 2. The micrometer value was carefully determined in the usual way.

Mr. Mosman had been previously engaged in astronomical duty, as will be stated under the head of Section V.

Triangulation of Pamplico Sound, North Carolina.—The triangulation of Pamplico Sound has been continued without intermission since the date of my last annual report. In pursuance of instructions, Assistant G. A. Fairfield organized his party early in December, 1872, and remained in the field during the summer and fall months. He is still at work, and will prosecute the triangulation during the coming winter and spring. This course was deemed advisable in order to avoid loss by using, as soon as possible after their construction, the high tripods and signals erected for observing across the sound. With a single exception, the party has so far escaped sickness.

The progress of the work was considerably delayed by the difficulty in obtaining lumber, and the coal required for the steamer *Hitchcock*, which is in service for the transportation and accommodation of the party, and by the long distances which it was necessary to run for coal and provisions.

Four sets of primary tripods and scaffolds were erected, one at each of the stations of Hog

Island, Egg Shoal, Gulf Island, and Long Shoal Point, ranging in height from 51 to 59 feet. On each of these tripods high poles were set up and secured, to be observed upon as signals. The tin cone on the top of the pole at Long Shoal Point was 111 feet above the ground. At Hog Island the pole was a hollow tin tube, secured by three sets of wire guys. This stood until June 17, when a very violent squall crushed the tube and the pole fell. Iron pipe was thereafter substituted for the tin tubes, and so far with entire success. The structures at the stations are believed to be now so firmly erected as to be able to withstand the most violent gales to which the sound is subject. It will be readily understood that on the character and permanency of the high tripods, scaffolds and signals much depends in the triangulation of so wide an expanse of water as Pamplico Sound, the shores of which are rarely more than two or three feet above high-water mark. Several of the triangle sides exceed twenty miles in length.

The observations at the primary stations, *Swan Quarter*, *Royal Shoal*, and *Ocracoke light-house*, have been completed, and those required at Egg Shoal nearly so.

The secondary triangulation as far eastward as *Bluff Point* has been finished. In the execution of this work tripods and scaffolds were erected to enable the observer to overlook the high grass of the marshes over which the lines passed.

Assistant Fairfield mentions with commendation the services rendered by his two aids, Messrs. B. A. Colonna and W. B. Fairfield. The former erected all the tripods, and during the temporary absence of Mr. Fairfield in June, occupied Bluff Point and made part of the observations needed at Swan Quarter and Royal Shoal Stations. The statistics for the year are as follows:

Signals erected	19
Stations occupied	10
Angles measured	78
Points determined	16
Single observations	3,470

Topography of the Pungo River, North Carolina.—On the 12th of December, 1872, Assistant F. W. Dorr again took charge of the *Hetzel*, a worn-out steamer, which, as a hulk, has been some time used for quarters in the field operations of this section. His plane-table party was organized at Washington, N. C., and started for Pungo River, in the old vessel, on the 6th of January, the excessive cold of the preceding month having frozen the Pamplico from shore to shore. Head winds and storms kept the *Hetzel* a week on her short passage, but by the middle of January the survey was resumed in the upper part of Pungo River. Assistant Dorr had previously mapped the shores of the river as high up as the mouth of Pungo Creek and Duran's Point. From those points, in going northward, he traced the shore-lines of the large, branching tributaries known as Pungo Creek and Pantego Creek, and many smaller streams. The numerous roads which traverse the vicinity, and all natural features near the shores of the Pungo, were included in the survey. A summary of statistics on the plane-table sheet shows:

Miles of shore-line surveyed	138
Miles of streams	209
Miles of roads	202
Area, including river (square miles)	110

Assistant Dorr was efficiently aided in this work by Mr. W. E. McClintock. Under the head of Section I, mention has been made of the subsequent operations of the party.

The survey of the Pungo River was completed at the end of April. Early in May the revenue-cutter *Stevens*, Capt. C. A. Abbey, to whom the survey is indebted for many acts of courtesy and assistance, took the *Hetzel* in tow, and, as desired, left the hulk at Edenton, where it will be available for the use of a party in the survey of Chowan River during the present winter. Before leaving the section in May, Mr. Dorr made a reconnaissance of the lower part of that river in order to facilitate the prospective operations.

Hydrography of Pamplico Sound, North Carolina.—With the steamer *Arago*, the party of Assistant F. F. Nes started on the 7th of December, 1872, to resume the hydrography of Pamplico Sound, but, in passing from Baltimore southward, by the line of inland navigation, the vessel was frozen up in Currituck Sound. Continued severity of weather in January opposed the expected progress, but signals were set up and determined in position, and soundings were resumed by the middle of that month. The work done is contained on three hydrographic sheets, one of which develops the waters of Croatan Sound as far up as Croatan Light. Another shows the hydrography of the lower part of Roanoke Sound. On the third sheet the hydrography of Pamplico Sound was continued from Long Shoal Light, northward, to a junction with soundings made and plotted on the two preceding sheets

In reference to Croatan Sound, Assistant Nes reports: "I found that off Pork Point there was a hulk near the channel, in nine feet water, with less than three feet on the hulk; and that others, seven in all, filled with stone and sunk during the war, remain as they were then placed. On these the depth of water is now from two and a half to seven feet. The positions of all were accurately determined, and soundings on and around them were carefully made and recorded."

Finding noticeable changes in the vicinity of the Roanoke Marshes, Mr. Nes erected signals and carefully traced the shore-lines. Jackson Island, formerly known, has been entirely washed away.

Subassistant C. P. Dillaway was attached to this party, and Mr. E. B. Pleasant served as aid.

All the buoys, twelve in number, within the working limits, were determined in position and marked on the chart. The tides were recorded at three stations between the middle of December and the middle of May. Other statistics of the work include:

Miles run in sounding	822
Angles measured	5,304
Number of soundings	46,785

Assistant Nes was employed in Section II, during the summer, but is again engaged in prosecuting the hydrography of Pamplico Sound.

Topography of Core Sound, North Carolina.—For the detailed survey of the shores of Core Sound, Assistant C. T. Iardella took the field on the 13th of January. After identifying two points which had been determined in the triangulation of the lower part of Pamplico Sound, Mr. Iardella commenced operations at Cedar Island, (Sketch No. 7,) and extended the triangulation southward and westward through Core Sound, as far as Bell's Point, on the lower side of Jarrett's Bay. In this preliminary work, eleven stations were occupied with the theodolite. At intervals, as changes of weather permitted, during a very inclement season, the plane-table survey was prosecuted within the limits of the triangulation. This work includes both shores of Core Sound, and on the inner side defines the entrances to Thoroughfare Bay, Nelson's Bay, Brett's Bay, and Jarrett's Bay. The plane-table sheet joins with one which was also filled this season by Assistant C. M. Bache, and to which further reference will be made presently. Assistant Iardella was aided by Mr. W. C. Hodgkins. His party used the schooner *Dana.*

At Cedar Inlet, about two miles from the anchorage of the *Dana*, the Italian barque *Lorenzo Valerio* went ashore in a heavy northeast storm, on the 30th of April. Mr. Iardella immediately started for the place and found that the captain and crew were in imminent peril. The sailing-master of the *Dana*, Mr. John F. Abbott, at the risk of his own life, boarded the Italian vessel from shore in a small boat, though it was several times upset in passing through the breakers, and, after laboring several hours, brought ashore a raft with water, provisions, and sails for the shelter of the captain and crew, who were safely landed toward evening. Next day, by direction of Assistant Iardella, the sailing-master took the boat of the *Dana* and landed the captain and his mate at Beaufort, where arrangements were made for floating the vessel. The statistics of work done by this party on the shores of Core Sound are:

Miles of shore-line surveyed	60
Miles of streams	20
Miles of roads	41
Area (square miles)	48

The working-season at the north was passed by Mr. Iardella in service which has been noticed under the head of Section I. During the winter he will be engaged in filling in the topography of the shores of Pamplico Sound, in Section IV.

From the southern limits reached by Mr. Iardella, the survey of Core Sound was extended toward Beaufort, by Assistant C. M. Bache, the topography being carefully joined with the work of this season as well as with the previous survey of Beaufort Harbor. Subassistants H. M. De Wees and H. W. Bache were attached to this party, and assisted also in its operations, later in the year, in Section II. The plane-table survey of Core Sound was closed on the 1st of June. The following is a synopsis of statistics from the report of Assistant Bache:

Miles of shore-line surveyed	127½
Miles of roads	117
Area (square miles)	59

The party of Assistant Bache is now engaged in a detailed plane-table survey in Section III.

SECTION V.

ATLANTIC COAST AND SEA-WATER CHANNELS OF SOUTH CAROLINA AND GEORGIA, INCLUDING SOUNDS, HARBORS, AND RIVERS. (SKETCH No. 8.)

Hydrography of Cape Fear River, North Carolina.—In continuation of his previous work at the Cape Fear entrances, Subassistant W. I. Vinal was directed, in November, 1872, to organize a party for service in the schooner *Bailey*, and to develop the channels of Cape Fear River as far up as Wilmington. Signals were put up in the latter part of the following month, but the unusual severity of the weather during last winter much retarded the progress of operations. The work done at favorable intervals, closing at the end of May, was returned to the Office on five sheets, which represent, besides the depths of water in the course of the river, the numerous artificial obstructions, such as ballast-rocks, rows of heavy piling bare only at low water, railroad iron, and other impediments intended to obstruct the ordinary channel during the war. Advantage was taken by Mr. Vinal of the presence of these obstacles. Signals were set on them for the measurement of angles needful in plotting the soundings.

Toward the close of the working season in the section a resurvey was made of the *Seward* channel, showing that its direction had changed considerably since April, 1872. At the request of the officers of the Engineer Corps United States Army, engaged in constructions for maintaining the channels near Cape Fear, Subassistant Vinal marked the *Seward* channel by four buoys, to facilitate the investigation of future changes in that passage.

Captain James Carson, of the revenue-cutter *Seward*, kindly afforded aid to further the operations of the surveying party in the schooner *Bailey*. Four tidal stations were occupied while the hydrography was in progress. The general statistics of work done this season in the Cape Fear River are:

Miles run in sounding	362
Angles measured	3,829
Number of soundings	58,470

Under Section II, mention has been made of work prosecuted by Subassistant Vinal during the summer, in which, as also in the survey of Cape Fear River, he was aided by Mr. J. J. Evans. The party is now engaged in soundings near the bar of Beaufort Harbor, North Carolina.

Coast measurement, triangulation, and topography below Little River, South Carolina.—The measurement and survey of the interval on the coast of South Carolina, between Winyah Bay and Little River, have been completed by Subassistant O. H. Tittmann. This season the work was resumed at Little River in January, and was carried southward and westward to meet the survey of 1872, which started from Winyah Bay and followed the coast in a northeasterly direction. The junction was effected toward the close of April.

A base was measured on the west side of Little River, and from this the triangulation was extended across the inlet, and so far to the eastward as was necessary to adjust the survey of Mr. Tittmann to that executed in 1860; and, also, to the westward as far as practicable. For the purpose of verifying the direction of the lines, an astronomical azimuth was observed at Battery station, and that point was connected with the triangulation.

At the terminal point of the last triangle to the westward the direct measurement of the coast was commenced, and was carried along the beach by means of a succession of lines and transfers of azimuth to the station where the operation was suspended in the previous year.

The measurement was made with a Stackpole tape, 15 meters in length, having at the forward end a handle attached to a steel spring, by means of which a uniform strain was applied to the tape. It was adjusted on tripods, and its temperature, inclination, and alignment were secured by a thermometer, a Locke hand-level, and a Casella magnetic theodolite. With important improvements, the apparatus was similar to that described in the annual report of 1869. A speed of half a mile per hour was readily maintained while the measurement was in progress. The details of this work are:

Stations occupied	24
Angles measured	74
Miles of beach measurement	15

At the same time that the operations just referred to were going on, a topographical survey of the coast was made, including Little River and the different inlets, and of the country and roads immediately back from the line of coast. During the progress of the survey, the position of certain marks and ruins, said to be on the boundary line between North and South Carolina, were fixed and designated on the plane-table sheet. The statistics of topography are: Topographic Sheet 1295 b

Miles of shore-line traced, including rivers and creeks	135
Miles of roads	48
Area surveyed (square miles)	45

Messrs. D. B. Wainwright and E. H. Wyvill served as aids, and the former made a considerable part of the topographical survey.

After closing this work, Subassistant Tittmann was detailed for service on the western coast, operations on which will be described under the head of Section X.

Topography and hydrography of North Santee and South Santee River, South Carolina.—With his party, in the schooner *Caswell*, Assistant W. H. Dennis commenced the survey of North Santee River, in the latter part of December, 1872. The bar has only 6½ feet on it at high water, and could be crossed by the vessel only under the most favorable circumstances.

After joining work with a sheet filled in the previous season, Mr. Dennis surveyed the course of the river to a distance of eleven miles, and mapped the topographical details between the main branches and north and south of the shore-lines, including also the lower part of South Island. The main road from Charleston to Georgetown, S. C., was taken as the western boundary of the survey. Subsequently, the South Santee and its branches were included within the limits of work. All the water-courses adjacent to the completed topography were carefully sounded. It is noticed in the field-report that some of the numerous rice-fields, which were of necessity traversed by the plane-table party, having been uncultivated for a few years, are now covered by a growth of vines and canes, so as to be almost impassable. The soundings made, in the aggregate upward of thirty-two thousand, were checked by nearly a thousand measured angles. Mr. Bryant Godwin joined the party early in February, and aided in the plane-table work and hydrography until the close of work, on the 11th of May, when the vessel was sent to Baltimore. The topographical statistics are:

Miles of shore-line traced	171
Miles of roads	115
Area of topography (square miles)	106

Field-work and hydrography will be continued during the winter in this section, by Assistant Dennis. The operations of his party during the summer have been mentioned under the head of Section I.

Topography of Sea Islands, South Carolina.—The detailed plane-table survey of the sea islands adjacent to the mouth of Coosaw River, at the head of Saint Helena Sound, was resumed by Assistant Charles Hosmer, at the end of November, 1872, with a party in the schooner *G. M. Bache.* Under favoring conditions of weather, the service assigned to the party in this section was completed by the middle of April. The operations included also the sounding of the water-passages within the topographical limits. Two plane-table sheets, returned to the Office by Assistant Hosmer from the field, show the hydrographic development of Ashepoo River and its branches, the lower part of the Combahee, seven miles of the course of the Coosaw, and parts of all the smaller streams that enter at the head of Saint Helena Sound. Assistant Hosmer was aided by Mr. R. B. Palfrey. The statistics of work are:

Miles of shore-line of rivers	119
Miles of creeks and marsh outlines	250
Miles of roads	75
Area (square miles)	88

Upwards of twelve thousand soundings were made and recorded for developing the channels through the various water-courses that came within the limits of field-work.

Assistant Hosmer is now prosecuting a detailed survey near Savannah, Ga. During the summer he was engaged in service, of which mention was made under the head of Section II.

Latitude.—Assistant A. T. Mosman reached this section at the end of December, 1872, and without delay resumed observations, in continuation of the series recorded last year, for the determination of latitude at Butler's Station, on Saint Simon's Island, Georgia. Two instruments were employed, zenith telescope No. 2, and the meridian telescope No. 7, and with these an aggregate of ninety results were found on thirteen nights. Time observations were recorded during nine nights, and the usual sets were registered for finding the micrometer value. Mr. Mosman completed observations at this station on the 27th of January. His subsequent occupation has been already mentioned. In August he assisted in the measurement of the primary base-line near Atlanta, Ga., mention of which will be found under Section VII.

SECTION VI.

ATLANTIC AND GULF COAST OF THE FLORIDA PENINSULA, INCLUDING REEFS AND KEYS, AND THE SEA-PORTS AND RIVERS. (SKETCH No. 9.)

Triangulation, Atlantic Coast of Florida.—The triangulation along the Atlantic coast of Florida was continued during the past season under the direction of Assistant A. M. Harrison, and was extended from the headwaters of the Matanzas River southward, to include Halifax River, for a distance of sixteen miles. That points required for the topographical survey might be determined before the arrival of the plane-table party, Subassistant J. N. McClintock was sent early in November, with directions to take up the triangulation where it was left off at the end of the previous season, and continue it to the southward. Mr. McClintock began field-work December 1st, and after a personal interview with Mr. Harrison, who reached Saint Augustine on the 5th of January, the triangulation was continued southward until the 26th of March. During the latter half of the season Mr. McClintock assisted Mr. Harrison in the detailed work, which was prosecuted with the sloop *Steadfast*, the vessel built for the accommodation of the party operating in this section.

The progress of the work during December and January was somewhat delayed by the difficulty of obtaining transportation for camp-fixtures and lumber, and especially by the necessity of opening most of the lines of the triangulation observed to the northward of Halifax River. The densely-wooded section known as the "*Barrier*" is now passed, and greater progress will be made hereafter in advancing the survey toward Cape Canaveral. The statistics of the work are as follows:

Stations occupied	18
Signals observed upon	24
Observations with theodolite	3,930

Subassistant McClintock was subsequently engaged in Sections I and II, and is now under instructions for duty in Section IX.

Coast topography between Matanzas Inlet and Halifax River, Florida.—In the middle of the *Barrier*, which has been mentioned in preceding reports, Assistant Harrison resumed the detailed survey of the Atlantic coast of Florida this season, and going southward extended the work sixteen miles. The resulting sheet shows the upper part of Halifax River and its tributaries, and all the water-courses, as well as the road, which runs evenly within three miles of the Atlantic coast in that vicinity. The stretch thus developed is known as Graham's Swamp, and is traversed by Bulow's Creek and Smith's Creek, both of which are northern tributaries of Halifax River. Part of Tomoka Creek, another tributary, coming from the southward and emptying into the river near its head, is also included in the survey of this year.

Mr. Bion Bradbury served efficiently as aid in the plane-table party, and, under the personal supervision of Assistant Harrison, mapped most of the ground included in the operations of this season. The statistics of topography are:

Miles of shore-line surveyed	81½
Miles of marsh, creeks, and ponds	173
Miles of roads	29
Area (square miles)	54¼

Under the head of Section II, mention has been made of the occupation of the party of Assistant Harrison during the summer. Points have been determined along the Halifax River for extending the survey in this section to include Mosquito Inlet, and Mr. Harrison is now preparing to resume topographical service in that quarter. Before leaving the section in May last, he established two tidal stations, and erected signals along the shores of Halifax River, the hydrography of which will be taken up early in the course of the coming winter.

Hydrography, Florida Reef.—The hydrographic party of Commander J. A. Howell, United States Navy, left New York in the steamer *Bache* on the 1st of December, 1872, and, after a stormy passage, reached Tortugas on the 2d of January, having touched, in the interval, at Norfolk and at Key West. The following month was employed in erecting and determining the position of signals on Bird Key, Garden Key, and Long Key, and in the measurement of a base-line for hydrographic purposes on Loggerhead Key. As weather permitted, the adjacent hydrography advanced, and was plotted by Lieutenant Jacques, United States Navy, to whose personal care in regard to details this mention is due.

From the 20th of April until the 12th of May, soundings were extended in the vicinity of the Tortugas. The vessel sailed at the last-mentioned date for New York, and was subsequently in hydrographic service, as stated under Section I.

For soundings along the reef, about 1,500 angles were measured, and 11,169 casts of the lead were recorded.

On the passage northward from this section, Commander Howell noticed a very strong current in the Gulf Stream. When further means are provided, special observations will be made by the same officer in regard to that important feature of the Atlantic coast approaches.

Triangulation, topography, and hydrography, western coast of Florida.—The work of continuing the survey, in all its branches, from Clear Water Harbor to Tampa Bay, was placed under the charge of Assistant Herbert G. Ogden, and, in view of the different classes of work to be executed, Messrs. Andrew Braid and S. N. Ogden were assigned to him as aids, and the schooners *Speedwell* and *Agassiz* for the use and accommodation of the party.

The *Speedwell*, from Baltimore, reached Cedar Keys on the 2d of January; and the *Agassiz*, from Mobile, after stopping at Appalachicola for the base-apparatus, arrived at Tampa Bay on the 29th of December. The *Agassiz*, soon after leaving Appalachicola, encountered a succession of severe gales, during which the vessel sprung a leak. At one time the water was over her cabin-floor, and, being an old vessel, she was found, on her arrival, to be in an unfit condition to leave the bay.

The work of the season was commenced by the measurement of a base on the north end of Sand Key, Clear Water Harbor, by the determination of an astronomical azimuth and latitude at a station of the first quadrilateral from the base, situated on the east side of the harbor, and by the connection of the base with the triangulation of 1861. The base, consisting of two lines slightly inclined, was two miles in length, and was measured with the secondary apparatus. The astronomical observations were made by Mr. Edwin Smith, aid, who had joined Assistant Ogden at Cedar Keys. Mr. Smith redetermined the direction and length of the sides of the most southern triangle of 1861, and strengthened the connection by angular measurements on Umbrella Pine, the position of which is shown on Sketch No. 10.

When the work required to the northward of the base was complete, the triangulation was extended to the southward, down Clear Water Harbor; through Indian Pass, where the triangles were necessarily small; thence down Boca Ceiga Bay, in which the scheme was gradually enlarged; and, finally, across the entrance of Tampa Bay to Anna Maria Key, in Sarasota Bay, terminating at a site selected for a base of verification. The crossing of the bay was effected by two quadrilaterals, in which the longest side was fourteen miles in length, and with eastern points well up the bay. For the verification of the work seven lines, varying in length from two and a half to nine miles, were carried through the scheme, independent of the general triangulation.

The season, which was made a most successful one, notwithstanding the delay caused by the non-arrival of the *Speedwell* as early as expected, closed on the 16th of May. The triangulation, of which the following are statistics, covers the line of coast lying between Tampa Entrance and Saint Joseph's Bay, (south:)

Stations occupied	56
Signals observed upon	82
Main angles measured	297
Subsidiary angles measured	101
Number of observations	8,274

The topographical survey was kept up with the triangulation, and embraces the coast from Clear Water Harbor to Tampa Bay and the islands lying off the entrance of the latter. The mainland, on Clear Water Harbor, is high, reaching 20 feet, a little back in the woods, but gradually recedes, merging into marsh, and, abreast of Indian Pass, it entirely disappears. The shores of Boca Ceiga Bay are low and generally dry, with little marsh. In this quarter the coast is covered with a growth of pines, interspersed here and there with a few round-leaf and live-oak trees. The islands are all of the same general character, low and sandy, and free from dunes. Their interior sides are bordered with mangrove, and many of the smaller islands are submerged at high tides. Good fresh water was very scarce, and neither the water taken by the party from the wells nor from the few streams which were found, would keep its quality longer than a few days. The statistics of the topography are:

Miles of shore-line traced	221
Miles of marsh-line traced	13
Miles of creeks and ponds	27½
Miles of road	29

In consequence of the condition of the schooner *Agassiz*, no attempt was made to bring the vessel up to the main party at Sand Key. Mr. Andrew Braid, who had charge of the schooner, was, therefore, directed to measure a preliminary base in the vicinity of where he then was; to erect signals and make a plane-table triangulation, and upon that sheet to develop the topography and hydrography. The signals were afterward determined by triangulation, and the work executed by Mr. Braid was thereby checked and found to be satisfactory.

The hydrography extends from the north point of the entrance to Tampa Bay, to Big Pass, and includes the six inlets on the coast, and the passage from Boca Ceiga into Tampa Bay. A channel of about 5 feet water was found through Clear Water Harbor and Boca Ceiga Bay, but the narrow strait connecting the two was impassable for even a small boat, except at very high tides. About 7 or 7½ feet can be carried over the bars of all the inlets, except Indian Pass, which is almost dry. Extensive flats make out from the shores of the inclosed basins, stretching sometimes nearly all the way across, and rendering the channels tortuous and difficult of navigation. The details of hydrography are:

Miles run in sounding	569
Sextant angles measured	4,009
Casts of the lead	55,187

Messrs. S. N. Ogden and W. S. Bond served efficiently as aids during the season. Assistant Ogden occupied the summer in prosecuting field-work, which has been mentioned under the head of Section II. He is now about to resume the survey of Tampa Bay, for the hydrography of which Subassistant Braid has been detailed with a separate party.

Tidal observations.—A self-registering gauge furnished from the Coast Survey Office has been running well for nearly a year at St. Thomas, West Indies, in the care of Colonel Thiilstrüp of the Royal Danish engineers, under arrangements made with the governor of the island. This series of observations is expected to throw light on the formation and progress of tidal waves and on their changes of form.

SECTION VII.

GULF COAST, AND THE SOUNDS OF WESTERN FLORIDA, INCLUDING PORTS AND RIVERS. (SKETCH No. 10.)

Triangulation eastward of Appalachee Bay, Florida.—The triangulation of the comparatively unknown coast from Saint Mark's toward Cedar Keys was assigned to Subassistant F. W. Perkins, with instructions to strengthen the triangulation connecting Saint George's Sound with Appalachee Bay before taking up field-work at Saint Mark's.

Mr. Perkins left Appalachicola in the schooner *Torrey* at the end of December, 1872, and reached Alligator Harbor, Saint James Island, on the 3d of January. After a diligent search one point only, *Wells*, of the former triangulation, could be identified, but as others were required, a rough triangulation was made, in which the line from *Wells* to a point assumed as one of the stations previously occupied was used as a base. By this method *Franklin Point* was recovered, and Mr. Perkins found that the granite block marking the station had not been disturbed. Search was continued in this vicinity, but proving unsuccessful, the *Torrey* was taken around into Ocklockony Bay, on the north side of the island, and on the day of the arrival of the party, January 16, the two stations, *Chaires* and *Piccoline Bayou*, were found. With these as a base, the line from *Chaires* to *Lansing* was redetermined, and from each of the two last stations a line six miles in length was opened through the woods and across the island to Franklin Station, effecting the desired junction by a single well-shaped triangle. To enable the observer to see over the ridges of high ground in the interior, tripods and scaffolds, ranging in height from 18 to 29 feet, were erected at the three principal stations. While occupying Franklin Point the angle between Lansing and Wells Stations was measured in order to transfer the azimuth to the other side of the island. The improvement consisted in substituting a direct connection across the island in place of the small triangulation following around its shores. The statistics of the work are as follows:

Tripod signals erected	6
Stations occupied	5
Angles measured	16
Angular measurements	864

Immediately after completing the work just described, Mr. Perkins proceeded with his party to the mouth of the Ocilla River, to continue the triangulation from Saint Mark's toward Cedar Keys. Two points about midway between Saint Mark's and the Ocilla River were recovered, and from this base the triangulation was extended down the coast to Warrior River, a distance of fifteen miles.

The following extracts from the report of Mr. Perkins well describe the character of this part of the coast of Florida, and the difficulties to be encountered in the prosecution of the work: "This marsh which forms the coast-line extends back to the woods, a distance of from one to two miles. The coral underlies this at a depth of from two to eight feet, occasionally cropping out and giving a foothold for the cabbage-palmetto and red-cedar which at those places form hummocks of a few rods in extent."

"Numerous creeks and rivers traverse this marsh in all directions, their beds and often their banks being formed of the solid coral-rock. Some of the rivers are quite deep, but the majority of the creeks are merely the natural surface-drains which carry off the water left upon the marshes by each high tide."

"Upon ascending the larger rivers four or five miles, I found their beds obstructed by large bowlders of coral-rock, the shores low and swampy, but with a rapid current. A little farther on, the banks were high, firm land, and the current in the contracted channels more uniform."

"There are no inhabitants near the coast, and but very few upon the high land visited in the interior."

"A near approach to the coast is quite difficult and attended with more or less danger. The shoal water extends from one to three miles from the shore, and ledges or reefs of coral-rock, rising abruptly from a very level bottom, make the greatest care necessary in coasting within sight of land."

"The bottom is of fossil-coral generally covered with a deposit of mud from one to three feet in depth."

"Shoals, impassable for boats, except at high water, extend from half a mile to a mile and a half from the shore, and these, together with the distance at which it is necessary to anchor the vessel, make landing with lumber and for observations very difficult, and cause much delay in the prosecution of the work."

"As the condition of the atmosphere over the marsh was generally unfavorable for observations, and the difficulty of reaching the wood-line very great, signals were erected upon the off-lying shoals, and the points along the shore-line were occupied with the theodolite."

"This left one concluded angle in each triangle, but the better seeing over the water and the greater rapidity with which the work was carried forward, more than counterbalanced the possible error so introduced."

"The legs of the water-signals were sharpened and driven down to the bed-rock and then braced together. No difficulty was found in making them stand during the time required to complete the measurements, but the summer gales will probably destroy most of them."

"As all the points that it was possible to occupy were in a nearly straight line, it became necessary to determine such third-order points as were required by the three-point problem."

In reference to the possible error dependent upon concluded angles, it should be mentioned that the work was checked by the transfer of the azimuth from the farthest visible station back to the most distant visible point forward, the line of verification passing generally through four triangles. The details of this work are:

Signals erected	22
Stations occupied	23
Points determined	31
Angles measured	207
Number of observations	2,610

During the summer Sub-Assistant Perkins was engaged in Section II. He is now about to resume the coast-development between Cedar Keys and Appalachee Bay.

Hydrography near Saint George's Sound, Florida.—For developing the hydrography of the Gulf of Mexico in the approaches to this sound, Assistant Horace Anderson established a tide-gauge near Saint George's light-house, in the middle of January, and during four months continued the record of high and low waters. Soundings, meanwhile, at all favorable intervals, were extended into the Gulf, the lines run being generally more than ten miles in length. These, crossed by others in a northeast direction, were properly joined with the work of last year. The space sounded defines the approaches to New Inlet, three miles to the south of which a shoal was developed having only nine feet of water. At all other parts of the working-ground the water was found to deepen uniformly in going broad off into the Gulf. Assistant Anderson used the schooner *Silliman* for service in this section, and also in Section I, where his party was employed during the summer. He was aided in both seasons of work by Messrs. F. H. North and E. H. King. The following is a synopsis of the Gulf hydrography:

Miles run in sounding	604
Angles measured	1,008
Number of soundings	15,699

Assistant Anderson is now on his way to resume work in the Gulf of Mexico near Cape San Blas.

Atlanta base-line and triangulation, (Sketch No. 11.)—The site of the primary base near Atlanta, Ga., was chosen as the natural terminus of a chain of large triangles, some of which have been already determined by occupying stations in the mountain region of the middle of Virginia. Assistant C. O. Boutelle determined the length of the base, toward the end of last year, by means of the primary base apparatus, but, in view of the importance of the site, a remeasurement of the line in hot summer weather was deemed advisable to insure accuracy, as upon the veracity of this line must depend, also, the correctness of positions chosen for the geodetic connection through this entire region.

Having provided all suitable means for comparing the standard bar with those used in the tubes of the base apparatus, Mr. Boutelle commenced the measurement of the line at the end of July. Assistant A. T. Mosman had then joined his party and assisted in the operation, which, as previously arranged, was prosecuted six hours daily in the field at an average temperature of upward of 90° Fahrenheit. At marked points, where the two measurements showed any appreciable difference, elaborate tests were made to determine whether or not the compensation provided for in the measuring-bars was effective beyond a limited range above and below average temperature. Many observations, recorded for this purpose, will be fully discussed hereafter. The remeasurement of the line was completed on the 21st of August, when Mr. Mosman left the party and engaged in service to which he had been previously assigned in Section III. Geodetic operations in the vicinity of the base were perfected by the careful selection of outlying stations. These, as opportunity offered, were occupied with the theodolite, and brought by angular measurements into connection with the ends of the line. Extended reconnaissance has already determined the proper courses for two series of large triangles, one going westward and the other northward from the Atlanta base. The height of the site of the line above the level of the Gulf of Mexico will be determined by Assistant Boutelle during the present winter. He has been aided in the field by Messrs. A. H. Scott, H. W. Blair, and Habersham Barnwell.

Five quadrilaterals, including in all eleven triangles, were closed at Stone Mountain on the 20th of the present month, December. The measurement of horizontal angles at that station required only nine days, the favorable condition of the atmosphere being almost unprecedented in the experience of observers engaged in the primary triangulation. Two months were occupied in securing the same number of angular measurements at the preceding station.

Triangulation, Georgia.—This work, which had been assigned to Assistant F. P. Webber, was commenced in February. During the preceding months of November and December, and part of January, he was engaged in observations for magnetic declination, horizontal intensity, and dip, at a station near the Atlanta base, and in assisting in the first measurement of that base under the direction of Assistant Boutelle. The latter part of January and the following month were occupied in the erection of primary signals on Sawnee Mountain and Kenesaw Mountain, and in making a new set of magnetic observations. March and April were spent in reconnaissance with Assistant Sullivan, though the country lying to the westward of Kenesaw Mountain, and in erecting primary signals on *Carnes*, *Pine Log*, and *Lavender* Mountains, and secondary signals on *Coosa*, *Pine*, and *Lost* Mountains, the point selected for the extension of the triangulation. At the end of May Mr. Webber proceeded to Kenesaw Mountain, where his camp had been pitched, but owing to rainy weather the observations there were not completed until the middle of August. The observations made include a set for magnetic declination, horizontal intensity, and dip.

Toward the close of August the party was transported to Sweat Mountain, to the summit of which a road had to be built for a distance of two miles. At this station the measurements of horizontal and vertical angles and the magnetic observations were completed by October 10. The camp was then removed to Carnes Mountain, a distance of fifty miles, where operations will be continued until the end of the year.

The 30-inch theodolite was used at the two stations last mentioned, but was subsequently employed by Assistant Boutelle at other points.

The statistics of work at Sweat and Kenesaw Mountains are as follows:

Signals observed on for horizontal angles	39
Vertical angles measured	26
Number of observations	1,814

Reconnaissance for the geodetic connection, Georgia.—Reconnaissance in Northern Georgia for points in the geodetic connection was resumed by Assistant John A. Sullivan in March, and was continued until the middle of June, but was suspended in consequence of illness. In September, Mr. Sullivan again took the field, and closed his reconnaissance in October. In the preceding winter he assisted in the measurement of the base-line near Atlanta.

After visiting the four western stations previously adopted, and adding a station still further to the westward, Mr. Sullivan made a thorough examination of the country as far as the Sand Mountain range, and selected five additional points, by means of which two bases will be supplied for crossing the Sand Mountain plateau and for a practicable connection with the Lookout range, as well as one for the extension of the triangulation to the northward across Tennessee to the Cumberland Mountains. He also made a reconnaissance of the country northeast of the Atlanta base, and beyond its immediate connections, resulting in the selection of two points, Skitt Mountain and Currahee Mountain, for extending the primary triangulation parallel with the Atlantic coast and toward the Shenandoah Valley. The scheme of triangulation is so arranged as to connect with the primary series before referred to, and independent of the base, to cover the entire northern part of Georgia. (Sketch No. 11.)

Assistant Sullivan reported at the Office in December, and during the present winter will be engaged in special field-duty in Section II.

SECTION VIII.

GULF COAST AND BAYS OF ALABAMA, AND THE SOUNDS OF MISSISSIPPI AND LOUISIANA, TO VERMILION BAY, INCLUDING THE PORTS AND RIVERS. (SKETCH No. 12.)

Hydrography of Chandeleur Sound, Mississippi.—The steamer *Endeavor* left Baltimore on the 7th of December, 1872, with the party of Subassistant F. D. Granger, but owing to bad weather did not reach the vicinity of New Orleans until the 18th of January. As soon as practicable the party was at work on the eastern side of Chandeleur Sound, and there continued operations until the middle of April. Owing to natural changes of recent years, and to the wanton displacement of screw-piles which marked the stations of the triangulation at the outset of the war, Mr. Granger was under the necessity of determining such points as were needful in the hydrography. The soundings subsequently made develop the eastern part of the sound, and join with work done in previous years. Some of the lines of soundings being fifteen miles distant from the Chandeleur Islands, were determined by observing, on signal-poles mounted on rafts, three of which Subassistant Granger moored at suitable positions, varying from six to ten miles from land, from time to time moving the rafts as occasion required. The signals of his device were visible seven miles; and the rafts being held in place merely by mushroom weights, were readily moved into other positions. The results of this survey show that eleven to twelve feet of water can be carried through the eastern part of the sound. In reference to the channels, Mr. Granger says: "With Chandeleur light-house bearing east, one mile off, by steering S. by W. ¾ W., vessels of eleven feet draught can go through, and will pass between Old Harbor Keys and a shoal which lies about three miles and a half northwest of said keys. This shoal is narrow, and extends about four miles in a N. by E. and S. by W. direction, and has as little as 4½ feet of water on it."

"The channels of the sound are known to few, except those who earn their living by fishing in its waters. Many vessels drawing only seven or eight feet pass to and fro eastward of the Chandeleur Islands, not daring to venture through the sound."

The report of Mr. Granger specifies many changes which have occurred in the contour of the islands, and corresponding alterations in the positions of some of the keys lying to the westward of the Chandeleurs. He was aided in this section by Messrs. D. C. Hanson and C. A. Ives. The general statistics are:

Miles run in sounding	960
Angles determined	3,175
Number of soundings	49,505

The subsequent work of this party has been noticed under the head of Section I. Subassistant Granger is now engaged in Section VI.

Triangulation, topography, and hydrography of Mississippi River, Louisiana.—Assistant Charles H. Boyd resumed work in this section on December 29, 1872. The progress made during the season in the triangulation, topographical survey, and hydrography of the river, has been entirely satisfactory. The weather was unusually favorable for field-operations.

Commencing at the base, *Fanny-Jesuit*, where the work was suspended early in 1872, the triangulation was extended up the river to New Orleans, a distance of 26 miles, and was well checked throughout its length. The connection with the point formerly occupied in New Orleans was partially effected; that with the Lake Borgne triangulation was arranged, and the intervening country was examined preparatory to the opening of the lines through the cypress-swamps.

In regard to the difficulties encountered in carrying on this work, Assistant Boyd mentions, among others, the necessity for extreme care in selecting lines across the belt of fast-land bordering each bank of the river. This belt is either densely wooded, or cultivated in sugar, rice, and fruits and hence, much labor was required to find the courses most free from obstructions and most favorable for the work, and, at the same time, unobjectionable to the proprietors of the land. So far, no damages have been paid or asked for. Behind the strip of fast-land are the cypress-swamps. Owing to the level character of the country, the theodolite, as in previous seasons, was elevated on tripods, from 20 to 25 feet in height, at every station occupied by the observer, except in cases where chimneys, steeples, and buildings could be used as substitutes.

Mr. C. H. Van Orden served as aid in the triangulation, and Mr. J. Hergesheimer in topography. Both performed their respective duties acceptably.

Field-work was closed on the 24th of April, when the schooner *Varina*, which had been used for the accommodation of the party, was sent to the "Head of the Passes" for the winter. Assistant Boyd and the triangulation-party then proceeded to Illinois to take up the work there, as will be presently referred to. The statistics of the triangulation on the Mississippi are as follows:

Lines opened	21
Points determined	54
Angles measured	278
Number of observations	4,776

The topographical survey covers all the fast-lands adjacent to the Mississippi, giving the swamp and marsh line, and showing all connections between the river and the bayous behind. The survey closed for the season with a full sheet, six miles below New Orleans. It was expected that another sheet would have been completed, but with the hope of closing the triangulation at New Orleans during April, the whole force of the party was given to that special work, and, after April, funds were not available for carrying out the plan of leaving the topographical party to bring up the survey. The plane-table statistics are:

Miles of shore-line surveyed	40
Miles of roads	275
Miles of levee and canal	310
Area (square miles)	54

The hydrography of the Mississippi also closed with a full sheet, just below "English Turn," where the freshets and rapid currents overtook the party in March. Soundings between that point and New Orleans can be made with greater accuracy and less labor in the early part of the coming season, at which time the river is low and the current less. The hydrographic statistics are:

Sounding-lines in miles	75
Casts of the lead	1,917
Sextant-angles	636
Sets of current-observations	6
Days' record of tides, January 1 to May 1	120

The party of Assistant Boyd is now arranged for resuming the detailed survey of the Mississippi in the vicinity of New Orleans. Under the next head mention will be made of its occupation during the summer and autumn.

Triangulation in Missouri.—The triangulation-party, under Assistant Boyd, was transferred at the end of April, from Louisiana to the vicinity of the base, in Illinois, opposite Saint Louis, where the work of the geodetic connection was resumed on the 1st of May. During that month, the four stations on the Illinois side of the Mississippi River, including the ends of the base measured on the American Bottom, were successively occupied, and, in June, the measurements of horizontal angles, at stations on the Missouri side, were in great part completed. The progress of the observations at these stations was greatly delayed by the smoke hanging over Saint Louis, through which some of the lines of sight necessarily passed. Early in July, the intense heat increased the difficulty of seeing the signals, and the malaria of the season and locality made all the party ill. Under these circumstances, it was impossible to obtain results at all adequate to expenditures. Field-work was consequently suspended during that month and August. Assistant Boyd and his aid devoted this interval to the large amount of office-work on hand, belonging to the survey of the Lower Mississippi.

Field-work was resumed near Saint Louis early in September, and continued until the 3d of November, when the season closed. During this period the reconnaissance was extended, and the triangulation, the sides of which vary in length from eight to eighteen miles, was completed for a distance of thirty-two miles westward of Saint Louis.

The principal obstacle to rapid progress in this triangulation is found in the forests of hard-wood, which cover all the ridges, and through which, without cutting lines of sight, the use of the theodolite is impossible. This natural impediment cannot well be met in July and August, for reasons already stated. The best months for carrying on the work, Assistant Boyd states, from the experience of two years, to be the season from September 15 to November 15, and during May and June.

Mr. C. H. Van Orden, the aid in the party, is commended for efficiency in the reconnaissance and triangulation. The statistics for this season are:

Signals erected	6
Lines opened	29
Stations occupied	14
Angles measured	107
Number of observations	6,678

This work will, if practicable, be resumed early in May of the coming year.

Geodetic connection.—The State of Wisconsin, having made ample provision for its geological survey, Dr. J. A. Lapham, chief geologist, in April, applied for the benefit of the provision of Congress in regard to the determination of geographical points on which to base the subsequent State survey. Prof. J. E. Davies, of the State University, at Madison, qualified himself for field-work in triangulation by personally witnessing the operations of Professor Quimby, who passed the summer in determining points within the limits of the State of New Hampshire. Owing, however, to the limited means available for continuing work already begun in the geodetic connection, it was found inexpedient to commence triangulation in Wisconsin within the present fiscal year. That the request of the State geologist might be met in part, arrangements were made for the determination of several geographical points by observations for latitude and longitude.

In July, Assistant G. W. Dean conferred with Dr. Lapham, at Madison, and established an astronomical station in the grounds of the university, about a mile west of the State-house. The station was carefully marked by stone piers, and the longitude of the point was determined by exchanging clock-signals during five nights in the latter part of July, between Assistant F. Blake, at Madison, and Assistant Edward Goodfellow, at Omaha; the longitude of the last-mentioned point having been determined in 1869.

At Madison, Assistant Blake determined the latitude by observing twelve pairs of stars during five nights with the zenith telescope.

At La Crosse, Wis., a station was marked in *Court-House Square*, and clock-signals were exchanged with the observer at Omaha during four nights. Latitude was determined at the same station from the record of observations on thirteen pairs of stars during three nights.

While these operations were in progress, request was made by Prof. William Folwell, president of the Minnesota State University, for the determination of a point at Minneapolis; some preliminary action having been taken in the State, in regard to a trigonometrical survey, which might soon be commenced, under the direction of the officers of the university. In accordance with the application, Assistant Blake was sent to Minneapolis, and marked a station near the university building. Clock-signals for determining the longitude of the point were exchanged on four nights with the observer at Omaha. Mr. Blake ascertained the latitude of the station at Minneapolis by observing on ten pairs of stars during five nights.

Telegraphic facilities for the work in Wisconsin and Minnesota were furnished free of charge by Z. G. Simmons, esq., president of the Northwestern Telegraph Company. All the astronomical records of the party have been completed in duplicate, and good progress has been made in the computation of results.

At Omaha, Assistant Goodfellow was cordially assisted by members of the Board of Education. His report mentions also his indebtedness to Mr. Frank Lehmer, manager of the Western Union Telegraph Office, at Omaha, for information and for many facilities in the prosecution of the work. Mr. J. B. Baylor served as aid in the astronomical party at Omaha. Leaving the observers to complete the details, which were planned at the outset of the season, Assistant Dean passed on westward to arrange for the determination of points in Colorado. The operations of his party there will be stated further on in this report, under the heading "Interior."

SECTION IX.

GULF COAST OF WESTERN LOUISIANA AND OF TEXAS, INCLUDING BAYS AND RIVERS. (SKETCH NO. 13.)

Triangulation at Galveston Harbor and of the coast from East Bay toward Sabine Pass, Texas.—The duty of determining the position of the light-houses and beacons erected in Galveston Harbor since the date of the survey, and of continuing the triangulation of the coast of Texas eastward from the head of East Bay, where it was suspended in 1861, was assigned to Assistant S. C. McCorkle.

The surveying party reached Galveston on the 7th of December, 1872, in charge of the aid, Mr. D. S. Wolcott, and a week after was joined by Mr. McCorkle. Two of the station-marks being found, viz, *Dollar Point* and *Bolivar Point*, a high tripod with its accompanying scaffold was erected at the latter, from which to observe on the cathedral tower, as within a few years a large building had been put up in the city, cutting off the view of the cathedral from the ground at Bolivar Point. A new station on Pelican Island was determined in position from the two stations mentioned, and was checked by observations on the cathedral. With these three the positions of the light-houses and beacons were fixed.

In the beginning of February the party was transferred to the head of East Bay, where, after diligent search, three of the interior points were identified. The line connecting two of these, Oyster Bayou and Northwest Bend, (Sketch No. 13,) was adopted as a base, and from this the triangulation was extended to the eastward as far as the season would permit. Unusually wet and stormy weather; the difficulty of obtaining means of transportation suitable to the character of the country, and the high charges for such service in that section, all conjoined to reduce the results below the standard usually reached by the same allotment for party expenses. While Assistant McCorkle was disabled by continued illness, the field-work was carried on efficiently by Mr. D. S. Wolcott, the aid in the party. The statistics of this work are:

Signals erected	12
Stations occupied	12
Angles measured	76
Number of observations	2,040

Assistant McCorkle was occupied in field-work during the summer in Section II, and is now preparing for reconnaissance duty in Section VII.

Hydrography of Espiritu Santo and San Antonio Bays, Texas.—The hydrographic survey of the inclosed basins of water on the coast of Texas was resumed in November last by Subassistant L. B. Wright. The schooner *Stevens* was assigned for the work, but, as that vessel could not cross several of the bars, the inside waters were sounded by means of a small coasting-schooner chartered for the purpose.

As in the case of Matagorda Bay, the triangulation-signals which had been erected, previous to the late civil war, on Espiritu Santo and San Antonio Bays, had been either blown down or destroyed; and only in a few cases could their positions be identified. Two of the old stations were found, and with the line connecting these as a base, a plane-table triangulation was carried, with good success, 31 miles; and with the new points thus established two hydrographic sheets were completed. These show in statistics:

Miles of sounding-lines	560
Number of angles measured	3,936
Number of soundings	38,334

Messrs. F. W. Ring and J. B. Baylor served efficiently as aids in the hydrographic party. Sub-assistant Wright passed the summer and autumn in service at the north, as mentioned under the head of Section II. He has now resumed hydrographic duty on the coast of Texas, and will there conduct a party during the winter and ensuing spring.

INTERIOR.

WEST OF MISSISSIPPI RIVER.

Geodetic connection.—In the interest of the geological survey, which is now in progress in the Territories of the United States under the direction of Prof. F. V. Hayden, application was made early in the present season by James T. Gardner, esq., chief of the geographical and topographical staff, for determinations of latitude and longitude at several points in Colorado. As already stated in this report, similar requests were made somewhat later in the year, in behalf of surveys contemplated by the States of Wisconsin and Minnesota.

The position of a station in Omaha, Neb., is known by careful determinations made for latitude and longitude in 1869. By proper arrangements, therefore, one observer at Omaha sufficed for the exchange of clock-signals by telegraph with several observers, each at a distant station. The telegraph circuit between that place and Denver, in Colorado, about six hundred and twenty miles, was the least distance through which signals were exchanged by the parties, the circuit between Omaha and Minneapolis being about nine hundred and twenty miles. Assistant George W. Dean, having made the requisite arrangements with telegraph companies in advance of taking the field, organized his party so as to occupy several stations at the same time. Assistant Edward Goodfellow was stationed at Omaha, and was there engaged from the beginning of July until the close of September in exchanging clock-signals with observers at six distant points, the exact longitude of which had not been previously known. By Mr. Goodfellow and his aid, Mr. J. B. Baylor, an aggregate of nine hundred and twenty observations on ninety-four stars were recorded, in the course of seventeen nights, for determining the clock and instrumental corrections.

At Denver, in Colorado, Assistant Dean selected a point favorable for connection with Mr. Gardner's survey of the mountain-ranges of the Territory. The longitude of the station was established by exchanging clock-signals during four nights with the observer at Omaha, local time and instrumental corrections being found in the usual way, by observing zenith and circumpolar stars.

Mr. Edwin Smith, aid in the party of Assistant Dean, determined the latitude at Denver by observing on sixteen pairs of stars during six nights. The magnetic declination, dip, and intensity were also ascertained by full series of observations at that station.

The position occupied at Denver by the astronomical instruments was referred by geodetic measurements to the spire of the public-school building in that city. At Colorado Springs a station was occupied, at which the summit of *Pike's Peak* is in full view. Observations for determining longitude were made as at other places, clock-signals being exchanged during four nights with Assistant Goodfellow, who remained at Omaha. Eight nights were employed by the party at Colorado Springs in observing fourteen pairs of stars for latitude. The magnetic elements were determined by the usual method.

At a third station, Trinidad, near the southern boundary of Colorado, observations similar to those already mentioned were recorded for the determination of latitude, longitude, and the magnetic elements. Mr. C. H. Fitch aided in the service at this station.

The report of Assistant Dean mentions renewed obligations for the friendly co-operation of General Anson Stager, superintendent of the Western Union telegraph lines, in addition to the free use of the lines accorded by the company for the exchange of time-signals. My thanks are due also to General W. J. Palmer, president of the Denver and Rio Grande Railway Company, for discriminating in rates of charges for transportation requisite in the service; and to Messrs. W. S. Jackson and W. W. Borst, of the same company, for facilities extended to the several observers who were engaged in Colorado.

The party of Assistant Dean is now arranged for determining the longitude at southern stations of the Atlantic and Gulf coast.

SECTION X.

COAST OF CALIFORNIA, INCLUDING THE BAYS, HARBORS, AND RIVERS. (SKETCHES NOS. 14, 15, AND 16.)

On the western coast the season has been generally unfavorable for field-work, but the autumn opened with good weather, and operations have been pushed so that a good average is shown by the abstracts of the several field-reports. As usual, the abstracts will be arranged in geographical order, beginning with mention of work done on the southern coast of California. All the chiefs of field-parties under my general instructions, assigning them to duty in specified sites, have had the advice of Assistant George Davidson in regard to the limits and character of their work. His intimate knowledge of the requirements of the service on this coast has availed also, as heretofore, in making the most judicious subdivision of the means allotted for continuing the survey.

The progress of work on the Santa Barbara Islands and their trigonometrical connection is very satisfactory. Mr. Davidson's party is now engaged in connecting points on them with the main triangulation of the coast of California, the scheme of which is now complete by reconnaissance from Santa Barbara to Monterey.

The geodetic connection across the continent has not been pressed from the western side for want of means. If practicable, reconnaissance for suitable stations will be resumed in the coming spring.

In addition to the details of estimates for the several parties, Assistant Davidson has supplied information verbally and in writing, to such as have applied for data needful in important local operations. By act of Congress approved in March, 1873, the President of the United States designated three commissioners to report upon the feasibility of plans for the irrigation of the Sacramento, San Joaquin, and Tulare Valleys, two of the commissioners to be officers of the Corps of United States Engineers, and the third from the Coast Survey. Assistant Davidson was appointed on account of his long service and familiarity with the geographical features of the western coast, and is now engaged in the joint report on their investigations.

The valleys just mentioned constitute, in reality, but one great valley between the Sierra Nevada range and the coast mountains, and between the thirty-fifth and forty-first degrees of latitude. The valley is four hundred and twenty miles long, has an average width of over forty miles exclusive of the foot-hills, and is a special feature of the Pacific coast geography. Mr. Davidson calls it the *Valley of California*, and, in his opinion, ten millions of acres of rich land in it admit of irrigation. The entire region and the surrounding foot-hills have been repeatedly traversed by the commissioners. Limited means in the appropriation did not admit of detailed observations on the soil, water-supply, and topographical features, but the commissioners are strongly impressed with the apparent feasibility of rendering the great valley the granary of the western coast.

Latitude and longitude of the Transit of Venus station, 1769.—Under special instructions, Assistant Davidson, accompanied by Messrs. S. R. Throckmorton, jr., and W. S. Edwards, aids, with two men, went to San José del Cabo in March, to identify, if possible, the transit of Venus station occupied by M. Chappe de l'Auteroche in 1769. Mr. Davidson had previously endeavored to gather information in regard to the locality, and Assistant Hilgard had sought, in Paris, to obtain a detailed description of the place, but without success; Cassini's meager description was the only guide available. Mr. Davidson's special report of April 12 made known the difficulties of ascertaining the exact station. The mission mentioned in the old record had occupied four positions, including that of 1769, within a stretch of five miles along the river, but there were no church records to specify the years of change. Some of the foundations were found, by personal examination. The third and the fourth, or present location of the building, were nearly identical. Fortunately the priest now in charge, an uneducated Indian, was able to point out the foundations of the third mission-building and the traditional position of the "large granary" attached to it. In this granary the French astronomer had erected the instrument, piers of masonry, &c., but all traces of piers or foundations were gone or covered up. The relative position and the limits of the granary were known to have been within certain circumscribed limits; and after sifting this and other evidence, and studying the peculiar topography of the site, Assistant Davidson became satisfied that the Venus station of 1769 was on the southeast side of the present sacristy, and between it and the wall bordering the street. His conclusion is that he has recovered de l'Auteroche's position within an area of twenty feet square.

The station thus identified was at once connected by triangulation with the Geographical Reconnaissance station used by Mr. Eimbeck at San José del Cabo a fortnight before Mr. Davidson's arrival. For this purpose a base of 3,804 feet was measured; observations were made for time by the sextant and for azimuth upon Polaris near elongation with theodolite No. 37. The records of this work were promptly transmitted to the office.

Assistant Davidson made diligent inquiry for the location of Don Joaquin Velasquez de Leon's Venus station at Santa Ana, not far from San José del Cabo, where the transit of 1769 was also observed; but there are no available church records, no local history or even tradition; and the government archives at Madrid and contemporary records at Paris have yielded scarcely any light upon the subject, although Assistant Hilgard, while in Europe, joined in every effort to obtain information.

During the voyage from San Francisco to San José del Cabo, Assistant Davidson seized every opportunity to obtain views of the points, capes, islands, and mountains on the coast, and made forty-two views from positions in the regular track of the steamers trading between California and Mexico.

Geographical and hydrographic reconnaissance, San Diego to Cape San Lucas.—In January, Assistant Davidson detailed from his party Sub-Assistant Wm. Eimbeck, Mr. T. J. Lowry, aid, and an efficient observatory hand, to accompany the steamer *Hassler* and make observations for determining the latitude, longitude, and magnetic declination, at points between San Diego and Cape San Lucas, Lower California. For this purpose, Mr. Davidson obtained from the Navy Department the use of twelve chronometers; seven were furnished from his own stock of instruments, and the observer had the use of five belonging to the *Hassler*. In order to obtain a preliminary traveling rate for the chronometers, Mr. Eimbeck made observations at San Francisco, and also at San Diego, where the work really commenced. The work along the western coast of Lower California embraced the occupation of fourteen astronomical stations, at six of which the magnetic elements were determined.

The following summary exhibits the statistics of the field-work commenced January 11, and terminated April 7: San Francisco, 49 star-transits on 4 nights; San Diego, 50 on 3 nights; Todos Santos Bay, 15 on 1 night, and 8 pairs of latitude-stars; San Martin's Island, 29 star-transits on 2 nights, 4 pairs of latitude-stars, and observations for magnetic declination; San Geronimo Island, 24 star-transits on 2 nights, and 6 pairs of latitude-stars; La Playa Maria, 15 star-transits on 1 night, and 13 pairs of latitude-stars; Lagoon Head, 14 star-transits on 1 night, 13 pairs of latitude-stars, and observations for magnetic declination; Cerros Island, 43 star-transits on 3 nights, 12 pairs of latitude-stars, and the magnetic elements; Cape San Lucas, 13 star-transits on 1 night, and 12 pairs of latitude-stars; San José del Cabo 15 star-transits on 1 night, 14 pairs of latitude-stars, and the magnetic elements; Magdalena Bay, 16 star-transits on 1 night, 10 pairs of latitude-stars, and the magnetic elements; Pequena Bay, 16 star-transits on 1 night, and 10 pairs of latitude-stars; Abreojos Point, 13 star-transits on 1 night, and 10 pairs of latitude-stars; Ascension Island, 20 star-transits on 2 nights, 8 pairs of latitude-stars, and magnetic declination.

The instruments used were the meridian instrument No. 1, which has proved itself well adapted for such work; and the theodolite magnetometer No. 3. The stars for time were taken from the field catalogue of 1,057 stars, prepared by Assistant Davidson, with mean places reduced to 1870.0. Observations for azimuth, in connection with the observations for magnetic declination were made on the Sun's limb. The stations were all permanently marked, and full descriptions and sketches have been filed with the records. Upon the return of the party to San Francisco, observations were made for the value of the micrometer screw of the meridian instrument, and for the value of the "finder" level divisions, as the delicate latitude-level had been broken by the blowing down of the portable observatory in a high wind on San Martin's Island.

During the voyage Messrs. Eimbeck and Lowry computed approximate results for the latitude and longitude. After the return of the party to San Francisco the records were duplicated and complete reductions and computations were made of all the observations. These results were furnished for the use of the hydrographic party, and give special value to the reconnaissance between San Diego and San José del Cabo, a stretch of the Pacific coast known to be very erroneously laid down on the most recent London charts, and a site of disaster to several steamships.

Magnetic observations at San Diego.—In November, 1872, Assistant Davidson sent his aid, Mr. S. R. Throckmorton, to San Diego, to determine the magnetic elements at the station occupied by the former in 1871, and to connect it with the present scheme of triangulation. The results point to a much larger annual increase than had been derived from previous discussions. Mr. Throckmorton recorded 64 observations for declination on three days; 32 for dip, with two needles; 30 for deflection; 27 for vibration. Observations for time were made with the sextant; and two stations were occupied with the theodolite.

Commander P. C. Johnson, United States Navy, Assistant Coast Survey, left San Francisco on the 15th of January, with his hydrographic party in the steamer *Hassler*. At San Diego, examination was commenced for the development of such dangers to navigation as might be found in the vicinity of the ordinary sailing route to Cape San Lucas. To the southward and westward of San Diego, and nearly five miles off shore, a kelp-patch was struck with eleven and three-quarter fathoms of water about it. Subsequently this locality was sounded, and the position of the kelp was marked on the chart.

Farther to the southward Todos Santos Bay was sounded by the party; and the shore-line, erroneous there as elsewhere on charts of the coast of Lower California, was carefully retraced, as was also the shore-line of Colnett Bay, where the steamer anchored on the night of the 28th of January. In passing southward, errors in shore-line, as given on the charts, were found to be larger, the most notable being at San Sebastian, Viscaino Bay, the shores of which were traced from the northward to a point opposite to Cerros Island.

At San Martin Island, where Subassistant Eimbeck was landed, with suitable instruments for determining its geographical position, his temporary observatory was blown away by a violent rain-squall on the night of the 1st of February. One side of the observatory was thrown a hundred feet across the rocks, and all the instruments were injured. While means were taken for repairing the damage as far as possible, soundings were made in the vicinity of the island. The dangerous rock reported to be near the route followed by vessels was found and developed. Commander Johnson states that it has only 9 feet of water on it, and that its position is south 3° east (magnetic) from the eastern end of San Martin Island, and distant 3.2 miles. While the party was searching, it was noticed that a vessel of less than 9 feet draught had passed directly over the rock. Before leaving the vicinity a map was carefully made of San Martin Island and of the adjacent coast, forty-five miles of shore-line being traced in passing from the island to Point Baja, where the steamer anchored on the 6th of February.

The position of San Geronimo Island, as determined by the observations of Subassistant Eimbeck, decidedly differs from that given on the London published chart. In fact, certain points marked on them, as prominent headlands, do not exist. The intention of the party in the *Hassler* was to determine in position such as were prominent, but of those so marked none were found conformable to the actual trend of the coast. The points, however, which were occupied by the party are well distributed; and the results, with the large amount of corrected coast-line, will avail for the speedy correction of the general sailing-chart of the coast of Lower California. Near Plaza Maria, the position of which was determined by the astronomical party, the shore-line was surveyed, and was found to differ greatly from the published outline. A point lower down, where a marked change occurs in the character of the coast, was named *Lagoon Head*, because of the large stretches of lagoon, which it is believed were formerly places of resort for whales. The position of the head was determined, and lines of soundings were run in the vicinity. Several days were passed in examining the waters near Cerros Island, while the party on shore made observations for its position and for determining the magnetic declination. Soundings were made in the passage between Natividad Island and Point Eugenio, in which passage a rock had been reported as having on it only 12 feet of water. During a heavy swell the channel was carefully observed, but the swell nowhere in it revealed such a danger. One heavy breaker was located for the chart, but the spot is much out of the channel, and is surrounded by kelp. The conclusion of Commander Johnson is that no dangers to navigation exist in this passage, except such as are well marked by kelp. Leaving Cerros Island on the 19th of February, the *Hassler* was kept on the usual route, going southward and eastward. In rounding Point Abreojos, soundings very suddenly shoaled from ten and a half fathoms to only four and a half, when the anchor was let go about three-quarters of a mile from shore. The reef and shoal in that vicinity were examined, and proved to be very extensive.

On the way southward Paymaster Stanton, of the steamer *Hassler*, made a panoramic sketch of the coast, specially including headlands and other landmarks, as material for engraved views to accompany the final chart of the coast of Lower California. At San José del Cabo Subassistant Eimbeck was landed, and determined the geographical position by the usual series of astronomical observations. The station was carefully marked, and by the president of the district and Eugene Gillespie, esq., United States consular agent, who visited the party on board of the *Hassler*, assurances were given to Commander Johnson that care would be taken to preserve the station-marks for any future purpose.

In turning northward from Cape San Lucas, no point on the coast was found suitable for landing the astronomer short of Magdalena Bay. Under favorable circumstances, landing was possible at Todos Santos River, but greater uncertainty attended re-embarkation; hence the first station occupied in the upward passage was at Magdalena, where John Ricketson, esq., resident there for several years, kindly put up a durable monument to mark the astronomical station. While the observations were in progress, Lieutenant Mansfield, of the hydrographic party, carefully examined the offing at Cape Redenda, and found that a rock said to be outside of the ten-fathom curve has no existence, the position of rocks inside of the ten-fathom curve having been probably misjudged by passing vessels.

Continuing northward, a station was occupied at Pequeña Bay, and from that bay to Abreojos Point the published erroneous shore-line was corrected. At Cerros Island the vessel stopped to test the run of the chronometers, after which the steamer passed on to San Diego. About five thousand soundings were made and recorded in the course of the reconnaissance. The shore-line surveys made by the party are comprised on five sheets. Off Point Loma search was made for a rock said to be only nine feet under water, but no rock was found.

Near Point Fermin, a rock reported by Captain Parker, of the Pacific Mail Steamship Company, was found and determined in position by the party in the steamer *Hassler*. This rock has seven feet of water on it. The vessel reached San Francisco on the 6th of April, and, needing repairs, was refitted for service on the northern part of the coast of California, as will be mentioned under another head.

Commander Johnson is now conducting hydrographic operations in the Santa Barbara Channel, assisted by Lieut. Commander C. W. Kennedy, U. S. N., and Lieutenants H. B. Mansfield, E. W. Remey, George W. Tyler, and J. D. Adams, U. S. N. Lieutenant M. S. Day, who joined the steamer *Hassler* in 1871, was detached from Coast-Survey service in May last.

San Diego Bay.—In November and December Mr. S. R. Throckmorton, of Assistant Davidson's party, determined the positions of the buoys which mark the entrance and approaches to San Diego Bay. By previous understanding with the local officers of the Light-House Board, as in all similar cases, the buoys, when found in their intended positions, are at once marked on the chart.

Triangulation and topography between San Pedro and San Juan Capistrano.—During the winter Assistant A. W. Chase was engaged in inking and tracing his topographical sheets of the coast between Chetko River and Mack's Arch, Oregon; computing the triangle sides and duplicating records. Four volumes were transmitted to the Office and two topographical sheets. On the 22d January, his party took the field for triangulation and topography on the shore of San Pedro Bay, from New River eastward. The country is very low and flat, and the coast bordered by broad marshes and intersected by sloughs, creeks, and small rivers. Secondary triangulation was extended from the main series developed in 1853 by Assistants Davidson and Ord. On the plains it was necessary to erect scaffolding upon which to mount the instrument. In this work measures were made from the two main stations to determine the position and elevation of peaks of the Sierra Madre, San Bernardino, and Temescal Mountains. The following are the statistics of the triangulation:

Signals erected	14
Stations occupied	14
Angles observed	66
Observations	1,010

The topography of one sheet, extending eastward from the work of last year, was carried to the Bolsas Chico, and on this the marsh-lines were traced out so as to include all the overflowed areas. The coast-line is a low, broad, sand beach. On this sheet the statistics are:

Miles of ocean shore	7¼
Miles of rivers	17
Area (square miles)	17

Before leaving the field for the North, Assistant Chase added to his previous plane-table sheet of Wilmington the improvements in that vicinity; the progress of the breakwater or jetty; changes in the shore-line of Rattlesnake Island adjacent, and the changes of the low-water line; all making a very interesting study. In his report he acknowledges the effective aid rendered by Mr. C. Uhlig. In May, Assistant Chase transferred his party to a site of work above Crescent City, mention of which will be made under the head of Section XI.

Triangulation and topography of Catalina Harbor.—In April, Assistant Chase went with his party to Catalina Island and completed the topographical survey of the harbor and its approaches from the north and south sides of the isthmus. The map represents elevations of 1,200 feet, with high, rocky, and precipitous shore-line; and embraces an area of two and a half square miles and four miles of coast-line. Mr. Chase discovered and located a dangerous sunken rock, having only four feet of water upon it at low-water, and lying about a mile to the westward of the north harbor. At the request of Assistant Davidson he also examined a peak of 1,730 feet elevation west of the isthmus, with reference to the practicability of occupying it as a station to connect with the main scheme of coast-triangulation.

Hydrography of New River and Anaheim River, California.—The bars to these rivers, which empty into the Santa Barbara channel, on the eastern side of San Pedro Bay, are crossed by boats and lighters in the transfer of passengers and freight. They were examined by Assistant Chase in April, and the depth was found to be inconsiderable; in fact, less than two feet at low water. The positions of the bars are constantly changing, and they are only crossed at high water. The approaches to the entrances were developed, and in this work sixteen miles were run in the boat, and 993 soundings were made, and adjusted by 36 angles, measured for position. Mr. Chase was aided in this work by Mr. C. Uhlig.

Triangulation and topography of Santa Rosa and adjacent islands.—Subassistant Stehman Forney remained in the field during the autumn, winter, and spring, engaged in the topographical survey of Santa Rosa island, and in completing the connection of the islands of San Miguel, Santa Rosa, and Santa Cruz by triangulation. The topography of the islands is executed upon a scale of $\frac{1}{20000}$, and detailed work is carried inland the usual distance; but, for the benefit of navigators approaching the coast, the interior topography of the island, embracing all the peaks, has been generalized. The coast-line of Santa Rosa is very bold, rough, and precipitous; the ravines, gulches, and slides are special features on the map. There are no large trees on the island, but scrub-oak, &c., grow in the gulches. The hills and table-lands are covered with herbage that supports a large number of sheep and some horses. A traced duplicate of the plane-table sheet of Santa Rosa Island has been received at the Office. The following are statistics of the work:

Signals erected	18
Stations occupied	12
Stations observed upon	48
Angular measurements	3,819
Miles of ocean shore-line	8½
Area of topography, (square miles)	39

Mr. Forney took the field on Santa Cruz Island early in October, and is now carrying on the detailed survey.

Topography between Gaviota Pass and Point Conception, California.—Assistant W. E. Greenwell was engaged during the winter in computing results from his field observations of the previous season and in inking and tracing the topographical sheets. In the spring he resumed the topographical survey at its western limit near the Gaviota Pass, and extended it to connect with Assistant Rockwell's former work at Point Conception. The detailed topography was carried inland to the usual limit; and to aid navigators in identifying this coast from a distance, the peaks and crest-line of the Sierra de la Conception, or Santa Inez Mountains, were determined and their topography generalized. This crest-line lies three or four miles from the shore, and, near the Gaviota, rises nearly three thousand feet, with unusually broken flanks and deep, rough gulches. The season was more or less boisterous, with much fog during the summer months, which retarded progress in the work. The statistics are:

Miles of ocean shore-line	20
Miles of streams	12
Miles of roads	11
Area (square miles)	47

Assistant Greenwell mapped in the wharves at Santa Barbara, San Buenaventura, and Goleta; and also surveyed the vicinity of the new town at Point Hueneme. Subassistant Eugene Ellicott was attached to his party. The field-report of Assistant Davidson acknowledges the aid rendered to his reconnaissance party by Mr. Greenwell.

Reconnaissance for main triangulation below Monterey, California.—After November, 1872, Assistant Davidson's party was engaged during several months, under charge of Subassistant Eimbeck, in reconnaissance for main triangulation to join the survey of Santa Barbara channel with that of Monterey Bay. The country traversed is marked at the south by mountain-ranges parallel with the coast of Santa Barbara channel, and reaching four thousand feet elevation. At the middle, just south of San Luis Obispo, the range is broken by irregular and interfering chains of mountains, nearly four thousand feet high. At the north are bold, high chains of mountains, parallel with the coast south of Monterey, and separated by the valley of the Salinas which runs to the northwest. Toward Point Pinos the western range, Sierra Santa Lucia, is bold, covered with chapparal, destitute of trails, and attains an elevation of 6,200 feet.

The plan of examination had been thoroughly explained by Assistant Davidson, and the scheme presented by Mr. Eimbeck, after a reconsideration of detail near Santa Anna Mountain, and at Gaviota by himself and Subassistant O. H. Tittman, and at Point Pinos by Mr. Throckmorton, aid, is very satisfactory. It embraces a full series of well-conditioned quadrilaterals, except where the mountain-chains interfere near San Luis Obispo. This series has been further developed by Assistant Davidson to the line *Santa Barbara, Santa Cruz west;* and connected with stations on the Santa Barbara Islands by a system of good secondary triangulation.

Soon after Subassistant Tittman reported for duty on the western coast, he took the field with the main triangulation party. At the date of Assistant Davidson's report Mr. Tittman was observing at a station on San Miguel Island, and observations for latitude and azimuth were in progress. He is aided by Messrs. W. S. Edwards and Thomas P. Woodward.

Magnetic observations at Point Conception.—Mr. S. R. Throckmorton, aid, under direction of

Assistant Davidson, determined the magnetic elements in December, 1872, at El Coxo, near Point Conception. For declination, 82 observations were recorded on 3 days; 32 for dip, with two needles; 30 for deflections; 27 sets of vibrations; two sets of sextant observations for time, and 16 observations on Polaris for azimuth. Assistant Davidson reports that the results for yearly change confirm those found for the San Diego station.

Triangulation and topography near San Luis Bay, California.—During the winter Assistant L. A. Sengteller was engaged in inking and tracing his topographical sheets, computing the triangle sides, and duplicating records. He has within the year transmitted to the Office twenty-one volumes of original records and computations, and the topographical sheet of his survey north of Point Arena.

In January, Mr. Sengteller transferred his party to San Luis Obispo Bay and resumed work to the southward of the previous season's limits. The triangulation was enlarged and developed to the Arroyo Grande, and the topography was extended from South Point in San Luis Bay to a point beyond the Arroyo Grande. The topographical features of the country are varied. As represented by the sheet, the western part is high, rolling land, with bluff shore-line, cut by numerous gulches; thence to the eastward runs a long line of sand-beach backed by sand-dunes, which become covered with chapparal and scrub-oak as they recede from the shore. Before closing operations for the season a survey was made of the vicinity of Barehill station from the sea-face to the summit of the mountain. The winter months were unfavorable, but weather improved as the spring advanced. Statistics of the work are as follows:

Signals erected	10
Stations occupied	9
Angles measured	53
Observations	867
Miles of ocean-shore line	$6\frac{3}{4}$
Miles of streams and ponds	14
Miles of roads and trails	12
Area (square miles)	$9\frac{1}{2}$

On the 5th of May this party was transferred to the upper part of the section near Noyo River, as will be mentioned presently. Mr. Sengteller was aided by Mr. H. I. Willey.

Latitude, longitude, and azimuth at San Simeon and San Luis Obispo, California.—In the spring Assistant Davidson detailed his aid, Mr. S. R. Throckmorton, to occupy the secondary astronomical stations at San Simeon and San Luis Opispo, for the determination of latitude and azimuth at one of the triangulation-stations of each locality.

At San Luis Obispo, Mr. Throckmorton occupied the station Avila, and with the twelve-inch theodolite No. 37, determined the azimuth of the line *Avila–West Base*, by 72 observations upon Polaris, near elongation. The time was determined by sextant observations.

At San Simeon station and with the same instrument, the azimuth of the line *San Simeon–North Base* was determined by 84 observations upon Polaris, near elongation, time being determined in the usual way.

The duplicate record of these observations has been received at the office. At both stations, Mr. Throckmorton was aided by Mr. W. S. Edwards.

Magnetic observations at Point Pinos.—In August and September Mr. Throckmorton, of Assistant Davidson's party, determined the magnetic elements at Point Pinos, where similar observations had been made by Mr. Davidson in 1851. In statistics, Mr. Throckmorton recorded 41 observations for declination on 3 days; 32 for dip, with two needles; 30 for deflections; 27 sets of vibrations; observations for time with sextant, and 15 observations on the sun for azimuth. The results found by Assistant Davidson indicate large yearly increase in the magnetic declination.

Triangulation and topography north of Piedras Blancas.—Assistant Cleveland Rockwell having previously completed his office-work and made suitable projections, took the field, in February, at Point Piedras Blancas, and carried the coast triangulation and topography to the northward, near the southern extremity of the Santa Lucia range of mountains. He made a reconnaissance along the seaward face of this range for eighteen miles beyond the Arroyo San Carpofero, and his observations confirm the previous descriptions of this bold, wild range.

The position of the Harlech Castle Rock, as determined by Assistant Rockwell, corresponds to that given by the preliminary survey of the late Assistant Cordell. The wreck of the *Sierra Nevada* was also located upon the plane-table sheet. The Arroyo La Cruz and San Carpofero are both considerable streams, with deep channels between high hills, which rise sharply to 500 and 600 feet elevation. The weather during the winter and spring was very boisterous, and retarded field-work; nevertheless the triangulation was carried from Point Piedras Blancas to Valenzuela, beyond the Arroyo Carpofero, and angular measurements were made upon mountain-peaks for position and elevation. The following are statistics of the work:

Signals erected	10
Stations occupied	13
Angles measured	86
Points determined	22
Observations	1,347
Miles of ocean shore-line	5½
Miles of roads	6½
Area, (square miles)	6

Assistant Rockwell was aided in this section by Mr. George H. Wilson, who is commended for zealous and efficient services in the field and in computation.

At the close of the summer season, this party was transferred to the Columbia River, as will be mentioned under Section XI.

Longitude observations, San Francisco, California.—For determining the difference of longitude between San Francisco and Kalama, on the Columbia River, Oregon, Assistant Davidson occupied the astronomical station in Washington Square, San Francisco. The station at Kalama was occupied by Sub-Assistant Eimbeck, whose operations will be noticed further on in this report.

The instruments used in this service were the Kessel clock, 1449; Hipp chronograph, 3753; and transit No. 3. The manager of the Western Union Telegraph Company gave the use of the line free of charge, at the request of Mr. Davidson.

Unusually foggy weather delayed the requisite astronomical observations, but they were completed by the 1st of October. Clock-signals were transmitted each way during six nights, and simultaneous time-observations were recorded. For instrumental and clock corrections Mr. Davidson recorded, during fourteen nights, 206 transits of 78 stars, over twenty-five threads, filling thirty-nine chronograph sheets. Observations for personal equation were made after Mr. Eimbeck's return from Kalama.

To assist observers in placing the transit instrument approximately in the plane of the meridian at any time, Assistant Davidson completed a table of the azimuth and apparent altitude of the Pole star at stations between latitude 30° and latitude 60° for each fifteen minutes of hour angle. This table has been printed for general distribution to observers.

Magnetic observations at San Francisco.—In 1852, Assistant Davidson determined the magnetic elements at the astronomical station, Presidio, near San Francisco. Under his direction, Mr. Throckmorton repeated the series of observations which had been renewed in December, 1871, and recorded 71 observations for declination on 3 days in October, 1872; 80 on 3 days in June, 1873; 67 on 3 days in July, 1873; 86 on 5 days in August, 1873.

The results of the field-computation indicate, as do those at all other stations on the western coast, that the annual increase of the magnetic declination has been about 2′.5 since 1850; and they are especially interesting as showing that the maximum easterly declination is nearly, if not quite, attained.

Topography of Table Mountain, San Francisco entrance.—After completing his office-work of the preceding season, Assistant A. F. Rodgers resumed field-work as early as practicable in the spring, and completed the detailed survey of Table Mountain, including its two principal peaks, the altitude of which was found to be twenty-six hundred feet.

This mountain, on the north side of the Golden Gate, is one of the notable land-marks for vessels approaching San Francisco Bar. As it presents from different points varied peculiarities, the flanking-spurs were represented on the plane-table sheet by Mr. Rodgers. The sides of the mountain are extremely rocky, with strongly-marked gulches. This survey, which was completed in April, includes an area of seventeen square miles. The subsequent operations of the party of Assistant Rodgers will be mentioned under another head.

Sand-dunes of San Francisco Peninsula.—In order to secure means for noting the progress of the sand-dunes in their encroachment upon the peninsula of San Francisco, especially those now advancing toward the city of San Francisco, Assistant Rodgers, who had made the original topographical survey, retraced the present outline of this great sand-drift, planted a number of properly marked stone-blocks in advance of its outline, and determined their relative positions. Annual or biennial examinations will henceforth be made to measure the rate of travel of the sand-drift. In this work, Assistant Rodgers was aided by Mr. E. F. Dickins. The sand-dunes are represented on a plane-table sheet of the scale used in the Coast Survey.

Hydrography of San Francisco Bay and approaches.—In the latter part of January, throughout February, and during parts of April and May, Assistant Gershom Bradford was engaged in noting the surface and subsurface currents of the water in San Francisco Bay. The observations at each station were made night and day for a given period, and the times and stations are well connected. This work includes also a series of observations in regard to the currents on and around South ampton shoal. Of the following particulars, most have been plotted in graphical form, and the sheet exhibits very marked peculiarities in hydrography.

Stations occupied	19
Angles and bearings of directions	3,249
Observations of currents	3,247

During three weeks in March, the party was employed in the vicinity of the wreck of the English ship *Patrician*, which struck on the outer end of the Four-fathom bank and was lost. This wreck had become a serious danger to navigation. After its separation into two parts, one was traced and was found to be harmless in deep water; the other was found by the aid, Mr. Ferdinand Westdahl, on the Four-fathom bank, near where the vessel had been run to save her from sinking. The exact position of the part of the wreck which is dangerous was determined and made known, for the benefit of navigators. In the operations needful, Assistant Bradford with his party, in the schooner *Marcy*, had also the use of the steam-tug *Sol Thomas*, which co-operated for the service without charge; and of the United States revenue-cutter *Wyanda*. In June, the hydrographic party was transferred to the vicinity of Humboldt Bay, for off-shore work, mention of which will be made under a subsequent head. In August, the schooner *Marcy* being unseaworthy, Assistant Bradford was directed to charter a tug and make a detailed survey of the approaches, the bar, and the Golden Gate of San Francisco Bay. This work was begun on the 7th of October, after the erection and determination of a sufficient number of signals for such service, and is well under way.

Enough has been done to indicate that important changes have probably taken place, and that the labor and care bestowed make this survey invaluable as a basis for future comparisons. At the date of Mr. Bradford's last report the weather continued favorable for soundings and for observing currents under apparently normal conditions. The following are statistics:

Signals erected	8
Stations occupied	18
Angular measurements	4,607
Soundings	7,900

Tidal observations.—The three permanent tidal stations on the western coast are yet under the care of Col. G. H. Mendell, United States Engineers. By the intelligent interest of that officer, the self-registering gauges have extended the series of observations. The gauge at Fort Point, near San Francisco, has worked remarkably well in the hands of the observer, Mr. E. Gray, who has also continued the series of meteorological observations. Both sets of observations have been regularly tabulated by the observer.

For suggestions of special value in regard to the tidal stations on the Pacific coast I am indebted also to Assistant George Davidson, whose recommendations have been met by the able co-operation of Colonel Mendell.

Hydrography of Cordell Bank.—In May Assistant Bradford was directed to extend soundings in the vicinity of this bank, but, on account of his illness, the duty devolved upon his aid, Mr. Westdahl, who conducted the work in the schooner *Marcy.* Good weather during part of the time served for determining the position of the bank, by observing mountain signals of the main triangulation, and by subsequent soundings the bank was developed beyond the limits of former work. Bad weather, however, set in before the completion of all the soundings deemed needful in that vicinity. The temperature of the water and the currents were incidentally noted, while the party was on the bank. About the middle of June last, the mean temperature of the water was 49° Fahrenheit.

Falmouth Shoal.—The site of a reported shoal in the Pacific, between the parallels 37° 15′ and 37° 38′ north, and between the meridians 137° 05′ and 138° 10′ west, has been again examined, but without finding any spot corresponding to that reported by the ship *Falmouth* several years ago. Commander Johnson, with the steamer *Hassler,* made 109 casts of the lead in the vicinity, but without finding bottom in 2,400 fathoms. In reference to the results of his examination, that officer says: "Lookouts were constantly aloft, but no indication of shoal water could be discovered. We frequently saw discolored water, caused by the shadow of a cloud. While on the ground we sighted, ran alongside of, and examined a saw-log of Oregon pine, squared at each end as for the saw-mill. The log, about twenty-five feet long, and more than two feet in diameter, was thickly covered with barnacles and mussels, except at the surface, and the influence which brought the log would naturally bring kelp to that same locality."

The steamer ran fourteen hundred miles during this examination, which was commenced on the 24th of May and occupied the hydrographic party until the middle of June.

Triangulation and topography north of Mendocino Bay.—After quitting the field near San Luis Obispo Bay, as stated under the preceding head, Assistant Louis A. Sengteller completed the office details pertaining to that survey, and transferred his party to the vicinity of Mendocino Bay, to resume the topography and triangulation from the northern limits of his previous work.

The shores of this part of the coast of California are moderately high bluffs bordered by innumerable rocks. From the flanks of the adjacent mountains the timber comes well down toward the shore-line, and adds to the difficulty of pushing triangulation along the ocean front. To avoid expense in opening lines, one of the stations occupied by Mr. Sengteller with the theodolite was upon a tree 103 feet above the ground. After determining a sufficient number of points the plane-table survey was extended along the coast from Russian Gulch to Pudding Creek, or several miles above the mouth of Noyo River. This survey includes the light-house site at Point Cabrillo, and the landing-places at Caspar Creek and Noyo River, at each of which, saw-mills now cut a daily average of thirty thousand feet of lumber. The landings afford tolerable shelter for vessels from the prevailing winds of summer, but are uncertain in winter, and in that season are unsafe. After extending the topographical survey as far as practicable, Mr. Sengteller, aided by Mr. Willey, pushed a tertiary triangulation to connect his work with that of Assistant Rodgers, whose party was employed to the northward. Both parties were yet in the field when the last reports from the section were received. The statistics of Mr. Sengteller's work are:

Signals erected	15
Stations occupied	25
Angles measured	211
Number of observations	3,315
Miles of shore-line surveyed	19
Miles of streams and ponds	8½
Miles of roads and trails	15½
Area of topography (square miles)	8½

Triangulation and topography between Noyo River and Shelter Cove, California.—As mentioned under a preceding head, Assistant A. F. Rodgers completed his office-work in the course of the winter of 1872, and early in the following spring took the field in the vicinity of San Francisco. In July, he transferred his party to the coast of California, north of Noyo River entrance, and resumed work where his operations had been closed in the preceding season. The region is wild, almost uninhabited, and destitute of roads. Mountain spurs, high, broken, and abrupt, covered with heavy timber and dense chapparal, came down boldly to the shore of the ocean. Advance in any direction on land was difficult, and the natural obstacles to progress were increased during the summer by prevailing fogs. As autumn approached the weather became more favorable. Assistant Rodgers pushed the needful triangulation, while his aid, Mr. E. F. Dickins, worked with the plane-table. The party, when the last report was received, was yet in the field, Mr. Rodgers intending to join his work with the survey which Assistant Sengteller was conducting along the coast from the southward. Statistics given in the field-report of Assistant Rodgers are:

Signals erected	38
Stations occupied	25
Objects observed on	53
Angles measured	303
Number of angular measurements	11,755

The three plane-table sheets now with the party represent twenty-four miles of the coast of the Pacific, and in detail an area of 13 square miles.

Off-shore hydrography near Humboldt Bay.—In December, 1872, while the schooner *Marcy* was under repairs, Assistant Bradford dispatched his aid, Mr. Westdahl, to watch in heavy weather, and determine the position of any undiscovered rocks off Cape Mendocino. In the course of a month he discovered five dangerous rocks, and saw the great swell of the Pacific breaking in two localities over large areas of ground on which subsequent soundings showed from 9 to 10 fathoms of water. He made 164 observations for the positions of ten sunken rocks, which had been indicated by sharp, distinct breakers.

Late in June the party sailed in the vessel for Humboldt Bay to prosecute the off-shore hydrography; but after the requisite operations on shore, the schooner was found to be unseaworthy, and returned to San Francisco in the middle of August. Before leaving Humboldt Bay, Assistant Bradford had erected twenty-one signals, and occupied five stations for conducting the off-shore hydrography. The work done after the return of the party to San Francisco has already been mentioned.

Hydrography off Crescent City, California.—The steamer *Hassler*, with the hydrographic party of Commander P. C. Johnson, United States Navy, Assistant in the Coast Survey, reached Crescent City early in July. Fogs and winds much interrupted progress in the soundings intended to be made in the vicinity. It was found, consequently, impracticable to run lines off shore to deep water, the needful signals being usually invisible when the vessel was only a mile or two from land. The reef off Crescent City was, however, thoroughly developed, and additional soundings were made in its vicinity. Tidal observations were recorded at Crescent City until the end of September, when the steamer returned to San Francisco. Under the head of Section XI, mention will be made of other surveys made by Commander Johnson.

Reconnaissance and triangulation from Rocky Point to Klamath River.—Late in the season, Assistant A. W. Chase transferred his party from the vicinity of Cape Sebastian, in Section XI, to the Klamath River, and made a reconnaissance and preliminary triangulation along the coast of California from the False Klamath to Rocky Point, north of Trinidad Bay, incidentally sketching in the shore-line and approximately locating the rocks along the coast. The shores traversed by his party being high, and covered with heavy timber from the mountain-crests inland, afford scanty means of carrying on the tertiary triangulation. Mr. Chase, however, found that a satisfactory trigonometrical connection can be effected between the Crescent City survey and the work on Humboldt Bay. In this reconnaissance, 725 preliminary angles were measured from the selected stations. The statistics of triangulation completed from False Klamath to a point two miles south of the Klamath River are:

Signals erected	8
Stations occupied	6
Angles observed	27
Observations	327

Assistant Chase was in the field at the date of his report. During the season he was aided by Mr. Paul Schumacher.

Aids to navigation.—In the course of the year Assistant Davidson has communicated for the information of the Light-House Board his views upon the best sites for light-houses and other aids to navigation on the western coast. His recommendations have included the erection of a light-house at Point Cabrillo, and of others in Admiralty Inlet, Puget Sound, and Hood's Canal, in the order of time in which the necessities of commerce may require them; a fog-whistle abreast of the southern limit of the bar of San Francisco Bay; a buoy to mark the wreck of the ship *Patrician* on the Four-fathom bank, near the Golden Gate; and a fog-whistle at the entrance to Humboldt Bay.

Subassistant George Farquhar has been employed, under the direction of Assistant Davidson, in making projections for the geographical reconnaissance of the western coast of Lower California, and projections for the inshore and offshore hydrography of the coast north and south of Crescent City reef. On these were plotted about two hundred trigonometrical points, the positions of which had been determined by field observations. He has also duplicated the numerous coast-views obtained by Mr. Davidson, exclusive of nearly one hundred views of points on the coast of Lower California and of the eastern shores of the Gulf of California kindly lent by Capt. William Metzgar. Of Scammon's Lagoon and others on the coast of Lower California, of which maps, with sailing directions, have been completed by Capt. C. M. Scammon, of the United States Revenue Marine, copies were made by Mr. Farquhar and filed in the archives. He has furnished the numerous tracings required in the operations of the field and hydrographic parties, and, under the inspection of Mr. Davidson, compiled data for the study of the great warm stream of the Pacific which passes the coast of Japan.

SECTION XI.

COAST OF OREGON AND OF WASHINGTON TERRITORY, INCLUDING THE INTERIOR BAYS, PORTS, AND RIVERS. (SKETCH No. 16, bis.)

Triangulation and topography between Mack's Arch and Rogue River, Oregon.—After closing at San Pedro Bay in Section X, Assistant A. W. Chase was engaged for a month in computations and other office-duty pertaining to his previous field-work. He took the field in July in the vicinity of Mack's Arch, and erected signals for a scheme of triangulation turning on Northwest rock of the Crescent City Reef; but bad weather prevented observations with the theodolite. This part of the season was employed in pointing out the localities of the stations of previous years for the use of Commander Johnson, chief of the hydrographic party. The tertiary triangulation was subsequently extended from Crook's Point to Cape Sebastian, and from thence Mr. Chase made a reconnaissance to Rogue River. This work was conducted over one of the roughest stretches of the coast of Oregon. The region is sparsely settled and without roads. The following are statistics of the triangulation:

Signals erected	18
Stations occupied	16
Angles observed	95
Observations	1,295

The topography was carried from Crook's Point to Cape Sebastian. A tracing made by plane table reconnaissance of Hunter's Cove anchorage was furnished to the hydrographic party. Mr. Chase also made sketches of Chetko River entrance and anchorage from seaward.

Hydrography of Hunter's Cove and Chetko entrance, Oregon.—An anchorage, with good shelter for small coasting-vessels, under Cape Sebastian, and of which the shore-line was traced this season, as already mentioned, was carefully sounded out by the hydrographic party of Commander Johnson, with the steamer *Hassler*. This anchorage is locally known as Hunter's Cove. Schooners can anchor safely under the lee of the island during stiff southeast winds.

Of Chetko Cove, which was also developed by soundings, Commander Johnson reports: "This is an excellent summer anchorage; even preferable to that at Crescent City, in case of a southeast wind, as there is more room for a sailing-vessel to work."

While soundings were in progress in the vicinity, simultaneous observations for high and low water were recorded from July 17 until August 25 at Hunter's Cove and Chetko entrance.

Latitude, longitude, and azimuth at Kalama, Oregon.—In August, Assistant George Davidson detached Subassistant William Eimbeck and Mr. T. J. Lowry from his party to occupy a station at Kalama, on the Columbia River, for the determination of longitude. As already stated, Mr. Davidson remained at San Francisco and exchanged signals by telegraph. The triangulation of the Columbia River includes the astronomical station of 1851 at Cape Disappointment, and is also connected with the survey of Shoalwater Bay. As heretofore, the Western Union Telegraph Company accorded the free use of their lines for this service. The season was favorable for work on the Columbia, but continuous fogs prevailed at San Francisco, so that on several nights when clock-signals were transmitted, one observer or the other was unable to make observations for time. At Kalama, transits were observed upon 18 nights, and signals were transmitted on 6 nights, when time observations were complete. The whole number of transits was 371, upon 30 stars, with the Davidson meridian instrument No. 1. The registry was made on the Hipp field-chronograph No. 4848, with the Frodsham break-circuit chronometer No. 3479. After completing these, observations were commenced for latitude with zenith telescope No. 1, and continued for 10 nights. The total number of observations was 155, upon 30 pairs and triplets. The reduction of this work is now in progress. Azimuth observations were completed in 6 nights, the record showing 120 measures for angle between the mark and Polaris, near eastern elongation, with the twelve-inch theodolite No. 37, and 92 observations for time with the sextant.

Subassistant Eimbeck, after closing at Kalama, transferred his party to Cape Disappointment.

Triangulation of the Columbia River.—In May, Assistant Cleveland Rockwell transferred his party from the southern coast of California to the Columbia River to continue the work of previous seasons. As it was important to adjust the survey of the Columbia by observing at a point for longitude, instead of continuing the topography of the river shores, the triangulation was pushed forward from Westport to Kalama a distance of 32 miles. At the last-named point the Northern Pacific Railroad leaves the Columbia River and passes northward toward Puget Sound. The valley of the Columbia is heavily wooded, and progress through it is impeded by a dense undergrowth. The old limits of the river are steep, rocky, basaltic banks, heavily timbered, wherever trees can find room. Within the original banks lie extensive timbered flats, and broad marshes everywhere cut up by sloughs. A boat furnished the only means of transportation for the party, and the work was consequently very laborious, especially when the freshets of June were running. In making the reconnaissance and reaching the stations, the only practicable route was through sloughs. Lines of sight had to be opened from each station, and every forward line was studied under great disadvantages; but the sketch of the triangulation exhibits a satisfactory scheme, and the progress made is evidence of special energy in the service. On the Columbia the weather was favorable, and only a few days were lost by reason of the prolonged smoky season. The following are statistics of the work:

Signals erected	34
Stations occupied	29
Angles measured	129
Points determined	40
Observations	4,640
Vertical angle-observations	250
Heights determined	40

After connecting his triangulation with the point occupied by Subassistant Eimbeck, at Kalama, for determining longitude, Assistant Rockwell returned to San Francisco, and is again engaged on the southern coast of California. He was aided in both sections by Mr. Geo. H. Wilson.

Magnetic observations at Cape Disappointment, Washington.—After closing the service mentioned under a preceding head, Subassistant Eimbeck and Mr. Lowry occupied the two magnetic stations at Cape Disappointment, where Assistant Davidson had determined the magnetic elements in 1851. The records of this season include 332 observations upon 9 days for declination; 125 observations for deflection; 100 for vibration; and 248 observations for dip, with two needles. The azimuth was determined by 41 observations on the sun, and the local time by 72 double altitudes with the sextant. From Cape Disappointment the party returned to San Francisco and engaged in the computations.

Triangulation and topography of Shoalwater Bay, Washington.—Subassistant J. J. Gilbert, after inking and tracing his topographical sheets and reviewing the field-computations of his triangulation of the coast of Washington Territory, took the field in April, and prosecuted work in Shoalwater Bay southward to connect with the survey of Columbia River. In order to do this, it was necessary to open nine avenues for lines of sight through dense fir forests, that cover the hills and low ground. The labor was great, but is repaid by the satisfactory junction of the two surveys. Both are now in known geographical relation by determinations made this season for the longitude of a station at Kalama, on the Columbia River. The following are statistics of Mr. Gilbert's triangulation:

Signals erected	35
Stations occupied	27
Angles measured	179
Objects observed upon	151
Observations	4,920

The topography on four sheets represents the shores of Shoalwater Bay southward from the limits of the last season's work and connects with the plane-table survey of Baker's Bay. The statistics are:

Miles of ocean and bay shores	52
Miles of sloughs	25
Miles of roads	5
Area (square miles)	32

Near the close of the season Mr. Gilbert started on a reconnaissance to examine the coast between Point Adams and Killamook, with reference to the practicability of conducting triangulation. He was engaged in that service at the date of his last report on field-work.

Tidal observations. The excellent series of tidal and meteorological observations made at Astoria have been continued by Mr. L. Wilson, under the supervision of Major G. H. Mendell, of the Corps of Engineers, Bvt. Col. U. S. A., who has ably carried out the plans furnished from the Office. The tabulations of high and low waters and the hourly readings are now made by the observer.

The self-registering gauge formerly used at San Diego has been put up at Port Townshend by Assistant Lawson, and is now working regularly. Mr. Wilson left Astoria for a few days to assist Mr. Lawson in this work and to instruct the observer, Mr. L. Nessel, who also tabulates the tidal registers and keeps up a series of meteorological observations.

Triangulation and topography of Puget Sound, Washington.—During the winter of 1872, Assistant James S. Lawson was engaged in computing the results of his field-observations of the previous year, and in inking and tracing the topographical sheets, duplicating records of observations, and making projections for work during the present season. Early in the spring he took the field for the triangulation, topography, and hydrography of Budd's Inlet and its approaches. The work includes the town of Tumwater, at the extreme southern end of Puget Sound, the town of Olympia, and the village of Swantown. In the immediate vicinity of the inlet the shores are thickly wooded, and covered also with a dense undergrowth, but the "logging roads" afforded tolerable means for carrying on the topography, of which the following are statistics:

Miles of bay-shore line	33½
Miles of roads	30
Area (square miles)	12

At station *Cooper*, between Budd and Eld Inlets, Assistant Lawson made 114 observations, by double zenith distances, for determining the approximate positions of the north, south, and middle peaks of Mount Rainiér, and the highest point of Mount Saint Helens.

In the field-work, and in office-reductions, Assistant Lawson was efficiently aided by Mr. Fred. A. Lawson. The party had the use of the brig *R. H. Fauntleroy*.

Hydrography of Puget Sound, Washington.—After completing the topography of Budd's Inlet, Assistant Lawson took up and prosecuted the hydrography of the inlet and its approaches, and was so engaged until the close of the season. Fogs and smoke retarded the progress of the work. The survey extends four miles northward of Olympia, and soundings have been made quite numerous on account of the proposed reclamation of the "flats" near Olympia. The hydrography includes also the terminus of one of the branches of the Northern Pacific Railroad. While soundings were in progress, Assistant Lawson kept up a series of tidal observations. The following are statistics of the hydrography:

Angles measured	691
Number of soundings	13,650

SECTION XII.

COAST OF ALASKA TERRITORY. (SKETCH No. 17.)

Reconnaissance of the coast of Alaska.—Further progress has been made in the development of the coast of Alaska, by a party under the direction of Assistant W. H. Dall. An outline of the operations of the season will be found in the appended extracts from his report.

With the schooner *Yukon*, which had been fitted out under his immediate supervision, Mr. Dall left San Francisco on the 28th of April, and reached Iliuliuk on the 20th of May, making the shortest run yet known between the two points. On the voyage very heavy weather was encountered, lasting nearly a week, and a calm which lasted three days.

"We made land when seventeen days out near the Saunakh reefs, and during the calm discovered a bank lying some distance off shore with thirty-eight fathoms of water and gravelly bottom. Here we found cod and halibut of large size and good quality in great abundance. We obtained a good series of observations, fixing the position, and approximately determining the southern and eastern limits of the Saunakh reefs. Within the limits of the bank, and between it and the shore, we found depths of 75 to 100 fathoms."

Mr. Dall remarks that this shoal ground in respect of distance from the nearest land corresponds with several other banks already known; in particular one off the southern end of Kadiak; another discovered by Assistant Davidson in 1867 off Unimak; and a third, known as the "offshore ground" of the Shumagin fishermen; and from this correspondence at four places he infers the existence of a submarine ridge running parallel with the peninsula, from Unimak eastward.

"Current observations were kept up during the voyage, the results tending to confirm the observations of previous years." * * * * * *

"The past winter in this region, as in the eastern United States, has been one of unusual severity; and the season was fully a month later than the average. Field-ice on the 20th of May in Behring Sea reached to within 130 miles of Unalaska, and was from 10 to 40 feet in height above the water. This has not been paralleled since 1831, according to local tradition and the church records." * * * * * * *

"After rating our chronometers, we sailed from Unalaska for the Western Islands, and visited in the course of the summer nearly all the harbors previously known. A new and excellent one was discovered at the island of Adakh. Returning to Unalaska, we obtained the summer rate of the chronometers, and, proceeding to the Shumagins, continued at work until the autumn storms rendered it advisable to close operations for the year." During a tremendous gale on the 12th of October, the *Yukon* was held by three anchors in Humboldt harbor, which had been surveyed by the party last year, but the schooner *William Whelan* was driven ashore and totally wrecked at Unga, twelve miles to the southward. On receipt of a note which Captain Holder had sent by a native, Assistant Dall promptly went to the site of the disaster and brought the captain and crew of the wrecked vessel, on the schooner *Yukon*, to San Francisco.

In advance of sailing for Alaska the attention of Mr. Dall had been requested for the selection of a site proper for landing a telegraph-cable intended to traverse the Northern Pacific. This service his large experience in the operations of the Western Union Telegraph Company in previous years enabled him to perform to the satisfaction of the agents of the enterprise. A site was chosen for a telegraph-station on the island of Kyska, and the harbor and its vicinity were carefully surveyed.

"We obtained over a thousand astronomical observations during the season, and nearly as many for magnetic elements. The latter show an average decrease in the declination of more than two degrees at most of the stations, since observations were last taken, more than twenty years ago. Our stations are at nearly even distances from the Shumagins to the western end of the chain."

"Deep-sea soundings were made wherever opportunity offered, and much greater depths were found than any previously reported in Behring Sea. We found, too, the deposition of Globigerina mud, or recent chalk-formation, going on at the depth of 800 fathoms."

Soundings made by the party in the *Yukon* disprove the existence of the Bogosloff reef, which has been marked on previous general charts as extending for twenty miles from Unimak. "We found 800 fathoms and no bottom on the exact line of the supposed reef less than ten miles from the island."

The report of Mr. Dall includes special mention of the energy, interest, and competency displayed by Mr. Marcus Baker, the astronomical aid in the party, who lost no opportunity for securing results. Much of the season was passed amid rains and fogs, but a large store of important hydrographic particulars has been gathered, and the positions of most of the prominent volcanic peaks were determined approximately, as landmarks for charts.

The schooner *Yukon* arrived at San Francisco on the 6th of November, after a passage of eighteen days, from the Shumagin Islands. Assistant Dall and his aid, Mr. Baker, are now engaged in the computations and other office details pertaining to the operations of the present year on the coast of Alaska.

The report made by Mr. Dall, after his return to San Francisco, is given in the Appendix, No. 11.

Tidal observations.—The self-registering gauge intended to secure a series of observations at Saint Paul's Island, in Behring Sea, arrived there in April, 1872, but unfortunately the fastenings of the clock-face had given way in the transit, and thus some parts of the apparatus had been injured. Capt. Charles Bryant, to whom the instrument was consigned, repaired the clock as far as possible in the absence of ordinary facilities, and put the tide-gauge into working order at Village Cove, on the western side of the island, where it was fastened to a crib of timber filled with stone. A bench-mark was established on a rock near the crib. With occasional stoppages, owing to the injury which the clock had received on its passage, the times and heights of the tide were recorded during June, July, and August of 1872. After that the record was more frequently interrupted by defect in the moving apparatus, and Captain Bryant, who had done the utmost to preserve continuity of the record, was constrained to remove the instrument in the middle of December. Soon afterward the northern drift-ice from Behring Sea, swept in by southwest winds, filled the cove, and in loosening with the approach of spring carried away the crib which had been constructed to sustain the tide-gauge. The records for six months, of which the last three are marked by numerous interruptions, have been received at the office.

COAST SURVEY OFFICE.

The operations of the Coast Survey Office have been conducted, as for many years past, by Assistant J. E. Hilgard, who resumed their immediate direction upon his return from Europe at the beginning of November, relieving Assistant C. S. Peirce from temporary charge of the Office.

The organization of the different divisions of the Office has remained unchanged. The following statement gives a succinct account of their operations during the past year, which have fully kept pace with the advance of the field-work.

Hydrographic division.—The planning and verifying the work of sounding-parties is under the immediate direction of Capt. C. P. Patterson, inspector of hydrography, who also has charge of the construction, repairs, and disposition of the vessels belonging to the Coast Survey service. The office-work under his direction, consisting of plotting and drawing of hydrographic charts from the field-records, has been performed by Mr. E. Willenbücher, the principal hydrographic draughtsman, who has also verified all reduced drawings of hydrography, and has prepared all notes relating to lights, buoys, and sailing-directions for the published charts. In drawing the charts from original notes, he was assisted by Mr. J. Sprandal.

Computing division.—The computing division of the Office has been continued in charge of Assistant Charles A. Schott, with the same general organization as in preceding years. The special duties assigned to the computers may be stated, in general, to have been as follows: To Assistant T. W. Werner, the computation of current work connected with triangulations; to Dr. G. Rumpf, the comparison of field and office computations of geodetic work, and charge of registers of results; to Mr. J. Main, the comparison of astronomical computations of time, azimuth, and latitude determinations; to Mr. E. H. Courtenay, the least squares adjustments of completed triangulations; to Prof. R. Keith and Mr. F. Hudson, temporary computers, the reduction of astronomical observations; and to Mr. H. H. Gerdes, the clerical work of the computing division. The direction and examination of computations and the duty of making special discussions after, and reporting the results reached, devolved upon Assistant C. A. Schott. During the temporary absence of Assistant Hilgard, Assistant Schott was acting assistant in charge, between August 11 and September 8. Respecting the *personnel*, the following changes have occurred during the year: Dr. F. Kampf gave up his connection with the survey March 31; Mr. M. H. Doolittle was temporarily engaged between April 21 and June 11, and took permanently the position vacated by Dr. Kampf, on September 1; Mr. W. B. French was assigned to field-duty March 6, and his position in the Office was filled by Mr. H. H. Gerdes, from that date; Mr. L. P. Shidy was temporarily connected with the computing division between July 19 and August 19, when he was transferred to the tidal division; Mr. C. L. Gardner was temporarily assigned to duty on September 1.

Of the special discussions made by Mr. Schott, the following may be mentioned: Results of hypsometric measures taken at Bodega Head and Ross Mountain, in 1860 and 1872, by Assistant G. Davidson, (a joint paper with the observer;) results of the secular change of the magnetic declination at various stations; adaptation of triangulations to various conditions and configurations of the earth's surface; results of the secular change of the magnetic declination, dip, and intensity, at Washington, D. C.; results of differential observations of the magnetic declination made by Dr. Walker, at Fort Steilacoom, in 1866, and at Camp Date Creek, Arizona, in 1867. He also made, on three days, the usual magnetic observations at Washington, and, in connection with these, tested the accuracy attainable with the $2\frac{3}{4}$-inch Casella theodolite, in observations for astronomical latitudes and azimuth.

Tidal division.—The duties of this division, consisting of the reduction of the tidal observations taken at the several established stations on the Atlantic and Pacific coasts; the prediction and publication of tide-tables for the principal ports of the United States; the preparation of all data relative to tides required for use in office and field work; correspondence with observers and in reply to inquiries; inspection of new apparatus, and the general supervision of the service, have been continued under the charge of Mr. R. S. Avery, who has been assisted in the computations by Messrs. J. Downs, A. Gottheil, C. Ferguson, L. P. Shidy, and Miss M. Thomas. The particulars relating to the permanent tidal-stations, and observers at the same, have been mentioned under the heads of the respective sections in which they are situated.

The amount of office-work has been much reduced of late, by instructing the observers to tabulate the high and low water as well as the height of the ordinates for every hour on suitably-prepared blank forms. This is done by the observers at North Haven, Fort Monroe, Fort Point, (San Francisco,) Astoria, and Port Townsend; and it would appear that the character of the observations has been sensibly improved by their attention being directed to the inconvenience of occasional failure. The tide-gauges of the new form, with cylinder revolving once in twenty-four hours, receiving a week's record, have been specially provided with all that is requisite for tabulating conveniently and accurately. Where these tables have not been made by observers, they have been made in the Office as soon as convenient. The primary reductions for all the observations are made soon after they are received, and the results put in a shape convenient for use when wanted. The duplication of hourly readings is completed for North Haven, Santiago, Fort Point, and Port Townsend, and nearly up to date for Boston and New York. For the latter places only selected years have been read, the earlier ones being too imperfect. The missing places in the Fort Point and Santiago series have been interpolated by curves.

On application of Mr. E. Roberts, of the British Nautical Almanac office, a copy of hourly readings of tidal observations at Fernandina, Fla., for one year, and of those at Santiago, Cal., for two years, were sent to him, to enable him to apply to them the new harmonic analysis of Professor Thomson, which had been used very successfully on several series of British observations, and on some of our own, previously sent to him.

The Tide-Tables annually issued, containing predictions of tides for the principal ports of the United States during the ensuing year, have been computed for 1874, under Mr. Avery's supervision, and published. The predictions for Boston were contributed by Mr. Ferrel, based on his discussions of his observations for that port. The table of constants appended to these publications was improved and extended by means of new matter received at the Office.

Drawing division.—This division is under the special direction of the assistant in charge of the Office. Its immediate supervision, as heretofore, has remained with Mr. W. T. Bright, who, from his long experience in the division, has been enabled efficiently to distribute the work, adapting it generally to the special fitness of the several draughtsmen. The duties of the division have been divided nearly as follows: (See also Appendix No. 4.)

Mr. A. Lindenkohl has been engaged in reducing for publication the topography and hydrography of the coast and harbor charts, and in making additions to the general coast and sailing charts. He has brought up to date the list of progress sketches that accompany the annual reports; made projections on copper, projections for field-parties, and diagrams. Mr. H. Lindenkohl was employed upon the finer topographical reductions as well as upon the hydrography of various charts of the coast. He has made field-projections, tracings, and a great portion of his time has been given to the production of a number of photolithographic maps and charts. He has also engraved on copper the topography of San Francisco and Tamal Pais peninsula, upon the $\frac{1}{200000}$ scale, chart of part of the western coast. Mr. L. Karcher has constructed the greater number of projections called for by the numerous field-parties, made diagrams and tracings, and has been engaged upon photolithographic charts and sketches. Mr. F. Smith continued tracing for photographing to the publication scale of $\frac{1}{80000}$ the original topographical field-sheets; made projects and copies of field-sketches. Messrs. F. and W. Fairfax have made traced copies of original hydrographic and topographical maps and charts called for by the public service, and done miscellaneous duty. Mr. E. J. Sommer, until May, when he left the Office, was engaged upon preliminary charts and sketches. Mr. P. Erichsen has filled in upon photographic prints, scale $\frac{1}{80000}$, the topographical details, and has been engaged upon various classes of miscellaneous work. Mr. H. Eichholtz has been employed upon adding corrections to charts already published. Mr. C. E. Lewis has attended to copying for the division and for the Office. Mrs. E. Nesbitt was employed in duplicating the volumes of geographical positions used by the division. Mr. E. Molkow was engaged during November and December in measuring the shore-line, &c., of recent topographical sheets. Mr. F. Hartig was assigned to the division in July, and worked upon special maps, charts, and tracings. Mr. M. Angles joined the division in February, and has been employed upon photolithographic charts and miscellaneous work. Messrs. R. F. Bartle and R. Wehrhan were temporarily attached to the division during a portion of the year, and made tracings, corrected published charts, &c.

In addition to the work shown in Appendix No. 4, the following statement as to the operations of this division is given:

Projects for new charts prepared	23
Projections made for the use of the topographical and hydrographical parties	96
Topographical sheets traced for reduction by photography	11

Diagrams	8
Projections on copper for engraved charts	11
Tracings made on special calls	85
Miscellaneous tracings and diagrams for field and office use	117

The information furnished by this division of the Office in reply to special calls, usually in the form of tracings from the original maps and charts of the survey, is given in Appendix No. 3.

Engraving division.—This division has remained under the charge of Mr. E. Hergesheimer, whose executive ability, no less than his technical knowledge of surveying, drawing, and engraving, is constantly exercised in promoting the efficiency of the work. The distribution of the work among the different engravers, the supervision of its execution, and verification of the same, the preparation of all the lettering, titles, and notes, and the arrangement of the work of electrotyping, are among the many duties performed by him.

During the last year the force of this division has been employed as follows: Messrs. J. Enthoffer, S. Siebert, H. C. Evans, A. Sengteller, W. A. Thompson, and A. M. Maedel as topographical engravers; Messrs. J. Knight, E. A. Maedel, F. Courtenay and A. Peterson as letter engravers; Messrs. H. M. Knight, H. S. Barnard, and F. W. Benner upon sanding; Messrs. J. C. Kondrup, R. F. Bartle, J. G. Thompson, E. H. Sipe, W. H. Davis, and W. H. Knight as miscellaneous engravers; Messrs. J. Enthoffer, S. Siebert, H. C. Evans, and F. Courtenay have been employed only upon contract work; Mr. E. Molkow, who for several years has reduced outlines on copper with the pantograph, resigned the early part of the year; Mr. R. F. Bartle was engaged but one month during the year, on account of failure of sight; Mr. G. A. Morrison, the clerk of the division, was transferred to the field in July; the clerical duties have since been performed by Mr. L. C. Kerr.

A tabular statement of the charts worked upon, and the work performed by each engraver, is given in Appendix No. 5.

Electrotyping and photographing.—Mr. George Mathiot conducted these operations as heretofore until the last day of May, when his life was suddenly and unexpectedly ended by the rupture of a large blood-vessel. Mr. Mathiot had had charge of that important branch of the work for more than twenty years; and the great perfection of details and invariable success of the operations were, in a large measure, owing to his untiring zeal and ingenuity in experiment. A description of the process of electrotyping, as carried on in the Coast Survey Office, was given by him in the Coast Survey Report for 1851.

He was succeeded in charge of the work by Mr. A. Zumbrock, who had previously assisted Mr. Mathiot, and who has since carried on the operations with entire success, Mr. F. Ober assisting, as heretofore. During the year thirty-three electrotypes of the engraved plates have been reproduced, and the photographic reductions required for the drawing and engraving divisions have been made as usual.

Division of charts and instruments.—The work in this division, which included, besides the safe-keeping of archives, the map-printing, distribution of charts and reports, and the mechanician's and carpenter shops, has been directed during the year by Mr. John T. Hoover.

The duty of registering and filing for convenient reference the original maps and charts of the survey, and the records of observations made in the field, and of keeping an account of the same, as they are used in the Office, was performed by Mr. A. Zumbrock until June; after that time by Mr. A. Schott.

By the press used for copper-plate printing 14,810 copies of charts and sketches have been printed within the year. The copper-plate press was worked by Mr. T. V. Durham until June; after that time by Mr. Frank Moore.

The work of backing with muslin the sheets required for office and field use, and the miscellaneous duties pertaining to the folding-room, were performed during the year by Mr. H. Nissen.

The map-room was in care of Mr. T. McDonnell. An aggregate of 16,584 copies of charts have been issued within the year, and 4,353 copies of annual reports of various years have been distributed.

The work in the instrument-shop was done under the supervision of Mr. John Clark, by John Foller, William Jacobi, Werner Suess, Charles F. Würdemann, and E. Eshleman.

The wood-work of instruments, their packing for transportation, and all work of carpentry required in the Office has been performed by Mr. A. Yeatman, assisted by Mr. F. E. Lackey.

Clerical force.—The general correspondence and office accounts have been, as heretofore, under the charge of Mr. V. E. King, assisted by Mr. F. W. Clancy. Mr. C. A. Hoover acted as writer in the hydrographic division. Mr. R. L. Hawkins has continued to discharge the duties of principal accountant and bookkeeper in the office of the general disbursing agent, Samuel Hein, esq., and the clerical work of that office has been performed by Mr. W. A. Herbert and W. I. Flenner.

The paper which follows (Appendix No. 1) specifies the sites of work occupied in the past year. It is gratifying that, widely distributed as the parties have been, the survey has been advanced in each site, as far as the appropriation would permit, and without special hinderance, either from accident or by reason of unusually unfavorable weather.

In many important details of the service the assistant in charge of the Office, Prof. J. E. Hilgard, has given his able co-operation. To the experience and care of the disbursing officer, Samuel Hein, esq., has been due the general promptitude in resuming work at the change of the season in places indicated by my instructions for the transfer of field and hydrographic parties, and in the arrangement of matter for this report and other office duties under my own direction. Assistant W. W. Cooper has rendered, as heretofore, acceptable services.

Respectfully submitted.

BENJAMIN PEIRCE,
Superintendent United States Coast Survey.

Hon. WM. A. RICHARDSON,
Secretary of the Treasury, Washington, D. C.

APPENDIX.

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APPENDIX No. 1.

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts of the United States during the surveying-season of 1872-'73.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Localities of work.
SECTION I.				
Atlantic coast of Maine, New Hampshire, Massachusetts, and Rhode Island, including sea-ports, bays, and rivers.	No. 1	Topography and hydrography.	J. W. Donn, assistant; F. C. Donn, aid.	Plane-table survey of the eastern end of Mount Desert Island, Me., and soundings adjacent to the shore-line. (See also Section III.)
	2	Topography	W. H. Dennis, assistant; S. N. Ogden, aid.	Topography of Deer Isle, Me., below Northwest Harbor, including Greenlaw's Neck and the adjacent islands and reefs. (See also Section V.)
	3	Topography	A. W. Longfellow, assistant; Joseph Hergesheimer, aid.	Detailed topographical survey continued in the vicinity of Castine, Me.
	4	Hydrography	Horace Anderson, assistant; F. H. North, E. H. King, and Charles Coburn, aids.	Hydrography of Castine Harbor, Me., including part of Penobscot Bay between Cape Rosier and the Fox Islands. (See also Section VII.)
	5	Topography	J. N. McClintock, subassistant ...	Detailed survey of Isle au Haut, including the small islands and reefs in its vicinity. (See also Section VI.)
	6	Topography	F. W. Dorr, assistant; D. B. Wainwright and W. W. Gilbert, aids.	Topography of the shores of Penobscot River, Me., between Indian Point and Parkins' Point, including the town of Winterport. (See also Section IV.)
	7	Topography	C. T. Iardella, assistant; W. C. Hodgkins, aid.	Plane-table survey of the western shore of Penobscot River, Me., from Stockton to Bucksport. (See also Section IV.)
	8	Special survey....	H. L. Whiting, H. Mitchell, and Hull Adams, assistants; J. B. Weir, aid.	Special observations in the waters of Fore River, Portland Harbor, Me., and shore-limits traced for preserving the river-current. (See also Section II.)
	9	Topography	Hull Adams, assistant	Examination at Old Orchard Beach, coast of Maine, and determination of recent changes in shore-line.
	10	Geodetic connection.	Professor E. T. Quimby	Points determined in geographical position by triangulation in New Hampshire.
		Magnetic observations.	T. C. Hilgard	Magnetic declination, dip, and intensity determined at Eastport, Brunswick, and Portland, Me., and at Gorham, Littleton, and Hanover, N. H. (See also Section II.)
	11	Hydrography	Commander John A. Howell, U. S. N., assistant; Lieutenants W. H. Jacques, E. S. Jacob, Richard Rush, and W. L. Field, U. S. N.	Hydrographic examination of George's Shoal off the coast of Massachusetts. Deep-sea soundings northward to Cape Sable, and dredgings on Jeffrey's Bank, Cashe's Ledge, and Stellwagen's Bank for the Fish Commission. (See also Section VI.)
	12	Hydrography	J. S. Bradford, assistant; John R. Barker.	Special hydrographic examinations in Penobscot Bay, and of harbors between Boston and Point Judith. Tests of sailing-courses, and preparation of notes and views for the Atlantic Coast Pilot. (See also Sections II and III.)
	13	Astronomical observations.	Professor Joseph Winlock	Observations for determining the difference of longitude between Cambridge, Mass., and Port Jervis, N. Y.

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c.—Continued.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Localities of work.
SECTION I—Continued....	No. 14	Gravitation	C. S. Peirce, assistant; W. E. McClintock, H. Farquhar, and A. W. Edmunds, aids.	Pendulum-experiments at a station near North Adams, Mass., for determining local variations in gravitation.
	15	Physical survey...	H. Mitchell, assistant; H. L. Marindin, subassistant.	Special examination at Nauset Beach and Monomoy Point, Mass., and development of changes in depth and shore-line. (See also Section II.)
	16	Hydrography	F. D. Granger, subassistant; D. C. Hanson, D. S. Wolcott, and C. A. Ives, aids.	Hydrographic development of changes in shoals at the eastern approach of Nantucket Sound, Mass. (See also Section VIII.)
		Tidal observations	J. G. Spaulding and H. Howland, observers.	Tidal and meteorological observations continued at North Haven (Fox Islands), Penobscot Bay, and at the Charlestown navy-yard, Mass. Series of tidal observations at Providence, R. I.
	17	Special examination.	H. L. Whiting and H. Mitchell, assistants,	Providence Harbor, R. I., examined in reference to the effect of proposed changes in shore-line and water-space. (See also Section II.)
	18	Hydrography	J. S. Bradford, assistant: John R. Barker.	Hydrographic examination of Narragansett Bay, R. I., for the selection of sailing-courses, and preparation of notes and views for the Atlantic-Coast Pilot. (See also Section III.)
SECTION II. Atlantic coast and sea-ports of Connecticut, New York, New Jersey, Pennsylvania, and Delaware, including bays and rivers, and also Lake Champlain.	1	Triangulation and topography.	A. M. Harrison, assistant; W. H. Stearns and Bion Bradbury, aids.	Topographical survey of the coast of Rhode Island extended westward to include Quonochontaug Pond. (See also Section VI.)
	2	Triangulation and topography.	R. M. Bache, assistant.............	Triangulation and detailed survey of the harbor-front, including wharf-lines, of the city of New Haven, Conn.
	3	Hydrography	H. Mitchell and F. F. Nes, assistants; H. L. Marindin, subassistant; E. B. Pleasants, W. B. French, and J. B. Weir, aids.	Soundings in New York Bay, near Sandy Hook; special observations on tides and currents; and development of a dangerous rock in East River. (See also Sections I and IV.)
	4	Topography	H. L. Whiting, assistant; H. M. De Wees, subassistant.	Detailed survey of the western side of New York Harbor, from Castle Point to Communipaw, N. J. (See also Sections I and IV.)
	5	Topography and hydrography.	F. H. Gerdes, assistant; C. P. Dillaway, subassistant; W. S. Bond, aid.	Plane-table survey and hydrography of Raritan River, N. J., including its navigable branches; and revision of shore-line and soundings in Hackensack River, N. J. (See also Section IV.)
	6	Astronomical observations.	G. W. Dean, assistant; Edwin Smith, aid.	Longitude, latitude, azimuth, and magnetic declination, dip, and intensity, determined at Carpenter's Point, near Port Jervis, N. Y. (See also Sections VI, VIII, and Interior.)
	7	Reconnaissance...	S. C. McCorkle, assistant	Selection of stations in the Hudson River Valley for connecting the coast-triangulation with the survey of Lake Champlain. (See also Section IX.)
	8	Topography	H. G. Ogden, assistant; Andrew Braid, aid.	Detailed survey of the west shore of Lake Champlain from Bluff Point to Jones' Point, and of the east shore, adjacent to Shelborne Bay. (See also Section VI)
	9	Hydrography.....	arles Junken, assistant; F. W. ng, aid.	Hydrography of the northeast arm of Lake Champlain from Butler's Island upward to the United States boundary-line, and including the south end of Missisquoi Bay.
	10	Hydrography	L. B. Wright, subassistant; E. H. Wyvill and W. B. French, aids.	Soundings in Lake Champlain from the "Four Brothers" southward to the vicinity of Crown Point. (See also Section IX.)

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c.—Continued.

Coast-sections.	Parties	Operations.	Persons conducting operations.	Localities of work.
SECTION II—Continued	......	Magnetic observations.	T. C. Hilgard	Magnetic declination, dip, and intensity determined at Burlington and Rutland, Vt., in New York City, and at Sandy Hook. (See also Section I.)
		Tidal observations	R. T. Bassett	Continuous observations at the tidal station on Governor's Island in New York Harbor; and occasional observations at Hamilton Ferry, Brooklyn.
	No. 11	Triangulation, topography, and hydrography.	Charles Hosmer, assistant; R. B. Palfrey, aid.	Topographical survey of the shores, and hydrographic development, including the adjacent parts, of Great South Bay, Long Island. (See also Section V.)
	12	Station-marks	John Farley, assistant	Examination of marks set for preserving triangulation-points on Long Island, N. Y., and near Perth Amboy, N. J.
	13	Triangulation	F. W. Perkins, subassistant; J. F. Pratt and F. W. Ring, aids.	Triangulation near Barnegat, connecting the detailed survey of the coast of New Jersey with the primary triangulation. (See als ection VII.)
	14	Topography	C. M. Bache, assistant H. M. De Wees and H. W. Bache, subassistants.	Detailed topography of the coast of New Jersey, between Barnegat light-house and Manahawken, and survey of the navigable part of Mullica River, N. J. (See also Section IV.)
	15	Hydrography	W. I. Vinal, subassistant; J. J. Evans and G. A. Morrison, aids.	Hydrography, nearly completed, in the upper part of Little Egg Harbor, N. J. (See also Section V.)
	16	Hydrography	H. Mitchell and Charles Junken, assistants.	Soundings in the Delaware River, and determination of proper wharf-lines at New Castle, Del. (See also Section I.)
	17	Topography	H. G. Ogden, assistant; R. B. Palfrey, aid.	Shore-line survey of Schuylkill River at Philadelphia, from League Island upward to Fairmount. (See also Section VI.)
SECTION III. Atlantic coast and bays of Maryland and Virginia, including sea-ports and rivers.	1	Triangulation, topography, and hydrography.	J. W. Donn, assistant; F. C. Donn, aid.	Positions determined of the light-houses on Thimble Shoal, Craney Island, Lambert Point, and Naval Hospital, and shore-line survey of Elizabeth River, Va. Detailed topography and hydrography of James River, Va., advanced upward, from Warwick River to Jamestown Island. (See also Section I.)
	2	Hydrography	Acting Master Robert Platt, U. S. N., assistant; J. B. Adamson, aid.	Complete hydrographic survey of Elizabeth River, Va., including its branches and tributaries. (See also Section IV.)
		Tidal observations	....	Observations continued with self-registering tide-gauge at Fortress Monroe, Old Point Comfort, Va.
	3	Hydrography	J. S. Bradford, assistant	Special hydrographic examinations in Chesapeake Bay and its branches, and tests of sailing-directions for publication in the Atlantic-Coast Pilot. (See also Section I.)
		Magnetic observations.	Charles A. Schott, assistant	Declination, dip, and intensity observed at the magnetic station in Washington City, D. C., and repeated discussion of the secular variation.
	4	Geodetic connection.	A. T. Mosman, assistant; W. B. French, aid.	Reconnaissance from Harper's Ferry northward and westward to the Monongahela River, Pa., for the selection of stations. (See also Sections IV, V, and VII.)

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c.—Continued.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Localities of work.
SECTION IV.				
Atlantic coast and sounds of North Carolina, including sea-ports and rivers.	No. 1	Astronomical observations.	A. T. Mosman, assistant; W. B. French, aid.	Latitude and the magnetic elements determined at Knott's Island, coast of Virginia. (See also Sections III, V, and VII.)
	2	Triangulation	R. E. Halter, assistant; C. L. Gardner, aid.	Triangulation of Currituck Sound, N. C.
	3	Hydrography	Acting Master Robert Platt, U. S. N., assistant; J. B. Adamson, aid.	Special examination of the shoals off Cape Hatteras. (See also Section III.)
	4	Astronomical observations.	A. T. Mosman, assistant; W. B. French, aid.	Latitude-observations completed at stations on Portsmouth Island, N. C. (See also Sections III, V, and VII.)
	5	Triangulation	G. A. Fairfield, assistant; B. A. Colonna and W. B. Fairfield, aids.	Triangulation of Pamplico Sound, N. C., continued in the vicinity of Hatteras Inlet and Ocracoke Inlet.*
	6	Topography	F. W. Dorr, assistant; W. E. McClintock, aid.	Detailed plane-table survey of the upper shores of Pungo River, N. C. (See also Section I.)
	7	Hydrography	F. F. Nes, assistant; C. P. Dillaway, subassistant; E. B. Pleasants, aid.	Hydrography of Croatan Sound and Roanoke Sound, including the adjacent parts of Pamplico Sound. (See also Section II.)
	8	Triangulation and topography.	C. T. Iardella, assistant; W. C. Hodgkins, aid.	Determination of points and plane-table survey of the shores of Core Sound, N. C., from Cedar Island southward and westward to Bell's Point. (See also Section I.)
	9	Topography	C. M. Bache, assistant; H. M. De Wees and H. W. Bache, subassistants.	Topography of the western shores of Beaufort Harbor, N. C., and of the lower part of Core Sound. (See also Section II.)
SECTION V.				
Atlantic coast and sea-water channels of South Carolina and Georgia, including sounds, harbors, and rivers.	1	Hydrography	W. I. Vinal, subassistant; J. J. Evans, aid.	Hydrography of Cape Fear River, N. C., up to Wilmington, and resurvey of the "Seward" Channel at Cape Fear entrance. (See also Section II.)
	2	Topography	O. H. Tittmann, subassistant; D. B. Wainwright and E. H. Wyvill, aids.	Triangulation, azimuth, and sea-coast measurement from Little River, S. C., southward and westward, with topography adjacent to the shore-line. (See also Section X.)
	3	Topography	W. H. Dennis, assistant; Bryant Godwin, aid.	Plane-table survey, including the vicinity of North Santee and South Santee Rivers, S. C. (See also Section I.)
	4	Topography and hydrography.	Charles Hosmer, assistant; R. B. Palfrey, aid.	Detailed survey of sea-islands at the head of Saint Helena Sound, S. C., and soundings in the *Coosaw, Combahee, Ashepoo, and adjacent* rivers. (See also Section II.)
	5	Astronomical observations.	A. T. Mosman, assistant; W. B. French, aid.	Latitude-observations completed at Butler station, on Saint Simon's Island, Ga. (See also Sections III, IV, and VII.)
SECTION VI.				
Atlantic and Gulf coast of the Florida peninsula, including reefs, and keys, and the sea-ports and rivers.	1	Triangulation and topography.	A. M. Harrison, assistant; J. N. McClintock, subassistant; Bion Bradbury, aid.	Topographical survey of the Atlantic coast of Florida below Matanzas Inlet, including the upper part of Halifax River. (See also Sections I and II.)
	2	Hydrography	Commander John A. Howell, U. S. N., assistant; Lieutenants W. H. Jacques, E. S. Jacob, Richard Rush, and W. L. Field.	Soundings near Garden Key, completing hydrography on the Florida Reef; and extension of hydrography in the vicinity of the Tortugas. (See also Section I.)
	3	Triangulation, topography, and hydrography.	H. G. Ogden, assistant; Edwin Smith, astronomical aid; Andrew Braid, S. N. Ogden, and W. S. Bond, aids.	Survey of the Gulf coast of Florida between Tampa entrance and Saint Joseph's Bay (south), including soundings in Boca Ceiga Bay. (See also Section II.)

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c.—Continued.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Location of work.
SECTION VI—Continued	....	Tidal observations	....	Series continued w t a self-registering tide-gauge at Saint Thomas, West Indies.
SECTION VII.				
Gulf coast and the sounds of Western Florida, including ports and rivers.	No. 1	Triangulation	F. W. Perkins, subassistant; J. F. Pratt.	Triangulation of the Gulf coast of Florida from Apalachee Bay southward and eastward toward Cedar Keys. (See also Section II.)
	2	Hydrography	Horace Anderson, assistant; F. H. North and E. H. King, aids.	Hydrography of the Gulf approaches to Saint George's Sound, Fla., and development of New Inlet. (See also Section I.)
	3	Geodetic connection.	C. O. Boutelle, assistant; A. T. Mosman, assistant; A. H. Scott, H. W. Blair, and R. H. Barnwell aids.	Geodetic operations in the vicinity of the Atlanta base in Georgia, and remeasurement of the line. (See also Sections III, IV, and V.)
	4	Triangulation	F. P. Webber, assistant	Triangulation to determine geographical points in the vicinity of Atlanta, Ga.
	5	Reconnaissance	J. A. Sullivan, assistant	Reconnaissance and selection of stations in Northern Georgia for geodetic connection.
SECTION VIII.				
Gulf coast and bays of Alabama, and the sounds of Mississippi and Louisiana to Vermilion Bay, including the ports and rivers.	1	Hydrography	F. D. Granger, subassistant; D. C. Hanson and C. A. Ives, aids.	Hydrography of the eastern part of Chandeleur Sound, Miss. (See also Section I.)
	2	Triangulation, topography, and hydrography.	C. H. Boyd, assistant; Joseph Hergesheimer and C. H. Van Orden, aids.	Detailed survey of the shores and hydrography of Mississippi River in the vicinity of New Orleans, La. Determination of points by triangulation in Illinois and Missouri east and west of Saint Louis.
	3	Astronomical observations.	G. W. Dean, assistant; Edward Goodfellow and F. Blake, assistants; J. B. Baylor and C. H. Fitch, aids.	Latitude and longitude determined at Madison and La Crosse in Wisconsin and at Minneapolis in Minnesota. (See also Sections II and Interior.)
SECTION IX.				
Gulf coast of Western Louisiana and of Texas, including bays and rivers.	1	Triangulation	S. C. McCorkle, assistant; D. S. Wolcott, aid.	Triangulation of the coast of Texas from East Bay towards Sabine Pass, and determination of the positions of light-houses and beacons in Galveston Bay. (See also Section II.)
	2	Hydrography	L. B. Wright, subassistant; F. W. Ring and J. B. Baylor, aids.	Hydrography of Espiritu Santo and San Antonio Bays, Texas. (See also Section II.)
INTERIOR.				
West of the Mississippi River.	....	Astronomical observations.	G. W. Dean, assistant; Edwin Smith and C. H. Fitch, aids.	Latitude, longitude, and the magnetic elements determined at Denver, Colorado Springs, and Trinidad, in Colorado Territory. (See also Sections II and VIII.)
SECTION X.				
Coast of California, including the bays, harbors, and rivers.	1	Astronomical and magnetic observations.	George Davidson, assistant; William Eimbeck, subassistant; S. R. Throckmorton and T. J. Lowry, aids.	Latitude, longitude, and the magnetic elements determined at stations on the coast of Lower California between Cape San Lucas and San Diego; also at the station occupied in 1769 by M. Chappe de l'Auteroche for observing the transit of Venus. Buoys determined in position at the entrance and approaches of San Diego Bay. (See also Section XI.)
	2	Hydrographic reconnaissance.	Commander P. C. Johnson, U. S. N., assistant; Lieut. Commander C. W. Kennedy, U. S. N.; Lieutenants H. B. Mansfield, E. W. Remy, George W. Tyler, and J. D. Adams; Lieutenant M. S. Day, part of season.	Shore-line survey and development of dangers to navigation between Cape San Lucas and San Diego. Rock determined in position near Point Fermin. Deep-sea soundings in the Pacific westward of San Francisco Entrance. (See also Section XI.)
	3	Triangulation, topography, and hydrography.	A. W. Chase, assistant	Detailed survey of coast of California between San Pedro and San Juan Capistrano. Survey of the shores and approaches of Catalina Harbor. Soundings in San Pedro Bay at the approaches to New River and Anaheim River. (See also Section XI.)

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c—Continued.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Localities of work.
SECTION X—Continued	No. 4	Topography.......	*Stehman Forney, subassistant*	*Topographical survey of Santa Rosa Island, Santa Barbara Channel.*
	5	Topography.......	W. E. Greenwell, assistant; *Eugene Ellicott, subassistant.*	Plane-table survey of the coast of California between Gaviota Pass and Point Conception.
	6	Reconnaissance and triangulation.	George Davidson, assistant; William Eimbeck and O. H. Tittmann, subassistants; S. R. Throckmorton, W. S. Edwards, and T. P. Woodward, aids.	Triangulation for connecting the Santa Barbara Islands with the shore-line survey of California. Stations selected for extending the main triangulation to Monterey Bay. Magnetic elements determined at Point Conception. (See also Section XI.)
	7	Triangulation and topography.	L. A. Sengteller, assistant; H. I. Willey, aid.	Topographical survey of the coast of California near San Luis Obispo Bay.
	8	Astronomical observations.	George Davidson, assistant; S. R. Throckmorton and W. S. Edwards, aids.	Latitude and azimuth determined at San Luis Obispo and at San Simeon, Cal. Magnetic elements determined at Point Pinos, Cal. (See also Section XI.)
	9	Triangulation and topography.	Cleveland Rockwell, assistant; George H. Wilson, aid.	Topography of the coast of California north of *Piedras Blancas*. (See also Section XI.)
	10	Astronomical observations.	George Davidson, assistant; S. R. Throckmorton, aid.	Telegraphic observations at San Francisco for determining the longitude of Kalama on the Columbia River. Magnetic elements determined at San Francisco. (See also Section XI.)
	11	Topography	Aug. F. Rodgers, assistant; E. F. Dickins, aid.	Topographical survey of Table Mountain on the north side of the Golden Gate. Survey of the sand-dunes near San Francisco.
	12	Hydrography	Gershom Bradford, assistant; F. Westdahl, aid.	Special observations on the currents of San Francisco Bay, and soundings to develop the changes in depth in the bay and on the bar. Hydrography of Cordell Bank.
		Tidal observations.	Col. G. H. Mendell, U. S. Engineers; E. Gray, observer.	Series of tidal and meteorological observations continued at Fort Point near San Francisco. (See also Section XI.)
	13	Triangulation and topography.	L. A. Sengteller, assistant; H. I. Willey, aid.	Topography of the coast of California north of Mendocino Bay.
	14	Triangulation and topography.	Aug. F. Rodgers, assistant; E. F. Dickins, aid.	Detailed survey of the coast of California north of Noyo River entrance.
	15	Hydrography	Gershom Bradford, assistant; F. Westdahl, aid.	Rocks off the coast of California determined in position near Cape Mendocino.
	16	Hydrography.....	Commander P. C. Johnson, U. S. N., assistant.	Soundings along the coast of California in the vicinity of Crescent City Reef. (See also Section XI.)
	17	Reconnaissance and triangulation.	A. W. Chase, assistant	Triangulation between Klamath River and False Klamath; and reconnaissance for its extension to Rocky Point, Cal. (See also Section XI.)
SECTION XI. Coast of Oregon and of Washington Territory, including the interior bays, ports, and rivers.	1	Triangulation and topography.	A. W. Chase, assistant	Topography of the coast of Oregon from Crook's Point to Cape Sebastian, and reconnaissance for extending the coast-triangulation northward to Rogue River entrance. (See also Section X.)
	2	Hydrography	Commander P. C. Johnson, U. S. N., assistant.	Soundings developing anchorage under Cape Sebastian, and at Chetko entrance, Oreg. (See also Section X.)
	3	Astronomical observations.	William Eimbeck, subassistant; T. J. Lowry, aid.	Latitude, longitude, and azimuth determined at Kalama on the Columbia River, Oreg. Magnetic declination, dip, and intensity determined at Cape Disappointment, W. T. (See also Section X.)

Distribution of surveying-parties upon the Atlantic, Gulf, and Pacific coasts, &c.—Continued.

Coast-sections.	Parties.	Operations.	Persons conducting operations.	Localities of work.
SECTION XI—Continued ..	No. 4	Triangulation	Cleveland Rockwell, assistant; George H. Wilson, aid.	Triangulation of the Columbia River extended from Westport to Kalama Oregon. (See also Section X.)
	5	Triangulation and topography.	J. J. Gilbert, subassistant	Detailed survey of the shores of Shoalwater Bay, W. T., and connection of work with the survey of Columbia River.
		Tidal observations.	Col. G. H. Mendell, U. S. Engineers; L. Wilson and L. Nessel, observers.	Tidal and meteorological observations continued at Astoria, Oreg., and at Port Townshend, W. T. (See also Section X.)
	6	Triangulation, topography, and hydrography.	James S. Lawson, assistant; F. A. Lawson, aid.	Topographical survey of the shores and hydrography of Budd's Inlet, including the development of the approaches from Puget Sound, W. T.
SECTION XII. Coast of Alaska Territory.	1	Geographical and hydrographic reconnaissance.	W. H. Dall, assistant; Marcus Baker, aid.	Geographical positions determined, and development of harbors, anchorages, and marine characteristics of the coast of Alaska.
		Tidal observations.	Capt. Charles Bryant, W. H. Dall .	Series of tidal observations recorded at Saint Paul's Island in Behring Sea, and at the Aleutian Islands, Alaska.

APPENDIX No. 2.

Statistics of field and office work of the United States Coast Survey during the year 1872.

Description.	Previous to 1872.	1872.	Total.
RECONNAISSANCE.			
Area in square miles	69, 846	4, 057	73, 903
Parties, number of	54	3	57
BASE-LINES.			
Primary, number of	12	1	13
Secondary, number of	84	8	92
Length of, in miles	234½	48¾	283¼
TRIANGULATION.			
Area in square miles	60, 672	1, 237	61, 909
Horizontal-angle stations occupied	6, 992	370	7, 362
Geographical positions determined	13, 100	721	13, 821
Vertical-angle stations occupied	382	8	390
Elevations determined, number of	798	23	821
Parties, number of	227	22	249
ASTRONOMICAL OPERATIONS.			
Stations occupied for azimuth	115	3	118
Stations occupied for latitude	196	6	202
Stations occupied for longitude	250	5	255
Permanent longitude-stations	42	....	42
Parties, number of	65	8	73
Magnetical stations occupied, number of	324	13	337
Parties, number of	62	7	69
TOPOGRAPHY.			
Area surveyed in square miles	21, 726	679	22, 405
Length of general coast in miles	5, 288	98	5, 386
Length of shore-line in miles, including rivers, creeks, and ponds	60, 531	1, 619	62, 140
Length of roads in miles	32, 428	746	33, 174
Parties, number of	312	21	333
HYDROGRAPHY.			
Parties, number of	222	18	240
Number of miles run while sounding	245, 884	10, 621⅓	256, 505⅓
Area sounded in square miles	56, 276	1, 873	64, 776
Miles run additional of outside or deep-sea soundings	30, 738	8, 500	39, 238
Soundings, number of	10, 700, 631	612, 514	11, 313, 145
Soundings in Gulf Stream for temperature	4, 072	....	4, 072
Tidal stations, permanent	168	8	176
Tidal stations occupied temporarily	1, 335	52	1, 387
Tidal parties, number of	226	34	260
Current-stations occupied	....	55	....
Current-parties	....	3	....
Specimens of bottom, number of	9, 609	89	9, 698
RECORDS.			
Triangulation, originals, number of volumes	1, 464	102	1, 566
Astronomical observations, originals, number of volumes	826	83	909
Magnetical observations, originals, number of volumes	284	14	298
Duplicates of the above, number of volumes	1, 891	119	2, 010
Computations, number of volumes	1, 805	93	1, 898
Hydrographical soundings and angles, original, number of volumes	5, 449	321	5, 770
Hydrographical soundings and angles, duplicates, number of volumes	403	68	471
Tidal and current observations, originals, volumes, number of	2, 229	106	2, 335
Tidal and current observations, duplicates, volumes, number of	1, 744	40	1, 784
Sheets from self-registering tide-gauges, number of	1, 947	104	2, 051
Tidal reductions, number of volumes	1, 448	39	1, 487
Total number of volumes of records	17, 363	985	18, 348

Statistics of field and office work of the United States Coast Survey, &c.—Continued.

Description.	Previons to 1872.	1872.	Total.
MAPS AND CHARTS.			
Topographical maps, originals	1, 238	70	1, 308
Hydrographic charts, originals	1, 139	49	1, 188
Reductions from original sheets	709	15	724
Total number of manuscript maps and charts	2, 477	2, 492	....
Number of sketches made in field and office	2, 633	56	2, 689
ENGRAVING AND PRINTING.			
Engraved plates of finished charts, number of	165	7	172
Engraved plates of preliminary charts, sketches, and diagrams for the Coast Survey reports, number of	547	4	551
Electrotype-plates made	965	42	1, 007
Finished charts published	154	4	158
Preliminary charts and hydrographical sketches published	455	3	458
Printed sheets of maps and charts distributed	278, 031	14, 810	292, 841
Printed sheets of maps and charts deposited with sale-agents	99, 115	5, 447	104, 562
LIBRARY.			
Number of volumes	5, 206	178	5, 384
INSTRUMENTS.			
Cost of	$76, 977. 66	$5, 035. 23	$82, 012. 89

APPENDIX No. 3.

Information furnished from the Coast Survey Office, by tracings from original sheets, &c., in reply to special calls, during the year ending November, 1873.

Date.		Name.	Data furnished.
1872.			
November	22	Maj. G. H. Elliot, United States Corps of Engineers	Hydrographic survey off entrance to Patapsco River, Md.
	26	W. F. McCornell, esq	Topographical survey of eastern shore of Buzzard's Bay, from north Pocasset to Nye's Neck, Mass.
	30	Thomas Bland, esq., New York	Line of deep-sea soundings across Yucatan Channel.
December	11	Jerome Collins, chief engineer, Marsh Land Co., N. Y.	Topographical survey of shores of Harlem River, and Spuyten Duyvel's Creek, N. Y., with adjacent topography.
	13	William H. Brown, civil engineer	Topographical survey of the upper part of Sassafras River, Md., and of the western shore of Delaware River, from Collins Point to Blackbird Creek, Del.
	16	Gen. A. A. Humphreys, Chief of Engineers	Topographical survey, vicinity of Point Peter, Ga.
1873.			
January	6	Col. John Newton, United States Corps of Engineers	Hydrographic survey of the Savannah River, vicinity of Elba Island, and part of Back River, Ga.
	14	United States Light-House Board	Topographical survey of the coast of California from Pilar Point to Point Montara.
	14	New York State Park Commission	Shore-line of Lake Champlain.
	23	United States Light-House Board	Topographical survey of part of Catalina Island, vicinity of Catalina Harbor.
	25	Daniel T. Van Buren, esq	Hydrographic survey of the Hudson River from Whiskey Point to Knickerbocker Pier.
	27	Hon. Samuel J. Randall	Hydrographic survey of Delaware River from navy-yard to Fort Mifflin light-house.
	27	Richard L. Pease, esq	Topographical survey of Conanicut Island, Narragansett Bay, R. I.
	30	William Senter, esq	Hydrographic survey of Wills' Strait, Me.
	31	Hon. J. M. Penedleton, esq	Hydrographic survey of the Appanaug River, Greenwich Bay, R. I.
February	1	J. Campbell, esq	Map of North Wimbee Creek, S. C.
	5	E. L. Brown, esq	Trigonometrical points and data, vicinity of Lynn, Mass.
March	5	Hon. W. Windom, United States Senate	Hydrographic survey of Columbia River from Tongue Point to Cathlamet Head.
	5	United States Light-House Board	Hydrographic survey of Middle Ground off Stratford Point, Long Island Sound.
	5	........do	Hydrographic survey of Cross Ledge Shoal, Delaware Bay.
	5	........do	Hydrographic survey of Bulk-head Shoal, Delaware Bay
	5	........do	Hydrographic survey of shoal off Thomas' Point, Chesapeake Bay.
	12	........do	Topographical survey of Point San Pablo and Brother Islands, Cal.
	19	........do	Hydrographic survey of Ship John Shoal, Delaware River.
	22	Duncan Walker, esq	Topographical survey adjacent to the District of Columbia.
	25	Col. J. H. Simpson, United States Corps of Engineers.	Topographical survey, vicinity of Saint Louis, Mo.
April	10	C. B. Burbank, esq., secretary Indianola Chamber of Commerce.	Hydrographic survey of Pass Cavallo, Tex.
	17	J. W. Burbridge & Co	Topographical survey of Union Plantation, Mississippi River.
	21	Gen. George B. McClellan	Topographical survey of Randall's Island and west shore of Harlem River.
	27	Col. Charles S. Stewart, United States Corps of Engineers.	Hydrographic survey of Santa Cruz Harbor, Cal.
May	20	Bureau of Ordnance	Shores of Severn River, vicinity of Annapolis, Md.
June	10	Capt. W. S. Stanton, United States Corps of Engineers	Unfinished proofs, with curves of equal depth of Plymouth, Duxbury, and Kingston Harbors, Mass.
	12	Sheffield Scientific School	Height and geographical positions, vicinity of New Haven, Conn.
	17	Col. J. D. Kurtz, United States Corps of Engineers	Hydrographic surveys off Cape May, N. J.
	26	Capt. E. A. Freeman, United States Revenue Marine	Hydrographic survey of Trinity Shoal, La.
	30	George S. Morrison, esq	Hydrographic survey of the Hudson River from Egar's Dog Head Cove Point.

Information furnished from the Coast Survey Office, by tracings, &c.—Continued.

Date.		Name.	Data furnished.	
1873.				
July	7	Capt. R. H. Wyman, United States Navy, Hydrographic Office.	Porpoise Harbor,	Harbors of Alaska.
	7	........do	Shumagin's Islands,	
	7	........do	Coal Harbor,	
	7	........do	Popoff Strait,	
	7	........do	Sanborn Harbor,	
	24	J. F. Waring, forwarding agent Central Railroad, Ga.	Distances from Savannah, Ga., to Baltimore.	
	24	........do	Distances from Savannah, Ga., to Philadelphia.	
	24	........do	Distances from Savannah, Ga., to New York.	
	24	........do	Distances from Savannah, Ga., to Boston.	
	24	Col. J. D. Kurtz, United States Corps of Engineers..	Topographical survey of Cape May and vicinity, N. J.	
August	7	Maj. Peter E. Hains, United States Corps of Engineers	Topographical survey of Morris Island, S. C.	
	12	Town-commissioners of New Castle, Del	Hydrographic survey of harbor of New Castle, Del.	
September	17	Verplanck Colvin	Duplicate projections of Lake Champlain, with light-houses, &c., platted thereon, on scales of $\frac{1}{63360}$ and $\frac{1}{126720}$.	
	18	William McGeorge, jr., esq	Hydrographic and topographical surveys of Paramore's Island and vicinity, Va.	
	25	Joshua Gilbert, esq	Hydrographic and topographical surveys from Saint Augustine to Halifax River, Fla.	
October	8	Maj. Henry M. Robert, United States Corps of Engineers.	Hydrographic information of the Columbia River from above Astoria, Oreg.	
	10	Gen. J. G. Barnard, United States Corps of Engineers	Hydrographic information of the Mississippi delta.	
	17	Brown and Le Baron, civil engineers	Topographical survey of part of Eastern Point, Gloucester, Mass.	
	24	A. P. Barnard, esq	Hydrographic survey of entrance to New Haven Harbor, Conn.	
	25	Hon. David Yulee, of Florida........	Hydrographic survey of Sawpit and Sister Creeks between Nassau Sound and Saint John's River, Fla.	
	30	John Daymond, esq	Topographical survey of the Mississippi River between Poverty Point and Jesuit's Bend, La.	
November	7	Bureau of Ordnance........	Topographical survey, east side of Potomac River, from Marbury Point toward Giesborough Point.	
	11	Bvt. Brig. Gen. W. F. Raynolds, United States Corps of Engineers.	Projection and trigonometrical points in the vicinity of Bulkhead Shoal, Delaware River.	

APPENDIX No. 4.

DRAWING DIVISION.

Charts completed or in progress during the year ending November 1, 1873.

1. Hydrography. 2. Topography. 3. Drawing for photographic reduction. 4. Details on photographic outlines. 5. Verification. 6. Lettering.

Titles of charts.	Scale.	Draughtsmen.	Remarks.
Moose-a-bec Reach, Me	1-40, 000	1. H. Lindenkohl	Preliminary edition; additions.
Coast-chart No. 3, Petit Menan light to Naskeag Head, Me	1-80, 000	3. F. Smith. 4. H. Lindenkohl.	
Coast-chart No. 4, Naskeag Head to White Head light, including Penobscot Bay, Me.	1-80, 000	1. H. Lindenkohl. 3. F. Smith. 4. H. Lindenkohl. 4. P. Erichsen.	
Penobscot Bay, Me. (western part)	1-40, 000	1. H. Lindenkohl. 2. A. Lindenkohl.	
Saint George's River and Muscle Ridge Channel, Me	1-40, 000	2. H. Lindenkohl	New edition; completed.
General coast-chart No. I, Quoddy Head to Cape Cod, Mass	1-400, 000	1, 2. H. Lindenkohl. 2. A. Lindenkohl	Additions.
Sheepscot and Kennebec Rivers, Me	1-40, 000	2. A. Lindenkohl	Additions; completed.
Coast-chart No. 7, Kennebec entrance to Cape Porpoise, Me	1-80, 000	1. L. Karcher	Additions; completed.
Damariscotta and Medomac Rivers, Me	1-40, 000	2. H. Lindenkohl	Additions; completed.
Coast-chart No. 11, Monomoy and Nantucket Shoals to Muskeget Channel, Mass.	1-80, 000	1. A. Lindenkohl	Additions; completed.
General coast-chart No. II, Cape Ann to Gay Head, Mass.	1-400, 000	1. A. Lindenkohl	Additions; completed.
Narragansett Bay, R. I. (upper part)	1-40, 000	2. P. Erichsen. 2. A. Lindenkohl	Completed.
Narragansett Bay, R. I. (lower part)	1-40, 000	2. H. Lindenkohl	Completed.
Coast-chart No. 13, Narragansett Bay, R. I	1-80, 000	2. A. Lindenkohl. 2. P. Erichsen. 2. H. Lindenkohl.	
Lake Champlain from Ligonier Point to Cumberland Head light (sheet No. 2).	1-40, 000	1, 2. A. Lindenkohl. 2. L. Karcher	Completed.
Lake Champlain from Plattsburgh to Canada boundary (sheet No. 1).	1-40, 000	1, 2. A. Lindenkohl. 2. L. Karcher	Completed.
Burlington Harbor, Vt	1-10, 000	1, 2. E. J. Sommer	Completed.
New York Bay and Harbor (upper sheet)	1-40, 000	1, 2. A. Lindenkohl. 1. H. Lindenkohl	Completed.
Atlantic coast No. II, Nantucket to Cape Hatteras	1-1, 200, 000	1. A. Lindenkohl	Additions; completed.
Delaware River, navy-yard to Fort Mifflin light	1-20, 000	1, 2. H. Lindenkohl	Completed.
New Castle Harbor, Del	1-1, 250	1, 2. F. Horteg	Completed.
Coast-chart No. 15, Plum Island to Welch's Point	1-80, 000	1, 2. A. Lindenkohl	Additions; completed.
General coast-chart No. IV, Cape May to Cape Henry	1-400, 000	1. A. Lindenkohl	Additions.
Coast-chart No. 32, Chesapeake Bay, York River to Pocomoke Sound, Va.	1-80, 000	1. A. Lindenkohl	Additions; completed.
Coast-chart No. 44, Pamplico and Neuse Rivers, N. C	1-80, 000	1, 2. A. Lindenkohl	Completed.
Coast-chart No. 50, Cape Fear and approaches, including the river to Wilmington, N. C.	1-80, 000	1. A. Lindenkohl	Additions; completed.
Coast-chart No. 57, Sapelo light, Ga., to Fernandina, Fla	1-80, 000	1. A. Lindenkohl. 2. P. Erichsen	Additions; completed.
Doboy and Altamaha Sounds, Ga	1-40, 000	1. F. Fairfax	Completed.
Saint Simon's Sound, Ga	1-40, 000	1. F. Fairfax. 2. F. Fairfax. 2. L. Karcher.	Additions.
Saint Andrew's and Jekyl Sounds, Ga	1-40, 000	1. H. Lindenkohl. 1. F. Fairfax. 2. H. Lindenkohl.	Completed.
General coast-chart No. VII, Cape Romain to Saint Mary's River.	1-400, 000	2. A. Lindenkohl	Additions.
Saint Mary's River and Fernandina Harbor	1-20, 000	1. H. Lindenkohl	Additions; completed.
Coast-chart No. 58, Cumberland Sound, Saint John's River, and coast southward.	1-80, 000	2. P. Erichsen. 6. H. Lindenkohl.	
Indian River Inlet, Fla	1-40, 000	1, 2. L. Karcher	Completed.
Saint John's River entrance, Fla	1-30, 000	1. L. Karcher. 1. A. Lindenkohl	Additions; completed.
Coast-chart No. 71, Tortugas, Loggerhead, and Garden Keys, Fla.	1-80, 000	1. A. Lindenkohl.	
Saint George's Sound, Fla. (eastern part)	1-40, 000	1. E. J. Sommer	Additions.
Saint George's Sound, Fla. (western part)	1-40, 000	1. E. J. Sommer	Additions.
Coast-chart No. 86, Pensacola Bay, &c., Fla	1-80, 000	1. A. Lindenkohl. 2. P. Erichsen.	

Charts completed or in progress, &c.—Continued.

Titles of charts.	Scale.	Draughtsmen.	Remarks.
Gulf coast, Key West to Rio Grande	1-1, 200, 000	1. A. Lindenkohl	Additions.
Coast-chart No. 91, Lakes Borgne and Pontchartrain, La	1-80, 000	1. A. Lindenkohl.	
General coast-chart No. XIII, approaches to Mississippi delta	1-400, 000	1. A. Lindenkohl	Additions.
Coast-chart No. 94, passes of the Mississippi	1-80, 000	1. A. Lindenkohl	Completed.
Pacific coast No. 2, Santa Barbara Channel, Cal	1-200, 000	2. A. Lindenkohl. 2. H. Lindenkohl.	
San Francisco Peninsula, Cal	1-200, 000	H. Lindenkohl, engraving topography	Completed.
Tamal Pais Peninsula, Cal	1-200, 000	H. Lindenkohl, engraving topography	Completed.
Pacific coast No. 7, Mendocino City to Humboldt Bay, Cal	1-200, 000	1. A. Lindenkohl.	
Trinidad Harbor, Cal	1-15, 000	1, 2. A. Lindenkohl	Completed.
Crescent City and Saint George's Reef, Cal	1-40, 000	1. H. Lindenkohl	Completed.
Cape Orford and reef, Oreg	1-40, 000	1. A. Lindenkohl	Completed.
Yaquinna River entrance, Oreg	1-20, 000	1. A. Lindenkohl	Additions; completed.
Columbia River, Oreg. (sheet No. 2)	1-40, 000	1. E. J. Sommer	Completed.
PRELIMINARY PHOTOLITHOGRAPHIC CHARTS.			
Somes' Sound, Me	1-10, 000	1, 2. E. J. Sommer	Completed.
Belfast Bay, Me	1-15, 000	1, 2. F. Horteg.	
Vineyard Haven, Mass	1-15, 000	2. P. Erichsen. 1. M. Angles	Completed.
New Haven Harbor, Conn	1-16, 000	1. L. Karcher. 1. M. Angles. 2. P. Erichsen.	Completed.
Burlington, Vt	1-16, 000	1, 2. M. Angles	Completed.
Plattsburgh and Cumberland Bay, N. Y	1-16, 000	1. F. Horteg. 2. H. Lindenkohl	Completed.
Lake Champlain, from Ligonier Point to Cumberland Head (sheet No. 2).	1-50, 000		Completed.
Lake Champlain, from Plattsburgh to Canada boundary (sheet No. 1).	1-50, 000	1, 2. H. Lindenkohl	Completed.
Hatteras Shoals, N. C	1-80, 000	1. M. Angles	Completed.
Saint Andrew's and Jekyl Sounds, Ga	1-60, 000	1, 2. M. Angles	Completed.
Trinidad Harbor, Cal	1-20, 000	1, 2. H. Lindenkohl	Completed.
HARBORS OF ALASKA.			
Sanborn Harbor, Nagai Island	1-40, 000	1, 2, 6. H. Lindenkohl	Completed.
Coal Harbor, Zachareffskaia Bay	1-20, 000	1, 2, 6. H. Lindenkohl	Completed.
Popoff Strait and Humboldt Harbor	1-40, 000	1, 2, 6. H. Lindenkohl	Completed.
Sketch of the Shumagin Islands	1-1, 000, 000	1, 2, 6. H. Lindenkohl	Completed.

APPENDIX No. 5.

ENGRAVING DIVISION.

Plates completed, continued, or commenced during the year 1873.

1. Outlines. 2. Topography. 3. Sanding. 4. Lettering.

Titles of plates.	Scale.	Engravers.
COMPLETED.		
Coast-charts.		
No. 5, from Penobscot Bay to Kennebec entrance	1-80, 000	4. J. Knight and E. A. Maedel.
No. 31, entrance to Chesapeake Bay (edition of 1872)	1-80, 000	3. F. W. Benner. 4. E. A. Maedel and A. Petersen.
No. 32, Chesapeake Bay, from York River to Pocomoke Sound (edition of 1872).	1-80, 000	3. W. A. Thompson. 4. A. Petersen.
No. 33, Chesapeake Bay, from Pocomoke Sound to Potomac River (edition of 1872).	1-80, 000	3. W. A. Thompson. 4. A. Petersen.
No. 34, Chesapeake Bay, from Potomac River to Choptank River (edition of 1872).	1-80, 000	3. W. A. Thompson. 4. A. Petersen.
No. 35, Chesapeake Bay, from Choptank River to Magothy River (edition of 1872).	1-80, 000	3. H. M. Knight. 4. A. Petersen.
No. 36, Chesapeake Bay, from Magothy River to head of bay (editon of 1872).	1-80, 000	3. W. A. Thompson. 4. A. Petersen.
No. 55, from Hunting Island to Ossabaw Sound (edition of 1872).	1-80, 000	3. H. S. Barnard. 4. E. A. Maedel.
Harbor-charts, &c.		
Southwest Harbor and Somes' Sound	1-40, 000	1, 3, 4. W. H. Knight.
Damariscotta and Medomac Rivers (preliminary edition)	1-40, 000	2. W. A. Thompson. 3. H. M. Knight. 4. A. Petersen.
Narragansett Bay (in two sheets)	1-40, 000	2. W. A. Thompson. 3. F. W. Benner and W. A. Thompson. 4. E. A. Maedel and A. Petersen.
Burlington Harbor, Vt	1-10, 000	1, 2. J. C. Kondrup and W. A. Thompson. 4. J. G. Thompson.
Hatteras Shoals	1-80, 000	1, 3, 4. W. H. Knight.
CONTINUED.		
General coast-charts.		
No. I, Quoddy Head to Cape Cod	1-400, 000	1, 2. J. Enthoffer. 3. H. M. Knight. 4. E. A. Maedel and F. Courtenay.
No. II, Cape Ann to Gay Head	1-400, 000	2. W. A. Thompson. 3. H. M. Knight. 4. J. Knight, E. A. Maedel, and J. G. Thompson.
No. V, Cape Henry to Cape Lookout	1-400, 000	1, 2. A. M. Maedel. 4. E. A. Maedel.
No. VII, Cape Romain to Saint Mary's River	1-400, 000	1, 2. A. M. Maedel. 4. F. Courtenay, E. A. Maedel, and J. Knight.
Coast-charts.		
No. 3, Frenchman's and Blue Hill Bays	1-80, 000	1, 2. J. Enthoffer. 4. E. A. Maedel.
No. 4, Penobscot Bay	1-80, 000	1, 2. J. Enthoffer. 4. E. A. Maedel.
No. 6, Kennebec entrance to Saco River	1-80, 000	3. H. S. Barnard. 4. E. A. Maedel.
No. 7, Kennebec entrance to Cape Porpoise	1-80, 000	1, 2. W. A. Thompson. 4. E. A. Maedel.
No. 29, Chincoteague Inlet to Hog Island	1-80, 000	3. F. W. Benner.
No. 30, Hog Island to Cape Henry	1-80, 000	3. W. A. Thompson.
No. 56, Savannah to Sapelo Island	1-80, 000	3. H. S. Barnard.
No. 57, Sapelo Island to Saint Mary's River	1-80, 000	2. A. Sengteller. 4. E. A. Maedel.
No. 91, Lakes Borgne and Pontchartrain	1-80, 000	4. F. Courtenay.
No. 94, Mississippi River No. 1	1-80, 000	1, 2. A. M. Maedel. 3. H. M. Knight. 4. J. Knight.
Harbor-charts.		
Moose-a-bec Reach	1-40, 000	1. W. H. Davis. 3. H. M. Knight. 4. J. G. Thompson.
Mount Desert Island, &c. (east)	1-40, 000	1. A. M. Maedel and J. C. Kondrup.
Penobscot Bay (east)	1-40, 000	1. E. Molkow and J. C. Kondrup.
Penobscot Bay (west)	1-40, 000	1. E. Molkow, J. C. Kondrup, and A. M. Maedel. 4. F. Courtenay.
Saint George's River and Muscle Ridge Channel	1-40, 000	2. W. A. Thompson. 3. H. M. Knight. 4. A. Petersen.
Plymouth, Kingston, and Duxbury Harbors	1-40, 000	4. J. G. Thompson and J. Knight.
Pamplico River	1-80, 000	1. J. C. Kondrup. 4. A. Petersen. 2. H. C. Evans.

Plats completed, continued, or commenced, &c.—Continued.

Titles of plates.	Scale.	Engravers.
Neuse River	1–80, 000	1. J. C. Kondrup. 4. A. Petersen.
Columbia River No. 1	1–40, 000	1, 2. S. Siebert.
COMMENCED.		
Santa Barbara Channel No. 2	1–200, 000	1. W. A. Thompson. 4. A. Petersen.
Coast-chart No. 86, from Choctawhatchee Bay to Pensacola Bay.	1–80, 000	1, 2. H. C. Evans. 4. A. Petersen and E. A. Maedel.
Hatteras Shoals	1–80, 000	1, 3, 4. W. H. Knight.
Saint Mary's River and Fernandina Harbor	1–20, 000	1, 4. J. G. Thompson. 2. J. C. Kondrup.
Columbia River No. 2	1–40, 000	1, 4. W. H. Davis.

APPENDIX No. 6.

List of original topographical sheets registered in the archives of the United States Coast Survey from June, 1865, to January, 1873.

Localities.	State.	Scale.	Date.	Topographer.	Register-number.
Letite Passage and vicinity	New Brunswick	1-10,000	1865	W. H. Dennis	1007
Part of Fundy Bay	Maine and New Brunswick.	1-10,000	1865	do	981
Saint Croix River (Calais and Saint Stephen's)	do	1-10,000	1869	do	1150
West Quoddy Bay	Maine	1-10,000	1865	do	980
Eastport and vicinity	do	1-10,000	1865	do	979
Moose-a-bec Reach (middle sheet)	do	1-10,000	1870	J. W. Donn	1171
Moose-a-bec Reach (upper sheet)	do	1-10,000	1870	do	1172
Moose-a-bec Reach (lower sheet)	do	1-10,000	1870	do	1173
Gouldsborough Bay	do	1-10,000	1865	C. Rockwell	1039
Winter Harbor to Gouldsborough Bay	do	1-10,000	1865	do	1040
Mount Desert Island	do	1-10,000	1871	J. W. Donn	1243
Mount Desert Island, southwestern part	do	1-10,000	1872	do	1281
Mount Desert Island, western part	do	1-10,000	1872	do	1282
Islands south of Mount Desert	do	1-10,000	1871	do	1245
Great and Little Cranberry Islands, &c	do	1-10,000	1871	do	1244
Belfast and Searsport	do	1-10,000	1872	C. T. Iardella	1272
North Haven Island, including ledges and island north of Main and Little Thoroughfares.	do	1-10,000	1867	F. W. Dorr	1072
Northern part of Vinal Haven Island, with Stimpson's, Calderwood's, and Babbage Islands.	do	1-10,000	1868	do	1075
North Isleborough, Penobscot Bay	do	1-10,000	1871	A. W. Longfellow	1257
South Isleborough, Penobscot Bay	do	1-10,000	1871	do	1256
Penobscot Bay, islands south of Isleborough	do	1-10,000	1870	do	1167
Penobscot Bay, western shore from Megunticook to Knight's Point.	do	1-10,000	1871	F. W. Dorr	1233
Fox Islands, western part of	do	1-10,000	1868	do	1093
Fox Islands, southeastern part of	do	1-10,000	1870	H. M. De Wees	1157a
Fox Islands, southeastern part of, and Smith, Saddleback, and Brimstone Islands.	do	1-10,000	1870	do	1157b
Rockland Harbor and vicinity	do	1-10,000	1870	W. H. Dennis	1160
Friendship	do	1-10,000	1867	Charles Hosmer	1058
Seal, Tennant's, and Mosquito Harbors	do	1-10,000	1868	W. H. Dennis	1081
Saint George's River entrance	do	1-10,000	1869	F. W. Dorr	1117
Saint George's River	do	1-10,000	1868	Charles Hosmer	1116
Weskeag River and vicinity	do	1-10,000	1869	W. H. Dennis	1151
Merrymeeting Bay, including Androscoggin, Muddy, and Cathance Rivers.	do	1-10,000	1871	C. H. Boyd	1214
Muscongus Bay, islands and ledges	do	1-10,000	1865	F. W. Dorr	1001
Muscongus Bay, southern part	do	1-10,000	1865	do	1002
Muscongus Bay, from Round Pond to Hocamoc	do	1-10,000	1866	C. Rockwell	1028
Pemmaquid Neck, including John's Bay and Pemmaquid River	do	1-10,000	1866	F. W. Dorr	1032
Pemmaquid Point, including New Harbor and west shore of Muscongus Bay.	do	1-10,000	1866	do	1033
Damariscotta River (lower part)	do	1-10,000	1865	S. A. Gilbert	995
Damariscotta River (upper part)	do	1-10,000	1865	do	994
Medomac River	do	1-10,000	1867-'68	Charles Hosmer	1076
Linekin's Bay and Islands at mouth of Damariscotta River	do	1-10,000	1865	F. W. Dorr	1000
Westport and Arrowsic Islands	do	1-10,000	1865	E. Hergesheimer	982
Kennebec River, head of	do	1-10,000	1859, '65	R. M. Bache	1061
Kennebec River, from Abagadasset Point to Richmond	do	1-10,000	1869	C. H. Boyd	1115
Kennebec River, from Richmond to Gardiner	do	1-10,000	1870		1158
New Meadow River, from Forster's Point to New Meadow Bridge.	do	1-10,000	1866	J. W. Donn	1021

List of original topographical sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Topographer.	Register-number.
Casco Bay, from Middle Bay to New Meadow River, including north end of Sebaskahegan Island.	Maine	1-10,000	1867-'69	A. W. Longfellow	1129
Casco Bay, Sebaskahegan and Orr's Islands	do	1-10,000	1865	do	1012
Casco Bay, sketch of Half-Way Rock	do	1-2,000	1867	C. H. Boyd	1056
Portland Harbor, wharf and shore-line	do	1-5,000	1867	A. W. Longfellow and H. W. Bache.	1111
Portland City and Harbor, special survey No. 1	do	1-1,200	1868-'69	A. Lindenkohl	1140a
Portland City and Harbor, special survey No. 2	do	1-1,200	1868-'69	do	1140b
Portland City and Harbor, special survey No. 3	do	1-1,200	1868-'69	do	1141a
Portland City and Harbor, special survey No. 4	do	1-1,200	1869	Charles Hosmer	1141b
Portland City and Harbor, special survey No. 5	do	1-1,200	1869	do	1142a
Portland City and Harbor, special survey No. 6	do	1-1,200	1869	J. W. Donn	1142b
Portland City and Harbor, special survey No. 7	do	1-1,200	1869	do	1143a
Portland City and Harbor, special survey No. 8	do	1-1,200	1869	Charles Hosmer	1143b
Portland City and Harbor, special survey No. 9	do	1-1,200	1869	J. W. Donn	1144a
Portland City and Harbor, special survey No. 10	do	1-1,200	1869	J. N. McClintock	1144b
Mouth of Saco River and Biddeford Pool	do	1-10,000	1870	H. Adams	1188
Saco River and towns of Biddeford and Saco	do	1-10,000	1871	do	1225
Goose Fair Creek to Spurwich River	do	1-10,000	1871	do	1224
Kennebunk Port and Cape Porpoise to Hog's Neck	do	1-10,000	1870	do	1150
Coast from Ogunquit, in Wells, to Mousam River	do	1-10,000	1869	do	1121
Wells Beach, included in sheet No. 1121	do	1-10,000	1867	do	1057
Coast from Kittery to York	do	1-10,000	1867	do	1050
Coast from Boar's Head to Rye Harbor	New Hampshire	1-10,000	1866	do	1023
Coast from Rye Harbor to near Portsmouth	do	1-10,000	1867	do	1047
North River, sheet No. 1	Massachusetts	1-5,000	1870	H. L. Whiting	1251a
North River, sheet No. 2	do	1-5,000	1870	do	1251b
Cape Cod Bay, western shore, from Ship Point to West Sandwich	do	1-10,000	1867	P. C. F. West	1062
Cape Cod Bay, western shore, from Eel River to Ship Point	do	1-10,000	1866	do	1063
Cape Cod Bay, southern shore, from Orleans to Brewster	do	1-10,000	1868	H. Adams	1078
Cape Cod Bay, northern shore, from North Dennis to Brewster	do	1-10,000	1868	P. C. F. West	1088
Cape Cod Bay, eastern shore, from Pleasant Bay to Nausett Harbor	do	1-10,000	1868	H. Adams	1077
Cape Cod, southern extremity, including village of Chatham	do	1-10,000	1868	H. W. Bache	1085a
Cape Cod, from Pleasant Point to Monomoy Island	do	1-10,000	1868	C. H. Boyd	1085b
Monomoy Point	do	1-20,000	1868	P. C. F. West	1090
City of Fall River and vicinity	do	1-10,000	1867	A. M. Harrison	1053
Town of East Greenwich and vicinity	Rhode Island	1-10,000	1868	do	1079
Mount Hope Bay, northern part	do	1-10,000	1865	do	1024
Seekonk River	do	1-5,000	1865	do	978
City of Providence, wharf-line	do	1-5,000	1867	do	1041
Warren	do	1-10,000	1869	do	1120
Prudence Island	do	1-10,000	1865	do	1054
Narragansett Pier to South Ferry	do	1-10,000	1869	do	1118
Seaconnet River, eastern part	do	1-10,000	1870	Charles Hosmer	1156
Seaconnet Point	do	1-10,000	1870	do	1161
Island of Rhode Island, from Black Point to Easton Point	do	1-10,000	1870	H. G. Ogden	1163
Island of Rhode Island, northern part	do	1-10,000	1870	A. M. Harrison	1162
Newport and vicinity	do	1-10,000	1870-'71	do	1194
Point Judith and vicinity	do	1-10,000	1871	do	1226
Conanicut, Dutch, and Gould Islands	do	1-10,000	1869	do	1119
Coast of Rhode Island, from Cross Mills eastward	do	1-10,000	1872	do	1271
Navy-yard near New London	Connecticut	1-1,200	1869	H. G. Ogden	1107
Lake Champlain, from White's Landing to Appletree Point	Vermont	1-10,000	1870	F. W. Dorr	1181
Lake Champlain, from Appletree Point to Hogback Island	do	1-10,000	1870	do	1182
Lake Champlain, from Trembleau Point to Port Jackson	do	1-10,000	1870	do	1183
Lake Champlain, from Trembleau Point to Ligonier Point	do	1-10,000	1870	F. W. Dorr and C. Hosmer	1185
Lake Champlain, vicinity of Plattsburgh	New York	1-10,000	1870	Charles Hosmer	1184
Lake Champlain, vicinity of Plattsburgh	Vermont	1-10,000	1870	do	1186
Lake Champlain, vicinity of Mallett's Bay	do	1-10,000	1871	do	1205
Lake Champlain, shore-line surveys	do	1-10,000	1871	do	1206
Lake Champlain, shore-line surveys	do	1-10,000	1871	do	1207
Lake Champlain, shore-line surveys	do	1-10,000	1871	do	1208
Lake Champlain, shore-line surveys	do	1-10,000	1871	do	1209

List of original topographical sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Topographer.	Register-number.
Lake Champlain, from Cumberland Head Point to Point-au-Roche	New York	1-10, 000	1871	H. G. Ogden	1917
Lake Champlain, the Gut and Point-au-Roche	do	1-10, 000	1871	do	1218
Lake Champlain, from Point-au-Roche to Long Point	do	1-10, 000	1871	do	1219
Lake Champlain, La Motte and Alburgh Passages	do	1-10, 000	1871	do	1220
Lake Champlain, from Isle La Motte to boundary-line	do	1-10, 000	1871	do	1221
Lake Champlain, part of Missisquoi Bay	Vermont	1-10, 000	1871	do	1222
Lake Champlain, Missisquoi Bay south of boundary-line	do	1-10, 000	1871	do	1223
Hudson River, from Anthony's Nose to Cold Spring	New York	1-10, 000	1861	John Mechan	1010
Hudson River, from Cold Spring to Newburgh	do	1-10, 000	1861	do	1011
North and South Shrewsbury Rivers	New Jersey	1-10, 000	1865	C. M. Bache	10[illegible]5
Shrewsbury River, South	do	1-10, 000	1866	do	1022
Coast between Deal and Squan Beach	do	1-10, 000	1867	do	1083
Coast between Squan Village and Barnegat	do	1-10, 000	1868	do	1084
Barnegat Inlet	do	1-10, 000	1866	C. Fendall	1015
Absecum Inlet and vicinity	do	1-20, 000	1869-'70	C. M. Bache	1166
League Island	Pennsylvania	1-2, 500	1865	R. M. Bache	975
Stakes in the Gut east of League Island	do	1-2, 500	1865	do	975 *bi*
Baltimore and vicinity	Maryland	1-10, 000	1865	C. T. Iardella	977
Patapsco River	do	1-10, 000	1865	do	983
Patapsco River, north shore, from Fort Marshall to Bear Creek	do	1-10, 000	1866	do	1004
Potomac River, from Saint George's Bay to Higgins' Point	do	1-20, 000	1868	J. W. Donn	1103
Potomac River, from Clement's Bay to Swan Point	do	1-20, 000	1868	do	1105
Potomac River, from Sharpsburgh to Bertin	do	1-10, 000	1865	do	985
Potomac River, from Bertin to Heter's Island	do	1-10, 000	1865	do	986
Potomac River, from Macon's Island to White's Ferry	do	1-10, 000	1865	do	987
Potomac River, from Harrison's Island to Young's Island	do	1-10, 000	1865	do	988
Potomac River, from Young's Island to Great Falls	do	1-10, 000	1865	do	989
Upper Potomac and Burnside Rivers	do	1-10, 000	1865	do	990
Upper Potomac, from lock No. 36 to High Knob	Maryland and Virginia.	1-10, 000	1866	do	1013
Upper Potomac, from High Knob to Shepherdstown	do	1-10, 000	1865-'66	do	1014
Arlington, part of, sheet No. 1	Virginia	1-1, 200	1864	E. Hergesheimer	1036
Arlington, part of, sheet No. 2	do	1-1, 200	1864	do	1025
Forts Chaplin, Mahan, and Sedgwick	Dist. of Columbia	1-10, 000	1865	C. M. Bache	1026
Yeocomico and Coan Rivers	Virginia	1-20, 000	1868	J. W. Donn	1102
Nomini and Currioman Bays	do	1-20, 000	1868	do	1104
Mattox Creek and part of Nomini Creek	do	1-20, 000	1868	do	1106
Piankatank River	do	1-20, 000	1869	do	1100
Mobjack Bay, North, Ware, and Severn Rivers	do	1-20, 000	1860, '68	G. D. Wise and J. W. Donn.	1101
Newport News Point	do	1-10, 000	1865	E. Hergesheimer	1003
James River, Newport News to Pagan Creek	do	1-20, 000	1872	J. W. Donn	1265
James River, Pagan Creek to Point of Shoal light-house	do	1-20, 000	1872	do	1266
Eastern shore of Virginia, Broadwater, sheet No. 3	do	1-20, 000	1871	do	1200
Eastern shore of Virginia, Broadwater, sheet No. 4	do	1-20, 000	1869-'70	do	1201
Eastern shore of Virginia, Broadwater, sheet No. 2	do	1-20, 000	1869, '70	do	1202*a*
Eastern shore of Virginia, Broadwater, New Inlet and north branches.	do	1-20, 000	1871	do	1202*b*
Eastern shore of Virginia, Broadwater, sheet No. 1	do	1-20, 000	1869-'70	do	1203
Eastern shore of Virginia, head of Machipongo River	do	1-20, 000	1871	do	1204
Pungo River	North Carolina	1-20, 000	1872	do	1273
Pamplico River, from Rumley Marshes to Ragged Point	do	1-20, 000	1871	F. W. Dorr	1210
Pamplico River, from Maul's Point to Rodman's Point	do	1-20, 000	1871	do	1211
Pamplico River, from Adams' Point to Rumley Marshes	do	1-20, 000	1871	do	1212
Pamplico River, from Light-house to Indian Island	do	1-20, 000	1871	do	1213
Washington and its environs	do	1-10, 000	1872	do	1274
Cape Hatteras to Hatteras Inlet	do	1-20, 000	1872	C. T. Iardella	1246
Bay River, Pamplico Sound	do	1-20, 000	1869	F. W. Dorr	1094
Shore-line from Bay River to Pamplico Sound	do	1-20, 000	1869	do	1095
Neuse River, from New Berne to Johnson's Point	do	1-10, 000	1866	do	1031
Neuse River, from Johnson's Point to Beard's Creek	do	1-20, 000	1866	do	1016
Neuse River, from Beard's Creek to Wilkinson Point	do	1-20, 000	1867	do	1051
Neuse River, from Wilkinson Point to Cedar Point	do	1-20, 000	1867	do	1052
Neuse River, from Cedar Point to Brown's Creek	do	1-20, 000	1868	do	1073

List of original topographical sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Topographer.	Register-number.
Neuse River, from Brown's Creek to Point of Marsh	North Carolina	1-20, 000	1868	F. W. Dorr	1074
Goldsborough, west of Wilmington and Weldon Railroad	....do	1-10, 000	1865	......do	970
Goldsborough, approaches to	....do	1-10, 000	1865	Cleveland Rockwell	971
Cedar Island and vicinity	....do	1-20, 000	1872	C. T. Iardella	1277*a, b*
Portsmouth Island and part of Core Beach	....do	1-20, 000	1866	C. Fendall	1016
Core Sound, northeast part of	....do	1-20, 000	1866	W. H. Dennis	1020
Core Sound, southwest part of	....do	1-20, 000	1866	......do	1017
Bogue Sound, from Broad Creek to Queen's Creek	....do	1-20, 000	1871	H. Adams	1215
Bogue Sound, part of	....do	1-10, 000	1867	A. W. Longfellow	1110
New Inlet, including Federal Point, Zeek's, and Smith Islands	....do	1-10, 000	1865	J. S. Bradford	999
Winyah Bay and vicinity	South Carolina	1-20, 000	1872	W. H. Dennis	1276
Defense of Charleston	....do		1865	C. O. Boutelle	976
Parry and Cane's Islands	....do	1-20, 000	1868	C. Hosmer	1070
Port Royal and vicinity	....do	1-20, 000	1865	W. H. Dennis	1006
Coosaw River and vicinity	....do	1-20, 000	1867	......do	996
Broad River, southern part of	....do	1-20, 000	1865	R. E. Halter	998
Broad Harbor	....do	1-20, 000	1865	R. E. Halter	997
Saint Helena and Lady's Island	....do	1-20, 000	1872	Charles Hosmer	1275
Pocotaligo	....do	1-10, 000	1865	F. W. Dorr	974
Between Broad and May Rivers, containing hydrography	....do	1-20, 000	1870-'71	C. Hosmer	1195
Savannah River to Cooper River, west of Daufuskie Islet, containing hydrography.	....do	1-20, 000	1870-'71	......do	1196
Savannah River, Forts Jackson and Lee, Batteries Tatnall and Barnwell.	....do	1-5, 000	1866	C. O. Boutelle and H. L. Marindin.	1027
Coast of South Carolina	....do	1-20, 000	1872	O. H. Tittmann	1280*a*
Coast of South Carolina	....do	1-20, 000	1872	......do	1280*b*
Savannah, vicinity of*	Georgia	1-47, 520	1865	W. H. Dennis	972
Summit of Lookout Mountain	Tennessee and Georgia.	1-10, 000	1865	C. H. Boyd	973
Wilmington River and estuaries	Georgia	1-20, 000	1865	C. Fendall	992
Romerly Marsh Creek	....do	1-20, 000	1869	C. Hosmer	1087
Ogeechee, Vernon, and Burnside Rivers	....do	1-20, 000	1865	C. Fendall	991
Ogeechee to Medway Bay	....do	1-20, 000	1869	C. Hosmer	1109
Saint Catharine's Island and vicinity	....do	1-20, 000	1867	C. Rockwell and J. A. Sullivan.	1060
Between the Medway and Julienton Rivers	....do	1-20, 000	1869	C. Hosmer	1155
Doboy Sound and vicinity	....do	1-20, 000	1868	W. H. Dennis	1080
Altamaha Sound and vicinity	....do	1-20, 000	1869	......do	1114
Darien City	....do	1-20, 000	1869	......do	1114*bis*
Saint Simon's and Long Island	....do	1-20, 000	1869	C. T. Iardella	1108
Mackay's River and vicinity	....do	1-20, 000	1869	W. H. Dennis	1113
Saint Andrew's Sound and vicinity	....do	1-20, 000	1869-'70	C. M. Bache	1145
Cumberland Island, part of	....do	1-20, 000	1870	W. H. Dennis	1152
Nassau Sound and vicinity	Florida	1-20, 000	1871	......do	1232*a*
Sister Creek	....do	1-20, 000	1871	......do	1232*b*
Coast from Saint Augustine to Matanzas Inlet	....do	1-20, 000	1867	C. M. Bache	1082
Matanzas River and vicinity	....do	1-20, 000	1872	A. M. Harrison	1268
Head of Key Biscayne Bay	....do	1-20, 000	1867	C. T. Iardella	1049
Shore and keys of Barnes' Sound	....do	1-30, 000	1868	......do	1071
Barnes' Sound	....do	1-40, 000	1870	J. G. Oltmanns	1154
Pine Island Sound, Charlotte Harbor	....do	1-20, 000	1866-'67	C. T. Iardella	1048
Saint Joseph's Bay, Cape San Blas and vicinity	....do	1-20, 000	1868	H. M. De Wees	1065
Western arm of Saint Andrew's Bay	....do	1-20, 000	1871	......do	1187
Saint Joseph's Bay to Saint Andrew's Point	....do	1-20, 000	1869	......do	1091
Saint Andrew's Bay, eastern and western branches	....do	1-20, 000	1870	C. T. Iardella	1146
Saint Andrew's Bay, northern branch	....do	1-20, 000	1870	......do	1147*a*
Saint Andrew's Bay, eastern branch	....do	1-20, 000	1870	......do	1147*b*
Choctawhatchee Bay, western part	....do	1-20, 000	1872	Herbert G. Ogden	1269
Choctawhatchee Bay, eastern part	....do	1-20, 000	1872	......do	1270
Choctawhatchee Bay and Santa Rosa Sound	....do	1-20, 000	1871	......do	1191
Santa Rosa Sound, from longitude 86° 43′ to 86° 58′	....do	1-20, 000	1871	H. G. Ogden	1192
Santa Rosa Sound, from longitude 86° 58′ to 87° 7′	....do	1-20, 000	1871	......do	1193

*Compiled from various sources.

List of original topographical sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Topographer.	Register-number.
Coast between Pensacola and Mobile, west part of Big Lagoon	Florida	1-10,000	1867	J. G. Oltmanns	1034
Coast between Pensacola and Mobile, from Lagoon to mouth of Perdido Inlet.	Florida and Alabama.	1-10,000	1867	do	1035
Coast between Pensacola and Mobile, from Perdido entrance to east Gulf shore.	do	1-10,000	1867	do	1042
Entrance to Mobile Bay	Alabama	1-20,000	1868	do	1066
Chandeleur Sound, west side, from Morgan Harbor to Indian Mound Bay.	Louisiana	1-20,000	1871	C. H. Boyd	1195
Isle au Breton Sound, Deep Water to California Point	do	1-20,000	1868-'69	do	1096
Isle au Breton Sound, California Point to Mozambique Point	do	1-20,000	1869	do	1098*a*
Isle au Breton Sound, California Point	do	1-20,000	1869	do	1098*b*
Isle au Breton Sound, south side	do	1-20,000	1869	do	1097
Isle au Breton Sound, Gardiner's to Otter Bayou	do	1-20,000	1869-'70	do	1099
Isle au Breton Sound, Otter Bayou to Point Comfort	do	1-20,000	1870	do	1148
Isle au Breton Sound, Errol Island	do	1-20,000	1869	do	1092
Mississippi delta, Southwest Pass, part of South Pass, East, West, and Garden Island Bays.	do	1-20,000	1867	J. W. Donn	1037
Mississippi delta, South Pass, Bayou Grand, and East Pass	do	1-20,000	1867	do	1038
Mississippi River, from Cubit Crevasse to the forts and Bird Island Sound.	do	1-20,000	1868	C. H. Boyd	1069
Mississippi River, from the forts to Grand Prairie	do	1-20,000	1870	do	1149
Mississippi River, from Grand Prairie to Point à la Hache	do	1-20,000	1871	do	1147
Mississippi River, from Bohemia to Poverty Point	do	1-20,000	1872	do	1258*a*
Mississippi River	do	1-20,000	1872	do	1258*b*
Matagorda Island	Texas	1-20,000	1859	W. H. Dennis	1030
Corpus Christi Bay, Corpus Christi to McGloin's Bluff	do	1-20,000	1867	C. Hosmer	1043
Corpus Christi Bay, McGloin's Bluff to Mustang Island	do	1, 20,000	1867	do	1044
Laguna Madre, eastern shore	do	1-20,000	1867	C. H. Boyd	1045
Laguna Madre, western shore	do	1-20,000	1867	do	1046
Coast east of San Pedro Bay	California	1-10,000	1872	A. W. Chase	1283
Point Fermin to Point Saint Vincent	do	1-10,000	1870	do	1153
Santa Barbara Channel, from Santa Barbara to Pelican's Point	do	1-10,000	1870	W. E. Greenwell	1230
Santa Barbara, town and vicinity	do	1-10,000	1870	do	1229
Point Saint Vincent, northward	do	1-10,000	1871	A. W. Chase	1231
Santa Barbara to Sand Point	do	1-10,000	1869	W. E. Greenwell	1128
Sand Point to Gorda Point	do	1-10,000	1869	do	1127
Punta Gorda and vicinity	do	1-10,000	1871	A. F. Rodgers	1237
Punta Gorda, Shelter Cove	do	1-10,000	1871	do	1238
Punta Gorda	do	1-10,000	1871	do	1239
Punta Gorda	do	1-10,000	1871	do	1240
Punta Gorda, toward Buenaventura	do	1-10,000	1870	W. E. Greenwell	1189
Town of Buenaventura and vicinity	do	1-10,000	1870	do	1190
Cañada de los dos Pueblos to Cañada de Tajiguas	do	1-10,000	1871	do	1247
Santa Cruz and Santa Barbara Channel	do	1-10,000	1850	W. M. Johnson	1003
Santa Barbara Channel from Pelican Point to los dos Pueblos	do	1-10,000	1871	W. E. Greenwell	1267
Santa Barbara Island	do	1-10,000	1871	A. W. Chase	1180
San Miguel Island, Santa Barbara Channel	do	1-20,000	1871	S. Forney	1242
Point Conception and vicinity, two sheets	do	1-10,000	1869	C. Rockwell	1122*a*, *b*
Alder Creek to Welch △	do	1-10,000	1870	L. A. Sengteller	1279
Point Sal, southern shore	do	1-5,000	1867	W. E. Greenwell	1055
San Simeon Bay and vicinity	do	1-10,000	1871	C. Rockwell	1273
Coast from Tunitas Creek northward	do	1-10,000	1866	A. F. Rodgers	1009
Half-Moon Bay	do	1-10,000	1861	W. M. Johnson	993
Point San Pedro to Pillar Point	do	1-10,000	1866	A. F. Rodgers	1019
Land-approaches to San Francisco	do	1-10,000	1867	A. W. Chase	1059
Approaches to San Francisco	do	1-10,000	1867	C. Rockwell	1067
Approaches to San Francisco	do	1-10,000	1868	do	1063
South Farallon Island	do	1-5,000	1872	A. F. Rodgers	1259
Suisun Bay	do	1-20,000	1866	do	1029
Point Arena and vicinity	do	1-10,000	1870	L. A. Sengteller	1228
Humboldt Bay to Table Bluff	do	1-20,000	1869	A. F. Rodgers	1137
Humboldt Bay, three sheets	do	1-10,000	1870	do	1174, 1175, 1176

List of original topographical sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Coast north of Humboldt Bay	California	1-10,000	1870	A. F. Rodgers	1177
Coast south of Trinidad Head	do	1-10,000	1870	do	1178
Coast north of Trinidad Head	do	1-10,000	1870	do	1179
Centreville to False Cape	do	1-10,000	1869	do	1135
Shelter Cove and vicinity	do	1-10,000	1871	do	1236
Cape Mendocino, south of	do	1-20,000	1871	do	1241
False Cape to Cape Mendocino	do	1-10,000	1869	do	1134
Eel River and vicinity	do	1-10,000	1869	do	1136*a*
Eel River, changes from 1869 to 1870	do	1-10,000	1869-'70	do	1136*b*
From Crescent City southward	do	1-10,000	1871	A. W. Chase	1248*a*
From Sister Rock to False Klamath	do	1-10,000	1871	do	1248*b*
Point Saint George and Crescent City Reef	do	1-10,000	1869	do	1132
From Point Saint George northward (Lake Earl)	do	1-10,000	1870	do	1199
From Cone Station to near Oregon boundary	do	1-10,000	1870	do	1216
From Oregon boundary to Chetko River	Oregon	1-10,000	1870	do	1227
Coast of Oregon, near Port Orford, reconnaissance	do	1-20,000	1869	do	1133
Orford Reef	do	1-10,000	1869	do	1131
Cape Blanco	do	1-10,000	1869	do	1130
Goat Island to Whale's Island	do	1-10,000	1871	do	1260
Cape Foulweather and entrance to Yaquina Bay	do	1-10,000	1868	do	1086
Columbia River, from Point Adams to Young's Bay	do	1-10,000	1868	C. Rockwell	1112
Columbia River, from Young's Bay to John Day's River	do	1-10,000	1868	do	1123
Columbia River, from south side of John Day's River to Warren's Landing.	do	1-10,000	1870	do	1234
Columbia River, from Warren's Landing to Three-Tree Point	do	1-10,000	1870	do	1235
Columbia River, from Cape Disappointment to Chinook Point	do	1-10,000	1869	do	1138
Columbia River, from Chinook Point to Gray's Point	do	1-10,000	1869	do	1139 *a*
Columbia River, Sandy Island and Chinook Spit	do	1-10,000	1869	do	1139 *b*
Columbia River, from Gray's Bay to Snag Island	do	1-10,000	1870	do	1249
Columbia River, from Three Point to Puget Island	do	1-10,000	1871	do	1250
Shoalwater Bay, sheet No. 1	Washington Ter.	1-10,000	1871	J. J. Gilbert	1261
Shoalwater Bay, sheet No. 2	do	1-10,000	1871	do	1262
Shoalwater Bay, sheet No. 3	do	1-10,000	1871	do	1263
Shoalwater Bay, sheet No. 4	do	1-10,000	1871	do	1264
Washington Harbor, Strait of Juan de Fuca	do	1-10,000	1870	J. S. Lawson	1165
Deception Pass to Finger △	do	1-10,000	1871	do	1252
Finger △ Point to Point Partridge, Whidbey Island	do	1-10,000	1871	do	1253
Point Partridge to eastward Whidbey Island	do	1-10,000	1871	do	1254
Killent Harbor	do	1-10,000	1871	do	1255
New Dungeness, part of	do	1-10,000	1870	do	1168
Protection Island to New Dungeness	do	1-10,000	1870	do	1169
Smith Island	do	1-10,000	1870	do	1170
Port Madison	do	1-10,000	1868	do	1087
Admiralty Bay, Puget Sound	do	1-10,000	1868	do	1164
Shilshole Bay, Admiralty Inlet	do	1-10,000	1867	do	1064
Port Discovery entrance, sheet No. 1	do		1868-'69	do	1124
Port Discovery entrance, sheet No. 2	do		1869	do	1125
Port Discovery entrance, sheet No. 3	do		1869-'70	do	1126

APPENDIX No. 7.

List of hydrographic sheets registered in the archives of the United States Coast Survey from June, 1865, to January, 1873.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Coast from Mosquito Harbor to Seal Harbor	Maine	1-10,000	1866	R. E. Halter	907
Quoddy Roads and Johnson's Bay	do	1-10,000	1866	H. L. Marindin	895
Western entrance Moose-a-bec Reach	do	1-10,000	1870	F. F. Nes	1060
Moose-a-bec Reach	do	1-10,000	1870	do	1059
Indian River	do	1-10,000	1870	do	1061
Winter Harbor and approaches	do	1-10,000	1867	H. Anderson	938
Southwest Harbor, Mount Desert, western approaches	do	1-10,000	1871	J. W. Donn	1120
Southwest Harbor, Mount Desert, eastern approaches	do	1-10,000	1871	do	1121
Somes' Sound	do	1-10,000	1871	do	1122
Prospect Harbor	do	1-10,000	1871	H. Anderson	1127
Entrance to Isle au Haut Bay	do	1-20,000	1870	F. P. Webber	1074
Isle au Haut Bay	do	1-20,000	1869	Charles Junken	1028
Hurricane Island Sound and vicinity	do	1-10,000	1869	do	1029
The Basin, on Vinal Haven Island	do	1-10,000	1870	F. P. Webber	1075
Fox Island Bay and vicinity	do	1-10,000	1870	do	1073
East side of Fox Island and Seal Bay	do	1-10,000	1871	do	1142
Fox Islands Thoroughfare, eastern part	do	1-10,000	1868	Charles Junken	983
Fox Islands Thoroughfare, western part	do	1-10,000	1868	do	982
Penobscot Bay, approaches to	do	1-20,000	1866,'7,'8	do	1051
Penobscot Bay, entrance to	do	1-20,000	1866-'67	do	943
Penobscot Bay, from Owl's Head to Ensign Island	do	1-20,000	1869	F. P. Webber	1086
Penobscot Bay, between Owl's Head and Fox Islands	do	1-20,000	1869	Charles Junken	1030
Penobscot Bay, islands south of Islesborough	do	1-10,000	1869	F. P. Webber	1087
Penobscot Bay, from Camden to Belfast Bay	do	1-20,000	1871	do	1143
Gilkey's Harbor, Penobscot Bay	do	1-10,000	1871	do	1144
Camden and Rockport Harbors	do	1-10,000	1865	H. Anderson	873
Penobscot River, from Bangor to Hampden	do	1-10,000	1867	J. A. Sullivan	934
Muscle Ridge Channel	do	1-10,000	1866-'67	R. E. Halter and Chas. Junken.	952
Muscle Ridge Islands	do	1-10,000	1867	R. E. Halter	953
Saint George's River entrance	do	1-10,000	1865	R. E. Halter and C. Fendall.	872
Saint George's River, sheet No. 1	do	1-10,000	1864	F. P. Webber	858
Saint George's River, sheet No. 2	do	1-10,000	1864	do	859
Muscongus Bay	do	1-10,000	1867	R. E. Halter	950
Muscongus Bay	do	1-10,000	1868	do	986
Meduncook River and Point Pleasant Gut	do	1-10,000	1866-'67	do	951
Medomac River	do	1-10,000	1866	H. Anderson	960
Medomac River, from Bremen to Havener's Ledge	do	1-5,000	1866	do	960 *bis*
John's Bay	do	1-10,000	1867	R. E. Halter	920
Damariscotta River, from New Castle Bridge to Clark's Cove	do	1-10,000	1866	E. Hergesheimer	903
Sheepscot Bay, between Griffith's Head and Kennebec River	do	1-10,000	1868	J. S. Bradford	971
Ebenecook Harbor, Town's End Gut, Back River	do	1-10,000	1866	E. Hergesheimer	891
Hell Gate, Back River	do	1-10,000	1865	H. Anderson	893
Great and Little Hell Gates and Goose-Rock Passage	do	1-5,000	1867	J. S. Bradford	930
Hockomock and Knubble Bays, Sasanoa River	do	1-10,000	1867	do	929
Kennebec River, from Swan Island to Richmond	do	1-10,000	1869	C. H. Boyd	1064
Kennebec River, from Richmond to Gardiner	do	1-10,000	1870	do	1065
Vicinity of Cape Small Point	do	1-10,000	1868	J. S. Bradford	972
New Meadow River	do	1-10,000	1866	J. W. Donn	899
Head of Maquoit, Middle, and Quohog Bays, and Harpswell Sound.	do	1-10,000	1869	H. Anderson	1008
Off-shore soundings from Seguin Island to Cape Elizabeth	do	1-40,000	1867	R. Platt, U. S. N	933
Approaches to Portland Harbor	do	1-40,000	1864	Lieut. T. S. Phelps	860
Portland Harbor	do	1-5,000	1867	R. Platt, U. S. N	949
Portland City and Harbor, sheet No. 1	do	1-1,200	1868	H. Anderson	1032
Portland City and Harbor, sheets Nos. 2 and 3	do	1-2,400	1869	do	1033*a*, *b*

List of hydrographic sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Portland City and Harbor, sheets Nos. 4 and 5	Maine	1-2, 400	1869	H. Anderson	1034*a*, *b*
Cape Porpoise and Stage Island Harbor; Wood Island Harbor and approaches to Saco River	...do	1-10, 000	1871	J. S. Bradford	1117*a*, *b*
Saco River	...do	1-5, 000	1866	G. Davidson	882
Saco River, from Saco to Chandler's Point	...do	1-5, 000	1867	F. F. Nes	941
Saco River, up to Chandler's Point	...do	1-5, 000	1867	...do	942
Jeffrey's Ledge	New Hampshire	1-150, 000	1863	Lieut. T. S. Phelps	861
Coast of New Hampshire, from Pulpit Rock to Great Boar's Head.	...do	1-10, 000	1870	H. Anderson	1068
Coast of New Hampshire, from Great Boar's Head to Salisbury	...do	1-10, 000	1870	...do	1069
Emerson's Point and Milk Island	Massachusetts	1-10, 000	1873	J. S. Bradford	396*b*
Town, Fore, and Back Rivers, Weymouth	...do	1-10, 000	1869	...do	1021
Duxbury Bay	...do	1-10, 000	1867, '70	H. Anderson	1035
Plymouth Harbor	...do	1-10, 000	1870	...do	1067
Monomoy Shoals, reconnaissance	...do	1-40, 000	1868	F. F. Nes	961
Vineyard Haven Harbor	...do	1-10, 000	1871	H. Mitchell	1106
Edgartown Harbor and Cotamy Bay	...do	1-10, 000	1871	...do	1126
Mitchell's Falls, Merrimack River	...do	200 ft. to 1 in.	1867	...do	1012
Narragansett Bay, from Quonset Point to Dutch Island	Rhode Island	1-10, 000	1868	F. P. Webber	992
Narragansett Bay, from Hope Island to Patience Island	...do	1-10, 000	1867-'68	...do	939
Greenwich Bay	...do	1-5, 000	1867	...do	940
Narragansett Bay, head of, and Providence River	...do	1-10, 000	1865-'67	...do	880
Providence River, from city of Providence to Stargut Island	...do	1-5, 000	1865	...do	878
Warren River	...do	1-5, 000	1865	...do	888
Seekonk River	...do	1-5, 000	1865	A. M. Harrison	865
Thames River, near New London	Connecticut	1-1, 200	1869	Charles Junken	1006
Frying Pan and Pot Rock	New York	1-1, 280	1866	W. S. Edwards	896
Wallabout Bay	...do	1-1, 250	1869	F. F. Nes	1085
Off the Battery	...do	1-2, 500	1867	W. S. Edwards	910
New York Bay, between Governor's Island and Robbin's Reef	...do	1-10, 000	1868	F. H. Gerdes	970
Swash Channel, examination of	...do	1-20, 000	1866	W. S. Edwards	897*a*
Shoal of vessel Warren, New York Lower Bay	...do	1-20, 000	1872	F. F. Nes	897*b*
Main channel between Sandy Hook and Flynn's Knoll and Scotland Shoal.	...do	1-20, 000	1869	...do	1011
Rondout Harbor, from entrance to Sleight's Ferry	...do	1-2, 500	1868	F. H. Gerdes and F. F. Nes.	979
Rondout Harbor, from Sleight's Ferry to entrance of Delaware and Hudson Canal.	...do	1-1, 250	1868	...do	978
Lake Champlain, from Cumberland Head to Valcour Island	...do	1-20, 000	1870	Charles Junken	1058
Lake Champlain, Valcour Island to Trembleau Point	...do	1-20, 000	1871	F. D. Granger	1118*a*
Lake Champlain, Colchester and Hog's Back Reefs	...do	1-10, 000	1871	...do	1118*b* 1119
Burlington Harbor	Vermont	1-10, 000	1871	...do	1105
Main channel between Sandy Hook and Flynn's Knoll and Scotland Shoal.	New Jersey	1-20, 000	1869	F. F. Nes	1009
Barnegat Inlet	...do	1-10, 000	1866	C. Fondall	883
Great Bay	...do	1-10, 000	1871	W. W. Harding	1125
Back Channel, League Island, Delaware River	Pennsylvania	1-2, 500	1865	E. Hergesheimer	862
Delaware River, Fort Mifflin to Gloucester Point; Delaware River, Gloucester Point to navy-yard	...do	1-5, 000	1871	F. F. Nes	1114*a*, *b*
Delaware River, from Ridley's Creek to Walsh Street wharf	...do	1-1, 200	1870	Charles Junken	1057*a*
Delaware River, from Walsh Street wharf to Carson's wharf	...do	1-1, 200	1870	...do	1057*b*
Susquehanna River, mouth of	Maryland	1-10, 000	1867	F. P. Webber	898
Sassafras River	...do	1-10, 000	1870	W. W. Harding	1071
Romney, Farley's, Stillpond, Churn, and Lloyd's Creeks	...do	1-10, 000	1870	...do	1072
Chester River, No. 1, and Morgan's Creek	...do	1-5, 000	1869-'70	...do	1026*a*, *b*
Chester River, No. 2	...do	1-5, 000	1869-'70	...do	1027
Langford Creek	...do	1-10, 000	1870	...do	1078
Patapsco River, mouth of	...do	1-20, 000	1866	F. P. Webber	913
Patapsco River, Brewster's Channel	...do	1-10, 000	1866	...do	914
Patapsco River, Brewster's Channel, enlarged from No. 913	...do	1-10, 000	1866	...do	915
Patapsco River, creeks emptying into	...do	1-20, 000	1869	J. W. Donn	1007
Tributaries of Severn and South Rivers	...do	1-20, 000	1870-'71	W. W. Harding	1077*a*

List of hydrographic sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Head of Severn River	Maryland	1-20,000	1870	W. W. Harding	1077*b*
Tributaries of Wye River	...do	1-10,000	1870	......do	1050*a*
Tributaries of Saint Michael's River	...do	1-10,000	1870	......do	1050*b*
Heads of Harris, Broad, and Porter's Creeks	...do	1-10,000	1870	......do	1049*b*
Tributaries of Tredhaven Creek	...do	1-10,000	1870	......do	1049*a*
Choptank River, from Wing's Landing to Denton	...do	1-10,000	1870	......do	1048
Eastern Branch, Anacostia Bridge to Benning's Bridge	Dist. of Columbia	1-5,000	1865	A. Balbach	863
Eastern Branch, Benning's Bridge to Bladensburgh	...do	1-5,000	1865	......do	864
Potomac River, from Analostan Island to Long Bridge	...do	1-5,000	1867	C. Fendall	1082
Wicomico River, Saint Clement's and Breton's Bay	Maryland	1-20,000	1860,'68	W. T. Muse, U. S. N., and J. W. Donn.	969
Nomini Bay, Lower Machodoc and Mattox Creeks	Virginia	1-20,000	1868	J. W. Donn	967
Yeocomico and Coan Creeks	...do	1-20,000	1868	......do	968
Smith's, Goose, and Fox Islands, Tangier Sound	...do	1-20,000	1869	W. W. Harding	997
Little Annemessex River	...do	1-10,000	1868-'69	......do	985
Pocomoke Sound, creeks from Messongo Creek to Onancock Creek.	...do	1-20,000	1869	......do	993
Pocomoke River entrance	...do	1-10,000	1869	......do	1004
Pocomoke River, sheets Nos. 1 and 2	...do	1-5,000	1869	......do	1022*a*, *b*
Pocomoke River, sheets Nos. 3 and 4	...do	1-5,000	1869	......do	1023*a*, *b*
Pocomoke River, sheets Nos. 5, 6, and 7	...do	1-5,000	1869	......do	1024*a*, *b*, *c*
Occohannock, Craddock, and Nandua Creeks	...do	1-20,000	1868	C. Fendall	976*a*
Naswaddox Creek	...do	1-20,000	1868	......do	976*b*
Hunger's Creek	...do	1-20,000	1868	......do	976*c*
Great Wicomico River	...do	1-20,000	1869	J. W. Donn	1003
Little Bay, Nantepoison, Tapp's, Dimer's, Indian, Dividing, and Mill Creeks.	...do	1-20,000	1869	......do	1005
Estuaries of the Corrotoman River	...do	1-10,000	1869	......do	1002
Estuaries of the Rappahannock River	...do	1-20,000	1869	......do	1001
Bowler's and Corner Rock, Rappahannock River	...do	1-2,500	1867	......do	937
Piankatank River	...do	1-20,000	1869	......do	988
Milford Haven (also topography)	...do	1-20,000	1868-'69	......do	987
Estuaries of Mobjack Bay	...do	1-20,000	1868	......do	984
Back and Pocosen Rivers	...do	1-20,000	1868	C. Fendall and W. W. Harding.	977
Magothy Bay	...do	1-20,000	1869	W. W. Harding	1013
Broadwater, from Ship Shoal Inlet to Sand Shoal Inlet	...do	1-20,000	1870	......do	1070*a*
Broadwater, from Sand Shoal Inlet to Hog Island Inlet	...do	1-20,000	1870	......do	1070*b*
Broadwater, Great Machipongo River and branches	...do	1-20,000	1871	J. W. Donn	1103
Little Machipongo, to head of Broadwater	...do	1-20,000	1871	......do	1104
Newport News Point	...do	1-10,000	1865	E. Hergesheimer	877
Elizabeth River, from Washington Point to navy-yard	...do	1-2,500	1866	R. Platt, U. S. N	894
Off-shore soundings from Sheephouse Hill to Killdevil Hills	Virginia and North Carolina.	1-40,000	1868	......do	965
Off-shore from Killdevil Hills to Loggerhead Inlet	North Carolina	1-40,000	1870	......do	1053
Off-shore soundings from Loggerhead Inlet to Cape Hatteras	...do	1-40,000	1869-'70	......do	1056
Off-shore soundings from Cape Hatteras to Federal Point	...do	1-240,000	1865-'66	......do	884
Cape Hatteras Shoals	...do	1-20,000	1871-'72	R. Platt, U. S. N	1135
Cape Hatteras Shoals, off-shore soundings	...do	1-40,000	1872	......do	1136
Lookout Shoals	...do	1-40,000	1865-'66	R. Platt and C. Junken	885
Long Shoal, Pamplico Sound, reconnaissance of	...do	1-10,000	1866	J. S. Bradford	887
Pamplico Sound, from Royal Shoal to Brant Island	...do	1-40,000	1866,'69 1870	J. S. Bradford and F. F. Nes.	1083
Pamplico Sound, western part	...do	1-20,000	1869	F. F. Nes	1010
Bay River	...do	1-20,000	1869	......do	1009
Pungo River, lower sheet	...do	1-20,000	1872	......do	1140*a*
Pungo River, upper sheet	...do	1-20,000	1872	......do	1140*b*
Pamplico River, from Pamplico light-house to Indian Island	...do	1-20,000	1869	......do	1088
Pamplico River, from Adams' Point to Rumley Marshes	...do	1-20,000	1868,'71	R. E. Halter and F. D. Granger.	1099
Pamplico River, from Rumley Marshes to Ragged Point	...do	1-20,000	1871	F. F. Nes	1100
Pamplico River, from Ragged Point to city of Washington	...do	1-20,000	1871	......do	1101
Pamplico River, from Cedar Grove to Tar River	...do	1-10,000	1872	......do	1139
Cedar Island, bay and vicinity	...do	1-20,000	1870	......do	1079

List of hydrographic sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Neuse River, from Point of Marsh to Cedar Point	North Carolina	1-20,000	1868	J. S. Bradford and F. F. Nes.	974
Neuse River, from Cedar Point to Wilkinson's Point	do	1-20,000	1868	J. S. Bradford	963
Neuse River, from Cherry Point to Johnson's Point	do	1-20,000	1867-'68	do	956
Neuse River, from Johnson's Point to Fort Anderson	do	1-10,000	1866	do	892
South River, Turnagain Bay, and other tributaries to Neuse River.	do	1-20,000	1868-'69	J. S. Bradford and F. F. Nes.	975
Entrance to Cape Fear River, the bars of Oak Island and Bald Head Channel.	do	1-5,000	1871	Charles Junken	1089
Entrance to Cape Fear River	do	1-10,000	1865	J. S. Bradford	870
Entrance to Cape Fear River, New Inlet	do	1-10,000	1865	do	875
New Inlet, Cape Fear River	do	1-10,000	1872	W. J. Vinal	1134
Cape Fear River, between Forts Caswell and Johnson	do	1-10,000	1866	J. S. Bradford	876
Cape Fear River, inner bar	do	1-10,000	1870	F. F. Nes	1014
Cape Fear River, western entrance	do	1-10,000	1872	W. J. Vinal	1128*a*
Main Channel over Charleston Bar	South Carolina	1-20,000	1869	R. E. Halter	981
Charleston Bar	do	1-20,000	1865	C. O. Boutelle	874
Charleston Harbor	do	1-10,000	1865	do	881
Bull and Combahee Rivers	do	1-10,000	1871	Charles Hosmer	1084
Broad River and tributaries and Whale Branch	do	1-10,000	1865	R. E. Halter	868
Broad River	do	1-10,000	1865	R. E. Halter	869
Jericho, Chowan, and Ballast Creeks, tributaries of Beaufort River	do	1-10,000	1868	Charles Hosmer	962
Off-shore soundings, from Port Royal entrance to Wassaw Sound, Gaskin and Joiner's Banks.	South Carolina and Georgia.	1-40,000	1866	C. O. Boutelle	966
Savannah River entrance	Georgia	1-20,000	1866	do	944
Savannah River, from Tybee Light to Elba Island	do	1-10,000	1866	do	945
Savannah River, from Elba Island to Fig Island	do	1-10,000	1865-'66	do	946
Savannah River, city-front	do	1-5,000	1865-'66	do	947
Entrance to Wassaw Sound	do	1-20,000	1864, '66	do	904
Wilmington River and estuaries	do	1-20,000	1865	C. Fendall	866
Ogeechee, Vernon, and Burnside Rivers	do	1-20,000	1865	do	867
Saint Catharine's Sound and estuaries	do	1-20,000	1867	Charles Junken	916
Saint Catharine's entrance	do	1-20,000	1867	do	928
Inland passages between Sapelo and Doboy Sounds	do	1-10,000	1868	do	959
Doboy Inlet and approaches	do	1-20,000	1868	do	957
Doboy Sound, with Darion and North River, and adjacent creeks	do	1-10,000	1868	do	964
Saint Simon's to Saint Andrew's Sound	do	1-20,000	1869-'72	R. E. Halter and F. P. Webber.	1133
Saint Andrew's and Jekyl Sounds	do	1-20,000	1870	R. E. Halter	1020
Coast from Saint Andrew's Bar to Saint Mary's Bar	do	1-20,000	1870	Charles Junken	1062
Florida Passage, from Saint Andrew's Sound to Cumberland Island.	do	1-20,000	1870	do	1063
Main ship-channel over Saint Mary's River Bar	Florida	1-20,000	1869	R. E. Halter	980
Coast of Florida, Saint Mary's to Saint John's Bars	do	1-20,000	1871	F. P. Webber	1110
Passage from Fernandina toward Saint John's River	do	1-10,000	1871	do	1111
Saint Mary's River and estuaries	do	1-10,000	1871	do	1112
Nassau Sound and estuaries } Part of Nassau River }	do	1-10,000	1871	do	1113*a*, *b*
Saint Augustine and vicinity	do	1-10,000	1870	H. Anderson	1036
North and Guano Rivers	do	1-10,000	1870	do	1046
Matanzas River	do	1-10,000	1870	do	1047
Off-shore soundings, from Sombrero to Sand Keys	do	1-160,000	1868	Rob. Platt, U. S. N	1066
Off-shore soundings, Straits of Florida westward	do	1-400,000	1869	do	1090
Off-shore soundings, Straits of Florida eastward	do	1-400,000	1869	do	1091
Off-shore soundings, from Key West to Charlotte Harbor	do	1-400,000	1867	do	911
Off-shore soundings, from Sand Key to Marquesas Keys	do	1-40,000	1867	do	912
Off-shore soundings, from Marquesas Keys to Rebecca Shoals	do	1-40,000	1870	do	1052
Off-shore soundings, approaches to Dry Tortugas Keys	do	1-40,000	1867-'68	do	955
Florida Reefs, from Marquesas to Dry Tortugas Keys	do	1-80,000	1867-'68	do	954
Florida Reefs, western end Marquesas to Dry Tortugas Keys	do	1-80,000	1871	do	1076
Key West, approaches from northwest	do	1-80,000	1872	R. Platt, U. S. N	1131
Deep-sea soundings, west coast of Florida		1-600,000	1872	J. A. Howell, U. S. N	1138
Yucatan Channel, Cape San Antonio, Cuba to Cape Catoche, Yucatan.		1-200,000	1872	R. Platt, U. S. N	1137

List of hydrographic sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
El Moro to Playa de Marianao, north coast of Cuba	Cuba	1-10,000	1867	W. S. Edwards	900
San Carlos Bay and Caloosa entrance	Florida	1-20,000	1866, '67	......do	917
Pine Island Sound, part of, and approaches to the Caloosahatchee	....do	1-20,000	1866	C. T. Iardella	908
Cedar Keys, main channel	....do	1-10,000	1871	F. P. Webber	1080
Saint George's Sound	....do	1-20,000	1871	H. Anderson	1092
Choctawhatchee Bay	....do	1-20,000	1872	H. G. Ogden	1141
Santa Rosa Sound, the Narrows, and west end of Choctawhatchee Bay.	....do	1-20,000	1871	......do	1107
Santa Rosa Sound, from Deer Point to Long Pritchard Point	....do	1-20,000	1871	......do	1108
The Rigolets	Louisiana	1-20,000	1870	F. P. Webber	1054
Lake Borgne	....do	1-40,000	1870	......do	1055*a*
Eastern part of Lake Pontchartrain	....do	1-40,000	1870	......do	1055*b*
Lake Pontchartrain	....do	1-40,000	1871	J. S. Bradford	1115
Isle au Breton Bay	....do	1-40,000	1869	F. P. Webber	999
Isle au Breton Sound, southeastern part	....do	1-40,000	1869	......do	1000
Approaches to Mississippi River	....do	1-40,000	1871	J. S. Bradford	1116
Trinity Shoals	....do	1-40,000	1872	F. D. Granger	1139*a*
Trinity Shoals and Tiger Shoals	....do	1-80,000	1872	......do	1139*b*
Pass à L'Outre and Southeast Pass	....do	1-20,000	1867	F. H. Gerdes	989
Pass à L'Outre and Bar	....do	1-10,000	1867	......do	927
Northeast and Southeast Passes	....do	1-10,000	1867	......do	926
West, East, and Garden Island Bays	....do	1-40,000	1868	F. P. Webber	991
South Pass	....do	1-20,000	1867	F. H. Gerdes	990
South Pass Bar	....do	1-10,000	1867	......do	925
Southwest Pass	....do	1-20,000	1867	......do	923
Southwest Pass and Bar	....do	1-10,000	1867	......do	924
Mississippi River, part of	....do	1-10,000	1866	......do	922
Mississippi River, from Grand Prairie to Bohemia	....do	1-20,000	1871	C. H. Boyd	1093
Galveston entrance and bar	Texas	1-10,000	1867	F. F. Nes	906
Galveston Bay, resurvey	....do	1-20,000	1867	......do	918
Galveston Bay, resurvey	....do	1-10,000	1867	C. H. Boyd	919
Galveston Harbor, comparative chart showing changes from 1851 to 1867.	....do	1-10,000	1867	......do	919 *bis*
Galveston Bay, western entrance	....do	1-20,000	1867	F. F. Nes	931
West Galveston Bay	....do	1-20,000	1867	......do	932
Matagorda Bay, part of	....do	1-20,000	1866, '71	F. P. Webber and F. D. Granger.	1031
Trespalacios and Turtle Bays	....do	1-20,000	1871	F. D. Granger	1094
Carancahua Bay	....do	1-20,000	1871	......do	1095
Pass Cavallo	....do	1-20,000	1871	......do	1097
Lavaca Bay and vicinity	....do	1-20,000	1871	......do	1098
Espiritu Santo Bay	....do	1-20,000	1871	......do	1096
Aransas Pass	....do	1-10,000	1868	F. F. Nes	996
Aransas Bay	....do	1-20,000	1869	H. Anderson	995
Corpus Christi Pass	....do	1-10,000	1869	......do	994
Corpus Christi Bay	....do	1-20,000	1868	F. F. Nes	958
Entrance to Brazos Santiago and Laguna Madre	....do	1-20,000	1867	C. H. Boyd	909
Magdalena Bay, from the Narrows to Cayuco Cove	Lower California	1-20,000	1871	G. Bradford	1123
Magdalena Bay, *from Man-o'-War Cove to the Narrows*	....do	1-40,000	1871	......do	1124
Santa Barbara Channel, in-shore sounding, No. 1	California	1-10,000	1869	E. Cordell and G. Farquhar.	1038
Santa Barbara Channel, in-shore sounding, No. 2	....do	1-10,000	1869	......do	1039
Santa Barbara Channel, in-shore sounding, No. 3	....do	1-10,000	1869	......do	1040
Santa Barbara Channel, *in-shore sounding, No. 4*	....do	1-10,000	1869	......do	1041
Santa Barbara Channel, in-shore sounding, No. 5	....do	1-10,000	1869	......do	1042
Santa Barbara Channel, in-shore sounding, No. 6	....do	1-10,000	1869	......do	1043
Santa Barbara Channel, in-shore sounding, No. 7	....do	1-10,000	1869	......do	1044
Santa Barbara Channel, off-shore soundings	....do	1-100,000	1869	......do	1045
Santa Barbara Channel, *entrance Coxo anchorage*	....do	1-10,000	1869	......do	1037
Roadstead under Point Sal	....do	1-5,000	1867	E. Cordell	921
Harbor of Buenaventura	....do	1-10,000	1870	W. E. Greenwell	1081
Off-shore soundings, Point Pedro, Santa Cruz	....do	1-100,000	1865	E. Cordell	871
Suisun Bay, Cordelia, Suisun, and Montezuma Creeks	....do	1-20,000	1867	......do	948

List of hydrographic sheets registered in the archives, &c.—Continued.

Localities.	State.	Scale.	Date.	Hydrographer.	Register-number.
Suisun Bay, with confluence of Sacramento and San Joaquin Rivers.	California	1-20,000	1866-'67	E. Cordell	905
Sacramento and San Joaquin Rivers	...do	1-10,000	1867	......do	935
Carquines Straits, part of	...do	1-10,000	1866	......do	879
Off-shore soundings from Point Reyes to Bodega Head	...do	1-100,000	1866	......do	889
Off-shore soundings from Point Reyes to Tomales Point	...do	1-20,000	1866	......do	890
Crescent City Reef	...do	1-20,000	1869	A. W. Chase	1025
Coose Bay	Oregon	1-10,000	1865	J. S. Lawson	901
Coose Bay	...do	1-10,000	1865	......do	902
Yaquina Bay	...do	1-10,060	1868	A. W. Chase	998
Nehalem River entrance	...do	1-5,000	1868	E. Cordell and G. Farquhar.	973
Tillamook Bay	...do	1-10,000	1866-'67	J. Kincheloe	936
Columbia River, from Three-Tree Point to Gray's Bay	...do	1-10,000	1867-'68	E. Cordell	1015
Columbia River, from Cathlamet Head to Settler's Point	...do	1-10,000	1868	......do	1016
Columbia River, from Settler's Point to Tongue Point	...do	1-10,000	1868	......do	1017
Columbia River, from Tongue Point to Cape Disappointment	...do	1-20,000	1868	......do	1018
Columbia River entrance	...do	1-20,000	1868	......do	1019
Destruction Island and vicinity	Washington Ter.	1-10,000	1866	J. S. Lawson	886
Lawson Reef, Rosario Strait	...do	1-10,000	1871	......do	1129
Partridge Bank, Strait of Juan de Fuca	...do	1-20,000	1871	......do	1130
Port Madison	...do	1-10,000	1868	......do	1102

APPENDIX No. 8.

REPORT ON THE PHYSICAL SURVEY OF PORTLAND HARBOR.

DEAR SIR: It is unnecessary for me to advert to the history of our renewed connection with the harbor-interests of Portland, because you will probably embrace this in your own comments upon the season's work. Suffice it to say that we were called upon to recommend harbor-lines for Fore River, and money was appropriated by the city of Portland to meet the expenses incurred in the preliminary examination of the locality.

My share in this examination involved a study of the movements of the tides and their relations to the channels and banks, which greatly interested me, because the instance before us was peculiar in some respects. Unlike most of the cases referred to us, we found, in the portion of the Fore River we were called upon to treat, a tidal channel with alluvial bed and banks nearly in their natural condition; and we were to suggest in what manner and to what degree this avenue could be encroached upon by wharves, &c., without so disturbing the regimen as to cause the mud to start from the bottom and move down into more valuable portions of the port. In other words, we were called upon, practically, to draw the line between *use* and *abuse*, to the end that no unnecessary restraint might be placed upon the commercial occupation of the water-front, and no increase of the scouring-power of the currents induced in a channel able to supply from its vast accumulations of mud enough material, if once set in motion, to do great mischief. The limits finally recommended were based mainly upon the "*isodynamic lines*", or lines of equal scouring-power, determined by us in a mannner that I propose to describe step by step.

With Mr. Horace Anderson's excellent hydrographic survey, we first of all, before making a single observation in the field, calculated the volume that must pass through different sections of the channel during the different hours of flood and ebb, at a time when the tides were at their average. When you consider that with every change in the height of the tide, the cubical contents of basins and creeks with which the channel communicates alter in a very irregular way, so that proportions can only be used for very small elements of height, you will appreciate the amount of labor which these computations involved. My skillful assistants, Mr. J. B. Weir and Mr. Ed. H. Foote, spent a busy month at the office in determining these *standard volumes*, as I shall hereafter call them. The next step was to determine from actual observations in what manner the volumes passing through the channel distributed themselves over the cross-sections; whether they ran over the flats or confined themselves to the channel; whether they pressed over on one shore in one part of the river or the other shore elsewhere, &c.; in short, to follow the water in its meandering course from point to point. This field-work was also assigned to Messrs. Weir and Foote, who organized parties, and, with the assistance of our friends at Portland, went into the field without a day's delay.

We selected ten characteristic lines, crossing the stream at right angles, and in each of them made simultaneous observations of the current on the ebb and on the flood, at four or more stations, which gave us *transverse curves of velocity*. Each transverse curve of velocity had then to be corrected for the mean. This was done by applying the co-efficient that would make the velocities multiplied into the depth of water give the *standard volume* previously computed for this section. Finally, all the transverse curves, having been observed and corrected for the mean, were plotted on a projection of the harbor, and lines of equal velocities were drawn along the borders of the stream, which were designated "*isodynamic lines*", because, properly speaking, they represented the mean movements from surface to bottom, and were, in effect, lines of equal *scour*.

Having given the above general sketch of our proceeding, I shall now go back over the ground and give in greater detail the actual process employed in a type case—that of Section 4 (see tables.)

At Section 4, which extends from "Stone Wharf", the whole distance across the water-way at high tide was found to be 1,586 feet, but the part in motion at the time of maximum ebb-current was only about 1,000 feet. Our stations lay at distances of 90 feet, 275 feet, 480 feet, and 720 feet from the wharf, and gave respectively 0.11, 0.87, 0.61, and 0.34 nautical mile per hour. These we plotted upon profile-paper, using distances and velocities as co-ordinates; and we completed the curve by sweeping a smooth line through the determined points. Then we took out the velocities for even hundred feet, and entered them in the third column of our annexed table. The same course was taken with flood-velocities. The next step was to correct these velocities for the mean, which was done by applying a co-efficient, obtained in the following manner:

Over each space of 100 feet, we took from Mr. Anderson's hydrographic sheet the average depth, and, having corrected it for the elevation of tide at the moment of our observations, multiplied it into the velocity and the distance (100 feet); then summed up the whole volume. This volume fell short of the *standard* for this section, because the fall of the tide for the day of observation fell below the mean, &c. So we divided the standard volume by the volume observed, and found that we must increase all the velocities 13 per cent. in order to have our transverse curve represent the mean movement.

We have spoken of the "*volume*" obtained by multiplying observed velocities into distance and depth; but we would not be understood to indicate that the word is here used in the same sense as in the case of standard volume for the section, because the observed velocities were those of the surface only. When corrected, as they appear in the last column of our table, the figures given are the true mean velocities from surface to bottom. If our observations had extended over a semi-lunation and embraced every tide, we should have found our average co-efficient below unity (perhaps about 0.90); because the mean rate from surface to bottom is usually less than the surface-velocity in tidal channels.

In the case of Portland, we had an advantage which we did not possess in New York. The Fore River is simply an avenue between the sea and interior basins, not so distant as to occasion much delay with the filling and draining; so that, for any section we had a mind to choose, we could compute, from Mr. Anderson's survey, the passing volume, and correct our surface-velocities. But in the East River at New York we were obliged to spend a great deal of time in making observations from surface to bottom at the Wall-street section, in order to obtain an initial volume.

In the Annual Report of the Coast Survey for 1871, there will be found a general paper on the location of harbor-lines, in which I have, with the help of a simple diagram, illustrated this matter of isodynamic lines more fully, and spoken of the conditions under which, not the simple velocities, but the resultant of all the velocities, are used; and it is for this reason that I employ the term *isodynamic* lines instead of lines of equal velocity, the former being more comprehensive. There are conditions where, instead of using simple velocities, we should use their squares; but the Fore River does not seem to be one of the cases.

I have thought best to furnish a sketch with this report, showing our ten sections at Portland and illustrating our tables. These were not furnished at the time the draughts containing the harbor-lines were sent to Portland, and may be of interest.

In drawing the harbor-line, we gave greater weight to the ebb, because it appeared to be the principal working agent; its *thalweg* lying more nearly over the line of greatest depression. We offer an illustration of this in our sketch, where, for "Section 3", we have compared both transverse curves with the profile of the bottom.

Mr. Weir sums up the statistics of his work as follows:

Number of sections	10
Number of stations occupied	40
Number of observations recorded	2,600

Respectfully submitted, by your obedient servant,

HENRY MITCHELL,
United States Coast Survey.

Prof. BENJAMIN PEIRCE,
Superintendent of the United States Coast Survey.

PORTLAND, *October* 16, 1872.

To the honorable members of the City Council of Portland:

Believing it is necessary that proper harbor-lines should be established in Fore River, to prevent encroachments that might be permanently injurious to the harbor, we respectfully ask your co-operation in appointing a commission to establish such lines as will, while protecting the harbor, give to riparian owners all the rights and privileges consistent with the public interest.

JACOB McLELLAN,
S. T. CORSER,
C. H. FARLEY,
Harbor-Commissioners.

Copy of records.

CITY OF PORTLAND, CITY CLERK'S OFFICE.

At a meeting of the city council, held October 17, 1872, a communication from the harbor-commissioners was received, recommending that it is necessary that proper lines should be established in Fore River, to prevent encroachments, and asking co-operation to establish such lines.

Read and accepted, and referred to the harbor-committee, with power to carry out the views of the report.

A true copy. Attest:

H. I. ROBINSON, *City Clerk.*

The recommendations of the harbor-commissioners were subsequently carried out, as per report of the advisory committee of the United States Coast Survey.

Attest:

H. I. ROBINSON, *City Clerk.*

To the honorable Mayor and City Council of Portland:

The undersigned, harbor-commissioners of Portland, have the honor to lay before you the report and accompanying maps, just received from the advisory council called together by us upon your authority to establish harbor-lines in Fore River. We obtained for this important work the services of Superintendent Peirce and Professors Whiting and Mitchell, of the United States Coast Survey, who, from their scientific knowledge and familiarity with such subjects, were best qualified to execute the work and give it a character of the highest authority. Their services were gratuitously rendered; and we are under special obligations to them for the interest manifested in this inquiry, and for the early completion of the survey, in spite of other pressing duties, which might reasonably have been pleaded as a cause for delay.

The execution of the work has been based upon purely scientific principles, excluding prejudice and error, and equitably adjusting public and private interests. The work will not need to be repeated, and we would respectfully recommend that the lines like those in the lower harbor be established and confirmed by suitable legislation.

JACOB McLELLAN,
ALBERT MARWICK,
C. H. FARLEY,
Harbor-Commissioners.

PORTLAND, *October* 1, 1873.

At the regular meeting of the mayor and board of aldermen, October 7, 1873, the report of the advisory council of the United States Coast Survey, with plan and description of the harbor-lines, was presented, with a communication from the harbor-commissioners in relation thereto.

The following resolution was unanimously passed:

"The city government desires to express its sense of obligation to the members of the advisory council—Superintendent Benjamin Peirce, and Professors Henry Mitchell and Henry L. Whiting, of the United States Coast Survey—for the services they have rendered us in making an elaborate physical survey of our harbor, for the purpose of establishing limits in an important section of it, o which marginal structures may be safely extended. We realize the fact that it is to the advantage of our city to secure in the development of our water-front all the territory that can be turned into productive and taxable property, without limiting too much the capacity of the harbor, or affecting its perpetuity.

"We are aware, also, that to do this without an accurate knowledge of the subject is dangerous, and may prove unprofitable. Questions of this nature belong to a branch of science of which these gentlemen are masters, and to a large extent the founders, and we gratefully recognize the high character of their services, their value to the city, and the interest and generosity manifested in rendering them gratuitously: Therefore,

"*Resolved*, That to these gentlemen individually, and to the United States Coast Survey, Portland is again laid under deep obligations, and with its future history their names and services will be intimately associated."

Approved October 10, 1873.

GEO. P. WESTCOTT,
Mayor of Portland, Me.

SECTION No. 1.—AT ROLLING-MILLS BRIDGE.

Velocities of tidal current.

Distance from Portland abutment.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 1.06	Co-ef. = 1.11	
0	....	....			Lat. = 43° 38′ 36″.35; Long. = 70° 16′ 30″.53.
250	0.00	0.00	0.00	0.00	True azimuth of bridge = 54° 40′.
300	0.04	0.04	0.04	0.04	
400	0.09	0.19	0.10	0.21	
500	0.17	0.31	0.18	0.35	
600	0.23	0.45	0.24	0.50	
700	0.32	0.58	0.34	0.65	
800	0.34	0.61	0.36	0.68	
900	0.24	0.45	0.25	0.50	
1,000	0.23	0.31	0.24	0.34	
1,100	0.39	0.40	0.41	0.44	
1,200	0.62	0.56	0.66	0.62	
1,300	0.76	0.65	0.81	0.72	Center of draw-way.
1,400	0.77	0.63	0.82	0.70	
1,500	0.52	0.41	0.55	0.46	
1,550	0.00	0.00	0.00	0.00	

SECTION No. 2.—AT VAUGHN'S BRIDGE.

Velocities of tidal current.

Distance from face of Portland abutment.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0.96	Co-ef. = 1.03	
0	0.02	0.04	0.02	0.04	Lat. = 43° 38′ 27″.11; Long. = 70° 16′ 26″.16.
10	0.03	0.05	0.03	0.05	True azimuth of bridge = 45° 30′.
110	0.07	0.10	0.07	0.10	
210	0.10	0.15	0.10	0.15	
310	0.16	0.21	0.15	0.22	
410	0.24	0.29	0.23	0.30	
510	0.40	0.49	0.38	0.50	
610	0.60	0.66	0.58	0.68	
710	0.84	0.84	0.81	0.86	
810	0.87	0.86	0.84	0.88	Center of draw-way.
910	0.18	0.25	0.17	0.26	
1,010	0.12	0.18	0.12	0.18	
1,110	0.07	0.10	0.07	0.10	
1,210	0.01	0.03	0.01	0.03	
1,240	0.00	0.00	0.00	0.00	

SECTION No. 3.—ON FLATS BELOW VAUGHN'S BRIDGE.

Velocities of tidal current.

Distance from Portland shore.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0. 89	Co-ef. = 1. 28	
0	0. 00	0. 00	0. 00	0. 00	Lat. = 43° 38′ 32″.50; Long. = 70° 16′ 9″.50.
100	0. 08	0. 09	0. 07	0. 12	True azimuth of line = 340° 30′.
200	0. 20	0. 24	0. 18	0. 30	
300	0. 39	0. 45	0. 35	0. 58	
400	0. 64	0. 69	0. 57	0. 89	
500	0. 80	0. 84	0. 71	1. 08	
600	0. 86	0. 55	0. 77	0. 71	
700	0. 85	0. 24	0. 76	0. 30	
800	0. 71	0. 14	0. 63	0. 18	
900	0. 44	0. 14	0. 39	0. 18	
1, 000	0. 09	0. 16	0. 08	0. 21	
1, 025	0. 00	....	0. 00	....	
1, 100	....	0. 24(?)	....	0. 30(?)	
1, 200	....	0. 21(?)	....	0. 29(?)	
1, 300	....	0. 13(?)	....	0. 16(?)	
1, 360	....	0. 00(?)	....	0. 00(?)	

SECTION No. 4.—FROM "STONE" WHARF.

Velocities of tidal current.

Distance from S. E. corner of wharf.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0. 75	Co-ef. = 1. 13	
−100	....	0. 00	....	0. 00	
0	....	0. 03	....	0. 03	Lat. = 43° 38′ 33″.30; Long. = 70° 15′ 51″.17.
90	0. 00	....	0. 00	....	True azimuth of line = 345° 53′.
100	0. 06	0. 12	0. 05	0. 14	
200	0. 59	0. 55	0. 44	0. 62	
300	0. 85	0. 88	0. 64	0. 99	
400	0. 91	0. 73	0. 68	0. 83	
500	0. 83	0. 59	0. 62	0. 67	
600	0. 74	0. 47	0. 55	0. 53	
700	0. 61	0. 36	0. 46	0. 41	
800	0. 49	0. 24	0. 37	0. 27	
900	0. 38	0. 12	0. 28	0. 14	
1, 000	0. 27	0. 01	0. 20	0. 01	
1, 010	....	0. 00	....	0. 00	
1, 100	0. 16	....	0. 12	....	
1, 200	0. 04	....	0. 03	....	
1, 230	0. 00	....	0. 00	....	

SECTION No. 5.—FROM PLASTER MILL WHARF.

Velocities of tidal current.

Distance from wharf.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0.67	Co-ef. = 0.90	
0	0.00(?)	0.00(?)	0.00(?)	0.00(?)	Lat. = 43° 38′ 34″.65; Long. = 70° 15′ 37″.49.
100	0.84(?)	0.94(?)	0.56(?)	0.84(?)	True azimuth of line = 353° 45′.
200	0.93	0.92	0.62	0.82	
300	0.74	0.88	0.50	0.79	
400	0.74	0.81	0.50	0.71	
500	0.74	0.74	0.50	0.67	
600	0.74	0.62	0.50	0.56	
700	0.74	0.48	0.50	0.43	
800	0.73	0.33	0.49	0.32	
900	0.68(?)	0.17	0.46(?)	0.15	
1,000	0.21(?)	0.02	0.14(?)	0.02	
1,010	0.00(?)	0.00	0.00(?)	0.00	

SECTION No. 6.—FROM NORTHERN ABUTMENT OF P. S. AND P. R. R. BRIDGE.

Velocities of tidal current.

Distance from abutment.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0.57	Co-ef. = 0.74	
0	0.00(?)	0.00(?)	0.00(?)	0.00(?)	Lat. = 43° 38′ 36″.94; Long. = 70° 15′ 23″.93.
100	0.84(?)	0.60(?)	0.48(?)	0.44(?)	True azimuth of line = 3°.
200	1.17(?)	0.76(?)	0.67(?)	0.56(?)	
300	1.19	0.77	0.68	0.57	
400	0.97	0.71	0.55	0.53	
500	0.86	0.73	0.49	0.54	
600	1.01	0.89	0.58	0.66	
700	1.12	0.99	0.64	0.73	
800	1.02	0.91	0.58	0.67	
900	0.76	0.70	0.43	0.52	
1,000	0.49	0.51	0.28	0.38	
1,100	0.20	0.30	0.11	0.22	
1,170	0.00	....	0.00	....	
1,200	....	0.10	....	0.07	
1,260	....	0.00	....	0.00	

SECTION No. 7.—AT PORTLAND BRIDGE.

Velocities of tidal current.

Dist. from pt. 225 ft. north of center of draw-pier.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0.97	Co-ef. = 1.38	
0	....	....			
75	0.00(?)	0.00(?)	0.00(?)	0.00(?)	True azimuth of bridge = 326° 10′.
100	0.62(?)	0.46(?)	0.60(?)	0.63(?)	
200	0.92	0.74	0.89	1.02	
225	....	....	....	....	Center of draw-pier. Lat. = 43° 38′ 41″.95; Long. = 70° 15′ 11″.48.
300	0.70	0.71	0.68	0.99	
400	0.60	0.52	0.58	0.72	
500	0.53	0.40	0.51	0.55	
600	0.49	0.32	0.48	0.44	
700	0.44	0.26	0.43	0.36	
800	0.38	0.18	0.37(?)	0.25	
900	0.21	0.12	0.20(?)	0.17	
955	0.00	0.08	0.00(?)	0.11	

SECTION No. 8.—FROM WHARF NEXT BELOW RAILROAD-WHARF.

Velocities of tidal current.

Distance from wharf.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0.74	Co-ef. = 0.80	
0	0.00	0.00	0.00	0.00	Lat. = 43° 38′ 51″.4; Long. = 70° 15′ 3″.8.
100	0.99	1.08	0.73	0.97	True azimuth of line = 317° 30′.
200	1.06	1.10	0.78	0.88	
300	1.01	1.10	0.75	0.88	
400	1.05	1.16	0.78	0.93	
500	1.21	1.34	0.90	1.07	
600	0.99	1.00	0.73	0.80	
700	0.16	0.12	0.12	0.10	
715	0.00	0.00	0.00	0.00	

SECTION No. 9.—FROM BROWN'S WHARF.

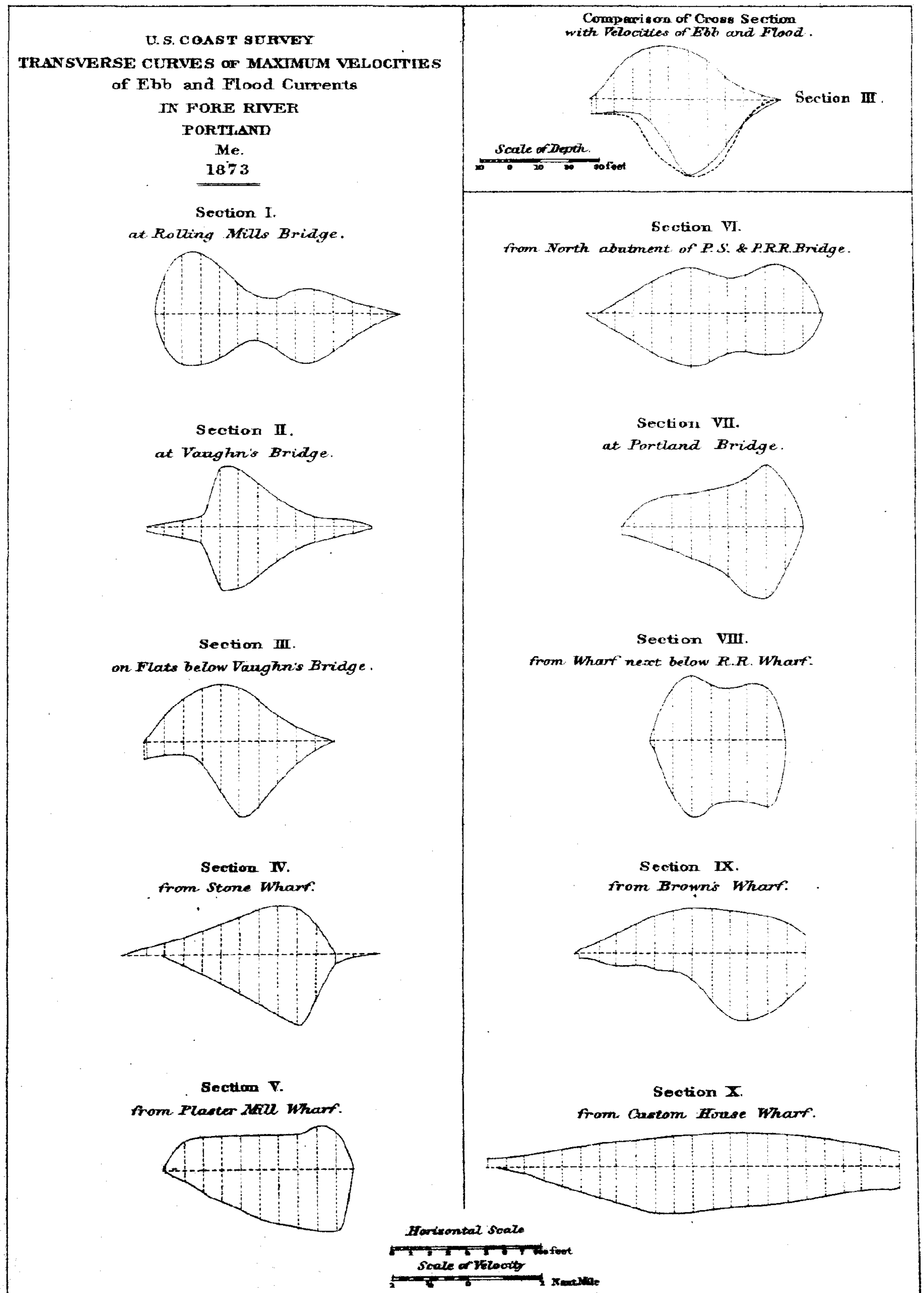
Velocities of tidal current.

Distance from wharf.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0. 66	Co-ef. = 0. 69	
0	0. 56	0. 67	0. 37	0. 46	Lat. = 43° 39′ 1″.4; Long. = 70° 14′ 49″.2.
100	0. 64	0. 99	0. 42	0. 68	True azimuth of line = 319° 50′.
200	0. 75	1. 22	0. 50	0. 84	
300	0. 83	1. 34	0. 55	0. 92	
400	0. 89	1. 32	0. 59	0. 91	
500	0. 94	0. 94	0. 62	0. 65	
600	0. 95	0. 51	0. 63	0. 35	
700	0. 93	0. 35	0. 61	0. 24	
800	0. 80	0. 30	0. 53	0. 21	
900	0. 62	0. 25	0. 41	0. 17	
1, 000	0. 43	0. 20	0. 28	0. 14	
1, 100	0. 23	0. 15	0. 15	0. 10	
1, 200	0. 06	0. 09	0. 04	0. 06	
1, 228	0. 00	....	0. 00	....	
1, 300	....	0. 03	....	0. 02	
1, 335	....	0. 00	....	0. 00	

SECTION No. 10.—FROM CUSTOM-HOUSE WHARF.

Velocities of tidal current.

Distance from wharf.	Observed maximum velocity.		Observed velocity reduced to mean maximum.		
	Flood.	Ebb.	Flood.	Ebb.	
Feet.	*Naut. miles per hour.*		*Naut. miles per hour.*		
			Co-ef. = 0. 64	Co-ef. = 0. 47	
0	0. 35	0. 62	0. 22	0. 29	Lat. = 43° 39′ 18″.47; Long. = 70° 14′ 35″.58.
100	0. 38	0. 67	0. 24	0. 31	True azimuth of line = 316° 10′.
200	0. 48	0. 74	0. 31	0. 35	
300	0. 54	0. 79	0. 35	0. 37	
400	0. 61	0. 86	0. 39	0. 40	
500	0. 67	0. 93	0. 43	0. 44	
600	0. 74	0. 99	0. 47	0. 47	
700	0. 76	1. 07	0. 49	0. 50	
800	0. 77	1. 14	0. 49	0. 54	
900	0. 76	1. 21	0. 49	0. 57	
1, 000	0. 75	1. 26	0. 48	0. 59	
1, 100	0. 74	1. 32	0. 47	0. 62	
1, 200	0. 72	1. 34	0. 46	0. 63	
1, 300	0. 67	1. 32	0. 43	0. 62	
1, 400	0. 62	1. 24	0. 40	0. 58	
1, 500	0. 59	1. 08	0. 38	0. 51	
1, 600	0. 53	0. 90	0. 34	0. 42	
1, 700	0. 47	0. 73	0. 30	0. 34	
1, 800	0. 42	0. 55	0. 26	0. 26	
1, 900	0. 37	0. 37	0. 24	0. 17	
2, 000	0. 31	0. 20	0. 20	0. 09	
2, 100	0. 27	0. 02	0. 17	0. 01	
2, 105	....	0. 00	....	0. 00	
2, 200	0. 22	....	0. 14	....	



Compiled by H. L. Marindin U. S. C. S., to accompany Report of H. Mitchell, U. S. C. S.

APPENDIX No. 9.

ADDITIONAL REPORT CONCERNING THE CHANGES IN THE NEIGHBORHOOD OF CHATHAM AND MONOMOY.

A year ago I had the honor to present a somewhat lengthy report concerning the coast of Chatham and the peninsula of Monomoy, since which time a few additional items of information have been collected, which deserve, perhaps, to be recorded.

In my previous report, I made some translations from Champlain's notes, made during a voyage along our coast in 1606, in which he speaks of Malle Barre (Nauset Inlet, of which he not only gives a special map on large scale, but distinctly marks the location upon his coast-chart of "*Nouvelle Franse*"), and of his coasting thence along an "arenaceous" shore and onward round a dangerous "*point of sand which juts out three leagues to the S. S. E.—a very dangerous place*", which he calls "*Cap Batturier*", and which we call Monomoy; and finally of his arrival at "*Port Fortune*", of which he gives a large-scale map, which we easily recognize as Chatham. I alluded to the popular tradition that Monomoy is a very recent creation of the sea, and cited maps and reports to show the connecting links of evidence between the Monomoy of to-day and the "*Cap Batturier*" of Champlain. It is true that if Monomoy had been from the outset increasing as rapidly as it has been since our first regular Coast Survey sheet of 1847, we might argue that in 1606 no decided peninsula existed. Still, in the face of its representation upon Champlain's map of "*Nouvelle Franse*", and upon the chart of the British Coast Pilot of 1707, and in spite of its length being stated in the "Description of Barnstable," of 1802, I did not think I could give any considerable weight to *traditions*, even though my excellent friend, Mr. Otis, of Yarmouth, had taken never so much care in collecting them. The fact that I was stating was simply the rapid gain of Monomoy upon the waters of Nantucket Sound; and I looked back into the history of this to ascertain whether there was any probability that this strip of beach would cross the channel lying between its extremity and the neighboring shoals, or even annex Nantucket to the mainland. I was satisfied that its progress had been intermittent, and that the gain had been at a higher rate recently than formerly; and I think any one who will go back over the charts, as I have done, selecting as authority only those which are professional in character, will come to the same conclusion.

The following table gives the distances from James Head (site of present Chatham lighthouses) to the extreme point of Monomoy:

Year.	Authority.	Distance in statute miles.	Remarks.
1606	Champlain's estimate:		
	"3 leagues", common (?)	8.28	The *common league* of France in the seventeenth century was 25 to the degree; the maritime, 20.
	3 leagues, maritime (?)	10.36	
1707	English Coast Pilot:		
	Sailing Directions	7.75	The bearing of Monomoy Point from the Tail of the Horse Shoe is given in the Sailing Directions. Upon the accompanying chart, Monomoy is represented as an island ten miles long, and three miles wide at broadest place.
	Chart	10.00	
1781	Des Barres large-scale map	8.50	On this chart, for the first time, Monomoy is properly oriented, and takes the form which we see on recent charts (essentially). See "Atlantic Neptune."
1802	"Description of Barnstable," Massachusetts Historical Collection.	7.75	
1853	United States Coast Survey	8.00	Plane-table sheet of S. A. Gilbert.
1856	do	8.08	Plane-table sheet of P. C. F. West.
1868	do	8.36	Plane-table sheet of C. H. Boyd.

NOTE.—The estimate of Champlain will be increased if we suppose that he counted from Morris Island instead of James Head. Upon his general coast-map of "*Nouvelle Franse*", Mono-

moy is represented in a manner that makes it doubtful whether he designed to make it dry sands or simply an extending shoal. But in the *Atlas Novus* (Dutch maps with Latin text), 1640, it is represented as a strip of dry land extending nearly south about six miles. Here it is called *Vlacke Hoeck, i. e., Flat Point.* Chatham, on the same map, bears the name *Ongeluckige Haven*, probably from Champlain, who named the place *"Port Fortuné, for the unhappy circumstances which had befallen us there."* It is a far better map than Champlain's, showing that more correct information had by this time been obtained.

Des Barres was the most remarkable geographer of the eighteenth century. Indeed, his maps were only superseded by the Coast Survey. He gives a view of Monomoy as seen from sea, in addition to his two maps, showing that he fully appreciated its importance to the mariner. It is very remarkable, then, that he should give this peninsula a length greater than it has to-day! Perhaps, as Captain Eldridge says, it was much longer before Egg Island broke off. I am, however, inclined to take the measurement stated in the "Description of Barnstable" as the first positive testimony concerning the true extent of this peninsula. It occurs in stating the position of a humane house, and is meant to be correct.

There are, as I stated in the previous article, plenty of old maps which give different testimony from that which my investigation has reached; but these are only popular pictures of the country, and not trustworthy, especially as regards worthless strips of beach. It was only a few weeks since that a bookseller in Boston showed me an expensive atlas, recently issued, which he regarded as the most complete set of maps in the market, but which failed to give the Monomoy Peninsula. Had this work been a *coast pilot*, or assumed to be a collection of *marine charts*, such an omission would have been fatal to its repute; but as it was nothing of this sort, the absence of a sand-bank, however notorious among sailors, was of no consequence to any one likely to purchase such an atlas.

Not wishing, however, to ignore traditions altogether, I have examined a sketch furnished me by Capt. George Eldridge, a resident of Chatham, who is well known as a *practical pilot*, a *surveyor*, and a *chart-publisher*. This sketch, although *traditional*, as it assumes to be, is confirmed, in one important feature at least, in Des Barres' remarkable chart of 1764, in this: that toward the close of the eighteenth century, Monomoy was joined to the upland, stopping the passage-way from the Sound, so that Pleasant Bay was only accessible from the ocean-side.

At the time of Des Barres, 1781, Nauset beach lay along the front of Pleasant Bay, and stretched half-way down to the present Chatham light-houses, and had advanced *two miles* in the previous *thirty years*. (*Atlantic Neptune.*)

Lieut. (now Rear-Admiral) Charles H. Davis, writing in 1848, gives, as the rate of advance for Nauset Beach from the northward, *two miles in twenty years*, upon the testimony of Capt. Franklin Nickerson, of Chatham.*

One may easily see how the Nauset beach, composed of alluvia swept down the outside coast by the sea from the northeast, has extended itself along the resultant between the ocean-waves on the one hand and the outflow of Pleasant Bay on the other. In this way, it has gone on till the too confined waters of Pleasant Bay have forced a more direct outlet again, and the march of the beach from above has recommenced. The early history of these movements is in no wise peculiar; the same may be observed at many other places upon our sandy coast. But this familiar history seems to be closed.

THE REAL POINT OF INTEREST.

It now appears that Nauset beach does not extend itself to renew the cordon in front of Chatham, but that the glacial hills, upon which the village stands, are to be thrown open to the fury of the sea, and the place is destined to renew its ancient reputation as the *Ongeluckige Haven.*

Since our survey of 1847, Nauset beach, which was found lying nearly across the mouth of Pleasant Bay by Mr. Glück, has not advanced. If this change of regimen is really taking place, to what shall we attribute it? to the failure of supply from above where the cliffs have lost their covering of sand and expose only hard clays to the present wear of the sea? or is the new order

* Memoirs of the American Academy, vol. iv, new series.

of things the sign of larger operations of the ocean affecting the submerged contours and forcing the sands back upon the continent? Should the supply of new material be really cut off, it is only a question of time when the sea, grinding along the shore, shall convert the present coarse gravel into dune-sand and deliver it to the wind and tide; for it is in this way that the material of our beaches is to be carried back into the interior or swept into sheltered bays and the advance of the sea continued, so that, geologically speaking, Monomoy may have but a short life before it.

The clay that underlies the gravel of Cape Cod does not supply *beach-sand*, properly speaking, when sifted by the sea, but ready-made dune-sand and fine material for salt-marshes. There is, I think, an interesting significance in this breaking-up of the littoral cordon at Cape Cod. We have no other instance like it that I am aware of. On the contrary, the sand-barriers along our coast have generally strengthened since our earliest surveys. For instance, Hatteras Banks, which is a slender strip of sand one hundred and eighty miles in length, lying at some points thirty miles from the mainland, has fewer breaks in it to-day than it had at the beginning of this century; and if we go back to the Raleigh chart, bearing date of 1588, we find that the number of inlets has diminished at least one-third. Mr. Frederick Kidder, who has given much study to the geography of North Carolina, thinks that the diminution in the number of water-ways through the beach has been the indirect results of the destruction of the forests and the cultivation of the soil upon the mainland, which have diminished the outflow of land-waters.

Glancing at our general coast-chart of New England, we see that a region of shallow water extends eastward from Cape Cod and Nantucket to a distance of one hundred and eighty miles, and we might hasten to the conclusion that here lies the foundation of lost lands, washed away by the sea precisely as the present cape is being destroyed, and this has been frequently suggested by geologists. But since the movements of the ocean are *toward* the continent, where is the material to be found? There are not sufficient beaches, dunes, and accumulations in sheltered bays and sounds in this part of the continent to balance such an account. In fact, it takes all the dunes and beaches of Provincetown and Monomoy and the shoals and marshes of Nantucket Sound and Cape Cod Bay to balance the loss of the comparatively narrow belt of land that we see, from the present elevation of the glacial cliffs, must be admitted to have fallen a prey to the waves.

As the glacial cliffs tumble down before the attacks of the sea, there are exposed, a short distance above the reach of storm-waves, as they now occur, rifts of oyster-shells like those of existing species, and the same are found also in wells far back from the coast, showing that, previous to the glacial deposit, there existed a bank extending into the sea; and I suggest that the shallow ground which I have spoken of above as stretching out one hundred and eighty miles to the eastward may never have been the site of glacial deposits.

There is one little point that I must touch upon here, which is irrelevant to the special subject of this report, but may interest somebody. It is this: the rate at which the coast falls back is not, on our shores, dependent upon elevation, as Sir Charles Lyell believes it to be in parts of England. There are, for instance, all sorts of elevations along the outer margin of Cape Cod, and yet the shore-line is remarkably smooth, having no indentations to mark the more rapid encroachments upon low countries. The rapidity of encroachment seems to depend upon the *character of the material* almost exclusively. The glacial drift has been dumped into the sea pell-mell, and, because so badly packed, is peculiarly perishable where attacked by the waves. On Martha's Vineyard, for instance, we have, in the same neighborhood, two lofty bluffs, Nashaquista and Gay Head, which have undergone very unequal erosion from the sea. The former (glacial) is falling rapidly away, while the latter (sedimentary) has been kindly dealt with. One is treated as an intruder upon the ocean's domain; the other, as a peaceful settler.

CORRECTIONS OF PREVIOUS PAPER.

In the sketch accompanying my former report, a portion of Morris Island, marked D, was stated to be "hillocks." I had not been on the precise ground at the time, and misinterpreted our topographical map. On revisiting Chatham, a few weeks since, I observed that what I had called "hillocks" were really hills of considerable heights clustered together. Captain Champlain describes the same locality as "*petis costaux de montaignes.*"

Captain Eldridge objects to my describing the little fresh pond, which appears on both Champlain's map and our own, as "lying in the hollow of the upland." A careful inspection shows that this pond rests against the upland on one side, and is separated from the sea on the other by a natural dike of alluvium.

RESULTS OF THE LAST SURVEY.

In the month of November last, Mr. H. L. Marindin, assisted by Mr. J. B. Weir, made another plane-table survey of the coast of Chatham, between the parallels 41° 39′ and 41° 42′, covering the area of waste, and he supplies the following tables, which are those previously published, brought up to date.

Table of areas of Chatham beach between latitude 41° 39′ *and* 41° 42′.

Between latitude—	Area of beach in the year—						
	1847.	1868.	Loss of area, 1847 to 1868.	1872.	Loss of area, 1868 to 1872.	1873.	Loss of area, 1872 to 1873.
° ′ ° ′	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
41 39 and 41 40	186	147	− 39	113	−34	66.5	−46.5
41 40 and 41 41	174	71	−103	35	−36	24.5	−10.5
41 41 and 41 42	146	49	− 97	39	−10	44.5	+ 5.5
			239		80		51.5

Loss between 1872 and 1873 = 28 per cent. of area in 1872.

Table of distances of the eastern shore of Chatham beach, west from meridian 69° 55′.

On latitude.	Distance west of meridian in the year—						
	1847.	1868.	Retreat, 1847 to 1868.	1872.	Retreat, 1868 to 1872.	1873.	Retreat, 1872 to 1873.
° ′ ″	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
41 39 00	6,475	6,075	+ 400	6,150	− 75	6,630	−480
41 39 15	5,525	5,650	− 125	5,802	−152	6,120	−318
41 39 30	4,925	5,275	− 350	5,595	−320	6,140	−545
41 39 45	4,550	5,005	− 455	5,405	−400	Inlet....	....
41 40 00	4,255	4,795	− 540	5,095	−300	Inlet....	....
41 40 15	3,975	4,570	− 595	Inlet (1871)..	....	Inlet....	....
41 40 30	3,625	4,285	− 660	4,635	−350	5,365	−730
41 40 45	2,870	3,627	− 757	3,895	−268	4,345	−450
41 41 00	2,060	3,127	−1,067	3,127	± 0	2,965	+162
41 41 15	1,820	3,085	−1,265	3,060	+ 25	3,180	+120
41 41 30	1,520	4,352	−2,835	5,155	−800	5,180	+ 25
41 41 45	1,360	N. Inlet	....	N. Inlet.....	....	Inlet....	....
41 42 00	Inlet....	Inlet....	....	Inlet.......	....	Inlet....	....

NOTE.—Width of beach on latitude 41° 41′ in 1847 = 1,700 feet. Width of beach on latitude 41° 41′ in 1868 = 590 feet. Width of beach on latitude 41° 41′ in 1872 = 590 feet. Width of beach on latitude 41° 41′ in 1873 = 820 feet.

The loss of beach between 1847 and 1868 was at the rate of 11.4 acres per annum; between 1868 and 1872, 20 acres; and, for the past year, 51.5 acres: so that the waste has been going on at an accelerating rate.

The most salient point of the remaining beach on the parallel of 41° 41′ has not wasted, but gained in width during the past year; this, however, seems to be a mere fluctuation.

The upland has been but little disturbed during the past year; but attacks from the sea are so much apprehended that buildings have been moved back from places where inroads are threatened.

Mr. Marindin has got up for me a series of little sketches of Chatham, which I append, beginning with the map of Champlain, "*rectified*", *i. e.*, put into proper shape, and oriented to the best of

WEAR OF THE SEA

UPON THE COAST

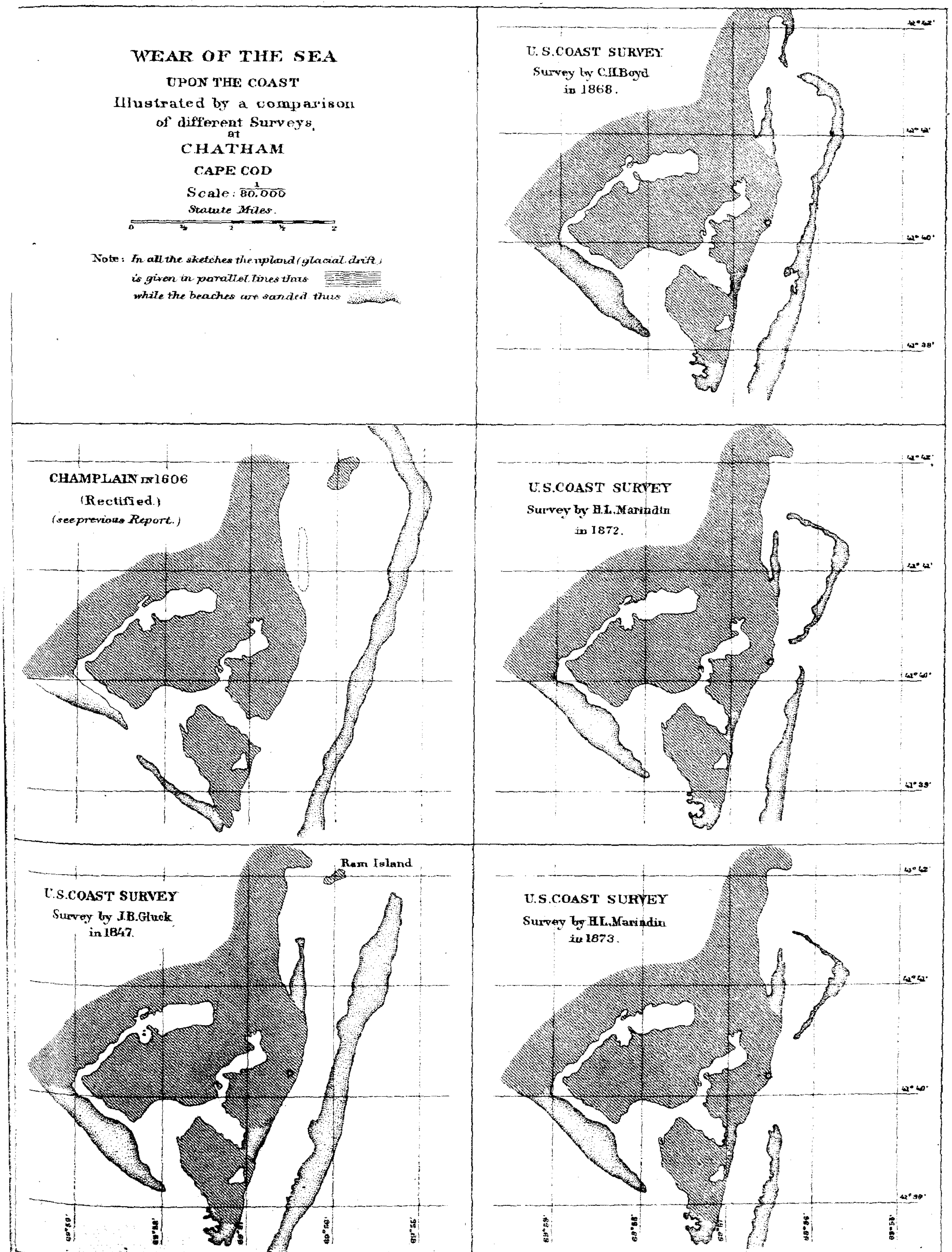
Illustrated by a comparison of different Surveys at

CHATHAM CAPE COD

Scale: $\frac{1}{80.000}$

Statute Miles.

Note: *In all the sketches the upland (glacial drift) is given in parallel lines thus while the beaches are sanded thus*



Compiled by H.L.Marindin U.S.C.S., to accompany Report of H.Mitchell, U.S.C.S. Dec. 1873.

our ability. Those points which have not been washed by the sea we supposed to have remained the same, and we have made them the base for determining the positions of other points that have undergone a "*sea-change.*"

Between the time of Champlain, 1606, and the date of our first regular survey, 1847, Des Barres' chart properly comes in; but the scale is smaller, and we should not feel justified in enlarging a printed sheet. (See *Atlantic Neptune.*) The beach was broken in Des Barres' time in front of Chatham, and the Monomoy Peninsula hooked on to the upland at James Head, near the present light-houses. Subsequently, however, Nauset beach advanced from the northward, and reproduced the *littoral cordon* in front of the town, as shown by Lieutenant Davis (before referred to); and finally, before 1847, another inlet opened above, *since which Nauset beach has not advanced.*

"Ram Island", which, upon the original map of Champlain, was called "*Isle remplis de bois dedans un grand cul de sac*" (to quote the exact phrase), obtained its recent name on Des Barres' chart, and still appeared in the survey of 1847, at which time it had an elevation of 20 feet, was used as a pasture, and had a building upon it. The subsequent surveyors found no such island existing.

The dwindling of the beach from date to date is well illustrated by these sketches, upon which we have carefully distinguished upland (glacial drift) from alluvia by shading the former in lines, the latter in dots.

Very respectfully, yours,

HENRY MITCHELL.

Prof. BENJAMIN PEIRCE,
Superintendent of the United States Coast Survey.

APPENDIX No. 10.

NOTE CONCERNING CHANGES IN THE SUBMERGED CONTOURS OFF SANDY HOOK.

DEAR SIR: Having insufficient time in which to prepare a full report upon the changes at Sandy Hook, but deeming the matter too important to be postponed altogether, I submit a few of our tables showing the results of comparisons among our repeated hydrographic surveys, with a rough sketch illustrating our manner of computation.

The survey of Captain Gedney in 1840 furnished but little data, and that of 1855 by Captain Craven is incomplete (although good); but the surveys of 1863 by myself, and 1873 by Mr. Nes, were made expressly for the purpose of comparison.

The shore-line surveys, which I have never regarded as furnishing the *kind* of data really necessary to measure the advance of the Hook, I have not used. I will remark, however, from memory, that there was little superficial change for several years before 1860; that a rapid growth took place between 1860 and 1863; and that since 1865 the Hook has apparently been washing away. Next season we propose to make another shore-line survey in great detail.

Regarding Sandy Hook as a great mole built out by the sea across the floor of the bay, I have considered the submerged contours as those most unlikely to be affected by accidental causes, and that their changes of position should furnish the best measures for the progress of this remarkable work of nature.

Inspecting the seven tables appended, with the help of the diagram which accompanies them, you will, I think, conclude that the Hook is rapidly advancing, and that we have no reason to suppose that its rate of progress has slackened.

Professor Bache, in his Reports of 1856 (Appendix No. 38) and 1857 (Appendix No. 37), gives the average rate of increase of the dry point of Sandy Hook 27½ feet per annum. Our comparison of submerged contours shows the increase recently to have been about 50 feet per annum! Professor Bache found that Flynn's Knoll, which lies on the other side of the main ship-channel, did not recede as the Hook advanced, so that this channel declined in width 27½ feet per annum. We find that the base of Flynn's Knoll begins to give way at the rate of 17 feet per annum, so that the main ship-channel loses about 33 feet per annum. The present width of this channel between the 24-foot curves is 2,800 feet, which is about the minimum required for a heavy sailing-ship beating to windward, so that, unless Flynn's Knoll beats a more hasty retreat hereafter than heretofore, we shall soon find this important channel falling into disrepute.

The main ship-channel at Sandy Hook is the direct avenue to Sandy Hook Bay, the grand outer roadstead of New York Harbor, and the route pursued by most heavy ships bound to the city. The Swash Channel is improving, so that it is more and more used as a direct avenue from the sea to New York City, and may, before many years, become a safe and adequate channel at all times. Still the loss of the Lower Bay as an outer roadstead would be a misfortune that can scarcely be estimated.

The material forming Sandy Hook is swept up from the Long Branch coast by the diagonal wash of the sea. This was placed beyond dispute by my observations of 1857. Materials of the same specific weight as the sand were placed in the sea at many different points down the outside shore, and at different distances off shore. Those within the action of the waves breaking near the shore were swept along to the northward, and finally collected at the point of the Hook. Those placed far off shore never came to land, so that I concluded that the tidal currents took very little part in the transaction.

Mr. Whiting suggests that the giving way of Flynn's Knoll has *admitted* the more rapid advance of the Hook.

I think Captain Patterson and Major-General Humphreys would feel an interest in seeing this report.

Very respectfully, yours,

HENRY MITCHELL,
United States Coast Survey.

Prof. BENJAMIN PEIRCE,
Superintendent of the United States Coast Survey.

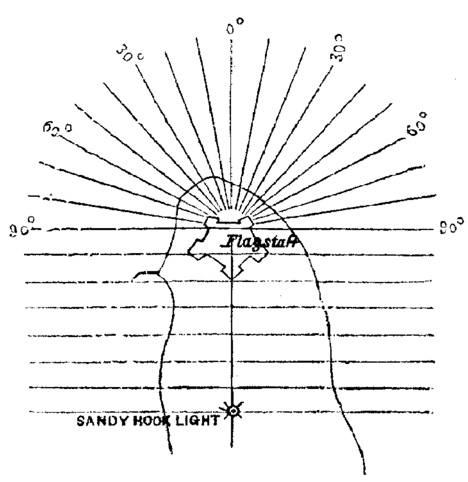
Comparison of changes in the submerged contours around Sandy Hook, from repeated surveys.

[These tables and those that follow have been computed by H. L. Marindin, assisted by Mr. John B. Weir and Mr. Ed. H. Foote. H. Mitchell.]

Depths, feet.	NORMAL 0°.					NORMAL 10° EASTWARD.				
	Distance of curve on normal, &c.				Advance per year.	Distance of curve on normal, &c.				Advance per year.
	In 1840.	In 1855.	In 1863.	In 1873.		In 1840.	In 1855.	In 1863.	In 1873.	
6	....	900	1, 450	1, 695	+24. 5	....	....	1, 500	1, 480	− 2. 0
12	....	1, 040	1, 590	2, 160	+57. 0	....	....	1, 675	1, 930	+25. 5
18	....	1, 340	1, 675	2, 320	+64. 5	700	....	1, 700	2, 395	+69. 5
24	....	1, 520	1, 705	2, 405	+70. 0	....	....	1, 910	2, 480	+57. 0
30	....	1, 600	1, 965	2, 440	+47. 5	....	....	1, 970	2, 565	+59. 5
36	....	1, 620	1, 990	2, 455	+46. 5	....	....	2, 000	2, 610	+61. 0
42	....	1, 640	2, 055	2, 495	+44. 0	....	....	2, 050	2, 645	+59. 0
48	....	1, 670	2, 075	2, 525	+45. 0	....	....	2, 075	2, 760	+68. 5
54	....	1, 900	2, 150	2, 590	+44. 0	....	....	2, 150	3, 000	+85. 0
	Mean	....	....	....	+49. 2	....	....	....	....	+53. 9
	NORMAL 20° EASTWARD.					NORMAL 30° EASTWARD.				
6	710	920	1, 425	1, 380	− 4. 5	....	....	1, 330	1, 290	− 4. 0
12	....	1, 140	1, 700	1, 710	+ 1. 0	....	....	1, 440	1, 565	+12. 5
18	....	1, 640	1, 875	2, 340	+46. 5	....	....	1, 900	1, 930	+ 3. 0
24	....	1, 760	1, 940	2, 570	+63. 0	....	....	1, 990	2, 600	+61. 0
30	....	1, 810	1, 990	2, 815	+82. 5	....	....	2, 050	2, 720	+67. 0
36	....	1, 840	2, 030	2, 825	+79. 5	....	....	2, 190	2, 750	+56. 0
42	....	1, 880	2, 070	2, 845	+77. 5	....	....	2, 280	2, 780	+50. 0
48	....	1, 910	2, 180	2, 930	+75. 0	....	....	2, 320	2, 840	+52. 0
54	....	1, 925	2, 240	3, 040	+80. 0	....	....	2, 600	2, 950	+35. 0
	Mean	....	....	....	+56. 1	....	....	....	....	+37. 4
	NORMAL 40° EASTWARD.					NORMAL 50° EASTWARD.				
6	....	....	1, 340	1, 205	−13. 5	....	1, 000	1, 275	1, 190	− 8. 5
12	....	....	1, 500	1, 495	− 0. 5	....	1, 300	1, 430	1, 520	− 9. 0
18	....	....	2, 140	1, 760	−38. 0	....	1, 475	2, 240	1, 680	−56. 0
24	....	....	2, 180	2, 030	−15. 0	....	2, 180	2, 370	1, 965	−40. 5
30	840	....	2, 220	2, 580	+36. 0	....	2, 420	2, 415	2, 770	+35. 5
36	....	....	2, 300	2, 920	+62. 0	....	....	2, 560	2, 805	+24. 5
42	....	....	2, 360	3, 008	+65. 0	....	....	2, 650	3, 065	+41. 5
48	....	....	2, 420	3, 200	+78. 0	....	....	2, 890	....	....
54	....	....	2, 640	....	....	....	....	3, 130	....	....
	Mean	....	....	....	+21. 8	....	....	....	....	− 1. 8
	NORMAL 60° EASTWARD.									
6	....	....	1, 130	1, 160	+ 3. 0					
12	....	....	1, 520	1, 510	− 1. 0					
18	....	....	1, 670	1, 730	+ 6. 0					
24	....	....	2, 775	2, 000	−77. 5					
30	....	....	2, 900	2, 110	−79. 0					
36	....	....	3, 050	....	....					
42	1, 700	....	....	....	....					
48	....	....	....	....	....					
54	....	....	....	....	....					
	Mean	....	....	....	−29. 7					

Comparison of changes in the submerged contours around Sandy Hook, &c.—**Continued.**

Depths, feet.	NORMAL 10° WESTWARD. Distance of curve on normal, &c. In 1840.	In 1855.	In 1863.	In 1873.	Advance per year.	NORMAL 20° WESTWARD. Distance of curve on normal, &c. In 1840.	In 1855.	In 1863.	In 1873.	Advance per year.
6	....	920	1,580	1,780	+20.0	....	1,000	1,610	1 540	− 7.0
12	....	1,090	1,640	1,970	+33.0	....	1,100	1,680	1,790	+11.0
18	....	1,200	1,660	2,220	+56.0	....	1,170	1,760	1,960	+20.0
24	....	1,350	1,760	2,270	+51.0	....	1,320	1,840	2,000	+16.0
30	....	1,520	1,875	2,330	+45.5	....	1,420	1,865	2,020	+15.5
36	....	1,550	1,950	2,400	+45.0	....	1,440	1,885	2,060	+17.5
42	....	1,560	2,000	2,475	+47.5	....	1,470	1,930	2,080	+15.0
48	....	1,575	2,010	2,560	+55.0	....	1,510	1,975	2,115	+14.0
54	....	1,620	2,020	2,710	+69.0	....	1,525	2,270	2,130	−14.0
	Mean	....	....	....	+46.9	....	....	....	....	+12.1
	NORMAL 30° WESTWARD.					**NORMAL 40° WESTWARD.**				
6	....	....	1,638	1,660	+ 2.2	....	....	1,710	1,520	−19.0
12	....	....	1,760	1,800	+ 4.0	....	....	1,755	1,870	+11.5
18	....	....	1,805	1,930	+12.5	....	....	1,795	1,940	+15.5
24	....	....	1,890	1,960	+ 7.0	....	....	1,885	1,950	+ 6.5
30	....	....	1,930	2,030	+10.0	....	....	1,905	1,970	+ 6.5
36	....	....	1,955	2,070	+11.5	....	....	1,950	1,980	+ 3.0
42	....	....	1,975	2,090	+11.5	....	....	2,000	1,990	− 1.0
48	....	....	2,000	2,135	+13.5	....	....	2,030	2,000	− 3.0
54	....	....	2,060	2,230	+17.0	1,590	....	2,110	2,140	+ 3.0
	Mean	....	....	....	+ 9.9	....	....	....	....	+ 2.5
	NORMAL 50° WESTWARD.					**NORMAL 60° WESTWARD.**				
6	....	1,230	1,540	1,580	+ 4.0	....	1,220	1,480	1,275	−20.5
12	....	1,280	1,555	1,640	+ 8.5	....	1,245	1,492	1,360	−13.2
18	....	1,310	1,600	1,660	+ 6.0	....	1,290	1,525	1,390	−13.5
24	....	1,345	1,620	1,680	+ 6.0	....	1,340	1,540	1,400	−14.0
30	....	1,380	1,660	1,700	+ 4.0	....	1,360	1,575	1,410	−16.5
36	....	1,410	1,700	1,720	+ 2.0	....	1,380	1,600	1,520	− 8.0
42	....	1,460	1,730	1,730	± 0.0	....	1,415	1,640	1,550	− 9.0
48	....	1,540	1,750	1,900	+25.	....	1,445	1,830	1,600	−23.0
54	....	....	....	....	....	....	....	....	....	....
	Mean	....	....	....	+ 6.9	....	....	....	....	−14.7



APPENDIX No. 11.

REPORT OF GEOGRAPHICAL AND HYDROGRAPHICAL EXPLORATIONS ON THE COAST OF ALASKA, BY W. H. DALL, ASSISTANT IN THE COAST SURVEY.

SAN FRANCISCO, CAL., *November* 10, 1873.

SIR: I have the honor of submitting the following report of our occupations during the past season, with accompanying papers.

We left San Francisco, Cal., April 28, 1873, on the United States Coast Survey schooner Yukon, and arrived at Unalashka, Aleutian Islands, May 20, 1873. During the voyage, current and temperature observations were kept up, as on previous occasions. We remained at Unalashka until June 11. This was for the purpose of carefully rating our chronometers. Signals were erected and preparations for continuing the survey of Captain's Bay were made, at such times as the weather allowed, until the rating of the chronometers was completed. During this period, 113 observations for time, 58 observations for latitude, and 96 observations for magnetic declination were obtained. I have already reported to you in regard to observations made in the vicinity of Sannakh, including the discovery of a new cod-bank, and the determination of the southern and eastern terminations of the celebrated reefs about Sannakh. These observations were taken prior to our arrival at Unalashka, and will be more fully alluded to hereafter.

Leaving Unalashka, June 11, we sailed directly for Attu, the most western island of the chain, arriving June 18. Here 216 observations were taken for dip and magnetic declination, and 80 for time, latitude, and azimuth.

We sailed hence June 27, and in latitude 52° 56′ 41″ north, and longitude 175° 38′ 20″ east, sounded in 1,018 fathoms without reaching any bottom, though all our available line was used. The next day, in latitude 52° 20′ north and longitude 177° 17′ 00″ east, sounded in 900 fathoms, finding the bottom to be composed of that peculiar ooze, full of *Foraminifera* belonging to the genus *Globigerina*, and which has been designated by the English investigators as "recent chalk." We arrived at the harbor of Kyska June 29, and, having determined its suitable character as a landing-point for a cable, proceeded to make a thorough reconnaissance-survey of it. Here we obtained 51 observations for tides; 1,414 soundings over lines twenty-seven miles in extent; 253 observations for horizontal angles; 631 observations for shore-line, covering an extent of fifty-five and one-half miles; 152 observations for azimuth, time, and latitude; and 192 for magnetic declination and dip. Observations were also taken for determining the position of the group known as the Davidoff Islands, which are placed about six miles too far north on the charts now in use. We left Kyska July 24, and arrived at Constantine Harbor, Amchitka, on the following day. Here we obtained 96 observations for magnetic declination, and 90 for azimuth, time, and latitude; the weather being very unfavorable.

Sailing hence August 6, we arrived at Adakh on the 9th, and discovered a new harbor in the Bay of Islands, in which we anchored and of which a sketch accompanies this report. Here we obtained 32 observations for magnetic declination, and 46 for latitude, time, and azimuth, in spite of the most discouraging fog and rain. We then sailed for Atka on the 13th of August, and arrived in Nazan Bay on the 17th. *En route* we obtained a sound in latitude 52° 19′ 00″ north, and longitude 175° 23′ west, getting rocky bottom at 700 fathoms.

At Atka, the weather did not improve, and we were unable to obtain observations for latitude, but obtained 48 for azimuth and time and 64 for magnetic declination. Examinations were also made of Korovinsky Bay and the solfataras of Boiling Spring volcano.

We then sailed for the islands of the Four Craters. Here, as there are no harbors, we were unable to effect a landing, but obtained sufficient information to show that they bear no resemblance, in position, size, or form, to the group, as represented on the charts in use. We then continued on our way, and arrived, August 29, in the vicinity of the Bogosloff volcano, where again the heavy sea prevented us from landing. We obtained observations, placing the island in 53° 58′ 36″ north latitude, and longitude about 167° 33′ 30″ west, agreeing with Lütké, but differing from all the other hydrographers by several miles. We obtained soundings on the line of the reported reef extending from this island to Umnak, and failed to obtain bottom at 800 fathoms within a few miles of shore, and the non-existence of the reef may be taken as demonstrated. Passing the northwest end of Unalashka, we came upon the western end of the great Bering Sea plateau, with soundings in 60 fathoms, gravelly bottom. We arrived at Unalashka on the 31st of August. Here we proceeded to obtain the summer-rates of our chronometers, which had not done as well as we had hoped for. The triangulation of the bay was continued, Uknadok Island completely surveyed, and our azimuth-observations continued and augmented.

We obtained here 113 observations for azimuth and time, 128 for magnetic declination, 430 for horizontal angles, and 182 observations for shore-line extending over fifteen and a half miles. The weather prevented our carrying on the soundings as I had hoped to do.

We then sailed, September 25, for the Shumagins, but, owing to long-continued gales, did not arrive there until the 5th of October, when we anchored in Humboldt Harbor, surveyed by us last year, and which has since become a favorite resort for vessels in this region during bad weather. Here bad weather and high winds were almost unremitting, yet we managed to obtain 185 observations for azimuth, time, and latitude, and 80 for magnetic declination. A genuine cyclone occurred on the 12th of October, driving the schooner Wm. Irelan ashore on the coast of Unga. We did what we could for the sufferers, who called on us for assistance, and brought them down to San Francisco. The weather offering no hopes of doing more work, we sailed from Humboldt Harbor on the 18th of October for San Francisco. Adverse winds driving us nearly to the north end of Vancouver Island before we passed south of the parallel of 50° north, we obtained a calm day, and having prepared a quantity of fine twine for the experiment, we sounded in latitude 49° 24′ 01″ and longitude 132° 47′ west, and with an excellent opportunity, we ran out the whole, 1,664 fathoms, without obtaining any bottom. We reeled in over 400 fathoms; but a whale became entangled in the line, and we lost the rest just when we had a good opportunity of recovering the whole. The weight used was a ten-pound lead, and the practicability of using even this fine and common material (ordinary hemp twine) was thoroughly demonstrated. We arrived in San Francisco November 6.

During the whole season, current and temperature observations were carried on, and observations for the height of many of the prominent peaks of the islands were obtained. The accompanying appendix contains much that I judged best to omit from this portion of the report for brevity's sake, with many of the observations in tabular form, and especially a table containing a list of the various determinations of latitude, time, and magnetic declination at the places where our observations were taken, arranged in chronological order. This is not without some historical, as well as comparative, value.

The officers of the vessel fulfilled their duties with care and promptitude. Mr. Noyes, as the records will attest, has used every endeavor to carry out his part of our work with neatness and care; and I must especially refer to the energy and interest displayed by Mr. Baker in seizing every opportunity for obtaining results under disadvantageous circumstances, and to the capability he has shown for fulfilling the duties of his position.

I remain, with great respect, your obedient servant,

WILLIAM H. DALL,
Acting Assistant in the United States Coast Survey.

Prof. BENJAMIN PEIRCE,
Superintendent of the United States Coast Survey.

ATTU.

This harbor, which is difficult to enter or to leave except with a perfectly fair wind, is subject to the effect of the heavy swell from northerly gales. It is very well represented on the chart published from the United States Naval Hydrographic Office, and constructed by Lieutenant Gibson. The position, which has been given very variously by different navigators, agrees in the essentials with that of Gibson. The azimuth will be found referred to under that head farther on.

This harbor was examined with regard to its capabilities as a landing-place for the cable, but possesses no recommendations except its geographical position. The entrance is narrow, shoal, and rocky, and in the winter storms it breaks clear across the mouth of the harbor.

Inpursuance of your instructions, I examined Sarauna Bay, on the east end of the Island, and found it shoal and rocky, with no protection. Gotzeb Harbor, mentioned by Gibson, is an open bay with deep water and rocky bottom; and Massacre Bay is reported to have similar characteristics. We may, therefore, reasonably assume that the island of Attu possesses no facilities for the telegraphic enterprise.

BOULDYR ISLAND.

Bouldyr possesses no harbors or anchorages. Large shoals are doubtfully reported between this island and Kyska. We were close to their reported position in heavy weather, but saw no breakers.

KYSKA ISLAND.

I reported to you last season that, from information derived from old navigators in this region, I deemed it probable that it was more likely than any other to have the characteristics required for a landing-place for the cable. I am glad to be able to state that a thorough examination has entirely confirmed the views I then expressed.

The harbor of Kyska is a noble bay, perfectly protected from all winds, with good holding-ground and a moderate depth of water, which increases very gradually seaward. The bottom of the bay is an almost level floor of sandy mud, and the western shore is an almost continuous sand-beach. The position is somewhat farther east and south than that assigned by Gibson. A thorough reconnaissance-survey was made of the bay and its approaches. It has not been previously visited by a surveying-vessel, so far as I can discover. The entrance is wide enough to enable a sailing-vessel to beat in or out at any time. There are no hidden dangers, and the depth of water is sufficient for any vessel.

From this point, observations were made fixing the position of the Davidoff Islands, which are very greatly in error in the charts now in use, and, as to which, considerable confusion of names has arisen.

AMCHITKA.

Enveloped in fog when we approached it, we were fortunately obliged to enter Constantine Harbor, instead of Kiriloff Harbor, as we intended, the reasons for which will presently appear. Constantine Harbor is open to the northeast, but otherwise is an excellent anchorage, as the southwest winds alone are prevalent during the summer months. The weather was almost constantly foggy, and we experienced the greatest difficulty in obtaining good astronomical observations. When obtained and repeated, these showed either that the whole island has been much misplaced on the charts, or that its eastern extremity has been erroneously elongated beyond its true position. The latitude is about the same as that given by most previous hydrographers, but the longitude is from 16 to 11 minutes of arc farther west than the charts put it. Our observations were sufficiently numerous, and agreed sufficiently among themselves, to place this beyond a doubt; and the correctness of our position is probably as great as our instruments were capable of determining.

When making for Kiriloff Harbor, stated in the United States Naval Directory for Bering Sea to be "the only place where a vessel can lay to anchor in the island", we could not find it. Hence I took the large boat from Constantine Harbor, and proceeded up the coast of Amchitka in search of it. We reached the middle cape of the island, about five miles east of Constantine Harbor, without seeing any bay or harbor on our way. We stopped here to take tea and obtain some bearings, and on our return I noticed a cross on a hill. Putting in here, we found the old Kiriloff village, abandoned by the Russians in 1849, and now in ruins, half covered by a luxuriant growth of nettles. Our astonishment may be imagined when we not only did not find any such bay as is represented on the charts, but on sounding found nowhere more than three fathoms of water, while our boat frequently touched on hidden rocks, and the only protection proved to be a narrow space between two broken reefs extending northward from the shore, and not room enough for a vessel to swing.

Only the very smallest class of vessels could go in here at all. The place is unworthy the name of a harbor, and the only recommendation I can give is that vessels should steadfastly avoid going near it. It is about three miles west and about one mile north of Constantine Harbor, and its position consequently partakes of the corrections to be applied to the former.

ADAKH.

This island offering a favorable position for continuing our observations on the declination, we proceeded to an anchorage in Chagakh Bay, which had been recommended to us by one of the Russian navigators, but, finding it closed by a bar with only nine feet of water on it, we were unable to enter. I took the boat and proceeded to examine an opening in the land, which had struck me as likely to afford shelter when beating into the strait the day before. Here I discoverd an excellent anchorage, with good holding-ground, and shelter behind what proved to be an island forming part of an archipelago, which closes the mouth of a very large and beautiful bay known as the Bay of Islands. A sketch of the anchorage accompanies this report.

The topography here is very broken, but covered with a carpet of luxuriant green, while the myriad winding channels between the islands offered great temptations to us to remain and attempt a survey. Here we obtained numerous enormous crabs, from which it is possible that the name of the main island may be derived; *Adakh* signifying a *crab* in the Aleutian dialect. The bay of Waterfalls near by is open to the south, and affords no safe anchorage.

It may be remarked that the Japanese junk whose wreck in 1871 attracted much attention, was cast ashore here, and not on the north shore of the island, as has been currently reported.

Our positions accorded tolerably well with the charts, on which, however, the shore-line, bay, and islands, are very insufficiently delineated.

ATKA.

On our way to Atka, we observed that the positions of the volcanic crater-islands of Kasatochi and Koniugi do not agree with the positions on Gibson's chart; one or the other being out in latitude a mile or two.

The harbor of Atka, in Nazan Bay, was examined in regard to its capacity for a telegraphic station, and the conclusion which I arrived at was unfavorable, as the bay is full of reefs and rocks the bottom irregular, and the harbor but second-rate. Bad weather set in here, and we could obtain no observations for latitude, and, with the greatest difficulty, those for azimuth and time. I obtained a skin-canoe and two natives, and crossed the island to Korovinsky Bay for the purpose of examining that locality and the deposits of coal said to exist in the vicinity. I found the harbor, nearly useless, having silted up within quite a recent period, so that not more than twelve feet can be carried over the bar at half tide. In the southeast corner of the bay, however, a good harbor exists, well sheltered, and with good holding-ground in nine fathoms. This locality is known as Martin's Harbor, having first been entered and subsequently used by Capt. Martin Klinkofström of the Russian American Company's service. It is marked as Sand Bay on some charts. There are a number of rocks bare at ordinary tides, off shore, in Korovinsky Bay, which are not on any chart, and which might pick up a vessel attempting to enter in the night.

I examined the so-called coal-vein, and found it to consist of fragments of black silicified wood, irregularly dispersed in the face of a bluff of crumbling sandstone.

After a fatiguing climb and walk, I reached the celebrated solfataras, or hot springs, of the Kluchefskaia Volcano. They are about six miles from the coast in a ravine on the side of the volcano. The outlets of hot water are quite numerous, but no geyser-action was observed. They have a temperature of 192° Fahrenheit, and contain lime, sulphur, and alum; the latter is abundantly deposited around the springs, together with a limy earth of very bright red, yellow, and slaty colors. The Russians had a house, bath-house, &c., here for invalids; but the buildings are in ruins. A brown leathery fucoid grew abundantly in the hot water, and the neighboring vegetation seemed little affected by the steam and hot water at its very roots. Two villages exist on Atka, with one on the adjacent end of Amlia. These, with that at Attu, are the only villages west of Umnak.

AMLIA.

North of the east end of this island a high rock has been reported, while its existence is denied by others. The foreman of the Aleut hunting-party, who arrived at Atka, while we were there from this very locality, informed us that there was no such rock there, but that there was a patch in the locality indicated, with five to ten fathoms of water on it, on which, in very heavy weather, breakers were visible. The rock may have sunk or been broken away since it was originally reported.

ISLANDS OF THE FOUR CRATERS.

On reaching this group, we hardly recognized it, so entirely different are the islands in position and form from anything delineated on the charts. A very heavy sea was running, though the weather was fine, and it was impossible to effect a landing. There were no appearances of anything like a harbor or anchorage. We cruised about the islands for some time, seeking a shelter or landing-place, but found none. Contrary to the charts, one island, perhaps Chugoula of the earlier charts, stands boldly to the northward of the others, and is separated from another by a narrow rocky strait. South of these, separated by a strait several miles wide, was a larger island, with an almost unbroken northerly shore, ending in a long narrow point to the westward We saw a number of rocks above water, but no evidences of submerged reefs. The position of the group, as a whole, agrees with the charts.

AGASHAGOK.

This island, otherwise known as Saint John the Theologian, or Joánna Bogoslóva in the Russian language, has always been of peculiar interest. Rising from the sea on St. John's Day, 1792, it was surveyed in some shape by Sarycheff before 1826, and on his chart is represented as a mile and three-quarters long, with several rocks about it, and numerous soundings, including a reef of submerged rocks extending from it to the north end of Umnak. Very conflicting statements have been made as to its height and position and as to the existence of the great reef. Lütké appears to have been the only hydrographer who has approximated to its true position, as will be seen by reference to the accompanying table of positions. I stated the grounds for my disbelief in the existence of the reef in my report of last year, and our observations this season completely sustain the position I took in regard to it. They also show the gross errors of Sarycheff's chart, and suggest that the conflicting statements referred to, are due to erroneous observations rather than to any great changes of level in the island itself. The Ship Rock and one other rock near to it have about the same relative position and height that are assigned to them by Sarycheff, and yet the absolute length of the island does not exceed three-quarters of a mile. Had any subsidence sufficient to produce these differences of size in the main island taken place, one at least of the rocks above mentioned would have been entirely submerged, and to a considerable depth. Our soundings directly on the line of the submerged reef show no bottom at 800 fathoms, and we were only prevented from running out all the line at our disposal by the heavy sea running at the time. The island is a sharp, serrated ridge, forming a very acute angle, and broken into numerous pinnacles toward the top, and it would seem impossible to scale it. There is no low land about it, and a landing cannot be effected except in very calm weather. Contrary to the received opinion, there is no crater, nor any appearance of a crater. The island is simply a jagged mass of rock upheaved through some channel by volcanic ejection. At the distance from which we saw it, it appeared of a light pinkish-gray color, totally devoid of vegetation or water, and covered with myriads of birds. There are a few breakers off the south end of it, and a talus, on which a landing under favorable circumstances might be effected. A large portion of the shore is, however, precipitous.

Ship Rock is a perpendicular square-topped pillar, half a mile north and west of the north end of the island.

There is a small rock, also given in Sarycheff's chart, half a mile north and east of the island which rises only a few feet above the water; and on all sides (except the west), and especially east-southeast of the island, scattered breakers were observed, extending less than three-quarters of a mile from the shore. From numerous observations, the height of the summit appears to be 844 feet.

The position is farther to the north and east than any of the charts place it, while none of them agree; even two in Tebenkoff's atlas differ nearly a mile, one having the reef indicated and the other not, though both bear the same date.

UNALASHKA.

The work done here chiefly related to the determination of the azimuth and the continuation of the triangulation and survey of Captain's Bay, commenced in 1871.

Uknadok Island was surveyed entirely; its position fixed by triangulation, as were the remarkable Needle Rock on the west side of Amaknak, and the east and west heads of Captain's Bay. The latter proved of more than usual interest, showing that on chart No. 7 of the Coast Survey Atlas of Harbor Charts of Alaska, the east head is placed fully a mile too far south and west, and the west head nearly as much too far north, while a careful examination of the chart itself shows that in these particulars it does not agree with the observations of Professor Davidson's party in 1867, though even these fall short of our determinations, even when corrected for the latest determination of the longitude from Sitka. In these respects this chart compares very unfavorably with that of Kotzebue (1804), from which it was principally taken; and that of Kotzebue still remains the most accurate delineation of Captain's Bay which has yet been published.

SANNAKH REEFS.

Our observations determining a new cod-bank in this vicinity were forwarded to you in the spring. At the same time, we determined the extent above water in an easterly and southerly direction of the northeastern and southern terminations of this formidable congeries of reefs. The positions give nearly the same extent respectively that is given for the entire reef on the old chart of the Russian admiralty office, but it is probable that the submerged rocks extend some distance farther, especially to the south. Our position places the group some miles farther south and east than that of Tebenkoff; and this difference may account for part of the difference ascribed to current by navigators who have sailed by Tebenkoff's charts.

POPOFF STRAIT.

Our observations here were limited to those for position and azimuth, which, on account of bad weather, we could not obtain last season. We were also enabled to correct an error in the position of one of the small islands in the strait to the south of our survey.

We have been informed most positively that rocks above water exist to the south and west of Simeonoff Island, as was stated on similar authority in my last report; but the bad weather prevented us from verifying this statement.

Humboldt Harbor, since our survey, has been greatly frequented by vessels, and I am continually applied to for tracings of our manuscript chart of the strait and the Shumagin group, which requests, from obedience to the rules of the Survey, I have been reluctantly obliged to refuse.

CURRENT-OBSERVATIONS.

Our current-observations were continuously carried on as usual. The overcast weather, however, prevented many observations of position on the return voyage, and hence the observations on that trip are very limited. Our up-voyage observations confirmed those of previous years; but the rate of the currents was manifestly interfered with by the strong and constant westerly winds.

In Bering Sea, notwithstanding constant observations, I find nothing to modify my remarks in last year's report.

The arctic character of the fauna in the western islands, and the comparatively low temperature of the sea-water, would lead to the inference that that portion of the Kuro-siwo which enters Bering Sea is comparatively chilled, or else of little importance compared with the Arctic or Kamchatka current.

We have definitely settled that the tide entering Bering Sea from the Pacific is invariably propagated from the east toward the west; that no efflux of importance takes place with the fall of the tide; and that the latter retains its compound and irregular character throughout the islands.

AZIMUTHS.

Perhaps the most interesting feature of our work this year has been the determining of the magnetic declination at stations, at nearly equal intervals from each other, from the Shumagins to the western end of the islands. Of course, from the great length of time which has elapsed since observations of this nature were taken in the islands to the westward, no clew is afforded as to whether the declination has been increasing or decreasing during that period, or any particular portion of it; or the rate at which the changes have occurred. From the observations of Professor Davidson's party in 1867, Kadin in 1869, and ours, this season, at Unalashka, it seems likely that at present the declination is decreasing in its amount of easting. This is rendered still more probable by the detection at the Presidio station, San Francisco, of a similar change, very recently.

At Unalashka, our observations were repeated until we became satisfied that they contained only such an amount of error as might reasonably be referred to the charactor of the instruments used.

The main result has been to show a decrease of the easterly variation at all stations where observations have been taken, when our results were compared with those heretofore published. Rejecting such changes as are evidently due to theory, unsupported by observations on record (and such occur in some of the charts examined), the diminution is about as follows:

Station.	Date of old observation.	Decrease.
		° ′
Attu	1855	2 15.5
Kyska	1849?	2 53.8
Amchitka	1849?	6 44.5
Adakh	1855	2 08.0
Atka	1855	0 03.0
Unalashka	1867	0 47.6
Popoff Strait	1849	1 30.0

The largest gap is between Unalashka and Atka, which we had hoped to fill at the Four Craters, but were prevented by causes previously mentioned.

In the following chronological table of positions, under the head of "Authority", our results are tabulated against the name of the schooner "Yukon", on which the work was done.

POSITIONS AND MAGNETIC DECLINATIONS, ALEUTIAN ISLANDS, A. T.

1.—*Astronomical Station, Chichagoff Harbor, Attu Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
			° ′ ″	° ′ ″	° ′ ″	
Sarycheff	1826	Chart No. 18	52 58 38	173 26 20 E.	Not given	Very imperfect chart.
Russian Hydrographic Office.	1848	Chart No. 7	58 20	25 00 E.	10 45 00 E.	
Tebenkoff	1849	Chart No. XXX	56 00	31 38 E.	11 30 00 E.	
United States Naval Hydrographic Office.	1855	Chart No. 55	55 45	12 42 E.	10 00 00 E.	Hydrography by Lieut. Gibson.
Etolin	?	United States Coast Survey Report, 1867.	56 06	23 30 E.	Not given	
United States Coast Survey	1869	Atlas of Harbor Charts	55 45	12 42 E.	11 00 00 E.	Taken in part from Gibson.
"Yukon"	1873		55 57.23	12 22.2 E.	7 44 36 E.	

2.—*Astronomical Station, Kyska Harbor, Kyska Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1826	Chart No. 18	52 12 00	177 48 00 E.	Not given	
Russian Hydrographic Office.	1848	Chart No. 7	04 20	40 20 E.	? 13 00 00 E.*	
Tebenkoff	1849	Chart No. XXIX	04 20	41 40 E.	14 00 00 E.	
Ingestrom	?	United States Coast Survey Report for 1867.	03 00	40 30 E.	Not given	
United States Naval Hydrographic Office.	1855	Chart No. 55	00 10	27 00 E.	? 13 00 00 E.	
"Yukon"	1873		51 58 59.11	29 46.3 E.	11 06 27 E.	

* Where an interrogation-point precedes a given variation, the latter is obtained by interpolation between the most adjacent variations given on the chart referred to.

POSITIONS AND MAGNETIC DECLINATIONS, &c.—Continued.

3.—*Peak of Iron Island = Chugul of the Russian Hydrographic and Davidoff Island of Sarycheff's chart of* 1826.

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
			° ′ ″	° ′ ″	° ′ ″	
Sarycheff	1826	Chart No. 18	52 15 30	178 11 00 E.	None given	
Russian Hydrographic Office	1848	Chart No. 7	52 06 00	20 00 E.	? 13 20 00 E.	
Tebenkoff	1849	Chart No. XXIX	51 57 30	23 00 E.	14 00 00 E.	
Klinkofstrom	?	United States Coast Survey Report for 1867.	51 58 00	23 00 E.	None given	
Russian authorities	?	United States Hydrographic Chart No. 55.	52 06 40	02 20 E.	? 13 30 00 E.	
"Yukon"	1873		52 02 13	Not obtained	? 8 00 00 E.	Approximate from east end of island.

4.—*Astronomical station, Constantine Harbor, Amchitka Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1826	Chart No. 18	51 35 30	179 35 00 E.	Not given	
Russian Hydrographic Office	1848	Chart No. 7	25 40	28 20 E.	14 00 00 E.	
Klinkofstrom	1849	Chart No. XXIX	23 57	22 00 E.	14 00 00 E.	
Klinkofstrom	?	United States Coast Survey Report for 1867.	24 00	23 00 E.	Not given	
United States Hydrographic Office.	1855	Chart No. 55	25 00	22 00 E.	14 15 00 E.	
Tebenkoff	1869	United States Coast Survey Atlas of Harbor Charts.	23 57	23 00 E.	13 30 00 E.	
"Yukon"	1873		23 32.9	12 12.2 E.	7 15 33 E.	

5.—*Kiriloff Harbor, Amchitka Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1826	Chart No. 18	51 37 00	179 30 00 E.	Not given	Approximate.
Russian Hydrographic Office	1848	Chart No. 7	25 50	19 00 E.	14 00 00 E.	
Tebenkoff	1849	Chart No. XXIX	27 00	19 00 E.	14 00 00 E.	
Ingestrom	?	United States Coast Survey Report for 1867.	36 00	19 00 E.	Not given	
United States Naval Hydrographic Office.	1855	Chart No. 55	25 30	15 00 E.	? 14 15 00 E.	
United States Coast Survey	1869	Atlas of Harbor Charts	27 00	20 00 E.	13 30 00 E.	
"Yukon"	1873		24 30	06 00 E.	? 7 15 00 E.	Approximate.

6.—*Astronomical station, Bay of Islands, Adakh Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1826	Chart No. 18	51 52 00	176 32 00 W.	Not given	Approximate only.
Russian Hydrographic Office	1848	Chart No. 7	46 20	37 00 W.	do	
Tebenkoff	1849	Chart No. XXVIII	49 35	55 00 W.	15 30 00 E.	
United States Naval Hydrographic Office.	1855	Chart No. 8	48 40	46 00 W.	16 00 00 E.	
United States Coast Survey	1869	Atlas of Harbor Charts	Not given	Not given	15 00 00 E.	At Bay of Waterfalls, near by
"Yukon"	1873		51 49 15.6	176 51 58.2 W.	13 52 03 E.	

7.—*Astronomical station in the village at Nazan Bay, Atka Island.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1826	Chart No. 19	52 14 30	174 01 30 W.	Not given	
Russian Hydrographic Office	1848	Chart No. 8	11 30	173 59 00 W.	16 21 00 E.†	
Tebenkoff	1849	Chart No. XXVII	10 27*	*174 01 00 W.	17 00 00 E.	
Salamatoff	?	United States Coast Survey Report for 1867.	10 27*	*174 01 00 W.	Not given	
United States Naval Hydrographic Office.	1855	Chart No. 8	10 35	174 11 15 W.	17 00 00 E.	
United States Coast Survey	1869	Atlas of Harbor Charts	10 35*	*174 11 15 W.	16 00 00 E.	
"Yukon"	1873		Not obtained	174 14 57.9 W.	16 57 00 E.	

* In these cases, 3″ of latitude have been deducted, and 30″ of longitude added, for reduction to station from the anchorage. † 1830.

POSITIONS AND MAGNETIC DECLINATIONS, &c.—Continued.

8.—*Peak of Agáshagok, Joánna Bogoslóva, or the Volcanic Island of Saint John the Theologian.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
			° ′ ″	° ′ ″	° ′ ″	
Sarycheff	1826	Chart No. 19	53 55 00	167 59 00 W.		Sketch of island makes length 1¾ miles
Lütké	1836	Voy. Seniav. par. Naut., p. 302.	58 00			
Vasilieff	1848	Chart No. 8	56 40	56 30 W.		
Tebenkoff	1849	Chart No. XXVI	51 35	39 00 W.		
Tebenkoff	1849	Chart No. XXV	51 00	39 30 W.		
Krenitzin	1869	United States Coast Survey Report for 1867.	52 00	39 00 W.		
"Yukon"	1873		58 36	33 30 W.		Length not over ¼ of a mile.

9.—*Points in Captain's Bay, Unalashka Island. United States Coast Survey astronomical station,* 1867, *Ulakhta Spit.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Sarycheff	1792	Old chart			19 00 00 E.	
Sarycheff	1826	Chart No. 19	53 54 20	166 31 30 W.	Not given	
Russian Hydrographic Office	1848	Chart No. 8	53 40	24 00 W.	19 30 30 E.	
United States Coast Survey parties.	1867	United States Coast Survey Report for 1867.	53 58	27 52 W.	47 24 E.	
United States Coast Survey	1869	Atlas Harbor Charts	53 56.5	28 34.5 W.	47 00 E.	
Kadin	1870	Manuscript chart			45 00 E.	
United States Coast Survey	1870	Office	53 56.5	30 21 W.	Not given	Corrected from improved Sitka position of 1869.
"Yukon"	1873				18 59 44 E.	Position of 1867 corrected adopted as a basis for all our work.

10.—*Church in the middle of Iliuliuk Village.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Kotzebue	1806	Sarycheff Atlas No. XV	53 55 00	166 43 00 W.	19 24 00 E.	
Tebenkoff	1849	Chart No. XXV	52 00	25 00 W.	20 00 00 E.	
United States Coast Survey	1867	United States Coast Survey Report for 1867.	52 39	29 06 W.	19 47 24 E.	
United States Coast Survey	1869	Office	52 37.5	31 35 W.	Not given	Corrected from improved Sitka position.
United States Naval Eclipse Expedition.	1869	Supplementary Report	52 38		Not given	Sun-dial just north of church.
United States Coast Survey parties.	1871, 1872, 1873	L. M. Z. Comp	52 37.7	31 36 W.	18 59 44 E.	

11.—*Cascade near Cape Cheerful.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
United States Coast Survey	1867	United States Coast Survey Report for 1867.	53 58 58	166 32 47 W.		Uncorrected for 1869 observations.
United States Coast Survey	1869	Office	58 56.5	35 16 W.		Corrected as before.
United States Coast Survey	1869	Harbor Charts, No. 7	58 56.5	35 33 W.		Correction allowed for.
"Yukon"	1873		58 36	35 18 W.		Approximated from Eider △ by the chart.

12.—*Cape Kalekhta.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
United States Coast Survey	1867	United States Coast Survey Report for 1867.	54 00 12	166 20 13 W.		Uncorrected.
United States Coast Survey	1869	Office	54 00 10.5	22 42 W.		Corrected for 1869 Sitka observations.
United States Coast Survey	1869	Harbor Charts, No. 7	53 59 26.5	22 55 W.		Correction allowed for.
"Yukon"	1873		54 00 35.0	22 02 W.		Approximated from Priest Rock.

POSITIONS AND MAGNETIC DECLINATIONS, &c.—Continued.

13.—*Additional points determined by the party on the "Yukon."*

Locality.	Latitude.	Longitude.	Remarks.
	° ′ ″	° ′ ″	
Priest Rock	54 00 36.5	166 22 03.9 W.	
Needle Rock	53 55 33.5	31 19.2 W.	
Eider △, northern bluff of Igognak Point	57 51.2	35 02.4 W.	
North end of Hog Island	54 06	33 58 W.	

14.—*Sannakh Reefs (our observations relate only to that portion of the reefs visible above water for five miles).*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
			° ′ ″	° ′ ″	° ′ ″	
Russian Hydrographic Office	1848	Chart No. 8	54 15 20	162 20 00 W.		Latitude of south end and longitude of northeast end of reefs referred to.
Tebenkoff	1849	Chart No. XXV	21 20	40 00 W.		
"Yukon"	1873		16 00	20 00 W.		Rocks above water only.

15.—*New cod-bank near the Sannakh Reefs.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
"Yukon"	1873		54 17 00	161 54 56 W.		

16.—*Astronomical station, Sandpoint △, Popoff Strait, Shumagin Islands.*

Authority.	Date.	Where recorded.	Latitude.	Longitude.	Variation of compass.	Remarks.
Russian Hydrographic Office	1848	Chart No. 8	55 19 40	160 27 32 W.	19 00 00 E.	
Tebenkoff	1849	Chart No. XXIV	19 00	32 00 W.	22 00 00 E.	
Humboldt	1872	Manuscript Report for 1871–'2.	19 26.5	33 00 W.	None obtain'd	Observations very unsatisfactory.
"Yukon"	1873		19 16.7	31 14.1 W.	20 29 23.7	Better (but not A 1) observations.

Thermometer.

Mean of observations for 1873.

	January.	February.	March.	First quarter.	April.	May.	June.	Second quarter.	July.	August.	September.	Third quarter.	October.*	Whole period.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Morning observations	26.3	32	23.6	27.3	32.2	35.1	42.9	36.7	46.7	50.5	47.2	48.1	42.8	37.9
Noon observations	29.5	35.9	30.3	31.9	39.2	43.9	50.4	44.5	53.4	55.1	52.2	53.6	48.1	43.8
Evening observations	26.5	31	23.5	27	31.6	38.2	47.8	39.2	50.7	52.6	49.8	51.0	45.1	39.7
Maximum observed	45	47	52	52	54	57	71	71	67	64	53	67	60	71
Minimum observed	13	14	11	11	19	28	38	19	43	45	42	42	33	11
Range	32	33	41	41	35	29	33	52	24	19	16	25	27	60

Weather.

	January.	February.	March.	First quarter.	April.	May.	June.	Second quarter.	July.	August.	September.	Third quarter.	October.*	Whole period.
Snowy days	13	13	23	49	13	8	0	21	0	0	0	0	2	72
Foggy or rainy days	1	5	0	6	1	2	14	17	25	20	11	56	8	87
Cloudy days	16	5	4	25	13	13	10	36	3	7	16	26	4	91
Clear days	1	5	4	10	3	3	6	12	3	4	3	10	4	36
Days work done						†6	9	15	15	10	15	40	4	59

* To 21st, inclusive.

† We arrived at the Aleutian Islands May 20, the record of working-days beginning then. Previous meteorological observations are due to the Rev. Innocentius Shayeshnikoff. His hours of observation were about 7 a. m., noon, and 8 p. m. Ours were every four hours at sea, and 6 a. m. and p. m., and noon, when in port.

Surface of sea-water.
1873.

	May.*	June.	July.	August.	September.	October.†	Whole period.
	°	°	°	°	°	°	°
Mean temperature	38.8	42.2	42.2	46.3	46.5	47.3	43.9
Maximum	43	48	46	51	48	49	51
Minimum	36	39	41	42	44	45	36
Range	7	9	5	9	4	4	15

Sea-water five fathoms below surface.
[Observations made in port only.]

	May.*	June.	July.	August.	September.	October.†	Whole period.
	°	°	°	°	°	°	°
Mean temperature	40.9	41.1	42.2	43.8	44.3	47.1	43.2
Maximum	42	45	43	45	45	48	48
Minimum	40	38	41	42	44	46.5	38
Range	2	7	2	3	1	1.5	10

Barometer.

	May.*	June.	July.	August.	September.	October.†	Whole period.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Mean of a. m. observations	30.149	30.056	30.115	30.182	29.751	29.520	29.962
Mean of noon observations	30.163	30.070	30.123	30.172	29.724	29.548	29.966
Mean of p. m. observations	30.176	30.060	30.101	30.166	29.733	29.549	29.964
Maximum	30.48	30.40	30.59	30.55	30.30	30.43	30.59
Minimum	29.62	29.48	29.51	29.55	28.58	28.68	28.58
Range	0.86	0.92	1.08	1.00	1.72	1.75	2.01

* From the 16th to the 31st of May. † To 21st, inclusive.

Current-observations made on board the United States Coast Survey schooner "Yukon" during the voyage from San Francisco, Cal., to Unalashka, A. T., in May, 1873.

Date.	Latitude.		Longitude.		Current.			Wind.	Temperature of air and water; distance and hour of observation for each day.												Total dist.
Nautical time.	D. R.	Obs.	D. R.	Obs.	Miles per day.	Knots per hour.	Direction.	Direction and strength.	4 hrs.		8 hrs.		12 hrs.		16 hrs.		20 hrs.		24 hrs.		D. R.
									T.	D.	T.	D.	T.	D.	T.	D.	T.	D.	T.	D.	
1873.		° ′		° ′																	*Naut. miles.*
April 30	Pt. of departure.	37 10	Pt. of departure.	127 54	......	......	......	......	...	...	...	...	...	...	...	...	...	...	...	...	......
	° ′		° ′						° 66		° 62		° 60		° 59		° 59		° 70		
May 1	37 07	37 06	129 22	129 30	6.41	0.27	S. 81° W.	N. W., light.	62	15	60	20	60	17	60	19	60	28	59	25	124
									60		59		58		57		57		62		
2	37 36	37 39	131 54	132 10	13.0	0.54	N. 77 W.	W. N. W.,	59	18	60	20	60	17	59	16	60	25	58	24	120
								moderate.	60		56		56		56		56		67		
3	37 25	37 21	135 06	134 44	18.0	0.75	S. 77 E.	N. W.	59	30	59	25	60	20	58	22	58	20	60	24	141
									65		62		60		60		61		63		
4	38 10	38 11	136 08	135 56	9.5	0.40	N. 84 E.	W. by N.	62	5	62	11	62	15	60	20	60	20	59	28	99
									64		60		56		56		58		67		
5	39 22	39 21	138 12	138 18	4.8	0.20	S. 78 W.	E., light.	58	12	59	26	58	20	57	22	58	25	58	27	132
									62		59		57		56		56		62		
6	40 58	41 01	141 50	141 25	19.0	0.79	N. 81 E.	S. E., fresh.	58	27	58	29	56	33	56	32	55	32	54	36	189
									62		56		55		52		52		56		
7	42 50	42 42	145 04	144 46	15.4	0.64	S. 58 E.	Southerly,	54	38	53	38	54	32	51	25	53	36	51	27	196
								moderate.	56		51		51		50		51		52		
8	44 03	44 03	147 52	147 22	21.6	0.90	East.	S. W., fresh.	50	30	49	29	49	32	50	24	49	25	48	29	159
									50		45		42		44		44		47		
9	45 30	45 30	148 53	149 05	8.4	0.35	West.	S. W., gale.	47	28	46	21	44	12	46	14	45	14	46	20	109
									48		44		43		43		43		48		
10	46 54	46 56	150 39	150 15	16.4	0.68	N. 83 E.	S. W., gale.	46	17	47	15	44	19	45	16	44	26	44	14	107
									43		43		42		42		42		45		
11	48 42	......	152 25	153 23	......	......	Westerly.	S. W., strong	44	15	43	19	44	14	43	16	43	36	42	38	138
									45		43		41		40		39		42		
12	50 27	50 24	156 05	155 22	27.4	1.14	S. 84 E.	W. S. W.,	42	35	42	31	41	30	41	13	40	26	40	16	151
								moderate.	41		40		40		38		39		44		
13	52 07	52 11	156 10	155 20	30.9	1.29	N. 83 E.	S. W., light.	40	17	39	14	40	15	39	16	39	21	39	26	109

Heights of mountains, determined in 1873 by triangulation, and by sextant altitudes.

(UNITED STATES COAST SURVEY SCHOONER "YUKON").

	Feet.
Peak of Bouldyr	1,145
North peak of Kyska	4,085
Iron Island, or Chugul	3,109
Gareloi, highest north peak	5,334
Tanaga, highest north peak	7,108
Adakh, highest north peak	5,678
Atka, highest northeast peak	4,988
Vsevidoff volcano, Umnak	*8,868
Bogosloff, volcanic Island	844
Akutan Volcano, highest point, edge of crater	3,888
Avatanak Island, highest peak	1,207
Shishaldin Volcano	8,683

* The heights marked with an asterisk depend for their accuracy upon the position of the peak on the charts, which has been taken as the true one. Gareloi, from the United States Exploring Expedition of Ringgold and Rogers, and Vsevidoff from Tebenkoff. Neither of them had previously been measured, but Gareloi has been supposed to be much higher, and Vsevidoff lower than our results show. My own opinion is that the heights are not far from the truth.

APPENDIX No. 12.

MEASUREMENT OF A PRIMARY BASE-LINE ON PEACH-TREE RIDGE, NEAR ATLANTA, GEORGIA, IN 1872 AND 1873, BY C. O. BOUTELLE, ASSISTANT.—COMPUTED AND REPORTED BY CHARLES A. SCHOTT, ASSISTANT.

A reconnaissance for the location of a primary base-line in Georgia or South Carolina, for the principal triangulation running along the Blue Ridge, was made in January, 1872, by Assistant J. A. Sullivan, under the direction of Assistant C. O. Boutelle, and resulted in the selection of a site on Peach-Tree Ridge, in De Kalb and Gwinnett Counties, Georgia, about fifteen miles northeast of Atlanta, Ga. The summit of the ridge is narrow and crooked; on it a line of about 5.8 miles in length was found within practicable grades and suitable terminal points for connection with the primary triangulation. The maximum slope for measure was fixed at about 4°, being 1° greater than had ever been attempted before, yet within the proper limits the apparatus would bear. After inspection and approval by the Superintendent, the site was adopted, and subsequently measured three times. Near the southern end is a deep but narrow ravine, which the line had to cross on a grade about 6 meters above ground. Everywhere else the grades were within 3 meters of the surface. The ground consists of loam and clay; about 70 per cent. of the line lay in woodland. The gulch near the south end was crossed on trestle-work, consisting of two separate structures, each solidly braced with uprights covered by capsills, resting on which were string-pieces and sleepers for the floors. The whole was 4½ meters wide, and built on a descending slope of 3° 35′; it proved abundantly stable. The measure was secured at each point of stoppage by a transfer to firm ground, for which purpose a portable transit was set up perpendicular to the line of the base. About 7½ meters off the line, a needle-drill-hole was made in a copper tack, placed vertically under the end of the agate of the tube. Hollows were crossed with the tubes high on the trestles, crests with the tubes low, for the purpose of diminishing the slope. A station in and near the middle of the base was occupied for astronomical latitude and azimuth. It is in approximate latitude 33° 54′.4, in approximate longitude 84° 16′.6 west of Greenwich, and the azimuth of the southwest end of the base is about 52° 8′. The approximate elevation above the sea-level is 320 meters. It is the seventh line measured with the primary apparatus. The southwest and the northeast ends of the base are each marked by a granite monument, with an upper and lower drill-hole mark in copper bolts. Each monument is surrounded by four side-monuments: two in the line of the base and two at right angles to it. There are in the line of the base five smaller granite posts, like those surrounding the terminal monuments; they were intended to take the place of the usual (so-called) mile-stones in the older base-lines; these are placed in suitable positions on crests of ridges; they have a copper bolt with drill-hole, and are respectively distant from the southwest terminus 273, 547, 753 (middle base), 978, and 1276 tubes, each of nearly 6 meters. The whole number of tubes of the measure is 1558.

The first and second measures being performed in *opposite* directions, it was expected that any effect in the resulting length due to *difference* of slope would become apparent. These measures were made in fall and winter: the first between November 8, 1872, and December 5, 1872; the second between December 5, 1872, and January 9, 1873. But the third measure was made in summer, between July 31, 1873, and August 21, 1873, in order to test to the utmost the quality of the tubes respecting their compensation for different temperatures and during rapid changes of temperature. Comparisons of the tubes with the standard bar were made immediately before the commencement of the first measure and during this measure; again, soon after the close of the second measure. A more elaborate comparison was had with the standard immersed in glycerine, the better to ascertain its temperature before the third measure; also during it and after its close.

The length of the iron standard bar, which was cut to length in March, 1847, is $5^{m}.9999407 \pm 0^{m}.0000009$ at 0° C. (for which see Coast Survey Report for 1862, Appendix No. 26.) Its co-efficient of expansion was ascertained to be 0.00000641 ± 0.00000002 (*vide* same report); both determinations having been made by Assistant J. E. Hilgard.

The co-efficient answers between the limits of 32° and 100° Fah. The bar is consequently 6 meters in length at a temperature of 33°.54 Fah. ± 0°.025 Fah., expressed in terms of the original committee meter of the American Philosophical Society at Philadelphia. Comparisons, made in 1867, at Paris, by Dr. Barnard and Mr. Tresca,* showed its length equal to 1.00000336 meter of the archives at the temperature of freezing water. Since all base-lines of the Coast Survey and all its computations have this committee meter for their unit of length,† that of the Atlanta base will also be expressed in terms of the same, in order that all reductions hereafter desired may apply systematically to all measures.

Before entering upon the detailed account of the operations and results of the base, a few words respecting the condition of the base-apparatus will find a proper place here, especially since the mode of treatment in the reduction of the various measures in some degree had to conform to existing conditions, as developed by the comparisons themselves. Though the apparatus was described and figured in Coast Survey Report of 1854, Appendix No. 35, the present scarcity of this report made it desirable to reproduce the plates illustrating its construction in detail. (See Plate No. 18.) With the exception of two changes—one due to an accident, the other one of design—the apparatus has remained materially in the same condition as when constructed in 1845 and 1846 by Mr. W. Würdemann (under the direction of Superintendent A. D. Bache). At Key Biscayne, during the measure of a base in 1855, one of the agates of Tube No. 1 was splintered, and a new one was substituted. This same tube was supplied with a new agate in 1872, owing to a defective knife-edge in the old agate. Tube 1, up to the accidental breakage of the agate, and Tube 2, up to this period (after the measure of the Atlanta base), when it became desirable to thoroughly examine the apparatus and repair such parts as showed signs of wear, both had evidently become shorter, partly it is supposed from wearing, partly from change of form; and it appeared also of late that there were reasons for doubting that the compensation had remained as perfect as it was at first. Advantage was taken at the same time to introduce some improvements, notably a Borda differential thermometer, by means of which, together with the immersion of the standard in glycerine during the field-comparisons, it is confidently expected that a much greater accuracy in the measured length of a base can be attained than has been found practicable heretofore.

For determining the length of the tubes at the time of the measures of the base, we have the following data: The value of one turn of the abutting-screw of the Saxton reflecting-comparator was found by repeated comparisons (in June, 1857) of five turns of the screw with a magnitude of 0.1 of an inch derived from the Troughton yard-scale; it equals 0.01912 ± 0.00004 inch, or 0.48565 ± 0.00102 millimeter. During the comparisons for length, there were used six standard Casella and three Green thermometers, which were corrected for errors of graduation from special comparisons made in February and March, 1873. Another set of six Green thermometers, with metallic scales, used in connection with the comparisons in glycerine, and for the third measure, were also tested in July, 1873, and corrected for graduation errors. In the Casella thermometers, the maximum correction at any one temperature is 0°.3; in the Green thermometers, it rises to 0.5 Fah. The value of one division of the scale of the comparator ‡ was determined by means of the known value of one turn of the abutting-screw, and found from a large number of sets of comparisons of whole turns and of fractions of turns for various parts of the screw and for various temperatures.

Four sets of observations in November, 1872, and January, 1873, give 1 div. = 1.384 ± 0.003 micron at 40° Fah. (one micron = one millionth of a meter), and 1 div. = 1.378 ± 0.003 micron at 66° Fah.

Again, seven sets of observations in July and September, 1873, give 1 div. = 1.376 ± 0.003 micron, which last value was used in connection with the third measure of the base. The minute-

* See Coast Survey Report of 1867, Appendix No. 7.

† The substitution of the meter of the archives would produce an increase of 14.6 units in the seventh place of decimals in the logarithm of the length of the Atlanta base.

‡ A description of this instrument will be found in the report of the Superintendent of Weights and Measures Senate Executive Document No. 27, Thirty-fourth Congress, third session, Washington, 1857, p. 15. It has since been slightly improved.

ness of this unit may be judged of by the fact that the expansion of the standard bar for 1° Fah. equals 38.46 ± 0.12 microns, or 27.956 ± 0.084 scale-divisions. We have also one turn of the screw = 350.9 scale-divisions at temperatures near 40° Fah. = 352.3 scale-divisions at temperatures near 66° Fah. = 353.06 ± 0.18 divisions at 82°.5 Fah. in connection with the last measure.

A very large number of direct comparisons of the tubes and standard were made at temperatures as nearly stationary as was practicable, or only slowly rising or falling, and for an absolute range between 32° and 100° Fah. In the reduction, care was taken, by using alternate means of allowing as far as possible for change of length during comparison of tube and standard; and it may be noted that in the earlier comparisons they were made by passing, in succession, through the comparator the standard, Tube 1 and Tube 2, which process was changed in the observations in connection with the third measure to taking five successive readings on each before changing bar or tube. In the following synopsis of results for length of tubes, the values are given arranged according to temperature of the standard for the comparisons in air, and of the tubes for those in glycerine, beginning with the lowest and ending with the highest. The column headed "n" contains the number of individual comparisons in each set; the column headed "Con." indicates the condition of the temperature with respect to "rising", "falling", or "stationary"; the columns headed "T_1 (III)" and "T_2" contain the resulting length of the first and second tubes, expressed in meters, and derived from the known length of the standard at its temperature of comparison, and from the measured difference of length of it and the tubes in each experiment.

Synopsis of results for length of Tube 1 and of Tube 2.

Temp.	n	Con.	T_1(III)	Temp.	n	Con.	T_2
COMPARISONS IN AIR.							
°			*Meters.*	°			*Meters.*
32.8	16	*r*	5.9999887	33.3	16	*r*	5.9996250
38.5	8	*r*	9944	39.1	8	*r*	6610
45.7	8	*f*	9630	45.4	8	*f*	5894
48.1	6	*r*	9764	48.2	6	*r*	6322
52.0	25	*r*	6.0000332	52.5	25	*r*	6685
55.9	6	*r*	0189	56.0	6	*r*	6777
60.0	75	*f*	0057	59.9	75	*f*	6458
63.8	8	*f*	0070	63.6	8	*f*	6574
65.4	4	*f*	0123	64.8	4	*f*	6776
COMPARISONS IN GLYCERINE.							
71.4	10	*f*	6.0000266	71.5	10	*f*	5.9996780
71.9	15	*f*	0301	71.9	15	*f*	6868
77.6	20	*r*	0550	77.6	15	*f*	7147
77.8	15	*f*	0599	78.2	25	*f*	7067
77.9	25	*r*	0589	78.6	20	*r*	7020
78.1	25	*f*	0558	78.8	25	*r*	7007
78.4	40	*r*	0617	79.1	40	*r*	7093
79.2	25	*r*	0664	79.3	25	*r*	7095
79.2	25	*r*	0692	79.5	25	*f*	7606
79.6	25	*f*	1188	80.5	25	*r*	7093
82.7	25	*r*	0715	81.7	25	*r*	7241
83.5	25	*r*	0978	87.7	25	*r*	7487
88.9	30	*r*	1638	86.0	30	*r*	7985
89.3	25	*r*	1267	89.7	25	*r*	7668
89.7	25	*r*	1246	93.7	25	*r*	7814
94.2	25	*r*	1405	94.5	25	*r*	7702
95.6	25	*r*	1512	96.2	40	*r*	7761
96.1	40	*r*	1412	98.5	45	*r*	7882
99.0	45	*r*	1714	98.9	25	*r*	7922
99.6	60	*r*	6.0001646	99.8	60	*r*	5.9997924

It is evident from the above tables that the tubes expand slightly with increasing temperatures—in other words, that they are *under*-compensated,—a fact which was already suspected in January, 1864, when the differential co-efficient of expansion was roughly made out between 0.0000002 and 0.0000009.

The above results, when projected in a diagram, further indicated that the compensation for changes of temperature was still close,—that is, about 21 parts of 22 remained compensated between the range of temperature from 32° to 71° Fah.; but, between temperatures ranging from 71° to 100° Fah., the tubes only compensated about 10 parts in 11. This break of continuity about the temperature 71° Fah. may be explained by the fact that when the apparatus was taken to pieces and examined in March, 1875, it was found that the two knife-edges of each lever had worn or hammered (during transportation to and from the base) grooves into the vertical abutting-plates deep enough to be felt when running the nail across them. The results for length of tubes are somewhat obscured by the effect of rising or falling temperatures during the comparisons, and the probable error of the length assigned for the whole base-line is materially increased by the fact that there are more sets with rising than with falling temperatures.

For tube 1, we obtain 9 conditional equations for the co-efficient $a_{,}$ in the two equations—

$$T_1 \text{ with rising temperature} = 6^{m}.0000023 + a_{,} (t - 45^{\circ}.5)$$
$$T_1 \text{ with falling temperature} = 5^{m}.9999970 + a_{,} (t - 58^{\circ}.7)$$

the absolute terms arising from combination to a mean of 5 comparisons between 32° and 71° with rising, and of 4 with falling temperatures.

Similarly, for Tube 2, we find a value for the co-efficient $a_{,,}$ in the equations—

$$T_2 \text{ with rising temperature} = 5^{m}.9996529 + a_{,,} (t - 45^{\circ}.8)$$
$$T_2 \text{ with falling temperature} = 5^{m}.9996426 + a_{,,} (t - 58^{\circ}.4)$$

and taking the mean of the constant terms, the following expressions for the length of each tube were finally established, answering between temperatures 32° and 71°, and consequently to be employed in the computation of the first and second measures:

$$\text{Length of Tube 1 (III)} = 5^{m}.9999997 + 0^{m}.000001873 (t - 52^{\circ}.1)$$
$$\text{Length of Tube 2} = 5^{m}.9996478 + 0^{m}.000002688 (t - 52^{\circ}.1)$$

with the probable errors $\pm 0^{m}.0000144$ and $\pm 0^{m}.0000193$ respectively.

For use in connection with the computation of the third measure at high temperatures, we have similarly, from the second part of our table—

$$T_1 \text{ with rising temperature} = 6^{m}.0001110 + b_{,} (t - 87^{\circ}.4)$$
$$T_1 \text{ with falling temperature} = 6^{m}.0000582 + b_{,} (t - 75^{\circ}.8)$$

with $b_{,}$ from 15 equations, temperature rising, and 5, temperature falling; and $b_{,,}$ from an equal number of equations for Tube 2, viz:—

$$T_2 \text{ with rising temperature} = 5^{m}.9997513 + b_{,,} (t - 88^{\circ}.3)$$
$$T_2 \text{ with falling temperature} = 5^{m}.9997094 + b_{,,} (t - 75^{\circ}.7)$$

Hence—Length of Tube 1 (III) $= 6^{m}.0000846 + 0^{m}.00000530 (t - 81^{\circ}.6)$

Length of Tube 2 $= 5^{m}.9997303 + 0.^{m}00000445 (t - 82^{\circ}.0)$

with the probable errors T $\pm 0^{m}.0000112$ and $\pm 0^{m}.0000116$ respectively.

The above probable errors were made out irrespective of temperatures rising or falling, in order to include any defect that may arise from it.

The following table contains, for *each* of the three measures of the base separately, and for each subdivision of it by the middle and line monuments, first, the mean temperature of measure (thermometers corrected for graduation-error); secondly, the mean length of Tubes 1 (III) and 2 from the above expressions and for the temperature of measure; thirdly, the number of such mean tubes or of single tubes; fourthly, the total resulting length; fifthly, the correction for inclination of tubes (also reduced to the temperature of measure); and, lastly, the resulting horizontal distance measured between the marks near the monuments.

Table of horizontal distances measured between temporary marks near the monuments in each of the three measures.

	Southwest monument to line-monument No. 1.	Line-monument No. 1 to line-monument No. 2.	Line-monument No. 2 to monument, middle base.	Middle base monument to line-monument No. 4.	Line-monument No. 4 to line-monument No. 5.	Line-monument No. 5 to northeast monument.
First measure.						°
Mean temperature, *t*, of measure	59°. 23	41°. 18	44°. 31	51°. 91	57°. 23	52°. 35
Mean length of tubes at *t*	5m. 9998400	5m. 9997988	5m. 9998060	5m. 9998233	5m. 9998355	5m. 9998244
Number of mean tubes, &c	272 + Tube 1	274	206	224 + Tube 2	298	282
Length represented	1631m. 95648 + 6m. 00001	1643m. 94487	1235m. 96004	1343m. 96042 + 5m. 99965	1787m. 95098	1691m. 95048
Correction for inclination	− 1m. 98162	− 1m. 63133	− 1m. 57671	− 1m. 07381	− 2m. 24198	− 1m. 71578
Horizontal distance measured..	1635m. 97487	1642m. 31354	1234m. 38333	1348m. 88626	1785m. 70900	1690m. 23470
Second measure.						
Mean temperature, *t*, of measure	42°. 12	49°. 00	39°. 71	37°. 34	42°. 03	55°. 26
Mean length of tubes at *t*	5m. 9998010	5m. 9998167	5m. 9997955	5m. 9997901	5m. 9998007	5m. 9998310
Number of mean tubes, &c	272 + Tube 2	274	206	224 + Tube 1	298	282
Length represented	1631m. 94587 + 5m. 99962	1643m. 94978	1235m. 95787	1343m. 95298 + 5m. 99999	1787m. 94061	1691m. 95234
Correction for inclination	− 1m. 96501	− 1m. 57295	− 1m. 54913	− 1m. 05697	− 2m. 22488	− 1m. 72944
Horizontal distance measured..	1635m. 98048	1642m. 37683	1234m. 40874	1348m. 89600	1785m. 71573	1690m. 22290
Third measure.						
Mean temperature, *t*, of measure	93°. 80	93°. 09	90°. 61	89°. 66	89°. 53	87°. 34
Mean length of tubes at *t*	5m. 9999660	5m. 9999625	5m. 9999505	5m. 9999458	5m. 9999452	5m. 9999345
Number of mean tubes, &c	272 + Tube 1	274	206	224 + Tube 2	298	282
Length represented	1631m. 99075 + 6m. 00015	1643m. 98973	1235m. 98980	1343m. 98786 5m. 99976	1787m. 98367	1691m. 98153
Correction for inclination	− 1. 97987	− 1m. 63179	− 1m. 55089	− 1m. 02120	− 2m. 19686	− 1m. 65693
Horizontal distance measured..	1636m. 01103	1642m. 35794	1234m. 43891	1348m. 96642	1785m. 78681	1690m. 32460

The minimum temperature during which any one set of tubes was laid was 18°.2 Fah. (the mean of 6 thermometers), and many tubes were laid with the temperature below the freezing-point of water. The maximum temperature during which any one set of tubes was laid was 107°.1 Fah.; and many were laid with the temperature of the air above 100°.

The maximum inclination of a tube laid was 4° 43′; and there were a great many with inclinations of 4°. An impression of the ruggedness of the profile of the base may be conveyed by the fact that the sum-total of the corrections for inclination amounts to no less a length than $10^{m}.22123$ in the first, and to $10^{m}.03754$ in the last measure.

The preceding distances, as measured between the sites of the monuments, require to be reduced to them as finally marked, according to the following statements in the record:

The first measure started from assumed southwest monument, fixed sites for positions of monuments I, II, middle, V, and VI, and fell short of position of northeast monument $1^{m}.45695$, as measured with the C. S. Lenoir brass meter at 56°.4 Fah. Applying the correction for length and for expansion, this measured distance becomes $1^{m}.45728$.

The second measure started from end of Tube 1558, or from the exact spot where the first measure had terminated; end of tube near V fell north or short of mark $0^{m}.01235$; end of tube near IV fell north of mark $0^{m}.00145$; end of tube near M fell south or beyond mark $0^{m}.01395$; end of tube near II fell south of mark $0^{m}.03475$; end of tube near I fell south of mark $0^{m}.09425$; and near southwest monument the second measure fell south, or beyond the starting-point of the first measure, $0^{m}.10670$.

The third measure started from southwest monument, as in first; near I, forward end of tube fell $0^{m}.04455$ north of mark or beyond first measure; near II, end of tube fell north of mark $0^{m}.09000$; near M, end of tube fell $0^{m}.13705$ north of mark; near IV, end of tube fell $0^{m}.21840$ north; and, near V, end of tube fell $0^{m}.30005$ north of mark. The distance between end of tube and the northeast monument was $1^{m}.05635$ at 85° Fah., or $1^{m}.05688$ when corrected; also, end of Tube 1558 fell $0^{m}.40010$ north of end of tube in first (and second) measure.

Applying these quantities, we obtain the following table of measured horizontal distances between the monuments:

Monuments.	First measure.	Second measure.	Third measure.	Mean.
	Meters.	*Meters.*	*Meters.*	*Meters.*
S. W. to I	1635. 97488	1635. 96803	1635. 96647	1635. 96979
I to II	1642. 31355	1642. 31733	1642. 31248	1642. 31445
II to M	1234. 38334	1234. 38794	1234. 39185	1234. 38771
M to IV	1348. 88627	1348. 88060	1348. 88506	1348. 88398
IV to V	1785. 70901	1785. 70483	1785. 70515	1785. 70633
V to N. E.	1691. 69199	1691. 69253	1691. 68152	1691. 68868
S. W. to N. E.	9338. 95904	9338. 95126	9338. 94253	9338. 95094

The discrepancies in these measures when compared with their respective means appear in the following table, expressed in millimeters:

Monuments.	First measure.	Second measure.	Third measure.
	Millimeters.	*Millimeters.*	*Millimeters.*
S. W. to I	− 5. 09	+ 1. 76	+ 3. 32
I to II	+ 0. 90	− 2. 88	+ 1. 97
II to M	+ 4. 37	− 0. 23	− 4. 14
M to IV	− 2. 29	+ 3. 38	− 1. 08
IV to V	− 2. 68	+ 1. 50	+ 1. 18
V to N E.	− 3. 31	− 3. 85	+ 7. 16
S. W. to N. E.	− 8. 10	− 0. 32	+ 8. 41

The table shows a maximum deviation in results of about one in a million. The frequent change in sign of the above discrepancies is taken as a favorable indication that the lengths of the tubes have been correctly assigned; and the general accord of the three individual measures among themselves must be taken as a severe test of the accuracy of the co-efficient of expansion of the standard-bar as determined in 1860.

To obtain the requisite data for the reduction of the measured base to its length at the sea-level, the following hypsometric operations were undertaken:

The base was leveled by spirit-level in April, 1872, and again in July, 1873. At southwest, middle, and northeast stations, double zenith-distances were measured to the primary-triangulation station, Stone Mountain. At Stone Mountain, double zenith-distances were measured to each of the three points of the base. A line of spirit-levelings was carried from Stone Mountain to the city of Augusta, Ga., in December, 1873, and January, 1874. Between Augusta and Port Royal Sound, the levelings of the railroad-engineers were made use of; lastly, the Port Royal and Beaufort, S. C., levelings were connected directly with tidal observations, giving the following results:

	Absolute height, in meters.
Mean of half-tidal level of the ocean from a number of observed high and low waters combined, with probable error of $\pm$ 0^m.013	0. 000
Bench-mark on wharf at Beaufort	2. 087
Bench-mark on gum-tree	5. 072
Bench-mark on Page's Point	5. 924
Bench-mark three-fourths of a mile south of Yemassee	2. 861
Bench-mark at Yemassee	6. 988
Bench-mark on willow-oak	41. 250
Bench-mark No. 22	39. 262
Bench-mark No. 20, at Augusta	40. 342
Bench-mark No. 10	186. 275
Bench-mark No. 6	259. 267
Bench-mark No. 1, at Stone Mountain Village	316. 207
And Stone Mountain △ ground	513. 948

The non-simultaneous double zenith-distances between Stone Mountain and the base give the following results when reduced to middle base △:

	Elevation of middle base, in meters.
From observations at southwest base and Stone Mountain	318. 128
From observations at middle base and Stone Mountain	318. 296
From observations at northeast base and Stone Mountain	318. 728
Mean adopted	318. 384

From the same observations it also follows that the co-efficient of refraction is about 0.0535 on these lines and along the base. To obtain the mean elevation of the tubes during the measures we combine the above value for height of middle base with the levels of the base, and add $1^{m}.524$ for average height of tubes above ground. The reduction to the half-tide level of the ocean is found by $b\left(-\frac{h}{\rho}+\frac{h^2}{\rho^2}\cdot\cdot\cdot\cdot\cdot\right)$

where—

b = length of base;

h = elevation above ocean; and

ρ = radius of curvature* for the latitude and azimuth of the base ($\log \rho = 6.804386$).

The following table gives the average elevation of tubes for each part of the base, the corresponding reduction to the sea-level, and the resulting distances.

Monuments.	Average elevation.	Reduction to sea-level.	Resulting lengths.	
	m.	m.	m.	
S. W. to I	315. 160	−0. 08089	1635. 88890	
I to II	315. 648	−0. 08133	1642. 23312	$4512^{m}.4477$
II to M	320. 189	−0. 06201	1234. 32570	
M to IV	325. 614	−0. 06891	1348. 81507	
IV to V	325. 553	−0. 09121	1785. 61512	$4826^{m}.0322$
V to N. E.	326. 621	−0. 08669	1691. 60199	
				$9338^{m}.4799$

We also have the separate values for length of base from first, second, and third measures, $9338^{m}.4880$, $9338^{m}.4802$, and $9338^{m}.4715$, respectively.

It was found by direct micrometric measures at southwest and northeast stations that the station middle base was $0^{m}.0423$ off and to the north and west of the direct line between the terminal monuments; the measured angle at middle base being 179° 59′ 56″.295 between northeast and southwest, counted in the direction of azimuths. The effect on the length of the base from this want of alignment is insensible.

We have a check on the length of the base by means of the angles measured at the three base-stations and at Stone Mountain; thus starting from the measured part, southwest base to middle base, we can compute by means of angles the length of the second part as well as that of the whole base.

Below are given the resulting angles at each station, directly derived from the least-square adjustment of the directions measured.† The corrections are due to the necessity that three geometrical conditions must be satisfied, viz: two angle-equations and the forward and backward azimuth of the base at middle base (in line) to differ 180°. The remaining excess of the angles over two right angles, in each group of three, is equal to the spherical excess.

	° ′ ″		″	
Stone Mountain	14 30 01.368	Corr.	−0.013	
Southwest base	65 44 22.204		+0.040	Spherical excess, 0″.186.
Middle base	99 45 36.656		−0.068	

* Appendix No. 11, Coast Survey Report of 1871, p. 169.

† Those measured at middle base having first been reduced to line from data given above.

	° ′ ″	″	
Northeast base	82 49 01.328	+0.107	Spherical excess, 0″.199.
Stone Mountain	16 56 35.265	+0.086	
Middle base	80 14 23.381	+0.031	
Northeast base	82 49 01.328	+0.106	Spherical excess, 0″.384.
Stone Mountain	31 26 36.633	+0.073	
Southwest base	65 44 32.204	+0.040	

Starting with the smaller part, viz, 4512^m.443, we find by the above angles the whole base 9338^m.502, with a difference from the measured line of only 0^m.022. The measured length is of course superior to that trigonometrically deduced, and it is consequently a check on the latter operation.

The probable error of the computed length of the base may be made out in two ways: firstly, by building it up from all known individual sources of error; secondly, by means of the tabular differences exhibited above for each part of the base, and resulting from the three separate measures. With respect to the individual sources of error, the accumulative effect of which is to be found, we have:

First, effect on the length of the base of the probable error assigned to the standard bar $= \pm 0^m.0000009 \times 1558 = \pm 0^m.00140$.

Secondly, effect on the base of uncertainty in the co-efficient of expansion of standard. The standard is 6^m at 33°.54 Fah. The mean temperatures during the three measures were 51°.41, 44°.70, and 90°.67; hence the probable errors,—

$$\pm .00000002 \times 6 \times 17.87 = \pm 0^m.00000214$$
$$\pm .00000002 \times 6 \times 11.16 = \pm 0^m.00000134$$
$$\pm .00000002 \times 6 \times 57.13 = \pm 0^m.00000686$$

giving respectively, when multiplied by 1558, the probable errors in the base $\pm 0^m.00334$, $\pm 0^m.00209$, and $\pm 0^m.01069$.

Thirdly, the effect of the probable error of the comparisons of the tubes with the standard, involving also the uncertainty of the differential expansions of the tubes. For the first and second measures we have the mean length of the tubes,—

$$5^m.99982375 + 0^m.0000022805\,(t - 52°.1) \pm 0^m.0000168$$

and for the third measure,—

$$5^m.99990745 + 0^m.0000048750\,(t - 81°.8) \pm 0^m.0000114$$

hence effect on first and second measures of base,—

$$\pm 0^m.0000168 \times 1558 = \pm 0^m.02617$$

and on third measure,—

$$\pm 0^m.0000114 \times 1558 = \pm 0^m.01776$$

Fourthly, the effect of transfers of end of tube to ground, or of the reverse operation from ground-mark to agate of tube. The number of transfers may be taken as four a day: one for picking up mark in the morning; two for securing work during lunch; and one of laying down mark at night. There were occupied in the three measures 17, 13, and 14 days, respectively; and, with the transfer error $= \pm 0^{mm}.082$, as found from measures at Bodies Island in 1848, the probable errors in length of base are,—

$$\pm 0.082\sqrt{68} = \pm 0^{mm}.676$$
$$\pm 0.082\sqrt{52} = \pm 0^{mm}.592$$
$$\pm 0.082\sqrt{56} = \pm 0^{mm}.613$$

Fifthly, the effect of contact-errors, which include effect of instability of apparatus during measure as due to wind, to yielding of ground, or elasticity of the same, and to other minor causes. The value of a contact-error was determined at Bodies Island $\pm 0^{mm}.010$; hence effect on base,—

$$\pm 0.010\sqrt{1557} = \pm 0^{mm}.395$$

Combining the above five principal errors by extracting the square root of the sum of their squares, we find—

Probable error of the first measure	$\pm 26^{mm}.43$
Probable error of the second measure	$\pm 26^{mm}.30$
Probable error of the third measure	$\pm 20^{mm}.79$

Expressed in terms of the length of the base, these errors are $\frac{1}{353310}$, $\frac{1}{355070}$, and $\frac{1}{449200}$, nearly, of the whole length. These fractions compare directly with the probable errors similarly expressed at the other base-lines, measured with the same apparatus, viz:

Dauphin Island, 1847	$\frac{1}{410000}$
Bodies Island, 1848	$\frac{1}{425500}$
Edisto Island, 1850	$\frac{1}{418600}$
Key Biscayne, 1855	$\frac{1}{454400}$
Cape Sable, 1855	$\frac{1}{409600}$
Epping Plains, 1857	$\frac{1}{551600}$
Peach Tree Ridge, 1872 and 1873	$\frac{1}{561880}$

from three measures.

The somewhat inferior accuracy reached in the first and second measures, when compared with the accuracy of the older base-lines, may be mainly attributed to deterioration in the apparatus from wear. The comparatively greater accuracy reached in the third measure is due to the comparisons having been made in glycerine instead of those taken in air. The final accuracy, the greatest reached in any of our base-lines, is of course due to the fact that three measures were made, which is believed to be unequaled in the history of geodesic operations.

If we attempt to deduce a probable error of the base from the differences of each measured part compared with its mean, which would include all errors except those arising from the uncertainty of the standard, we should find, after allowing for the latter, the probable errors $\pm 2^{mm}.69$, $\pm 2^{mm}.93$, and $\pm 4^{mm}.10$, respectively, for the three measures. These errors are much smaller than those deduced above; but there can be no question as to which set of values should be retained. In the first place, it is a precarious proceeding to deduce probable errors from three separate (and *not* independent) measures; secondly, the possibility of an accumulation of errors of known individual magnitude can not be ignored. That the probable errors last made out should be smaller than those first made out is rather fortuitous, yet satisfactory in itself. In conformity with our deductions for probable error of the older base-lines, we have:—

Length of base, first measure	$9338^{m}.4880 \pm 0^{m}.0264$
Length of base, second measure	$9338^{m}.4802 \pm 0^{m}.0263$
Length of base, third measure	$9338^{m}.4715 \pm 0^{m}.0208$

Considering that these are so-called "entangled measures"—that is, they and their probable errors are not independent—we have weighted mean of the first and second measures, $9338^{m}.4841 \pm 0^{m}.0263$, and the combination, by weights, of this with the last measure, $9338^{m}.4763 \pm 0^{m}.0166$, which latter value is proposed for adoption as the final length assignable to the Atlanta base.

We have also the separate parts, using weights as above,—

Southwest base to middle base	$4512^{m}.4460$
Middle base to northeast base	$4826^{m}.0303$

The logarithms of these lengths, together with their probable errors, are as follows:—

log whole base	3.9702760 214 ± 0.0000007 729
log first part	3.6544120 16
log second part	3.6835900 47

which logarithms should be used in the computations for adjustment of the triangulation.

Description of the compensation base-apparatus of the United States Coast Survey.—By Lieut. E. B. Hunt, U. S. A., Assistant in the United States Coast Survey.—(*With Sketch No.* 18.)

[Reprint from Appendix No. 35, Coast Survey Report for 1854, pp. *103 to *108.]

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The main essentials for a base-measuring apparatus are embraced in the following general conditions:

I. The extreme points of the apparatus used as measuring-limits must, under all circumstances of operation, remain at an invariable distance from each other, or the corrections for variations in this distance must be capable of easy and accurate determination.

II. The distance between the measuring-limits must be compared with the standard unit of length to the last degree of attainable accuracy, and its precise length so determined.

III. In the apparatus, the necessary parts and constructions for its easy and safe transportation, firm support, accurate contacts or coincidences, for slope-measurements, and also all requisite auxiliaries to the several adjustment-manipulations, must be so provided and combined as to give the whole a union of portability, convenience, and delicacy.

The Coast Survey apparatus, as it now stands, was devised with special regard to all the conditions for extreme accuracy and convenience in the field. Some slight modifications, indicated by experience in its use during the measurement of three base-lines, have since been embodied; but, in the main, the apparatus remains unaltered from the plans devised by Professor Bache in 1845, and executed, under his direction, in 1845 and 1846, by Mr. William Würdemann, then mechanician of the Coast Survey, to whom many of the details of arrangement are due. It may here be stated that the experience of three base-line measurements with this apparatus has fully shown it to be a highly satisfactory solution of the problem proposed, and it has been found to excel alike in accuracy, economy, and facility of use.

A base-line being duly reconnoitered, opened, and graded, and monuments being fixed for the permanent preservation of its extremities, or the base station-points, the measurement proper proceeds. The apparatus sent to the field for this purpose, when a primary base is to be finally measured, consists of the following parts: 1. Two measuring-tubes, exactly alike, each being packed for transportation in a wooden box. 2. Six trestles for supporting and adjusting the tubes, three being fore-trestles and three rear-trestles, each of which is packed for transportation in a three-sided wooden box. 3. Eight or more iron foot-plates, on which to support the trestles; and a wooden frame is afterward made, to serve as a guide in laying down the foot-plates. 4. Manipulating-handles for the adjustments; a theodolite for making the alignment, and for occasionally referring the tube-end to stakes driven for the purpose; also some minor auxiliaries. 5. A standard six-meter bar of iron, in its wooden case, arranged for comparisons, and a Saxton's pyrometer, arranged for indicating minute variations in length.

The measuring-tubes are carefully compared with the standard bar before beginning the measurement, and again after its completion, to make sure of the exact condition of the somewhat complex mechanism in the measuring-tubes. For these field-comparisons, the pyrometer is simplified, by causing the bar or tube undergoing comparison to abut against the spherical head of an arm, springing horizontally from the vertical axle, to which is attached the mirror for reflecting the remote arc-graduations into the telescope fixed on this arc. Variations or inequalities of the bars examined act on the arm, and thus turn the mirror, causing it to reflect the corresponding arc-reading into the telescope. A spring is so arranged as to make the arm-head press with a constant pressure against the bar-end.

When the comparison with the standard is completed, the foot-plates are successively placed by the aid of the wooden spacing-frame, which gives an approximate distance and alignment. Four trestles are so placed and leveled on these plates that the three foot-screws of each rest in three radial grooves of the plates. The two tubes are then mounted on their trestles, and, the rear extremity having been adjusted vertically over the station-point, the fore-tube is then adjusted to make a contact with the rear-tube extremity by means of a level of contact. Both tubes have to be first aligned by the aid of a theodolite advanced some distance on the line or following the measurement, in the field of which two standing sights, one on each tube, are made to cover. The placing of plates proceeds as fast as is necessary for keeping work always provided for the tubes, and, the extra trestles being duly placed and approximately adjusted, the rear-tube is carried forward in place and the adjustments executed. Thus the components of the apparatus are carried from rear to front in a determined order; and the measuring operations consist in the preparation for, and execution of, these progressive transfers, in effecting the more delicate adjustments, and in making a full record of all the essential circumstances. Points marked on copper nails in the heads of well-driven stakes usually indicate temporarily the end of each day's work, and great care is taken permanently to secure the precise extremity, or base-station point, from all disturbance.

From this synopsis of the general character and mode of using the Coast Survey base-apparatus, a ready and intelligent transition to the details of its composition and construction can now be made. While many minute arrangements and parts of this apparatus must here be unnoticed, I will endeavor to present a satisfactory summary. * * * * * * *

The tube is a spar-shaped double casing, Fig. 1, designed especially to embrace and protect the trusses which support and stiffen the system of bars on which the actual measurement depends. Its length is nearly six meters, or about twenty feet. The length of any simple bar of iron, or other metal, is so much affected by variations of its temperature as to make it necessary, where such bars are used for base-measurements, constantly to observe and correct for the temperature; the formula for correction being derived from previous experiments. But changes of temperature cannot, in this case, be exactly determined so as to know, at a given moment, the precise condition of the bar undergoing change; hence the temperature-correction is always uncertain in its value, besides causing much extra labor in observing and reducing. This makes apparent the importance of an arrangement, the limiting points of which will always be found at a constant distance apart, under all field-circumstances of temperature. No single material can give this exemption from expansions and contractions. It is found, however, in a combination of two metals having different rates of expansion, and hence admitting a resort to the principle of compensation, illustrated in the gridiron or compensating clock-pendulum.

This principle was independently applied to the construction of base-apparatus, composed of two bars, one of brass and one of iron, connected by a lever of compensation at their ends, first by Colonel Colby, in the Ordnance Survey of Ireland in 1827 (see Captain Yolland's Lough Foyle Base, p. 10); and again by Mr. Borden, of Fall River, in the Massachusetts Survey, during the winter of 1830. (See Palfrey's Tables, Survey of Mass., p. 1; Am. Phil. Trans., vol. ix, p. 34; and N. Am. Rev., Oct., 1845, pp. 458–461.) Mr. Borden made no provision for causing the two bars in his apparatus to change their temperatures at the same rate, though his tin tubular arrangement admirably checks the frequency and rapidity of such changes as in practice they must undergo. Colonel Colby attempted, by the aid of varnishes and lampblack coatings, as fixed by numerous experiments in 1827, to make both bars maintain the same temperature during the changes of surrounding heat. He made both bars of the same cross-section, and thought, by regulating the surface-radiation and absorption, to effect the required equalization of rate for heating and cooling. His method, though giving a good approximation, is radically faulty in not taking the specific heats and conducting powers of the bars into the account. The method first introduced and originated by Professor Bache is capable of insuring a very perfect equalization of temperature in the two bars. By numerous experiments in 1845 and 1846, he so arranged the cross-sections of the bars as that, while the two have equal absorbing surface, their masses are inversely as their specific heats, allowance being made for their different conducting powers. Thus, while each receives the same accession of heat in a given time, the temperature of the two will continue equal, because, except for the conducting rates, their masses are inversely as their specific heats. The same varnish on both surfaces gives them equal absorbent powers. The last minute adjustment of compensation was effected by making one surface slightly more absorbent than the other, as required by circumstances. Thus, as both bars vary essentially together, the point of compensation is never shifted by their diverse actions under thermal variations.

A bar of brass and a bar of iron, each less than six meters long, are supported parallel to each other, and, at one end, are so firmly connected together by means of an end-block, in which each bar is mortised and strongly screwed, as there to preserve an unalterable relation. The brass bar, which has the largest cross-section, is sustained on rollers mounted in suspending stirrups; and the iron bar rests on small rollers, which are fastened to the iron bar, and run on the brass one. Supporting-screws through the sides of the stirrups are adjusted to sustain the bars in place, and also serve to rectify them. Thus, while the two bars are relatively fixed at one end, they are elsewhere free to move, and hence the entire expansions and contractions are manifested at the free end. The medium of connection between the free ends of the two bars is the *lever of compensation*, which is joined to the lower or brass bar by a hinge-pin, around which it turns during changes of temperature. A steel plane on the end of the iron bar abuts against an agate knife-edge on the inner side of the lever of compensation. This lever terminates in a knife-edge, turned outward at such a distance from the center pin and the other knife-edge bearing, that the end edge will remain unmoved by equal changes of temperature in the two bars. The end edge presses against a steel face in a loop made in the *sliding-rod*. This rod slides in a frame fastened to the top of the iron bar, and passes through a spiral spring, which acts with a constant force to press the loop against the knife-edge. The outer end of the sliding-rod bears the limiting agate plane. Thus the end agate is not affected in position by the expansions of the brass and iron, acting as they do at proportional distances along the lever of compensation, measured from its sliding end bearing. The rates of expansion for iron and brass may safely be taken as uniform between the extreme expansions and contractions to which they are subject in practice, and the compensating adjustment once made is permanent.

The stirrups sustaining the rollers on which the brass bar runs are made fast to the main horizontal sheet of the iron supporting and stiffening work. This consists of a horizontal and a vertical plate of boiler-iron, joined along the middle line of the horizontal sheet by two angle-irons, all being permanently riveted. Circular openings are cut out from both plates to lighten them as much as practicable. A continuous iron tie-plate, turned up in a trough-form, connects the bottoms of all the stirrups. At the ends, stiffening braces connect the two plates.

We now pass from the compensating to the *sector end* of the tube, at which extremity are arranged the parts giving the readings, and for adjusting the contacts between successive tubes in measuring, thus making it the station of the principal observer. The sector end terminates in a *sliding-rod*, which slides through two upright bars, and at its outer end bears a blunt agate knife-edge, horizontally arranged, which in measuring is brought to abut with a uniform pressure against the limiting agate plane of the compensating end of the previous tube. At its inner end, this sliding-rod rests against a cylindrical surface on the upright *lever of contact*, so mounted as at its bottom to turn around a hinge-pin. At top, this lever rests against a tongue, or drop-lever, descending from the middle of the *level of contact*, which is mounted on trunnions.* The sliding-rod, when forced against the side of the lever of contact, presses its top against the tongue of the level, and thus turns the level by overcoming a preponderance of weight given to its farther end, to insure the contact being always at a constant pressure between the agates, the same force being always required to bring the bubble to the center.

The sector is a solid metal plate, mounted with its center of motion in the line of the sliding-rod, and having its arc graduated from a central zero to the limits of ascending and descending slopes on which the apparatus is to be used. A fixed vernier in contact with the arc gives the slope-readings. A long level and bubble-scale are so attached and adjusted to the face of the sector-plate that the zeros of the level and of the limb correspond to the horizontal position of the whole tube. If, then, on slopes, the bubble be brought to the middle by raising or lowering the arc end of the sector (a movement made by a tangent-screw, whose milled head projects above the tin case of the tube), the vernier will give the slope at which the tube is inclined, and the sloping measure is readily reduced to the horizontal by means of a table prepared for the purpose. The level of contact and the lever of contact, with their appendages, are all mounted on the sector and partake of its motions. A knife-edge end of the sliding-rod presses on the cylindrical face of the contact-lever, this cylinder being concentric with the sector, and the sector can therefore be turned without deranging the contact. In fact, the contacts are made with the sector-level horizontal, thus insuring the accuracy of the contact-pressure. The contact-lever is supported at bottom by

* The device of the *level of contact* is supposed to be due to the elder Repsold, who applied it first to the comparing-apparatus used by Bessel, in constructing the Prussian standards of length. A duplicate of that comparator was procured for the Coast Survey, by F. R. Hassler, Superintendent, in 1842.—[Note added in 1875.]

two braces dropping down from the sector-plate, and a spring, acting on a pin in the lever, steadies it against an adjusting screw-end. A bracket from the sector-plate receives the trunnions of the contact-level. A small screw projects from the end of the tube to clamp or set the lever and level of contact against a pin in the sector for security in transportation.

What is called the *fine motion*, required for adjusting the contacts between the successive tubes, is produced by means of a compensating rod or tube, one end of which is attached to the truss-frame by a bracket over the rear trestle, and the other receives a screw terminating in a projecting milled head. This screw turns freely in a collar, bearing, by a projecting arm, against the cross-bar which joins the main brass and iron bars, and its nut is in the end of the compensation-rod. By turning the screw in one direction, the bars are pushed forward, and the opposite turning permits a spiral spring, arranged for the purpose, to push back the system of bars, which slides through its supports. Thus the contact is made by turning the screw until the contact-level is horizontal. The compensating-rod is composed of several concentric tubes, alternately of brass and iron, arranged one within the other, and fastened at opposite ends alternately. Thus, when a contact has been made by the *fine-motion* screw, changes of temperature will not produce derangement, as would be the case if this rod were not compensating. The arrangement permits the observer conveniently to work the fine-motion screw, and to observe its action on the contact-level.

The apparatus thus described is inclosed in a double tin tubular case; diaphragms being adapted for supporting and strengthening the whole. The air-chamber between the two cases, $1\frac{1}{2}$ inches apart, is a great check on heat-variations. Three side-openings, with tin and glass doors in each tube, permit observations of the parts and of inserted thermometers. The ends are *closed*, only the sliding-rod ends projecting at each extremity, exposing the agates. Brass guard-tubes protect these, and for transportation tin conical caps are screwed on the tube ends. The fine-motion screw, the sector-tangent screw, and the contact-lever-clamp screw project beyond the case. The tube is painted white, which, with the air-chamber and thorough compensation, effectually obviates all need of a screen from the sunshine, which has usually been deemed requisite.

The tube rests on a fore-trestle and rear trestle, which are alike, except in the heads. Each trestle has three legs, composed of one iron cylinder moving in another by means of a rack, pinion, and crank, so as to raise or sink the head-plate. The leveling and finer adjustment are by means of a foot-screw in each leg, by working which a circular level on the connecting-frame is adjusted. A large axis-screw, resting on the connecting-frame, and rising into a tubular nut, is turned by beveled pinions worked by a crank, and thus raises or lowers this tubular nut and the cap-piece which it supports at top. The axis-screw, the leg-racks, and the foot-screws give three vertical movements in the trestle, by which its capacity for slope-measurements is much amplified.

In the cap of the rear trestle, a lateral and a longitudinal motion are provided for, by means of two tablets arranged to slide, the upper one longitudinally on the lower one, and the lower laterally on the head-plate of the axis-screw tube. Long adjusting screw-handles extend to the observer's stand from these two plates and from the axis-screw, enabling him to raise or lower, to slide forward or back, to the right or the left, the rear end of the tube. The fore trestle is similar, except that its head is only arranged for a lateral movement, and a second observer makes its adjustments by a simple crank.

Four men can carry a tube, by levers passed through staples in blocks strapped under the tubes. The principal observer and an assistant make the contacts and rectifications, the first assistant directs the forward tube, and another preserves the alignment with a theodolite. A careful recorder notes down the observations, and an intelligent aid places the trestles and foot-plates. The labor of grading, especially in level sand-lines, is quite trifling.

The first base-line measured with the apparatus now described was the Dauphine Island base, near Mobile, and about six and two-thirds miles long, which was measured by Professor Bache in 1847. (Coast Survey Report, 1847, p. 39.) The party was on the ground six weeks, between April 30 and June 12, though only 17 working-days were consumed in the final measurement. The greatest day's work was 183 tubes, or near seven-tenths of a mile. From some remeasurements the greatest supposable error for the entire base was computed to be less than six-tenths of an inch.

The second base-measurement with this apparatus was also by Professor Bache in 1848 (Coast Survey Reports, 1848, p. 43, and 1849, p. 38), being the Bodies Island base, North Carolina, about six and three-quarter miles long. Ten working-days were employed in the actual measurement, between the 4th and 23d of November. The greatest day's work was 1,692 meters, or 1.06 miles, in eight and a half hours. Several partial remeasurements give the total probable error for the entire base at less than one-tenth of an inch, and the greatest supposable error at less than three-tenths of an inch.

The only other base hitherto measured with these means is the Edisto Island base, South Carolina, which operation was conducted by Professor Bache, between the 3d and 18th of January, 1850 (Coast Survey Report, 1850, p. 34); thirteen days being occupied in the actual measurement. Its length is about six and two-thirds miles, and it was much more uneven than the previous base. The greatest day's work was 1,122 meters, or about three-fourths of a mile. A partial remeasurement gave one-tenth of an inch as the probable accidental error of measurement for the whole base.

It will be abundantly evident, on examining the results of other modes of measurement, that the Coast Survey apparatus is a superior combination of the requisite elements for such operations, giving a gain in accuracy, rapidity, and economy of use over its predecessors. The multiplication of bases is no longer a source of such formidable expenditures of time and money; hence geodetic operations are much facilitated and benefited by this fundamental improvement in the instruments employed. The more perfect compensation from regulating the masses of the bars, the application of the principle of contact-indication by the level, the stiffness of the support for the bar-system, the sector for slope-measurements, and the trestles, combining such a variety of movement with very great firmness—these features all attest the thorough study of the problem, which was made by Professor Bache, preparatory to calling forth the peculiar skill of Mr. Würdemann. Bessel's contact-level, before employed in the comparison of standards, has the same readily available accuracy in this apparatus, and should supersede the comparing-microscope entirely for final measurements. For field-comparisons with standards, the peculiarly elegant principle of Saxton's pyrometer is even better than the contact-level.

Whatever improvements may still need to be made in base-measuring apparatus, this important point is now reached: that the bases are measured at once with an accuracy far exceeding that of the angular measures given by any practicable number of repetitions on portable angle-instruments, and of the same order with the comparisons between the actual standards and their copies used in the measurements.

SUPPLEMENT.

Up to 1874, the indications of the thermometers within the tubes have been taken as the means for applying any residual correction for want of perfect compensation which might be shown to be requisite. While this correction is only of very small amount, and affects the length of a base only so far as the mean temperature during the measurement of a base-line is different from that at which the apparatus has been compared with the standard bar, it is, nevertheless, subject to the uncertainty arising from the fact that those thermometers do not show the actual temperature of the compensating bars, except when the temperature has been stationary for some time. In order to obviate this source of error, an arrangement has been designed and adapted to the apparatus by Assistant J. E. Hilgard, by which the difference in the length of the two bars may be read on a scale attached to the iron bar by means of a vernier fixed to the brass bar, forming a "Borda thermometer", as shown in Fig. 3. The scale is divided to half-millimeters, of which the vernier indicates the fiftieth part, so that, by means of a long-focus microscope, the difference may be read to the hundredth part of a millimeter without opening the case. Since the compensation can readily be made correct to within its thirtieth part, it is evident that the true length of the compound bars may be inferred at any time from the indications of the scale-reading, with an uncertainty no greater than the thousandth part of a millimeter, or a *micron*, as that value is now called. In making this correction, no reference to the thermometers is necessary, as the length is directly derived from the scale-readings. In the comparisons of the compensating measuring bars with the six-meter standard, the latter is immersed in glycerine, and its temperature and inferred length are very closely indicated by the thermometers distributed along its entire length, nearly in contact with it, and of course equally immersed in the liquid.

APPENDIX No. 13.

NOTE ON INTERVISIBILITY OF STATIONS.

1. Let h, be the height in *feet;*
d, the distance of visibility to the horizon in *miles*, or 5,280 feet; and
r, the average radius of curvature of the earth, say 20,890,000 feet:
taking the distance as the chord, the height as the versed-sine (the angles being small,) we have—

$$h : d = d : 2\,r$$

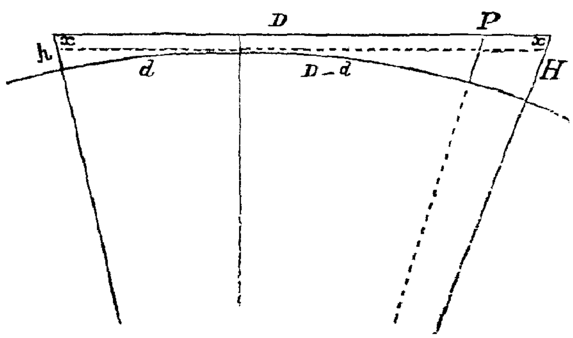
which gives—

$$h = 0.5300\, d^2$$

This is to be increased by its $\frac{1}{16}$ part to allow for ordinary refraction, and we get—

$$h = \tfrac{9}{16}\, d^2 \text{ and } d = \tfrac{4}{3}\sqrt{h}$$

2. If we desire to know the height at which a line of sight will pass above the horizon, we will first seek the distance to the tangent-point, as follows: call x the height above the tangent



parallel to the line of sight; d, the distance from the lower station to the tangent-point; D, the whole distance between the stations; h, H, their heights: then—

$$\begin{aligned} h - x &= \tfrac{9}{16}\, d^2 \\ H - x &= \tfrac{9}{16}\,(D - d)^2 \\ \hline H - h &= \tfrac{9}{16}\,(D^2 - 2\,Dd) \end{aligned} \quad \therefore d = \frac{D^2 - \frac{16}{9}\,(H - h)}{2\,D}$$

$$\text{Thus if } h = 900 \text{ feet}, \quad H = 3600 \text{ feet}, \quad D = 80 \text{ miles}, \quad x = h - \tfrac{9}{16}\, d^2$$

then—

$$d = 10 \text{ miles}, \; x = 844 \text{ feet}$$

3. If we now wish to know at what height the line of sight passes over a given point in its course, we have only to compute the height of visibility for the distance from the tangent-point, and add the height x, by which the line passes above the latter. For a point P, distant ten miles from H, we shall have the distance from the tangent-point = 60 miles, the height of visibility = 2025 feet, to which is added 844 feet for the elevation at which the line of sight from H to h passes at P, or 2869 feet.

4. The co-efficient of refraction which enters into the rule $h = \frac{9}{16}\, d^2$ above given is rather low, corresponding to $m = 0.0613$, and is therefore on the safe side for presumed intervisibility. The expression $h = \frac{4}{7}\, d^2$, corresponding to $m = 0.0781$, will more correctly represent the actual visibilities in regions bordering on the ocean.

For $d = 50$ miles, we have—

$$h = \tfrac{9}{16}\, d^2 = 1406 \text{ feet}$$
$$h = \tfrac{4}{7}\, d^2 = 1429 \text{ feet}$$

J. E. HILGARD.

APPENDIX No. 14.

A LIST OF STARS FOR OBSERVATIONS OF LATITUDE.

It has been the custom heretofore in the Coast Survey to select from the British Association's Catalogue the pairs of stars suitable for the determination of latitude, by the method of observing equal meridian zenith-distances with the zenith-telescope. The numbers of the stars so selected for observation at any station were sent to the Office, where the mean declinations for the year of observation were obtained by reference to all recent catalogues of precision, comprising the several Greenwich Catalogues, the Washington Observations, the Radcliffe and Armagh, and, where these failed, the Rumker Catalogue. For stars not found in at least two of these catalogues, and those which exhibited large discrepancies in position, express observations were made, by request, at the observatories at Washington and Cambridge.

This practice of deducing the declinations of stars from observations made with different circles and under varied circumstances has led to a great degree of precision in the assumed declinations. The stars used in the method of equal zenith-distances comprise those down to the sixth magnitude, most of which have not been the object of precise determination as standard stars. Still we find that the probable error of the declination of a star derived in the manner above mentioned does not exceed $\pm 0''.3$. And the probable error of one observation with the instruments used being between $0''.3$ and $0''.5$, the observation of sixteen pairs of stars on four nights never fails to reduce the probable error of the latitude below $0''.1$.

The British Association's Catalogue is now very difficult to obtain, and its constants have become obsolete by lapse of time. The continued demand on the Office for copies which could not be procured led to the preparation of the catalogue given below, which is intended to replace it as a list of stars available for the observation of latitude by the zenith-telescope in the limits of the United States. That list, giving the right ascensions only to the nearest tenth of a minute in time, and the declinations to the nearest minute of arc, for the epoch 1880, is intended to serve merely for the selection of stars for the observation of latitude. They comprise all the stars that are found in the "*Bonner Verzeichniss*," or *Nördliche Durchmusterung* of Argelander, included between 88° 40′ north and 1° 48′ south declination, and to his 5.9 degree of magnitude inclusive. The list was selected under the direction of Assistant C. S. Peirce, and their places computed for the epoch of 1880 with sufficient accuracy for the purposes above stated.

The magnitudes have been reduced to a scale of "equable distribution," according to the method explained in Mr. Peirce's Photometric Researches in the Annals of the Harvard College Observatory. It is the intention of the Coast Survey Office to reprint at an early day this list of stars, with their accurate positions in declination and right ascension as far as ascertainable. The Catalogue of Heis having been thoroughly compared in the preparation of this list, numerous errata have been discovered in the same, which are here given as a supplement.

The numbers of those stars which are contained in the British Association's Catalogue are given in the second column of the list; the third column gives the usual designation by constellations. Other references are given in the last column; the following abbreviations being used:

ABBREVIATIONS.

A. Oe.	Argelander Oeltsen, Wien, 1851–52.
B.	Argelander, Bonn, 1861–62.
D. M.	Durchmusterung.
F.	Bradley's, Bessel, 1818.
L. L.	Delalande, Baily, 1847.
P.	Piazzi, 1814.
Rad.	Radcliffe, 1860.
Ru.	Rumker, 1843.
S.	Struve, 1852.
W.	Weisse, 1863.
W².	Weisse, 1842.

List of stars for latitude-observations.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1	8373	10 Cassiop	5.3	0 0.2	63 31	
2	4	Androm ... α	1.9	2.2	28 26	
3	7	Cassiop ... β	2.5	2.8	58 29	
4	8	87 Pegasi	5.4	2.9	17 34	
5	14	34 Piscium	5.6	3.9	10 29	
6	16	22 Androm	5.1	4.1	45 24	
7	....	Androm	5.4	5.7	47 29	16 Rad.
8	....	D. M. 14	5.9	5.8	22 49	
9	26	88 Pegasi ... γ	2.7	7.0	14 31	
10	28	23 Androm	5.4	7.3	40 22	
11	32	89 Pegasi ... χ	4.9	8.4	19 33	
12	....	Pegasi ... (452 B.)	5.9	8.7	21 37	0h, 199 W.
13	36	35 Piscium	5.9	8.8	8 09	
14	....	Androm	5.9	10.1	42 56	44 Rad.
15	46	Cassiop	5.9	10.5	60 52	
16	51	Androm	5.9	10.8	47 16	
17	52	24 Androm ... θ	4.5	10.8	38 01	
18	58	25 Androm ... σ	4.4	12.0	36 07	
19	60	26 Androm	5.7	12.4	43 08	
20	....	Androm ... (72 B.)	5.9	12.5	30 52	0h, 38 Piazzi.
21	....	Androm ... (76 B.)	5.9	14.5	32 15	367 L. L.
22	67	27 Androm ... ρ	5.4	14.9	37 18	
23	79	Cassiop	5.9	17.8	51 21	
24	78	Androm	5.4	17.4	43 45	
25	83	Cassiop	5.9	18.6	52 23	
26	101	47 Piscium	5.3	21.8	17 13	
27	102	48 Piscium	5.9	22.0	15 46	
28	....	Cassiop	5.9	23.7	59 18	655 L. L.
29	109	28 Androm	5.7	23.8	29 05	
30	121	14 Cassiop ... λ	5.1	25.1	53 50	
31	120	75 Androm ... (104 B.)	5.9	25.1	32 56	
32	126	Cassiop ... κ	4.5	26.1	62 16	
33	130	52 Piscium	5.4	26.3	19 38	
34	142	Piscium ... (123 B.)	5.9	28.7	12 43	
35	147	Ceti	5.6	29.4	− 1 11	M. 14.
36	146	Cassiop ... (58 B.)	5.6	29.5	53 30	
37	148	Cassiop ... (59 B.)	5.9	29.7	59 39	
38	152	Androm	5.3	30.2	43 50	(17 H.)
39	153	17 Cassiop ... ζ	4.2	30.3	53 14	
40	155	29 Androm ... π	4.2	30.5	33 04	
41	....	Androm ... (117 B.)	5.9	30.8	23 21	0h, 757 W.
42	158	F. 430	5.6	31.0	34 44	
43	164	Androm ... ε	4.5	32.2	28 40	
44	165	Cassiop	5.9	32.5	48 42	
45	166	Androm ... δ	3.5	32.9	30 12	
46	170	55 Piscium	5.4	33.6	20 48	
47	169	Cassiop ... α	2 var.	33.7	55 53	
48	173	32 Androm	5.4	34.6	38 47	
49	175	Cassiop ... (68 B.)	5.9	34.9	65 28	
50	178	Androm ... (128 B.)	5.9	35.3	23 59	1087 L. L.
51	180	19 Cassiop ... ξ	5.0	35.5	49 51	
52	189	20 Cassiop ... π	4.5	36.8	46 22	
53	194	21 Cassiop	5.4	37.8	74 20	
54	197	Cassiop	5.6	37.8	47 12	
55	198	22 Cassiop ... ο	4.7	38.1	47 38	
56	201	Cassiop ... (74 B.)	5.6	38.4	54 34	
57	206	23 Cassiop	5.6	39.8	74 12	
58	211	57 Piscium	4.9	40.3	14 49	
59	213	58 Piscium	5.1	40.7	11 20	
60	215	34 Androm ... ζ	3.9	41.0	23 37	
61	218	24 Cassiop ... η	3.8	0 41.8	57 11	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
62	219	25 Cassiop .... ν..	5.1	0	42.0	50	19	
63	221	Piscium	5.9		42.1	4	40	M. 20.
64	222	63 Piscium .... δ..	4.5		42.5	6	56	
65	223	64 Piscium	5.4		42.7	16	18	
66	227	35 Androm .... ν..	4.6		43.2	40	26	
67	228	Cassiop	5.6		43.5	63	35	
68	229	65 Piscium .... i..	5.3		43.5	27	04	
69	....	Cassiop	4.9		45.9	63	27	(18 H.)
70	242	20 Ceti	5.1		46.9	−1	48	
71	244	26 Cassiop .... υ¹..	4.9		47.9	58	19	
72	247	66 Piscium	5.9		48.2	18	32	
73	256	67 Piscium .... k..	5.9		48.5	26	33	
74	253	Cassiop .... γ..	2.6		49.5	60	05	
75	254	28 Cassiop .... υ²..	4.9		49.5	58	31	
76	259	37 Androm .... μ..	4.3		50.1	37	51	
77	264	38 Androm .... η..	4.5		50.8	22	47	
78	261	Cassiop .... (97 B.)..	5.9		51.0	65	41	
79	267	68 Piscium .... h..	5.9		51.3	28	21	
80	269	Piscium	5.9		51.6	13	04	M. 28.
81	....	Cephei	4.9		52.6	85	37	(43 H.)
82	283	39 Androm	5.9		56.2	40	41	
83	285	Piscium .... σ¹..	5.4		56.2	31	10	
84	288	71 Piscium .... ε..	4.3		56.7	7	15	
85	....	Cassiop .... (101 B.)..	5.9		57.0	60	57	313 Rad.
86	....	D. M. 220	5.9		57.0	51	51	
87	295	26 Ceti	5.9		57.7	0	43	
88	303	73 Piscium	5.9		58.7	5	00	
89	305	72 Piscium	5.4		58.8	14	18	
90¹	307	Piscium .... ψ¹..	4.9		59.3	20	50	
90²	308	Piscium	5.9	0	59.3	20	50	
91	314	30 Cassiop .... μ..	5.4	1	0.4	54	20	
92	318	41 Androm	5.1		1.1	43	18	
93	322	79 Piscium .... ψ²..	5.6		1.5	20	06	
94	320	Cephei	5.4		2.2	79	02	(44 H.)
95	328	80 Piscium .... e..	5.9		2.2	5	01	
96	330	42 Androm .... φ..	4.4		2.5	46	36	
97	327	31 Cassiop	5.9		2.7	68	08	
98	334	43 Androm .... β..	2.5		3.0	34	59	
99	336	81 Piscium .... ψ³..	5.6		3.4	19	01	
100	....	F. 384	5.9		3.6	63	33	
101	339	Cassiop .... θ..	4.7		3.8	54	31	
102	....	Piscium	5.9		3.8	24	50	1ʰ, 20 P.
103	338	32 Cassiop	5.7		4.0	64	21	
104	343	45 Androm	5.9		4.4	37	05	
105	344	33 Ceti	5.9		4.5	1	47	
106	345	82 Piscium .... g..	5.4		4.7	30	47	
107	349	83 Piscium .... τ..	4.3		5.0	29	28	
108	348	84 Piscium .... χ..	4.6		5.0	20	24	
109	365	85 Piscium .... φ..	4.5		7.3	23	56	
110	368	86 Piscium .... ζ..	5.1		7.5	6	57	
111	....	Cephei	5.9		8.1	71	08	
112	374	38 Ceti	5.6		8.7	−1	37	
113	388	89 Piscium .... f..	5.4		11.6	2	59	
114	395	90 Piscium .... υ..	4.6		12.9	26	37	
115	393	Cephei	5.9		13.4	78	05	
116	400	42 Ceti	5.6		13.7	−1	10	
117	401	91 Piscium .... l..	4.9		14.5	28	06	
118	....	Urs. Minor (Polaris) .... α..	1.9		14.6	88	40	
119	404	46 Androm	5.1		15.3	44	54	
120	409	47 Androm	5.9		16.8	37	06	
121	412	36 Cassiop .... ψ..	5.1	1	17.5	67	30	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
122	416	37 Cassiop δ	3.1	1	18.0	59	37	
123	425	Androm (207 B.)	5.9		19.3	42	49	
124	427	93 Piscium ρ	5.3		19.8	18	33	
125	431	94 Piscium	5.4		20.2	18	37	
126	432	48 Androm ω	4.9		20.5	44	47	
127	....	D. M. 289	5.9		20.5	40	29	
128	....	Cassiop	5.9		22.5	65	29	1565 A. Oe.
129	441	49 Androm A	5.6		22.9	46	23	
130	448	98 Piscium μ	4.9		23.9	5	31	
131	453	99 Piscium η	4.2		25.1	14	44	
132	456	39 Cassiop χ	5.9		26.1	58	37	
133	468	40 Cassiop	5.1		29.0	72	25	
134	480	50 Androm	4.2		29.7	40	48	
135	482	Cassiop	5.9		30.3	57	22	
136	487	Persei υ (or 51 Androm.)	3.8		30.6	48	01	
137	488	102 Piscium π	5.9		30.7	11	32	
138	492	52 Androm χ	4.9		32.2	43	45	
139	501	Androm (227 B.)	5.9		33.5	42	41	
140	502	53 Androm τ	5.3		33.6	39	58	
141	499	42 Cassiop	5.1		33.8	70	00	
142	510	Androm	5.3		34.5	42	01	
143	....	Piscium	5.9		34.6	25	08	289 B.
144	514	Trianguli (8 B.)	5.9		34.8	29	27	
145	519	1 Trianguli	5.9		35.2	34	38	
146	518	106 Piscium ν	4.9		35.2	4	53	
147	515	44 Cassiop	5.9		35.3	59	57	
148	523	107 Piscium	5.3		36.0	19	42	
149	522	Persei φ (or 54 Androm.)	4.2		36.1	50	05	
150	537	110 Piscium ο	4.5		39.1	8	33	
151	544	Androm	5.9		41.6	37	21	
152	546	Arietis	5.9		41.7	16	22	
153	556	1 Arietis	5.9		43.5	21	40	
154	558	1 Persei	5.4		44.1	54	33	
155	561	54 Aries (or Ceti)	5.4		44.5	10	28	M. 63.
156	564	45 Cassiop ε	3.5		45.8	63	05	
157	566	55 Androm	5.9		46.1	40	09	
158	569	Trianguli α	3.8		46.3	29	00	
159	568	46 Cassiop	5.1		46.8	68	05	
160	572	5 Arietis γ¹	3.7		46.9	18	42	
161	574	111 Piscium ξ	4.5		47.4	2	36	
162	577	6 Arietis β	2.7		48.0	20	13	
163	580	56 Androm	5.6		48.8	36	41	
164	579	Androm	5.6		49.1	36	40	D. M. 355.
165	592	8 Arietis ι	5.4		50.8	17	14	
166	....	F. 339	5.4		50.9	64	02	
167	593	9 Arietis λ	4.9		51.3	23	01	
168	595	48 Cassiop	4.5		52.1	70	19	
169	600	50 Cassiop	4.2		53.2	71	50	
170	597	47 Cassiop	5.3		53.8	76	42	
171	608	49 Cassiop	4.9		54.1	75	32	
172	610	52 Cassiop	5.9		54.1	64	19	
173	611	53 Cassiop	5.9		54.1	63	49	
174	614	4 Persei	4.9		54.4	53	55	
175	625	113 Piscium α	3.7		55.9	2	11	
176	624	3 Trianguli ε	5.4		56.1	32	43	
177	628	57 Androm γ	1.9		56.6	41	45	
178	630	10 Arietis	5.9		56.8	25	21	
179	633	60 Ceti	5.9		57.1	− 0	27	
180	644	12 Arietis κ	5.9	1	59.8	22	05	
181	648	13 Arietis α	1.9	2	0.4	22	55	
182	649	58 Androm	4.9	2	1.3	37	18	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
183	653	Persci (or Cassiop) ...(30 B.)..	5.9	2 2.1	53 17	20023 A. Oe.
184	656	4 Trianguli ....β..	3.1	2.4	34 25	
185	657	14 Arietis	4.9	2.6	25 23	
186	665	15 Arietis	5.9	4.0	18 56	
187	668	55 Cassiop	5.9	5.2	65 57	
188	675	6 Trianguli	4.9	5.4	29 45	
189	676	60 Androm ....b..	5.1	5.8	43 40	
190	682	17 Arietis ....η..	5.4	6.1	20 39	
191	683	19 Arietis	5.9	6.5	14 42	
192	684	65 Ceti..........ξ¹..	4.5	6.6	8 17	
193	693	21 Arietis	5.9	8.9	24 30	
194	691	7 Trianguli	5.1	9.0	32 49	
195	697	8 Trianguli..........δ..	4.9	9.9	33 42	
196	698	9 Trianguli..........γ..	4.2	10.4	33 18	
197	706	62 Androm..........c..	5.1	11.5	46 49	
198	707	22 Arietis..........θ..	5.9	11.5	19 21	
199	708	Ceti..........	5.6	11.8	1 11	
200	710	10 Trianguli	5.6	12.0	28 05	
201	....	Arietis ....(70 B.)..	5.9	12.2	22 37	1161 Ru.
202	721	9 Persei..........i..	5.4	14.0	55 18	
203	729	69 Ceti	5.4	15.8	−0 10	
204	732	70 Ceti	5.6	16.1	−1 26	
205	731	64 Androm	5.6	16.5	49 27	
206	735	65 Androm	4.7	17.7	49 44	
207	745	24 Arietis..........ξ..	5.4	18.4	10 05	
208	744	Cassiop	4.6	19.2	66 52	
209	752	11 Trianguli	5.4	20.4	31 15	
210	757	12 Trianguli	5.4	21.2	29 08	
211	760	73 Ceti..........ξ²..	4.5	21.8	7 56	
212	....	Arietis ....(85 B.)..	5.9	22.4	22 56	1627 Ru.
213	772	14 Trianguli	5.4	24.8	35 38	
214	776	30 Ceti	5.4	25.3	1 45	
215	778	75 Ceti	5.4	26.0	−1 34	
216	777	36 Cassiop	4.9	26.8	72 17	(36 H.)
217	....	Persei	5.9	28.2	36 48	2ʰ, 642 W.
218	786	15 Trianguli	5.4	28.6	34 10	
219	794	78 Ceti ....ν..	5.3	29.6	5 05	
220	798	31 Arietis	5.0	30.1	11 57	
221	784	Cephei..........	5.7	30.5	80 56	
222	808	32 Arietis..........ν.	5.5	32.0	21 27	
223	811	82 Ceti..........δ..	3.8	33.3	−0 11	
224	813	33 Arietis	5.4	33.7	26 33	
225	816	11 Persei	5.9	34.5	54 36	
226	819	Persei..........(64 B.)..	5.9	34.5	53 01	
227	821	12 Persei	4.7	34.8	39 41	
228	825	34 Arietis ....μ..	5.6	35.6	19 29	
229	827	13 Persei ....θ..	4.3	36.0	48 43	
230	829	14 Persei	5.4	36.4	43 47	
231	831	35 Arietis	4.9	36.4	27 12	
232	837	86 Ceti..........γ..	3.7	37.1	2 44	
233	842	37 Arietis ....o..	5.9	37.9	14 49	
234	844	38 Arietis	5.1	38.4	11 57	
235	845	Arietis (or u Ceti)..........	4.2	38.5	9 36	
236	861	39 Arietis	5.1	40.8	28 45	
237	866	Arietis..........(116 B.)..	5.9	41.8	24 42	
238	867	40 Arietis	5.9	41.8	17 48	
239	863	15 Persei..........η..	3.7	41.9	55 24	
240	870	42 Arietis..........π..	5.4	42.6	16 58	
241	872	41 Arietis	3.8	42.9	26 46	
242	871	16 Persei	4.7	43.0	37 49	
243	....	Persei	5.9	2 43.7	46 21	3530 A. Oe.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
244	877	17 Persei	4.3	2 44.2	34 34	
245	881	43 Arietis ..σ..	5.9	44.9	14 34	
246	885	18 Persei ..τ..	4.3	45.8	52 16	
247	888	20 Persei	5.9	46.2	37 52	
248	....	D. M. 591	5.9	46.4	61 02	
249	....	D. M. 658	5.9	48.5	46 40	
250	901	45 Arietis ..ρ².	5.9	49.1	17 51	
251	904	21 Persei	4.7	50.0	31 26	
252	896	Cephei	5.4	50.3	78 57	47 H.)
253	912	22 Persei ..π..	5.0	51.1	39 11	
254	913	47 Arietis	5.9	51.2	20 10	
255	914	Persei ....(97 B.)	5.5	51.7	46 44	
256	915	24 Persei	5.3	51.7	34 42	
257	918?	Persei	5.4	52.4	51 54	(F. 431.)
258	921	48 Arietis ..ε..	4.3	52.4	20 52	
259	908	Cephei	5.4	53.2	81 00	
260	929	91 Ceti ..λ..	4.7	53.3	8 26	
261	941	49 Arietis	5.5	54.8	26 00	
262	949	92 Ceti ..α..	2.7	56.0	3 37	
263	947	23 Persei ..γ..	3.4	56.1	53 02	
264	....	Cassiop	5.9	57.3	63 36	3411 A. Oe.
265	953	25 Persei ..ρ..	3.8 var.	57.5	38 22	
266	957	52 Arietis	5.9	58.4	24 47	
267	955?	Cassiop	5.1	58.9	73 56	(37 H.)
268	....	Arietis ....(147 B.)	5.1	2 59.8	12 44	5725 L. L.
269	963	26 Persei ..β..	2 var.	3 0.3	40 30	
270	962	Persei ..i..	4.3	0.4	49 09	
271	967	27 Persei ..κ..	4.5	1.4	44 24	
272	974	55 Arietis	5.9	2.4	28 37	
273	980	Arietis ....(155 B.)	5.9	3.3	26 26	
274	981	28 Persei ..ω..	5.1	3.6	39 09	
275	960	Urs. Minor	5.9	4.1	84 29	
276	986	57 Arietis ..δ..	4.3	4.8	19 16	
277	994	94 Ceti	5.3	6.7	— 1 37	
278	....	Persei ....(122 B.)	5.9	6.7	56 41	
279	995	Persei ....(128 B.)	5.9	7.6	50 29	
280	999	Arietis ..ζ..	4.5	8.0	20 36	
281	....	Persei	5.5	8.1	30 07	3ʰ, 12 P.
282	1001	Camelop	4.5	9.5	65 13	(1 H.)
283	1006	30 Persei	5.9	9.7	43 35	
284	1007	29 Persei	5.4	10.1	49 48	
285	1011	31 Persei	5.4	10.7	49 40	
286	1017	Persei	4.9	11.3	33 46	(23 H.)
287	1023	59 Arietis	5.9	12.7	26 38	
288	1028	96 Ceti ..κ¹..	5.3	13.1	2 56	
289	1025	Arietis	5.1	13.1	28 37	F. 144.
290	1026	32 Persei ..ι..	5.3	13.5	42 54	
291	1030	Camelop	5.9	14.3	64 09	D. M. 391.
292	1034	61 Arietis ..τ¹..	4.9	14.3	20 43	
293	1040	62 Arietis	5.4	15.0	27 11	
294	1045	63 Arietis ..τ²..	4.9	15.8	20 19	
295	1043	33 Persei ..α..	1.9	15.8	49 26	
296	....	Persei ....(146 B.)	5.4	17.0	33 06	3ʰ, 320 W.
297	1052	64 Arietis	5.5	17.2	24 19	
298	1053	65 Arietis	5.5	17.5	20 23	
299	....	Tauri ....(8 B.)	5.9	17.6	12 12	6268 L. L.
300	1057	1 Tauri	3.8	18.4	8 36	
301	1058	Camelop	4.5	19.4	59 31	(2 H.)
302	1059	Persei ....(147 B.)	5.9	19.6	48 39	
303	1062	Camelop	4.9	20.3	58 28	(3 H.)
304	1068	2 Tauri	4.2	3 20.7	9 19	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
305	1066	34 Persei	5.3	3 20.8	49 07	
306	....	Persei .... (152 B.)	5.9	20.8	33 23	33656 B.
307	....	Camelop	4.7	20.9	55 02	(4 H.)
308	1069	66 Arietis	5.9	21.4	22 25	
309	1071	35 Persei .... σ	4.7	22.1	47 35	
310	1084	4 Persei (or Tauri S.)	5.3	23.8	10 56	
311	....	Tauri .... (Σ 401)	5.4	24.1	27 09	3ʰ, 466 W.
312	1087	5 Tauri .... f	4.2	24.2	12 33	
313	1083	36 Persei	5.9	24.2	45 39	
314	....	Camelop	5.9	24.5	54 33	3875 A. Oe.
315	....	Persei .... (159 B.)	5.9	25.0	35 03	3ʰ, 484 W.
316	....	Persei .... (160 B.)	5.9	25.7	39 30	1004 Rad.
317	1061	Cephei .... (323 B.)	5.9	27.3	86 16	
318	1099	Persei .... ψ	5.2	28.0	47 48	
319	1112	10 Tauri	4.3	30.8	— 0 01	
320	1111	Camelop	4.9	31.7	62 51	
321	....	Tauri	5.9	32.0	20 31	6686 L. L.
322	1119	Tauri .... (33 B.)	5.9	32.7	16 09	
323	1117	Camelop .... (4 B.)	5.9	32.8	59 35	
324	1123	Persei .... (164 B.)	5.4	33.4	37 12	
325	1128	12 Tauri	5.5	33.6	2 41	
326	1132	40 Persei	4.7	34.8	33 34	
327	1135	13 Tauri	5.4	35.4	19 19	
328	1133	Camelop	5.3	35.6	62 58	(6 H.)
329	....	16 Camelop	5.4	36.8	70 30	
330	....	Persei .... (167 B.)	5.4	36.8	36 05	4ʰ, 766 W.
331	1138	Persei .... o	3.8	36.8	31 54	
332	1140	14 Tauri	5.9	36.8	19 17	
333	1139	Persei .... ν	4.2	37.0	42 12	
334	1137	Camelop	4.3	37.7	70 58	(5 H.)
335	1147	17 Tauri	4.6	37.8	23 44	
336	1151	19 Tauri	4.9	38.1	24 05	
337	1153	24 Eridani	5.5	38.4	— 1 32	
338	1144	Camelop	4.5	38.5	65 09	(7 H.)
339	1154	20 Tauri	4.7	38.7	24 00	
340	1161	23 Tauri	4.5	39.2	23 34	
341	1162	29 Tauri .... u¹	5.4	39.3	5 40	
342	....	Persei	5.9	39.5	50 21	1064 Rad.
343	1166	Tauri .... η	3.4	40.4	23 44	
344	1174	30 Tauri .... e	5.1	41.7	10 46	
345	1172	Persei .... (176 B.)	5.5	41.8	44 35	
346	1176	27 Tauri	4.2	42.0	23 41	
347	1175	42 Persei	5.5	42.1	32 43	
348	1192	Tauri	5.9	43.1	25 14	(14 H)
349	....	Camelop	5.9	44.0	57 36	4208 A. Oe.
350	....	Persei .... δ	3.7	44.4	47 24	
351	1207	44 Persei .... ζ	3.1	46.6	31 34	
352	1203	Camelop	5.1	46.8	62 43	(8 H.)
353	1204	Camelop	5.5	47.0	60 45	(9 H.)
354	1210	Persei	5.9	47.3	47 32	(F. 89.)
355	1214	43 Persei .... A	5.4	47.7	50 21	
356	1221	32 Tauri	5.9	49.7	22 08	
357	1219	45 Persei .... ε	3.4	49.8	39 40	
358	....	Cephei	4.7	50.0	80 22	(49 H.)
359	1228	46 Persei .... ξ	4.3	51.2	35 27	
360	1240	Tauri .... (163 B.)	5.9	53.9	17 52	
361	....	Camelop	5.9	54.0	68 20	4351 A. Oe.
362	1241	35 Tauri .... λ	2.8 var.	54.0	12 09	
363	1237	Camelop	5.0	54.6	58 49	(10 H.)
364	1244	Tauri .... (167 B.)	5.5	55.2	9 39	
365	1245	35 Eridani	5.4	3 55.5	— 1 53	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
366	1251	38 Tauri ν	4.2	3	56.8	5	39	
367	1253	36 Tauri	5.9		57.2	23	47	
368	....	D. M. 732	5.9		57.3	53	41	
369	....	Tauri (171 B.)	5.7		57.5	7	52	3^h, 234 P.
370	1260	39 Tauri A^2	4.9		57.6	21	45	
371	1254	47 Persei λ	4.3		57.7	50	01	
372	....	Tauri	5.5		57.9	2	30	3^h, 238 P.
373	1262	41 Tauri	5.0		59.2	27	18	
374	1265	42 Tauri ψ	5.2		59.6	28	41	
375	....	D. M. 740	5.9	3	59.9	54	30	
376	1266	48 Persei *c*	4.5	4	0.0	47	24	
377	1268	49 Persei	5.9		0.3	37	25	
378	1247	Cephei	4.9		0.4	83	31	
379	1269	50 Persei	5.4		0.6	37	44	
380	1272	Tauri (190 B.)	5.4		1.1	17	01	
381	1279	44 Tauri	5.5		3.5	26	09	
382	1263	153 Cephei	4.9		3.8	83	03	
383	1285	45 Tauri	5.9		4.9	5	13	
384	....	Tauri (193 B.)	5.9		5.6	16	50	4^h, 59 W.
385	1289	Tauri	5.9		5.7	22	07	(192 B.)
386	1287	Persei μ	4.3		6.1	48	06	
387	....	Persei	5.9		6.1	37	39	4^h, 54 W.
388	1276	Cephei	5.4		6.2	80	32	
389	1286	Camelop	5.4		6.4	61	33	(11 H.)
390	1291	52 Persei *f*	4.7		6.7	40	11	
391	1296	46 Tauri	5.4		7.1	7	25	
392	....	Tauri	5.9		7.2	12	28	197 B.
393	1293	Camelop	4.9		7.4	53	18	(12 H.)
394	1298	47 Tauri	4.6		7.4	8	58	
395	....	Tauri (201 B.)	5.4		8.1	9	42	4^h, 19 P.
396	1304	49 Tauri μ	4.5		9.0	8	36	
397	1301	Persei b^1	4.7		9.2	50	00	
398	1300	Camelop	5.9		9.4	64	51	(13 H.)
399	1311	50 Tauri ω^2	5.4		10.2	20	17	
400	1316	51 Tauri	5.9		11.3	21	17	
401	1313	Camelop	5.4		11.5	60	28	(14 H.)
402	1324	56 Tauri	5.5		12.5	21	31	
403	1322	54 Persei	4.9		12.7	34	17	
404	1323	53 Persei *d*	5.0		13.0	46	13	
405	1326	52 Tauri φ	5.4		13.0	27	04	
406	1328	54 Tauri γ	3.8		13.0	15	20	
407	1330	57 Tauri *h*	5.4		13.2	13	44	
408	....	85 Tauri	5.9		13.4	18	26	4^h, 248 W.
409	1332	58 Tauri	5.7		13.8	14	48	
410	1341	59 Tauri χ	5.4		15.3	25	20	
411	1343	60 Tauri	5.4		15.3	13	47	
412	1346	61 Tauri δ^1	3.8		16.0	17	15	
413	1350	63 Tauri	5.9		16.5	16	31	
414	1349	55 Persei	5.9		16.7	33	51	
415	1352	56 Persei	5.9		16.9	33	42	
416	1356	64 Tauri δ^2	4.7		17.2	17	10	
417	1357	66 Tauri τ	5.1		17.3	9	11	
418	1362	65 Tauri κ^1	4.3		18.2	22	02	
419	1363	67 Tauri κ^2	5.9		18.3	21	55	
420	1364	Persei	4.9		18.5	31	10	(45 H.)
421	1365	68 Tauri δ^3	4.6		18.6	17	39	
422	1367	69 Tauri υ^1	4.6		19.1	22	32	
423	1369	71 Tauri	4.9		19.5	15	20	
424	....	Camelop	5.9		19.7	72	16	1221 Rad.
425	1370	73 Tauri π	4.9		19.8	14	26	
426	....	Tauri	5.9	4	21.3	30	07	4^h, 422 W.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
427	1376	74 Tauri .... ϵ	3.8	4 21.6	18 55	
428	1377	75 Tauri	4.9	21.6	16 06	
429	1380	77 Tauri .... θ^1	4.2	21.7	15 42	
430	1381	78 Tauri .... θ^2	4.2	21.8	15 36	
431	1384	79 Tauri .... b	4.9	22.1	12 47	
432	1386	44 Eridani	5.4	22.3	1 07	
433	1382	1 Camelop	5.9	22.5	53 39	
434	1390	80 Tauri	5.9	23.3	15 22	
435	1391?	Tauri	4.9	23.7	15 56	M. 160.
436	1392	81 Tauri	5.4	23.8	15 27	
437	1393	83 Tauri	5.4	23.9	13 29	
438	1403	45 Eridani	4.9	25.7	− 0 19	
439	1409	86 Tauri .... ρ	5.2	27.0	14 35	
440	1408	Tauri	5.4	27.1	28 43	
441	....	Tauri .... (280 B.)	5.9	27.8	5 19	8612 L. L.
442	1414	58 Persei .... e	4.9	28.4	41 01	
443	1420	87 Tauri .... α	0.9	29.0	16 16	
444	1421	88 Tauri .... d	4.3	29.1	9 55	
445	1424	2 Camelop	5.2	30.5	53 14	
446	1425	3 Camelop	5.3	30.5	52 50	
447	1431	49 Eridani	5.4	31.0	0 46	
448	....	Tauri	5.5	31.2	21 27	4h, 650 W.
449	1434	90 Tauri .... c^1	4.2	31.5	12 16	
450	1436	Tauri .... (91 Arg.), σ^1	5.3	32.3	15 33	
451	1437	Tauri .... (σ Arg.), σ^2	5.3	32.4	15 42	
452	....	Persei .... (233 B.)	5.9	32.5	48 04	1283 Rad.
453	....	Tauri .... (293 B.)	5.5	32.6	7 38	4h, 146 P.
454	1428	Camelop	5.9	32.8	75 43	
455	1442	93 Tauri .... c^2	5.9	32.4	11 58	
456	1444	Tauri	4.9	33.8	28 24	
457	....	Persei .... (235 B.)	5.4	34.3	49 45	1289 Rad.
458	1445	59 Persei	5.4	34.3	43 08	
459	1449	94 Tauri .... τ	3.4	35.0	22 44	
460	1460	Tauri	5.4	37.8	10 56	
461	....	Cephei	5.4	38.0	80 59	(50 H.)
462	1456	4 Camelop	5.5	38.0	56 33	
463	....	Orionis	5.4	39.4	11 29	8943 L. L.
464	1470	Camelop	5.5	40.9	63 18	
465	1475	Aurigæ	5.9	41.5	32 24	
466	....	Aurigæ	5.3	41.5	31 13	4h, 889 W.
467	1476	1 Aurigæ	5.4	41.8	37 17	
468	1474	9 Camelop	5.0	42.1	66 08	
469	1477	Aurigæ .... (9 B.)	5.5	42.2	48 32	
470	1486	1 Orionis .... π^1	3.5	43.3	6 45	
471	1491	2 Orionis .... π^2	4.9	44.1	8 42	
472	1493	97 Tauri i	4.5	44.3	18 39	
473	1492	2 Aurigæ	4.9	44.6	36 31	
474	1495	3 Orionis .... π^3	4.2	44.8	5 24	
475	1494	5 Camelop	5.5	45.3	55 04	
476	....	D. M. 701	5.9	45.3	27 42	
477	1500	4 Orionis .... o^1	4.9	45.8	14 03	
478	1508	5 Orionis	4.9	47.1	2 19	
479	1504	7 Camelop	4.9	47.7	53 34	
480	1514	8 Orionis .... π^5	3.7	48.0	2 15	
481	1516	7 Orionis .... π^4	5.3	48.3	9 59	
482	....	Orionis .... (19 B.)	5.4	48.3	7 35	4h, 236 P.
483	1520	3 Aurigæ .... ι	3.1	49.2	32 58	
484	....	Cephei	5.9	49.5	85 48	1311 Rad.
485	1525	9 Orionis .... o^2	4.9	49.6	13 19	
486	1526	Tauri	5.4	50.4	16 58	M. 180.
487	1529	98 Tauri .... k	5.9	4 50.8	24 52	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
488	1530	4 Aurigæ	5.4	4	51.1	37	42	
489	1538	10 Orionis π^6	4.9		52.3	1	33	
490	1536	10 Camelop β	4.9		52.8	60	16	
491	1540	7 Aurigæ ϵ	3.8 var.		53.4	43	39	
492	1541	8 Aurigæ ζ	3.8		54.1	40	54	
493	1546	11 Camelop	5.9		55.7	58	48	
494	1551	102 Tauri ι	4.7		55.9	21	25	
495	1549	Camelop	5.4		57.3	73	47	(18 H.)
496	1554	9 Aurigæ	5.1		57.3	51	26	
497	1557	11 Orionis	5.3		57.7	15	14	
498	1558	10 Aurigæ η	3.5		58.1	41	04	
499	....	Orionis (38 B.)	5.9		59.2	1	01	
500	1568	104 Tauri *m*	5.1	4	59.9	18	30	
501	1570	106 Tauri *l*	5.3	5	0.7	20	25	
502	1572	103 Tauri	5.5		0.8	24	07	
503	1584	14 Orionis *i*	5.5		1.3	8	21	
504	1582	Aurigæ (45 B.)	5.9		1.8	46	49	
505	....	Tauri	5.4		2.2	27	53	4^h, 1421 W.
506	1590	16 Orionis *h*	5.9		2.7	9	40	
507	1565	Camelop	5.1		2.8	79	05	(19 H.)
508	1591	15 Orionis	4.9		2.8	15	27	
509	1585	Camelop (65 B.)	5.5		3.6	73	08	
510	1601?	Orionis	5.4		4.8	15	54	(F. 160.)
511	1602	11 Aurigæ μ	5.1		5.2	38	21	
512	1611	17 Orionis ρ	4.7		7.0	2	43	
513	1614	14 Aurigæ	5.4		7.6	32	33	
514	1613	13 Aurigæ α	5.3		7.8	45	52	
515	....	Orionis (67 B.)	5.9		8.4	5	01	9820 L. L.
516	....	Camelop	5.9		9.2	62	31	62 742 B.
517	1624	18 Orionis	5.9		9.4	11	12	
518	....	Aurigæ (60 B.)	5.9		9.7	42	40	1441 Rad.
519	1627	16 Aurigæ	5.0		10.3	33	15	
520	1631	15 Aurigæ λ	4.7		10.7	39	59	
521	....	Aurigæ	5.5		11.8	40	58	5^h, 266 W.
522	1636	19 Aurigæ	5.7		12.1	35	50	
523	1637	109 Tauri *n*	5.4		12.1	21	59	
524	1642	16 Camelop	5.2		13.2	57	26	
525	1645	20 Aurigæ ρ	5.9		13.4	41	41	
526	1649	73 Aurigæ	5.9		13.6	29	27	
527	....	Aurigæ	5.9		14.0	40	54	1458 Rad.
528	1660	22 Orionis o	4.7		15.6	− 0	30	
529	1663	21 Aurigæ σ	5.2		16.5	37	16	
530	1665	23 Orionis *m*	5.3		16.5	3	26	
531	1671	111 Tauri	5.4		17.4	17	17	
532	1682	27 Orionis *p*	5.9		18.4	− 1	0	
533	1685	25 Orionis ψ^1	4.9		18.5	1	44	
534	1681	112 Tauri β	1.9		18.7	28	30	
535	1687	24 Orionis γ	1.9		18.7	6	14	
536	1676	17 Camelop	5.9		18.9	62	58	
537	1683	Aurigæ	5.9		19.7	34	22	
538	1692	115 Tauri	5.9		20.2	17	52	
539	1695	114 Tauri o	5.5		20.4	21	50	
540	1700	30 Orionis ψ^2	5.3		20.6	2	59	
541	1701	116 Tauri	5.9		20.9	15	47	
542	1707	118 Tauri	5.1		21.9	25	03	
543	1662?	Urs. Min.	5.9		23.5	85	06	944 G.
544	1717	31 Orionis	5.4		23.6	− 1	11	
545	1722	32 Orionis A	5.4		24.4	5	51	
546	1723	25 Aurigæ χ	4.7		24.6	32	06	
547	1726	119 Tauri	4.4		25.2	18	30	
548	1730	34 Orionis δ	1.9	5	25.9	− 0	23	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. *m.*	° ′	
549	....	Aurigæ	5.9	5 26.7	54 20	1503 Rad.
550	....	Orionis	5.9	26.7	— 1 41	5h, 962 W.
551	1736	Aurigæ .... (104 B.)	5.9	27.2	47 40	
552	1737	35 Orionis	5.4	27.3	14 13	
553	1742	121 Tauri	5.7	28.1	23 58	
554	1748	37 Orionis .... φ¹	4.9	28.2	9 24	
555	1749	39 Orionis .... λ	3.7	28.5	9 51	
556	1765	46 Orionis .... ε	1.9	30.1	— 1 17	
557	1766	40 Orionis .... φ²	4.5	30.3	9 13	
558	1751	Camelop	5.9	30.5	65 39	
559	1767	123 Tauri .... ζ	3.3	30.5	21 04	
560	1768	26 Aurigæ	5.9	31.6	30 25	
561	1775	125 Tauri	5.4	32.3	25 50	
562	1782	47 Orionis .... ω	4.9	32.9	4 03	
563	1792	126 Tauri	5.4	34.4	16 29	
564	1806	51 Orionis .... b	5.4	36.3	1 25	
565	1804	27 Aurigæ .... o	5.4	36.6	49 47	
566	1826	Orionis	5.9	40.3	9 29	
567	1827	131 Tauri	5.9	40.4	14 27	
568	1830	29 Aurigæ .... τ	4.6	40.9	39 08	
569	1834	133 Tauri	5.3	40.9	13 52	
570	1839	52 Orionis	5.4	41.6	6 25	
571	1837	132 Tauri	5.2	41.7	24 33	
572	1846	134 Tauri	5.0	42.8	12 37	
573	1844	31 Aurigæ .... υ	4.9	43.0	37 16	
574	1845	32 Aurigæ .... ν	4.2	43.2	39 08	
575	1851	Orionis	5.9	43.4	9 50	
576	1852	135 Tauri	5.4	43.6	14 16	
577	....	Orionis .... (200 B.)	5.9	43.9	4 23	11061 L. L.
578	1849	31 Camelop	5.4	44.2	59 53	
579	1854	30 Aurigæ .... ξ	4.9	44.8	55 41	
580	....	D. M. 1110	5.9	45.3	19 50	
581	1862	137 Tauri	5.9	45.5	14 08	
582	1863	136 Tauri	5.4	45.8	27 36	
583	1869	56 Orionis	5.5	46.2	1 49	
584	1876	54 Orionis .... χ¹	4.9	47.3	20 16	
585	1883	58 Orionis .... α	1 var.	48.7	7 24	
586	1885	33 Aurigæ .... δ	4.2	49.6	54 17	
587	....	Tauri	5.9	49.6	24 14	412 B.
588	....	Aurigæ	5.9	50.1	49 55	1592 Rad.
589	1896	139 Tauri	5.1	50.6	25 56	
590	1895	34 Aurigæ .... β	1.9	50.7	44 57	
591	1897	35 Aurigæ .... π	4.7	51.0	45 56	
592	1900	37 Aurigæ .... θ	3.2	51.5	37 12	
593	1902	36 Aurigæ	5.9	51.9	47 52	
594	1913	60 Orionis	5.4	52.7	0 32	
595	1914	Aurigæ	5.9	53.5	49 53	
596	1928	61 Orionis .... μ	4.9	55.8	9 39	
597	1934	64 Orionis .... χ³	5.4	56.4	19 42	
598	1938	1 Geminor	5.1	56.8	23 16	
599	1939	62 Orionis .... χ⁴	5.0	56.8	20 00	
600	1942	40 Aurigæ	5.9	58.4	38 30	
601	....	Orionis	5.9	58.7	29 31	183 B.
602	1945	66 Orionis	5.9	58.8	4 16	
603	1943	37 Camelop	5.9	5 59.4	58 57	
604	1958	67 Orionis .... ν	4.5	6 0.7	14 47	
605	1952	36 Camelop	5.4	0.9	65 43	
606	1963	41 Aurigæ	5.9	2.4	48 45	
607	....	Aurigæ .... (194 B.)	5.9	4.3	51 12	1660 Rad.
608	....	Aurigæ	5.9	4.5	32 43	6h, 26 W.
609	1979	40 Camelop	5.5	6 4.9	60 02	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
610	1986	68 Orionis	5.9	6 4.9	19 49	
611	1989	69 Orionis ......f¹	5.5	5.1	16 09	
612	1990	70 Orionis ......ξ	4.7	5.1	14 14	
613	1980	Camelop	4.6	5.6	69 22	(22 H.)
614	1992	1 Lyncis	5.4	6.9	61 33	
615	2002	7 Geminor ......η	3.4	7.6	22 32	
616	2001	44 Aurigæ ......κ	4.3	7.7	29 32	
617	2009	72 Orionis ......f²	5.4	8.5	16 10	
618	2012	73 Orionis ......k¹	5.9	9.0	12 35	
619	2007	2 Lyncis	4.9	9.1	59 03	
620	......	D. M. 1235	5.9	11.3	14 26	
621	2024	45 Aurigæ	5.5	12.1	53 30	
622	....	Orionis ......(291 B.)	5.5	13.2	14 43	12057 L. L.
623	....	Camelop	5.9	14.5	70 37	1707 Rad.
624	2044	46 Aurigæ	5.9	15.7	49 21	
625	2047	13 Geminor ......μ	3.1	15.7	22 35	
626	2045	5 Lyncis	5.9	16.6	58 29	
627	2057	8 Monocer	4.7	17.4	3 49	
628	2082	48 Aurigæ	5.9	20.9	30 34	
629	2081	47 Aurigæ	5.9	21.1	46 46	
630	2086	77 Orionis	5.7	21.1	0 22	
631	2090	18 Geminor ......ν	4.3	21.8	20 17	
632	2069	Camelop ......(121 B.)	5.9	22.1	78 06	
633	2083	Camelop	5.9	22.8	73 46	
634	2110	Aurigæ	5.5	24.6	32 32	
635	....	Monocer ......(50 B.)	5.4	25.1	11 38	12494 L. L.
636	....	Camelop	5.4	25.8	79 42	(23 H.?)
637	2126	13 Monocer	4.9	26.4	7 26	
638	....	Camelop	5.9	26.4	71 51	6978 A. Oe.
639	2129	Geminor ......(46 B.)	5.9	26.8	14 14	
640	....	Monocer ......(58 B.)	5.7	27.5	−1 07	12587 L. L.
641	2133	49 Aurigæ	5.0	27.7	28 07	
642	2159	50 Aurigæ	4.7	30.8	42 36	
643	2163	24 Geminor ......γ	2.4	30.8	16 31	
644	2170	54 Aurigæ	5.9	32.0	28 22	
645	2182	55 Aurigæ	5.4	34.4	44 39	
646	2185	15 Monocer	4.2	34.4	10 01	
647	2191	26 Geminor	5.4	35.4	17 46	
648	2187	12 Lyncis	4.9	35.7	59 33	
649	2194	27 Geminor ......ε	3.4	36.6	25 15	
650	2197	28 Geminor	5.9	37.2	29 06	
651	2199	30 Geminor	5.0	37.2	13 21	
652	....	Lyncis ......(Σ 958)	5.9	38.1	55 49	1806 Rad.
653	2200	56 Aurigæ	5.4	38.2	43 42	
654	2198	42 Camelop	5.1	38.4	67 42	
655	2201	57 Aurigæ	5.4	38.5	48 54	
656	2206	31 Geminor ......ξ	3.8	38.6	13 02	
657	2211	16 Monocer	5.9	40.0	8 43	
658	2209	43 Camelop	5.1	40.8	69 02	
659	2216	17 Monocer	5.2	40.8	8 10	
660	2222	18 Monocer	4.7	41.6	2 33	
661	....	Geminor ......(76 B.)	5.5	41.9	32 44	6ʰ, 1227 W.
662	2223	58 Aurigæ	5.1	42.3	41 56	
663	2210	Camelop	4.6	42.6	77 08	(24 H.)
664	2220	14 Lyncis	5.9	42.6	59 35	
665	....	Cephei	4.9	43.8	87 15	51 H.
666	2233	36 Geminor ......d	5.9	44.4	21 55	
667	2237	34 Geminor ......θ	3.3	44.9	34 06	
668	2248	15 Lyncis	4.9	46.9	58 35	
669	2247	Camelop	5.9	47.7	70 58	
670	2255	38 Geminor ......e	5.3	6 47.9	13 20	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
671	2261	16 Lyncis	5.9	6	48.9	45	17	
672	2285	41 Geminor	5.9		53.4	16	14	
673	2299	Geminor ... ω	5.5		55.1	24	23	
674	....	Geminor ... (110 B.)	5.9		55.4	17	55	6h, 1630 W.
675	....	Geminor ... (111 B.)	5.9		55.4	15	30	6h, 1633 W.
676	2305	43 Geminor ... ζ	4.2 var.		57.0	20	45	
677	2306	Geminor	4.9		57.0	11	07	(F. 10.)
678	2314	Aurigæ	5.9		58.2	34	40	
679	....	Aurigæ	5.9	6	59.5	34	11	13704 L. L.
680	....	Monocer ... (32 B.)	5.7	7	1.3	7	40	13799 L. L.
681	2330	45 Geminor	5.5		1.5	16	07	
682	2338	63 Aurigæ	5.3		3.4	39	31	
683	2340	46 Geminor ... τ	4.6		3.5	30	26	
684	2343	47 Geminor	5.4		3.9	27	04	
685	2341	Lyncis	5.9		4.0	51	37	
686	2350	48 Geminor	5.9		5.2	24	20	
687	2349	18 Lyncis	4.9		5.4	59	51	
688	2356	Canis Min ... (1 B.)	5.9		5.5	5	51	
689	....	Camelop	5.4		5.7	82	39	(25 H.)
690	2358	22 Monocer	4.3		5.7	— 0	18	
691	2362	51 Geminor	5.4		6.5	16	22	
692	2361	Lyncis ... (43 B.)	5.4		7.0	47	28	
693	2373	Canis Min.? ... (141 B.)	5.9		8.0	3	19	
694	2379	Lyncis	5.2		9.4	49	41	
695	2381	63 Aurigæ	5.9		9.7	41	06	
696	2398	54 Geminor ... λ	4.0		11.2	16	46	
697	....	Lyncis	5.9		12.6	45	27	1929 Rad.
698	2410	55 Geminor ... δ	3.7		13.0	22	12	
699	2407	19 Lyncis	5.4		13.1	55	30	
700	2416	65 Aurigæ	5.3		14.0	36	59	
701	2423	56 Geminor	5.9		14.9	20	39	
702	2429	66 Aurigæ	5.5		15.8	40	54	
703	2431	57 Geminor ... A	4.9		16.2	25	17	
704	2441	21 Lyncis	4.5		17.7	49	27	
705	2444	1 Canis Min	5.5		18.2	11	54	
706	2442	60 Geminor ... ι	4.2		18.3	28	02	
707	2439	Camelop ... (143 B.)	5.4		18.4	68	43	
708	2451	2 Canis Min ... ε	5.3		19.1	9	31	
709	....	Lyncis ... (51 B.)	5.9		20.0	48	26	1960 Rad.
710	2460	63 Geminor	5.5		20.6	21	41	
711	2462	3 Canis Min ... β	3.1		20.7	8	32	
712	2459	22 Lyncis	5.9		20.9	49	55	
713	2464	Geminor ... ρ	4.9		21.4	32	01	
714	2468	4 Canis Min ... γ	4.9		21.6	9	10	
715	2465	5 Canis Min ... η	5.9		21.6	7	11	
716	2467	64 Geminor ... b^1	5.9		21.9	28	23	
717	2469	65 Geminor ... b^2	4.9		22.4	28	10	
718	2473	6 Canis Min	4.9		23.1	12	15	
719	....	D. M. 1744	5.9		25.7	23	09	
720	2480	7 Canis Min ... δ^1	5.5		25.9	2	10	
721	2486	68 Geminor	5.4		26.8	16	08	
722	....	Lyncis ... (54 B.)	5.9		27.0	56	02	1998 Rad.
723	2485	66 Geminor ... α	1.5		27.0	32	09	
724	2488	Lyncis	5.9		27.9	46	27	
725	2493	69 Geminor ... υ	4.3		28.5	27	10	
726	2504	70 Geminor	5.5		30.7	35	20	
727	2509	71 Geminor ... ο	4.9		31.3	34	52	
728	....	Lyncis	5.7		32.2	38	37	2006 Rad.
729	....	Lyncis ... (58 B.)	5.5		32.4	46	24	2005 Rad.
730	2519	74 Geminor ... f	5.2		32.6	17	57	
731	2522	10 Canis Min ... α	5.3	7	33.0	5	32	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
732	2516	24 Lyncis	4.9	7	33.1	58	58	
733	....	Geminor	5.9		33.8	23	19	7^h, 955 W.
734	2532	Lyncis ....(60 B.)	5.5		35.0	50	42	
735	....	Geminor ....(189 B.)	5.9		35.3	14	29	14961 L. L.
736	2540	75 Geminor ....σ	4.9		35.8	29	10	
737	2551	77 Geminor ....κ	3.8		37.2	24	41	
738	2555	78 Geminor ....β	1.3		38.0	28	19	
739	....	Lyncis	5.3		38.6	37	48	7^h, 1083 W.
740	2558	81 Geminor ....g	5.0		39.2	18	48	
741	2563	80 Geminor ....π	5.3		39.7	33	43	
742	2564	11 Canis Min	4.9		39.7	11	04	
743	2612	13 Canis Min ....ζ	5.4		45.5	2	04	
744	2590?	Camelop. ....(161 B.)	5.5		45.8	79	48	
745	2596?	Camelop. ....(166 B.)	5.1		45.8	74	14	
746	2609	26 Lyncis	5.4		46.0	47	53	
747	2617	83 Geminor ....ϕ	4.9		46.2	27	05	
748	2585?	Camelop. ....(156 B.)	5.9		48.0	84	24	
749	2632	85 Geminor	5.9		48.7	20	13	
750	2639	1 Cancri	5.9		50.2	16	06	
751	2647	Canis Min	5.9		50.8	8	58	(F. 199.)
752	....	D. M. 1130	5.9		51.4	59	23	
753	2649	Cancri ....(2 B.)	5.9		51.7	16	49	
754	....	Camelop.?	5.9		51.9	63	25	
755	2653	14 Canis Min	5.9		52.1	2	33	
756	2659	3 Cancri	5.5		53.9	17	39	
757	2668	28 Monocer	5.3		55.1	− 1	03	
758	2673	Canis Min	4.9		56.0	2	40	(12 H.)
759	2672	6 Cancri	5.2		56.2	28	08	
760	2690	8 Cancri	5.5		58.4	13	28	
761	2700	9 Cancri ....μ^1	5.9		59.2	22	59	
762	2697	27 Lyncis	5.0	7	59.4	51	51	
763	2714	10 Cancri ....μ^2	5.3	8	0.7	21	56	
764	2707	Urs. Major ....(55 Can. Ven.)	4.7		0.9	68	50	(3 H.)
765	....	Camelop. ....(173 B.)	5.9		4.2	76	07	2092 Rad.
766	2732	Lyncis	5.4		4.2	56	49	(F. 505.)
767	2744	16 Cancri ....ζ	4.4		5.3	18	01	
768	2747	15 Cancri	5.4		5.7	30	02	
769	2757	29 Lyncis	5.9		7.9	59	56	
770	2765	Urs. Major	5.9		8.9	62	52	
771	2778	17 Cancri ....β	3.8		10.0	9	33	
772	2786	18 Cancri ....χ	5.4		12.8	27	37	
773	2789	19 Cancri ....λ	5.9		12.9	24	24	
774	2788	Cancri	5.9		13.4	21	06	(F. 93.)
775	2793	31 Lyncis	4.9		14.6	43	35	
776	2792	Lyncis ....(97 B.)	5.9		14.7	53	36	
777	....	Lyncis ....(101 B.)	5.9		17.4	35	25	16431 L. L.
778	2803	Urs. Major	5.9		18.4	67	42	
779	2815	22 Cancri ....ϕ^1	5.9		19.2	28	17	
780	....	Lyncis	5.9		19.3	46	03	2111 Rad.
781	2817	23 Cancri ....ϕ^2	5.4		19.5	27	20	
782	2822	Cancri	5.1		19.5	7	57	(12 H.)
783	2826	27 Cancri	5.5		20.1	13	03	
784	2819	1 Urs. Major ....o	3.5		20.3	61	08	
785	2833	28 Cancri ....υ^2	5.5		21.5	24	33	
786	2842	2 Urs. Major ....A	5.5		23.9	65	33	
787	2850	30 Cancri ....υ^3	5.5		24.4	24	29	
788	2853	31 Cancri ....θ	5.9		24.7	18	30	
789	2862	33 Cancri ....η	5.4		25.8	20	51	
790	2871	33 Lyncis	5.7		27.1	36	50	
791	2876	3 Urs. Major	5.5		28.5	65	26	
792	2889	Hydræ ....(18 B.)	5.9	8	29.5	7	02	

List of stars for latitude observations—Continued.

No.	B. A. C.	Constellation.	Magni-tude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
793	2884	4 Urs. Major ....π..	4.7	8	29.7	64	46	
794	2897	36 Cancri ....c^1..	5.9		30.6	10	05	
795	2901	4 Hydræ........δ..	4.5		31.3	6	07	
796	2911	5 Hydræ ....σ..	4.7		32.5	3	46	
797	2909	34 Lyncis........	5.4		32.8	46	16	
798	2937	43 Cancri........γ..	4.5		36.3	21	55	
799	2942	45 Cancri ....A^1..	5.9		36.6	13	07	
800	2945	7 Hydræ........η..	4.9		37.0	3	50	
801	2943	Urs. Major........	5.9		37.9	67	08	P. 286.
802	2953	47 Cancri ....δ..	4.5		37.9	18	36	
803	2956	49 Cancri ....b..	5.9		38.2	10	31	
804	2965	48 Cancri ....ι..	4.3		39.4	29	13	
805	2971	11 Hydræ........ε..	3.7		40.4	6	52	
806	2976	Hydræ ....(39 B.)..	5.9		41.2	− 1	28	
807	2978	13 Hydræ........ρ..	4.7		42.1	6	17	
808	2982	5 Urs. Major........b..	5.4		43.5	62	24	
809	2989	35 Lyncis........	5.4		43.9	44	11	
810	2999	51 Cancri........	5.9		45.2	32	56	
811	3002	55 Cancri ....ρ^2..	5.9		45.5	28	47	
812	3003	6 Urs. Major........	5.9		46.4	65	04	
813	3016	57 Cancri........σ^2..	5.3		46.9	31	03	
814	3033	59 Cancri........	5.9		48.5	33	22	
815	3026	58 Cancri ....ρ^3..	5.4		48.5	28	23	
816	3027	Lyncis........	5.9		48.7	40	40	D. M. 2125.
817	3032	16 Hydræ........ζ..	3.1		49.1	6	24	
818	3035	60 Cancri	5.5		49.4	12	06	
819	....	Camelop	5.9		50.2	84	40	2218 Rad.
820	3047	62 Cancri ....o^1..	5.4		50.6	15	47	
821	3048	9 Urs. Major ....ι..	3.3		51.0	48	31	
822	3053	Cancri	5.9		51.2	9	51	
823	3049	8 Urs. Major........ρ.	5.0		51.7	68	06	
824	3055	65 Cancri........α..	4.3		51.9	12	19	
825	3056	64 Cancri........	5.4		52.2	32	53	
826	3059	10 Urs. Major........	4.2		52.9	42	16	
827	3072	Urs. Major ....(44 B.)..	5.5		55.2	54	45	
828	3075	Urs. Major ....κ..	3.7		55.4	47	38	
829	3079	69 Cancri........ν..	5.3		55.8	24	56	
830	3087	11 Urs. Major........σ^1..	5.1		57.9	67	21	
831	3100	Lyncis?........	4.6		58.9	38	56	(17 H.)
832	3105	18 Hydræ ....ω..	5.4		59.7	5	35	
833	3099	13 Urs. Major........σ^2..	5.3	8	59.8	67	37	
834	3106	15 Urs. Major ....f..	4.9	9	0.4	52	05	
835	3109	72 Cancri........τ..	5.9		0.7	30	09	
836	3108	14 Urs. Major........τ..	4.9		1.0	64	00	
837	3111	76 Cancri........κ..	5.4		1.3	11	09	
838	3113	75 Cancri........	5.9		1.7	27	07	
839	3117	77 Cancri. ....ξ..	4.7		2.5	22	31	
840	3116?	Urs. Major........	5.9		3.8	73	26	(F. 399.)
841	3125	16 Urs. Major........c..	4.9		4.9	61	55	
842	3131	36 Lyncis........	4.9		6.0	43	43	
843	3135	17 Urs. Major........	4.9		6.9	57	13	
844	3140	18 Urs. Major........e..	5.4		7.6	54	31	
845	3146	22 Hydræ ....θ..	4.3		8.1	2	49	
846	3132	81 Cancri ....π^1..	5.5		8.6	15	27	
847	3162	38 Lyncis........	4.4		11.4	37	19	
848	3172?	Urs. Major........	5.5		12.9	57	13	(F. 445.)
849	3178	40 Lyncis........α..	3.3		13.8	34	54	
850	3204	1 Leonis........κ..	4.3		17.7	26	42	
851	3199	Draconis........	4.3		19.8	81	51	(1 H.)
852	3218?	Urs. Major. (or 41 Lyncis)	5.4		20.9	46	08	(22 H.)
853	3227	2 Leonis ....ω..	5.3	9	22.0	9	35	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
854	3221	23 Urs. Major ....*h*..	3.7	9	22.1	63	35	
855	3228	3 Leonis	5.9		22.1	8	43	
856	3231	22 Urs. Major....................	4.9		23.6	72	44	
857	3232	24 Urs. Major..................*d*..	5.1		23.9	70	21	
858	3241	8 Leonis Min	5.4		24.3	35	39	
859	3242	25 Urs. Major.................*θ*..	3.1		24.8	52	13	
860	3246	4 Leonis......................*λ*..	4.5		24.9	23	30	
861	3250	5 Leonis......................*ξ*..	5.3		25.5	11	50	
862	3251	6 Leonis......................*h*..	5.9		25.5	10	15	
863	3253	32 Hydræ.....................*τ*²..	4.7		25.9	− 0	39	
864	3256	26 Urs. Major....................	4.9		26.6	52	36	
865	3261	10 Leonis Min	4.8		26.9	36	56	
866	3265	Lyncis..........................	4.6		27.7	40	09	
867	3268	11 Leonis Min	5.4		28.5	36	22	
868	3273	Leonis..........................	5.3		29.6	31	42	(6 H.)
869	3286	1 Sextantis (or 10 Leonis).......	5.5		30.9	7	22	
870	3281	42 Lyncis.........................	5.4		31.0	40	47	
871	3283	27 Urs. Major.....................	5.3		32.0	72	48	
872	3295	2 Sextantis	4.9		32.2	5	11	
873	3284	Camelop (or Draconis)	5.9		33.0	79	41	(188 B.)
874	3303	35 Hydræ..........................	4.2		33.7	− 0	36	
875	3307	43 Lyncis.........................	5.5		34.6	40	18	
876	3312	Leonis.......................*o*..	3.8		34.8	10	26	
877	3317	15 Leonis.......................*f*..	5.3		36.5	30	32	
878	3321	16 Leonis ....*ψ*..	5.9		37.2	14	34	
879	3324	Urs. Major ....(99 B.)..	4.9		38.1	57	40	
880	3331	17 Leonis.........................	3.4		39.1	24	20	
881	3336	Leonis	5.5		39.8	7	15	(F. 240.)
882	3339	Sextantis..............(12 B.)..	5.4		40.2	2	20	
883	3341	15 Leonis Min	5.7		40.8	46	35	26 4.
884	3345	Leonis ....R..	6 var.		41.1	11	59	M. 420.
885	3346	29 Urs. Major...................*υ*..	4.2		42.5	59	36	
886	3358	30 Urs. Major ....*ϕ*..	4.9		44.0	54	38	
887	3366	22 Leonis......................*g*..	5.5		45.1	24	58	
888	3371	24 Leonis......................*μ*..	4.2		45.9	26	34	
889	3374	7 Sextantis	5.9		46.0	3	01	
890	3381	31 Urs. Major.....................	5.4		47.9	50	24	
891	3399	19 Leonis Min	5.1		50.4	41	38	
892	3402	Urs. Major......................	4.9		51.6	57	23	(F. 391.)
893	3406	Leonis......................*ν*..	5.4		51.8	13	00	
894	3409	Leonis .... (92 B.)..	5.9		52.7	30	13	
895	3415	29 Leonis......................*π*..	4.9		53.9	8	37	
896	3416	20 Leonis Min	5.5		54.1	32	31	
897	3423	Leonis	5.2	9	56.1	32	33	(15 H.)
898	3446	21 Leonis Min	4.4	10	0.4	35	50	
899	3453	30 Leonis......................*η*..	3.5		0.8	17	21	
900	3457	31 Leonis ....A..	4.9		1.5	10	35	
901	3458	15 Sextantis	4.2		1.8	0	13	
902	3459	32 Leonis......................*α*..	1.3		2.0	12	33	
903	3468	Leonis Min............(64 B.)..	5.9		4.1	38	00	
904	3496	32 Urs. Major	5.5		9.3	65	42	
905	3500	23 Leonis Min	5.9		9.4	29	54	
906	3505	33 Urs. Major..................*λ*..	3.7		9.9	43	31	
907	3508	Leonis.......................*ζ*..	3.7		10.0	24	01	
908	3510	37 Leonis	5.4		10.2	14	21	
909	....	Camelop	4.9		12.0	84	51	(29 H.)
910	3514	Urs. Major	5.9		12.0	69	22	F. 447.
911	....	Urs. Major.......................	5.9		12.0	49	00	49, 1940 B.
912	3522	40 Leonis	5.7		13.3	20	05	
913	3523	Leonis .... *γ*..	1.9		13.4	20	27	
914	3533	Urs. Major ....*μ*..	3.3	10	15.9	42	06	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
915	3531	Urs. Major	4.9	10	15.5	66	11	
916	3542	27 Leonis Min	5.9		16.2	34	31	
917	3528	Camelop	5.1		16.3	83	10	(30 H.)
918	3548	28 Leonis Min	5.5		17.2	34	19	
919	3560	30 Leonis Min	4.5		19.0	34	25	
920	3561	44 Leonis	5.9		19.0	9	25	
921	3572	31 Leonis Min ... β	4.2		21.0	37	19	
922	3580	36 Urs. Major	4.6		23.0	56	36	
923	3597	30 Sextantis	5.3		24.2	− 0	01	
924	3593	Draconis	4.9		24.6	76	21	(9 H.)
925	3606	46 Leonis ... *i*	5.9		25.8	14	45	
926	3607	Urs. Major	5.1		26.2	41	03	(33 H.
927	3609	47 Leonis ... *ρ*	4.2		26.5	9	56	
928	3610	34 Leonis Min	5.9		26.7	35	36	
929	3612	37 Urs. Major	4.9		27.4	57	42	
930	3639?	Urs. Major ... (166 B.)	5.9		31.7	54	17	
931	3640	37 Leonis Min	4.7		32.0	32	36	
932	3641	38 Leonis Min	5.4		32.3	38	31	
933	3645	Urs. Major	5.4		33.4	69	03	(F. 449.)
934	3647	38 Urs. Major	5.1		33.8	66	20	
935	3652	Urs. Major	4.6		34.5	69	42	(35 H.)
936	3664	39 Urs. Major	5.5		36.2	57	49	
937	3665	36 Urs. Major	5.1		36.5	46	56	(36 H.)
938	3666	40 Leonis Min	5.2		36.5	26	58	
939	3671	41 Leonis Min	5.4		36.9	23	49	
940	3685	42 Leonis Min	5.1		39.2	31	19	
941	3691	51 Leonis ... *m*	5.4		39.9	19	32	
942	3693	52 Leonis ... *k*	5.5		40.1	14	51	
943	3708	53 Leonis ... *l*	5.3		43.0	11	11	
944	3714	42 Urs. Major	5.5		43.9	59	57	
945	....	Urs. Major	5.9		45.4	70	29	2569 Rad.
946	....	Urs. Major ... (194 B.)	5.9		45.4	53	09	{2571, 2572} Rad.
947	3725	44 Urs. Major	5.4		46.3	55	13	
948	3728	46 Leonis Min	4.2		46.6	34	52	
949	3729	45 Urs. Major ... ω	5.1		47.1	43	50	
950	3732	Leonis ... p^1	5.4		47.6	− 1	30	(29 H.)
951	3742	54 Leonis	4.2		49.1	25	23	
952	3741?	46 Urs. Maj. or Leon. Min. (128 B.)	5.4		49.2	34	09	
953	....	Urs. Major	5.9		52.2	52	32	11292 A. Oe.
954	3757	47 Urs. Major	4.7		52.8	41	04	
955	....	Urs. Major ... (208 B.)	5.9		52.8	36	46	10h, 203 P.
956	3758	Urs. Major	5.9		53.4	46	09	(39 H.)
957	3768	58 Leonis ... *d*	4.5		54.4	4	16	
958	3769	59 Leonis ... *c*	5.1		54.5	6	44	
959	3767	48 Urs. Major ... β	2.6		54.6	57	01	
960	3765?	49 Urs. Major	4.7		54.1	39	57	
961	3775	61 Leonis ... p^1	5.1		55.7	− 1	50	
962	3776	60 Leonis ... *b*	4.3		55.9	20	49	
963	3777	50 Urs. Major ... α	1.9		56.3	62	24	
964	3788	63 Leonis ... χ	5.1	10	58.8	7	59	
965	3798?	65 Leonis ... p^3	5.9	11	0.8	2	37	
966	3809	67 Leonis	5.9		2.4	25	20	
967	3811	Urs. Major ... (220 B.)	5.7		2.8	36	58	
968	3812	52 Urs. Major ... ψ	3.7		2.9	45	09	
969	3832	69 Leonis ... p^5	5.3		7.6	0	36	
970	3834	68 Leonis ... δ	2.6		7.7	21	11	
971	3838	70 Leonis ... θ	3.5		7.9	16	05	
972	3842	72 Leonis	4.9		8.8	23	45	
973	3843	73 Leonis ... *n*	5.3		9.6	13	58	
974	3846	Urs. Major	5.9		9.9	50	08	(F. 394.)
975	3850	75 Leonis	5.4	11	11.1	2	41	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
976	3851	53 Urs. Major ξ	3.8	11	11.8	32	13	
977	3852	54 Urs. Major ν	3.5		12.0	33	45	
978	3856	55 Urs. Major	4.7		12.6	38	51	
979	3862	77 Leonis σ	4.3		15.0	6	41	
980	3864	Urs. Major	5.9		15.7	65	00	(F. 392.)
981	3868	56 Urs. Major	5.3		16.3	44	09	
982	3877	78 Leonis ι	4.2		17.7	11	12	
983	3879	79 Leonis	5.9		17.9	2	04	
984	3886	81 Leonis	5.9		19.4	17	08	
985	3900	Leonis τ	4.9		21.8	3	31	
986	3905	57 Urs. Major	4.9		22.6	40	00	
987	3915	86 Leonis	5.4		24.2	19	04	
988	3914	Draconis λ^1	3.5		24.3	70	00	
989	3918	Urs. Major	5.9		25.5	61	44	(F. 124.)
990	3932	90 Leonis	5.4		28.5	17	27	
991	3931	Urs. Major (279 B.)	5.9		28.5	55	27	
992	3933	2 Draconis	5.1		29.0	70	00	
993	3937?	Leonis	5.9		30.0	28	26	(45 H.)
994	3946	91 Leonis υ	4.6		30.8	− 0	10	
995	3949	Urs. Major (283 B.)	5.9		31.4	51	18	
996	3952	59 Urs. Major	5.9		32.0	44	17	
997	3964	92 Leonis	5.4		34.6	22	01	
998	3965	61 Urs. Major	5.0		34.8	34	53	
999	3966	62 Urs. Major	5.9		35.4	32	25	
1000	3968	3 Draconis	5.3		35.8	67	25	
1001	3979	2 Virginis ξ	4.9		39.1	8	55	
1002	3981	62 Urs. Major χ	4.2		39.7	48	27	
1003	3982	Virginis ν^3	4.3		39.7	7	12	
1004	3985	Urs. Major	5.4		40.5	56	19	(F. 123.)
1005	3990	93 Leonis	4.2		41.8	20	53	
1006	3989	4 Virginis A^1	5.9		41.8	8	55	
1007	3995	94 Leonis β	1.9		42.9	15	15	
1008	3998	55 Urs. Major	5.2		43.3	35	36	
1009	4002	5 Virginis β	3.5		44.4	2	27	
1010	4017	64 Urs. Major γ	2.7		47.5	54	22	
1011	4027	6 Virginis A^2	5.4		48.9	9	07	
1012	4031	95 Leonis o	5.9		49.5	16	20	
1013	4033	66 Urs. Major	5.9		49.7	57	15	
1014	....	Urs. Major	5.9		53.1	33	50	11^h, 1013 W.
1015	4049	7 Virginis b	5.5		53.8	4	20	
1016	4052	8 Virginis π	4.5		54.7	7	17	
1017	....	Urs. Major	5.4		55.5	36	43	(57 H.)
1018	4057	67 Urs. Major	5.0		56.0	43	43	
1019	4066	2 Comæ	5.9		58.6	22	07	
1020	4072	9 Virginis o	4.3		59.1	9	24	
1021	....	Draconis	5.5		59.4	77	35	2794 Rad.
1022	4674	Urs. Major (366 B.)	5.9	11	59.7	63	36	
1023	4099	3 Comæ	5.9	12	4.4	17	28	
1024	4100	Comæ	5.7		4.7	27	57	
1025	4107	4 Comæ	5.4		5.8	26	32	
1026	4110	5 Comæ	5.9		6.1	21	13	
1027	4111	Draconis	5.0		6.6	78	17	(4 H.)
1028	4122	Draconis (17 B.)	5.9		9.4	70	53	
1029	4123	Urs. Major δ	3.5		9.5	57	42	
1030	4125	6 Comæ	5.0		9.9	15	34	
1031	4126	2 Can. Ven	5.4		10.1	41	20	
1032	4127	7 Comæ	5.3		10.3	24	37	
1033	4128	Can. Ven	4.9		10.5	33	44	(2 H.)
1034	....	Comæ (36 B.)	5.5		10.5	29	37	
1035	4143	Draconis	5.5		11.5	75	51	(5 H.)
1036	4145	15 Virginis η	3.4	12	13.4	0	00	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
1037	4148	3 Can. Ven	5.4	12	13.8	49	39	
1038	4152?	Comæ	4.9		13.9	27	17	52 B.
1039	4151	16 Virginis ... c	5.1		14.3	3	59	
1040	4153	Comæ	5.9		14.3	27	44	55 B.
1041	4156	11 Comæ	4.5		14.7	18	27	
1042	4169	12 Comæ	4.9		14.7	26	31	
1043	4180	5 Can. Ven	5.1		16.5	52	12	
1044	4181	13 Comæ	5.2		18.3	26	46	
1045	4184	Comæ ... (69 B.)	5.9		19.2	24	36	
1046	....	Urs. Major	5.9		19.5	64	29	400 B.
1047	4188	6 Can. Ven	5.2		20.0	39	41	
1048	4191	Comæ	5.0		20.4	27	54	(14 H.)
1049	4195	15 Comæ ... γ	4.6		21.0	28	54	
1050	4196	16 Comæ	5.1		21.0	27	29	
1051	4203	73 Urs. Major	5.9		21.8	56	19	
1052	4207	17 Comæ	5.9		22.9	26	35	
1053	4209	18 Comæ	5.4		23.5	24	46	
1054	4212	20 Comæ	5.5		23.7	21	34	
1055	4216	74 Urs. Major	5.4		24.3	59	04	
1056	4222	4 Draconis	4.6		25.0	69	52	
1057	4223	21 Comæ	5.2		25.0	25	14	
1058	4233	Can. Ven	5.3		27.8	33	55	(5 H.)
1059	4235	8 Can. Ven ... β	4.5		28.0	42	01	
1060	4239	5 Draconis ... κ	3.5		28.4	70	27	
1061	4240	23 Comæ	4.7		28.9	23	17	
1062	4242	24 Comæ	4.3		29.1	19	02	
1063	4246	6 Draconis	4.7		29.7	70	42	
1064	4248	25 Comæ	5.5		31.0	17	45	
1065	4254	Virginis ... (250 B.)	5.9		32.3	2	31	
1066	....	Virginis ... R	6 var.		32.4	7	39	7, 2561 B.
1067	4260	26 Comæ	5.4		33.2	21	44	
1068	....	Can. Ven ... (44 B.)	5.9		33.4	36	38	12h, 683 W.
1069	4268	29 Virginis ... γ	2.8		35.6	−0	47	
1070	4274	31 Virginis ... δ^1	5.9		35.9	7	28	
1071	4271	30 Virginis ... ρ	5.1		35.8	10	54	
1072	4287	Can. Ven ... (60 B.)	5.4		39.5	46	05	
1073	4286	32 Virginis ... δ^2	5.9		39.6	8	20	
1074	4290	27 Comæ	5.1		40.7	17	14	
1075	....	Urs. Major ... (414 B.)	5.9		42.3	63	26	2913 Rad.
1076	4302	7 Draconis	5.3		42.6	67	27	
1077	4301	29 Comæ	5.9		42.9	14	47	
1078	....	Comæ ... (128 B.)	5.9		43.0	25	30	12h, 854 W.
1079	4303	11 Can. Ven	5.9		43.2	49	08	
1080	4305	Urs. Major ... (415 B.)	5.9		43.5	60	58	
1081	4311	Can. Ven	5.9		44.4	38	11	(6 H.)
1082	4315	31 Comæ	4.9		45.9	28	12	
1083	4328	35 Comæ	5.1		47.4	21	54	
1084	4329	41 Virginis	5.9		47.8	13	04	
1085	4339	Camelop ... f	5.4		48.2	84	04	(32 H.)
1086	4335	77 Urs. Major ... ε	1.9		48.7	56	37	
1087	4341	Can. Ven	5.5		49.5	47	51	
1088	4340	43 Virginis ... δ	3.1		49.6	4	03	
1089	....	70 Urs. Major	5.9		50.0	58	32	
1090	4346	12 Can. Ven ... α	3.1		50.4	38	58	
1091	4347	8 Draconis	4.9		50.7	66	06	
1092	4351	36 Comæ	4.7		53.0	18	04	
1093	4360	37 Comæ	5.1		54.5	31	26	
1094	....	Draconis	5.9		55.2	76	07	2950 Rad.
1095	4365	9 Draconis	5.5		55.3	67	15	
1096	4366	78 Urs. Major	4.9	12	55.6	57	01	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0. h.	m.	Declination, 1880.0. °	′	Various.
1097	4367	Virginis ....ε..	3.1	12	56.2	11	36	
1098	4371	Draconis...............(33 B.)..	5.9		57.0	64	16	
1099	....	Can Ven..............(87 B.)..	5.9	12	58.4	43	39	2955 Rad.
1100	4384	14 Can. Ven.......................	5.4	13	0.1	36	26	
1101	4389	Can. Ven ....(92 B.)..	5.9		0.5	45	55	
1102	4387	39 Comæ...........................	5.9		0.5	21	48	
1103	4388	40 Comæ...........................	5.5		0.6	23	16	
1104	....	Urs. Minor ....(7 B.)	5.9		1.1	73	40	2963 Rad.
1105	4393?	Comæ..............................	5.0		1.4	28	16	12h, 854 W.
1106	4392	Urs. Major ....(420 B.)..	5.9		1.7	62	42	2965 Rad.
1107	4407	44 Can. Ven ....(97 B.)..	5.9		4.1	38	05	
1108	4406	42 Comæ ....μ..	4.9		4.2	18	10	
1109	4421	43 Comæ ....β..	4.9		6.3	28	29	
1110	4423	Virginis ....(404 B.)..	5.9		6.6	12	12	
1111	4433	Can. Ven..........................	4.9		8.3	40	47	(11 H.)
1112	4438	19 Can. Ven.......................	5.9		10.2	41	30	
1113	4440	59 Virginis ....e..	5.9		10.8	10	03	
1114	4448	Virginis..............(485 B.)..	5.4		11.3	14	19	
1115	4446	60 Virginis ....σ..	5.1		11.5	6	06	
1116	4451	20 Can. Ven.......................	4.3		12.2	41	12	
1117	....	Draconis..........................	5.9		12.5	69	02	13510 A. Oe.
1118	4456	21 Can. Ven.......................	4.9		13.1	50	19	
1119	4467	23 Can. Ven.......................	5.4		15.0	40	18	
1120	4470	Virginis	5.5		15.6	2	43	F. 387.
1121	4479	Can. Ven..........................	5.9		18.5	37	39	(141 B.)
1122	4484	79 Urs. Major..................ζ..	1.9		19.1	55	33	
1123	....	Comæ..............................	5.4		19.4	24	28	(18 H.)
1124	4493	80 Urs. Major..................g..	4.9		20.4	55	37	
1125	....	Can. Ven ....(147 B.)..	5.9		21.1	46	39	3013 Rad.
1126	4499	70 Virginis	5.4		22.6	14	27	
1127	4506	Canis Min ....(9 B.)..	5.9		23.0	73	01	
1128	4510	Urs. Major........................	5.3		24.0	60	35	(69 H.)
1129	4527	Camelop...............(215 B.)..	5.9		26.1	79	15	
1130	4526	Comæ..............................	5.9		27.1	24	59	
1131	4529	78 Virginis	4.9		28.1	4	16	
1132	4532	79 Virginis ....ζ..	3.7		28.6	0	01	
1133	4536	Can. Ven..........................	5.1		29.4	37	48	(17 H.)
1134	4540	81 Urs. Major......................	5.9		29.6	55	58	
1135	4538	24 Can. Ven.......................	4.7		29.6	49	38	
1136	....	Comæ..............................	5.9		31.3	25	13	(20 H.)
1137	4552	25 Can. Ven.......................	5.2		32.1	36	54	
1138	....	D. M. 516..........................	5.9		33.1	77	10	
1139	4559	Bootis (or Virginis)	5.4		33.6	11	21	(1 H.)
1140	....	Urs. Minor ....(13 B.)..	5.5		34.4	71	51	3068 Rad.
1141	....	Can. Ven..........................	5.9		34.8	31	37	13h, 686 W.
1142	4564	82 Urs. Major......................	5.5		34.9	53	31	
1143	4562	1 Bootis	5.4		34.9	20	34	
1144	4566	2 Bootis	5.4		35.4	23	09	
1145	4568	83 Urs. Major	5.4		36.2	55	17	
1146	4570	84 Virginis ....o..	5.4		37.1	4	09	
1147	....	Can. Ven ....(194 B.)..	5.9		37.4	42	17	3074 Rad.
1148	4577	Draconis..........................	5.9		37.7	65	26	
1149	....	D. M. 2678..........................	5.9		41.1	39	06	
1150	4587	Can. Ven..........................	5.4		41.2	41	41	(20 H.)
1151	4594	3 Bootis	5.9		41.2	26	18	
1152	4597	4 Bootis ....τ..	4.5		41.6	18	03	
1153	....	Can. Ven..........................	5.4		41.8	39	10	(21 H.)
1154	....	D. M. 466..........................	5.5		42.1	78	40	
1155	4607	85 Urs. Major..................η..	1.9		42.8	49	55	
1156	4610	Can. Ven..........................	5.4		43.3	31	47	(F. 131.)
1157	4615	5 Bootis ....υ..	4.3	13	43.7	16	24	

List of stars for latitude-observations—Continued.

No.	A. B. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1158	4618	6 Bootis ....ε..	5.0	13 44.0	21 52	
1159	4628	Can. Ven........................	5.5	45.9	35 17	(23 H.)
1160	....	Draconis ....(44 B.)..	5.9	46.0	62 05	3103 Rad.
1161	....	D. M. 2496........................	5.4	46.5	35 02	
1162	4640	Bootis	5.9	47.7	29 15	T. 213.
1163	4646	10 Draconis ....i..	4.7	47.9	65 19	
1164	....	Draconis........................	5.9	48.1	68 54	46 B.
1165	4648	8 Bootis ....η..	3.4	49.0	19 00	
1166	4649	86 Urs. Major......................	5.9	49.5	54 19	
1167	4651	92 Virginis	5.5	50.4	1 38	
1168	4656	9 Bootis	4.9	51.1	28 05	
1169	4664	10 Bootis	5.4	53.0	22 17	
1170	....	Bootis.................(53 B.)..	5.9	55.4	9 29	25746 L. L.
1171	4672	93 Virginis ....τ..	4.3	55.6	2 07	
1172	....	Can. Ven........................	5.9	57.4	46 20	25839 L. L.
1173	4684	Bootis	5.9	13 58.6	51 34	D. M. 1889.
1174	4696	11 Draconis ....α..	3.5	14 1.1	64 57	
1175	4699	Bootis	5.3	3.1	44 25	(9 H.)
1176	4701	13 Bootis	5.4	3.7	50 02	
1177	4706	12 Bootis ....d..	4.7	4.9	25 40	
1178	....	Draconis........................	5.9	5.1	59 54	52 B.
1179	4713	Virginis	4.7	6.2	2 58	(42 H.)
1180	4724	15 Bootis	5.3	9.0	10 40	
1181	4726	Bootis ....x..	4.5	9.2	52 21	
1182	4733	4 Urs. Minor........................	4.9	9.3	78 07	
1183	4732	Urs. Minor........................	5.3	9.9	70 00	(3 H.)
1184	4729	16 Bootis ....α..	5.3	10.2	19 49	
1185	4741	19 Bootis ....λ..	4.2	11.8	46 38	
1186	4742	21 Bootis........................ι..	4.5	11.9	51 55	
1187	4747	Bootis ....A..	4.7	13.0	36 04	(16 H.)
1188	4748	102 Virginis ....υ..	4.9	13.4	− 1 42	
1189	4751	18 Bootis........................	5.4	13.5	13 34	
1190	4753	20 Bootis	5.3	14.1	16 51	
1191	4758	Bootis ....(149 B.)..	5.9	14.9	39 22	
1192	4766	Bootis........................	4.9	17.5	9 00	(18 H.)
1193	4773	Bootis (or Virginis)........(?)..	5.4	18.2	6 22	(19 H.)
1194	4789	23 Bootis ....θ..	4.2	21.1	52 24	
1195	4792	105 Virginis ....φ..	4.9	22.0	− 1 41	
1196	4804	24 Bootis ....g..	5.5	24.6	50 23	
1197	4808	25 Bootis ....ρ..	4.2	26.7	30 54	
1198	4810	26 Bootis	5.3	27.1	22 47	
1199	4812	27 Bootis ....γ..	2.8	27.2	38 50	
1200	4822	5 Urs. Minor........................	4.9	27.8	76 14	
1201	....	Draconis........................	5.7	28.8	55 56	14665 A. Oe.
1202	4823	28 Bootis ....σ..	5.0	29.5	30 16	
1203	....	F. 481........................	5.4	30.5	49 54	
1204	4841	Bootis ....(244 B.)..	5.9	33.7	44 10	
1205	4845	Bootis ....(256 B.)..	5.5	34.4	54 32	
1206	4843	33 Bootis	5.3	34.4	44 55	
1207	....	Bootis ....(248 B.)..	5.9	34.9	22 30	14h, 703 W.
1208	4847	29 Bootis* ....π..	3.8	35.1	16 56	
1209	4849	30 Bootis ....ξ..	3.7	35.4	14 15	
1210	4850	31 Bootis	5.4	35.8	8 41	
1211	4853	32 Bootis	5.3	36.0	12 09	
1212	4864	34 Bootis	5.5	38.2	27 03	
1213	4874	Draconis ....(59 B.)..	5.9	39.0	61 46	
1214	....	Virginis...............(718 B.)..	5.9	39.0	− 0 54	26869 L. L.
1215	4870	Bootis...............(274 B.)..	5.4	39.1	40 57	
1216	4873	35 Bootis ....o..	4.5	39.7	17 29	
1217	4876	36 Bootis........................ε..	2.6	39.8	27 35	
1218	4878	109 Virginis	4.2	14 40.2	2 24	

* Double star, smaller = + 0° 54′ − 1″.09 in Dec.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
1219	....	Bootis (279 B.)	5.4	14	40.5	15	39	14h, 178 P.
1220	4898	11 Lyræ	4.5		44.8	− 1	48	
1221	....	Bootis (296 B.)	5.5		44.9	24	25	14h, 945 W.
1222	4903	38 Bootis *h*	5.9		45.1	46	37	
1223	4907	39 Bootis	5.5		45.6	49	13	
1224	4906	Bootis	5.5		45.6	37	46	(34 H.)
1225	4905	37 Bootis * ξ	4.9		45.9	19	36	
1226	4918	Draconis (61 B.)	5.4		48.3	59	47	
1227	4936	7 Urs. Minor β	2.4		51.1	74	39	
1228	4931	1 Serpentis (48 B.)	5.9		51.4	0	19	
1229	4937	Bootis	5.9		52.4	50	06	F. 209.
1230	4943	40 Bootis	5.4		55.1	39	45	
1231	4949	Urs. Minor (or Draco)	4.5		55.7	66	25	(2 H.)
1232	4951	110 Virginis	4.6		56.8	2	34	
1233	4953	41 Bootis ω	4.6		56.9	25	29	
1234	4958	42 Bootis β	3.1		57.4	40	52	
1235	4961	Bootis	5.5		58.3	35	41	(39 H.)
1236	4982	Camelop (or Urs Min). (223 B.)	5.9		58.4	83	01	
1237	4967	Draconis (63 B.)	5.9		58.6	60	41	
1238	4969	43 Bootis ψ	4.6		59.3	27	25	
1239	4974	44 Bootis *i* *	4.5	14	59.8	48	07	
1240	4980	47 Bootis κ	5.4	15	1.5	48	38	
1241	4981	45 Bootis *c*	4.7		2.0	25	20	
1242	4989	Draconis (41 B.)	5.5		2.2	66	23	
1243	4992	Draconis	5.4		2.9	55	01	
1244	....	Bootis (384 B.)	5.7		6.6	19	26	15h, 106 W.
1245	5026	Bootis (390 B.)	5.9		9.0	38	42	
1246	5024	3 Serpentis	5.3		9.2	5	24	
1247	5031	48 Bootis χ	5.4		9.5	29	36	
1248	5030	4 Serpentis	5.7		9.7	0	49	
1249	5036	49 Bootis δ	3.1		10.7	33	46	
1250	5047	5 Serpentis	4.9		13.2	2	13	
1251	5058	Urs. Minor	5.1		13.3	67	48	(1 H.)
1252	....	D. M. 2052	5.9		14.2	46	03	
1253	5061	1 Coronæ *o*	5.9		15.3	30	02	
1254	....	Coronæ	5.9		15.9	25	24	3 B.
1255	5071	Draconis	5.4		16.5	52	25	
1256	5072	50 Bootis	5.4		17.0	33	21	
1257	5079	11 Urs. Minor	5.4		17.2	72	15	
1258	5076	Bootis (408 B.)	5.4		18.2	40	01	3369 Rad.
1259	5075	Coronæ η²	5.1		18.2	30	43	
1260	5084	51 Bootis μ	4.2		20.0	37	48	
1261	....	D. M. 2284	5.7		20.1	45	42	
1262	5085	9 Serpentis τ¹	4.7		20.2	15	51	
1263	....	Draconis	5.9		20.4	62	27	3380 Rad.
1264	5091	Draconis	5.9		20.6	63	47	
1265	5094	13 Urs. Minor γ	2.8		20.9	72	16	
1266	....	Bootis (410 B.)	5.9		21.7	34	45	15h, 81 P.
1267	5097	12 Draconis ι	3.1		21.8	59	23	
1268	....	Coronæ (13 B.)	5.9		22.5	25	31	15h, 83 P.
1269	5098	3 Coronæ β	4.2		22.9	29	31	
1270	....	D. M. 2227	5.4		24.9	47	38	
1271	5122	52 Bootis (or ψ Herculis)	4.5		26.6	41	14	
1272	5119	11 Serpentis A¹	5.9		26.8	− 0	46	
1273	5130	53 Bootis ν²	4.7		27.5	41	18	
1274	5131	4 Coronæ θ	5.4		28.1	31	46	
1275	5135	13 Serpentis† δ	3.5		29.1	10	57	
1276	5147	Draconis (75 B.)	5.5		29.4	64	35	
1277	5143	5 Coronæ α	1.9		29.6	27	07	
1278	5146	15 Serpentis ψ²	5.9		30.1	18	03	
1279	5155	8 Coronæ μ	4.9	15	30.9	39	25	

* Double, same size, = + 0s 11′ − 5″.9 in Dec.

† Double δ², same size, = 0s.03′ + 3″ in Dec.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1860.0. h.	m.	Declination, 1880.0. °	′	Various.
1280	5153	18 Serpentis .... τ^5	5.9	15	31.0	16	31	
1281	....	Draconis	5.9		32.1	54	20	3418 Rad.
1282	....	D. M. 1886	5.9		32.7	52	28	
1283	....	D. M. 1766	5.9		32.9	55	01	
1284	5168	Bootis .... ϕ	4.9		33.5	40	45	
1285	....	Draconis	5.9		34.4	54	55	3426 Rad.
1286	5177	Bootis	5.4		34.5	47	12	F. 270.
1287	5178	7 Coronæ .... ζ	4.4		34.9	37	02	
1288	5191	15 Urs. Minor .... θ	4.9		35.0	77	45	
1289	5181	Draco (or Bootis)	5.9		35.0	50	48	
1290	5180	Serpentis .... τ^6	5.9		35.5	16	26	
1291	5185	20 Serpentis .... χ	5.4		36.1	13	14	
1292	5187	Serpentis .... ι	4.5		36.2	20	03	
1293	5189	22 Serpentis .... τ^7	5.9		36.5	18	52	
1294	....	Urs. Minor	5.9		37.4	69	40	15584 A. Oe.
1295	5192	8 Coronæ .... γ	4.2		37.7	26	41	
1296	5196	24 Serpentis .... α	2.5		38.4	6	48	
1297	5210	Draconis	4.9		39.6	52	45	
1298	5206	25 Serpentis .... A^2	5.4		39.9	−1	26	
1299	5214	27 Serpentis .... λ	4.9		40.6	7	44	
1300	5216	28 Serpentis .... β	3.5		40.7	15	48	
1301	5223	31 Serpentis .... υ	5.9		41.7	14	30	
1302	5234	Serpentis .... κ	5.9		43.3	18	31	
1303	5236	Coronæ .... (50 B.)	4.9		43.6	28	31	
1304	5238	34 Serpentis .... ω	5.5 var.		44.2	2	33	
1305	5248	Draconis	5.9		44.6	55	44	
1306	5244	10 Coronæ .... δ	4.5		44.6	26	26	
1307	5245	37 Serpentis .... ϵ	3.7		44.8	4	50	
1308	5249	Draconis	5.5		44.9	62	58	12 H.
1309	....	Draconis .... (82 B.)	5.9		45.2	59	57	3459 Rad.
1310	5252	38 Serpentis .... ρ	4.9		46.0	21	20	
1311	5259	11 Coronæ .... κ	4.9		46.7	36	02	
1312	5271	1 Herculis .... χ	4.3		48.6	42	47	
1313	5285	Urs. Minor .... ζ	4.6		50.7	78	10	
1314	5287	2 Herculis	5.4		50.7	43	30	
1315	5284	41 Serpentis .... γ	3.8		50.9	16	03	
1316	5295	12 Coronæ .... λ	5.4		51.4	38	18	
1317	5298	4 Herculis	5.9		51.5	42	54	
1318	5293	Serpentis .... ϕ	5.9		51.7	14	46	
1319	5302	13 Coronæ .... ϵ	4.2		52.6	27	14	
1320	5310	Coronæ .... (68 B.)	5.5		54.5	36	58	
1321	5313	Draconis	5.0		55.0	55	05	
1322	5316	Bootis	5.9		55.7	50	15	D. M. 2239.
1323	5315	5 Herculis .... τ	4.9		55.9	18	09	
1324	5319	15 Coronæ .... ρ	5.4		56.5	33	40	
1325	5321	14 Coronæ .... ι	4.9		56.7	30	11	
1326	5322	44 Serpentis .... π	4.5		57.1	23	08	
1327	5341	Draconis	5.9		59.0	53	15	
1328	5338	6 Herculis .... ν	4.2		59.1	46	22	
1329	5348	13 Draconis .... θ	3.7	15	59.7	58	53	
1330	5367	7 Herculis .... k	5.4	16	2.7	17	22	
1331	5385	16 Coronæ .... τ	4.9		4.6	36	47	
1332	5388	11 Herculis .... ϕ	3.8		5.9	45	15	
1333	5406	Draconis .... (87 B.)	5.9		6.0	68	06	
1334	5399	10 Herculis	5.9		6.5	23	49	
1335	5405	9 Herculis	5.5		7.3	5	20	
1336	....	Urs. Minor	5.9		7.6	77	07	3594 Rad.
1337	....	Herculis	5.9		7.9	39	21	31 B.
1338	5426	16 Herculis	5.9		10.2	19	08	
1339	5432	17 Coronæ	5.4		10.2	34	10	
1340	5440	18 Coronæ	5.4	16	11.9	29	27	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination. 1880.0.		Various.
				h.	m.	°	′	
1341	5462	19 Urs. Minor	5.9	16	14.2	76	11	
1342	5459	Draconis (92 B.)	5.2		15.3	60	04	
1343	5460	Herculis (49 B.)	5.4		15.7	39	58	
1344	5456	50 Serpentis σ	4.9		16.0	1	19	
1345	5463	22 Herculis τ	3.7		16.1	46	36	
1346	5466	20 Herculis γ	3.1		16.6	19	26	
1347	5473	19 Coronæ ξ	5.0		17.4	31	10	
1348	5479	20 Coronæ ν^1	5.1		17.8	34	05	
1349	5480	21 Coronæ ν^2	5.3		18.0	33	59	
1350	5481	21 Herculis o	5.9		18.4	7	13	
1351	5490	24 Herculis ω	5.1		19.9	14	19	
1352	5511	21 Urs. Minor η	5.2		21.0	76	02	
1353	5496	25 Herculis	5.5		21.1	37	40	
1354	5502	Draconis (98 B.)	5.4		21.8	55	29	
1355	5514	Draconis (102 B.)	5.4		22.2	69	24	
1356	5512	14 Draconis* η	2.7		22.4	61	47	
1357	....	Ophiuchi (21 B.)	5.9		22.5	0	55	16^h, 391 W.
1358	5523	30 Herculis g	4.7		24.7	42	09	
1359	5520	10 Ophiuchi λ	4.2		24.9	2	15	
1360	5525	37 Herculis β	2.7		25.1	21	45	
1361	5527	Herculis s	5.9		25.4	20	45	F. 492.
1362	5531	28 Herculis n	5.7		26.7	5	46	
1363	5535	34 Herculis	5.5		26.8	49	14	
1364	5532	29 Herculis h	5.1		27.0	11	45	
1365	5545	15 Draconis A	5.1		28.2	69	02	
1366	....	Herculis (Σ 2063)	5.4		28.3	45	53	16^h, 810 W.
1367	5552	35 Herculis σ	4.2		30.2	42	42	
1368	5560	Draconis (106 B.)	5.9		30.7	61	05	
1369	5563	Herculis	5.9		32.3	13	56	107 B.
1370	5592	Urs. Minor	5.4		32.4	79	13	
1371	5568	Herculis	5.9		32.8	46	52	
1372	5574	16 Draconis	5.2		33.4	53	08	
1373	5575	17 Draconis	4.9		33.4	53	10	
1374	5587	Herculis (121 B.)	5.9		35.3	12	39	
1375	5596	42 Herculis	4.9		35.5	49	20	
1376	5599	Draconis (110 B.)	5.2		35.6	56	15	
1377	5597	Herculis (125 B.)	5.9		36.0	25	05	
1378	5604	40 Herculis ζ	3.1		36.8	31	49	
1379	5602	39 Herculis	5.9		36.8	27	09	
1380	5617	44 Herculis η	3.1		38.8	39	09	
1381	5619	Herculis (138 B.)	5.9		39.4	34	16	
1382	5628	18 Draconis g	5.1		40.1	64	49	
1383	5621	43 Herculis i	5.4		40.1	8	48	
1384	....	Herculis	5.9		41.4	43	26	16^h, 1289 W.
1385	5631	45 Herculis l	5.3		41.9	5	34	
1386	....	Herculis	5.7		42.6	13	48	142 B.
1387	5643	Draconis (114 B.)	4.9		43.0	57	00	
1388	5647	Herculis	5.4		44.0	13	29	F. 294.
1389	5648	47 Herculis k	5.9		44.5	7	28	
1390	5659	21 Ophiuchi	5.9		45.3	1	25	
1391	5667	52 Herculis	4.9		45.7	46	12	
1392	5677	51 Herculis	5.3		46.8	24	52	
1393	5692	35 Ophiuchi ι	4.2		48.3	10	22	
1394	5705	Urs. Minor	5.9		48.4	77	42	
1395	....	Herculis (174 B.)	5.9		49.7	21	11	16^h, 1513 W.
1396	5702	54 Herculis	4.7		50.1	18	38	
1397	5708	27 Ophiuchi κ	3.1		52.0	9	34	
1398	5740	19 Draconis h	5.3		55.4	65	19	
1399	5731	58 Herculis ε	3.7		55.7	31	06	
1400	....	Herculis (191 B.)	5.6		55.9	22	49	16^h, 1688 W.
1401	5759	Draconis (124 B.)	5.9	16	57.2	56	52	

*Double. $2d = +0^s.4$.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1402	5747	59 Herculis .... *d* ..	5.0	16 57.2	33 45	
1403	....	Herculis .... (200 B.) ..	5.9	57.4	25 41	16h, 1725 W.
1404	5749	Herculis	4.7	57.6	14 18	
1405	5780	Urs. Minor .... *e* ..	4.2	58.3	82 14	
1406	5769	Urs. Minor	5.9	58.6	73 17	
1407	5760	Ophiuchi .... (120 B.?) ..	5.5	59.3	− 0 43	
1408	....	Herculis .... (251 B.) ..	5.9	59.3	19 46	16h, 1791 W.
1409	5765	60 Herculis	4.5	16 59.8	12 54	
1410	....	93 Herculis .... (212 B.) ..	5.9	17 1.2	22 15	16h, 1844 W.
1411	5776	95 Herculis	5.5	1.7	48 59	
1412	5785	Draconis .... *μ* ..	4.7	2.8	54 38	
1413	5788	Herculis .... *c* ..	5.4	3.8	36 06	
1414	5811	Urs. Major .... (77 B.) ..	5.5	5.5	75 27	
1415	....	Herculis .... (228 B.) ..	5.1	5.7	40 56	17h, 114 W.
1416	5802	37 Ophiuchi	5.5	6.8	10 44	
1417	....	Draconis	5.9	7.9	52 33	31378 L. L.
1418	5823	22 Draconis .... *ζ* ..	3.1	8.4	65 52	
1419	5821	64 Herculis* .... *α* ..	3.1	9.2	14 32	
1420	5828	Herculis .... *δ* ..	var. 3.1	10.1	24 59	
1421	....	Ophiuchi	5.4	10.5	1 21	17h, 143 W².
1422	5830	41 Ophiuchi	4.3	10.5	− 0 18	
1423	5834	Herculis .... *π* ..	3.1	10.9	36 57	
1424	5840	Draconis .... (131 B.) ..	5.5	11.6	63 01	
1425	....	Herculis .... (245 B.) ..	5.9	12.8	17 27	17h, 308 W.
1426	5842	68 Herculis .... *μ* ..	4.9	12.9	33 14	
1427	5841	Ophiuchi .... *e* ..	4.9	13.0	11 00	
1428	5847	69 Herculis .... *e* ..	4.6	13.5	37 25	
1429	....	Herculis .... (252 B.) ..	5.5	14.1	28 56	31545 L. L.
1430	....	Herculis .... (258 B.) ..	5.9	14.4	38 56	17h, 377 W.
1431	5856?	Herculis .... (256 B.) ..	5.4	15.0	18 13	
1432	....	Herculis .... (259 B.) ..	5.9	15.3	25 39	17h, 405 W.
1433	5860	70 Herculis	5.9	16.0	24 36	
1434	5863	72 Herculis .... *w* ..	5.4	16.2	32 38	
1435	5871	74 Herculis	5.4	17.1	46 21	
1436	5874	Herculis .... (271 B.) ..	5.1	17.9	40 05	
1437	5883	73 Herculis	5.5	19.1	23 05	
1438	....	Ophiuchi .... (201 B.) ..	5.4	19.1	16 26	17h, 516 W.
1439	....	Draconis	5.9	19.2	53 32	1937 B.
1440	5886	75 Herculis	4.2	19.6	37 16	
1441	5893	49 Ophiuchi	4.2	20.6	4 15	
1442	5900	Herculis .... (27[illegible] B.)	5.4	21.6	20 12	
1443	5903	Ophiuchi .... (214 B.) ..	5.4	22.7	0 27	
1444	5911	77 Herculis .... *x* ..	5.9	23.6	48 23	
1445	5917	Draconis	5.4	24.2	60 09	
1446	5910	Ophiuchi .... ([illegible]21 B.) ..	5.3	24.2	− 0 57	
1447	5918	Draconis	5.9	24.3	58 46	
1448	5919	Ophiuchi .... (225 B.) ..	5.4	25.3	2 50	
1449	5922	76 Herculis .... *λ* ..	4.9	25.9	26 12	
1450	5927	Herculis	5.5	26.4	31 15	F. 429.
1451	5931	78 Herculis	5.4	27.1	28 29	
1452	5937	23 Draconis .... *β* ..	3.1	27.7	52 23	
1453	....	Herculis .... (295 B.) ..	4.9	28.1	19 21	17h, 613 W.
1454	....	Ophiuchi .... (238 B.) ..	4.9	28.3	16 26	30015 L. L.
1455	5944	Herculis .... (297 B.) ..	5.4	29.3	41 20	
1456	5941	55 Ophiuchi .... *α* ..	1.9	29.4	12 39	
1457	5950	24 Draconis .... ν^1 ..	5.1	29.8	55 16	
1458	5951	25 Draconis .... ν^2 ..	5.1	29.9	55 15	
1459	....	Herculis .... (299 B.) ..	5.9	30.9	21 05	17h, 911 W.
1460	5962	Herculis .... (306 B.) ..	5.9	32.0	30 52	
1461	5972	27 Draconis .... *f* ..	5.4	32.5	68 13	
1462	5967	79 Herculis	5.9	17 32.6	24 23	

* Double. α^2 = 8th mag. + $0^s.3$.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
1463	5975	82 Herculis .... γ	5.9	17	33.5	48	40	
1464	5978	26 Draconis	5.9		33.8	61	58	
1465	....	Ophiuchi .... (263 B.)	5.9		35.7	15	14	17h, 1110 W.
1466	5990	85 Herculis .... ι	4.2		36.1	46	04	
1467	5591	74 Ophiuchi .... (267 B.)	5.0		36.6	16	02	
1468	5999	83 Herculis	5.9		37.6	24	38	
1469	5996	69 Ophiuchi .... β	3.1		37.6	4	37	
1470	6006	28 Draconis .... ω	4.7		37.7	68	49	
1471	....	Ophiuchi .... (271 B.?)	5.9		37.9	14	21	
1472	....	Draconis	5.9		38.6	51	53	32455 L. L.
1473	....	Ophiuchi .... (275 B.)	5.9		38.8	14	28	32408 L. L.
1474	....	D. M. 800	5.9		39.4	72	31	
1475	....	Draconis	5.4		41.6	53	50	32566 L. L.
1476	6021	86 Herculis .... μ	3.7		41.8	27	48	
1477	....	Herculis .... (332 B.)	5.4		41.8	17	47	17h, 1324 W.
1478	....	Herculis .... (336 B.)	5.9		41.9	38	56	17h, 1334 W.
1479	6020	62 Ophiuchi .... γ	3.7		41.9	2	45	
1480	....	Herculis .... (337 B.)	5.9		42.0	39	22	17h, 1342 W.
1481	....	Herculis	5.5		43.3	20	36	20h, 3576 W.
1482	6030	Herculis .... (339 B.)	5.9		43.6	19	17	
1483	6033	87 Herculis	5.4		44.0	25	40	
1484	6047	31 Draconis .... ε	4.7		44.1	72	12	
1485	....	Herculis .... (349 B.)	5.9		45.7	29	22	17h, 1438 W.
1486	6052	30 Draconis	4.9		46.2	50	50	
1487	....	Ophiuchi .... (297 B.)	5.9		46.5	1	21	
1488	....	Ophiuchi	5.7		47.4	6	07	32707 L. L.
1489	6068	90 Herculis .... f	4.9		49.5	40	02	
1490	6069	Ophiuchi	5.5		50.2	0	42	
1491	6073	89 Herculis	5.4		50.6	26	05	
1492	....	Herculis	4.9		50.8	22	28	15h, 1591 W
1493	6079	32 Draconis .... ξ	3.7		51.5	56	54	
1494	6082	91 Herculis .... θ	3.8		52.1	37	16	
1495	6084	92 Herculis .... ξ	4.2		53.1	29	16	
1496	6091	33 Draconis .... γ	2.5		53.8	51	30	
1497	6087	94 Herculis .... ν	4.5		53.9	30	12	
1498	6089	66 Ophiuchi	5.3		54.3	4	23	
1499	....	Herculis	5.9		54.5	36	17	17h, 1719 W.
1500	6094	93 Herculis	4.7		54.7	16	46	
1501	6092	67 Ophiuchi	4.2		54.7	2	56	
1502	6114	35 Draconis	5.1		54.8	76	59	
1503	6101	68 Ophiuchi	4.5		55.7	1	18	
1504	....	Herculis .... (387 B.)	5.4		56.2	33	13	17h, 1764 W.
1505	6106	95 Herculis	4.3		56.5	21	37	
1506	6109	Herculis .... (391 B.)	5.9		56.6	45	31	
1507	....	D. M. 3009	5.9		57.2	33	20	
1508	6110	96 Herculis	5.1		57.3	20	50	
1509	6122	34 Draconis .... ψ²	5.9		57.4	72	00	
1510	6123	70 Ophiuchi*	4.2	17	59.4	2	32	
1511	6134	98 Herculis	5.1	18	1.0	22	12	
1512	....	Herculis .... (404 B.)	5.9		1.4	32	14	17h, 1941 W.
1513	6142	71 Ophiuchi	4.9		1.6	8	43	
1514	6143	72 Ophiuchi	3.5		1.7	9	33	
1515	6147	99 Herculis .... b	4.9		2.5	30	33	
1516	6150	103 Herculis .... o	3.9		2.9	28	45	
1517	6151	100 Herculis	5.7		3.0	26	05	
1518	6157	102 Herculis	4.3		3.6	20	49	
1519	6159	101 Herculis	5.4		3.7	20	03	
1520	....	Herculis	5.7		3.9	36	23	18h, 76 W.
1521	6162	Herculis	5.1		4.0	43	27	
1522	....	D. M. 3620	5.9		4.7	3	18	
1523	....	Herculis .... (417 B.)	5.9	18	4.8	16	27	33412 L. L.

* Double. 2d = 0s 3; — 3″ in Dec.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magni-tude.	Right ascen-sion, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1524	....	Herculis ....(425 B.)..	5.9	18 5.8	36 26	18h, 137 W.
1525	6178	104 Herculis ....A..	4.9	7.4	31 22	
1526	6185	Draconis ....(157 B.)..	5.9	8.1	54 15	
1527	....	Lyræ..................(2 B.)..	5.5	8.9	41 08	33612 L. L.
1528	6193	Lyræ..................(3 B)..	5.9	9.1	38 46	
1529	....	Urs. Major.................δ..	4.5	11.0	86 37	
1530	6203	Lyræ..................(5 B.)..	5.4	11.9	42 08	
1531	6224	36 Draconis........................	4.9	13.2	64 21	
1532	6218	Lyræ..................(8 B.)..	5.9	13.3	40 53	
1533	6213	Ophiuchi........................	5.5	13.4	7 13	
1534	6223	105 Herculis........................	5.4	14.3	24 24	
1535	6227	74 Ophiuchi........................	5.4	15.0	3 20	
1536	6231	106 Herculis........................	5.9	15.2	21 55	
1537	....	24 Urs. Minor........................	5.9	15.5	86 59	
1538	6235	1 Lyræ ....κ¹..	4.6	15.7	36 01	
1539	6243	37 Draconis........................	5.9	16.1	68 42	
1540	6237	108 Herculis........................	5.4	16.3	29 48	
1541	6238	107 Herculis ....ι..	4.7	16.3	18 49	
1542	....	Ophiuchi........................	5.9	17.0	11 59	33895 L. L.
1543	6245	Herculis............(447 B.)..	5.1	17.5	17 46	
1544	6255	Draconis ....(168 B.)..	5.0	18.5	49 04	
1545	6251	109 Herculis........................	4.5	18.6	21 43	
1546	....	Ophiuchi........................	5.5	19.9	7 58	34062 L. L
1547	6268	2 Lyræ ....μ..	5.0	20.3	39 27	
1548	6269	59 Serpentis ....d..	5.3	21.1	0 08	
1549	6289	39 Draconis..................b..	4.7	22.2	58 44	
1550	6297	43 Draconis ....φ..	4.6	22.5	71 16	
1551	6302	44 Draconis ....χ..	3.8	23.2	72 41	
1552	6300	Herculis ....(460 B.)..	5.9	24.6	23 47	
1553	6316	42 Draconis........................	4.9	25.6	65 29	
1554	....	Herculis............(462 B.)..	5.4	25.7	16 51	18h, 703 W.
1555	6322	Herculis............(464 B.)..	5.9	27.8	23 32	
1556	....	Lyræ..................(28 B.)..	5.4	28.3	30 28	18h, 794 W.
1557	6348	45 Draconis ....d..	5.2	30.5	56 57	
1558	6341	Herculis........................	5.9	30.5	23 02	
1559	....	Ophiuchi........................	5.3	30.7	9 02	18h, 710 W.
1560	....	Ophiuchi........................	5.5	30.8	6 34	34486 L. L.
1561	6350	Draconis ....(190 B.)..	5.4	31.2	52 15	
1562	....	Serpentis..........(196 B.), e..	5.4	31.4	− 0 25	34499 L. L.
1563	....	Lyræ..................(38 B.)..	5.5	32.2	33 22	18h, 934 W.
1564	6355	3 Lyræ ....a..	5.3	32.9	38 40	
1565	....	Lyræ..................(42 B.)..	5.9	33.1	43 08	3995 Rad.
1566	....	Draconis........................	5.9	35.8	65 22	34817 L. L.
1567	....	Draconis........................	5.4	36.5	62 25	18518 A. Oe.
1568	6372	Draconis ....(193 B.)..	5.4	37.2	52 05	
1569	6379	4 Aquilæ........................	4.9	38.8	1 56	
1570	....	Lyræ..................(53 B.)..	5.4	39.4	31 49	34853 L. L.
1571	6368	46 Draconis.................. c..	5.3	40.3	55 25	
1572	6390	4 Lyræ......................ε¹..	4.3	40.4	39 33	
1573	6391	5 Lyræ......................ε²..	4.5	40.4	39 29	
1574	6387	110 Herculis........................	4.2	40.5	20 26	
1575	6392	6 Lyræ......................ζ¹..	4.4	40.6	37 29	
1576	6394	7 Lyræ......................ζ²..	5.4	40.7	37 28	
1577	....	D. M. 2126........................	5.9	40.9	53 45	
1578	....	Lyræ..................(63 B.)..	4.7	41.2	26 32	18h, 1218 W.
1579	6397	111 Herculis........................	4.2	41.7	18 03	
1580	6404	Lyræ..................(65 B.)..	5.9	42.3	41 19	
1581	....	161 Draconis........................	5.9	42.5	54 46	18618 A. Oe.
1582	6410	Draconis ....(203 B.)..	5.9	43.0	60 55	
1583	....	Lyræ..................(67 B.)..	5.9	43.5	31 38	35045 L. L.
1584	....	Lyræ	5.9	18 44.3	24 54	68 B.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1585	6428	Draconis .... (206 B.)	5.9	18 45.1	48 57	
1586	6427	9 Lyræ .... ν²	5.4	45.4	32 25	
1587	6429	10 Lyræ .... β	2.8 var.	45.7	33 13	
1588	....	Aquilæ .... (10 B.)	5.7	46.5	13 50	35150 L. L.
1589	6438	112 Herculis	5.4	47.1	21 17	
1590	....	F. 85	5.3	48.8	73 57	
1591	6452	Draconis .... (209 B.)	5.4	48.9	52 49	
1592	6463	47 Draconis .... o	4.3	49.4	59 14	
1593	6451	62 Serpentis	5.5	49.6	6 28	
1594	6453	113 Herculis	4.9	49.7	22 30	
1595	6478	50 Draconis	5.6	50.2	75 17	
1596	6460	63 Serpentis .... θ	4.2	50.2	4 03	
1597	6470	Draconis .... (213 B.)	5.1	50.3	50 34	
1598	6466	12 Lyræ .... δ²	4.5	50.3	36 45	
1599	....	Herculis .... (493 B.)	5.7	50.8	17 58	18h, 1526 W.
1600	6473	Lyræ .... (92 B.)	5.4	51.0	41 27	
1601	6471	64 Serpentis	5.5	51.2	2 23	
1602	6476	Draconis .... (214 B.)	5.4	51.7	48 43	
1603	6475	13 Lyræ	4.9 var.	51.7	43 47	
1604	....	Aquilæ .... (18 B.)	5.5	52.9	17 12	35421 L. L.
1605	....	Herculis	5.5	53.5	19 38	494 B.
1606	6483	11 Aquilæ	5.3	53.6	13 28	
1607	6487	13 Aquilæ .... ε	3.9	54.2	14 54	
1608	6491	14 Lyræ .... γ	3.4	54.5	32 32	
1609	6496	48 Draconis	5.5	54.7	57 39	
1610	....	Lyræ .... (102 B.)	5.5	54.9	26 04	18h, 1670 W.
1611	6497	15 Lyræ .... λ	5.5	55.5	31 59	
1612	6510	52 Draconis .... υ	5.3	55.9	71 08	
1613	....	Draconis	5.4	56.0	65 07	18836 A. Oe.
1614	....	D. M. 4022	5.9	56.2	20 40	
1615	....	Draconis	4.7	57.2	50 22	35681 L. L.
1616	....	Aquilæ .... (30 B.)	5.9	57.5	1 38	35598 L. L.
1617	....	D. M. 3888	5.9	57.7	19 29	
1618	6520	16 Lyræ	5.4	58.0	46 47	
1619	6522	49 Draconis	5.4	58.4	55 29	
1620	6528	17 Aquilæ .... ζ	3.1	18 59.9	13 41	
1621	6534	50 Lyræ .... (122 B.)	5.9	19 0.4	31 34	
1622	6543	18 Aquilæ	5.1	1.3	10 53	
1623	6542	Vulpe .... (2 B.)	5.3	1.6	24 04	
1624	....	Aquilæ .... (47 B.)	5.4	1.6	16 41	35851 L. L.
1625	6547	Lyræ .... (125 B.)	5.4	1.9	28 26	
1626	6551	51 Draconis	5.2	2.2	53 14	
1627	6553	17 Lyræ	5.9	2.9	32 18	
1628	6556	18 Lyræ .... ι	5.1	3.0	35 55	
1629	....	D. M. 572	5.9	6.6	82 12	
1630	6571	19 Lyræ	5.9	7.2	31 05	34853 L. L.
1631	6574	Herculis (or Vulpe)	5.9	7.5	21 21	(F. 273.)
1632	6572	21 Aquilæ	5.4	7.7	2 05	
1633	6583	53 Draconis	5.4	9.4	56 39	
1634	6581	20 Lyræ .... η	4.5	9.7	38 56	
1635	6582	Vulpe	5.9	9.8	20 00	9 B.
1636	6589?	1 Vulpe (or Sagittæ)	5.9	10.1	21 01	
1637	6585	22 Aquilæ	5.4	10.6	4 38	
1638	....	Lyræ .... (145 B.)	5.5	10.8	30 19	36282 L. L.
1639	....	Aquilæ .... (71 B.)	5.7	11.0	14 20	
1640	6602	2 Vulpe	4.6	11.1	21 11	
1641	6601	54 Draconis	5.2	11.8	57 30	
1642	6599	21 Lyræ .... θ	4.6	12.2	37 55	
1643	6595	25 Aquilæ .... ω	5.3	12.2	11 23	
1644	6597	23 Aquilæ	4.9	12.4	0 52	
1645	6612	57 Draconis .... δ	3.5	19 12.5	67 27	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1646	....	Aquilæ	5.9	19 13.2	9 24	80 B.
1647	6625	59 Draconis..........................	5.4	13.5	76 21	
1648	6615	28 Aquilæ ....A..	5.4	14.0	12 09	
1649	6623	1 Cygni......................κ..	4.5	14.3	53 09	
1650	6618	27 Aquilæ ....d..	5.3	14.4	— 1 07	
1651	....	Aquilæ..............(88 B.)..	4.9	16.2	— 0 30	36489 L. L.
1652	6650	60 Draconis......................τ..	4.3	17.9	73 08	
1653	6637	3 Vulpe..........................	5.4	17.9	26 02	
1654	6640	Draconis ....(245 B.)..	5.9	18.1	57 25	
1655	6642	2 Sagittæ	5.5	19.0	16 43	
1656	6644	31 Aquilæ ....b..	5.4	19.3	11 41	
1657	6648	2 Cygni	5.2	19.4	29 23	
1658	6646	30 Aquilæ ....δ..	3, 4	19.5	2 53	
1659	6662	Draconis ....π..	5.3	20.1	65 29	
1660	6656	Lyræ..................(170 B.)..	5.4	20.2	43 09	
1661	6654	4 Vulpe	4.9	20.2	19 34	
1662	6653	32 Aquilæ ....ν..	4.9	20.4	0 06	
1663	....	Aquilæ..............(106 B.)..	5.9	20.8	12 48	36715 L. L.
1664	6667	4 Cygni..........................	4.0	21.8	36 05	
1665	....	Aquilæ	5.9	22.0	14 02	36781 L. L.
1666	6674	6 Vulpe ....α..	4.3	23.7	24 25	
1667	....	Aquilæ..............(115 B.)..	5.9	23.9	14 21	36867 L. L.
1668	6690	6 Cygni ....β..	3.1	25.9	27 43	
1669	6687	7 Cygni......................ι..	4.2	26.7	51 28	
1670	6698	8 Cygni..........................	4.5	27.4	34 12	
1671	....	Cygni..........................	5.9	28.2	50 03	19337 A. Oe.
1672	6701	38 Aquilæ......................μ..	4.7	28.2	7 08	
1673	6709	9 Vulpe	5.5	29.3	19 31	
1674	....	133 Aquilæ	5.9	30.0	15 21	
1675	6714	9 Cygni..........................	5.5	30.1	29 12	
1676	....	Cephei..........................	5.9	30.2	83 14	3268 Rad.
1677	6715	41 Aquilæ ....ι..	4.3	30.5	— 1 33	
1678	6718	Cygni..........................	5.5	30.8	42 08	(F. 423.)
1679	6723	Cygni ....(47 B.)..	5.9	31.2	50 59	
1680	6722	11 Cygni..........................	5.9	31.5	36 41	
1681	6724	4 Sagittæ ....ε..	5.1	31.9	16 12	
1682	6735	61 Draconis......................σ..	4.9	32.6	69 27	
1683	6731	Cygni ....(54 B.)..	5.3	32.9	44 26	
1684	6734	13 Cygni......................θ..	4.7	33.2	49 57	
1685	6740	12 Cygni ....φ..	5.2	34.6	29 53	
1686	6736	45 Aquilæ	5.5	34.6	— 0 54	
1687	6739	5 Sagittæ......................α..	4.4	34.7	17 44	
1688	....	Aquilæ..............(150 B.)..	5.5	35.5	13 33	19h, 884 W2.
1689	6745	14 Cygni..........................	5.9	35.6	42 32	
1690	6744	6 Sagittæ......................β..	4.4	35.7	17 12	
1691	6748	Cygni ....(65 B.)..	5.6	36.1	54 41	
1692	6749	47 Aquilæ......................χ..	5.4	36.9	11 32	
1693	6754	Cygni ....(66 B.)..	5.4	37.2	45 14	
1694	....	Cygni ....(67 B.)..	5.9	38.1	32 09	37527 L. L.
1695	6758	10 Vulpe	5.5	38.7	25 29	
1696	6759	48 Aquilæ......................ψ..	5.9	39.0	13 01	
1697	6769	Cygni ....(76 B.)..	5.9	39.8	41 29	
1698	6767	49 Aquilæ......................υ..	5.9	39.8	7 19	
1699	6771	15 Cygni..........................	5.3	40.0	37 04	
1700	6772	50 Aquilæ......................γ..	3.1	40.6	10 19	
1701	6779	18 Cygni......................δ..	3.1	41.2	44 50	
1702	6784	17 Cygni ....χ..	3.2	41.9	33 27	
1703	6783	7 Sagittæ ....δ..	4.2	42.1	18 14	
1704	6789	52 Aquilæ......................π..	5.5	43.2	11 31	
1705	6794	8 Sagittæ......................ζ..	4.9	43.7	18 51	
1706	6802	53 Aquilæ ....α..	1.1	19 43.9	8 33	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
1707	6799	Cygni........................	5.5	19	44.0	47	38	
1708	6805	54 Aquilæ....................o..	5.4		45.3	10	07	
1709	6810	12 Vulpe........................	5.4		45.9	22	18	
1710	6800?	Cygni........................	6 var.		46.0	32	37	
1711	6813	19 Cygni........................	5.4		46.4	38	25	
1712	6811	55 Aquilæ....................η..	3.8 var.		46.4	0	42	
1713	6817	Cygni................(91 B.)..	5.4		46.5	40	18	
1714	....	Vulpe........................	5.4		47.0	24	41	19h, 1501 W.
1715	6824	20 Cygni....................d..	5.3		47.6	52	41	
1716	....	Cygni........................	5.5		48.4	46	43	19720 A. Oe.
1717	6827	13 Vulpe........................	4.5		48.4	23	46	
1718	6825	59 Aquilæ....................ξ..	5.1		48.5	8	09	
1719	6836	63 Draconis..................e*..	3.8		48.6	69	57	
1720	6826	58 Aquilæ........................	5.9		48.6	− 0	02	
1721	6830	Cygni................(99 B.)..	5.5		48.7	47	39	
1722	....	Vulpe........................	5.7		49.4	24	00	(F. 22.)
1723	6833	60 Aquilæ....................β..	4.2		49.4	6	06	
1724	....	Cygni................(104 B.)..	5.9		50.4	36	41	38039 L. L.
1725	6838	61 Aquilæ....................φ..	5.4		50.4	11	06	
1726	6839	10 Sagittæ........................	5.1		50.6	16	19	
1727	6847	23 Cygni........................	5.2		50.8	57	12	
1728	6852	Cygni (or Draco)..............	5.5		51.4	59	23	
1729	6849	22 Cygni........................	5.4		51.6	38	10	
1730	6851	21 Cygni....................η..	4.3		51.8	34	46	
1731	6853	11 Sagittæ........................	5.5		52.3	16	29	
1732	6856	24 Cygni....................ψ..	5.4		52.6	52	07	
1733	6857	Cygni................(113 B.)..	5.5		53.1	40	03	
1734	6858	12 Sagittæ....................γ..	3.8		53.4	19	10	
1735	6867	Cygni (or Cephei)..............	5.0		53.6	58	32	
1736	....	Cygni........................	5.5		53.9	30	39	19h, 1739 W.
1737	6866	14 Vulpe........................	5.7		54.0	22	40	
1738	6868	13 Sagittæ........................	5.8		54.6	17	11	
1739	6876	Cygni................(120 B.)..	5.5		55.5	45	27	
1740	6875	25 Cygni........................	5.5		55.5	36	43	
1741	6879	15 Vulpe........................	4.9		56.2	27	26	
1742	6883	16 Vulpe........................	5.4		56.9	24	36	
1743	6895	26 Cygni....................e..	5.0		58.0	49	46	
1744	6890	14 Sagittæ........................	4.9		58.0	15	42	
1745	6893	63 Aquilæ....................τ..	5.9		58.3	6	57	
1746	....	Cygni........................	5.9		58.7	29	35	19h, 1910 W.
1747	6897	15 Sagittæ........................	5.4		58.7	16	45	
1748	6901	16 Sagittæ....................η..	5.4		59.8	19	39	
1749	....	Cygni................(134 B.)..	5.9		59.9	31	53	19h, 4957 W.
1750	....	Aquilæ................(221 B.)..	5.9	19	59.9	15	10	
1751	6905	64 Draconis....................e..	4.9	20	0.2	64	29	
1752	6912	17 Vulpe........................	5.1		1.7	23	16	
1753	6915	27 Cygni....................b¹..	5.4		1.9	35	38	
1754	6926	67 Draconis....................ρ..	5.0		2.3	67	32	
1755	....	Aquilæ................(226 B.)..	5.9		2.9	10	22	38554 L. L.
1756	6936	69 Draconis........................	5.9		3.0	76	08	
1757	6928	Cygni................(141 B.)..	5.7		3.1	52	49	
1758	....	Cygni................(140 B.)..	5.9		3.1	34	04	38588 L. L.
1759	6932	66 Draconis........................	4.9		3.6	61	38	
1760	6937	28 Cygni....................b²..	5.4		5.0	36	29	
1761	6934	65 Aquilæ....................θ..	3.5		5.1	− 1	11	
1762	6940	18 Vulpe........................	5.4		5.5	26	33	
1763	....	Vulpe........................	5.9		6.1	21	31	74 B.
1764	6943	19 Vulpe........................	5.5		6.8	26	27	
1765	6952	67 Aquilæ....................ρ..	4.9		8.7	14	50	
1766	6957	21 Vulpe........................	5.9		9.3	28	20	
1767	6962	Cygni....................o¹..	4.9	20	9.5	46	27	

* Double. North star precedes 0s. 2 ·.· + 2″. 6 in Dec.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
1768	6970	68 Draconis	5.5	20	9.6	61	43	
1769	6965?	31 Cygni ... o^2	4.2		9.9	46	23	
1770	6967	29 Cygni ... b^3	5.2		10.1	36	27	
1771	6966	Vulpe	5.1		10.2	25	14	(16 H.)
1772	6968	22 Vulpe	5.4		10.3	23	08	
1773	6976	33 Cygni	4.5		10.6	56	12	
1774	6973	23 Vulpe	4.7		10.8	27	27	
1775	6975	18 Sagittæ	5.9		11.1	21	14	
1776	6980	Draconis	5.9		11.3	60	17	D. M. 2099.
1777	....	24 Vulpe	5.9		11.7	24	18	
1778	6983	32 Cygni	4.9		11.8	47	21	
1779	6986	Lyræ ... (166 B.)	5.3		12.5	39	59	
1780	7005	1 Cephei* ... κ	4.7		12.9	77	21	
1781	6990	34 Cygni	5.3		13.4	37	39?	
1782	....	Delphini ... (1 B.)	5.4		13.9	12	52	20^h, 302 W.
1783	6998	35 Cygni	5.3		14.0	34	37	
1784	....	Cygni	5.9		15.5	55	01	4734 Rad.
1785	7014	Aquilæ	5.4		17.2	4	58	(23 H.)
1786	....	Delphini ... (5 B.)	5.5		17.3	14	09	39188 L. L.
1787	7024	71 Draconis	5.5		17.6	61	52	
1788	7022	37 Cygni ... γ	2.8		17.9	39	52	
1789	....	Cygni ... (182 B.)	5.5		18.2	45	24	20430 A. Oe.
1790	7027	Cygni ... (183 B.)	5.9		18.5	40	39	
1791	7029	39 Cygni	4.9		19.1	31	48	
1792	....	Cygni ... (190 B.)	5.9		19.3	37	05	20^h, 665 W.
1793	....	D. M. 1618	5.7		19.5	63	37	
1794	7037?	Draconis ... (275 B.)	5.9		19.6	68	30	
1795	....	Vulpe ... (90 B.)	5.4		20.4	21	01	39329 L. L.
1796	7061	40 Cygni	5.9		23.1	38	03	
1797	7062	43 Cygni ... ω^1	5.9		23.3	48	59	
1798	7067	41 Cygni	4.3		24.5	29	58	
1799	7079	1 Delphini	5.5		24.6	10	30	
1800	7085	45 Cygni ... ω^2	4.9		26.3	48	33	
1801	7086	Cygni (or Cephei)	5.9		26.4	55	40	
1802	....	Vulpe	5.9		26.8	25	24	39594 L. L.
1803	7088	2 Delphini ... ε	3.8		27.5	10	54	
1804	7098	2 Cephei ... θ	4.2		27.6	62	35	
1805	7091	46 Cygni ... ω^3	5.7		27.6	48	49	
1806	....	Cygni	5.9		27.9	51	54	212 B.
1807	7094	3 Delphini	5.9		28.3	12	38	
1808	7103	47 Cygni	5.3		29.3	34	51	
1809	7107	4 Delphini ... ζ	4.5		29.7	14	16	
1810	7112	Cygni ... (217 B.)	5.9		30.0	46	17	
1811	7121	6 Delphini ... β	3.7		31.9	14	11	
1812	....	27 Vulpe	5.9		32.0	26	03	
1813	7122	71 Aquilæ	4.6		32.1	− 1	32	
1814	7125	5 Delphini ... ι	4.9		32.1	10	58	
1815	....	Cygni ... (222 B.)	5.9		32.9	37	55	39885 L. L
1816	7137	8 Delphini ... θ	5.4		33.1	12	54	
1817	7156	73 Draconis	5.4		33.2	74	32	
1818	7140	29 Vulpe	4.6		33.2	20	47	
1819	7143	28 Vulpe	5.3		33.3	23	42	
1820	7141	7 Delphini ... κ	5.4		33.3	9	40	
1821	7138	1 Aquarii	5.3		33.3	0	04	
1822	7146	Delphini	5.9		33.5	15	26	32 B.
1823	....	Vulpe ... (105 B.)	5.9		33.8	21	24	20^h, 1116 W.
1824	7149	9 Delphini ... α	3.7		34.1	15	29	
1825	7158?	Cygni ... (226 B.)	5.9		35.2	40	09	
1826	7160	10 Delphini	5.9		35.6	14	11	
1827	7178	75 Draconis	5.5		35.7	81	01	
1828	....	Cygni	5.9	20	35.8	43	02	20^h, 1193 W.

* Double. 2d star = + 2.17 ˢ . ·. − 4.5 in Dec.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	*m.*	°	′	
1829	7164	49 Cygni	5.9	20	36.2	31	53	
1830	7171	50 Cygni .... α	1.5		37.3	44	51	
1831	7174	Cygni .... (232 B.)	5.3		37.6	41	17	
1832	7173	14 Delphini .... δ	4.3		37.9	14	39	
1833	7182	51 Cygni	5.4		38.5	49	55	
1834	7188	30 Vulpe	5.4		39.7	24	51	
1835	7200	12 Delphini .... γ	3.7		40.1	15	42	
1836	7194	52 Cygni	4.3		40.7	30	17	
1837	7189?	Cephei	5.9		41.1	56	03	
1838	7204	53 Cygni .... ε	2.8		41.4	33	31	
1839	7211	4 Cephei	5.4		41.7	66	13	
1840	7215	Cephei	4.5		42.4	57	09	(6 H.)
1841	....	Cygni .... τ	5.9		42.4	33	56	20ʰ, 1373 W.
1842	7213	54 Cygni .... λ	4.6		42.7	36	03	
1843	7220	3 Cephei .... η	3.8		42.9	61	22	
1844	....	Cygni	5.4		43.9	47	23	21126 A. Oe.
1845	7223	15 Delphini	5.4		43.9	12	07	
1846	7222	14 Delphini	5.4		43.9	7	25	
1847	....	Cygni .... (247 B.)	5.9		44.3	51	58	21140 A. Oe.
1848	7233	55 Cygni	5.4		44.9	45	40	
1849	....	Cygni	5.9		45.1	51	28	21161 A. Oe.
1850	7241	56 Cygni	5.4		45.9	43	36	
1851	....	Delphini .... (50 B.)	6.0		47.0	17	34	20ʰ, 1483 W.
1852	7246	31 Vulpe	4.0		47.0	26	38	
1853	7253	57 Cygni	5.3		49.0	43	56	
1854	....	Cygni	5.9		49.0	32	59	32ʰ, 3980 B.
1855	7256	32 Vulpe	5.3		49.5	27	36	
1856	7255?	Equulei	5.4		49.7	4	04	
1857	7258	17 Delphini	5.4		49.9	13	16	
1858	7257	16 Delphini	5.4		49.9	12	07	
1859	....	76 Draconis	5.9		51.2	82	05	
1860	7268	Cygni	5.9		51.8	46	58	
1861	7278	Cygni .... (275 B.)	5.4		52.6	50	16	
1862	7277	58 Cygni .... ν	4.2		52.7	40	42	
1863	7271	18 Delphini	5.1		52.7	10	24	
1864	7275	33 Vulpe	5.0		52.9	21	52	
1865	....	Draconis	5.2		53.0	80	06	5066 Rad.
1866	7276	1 Equulei	5.4		53.1	3	50	
1867	....	Cephei	5.9		53.1	56	26	
1868	7290	Cygni	5.9		54.0	44	00	
1869	7294	Cygni .... (Σ 2741)	5.4		54.6	50	00	
1870	....	Delphini .... (55 B.)	5.7		55.0	18	52	40682 L. L.
1871	7301	59 Cygni .... f	5.2		55.7	47	03	
1872	7311	Cephei .... (85 B.)	5.9		56.2	75	27	
1873	7310	Cephei	5.4		56.6	58	58	
1874	7306	60 Cygni	5.4		57.0	45	41	
1875	7320	Cygni	5.9		58.4	38	11	
1876	7318	3 Equulei	5.4		58.6	5	01	
1877	....	Cephei .... (83 B.)	5.5	20	58.9	56	11	5091 Rad.
1878	7332	Cygni .... (294 B.)	5.4	21	0.1	52	49	
1879	7333	62 Cygni .... ξ	4.2		0.6	43	27	
1880	7336	} 61 Cygni {	4.9		1.5	38	09	
1881	7337		5.2		1.5	38	09	
1882	....	Cygni	5.4		1.5	30	42	40951 L. L.
1883	7345	63 Cygni .... f₂	4.5		2.5	47	10	
1884	7350	5 Equulei .... γ	4.2		4.5	9	39	
1885	7363	Cephei	5.9		5.6	70	57	
1886	7365	Cygni .... (304 B.)	5.4		6.5	53	04	
1887	7368	64 Cygni .... ζ	3.1		7.6	29	44	
1888	7372	7 Equulei .... δ	4.6		8.7	9	31	
1889	7377	Cephei	5.9	21	8.8	59	28	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
1890	7380	8 Equulei α	4.5	21 9.8	4 45	
1891	7385	65 Cygni τ	4.2	10.0	37 32	
1892	7398	67 Cygni σ	4.5	12.7	38 53	
1893	7399	66 Cygni υ	4.3	13.0	34 24	
1894	....	D. M. 2588	5.5	13.3	53 30	
1895	7401	Cephei (100 B.)	5.9	13.7	55 17	100 B.
1896	7402	68 Cygni A	5.3	14.1	43 26	
1897	....	Pegasi (11 B.)	5.9	14.8	21 32	21h, 319 W.
1898	7405	9 Equulei	5.9	15.1	6 52	
1899	7411	Cygni (325 B.)	5.3	15.4	49 00	
1900	7410?	34 Vulpe	5.7	15.6	23 21	F. 25.
1901	7416	5 Cephei α	3.1	15.7	62 05	
1902	....	Cygni (326 B.)	5.9	16.3	32 06	41554 L. L.
1903	7418	1 Pegasi	4.3	16.5	19 18	
1904	7428	6 Cephei	5.4	16.9	64 22	
1905	7421	10 Equulei β	5.0	16.9	6 18	
1906	7438	Draconis (107 B.)	5.9	17.1	76 30	
1907	7431	Cygni (331 B.)	5.4	17.9	48 52	
1908	7437	Pegasi (15 B.)	5.5	18.6	23 46	
1909	....	Cygni (334 B.)	5.9	18.9	36 50	
1910	7444	Vulpe (131 B.)	4.9	19.3	25 41	
1911	7455	Cygni	5.9	20.9	46 12	
1912	7453	69 Cygni	5.9	20.9	36 09	
1913	7462	70 Cygni	4.9	22.4	36 36	
1914	7461	35 Vulpe	4.3	22.4	27 05	
1915	....	Cygni	5.4	22.6	48 19	22275 A. Oe.
1916	7468	Cygni (347 B.)	5.5	22.8	52 22	
1917	7465	Cygni (346 B.)	5.5	23.1	31 42	
1918	....	Pegasi (21 B.)	5.4	23.5	21 40	21h, 536 W.
1919	7474	2 Pegasi	4.5	24.5	23 06	
1920	7480	71 Cygni g	5.3	25.0	46 01	
1921	....	Pegasi (26 B.)	5.9	25.3	11 37	21h, 557 W.
1922	7482	7 Cephei	5.4	25.6	66 17	
1923	....	Cephei β	3.1	27.1	70 02	
1924	7495	Cephei (116 B.)	5.4	27.7	59 56	
1925	7510	Cephei (122 B.)	5.9	28.4	79 47	
1926	....	Cygni	5.9	28.7	49 25	22436 A. Oe.
1927	7503	73 Cygni ρ	4.0	29.5	45 04	
1928	7505	72 Cygni	4.9	29.9	38 00	
1929	7520	5 Pegasi	5.5	32.1	18 47	
1930	7521	74 Cygni	4.9	32.2	39 52	
1931	....	Pegasi	5.9	33.4	19 44	42199 L. L.
1932	7527	25 Aquarii d	4.9	33.5	1 43	
1933	7542	9 Cephei	4.9	34.7	61 32	
1934	7544	75 Cygni	5.1	35.4	42 44	
1935	7546	26 Aquarii	5.5	36.1	0 45	
1936	7547	7 Pegasi	5.4	36.3	5 08	
1937	7555	Cephei (132 B.)	5.9	36.7	54 20	
1938	7554	Cygni (377 B.)	5.7	37.5	40 32	
1939	7560	80 Cygni π^1	5.0	37.8	50 38	
1940	....	Cygni	5.0	38.3	40 37	(F. 24.)
1941	7561	8 Pegasi ε	2.6	38.3	9 19	
1942	7566	79 Cygni	5.9	38.5	37 44	
1943	7568	78 Cygni μ	4.5	38.8	28 12	
1944	7567	9 Pegasi	4.2	38.8	16 48	
1945	7571	10 Pegasi	4.2	39.2	25 04	
1946	7582?	Cephei	4.9 var.	40.0	58 14	
1947	7588	11 Cephei	4.9	40.2	70 45	
1948	7585	12 Pegasi	4.9	40.6	22 24	
1949	7587	27 Aquarii (11 Pegasi)	5.4	41.2	2 08	
1950	....	D. M. 4598	5.9	21 41.4	16 39	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.		Declination, 1880.0.		Various.
				h.	m.	°	′	
1951	7597	Cephei (or 78 Draconis)	5.4	21	41.6	71	46	(16 H.)
1952	7595	10 Cephei .... ν	4.5		42.0	60	34	
1953	7598	81 Cygni .... π^2	4.5		42.4	48	45	
1954	7605	12 Cephei	5.9		43.9	60	09	
1955	7606	13 Pegasi	5.4		44.4	16	45	
1956	7607	14 Pegasi	5.2		44.5	29	37	
1957	....	Pegasi .... (72 B.)	5.4		45.9	19	16	21h, 1096 W.
1958	7623	15 Pegasi	5.7		47.2	28	14	
1959	7627	16 Pegasi	5.4		47.6	25	21	
1960	7631	Cephei ....(147 B.) (Σ A 10)	5.9		48.0	55	14	
1961	....	Pegasi .... (78 B.)	5.5		48.0	19	06	21h, 1136 W.
1962	....	D. M. 5046	5.5		50.8	20	42	
1963	7641	17 Pegasi	5.9		51.1	11	32	
1964	7658	Cephei	5.4		53.2	63	03	
1965	7659	18 Pegasi	5.9		54.1	6	09	
1966	7660	28 Aquarii	5.9		55.0	0	02	
1967	7662	19 Pegasi	5.5		55.2	7	41	
1968	7664	20 Pegasi	5.9		55.3	12	33	
1969	7676	Cygni	5.3		57.4	52	18	
1970	7686	16 Cephei	4.9		57.5	72	36	
1971	7681	Lacertæ .... (4 B.)	5.9		58.2	44	04	
1972	7685	32 Aquarii	5.9		58.6	−1	28	
1973	7689	22 Pegasi .... ν	4.9		59.6	4	28	
1974	7688	34 Aquarii .... α	2.8	21	59.6	−0	54	
1975	7693	23 Pegasi	5.7	22	0.2	28	23	
1976	7700	17 Cephei .... ξ	4.5		0.3	64	03	
1977	7699	18 Cephei	5.7		0.3	62	36	
1978	7705	Lacertæ .... (10 B.)	4.6		1.2	44	26	
1979	7707	20 Cephei	5.9		1.4	62	11	
1980	7706	24 Pegasi .... ι	4.2		1.4	24	46	
1981	7708	19 Cephei	5.9		1.5	61	42	
1982	7712	25 Pegasi	5.7		2.2	21	07	
1983	7721	27 Pegasi .... π^1	5.4		3.9	32	35	
1984	7723	26 Pegasi .... θ	3.5		4.2	5	36	
1985	7731	Pegasi .... π^2	3.8		4.7	32	35	
1986	....	Pegasi .... (130 B.)	5.9		4.8	11	02	22h, 53 W.
1987	7733	28 Pegasi	5.9		4.9	20	23	
1988	7746	Lacertæ .... (17 B.)	5.9		6.5	50	14	
1989	7749	21 Cephei .... ζ	4.2		6.7	57	37	
1990	7758	24 Cephei	5.1		7.5	71	45	
1991	7754?	Cephei .... (183 B.)	5.9		7.5	56	15	
1992	7753?	Pegasi .... (145 B.)	5.5		7.5	34	01	
1993	7755	22 Cephei .... λ	5.4		7.6	58	49	
1994	7760?	Cephei .... (189 B.)	5.7		7.9	69	32	
1995	7759	Cephei	5.3		8.1	60	10	
1996	....	Lacertæ	4.7		8.7	39	07	(1 H.)
1997	....	Lacertæ .... (22 B.)	5.9		8.8	44	51	5614 Rad.
1998	7770	Lacertæ .... (24 B.)	5.9		9.7	42	21	
1999	7778	23 Cephei .... ε	5.0		10.6	56	27	
2000	7777	1 Lacertæ	4.8		10.7	37	09	
2001	7789	25 Cephei	5.9		14.3	62	11	
2002	7796	31 Pegasi	5.4		15.6	11	36	
2003	7798	32 Pegasi	4.9		15.8	27	44	
2004	7800	2 Lacertæ	4.9		16.1	45	56	
2005	7807	33 Pegasi	5.9		17.9	20	14	
2006	7815	3 Lacertæ	4.6		18.9	51	38	
2007	7814	52 Aquarii .... π	4.5		19.2	0	46	
2008	7820?	4 Lacertæ	4.9		19.7	48	52	
2009	7823	34 Pegasi	5.9		20.5	3	47	
2010	7827	35 Pegasi	4.7		21.8	4	06	
2011	....	Lacertæ	5.9	22	22.2	39	12	22h, 467 W.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.		Declination, 1880.0.		Various.
				h.	m.	°	′	
2012	7851	Cephei (or Urs. Minor)	4.9	22	22.7	85	30	(32 H.)
2013	....	Cephei	5.9		22.7	70	09	24148 A. Oe.
2014	7832	55 Aquarii ζ	3.5		22.7	−0	38	
2015	7833	36 Pegasi	5.5		23.1	8	31	
2016	7837	26 Cephei	5.5		23.3	64	31	
2017	....	Pegasi (188 B.)	5.4		23.5	26	09	22^h, 120 P.
2018	7843	38 Pegasi	5.9		24.5	31	57	
2019	7845	5 Lacertæ	4.7		24.6	47	06	
2020	7848	27 Cephei δ	3.8 var.		24.7	57	48	
2021	7850	6 Lacertæ	4.9		25.3	42	30	
2022	7857	28 Cephei	5.9		25.8	78	10	
2023	7855	7 Lacertæ α	4.2		26.4	49	40	
2024	7874	29 Cephei ρ	5.4		28.9	78	12	
2025	7868	62 Aquarii η	3.8		29.2	−0	44	
2026	7876	Cephei (223 B.)	5.9		29.6	69	16	
2027	7881	Cephei (226 B.)	5.4		30.2	75	35	
2028	7880	8 Lacertæ	5.4		30.6	39	01	
2029	7888	9 Lacertæ	5.4		32.5	50	56	
2030	7896	31 Cephei	5.4		32.8	73	01	
2031	7893	40 Pegasi	5.9		33.1	18	56	
2032	....	Cephei (227 B.)	5.9		33.9	56	10	5781 Rad.
2033	7901	10 Lacertæ	4.9		33.9	38	26	
2034	....	Lacertæ	5.9		34.2	36	58	44342 L. L.
2035	7902	30 Cephei	5.2		34.4	62	58	
2036	7912?	Pegasi (224 B.)	5.5		34.9	13	55	22^h, 186 P.
2037	....	Lacertæ	5.9		35.4	53	13	5791 Rad.
2038	7906	11 Lacertæ	4.7		35.4	43	38	
2039	7908	42 Pegasi ζ	3.7		35.5	10	11	
2040	7915	12 Lacertæ	5.3		36.1	39	37	
2041	7914	43 Pegasi ο	4.5		36.1	28	40	
2042	....	D. M. 2960	5.9		37.4	53	16	
2043	7923	44 Pegasi η	3.4		37.4	29	35	
2044	7932	13 Lacertæ	5.1		38.9	41	12	
2045	7943	46 Pegasi ξ	4.7		40.7	11	33	
2046	7948	Lacertæ (60 B.)	5.9		40.8	43	55	22^h, 927 W.
2047	7945	47 Pegasi λ	3.9		40.9	22	56	
2048	....	D. M. 4933	5.9		42.7	36	46	
2049	....	Lacertæ	5.9		43.8	53	47	5839 Rad.
2050	....	Cephei (238 B.)	5.9		44.2	62	18	5842 Rad.
2051	7958	48 Pegasi μ	3.9		44.2	23	58	
2052	7961	Cephei	5.7		44.8	55	16	
2053	7967	32 Cephei	8.8		45.4	65	34	
2054	7971	49 Pegasi σ	4.9		46.3	9	13	
2055	7973	Cephei (241 B.)	5.9		46.7	61	03	
2056	7972	15 Lacertæ	4.9		46.7	42	39	
2057	7975	Pegasi (254 B.)	5.4		47.1	16	12	
2058	....	Cephei	4.9		47.9	82	31	
2059	7983	Lacertæ	5.9		48.3	44	07	
2060	7984	Lacertæ	5.5		48.6	39	44	
2061	7968	50 Pegasi ρ	4.5		49.2	8	11	
2062	....	Lacertæ	5.7		49.5	36	27	22^h, 1121 W.
2063	....	Lacertæ	5.9		50.2	35	44	22^h, 1133 W.
2064	7995?	Lacertæ (F. 64)	4.5		51.2	49	06	(F. 64.)
2065	7997	51 Pegasi	4.9		51.6	20	08	
2066	7999?	Lacertæ (F. 65)	5.2		51.8	48	02	(F. 65.)
2067	8005	2 Piscium	5.9		53.3	0	20	
2068	....	D. M. 3514	5.9		54.0	52	00	
2069	....	Pegasi (273 B.)	5.9		55.0	30	27	273 B.
2070	....	Cephei (or Cassiop.)	5.9		55.1	56	18	D. M. 2923.
2071	....	Cephei (36 H.)	4.9		55.4	83	42	(36 H.)
2072	8023	1 Androm o^1	3.8	22	56.4	41	41	

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
2073	....	D. M. 4762	5.9	22 56.5	22 40	
2074	8031	4 Piscium β	4.6	57.8	3 10	
2075	8032	53 Pegasi β	2 var.	58.0	27 26	
2076	8036	3 Androm	4.7	58.8	49 24	
2077	8034	Pegasi α	1.9	58.8	14 34	
2078	8039	Cephei (255 B.)	5.4	22 59.0	66 34	
2079	8051	55 Pegasi	5.1	23 1.0	8 46	
2080	8052	56 Pegasi	5.3	1.3	24 49	
2081	8054	1 Cassiop	5.3	1.5	58 47	
2082	....	D. M. 3371	5.4	1.7	52 10	
2083	8058	4 Androm	5.4	2.2	45 44	
2084	8059	5 Androm	5.9	2.3	48 39	
2085	8060	5 Piscium A	5.9	2.6	1 27	
2086	8070	57 Pegasi	5.3	3.5	8 02	
2087	8071	58 Pegasi	5.4	4.0	9 11	
2088	8074	33 Cephei π	4.5	4.1	74 44	
2089	....	Pegasi (305 B.)	5.5	4.7	16 56	23^h, 4 P.
2090	8076	6 Androm	5.9	4.9	42 55	
2091	8078	59 Pegasi	5.9	5.7	8 04	
2092	8082	7 Androm	4.9	7.1	48 45	
2093	8083	Cassiop	5.9	7.5	56 30	
2094	8106	Cephei (268 B.)	5.9	11.0	70 14	
2095	8107	Androm	5.3	11.0	52 34	
2096	8105	6 Piscium γ	3.8	11.0	2 38	
2097	8114	8 Androm	4.7	12.2	48 22	
2098	8124	34 Cephei o	5.1	13.8	67 28	
2099	8125	11 Androm	5.9	13.9	47 58	
2100	8128	10 Androm	5.7	14.2	41 25	
2101	8127	7 Piscium b	5.4	14.3	4 43	
2102	8136	12 Androm	5.9	14.7	37 31	
2103	8131	62 Pegasi τ	4.9	14.7	23 05	
2104	8138	Cassiop	5.9	15.3	61 33	
2105	8141	64 Pegasi	5.5	16.1	31 09	
2106	8149	66 Pegasi	5.3	17.0	11 39	
2107	8153	Cassiop (274 B.)	5.9	17.2	59 28	
2108	8159	67 Pegasi	5.9	19.0	31 43	
2109	8160	Pegasi υ	4.5	19.4	22 45	
2110	8162	4 Cassiop	5.3	19.5	61 37	
2111	8169	Piscium κ	5.4	20.8	0 36	
2112	8177	10 Piscium θ	4.6	21.9	5 43	
2113	8182	70 Pegasi g	4.7	23.1	12 06	
2114	8188	Cassiop	5.5	24.5	57 53	(1 H.)
2115	8195	14 Androm	5.5	25.5	38 34	
2116	....	Pegasi (366 B.)	5.9	25.5	28 00	23^h, 516 W.
2117	8203	71 Pegasi	5.9	27.5	21 52	
2118	8213	Cephei (39 H.)	5.9	27.8	86 39	(39 H.)
2119	....	Pegasi	5.9	27.9	20 11	23^h, 567 W.
2120	8206	72 Pegasi	4.9	28.0	30 40	
2121	8211	73 Pegasi	5.9	28.7	32 50	
2122	8212	15 Androm	5.9	28.8	39 34	
2123	8217	Cephei (295 B.)	5.9	29.7	70 58	
2124	8224	16 Androm λ	3.7	31.7	45 49	
2125	8227	75 Pegasi	5.5	31.9	17 46	
2126	8229	17 Androm ι	4.3	32.3	42 36	
2127	8231	18 Androm	5.4	33.3	49 48	
2128	8234?	Pegasi	5.9	33.7	9 01	(F. 57.)
2129	8233	Piscium ι	4.3	33.8	4 59	
2130	....	Cephei	5.4	34.2	73 18	6148 Rad.
2131	8238	35 Cephei γ	3.7	34.4	76 58	
2132	8237	19 Androm	4.6	34.5	43 40	
2133	....	Androm (23 B.)	5.9	23 34.7	36 03	23^h, 735 W.

List of stars for latitude-observations—Continued.

No.	B. A. C.	Constellation.	Magnitude.	Right ascension, 1880.0.	Declination, 1880.0.	Various.
				h. m.	° ′	
2134	8243	18 Piscium ....λ..	4.5	23 35.9	1 07	
2135	....	D. M. 2038..........................	5.9	36.7	63 51	
2136	8250	77 Pegasi..........................	4.9	37.3	9 40	
2137	8256	78 Pegasi..........................	5.1	38.0	28 42	
2138	8261	20 Androm...................ψ..	5.1	40.1	45 45	
2139	....	Cassiop	5.9	41.2	56 47	26023 A. Oe.
2140	8268	5 Cassiop ....τ..	5.2	41.2	57 59	
2141	8273	Cephei..........................	5.4	42.2	67 08	
2142	8279	6 Cassiop	5.7	43.1	61 32	
2143	....	Androm	5.7	43.6	35 46	46676 L. L.
2144	8296	Pegasi..........................	5.5	46.3	21 00	
2145	8299	81 Pegasi ....φ..	4.9	46.4	18 27	
2146	8300	82 Pegasi..........................	5.9	46.5	10 16	
2147	8310	7 Cassiop....................ρ..	4.9	48.5	56 49	
2148	....	D. M. 4214..........................	5.7	49.5	46 41	
2149	....	Pegasi ....(420 B.)..	5.9	50.6	21 59	23ʰ, 235 P.
2150	8321	Cephei..........................	5.9	50.9	82 31	
2151	....	Androm...............(32 B.)..	5.9	51.0	41 59	6226 Rad
2152	8322	Cassiop...............(16 B.)..	5.9	51.2	55 03	
2153	8324	84 Pegasi ....ψ..	4.3	51.6	24 28	
2154	8330	8 Cassiop	4.9	53.0	55 05	
2155	8331	28 Piscium....................ω..	4.4	53.2	6 12	
2156	....	Androm	5.5	53.4	33 04	2861 S.
2157	....	D. M. 4538.......	5.9	54.6	44 35	
2158	8344	Cassiop ....(22 B.)..	5.9	55.5	60 33	
2159	....	Pegasi...............(435 B.)..	5.9	57.1	16 52	435 B.
2160	8359	9 Cassiop	5.4	58.1	61 37	
2161	....	Cephei...............(313 B.)..	5.9	58.5	66 29	6293 Rad.
2162	....	Androm	5.9	58.5	41 26	D. M. 4933.
2163	8366	Cassiop ....(25 B)..	5.9	58.9	60 39	
2164	8370	86 Pegasi..........................	5.4	23 59.6	12 44	

Annual precession in declination.

Right ascension.	Annual precession.	Right ascension.	Right ascension.	Annual precession.	Right ascension.
h. m.	″	h. m.	h. m.	″	h. m.
0 00	+ 20.05	24 00	6 00	0.00	18 00
30	19.88	30	30	− 2.62	30
1 00	19.37	23 00	7 00	5.19	17 00
30	18.53	30	30	7.67	30
2 00	17.37	22 00	8 00	10.03	16 00
30	15.91	30	30	12.21	30
3 00	14.18	21 00	9 00	14.18	15 00
30	12.21	30	30	15.91	30
4 00	10.03	20 00	10 00	17.37	14 00
30	7.67	30	30	18.53	30
5 00	5.19	19 00	11 00	19.37	13 00
30	+ 2.62	30	30	19.88	30
6 00	0.00	18 00	12 00	− 20.05	12 00

APPENDIX No. 15.

ERRATA IN THE HEIS CATALOGUE OF STARS.

Page viii, note. For $\delta=30^\circ\ 27'$ read $\delta=31^\circ\ 27'$.
Page xii, line 2. For sexta read septima.
Page xii, line 5. Sentence inserted in Heis's Corrigenda.
Corrigenda, first page, fifth line from bottom, for "b loco b^1" read "dele b^1".
Same page, fourth line from bottom, for "dele b^2" read "b loco b^2".
Second page of Corrigenda, fourth line from bottom, for "dele g^1" read "g^1 loco g".
Same page, third line from bottom, for "g loco g^2" read "dele g^2".
Page 1, No. 14. For B. A. C. read R.
Page 1, No. 16. Dele asterisk.
Page 1, No. 20. 4966 B. A. C. =8 Urs. Min.
Page 3. No. 4. Add an asterisk.
Page 3, No. 8. This is 2 Draconis.
Page 3, No. 13. Dele second line.
Page 3, No. 16. For 4122 B. A. C. read 4112 B. A. C.
Page 3, No. 29. For 2983 R. read 2985 R., and change the place to R. A. 197° 7′, Decl.+68° 3′.
Page 4, No. 37. For 26209 read $\left\{\begin{matrix} +57^\circ\ 1498\ \text{B} \\ +57^\circ\ 1499\ \text{B} \end{matrix}\right\}$.
Page 4, No. 46. This is 294 of Struve's second catalogue.
Page 7, No. 142. Dele asterisk.
Page 7, No. 161. Dele 18.
Page 9, No. 216. =7187 B. A. C.
Page 9, No. 220. =7299 B. A. C.
Page 10, No. 33. $=440^2$.
Page 11, No. 40. The places should be—

A. R.	Decl.
322° 52′	+66° 5′
322° 54′	+66° 8′

Page 11, No. 51. =Σ 2836.
Page 11, No. 52. Strike out this star, which is Heis 196 Cygni.
Page 11, note. For "min. 5^m" read "min. $6^m.5$".
Page 12, No. 76. =7799 B. A. C.
Page 12, No. 78. =Σ 2903.
Page 12, No. 88. For 7799 B. A. C. read 7871 B. A. C.
Page 13, No. 99. Dele +67° 48′. This is Σ 2947.
Page 13, No. 101. =Σ 2950.
Page 13, No. 131. For B. A. C. read R.
Page 15, No. 19. =Σ 3049.
Page 16, No. 35. Transpose the designations of the two stars.
Page 16, No. 40. =16 Cassiopeæ.
Page 16, No. 46. Should be 175 B. A. C., R. A. 8° 22′, Decl. +65° 20′.
Page 17, No. 80. =35 Cassiopeæ.
Page 18, No. 99. Dele asterisk.
Page 18, No. 120. =Σ 302.
Page 19, No. 9. =*g*.
Page 19, No. 20. =Σ 268.
Page 19, No. 21. =Σ 279.
Page 20, No. 61. For B. A. C. read R.

Page 21, No. 80. Should be D. M. + 46° 762, A. R. 49° 53′, Decl. 46° 27′.
Page 21, No. 94. =38 Persei.
Page 22, No. 108. Should read 1219 B. A. C.
Page 22, No. 109. Should read 1228 B. A. C.
Page 22, No. 115. Should read 73^2.
Page 23, No. 9. For 1415 B. A. C. read 3936 A. Oe.
Page 23, No. 19. Should read D. M. +8° 286, A. R. 54° 22′, Decl. + 68° 3′.
Page 24, No. 29. Should read 58° 310 B., A. R. 58° 35′, +68° 8′.
Page 25, No. 59. =8 Camelopardalis.
Page 25, No. 77. =18 Camelopardalis.
Page 25, No. 79. =19 Camelopardalis.
Page 26, No. 114. For 2650 B. A. C. read 2059 R.
Page 26, No. 115. Should read 2650 B. A. C.
Page 26, No. 117. For 2092 R. read 2722 B. A. C.
Page 28, No. 28. Dele 475^2.
Page 28, No. 32. Should be 44484 L. L., A. R. 339° 12′, Decl. +46° 24′.
Page 30, No. 51. =2732 B. A. C.
Page 30, No. 56. =30 Lyncis.
Page 31, No. 65. Add an asterisk, and for 33 read 32.
Page 31, No. 67. Dele asterisk. This is 33 Lyncis.
Page 31, No. Insert as No. 38½*, D. M. 47° 1660, mag. 6.7.
Page 34, No. 66. Heis has this star on maps III and IV.
Page 34, No. 66. =521^2.
Page 34, No. 80. Should be 2469 R., A. R. 152° 9′, Decl. 42° 10′.
Page 35, No. 115. Dele asterisk, and for 40 read 46.
Page 35, No. 128. For B. A. C. read R., both lines.
Page 36, No. 148. Should be 3904 B. A. C.
Page 37, No. 177. Dele 241^2.
Page 38, No. 200. =4300 B. A. C.
Page 38, No. 208. =4392 B. A. C.
Page 40, No. 43. 15 Can. Ven. =4408 B. A. C.; 17 Can. Ven. =4415 B. A. C.
Page 40, No. 45. =261^2.
Page 40, No. 57. Dele 269^2.
Page 40, No. 61. =269^2.
Page 41, Nos. 81 and 82. Brace the star identified with 82 as a part of 81, and insert for 82, 4632 B. A. C., A. R. 206° 21′, Decl. + 35° 10′.
Page 42, No. 25. =500^2.
Page 43, No. 42. =8345 B. A. C.
Page 43, No. 61. =26 Androm. =5^2.
Page 44, No. 86. =178 B. A. C.
Page 44, No. 87. =184 B. A. C.
Page 44, No. 101. =515^2.
Page 45, No. 108. =Σ 108.
Page 46. All the stars of Equuleus, except 10, are wrongly identified. They should be as follows:

1. =7255 B. A. C.
2. =7276 B. A. C.
3. =7302 B. A. C.
4. =40806 L. L.
5. =7318 B. A. C.
6. =7324 B. A. C.
7. =20^h 484 P.
8. =7350 B. A. C.
9. = { 41136 L. L. / 41147 L. L. }
11. =7372 B. A. C.
12. =7380 B. A. C.
13. =7405 B. A. C.
14. =41533 L. L.
15. =7421 B. A. C.
16. =41615 L. L.

Page 47, No. 7. For W read W^2.
Page 47, No. 11. For W read W^2.
Page 47, No. 17. =7528 B. A. C.
Page 47, No. 22. For W read W^2.
Page 47, No. 26. For W read W^2.
Page 47, No. 28. For W read W^2.
Page 48, No. 38. For W read W^2.
Page 48, No. 54. For W read W^2.
Page 48, No. 55. Add π. For 28 read 29.
Page 48, No. 56. Add 28.
Page 48, No. 62. For W read W^2.
Page 49, No. 64. For W read W^2.
Page 49, No. 65. For W read W^2.
Page 49, No. 83. For W read W^2.
Page 49, No. 84. For W read W^2.
Page 49, No. 85. For W read W^2.
Page 49, No. 89. For W read W^2.
Page 49, No. 96. For W read W^2.
Page 54, No. 71. =299 B. A. C.
Page 54, No. 77. =321 B. A. C.
Page 56, No. 12. Add 5.
Page 58, No. 42. =834 B. A. C.

Page 59, No. 54. Insert before 54: 54*a**=45 Arietis=901 B. A. C., AR. 41° 55′, Decl. +77° 44′. Also, change 54 to 54*b*, and dele first line.

Page 60, No. 5. Under 70° 27′, in column AR., place 70° 16′, and brace. Under +45° 41′, in column Decl., place +45° 36′, and brace.

Page 61, No. 48. Above 5^h 702 W place 5^h 691 W, and brace.

Page 61, No. 48. Above 81° 4′ place 81° 0′. Above +32° 38′ place +32° 42′, and brace.

Page 61, No. 56. For +34° 18′ read 54° 18′.

Page 62, No. 56. Over 10569 L. L. write 10533 L. L.; under same write 10560 L. L., and brace. Over 82° 30′ write 82° 17′; under same write 37° 54′, and brace.

Page 62, No. 72. For 1857 B. A. C. read 1850 B. A. C.
Page 62, No. 75. =1875 B. A. C.
Page 62, No. 83. For +48° 51′ read +48° 57′.
Page 65, No. 35. For 1182 B. A. C. read 1177 B. A. C.; and for 55° 7′ read 55° 9′.
Page 66, No. 59. For A^1 read A.
Page 66, No. 61. Dele A^2.
Page 67, No. 89. For 4^h 311 W read 1342 B. A. C.
Page 67, No. 91. For δ^1 read δ.
Page 67, No. 92. For 1342 B. A. C. read 4^h 311 W.
Page 67, No. 94. Dele δ^2.
Page 67, No. 99. Dele δ^3.
Page 67, No. 100. Dele v^1.
Page 68, No. 101. For v^2 read v.
Page 68, No. 130. For c^1 read c.
Page 69, No. 134. Dele c^2.

Page 70, No. 165. For 5^h 606 W read 1734 B. A. C.; for 80° 13′ read 81° 16′; and for +18° 15′ read +18° 26′.

Page 70, No. 175. =1793 B. A. C.

Page 71, No. 33. Under 39 write 40; under 2275 B. A. C. write 2278 B. A. C.; for 102° 38′ read 102° 28′, and under it 102° 38′; for +26° 6′ read 26° 16′, and under it write 26° 6′, and brace.

Page 71, No. 38. For ω^1 read ω.
Page 72, No. 45. Dele ω^2.
Page 72, No. 70. Dele b^1.

Page 74, No. 16. Dele δ^3.
Page 75, No. 28. For 2647 read 2636.
Page 75, No. 33. In column Dupl. Str. write 1168.
Page 75, No. 35. For 15667 L. L. read 2647 B. A. C.
Page 75, No. 35. For 118° 30′ read 117° 21′; for +9° 18′ read +9° 2′.
Page 75, No. 36. =2673 B. A. C.
Page 75, No. 37. For 9° 1860 B read 15667; for 199° 9′ read 118° 30′; for + 9° 41′ read 9° 18′.
Page 75, No. 12. Dele μ^1.
Page 75, No. 13. For μ^2 read μ.
Page 76, No. 47. For 127° 59′ read 128° 2′.
Page 77, No. 57. =2991 B. A. C.
Page 77, No. 66. Dele α^1.
Page 77, No. 74. For α^2 read α.
Page 78, No. 8. For + 23° 34′ read + 23° 36′.
Page 79, No. 27. For 9^h 809 W read 9^h 780 W; for 144° 27′ read 144° 6′; for +19° 21′ read 19° 32′.
Page 79, No. 32. Add 20.
Page 80, No. 66. Add 42.
Page 83, No. 161. For 177° 32′ read 177° 34′.
Page 84, No. 1. Dele 1596.
Page 84, No. 2. In column Dupl. Str. place 1596.
Page 84, No. 13. Add $\begin{cases} 9. \\ 10. \end{cases}$
Page 85, No. 14. =4152 B. A. C.
Page 85, No. 37. For 4232 B. A. C. read 12^h 757 W.
Page 87, No. 1. For +13° 10′ read +13° 16′.
Page 88, No. 28. For 14° 271 B. read 14° 2718 B.
Page 90, No. 102. In column Dupl. Str. place 288^2.
Page 90, No. 103. In column Dupl. Str. place 289^2.
Page 91, No. 135. =5084 B. A. C.
Page 93, No. 9. Dele 10.
Page 93, No. 15. Add 14.
Page 93, No. 39. Add 34.
Page 94, No. 48. After 16^h 147 P. write 5504 B. A. C., and after 16^h 149 P. write 5582 B. A. C.
Page 94, No. 63. =5647 B. A. C.
Page 94, No. 69. Dele 49.
Page 96, No. 108. For 228^2 read 328^2.
Page 96, No. 110. For 31545 read 31544.
Page 96, No. 117. For ω read W.
Page 98, No. 192. For 6154 read 6151, and write under it 6152 B. A. C., and brace.
Page 98, No. 197. In column Dupl. Str. place 344^2.
Page 101, No. 33. =6455 B. A. C.
Page 101, No. 35. In column Dupl. Str. place 525^2.
Page 103, No. 41. In column Dupl. Str. place 290^2.
Page 104, No. 70. In column Flamst. place 30 opposite 6962, and 31 opposite 6965, and dele bracket.
Page 105, No. 92. Add 43′.
Page 105, No. 98. For 7091 read 7085.
Page 105, No. 100. For 7085 read 7091.
Page 107, No. 159. In column Litt. Bay. al. place A.
Page 107, No. 161. Dele A.
Page 107, No. 179. =7889 B. A. C.
Page 113, No. 24. Add 14.
Page 113, No. 29. In column Litt. Bay. al. place φ^1.
Page 117, No. 156. Add 93.

Page 118, No. 25. For 997 B. A. C. read 59255 L. L.
Page 118, No. 27. For 1013 read 997.
Page 118, No. 29. =1013 B. A. C.
Page 125, No. 120. Add 68.
Page 127, No. 18. =2070 B. A. C.
Page 127, No. 19. For 2070 B. A. C. read 12278 L. L. At bottom of page read 1868 for 1856.
Page 128, No. 76. Add 24. In column Dupl. Str. place 169^2.
Page 128, No. 77. Dele 24.
Page 129, No. 105. For 16559 L. L. read 2825 B. A. C.
Page 132, No. 22. Add 6.
Page 133, No. 35. Add 12.
Page 134, No. 18. Add 1.
Page 139, No. 90. Dele λ^1.
Page 139, No. 91. For λ^2 read λ.
Page 139, No. 113. Dele b^2.
Page 139, No. 115. For b^3 read b^2.
Page 140, No. 117. For χ^1 read χ.
Page 140, No. 118. Dele χ^2.
Page 140, No. 143. Add 48.
Page 141, No. 1. =3286 B. A. C.
Page 141, No. 18. For 140° 9′ read 149° 9′.
Page 141, No. 19. =3449 B. A. C. Add 14.
Page 142, No. 35. For 5^h read 10^h.
Page 143, No. 10. For ^{2} read A^2.
Page 143, No. 21. For 503 M read 12^h 46 W^2; for 180° 45′ read 180° 59′.
Page 144, No. 38. =4230 B. A. C.
Page 147, No. 136. =4666 B. A. C.
Page 147, No. 157. For v^1 read v.
Page 147, No. 159. Dele v^2.
Page 149, No. 27. =3995 B. A. C.
Page 149, No. 33. For B^2 read W^2.
Page 152, No. 41. For B^2 read B.
Page 154, No. 31. =5760 B. A. C.
Page 154, No. 44. For c read e.
Page 155, No. 66. For +13° 59′ read +13° 55′.
Page 155, No. 71. =5985 B. A. C.
Page 156, No. 93. For 268° 16′ read 268° 21′.
Page 158, No. 30. For ω^1 read ω.
Page 158, No. 35. Dele ω^2.
Page 159, No. 50. =6679 B. A. C.
Page 159, No. 54. Dele k.
Page 161, No. 123. =7130 B. A. C.
Page 162, No. 14. Dele ξ^1.
Page 162, No. 15. For ξ^2 read ξ.
Page 162, No. 35. Dele ζ^1.
Page 162, No. 36. Dele ζ^3.
Page 162, No. 38. For ζ^2 read ζ.
Page 163, No. 2*. For ψ read γ.
Page 163, No. 4*. For ξ read μ.
Page 164, No. 28. For d read c^2.
Page 165, No. 12. =6161 B. A. C.
Page 166, No. 28. =6343 B. A. C; for −23° 38′ read −23° 31′.
Page 166, No. 43. Dele ξ^1.
Page 166, No. 44. For ξ^2 read ξ.

Page 167, No. 70. Dele h^1.
Page 167, No. 71. For h^2 read h.
Page 167, No. 76. Dele e^1.
Page 167, No. 77. For e^2 read e.
Page 167, No. 89. Add 65.
Page 168, No. 24. =7221 B. A. C.; for −13° 4′ read −13° 5′.
Page 169, No. 37. For 314° 49′ read 314° 54′; for −18° 1′ read −18° 2′.
Page 170, No. 7. =7242 B. A. C.
Page 171, No. 42. =7672 B. A. C.
Page 171, No. 47. Add 36.
Page 172, No. 66. For 7793 read 7804; for 334° 11′ read 333° 59′; for 7° 58′ read 7° 56′.
Page 172, No. 84. For g^1 read g.
Page 172, No. 85. Dele g^2.
Page 173, No. 96. For −26° 56′ read −25° 56′.
Page 175, No. 15. For 7986 read 7987.
Pages 176–177, Cepheus. In column 6m, for 39 read 38.
Pages 176–177, Urs. Maj. In column 6m.7, for 100 read 101.

Pages 176–177, Aries. In column 2, place 1; in column 2m.3, dele 1; in column 6m, for 22 read 23; in column Summa, for 80 read 81.

Pages 176–177, Cassiopeæ. In column 5m.4, for 5 read 4; and in column 6m, for 24 read 25.

Pages 176–177, Pegasus. In column 4m, for 3 read 5; and in column 4m.5, for 5 read 3.

Pages 178–179, Mediæ. In column 2m, for 7 read 8; in column 6m, for 584 read 585; in column Summa, for 2184 read 2185.

Pages 178–179, Omnes. In column 2m, for 27 read 28; in column 6m, for 1533 read 1534; in column Summa, for 5421 read 5422.

LIST OF SKETCHES.

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

Please Note:

This project currently includes the imaging of the full text of each volume up to the "List of Sketches" (maps) at the end. Future online links, by the National Ocean Service, located on the Historical Map and Chart Project webpage (http://historicals.ncd.noaa.gov/historicals/histmap.asp) will includes these images.

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