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REPORT OF THE SUPERINTENDENT

OF THE

U. S. COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

DURING THE

FISCAL YEAR ENDING WITH

JUNE, 1892.

IN TWO PARTS.

PART I.

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1893.

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 Report of the Superintendent of the Coast and Geodetic Survey for the fiscal year 1892.

TREASURY DEPARTMENT, *December 17, 1892.*

SIR: In compliance with the requirements of Section 4690, Revised Statutes, I have the honor to transmit herewith, for the information of Congress, a report addressed to this Department by T. C. Mendenhall, Superintendent of the Coast and Geodetic Survey, showing the progress made in that work during the fiscal year ended June 30, 1892, and accompanied by maps illustrating the general advance in the operations of the Survey up to that date.

Respectfully yours,

CHARLES FOSTER,
Secretary.

Hon. VICE PRESIDENT OF THE UNITED STATES
AND PRESIDENT OF THE SENATE.

December 20, 1892. Referred to the Committee on Printing, and the letter of transmittal ordered to be printed.

January 16, 1893. *Ordered*, That the usual number of the Report of the Superintendent of the Coast and Geodetic Survey for the fiscal year ended June 30, 1892, be printed.

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LETTER OF TRANSMISSION.

UNITED STATES COAST AND GEODETIC SURVEY,

Washington, D. C., December 17, 1892.

SIR: In conformity with law, and with the regulations of the Treasury Department, I have the honor of submitting herewith for transmission to Congress the Annual Report of the Coast and Geodetic Survey, showing the progress of the work during the fiscal year ended June 30, 1892, and accompanied by maps illustrating the general advance in the operations of the Survey up to that date.

Very respectfully yours,

T. C. MENDENHALL,
Superintendent.

Hon. CHARLES FOSTER,
Secretary of the Treasury.

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REPORT OF THE SUPERINTENDENT

OF THE

U. S. COAST AND GEODETIC SURVEY

FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

IN TWO PARTS.

PART I.

RECORDS OF PROGRESS IN FIELD AND OFFICE WORK.
ESTIMATES FOR FUTURE PROGRESS.
REPORT OF EXPENDITURES.

PREFATORY NOTE.

The text of this Report for the fiscal year 1892 has been arranged for publication in two parts, like that for the fiscal year preceding.

Part I, in quarto form, contains the historical portion. It presents abstracts of progress in field and office work, gives estimates for future progress, and a statement of expenditures during the fiscal year. Accompanying it are maps of general progress, and sketches more in detail showing the localities of field operations referred to in the Report.

In Part II, in octavo, are published the Appendices which relate to the methods, discussions, and results of the Survey, with such illustrations as are required.

The octavo form is more convenient and suitable for the scientific and professional papers, while the quarto form appears to be demanded for the statistical matter and the progress sketches. Since the latter are of less general interest than the former, in the future distribution of the Report, Part II only will be sent, as it is believed that this will include all that is generally desired, and in a much more compact and convenient form than that of the old quarto.

In special cases, where both parts are desirable, they will be sent.

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ABSTRACT OF CONTENTS OF REPORT.

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REPORT.

PART I.

INTRODUCTORY STATEMENT.

During the fiscal year 1892, upwards of eighty-five field parties were actively employed upon the coasts of the Atlantic, the Gulf of Mexico, the Pacific Ocean, and Bering Sea, and in the interior of the United States. Their work was carried on within the limits and on or off the coasts of sixteen States on the Atlantic and Gulf seaboard; three States and one Territory bordering on the Pacific Ocean and on Bering Sea, and in fourteen States and three Territories in the interior. It included the measurement of base lines; reconnaissance and triangulation; time, latitude, longitude, and azimuth determinations; gravity research; geodetic leveling; magnetic observations; topographic surveys, and hydrographic work involving inshore and offshore soundings and observations of currents and tides.

Among work of importance may be mentioned the continuation of the surveys of the Northeastern Boundary Lakes, the completion of which will afford data for the location of a part of the boundary line between the United States and the Dominion of Canada; the beginning of the resurvey of Boston Harbor; the completion of the resurvey of Nantucket Shoals; the connection of the longitude determinations coming westward from the Atlantic Coast with those coming eastward from the Pacific; the resurvey of Mobile Bay and Entrance; the advance towards a junction in Colorado of the transcontinental triangulation proceeding westward from the Atlantic Coast with that proceeding eastward from the Pacific; the completion of the observations for the variations of latitude at three widely separated stations in coöperation with the work of the International Geodetic Association, and the progress towards completion of the surveys in Alaska for the more exact determination of the geographical position of Mount St. Elias, and of its height and distance from the coast.

In addition to this advance of the regular operations of the Survey, a number of requests from National or State authorities for the detail of officers for special service were acceded to, this policy being in accord with the practice of the Department, and action taken always with the approval of the Secretary of the Treasury, or, in one or two instances, by direction of the President.

BOUNDARY LINE BETWEEN THE STATES OF PENNSYLVANIA AND DELAWARE.

Upon the application of the Hon. Thomas F. Bayard, representing the Commission to adjust the boundary line between the States of Delaware and Pennsylvania, an officer of the Survey was detailed to execute the reconnaissance and triangulation desired by the Commission.

SPECIAL SURVEYS FOR THE STATE OF VIRGINIA.

In compliance with a request received from the Committee of Fish and Game of the Senate of Virginia, and the Committee on the Chesapeake and its Tributaries of the Virginia

House of Delegates, through their respective Chairmen, an officer of the Survey was detailed to make the observations required for the accurate delineation and mapping of the natural oyster beds and planting grounds in the waters of the State.

BOUNDARY LINE BETWEEN THE STATES OF OHIO AND INDIANA.

A question having arisen between the States of Ohio and Indiana in regard to the boundary line between those States, which, it was known, had been intended to be run as a true meridian line from its initial point, action was taken by the Superintendent at the request of the Governor of Ohio, looking to such a preliminary investigation of the points at issue as might result in the organization of a Joint Commission, empowered to establish and mark the line by suitable monuments. A strip of territory nearly one hundred square miles in area is involved in a corrected location of this boundary line.

BOUNDARY LINE BETWEEN THE UNITED STATES AND MEXICO.

At the suggestion of the Secretary of State, made by him to the Secretary of the Treasury, the Superintendent was authorized to detail officers of the Survey for the determination in latitude and longitude of such points on the boundary line between the United States and Mexico as the International Boundary Commission, on the part of the United States, might indicate.

SPECIAL SURVEYS FOR THE CITY AND COUNTY OF SAN FRANCISCO.

In May, 1892, the Mayor and Board of Supervisors of the City and County of San Francisco addressed a letter to the Secretary of the Treasury, stating that they had in view the preparation of a comprehensive system of grading and sewerage for the city, and asking that they might have temporarily the services of Assistant George Davidson of the Coast and Geodetic Survey as consulting engineer in association with Col. George H. Mendell, U.S. Corps of Engineers. In accordance with this request, which was seconded by the Senators from the State of California, Mr. Davidson, by authority from the President, was instructed to render such services as would not interfere with his regular duties on the Survey.

SURVEYS FOR THE HARBOR LINE COMMISSION OF THE STATE OF WASHINGTON.

At the request of the Harbor Line Commission of the State of Washington, the detail of Assistant J. J. Gilbert, to coöperate with the Commission in the important work of harbor surveys on Puget Sound, was renewed in the spring of 1892. This detail had first taken effect in May, 1891, and upon its close in November, a communication was received from the President of the Commission transmitting a resolution expressing their thanks to the Superintendent, and their appreciation of the high character of the work executed by Mr. Gilbert.

OBSERVATIONS FOR INVESTIGATING THE VARIATIONS OF LATITUDE IN COÖPERATION WITH THE WORK OF THE INTERNATIONAL GEODETIC ASSOCIATION.

The investigation of the origin and law of change of the variations in latitude, which was undertaken by the Survey last year in coöperation with the International Geodetic Association at a station near Washington, D. C., at San Francisco, and at a station in the Hawaiian Islands, has been continued during the fiscal year 1892, and the reduction of the observations has been sufficiently advanced to permit the publication in Part II of this Report of the results at two of the stations.

SPECIAL APPOINTMENTS.

In addition to the service of one of the older officers of the Survey as a member of the Mississippi River Commission as required by law, another officer was appointed by the

President as a member of the International Boundary Commission, organized for the location of the United States and Mexican boundary line.

OFFICE OF STANDARD WEIGHTS AND MEASURES.

During the fiscal year, a complete set of Weights and Measures, customary and metric, was adjusted and verified, and delivered to the Governor of the State of Idaho, under the provisions of the Acts of Congress relating to the distribution of standard weights and measures to the States.

Much of the time of the limited force of the office was occupied in meeting the demands of the Internal Revenue Bureau for the verification of alcoholometers, saccharometers, sugar flasks, weights, and quartz plates for use with polariscopes in the analysis of sugars.

For the Customs Division of the Treasury, several sets of glass capacity measures intended for distribution to Customhouses were verified.

In compliance with a rapidly increasing demand from engineers, surveyors, manufacturers, and others who have submitted weights and measures for comparison with the United States Standards, this office, being the custodian of these standards, has endeavored to serve the public by making the comparisons desired, although greatly in need of the more extended facilities for such service which all other civilized countries provide.

While renewing the recommendations made in my last annual report, and sanctioned by the Secretary of the Treasury, that the metric system of weights and measures should be made obligatory in transactions at United States Customhouses from and after the first day of the calendar year 1895, I would call attention to the recent action of the Chambers of Commerce in Great Britain recommending the early introduction of the metric system into that country.

GEOGRAPHICAL ORDER OF THE LOCALITIES OF FIELD WORK.

In this Report the localities of field operations are arranged in a geographical order in four divisions, the same as that followed in the report of 1891; the early classification by sections having been discarded in that report for the reasons there stated.

These divisons are :

I. The Eastern Division, including the States east of the Mississippi River.

II. The Middle Division, comprising the States and Territories between the Mississippi River and the Rocky Mountains.

III. The Western Division, including the States and Territories between the Rocky Mountains and the Pacific.

IV. The Division of Alaska, including its coasts bordering on the Pacific Ocean, on Bering Sea, and on the Arctic Ocean; also its inlets, sounds, bays, rivers, and the Aleutian and Pribilof Islands.

ARRANGEMENT OF PART I OF THIS REPORT.

The records of progress in field and office work, the notices of publications and of special operations, the explanation of estimates and estimates in detail, the abstracts of reports from field parties and of the annual office reports, and the tabular statements and reports which conclude this volume are arranged as follows, and constitute Part I, Report for 1892.

Introductory statement; notice of field work and of the geographical order and classification of its localities; the office of Standard Weights and Measures; general statements of progress in field and office work, including notices of some of the publications of the Survey issued during the year; explanation of estimates and estimates in detail; abstracts of reports from field parties and of reports of special operations, abstracts of the annual office reports; notices of the Sub-offices at Philadelphia and San Francisco; and concluding statement.

Supplementary to this record and immediately following it are three tabular statements and four annual office reports. The tabular statements are: 1. One showing the distribution of the field parties of the Survey. 2. One which presents the statistics of field and office work. 3. One giving a list of information furnished in reply to requests official or personal. The annual office reports are: 1. That of the Assistant in charge of the Office. 2. That of the Hydrographic Inspector. 3. That of the Disbursing Agent. 4. That of the Assistant in immediate charge of State surveys. 5. That of the Assistant in charge of the office of Standard Weights and Measures.

A list of the maps and sketches illustrating the advance of the work to the close of the fiscal year follows, and the sketches themselves complete the volume.

The progress of the survey afield and afloat throughout the entire territory of the United States to the close of the fiscal year is shown graphically in the maps of general progress, Nos. 1 and 2, and in map No. 3, which exhibits progress in Alaska. In map No. 4 are shown the longitude stations and connections determined by means of the electric telegraph between 1846 and the end of the fiscal year; in map No. 5 are given the positions of the stations occupied for determinations of the magnetic declination, dip, and intensity between 1844 and June 30, 1892, and in map No. 6 are shown the lines of spirit-leveling of precision run, and the positions of gravity stations occupied to June 30, 1892.

GENERAL STATEMENT OF PROGRESS.

I. FIELD WORK.

EASTERN DIVISION.—*States east of the Mississippi River.*—The following named operations were in progress or completed within the limits and upon or off the coasts of the States east of the Mississippi River during the fiscal year 1892:

Triangulation, topography, and hydrography of the Schoodic Lakes from the vicinity of Grand Lake towards the Northeastern Boundary Monument; detailed topographic survey of the shores of the Kennebec River, Maine, from Gardiner to Augusta; hydrographic examinations for the Coast Pilot on the coasts of Massachusetts and Rhode Island from Cape Ann to Point Judith; topographic and hydrographic resurvey of Boston Harbor; delineation of marginal topography in the vicinity of Plymouth, Massachusetts; continuation of the town boundary survey for the State of Massachusetts; completion of the hydrographic resurvey of Nantucket Shoals, and examination made of Squipnocket Ridge southwest of Marthas Vineyard; detailed topographical survey of the north shore of Nantucket Sound from Falmouth Heights to Hyannis Light; completion of the physical hydrographic survey of the south coast of the Island of Nantucket, and beginning of a similar survey on the south coast of Marthas Vineyard; topographical additions and resurveys on Marthas Vineyard; continuation of the automatic tide gauge record at Bristol, Rhode Island, and similar record begun at Newport, Rhode Island; detailed topographical survey of Coasters Harbor Island for the Navy Department; topographic and hydrographic surveys of the Connecticut River and triangulation incidental thereto continued; topographic and hydrographic surveys of the shore of Long Island continued from Southampton towards Montauk Point, and hydrographic survey made of Shelter Island Sound, Great and Little Peconic Bay and approaches; determination by exchanges of telegraphic signals of the longitude lines, Albany–Detroit, Detroit–Chicago, and Chicago–Minneapolis, with observations for latitude at Chicago; continuation of the topographical survey of the Hudson River; automatic tide gauge record maintained at Willets Point, New York; determination in position of range points in use by New York Harbor pilots; tidal record continued at the automatic tidal station, Sandy Hook, New Jersey; geodetic operations continued in the State of New Jersey; topographic and hydrographic surveys on the coast of New Jersey between Atlantic City and Cape May; automatic tidal station established on South Wharves near the old Navy Yard, Philadelphia; completion of the topographical revision of the Delaware River water front of the City of Philadelphia; surveys for the Commission to adjust the boundary line between the States of Pennsylvania and Delaware; connection of the astronomical station at Rockville, Maryland, with the triangulation and observations for the variations of latitude at that station; establishment of an automatic tide gauge at the Navy Yard, Washington, D. C.; topographical surveys on different scales of a designated area in the District of Columbia; determination in geographical position of the astro-physical station in the grounds of the Smithsonian Institution; hydrographic survey of part of the Washington Channel, Potomac River; special surveys for the delineation and mapping of oyster beds in the waters of the State of Virginia; triangulation of the Appomattox River, Virginia; hydrographic examination off Cape Charles, Virginia; geodetic leveling between Richmond and Fortress Monroe; topographical additions and revisions in the vicinity of Old Point Comfort, Newport News, and Elizabeth River, Virginia; hydrographic resurvey of parts of Beaufort River, South Carolina; automatic tidal record maintained during part of the year at Tybee Island, Savannah River Entrance, Georgia; hydrographic work at the entrance to St. Simon

Sound, Georgia; geodetic leveling between St. Augustine and Cedar Keys, Florida, and in connection with that work, establishment of automatic tidal stations at those ports; hydrographic examinations at Key West and in the vicinity; surveys of the Caloosahatchee River, Florida, and of Pensacola Bay; shore line topography and trigonometrical connection between Perdido and Mobile Bays; and hydrographic resurveys in Mobile Bay; continuation of triangulation in Alabama towards the Gulf of Mexico; determinations of the magnetic elements at stations in Michigan, Wisconsin, Ohio, Indiana and Illinois; also in Washington, D. C., and Richmond, Virginia; geodetic operations continued in the State of Wisconsin; determinations in geographical position of points on the boundary line between the States of Ohio and Indiana; measurement of primary base line at Holton, Indiana; connection of the base line at St. Albans, West Virginia, with the triangulation, and continuation of geodetic operations in the State of Tennessee.

MIDDLE DIVISION.—*States and Territories between the Mississippi River and the Rocky Mountains.*—Within the limits of the States and Territories just named the following operations were in progress or completed:

Geodetic work continued in the State of Minnesota, including the connection of the triangulation of that State with the triangulation of the State of Wisconsin, and of the Snelling Avenue base with a bench mark of leveling of precision; determination of the primary longitude line Minneapolis–Omaha by exchanges of telegraphic signals; occupation of magnetic stations in the States of Minnesota and Iowa; exchanges of telegraphic signals for longitude between St. Louis and Macon City, Missouri; lines of geodetic leveling carried from Jefferson City to Kansas City, Missouri, and thence to Olathe, Kansas; extension to the westward in Kansas of the transcontinental triangulation along or near the thirty-ninth parallel, and advance of this triangulation in western Kansas and eastern Colorado; topographic and hydrographic resurvey of Brazos River Entrance, Texas; reconnaissance for triangulation along the Rio Grande boundary between the United States and Mexico, and continuation of the magnetic record by means of the Adie magnetographs at San Antonio, Texas.

WESTERN DIVISION.—*States and Territories between the Rocky Mountains and the Pacific.*—Field work in progress or completed within the limits and upon or off the coasts of the States and Territories between the Rocky Mountains and the Pacific included the following operations: Determinations in latitude and longitude of points upon the boundary line between the United States and Mexico for the International Boundary Commission; topographical survey upon the south coast of California, vicinity of Monterey; primary triangulation upon or near the coast of California continued by the occupation of Mount Diablo; observations for the variations of latitude at the Lafayette Park Station, San Francisco, and for the magnetic elements at Station Presidio; automatic tidal record maintained at Sausalito, Bay of San Francisco; triangulation preparatory to a topographical resurvey of San Francisco Entrance; trial course for steam vessels laid off in San Francisco Bay for the use of the Union Iron Works; occupation of stations in continuation of the primary triangulation to the north of San Francisco Bay; hydrographic surveys on the coast of Oregon from Cape Meares to Cape Kiwanda, and in Willapa Bay and Grays Harbor; triangulation and topography of the Columbia River continued above Vancouver; hydrographic surveys on the coast of Washington from Osett Island to James Island; resurveys of the water fronts of Port Townsend and Seattle, Washington; chronometric base station for longitudes maintained at Tacoma for comparison with chronometers brought from Sitka, Alaska, and topographic and hydrographic resurvey of Tacoma water front; resurveys for the Harbor Line Commission of the State of Washington of ports on Puget Sound; hydrographic surveys in Washington Sound continued; determination in geographical position of a station in the Yellowstone National Park, Wyoming, with observations of the magnetic elements, and continuation to the eastward of the primary triangulation near the thirty-ninth parallel in the Territory of Utah.

DIVISION OF ALASKA.—In the Division of Alaska, which includes the coasts of that territory bordering upon the Pacific Ocean, upon Bering Sea, and upon the Arctic Ocean, with the

sounds, bays, inlets, and rivers, the following field operations were in progress: Surveys, including triangulation, topography, and hydrography in Behm Canal and vicinity, in Boca de Quadra, Dixon Entrance, and Clarence Strait, and neighboring waters; determination of the longitude of Sitka, and of a station on Yakutat Bay by transportation of chronometers from Tacoma; shore line and hydrographic surveys of Yakutat Bay, and base measurement and triangulation for the determination in height and geographical position of Mount St. Elias. In addition to the observations for gravity at St. Paul Island, Pribilof Group, Bering Sea, referred to in the last annual report, the Superintendent made a reconnaissance survey of that island, upon which was based a map, published in April, 1892.

SPECIAL OPERATIONS.

In coöperation with National or State authorities and with the International Geodetic Association, have been referred to in the introductory statement, and will receive notices more in detail towards the close of this volume.

TOPOGRAPHICAL CONFERENCE.

The Topographical Conference, called by the Superintendent in December, 1891, in order that an opportunity might be given to the topographers of the Survey for full and free discussion of aims, methods, and recent advances in topography, met in Washington, D. C., in January, 1892, and, after a session lasting into March, submitted a report of their proceedings, which has been published as Appendix No. 16, Report for 1891, Part II.

OFFICE WORK.

During the past fiscal year the great need of more space for some of the most important work of the office has been largely met by the acquisition by the United States of the Butler buildings adjoining the office building on the north. The advantages thus gained by the Survey, and the improvements introduced in the buildings under the direction of the Supervising Architect of the Treasury, are fully set forth in the annual report of the Assistant in charge of the Office, which is published as Office Report No. 1 towards the close of this volume. This report, taken in connection with the annual report of the Hydrographic Inspector, published as Office Report No. 2, gives a comprehensive view of the operations of the office during the year.

Abstracts of these reports, summarizing their leading topics, follow the abstracts of the reports from field parties.

HYDROGRAPHIC DISCOVERIES AND DEVELOPMENTS AS ANNOUNCED IN NOTICES TO MARINERS.

The Notices to Mariners, which are issued monthly throughout the fiscal year, and oftener should occasion demand it, have a special value to all who use the charts of the Survey. By their aid the charts can be corrected to date, since they contain information of changes in aids to navigation, of dangers discovered, and of changes in depths on the coasts and approaches to the coasts of the United States and adjacent territories. They give also lists of new charts, chart agencies in the principal seaports, and of new publications; the names of charts the editions of which are exhausted, and the names of all charts canceled. A circular accompanies each notice, by means of which information deemed of importance to mariners can be communicated to the Superintendent.

During the fiscal year, beginning with No. 143 for July, 1891, and ending with No. 155 for June, 1892, thirteen separate numbers were issued, No. 149 being an index number, containing a full index by localities, charts affected, and numbers and paragraphs of the notices, to the chart corrections made between January 1 and December 31, 1891.

There were printed for free distribution 130 000 copies of these notices. They are furnished to all who may apply for them at the agencies of the Survey in the principal ports of the United States, at the United States Customhouses, at the branch Hydrographic Offices of the Navy Department in the principal seaport cities; at United States Consulates in foreign ports, at the Office of the Survey in Washington, D. C., and at the Sub-offices in Philadelphia and San Francisco.

EXPLANATION OF ESTIMATES.

The estimates submitted to the Secretary of the Treasury for the fiscal year 1894 were accompanied by the following statement:

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE SUPERINTENDENT,
Washington, D. C., September 30, 1892.

SIR: In transmitting herewith estimates of the sums required for the maintenance of the operations of the Coast and Geodetic Survey for the fiscal year ending June 30, 1894, I beg to submit a few statements relative thereto. The amount asked for under the head of "Party Expenses" is considerably less than that in the estimates for the current year, the difference being about equal to the sum required for the prosecution of the Alaska Boundary Survey.

In view of the treaty recently made with the Government of the Dominion of Canada upon this subject, the survey of this boundary line must be vigorously pushed during the next two or three years. This will demand the service of several of the most experienced field officers, as persons competent to do this class of work can not be obtained from other sources. We are therefore compelled to postpone for the present year several important operations upon both the Atlantic and Pacific Coasts, those most urgent being included in the estimates.

An increase in the amount for the repairs of vessels has been several times requested but not granted by Congress. It is again submitted and urged as an absolute necessity. Many of the vessels of the Survey are becoming old, and the demands for repairs are constantly increasing. Some of them are now absolutely unseaworthy and are no longer of service. Additional schooners are imperatively demanded for the execution of work on the Atlantic and Gulf Coasts, and it is to be hoped, with the aid of the additional amount asked for, that one new vessel of this type may be purchased this year.

The estimates for pay of field officers are precisely as estimated and appropriated for the past two years. In the pay of the office force a few changes have been made, recommended by the Assistant in charge of the Office, and suggested by the experience of the past few years, during which the office force has remained essentially the same. The total sum required is somewhat less than the appropriation for the current year. In the way of furnishing the information regarding persons employed in the field and in the office, called for in the act making this appropriation, I submit the following:

The appropriations made at the first session of Fifty-second Congress for the support of this Bureau during the fiscal year 1893, including the amount specially appropriated for the Alaska Boundary Survey, were less than the amounts estimated for by about $23 000. Of this $17 500 was taken from the estimates for party expenses. Out of this fund, the expenses of the field operations are paid, except the salaries of the field officers which are appropriated for in detail. A field party consists generally of from three to ten or more persons, only one of which, the chief of the party, is one of the regularly employed field officers. The others are, in the interest of economy, employed temporarily, during the period in which their services are actually required in the field. As the larger part of the party expenses arises out of this temporary employment, such employment has necessarily been dispensed with during the current year about in proportion to the reduction of the amount appropriated.

The number of field officers has also been somewhat less than before, not, however, on account of the lack of opportunity for their useful employment, but by reason of an actual diminution of their number through resignations and the extreme difficulty of filling their places. There has been a deficiency in the number available of both civilian and naval officers during the year, which, it is hoped, will prove to be but temporary. Several of the most experienced of the civilian experts have been called upon by other Departments of the Government, and by State and municipal authorities for service along lines for which their experience and training have especially fitted them. In this way the Mississppi River Commission, the Mexican Boundary Commission, one or two interstate Boundary Commissions, and other National and State authorities have been able to avail themselves of a technical skill which, it is safe to say, can not elsewhere be found. It is proper to remark that in all cases where such details have been made, it has been upon the order of the President or that of the Honorable Secretary of the Treasury upon the request of the proper authorities. The expansion in the U. S. Navy during the past few years has made it continually more difficult to procure the detail of the proper number of officers for duty on the vessels of the Survey, and the number actually thus in our service has decreased considerably within the past year or two, although it is proper to add that the Honorable Secretary of the Navy has always endeavored to supply the demands of this service as far as it appeared to be possible for him to do so.

Some of our most valuable civilian experts have been lost during the year by their voluntary withdrawal from the service, owing to the much greater rewards for the present and promises for future professional advancement which they have found outside of Government employ.

Owing to the dfficulty of filling the places thus made vacant, this tendency can not but cause anxiety to all who have the best interests of the Government in mind. The corps of field officers is one almost unique in its training and experience. With a maximum continuous service of fifty-four years, and an average of about twenty-seven years, it can safely challenge comparison with any other in the Government. Promotions are not rapid, and the compensation of the officers of the Survey, relative to that of any other profession in which a comparable amount of technical skill, training, and education is required, is very low. The important and responsible work which they are called upon to perform is such that the Government could not afford to entrust it to any body of men lacking the skill which they have acquired through their long experience and special training. A single serious blunder might be more costly than the maintenance of the whole corps for several years.

The same remarks may be justly applied to the office force, where skilled computers, clerks trained to the performance of special duties, and technical experts of various kinds, receive much less compensation than the rarity and value of their accomplishments entitle them to. It would be unjust to allow this opportunity to pass without bearing testimony to the generally faithful and conscientious manner in which they discharge the duties which devolve upon them.

In the estimates for office expenses, a few changes have been made in the sums asked for in the several paragraphs involving both reduction and increase. They are such as experience has shown to be in the direction of a wiser distribution of the sum total which is not increased thereby.

In conclusion I desire to invite attention to the fact that these estimates are lower than any made during the past twenty-five years, as a result of a careful scrutiny of every item, and a desire to conform strictly to the policy which I adopted in the beginning, of asking Congress for the minimum sum absolutely required for the execution of the important operations entrusted to this Bureau.

The amount estimated for the office of Standard Weights and Measures is identical with that appropriated for the current year, except two additional sums, one for the purchase of an instrument, and the other to provide a suitable room for a balance of precision.

During the past year or two, the office has been called upon by the Department of Agriculture and the Bureau of Internal Revenue of the Treasury Department for the standardizing of the quartz plates used in the classification of sugar. The important interests involved and the high accuracy demanded render necessary the purchase of an instrument of the highest degree of precision.

There is at present no place in the office suitable for the mounting of the most accurate balance belonging to the Government. The number of weights received for standardizing is increasing rapidly, and the degree of accuracy required is constantly becoming higher. A suitable balance room can be had at comparatively small cost by utilizing the space between the Butler building and the Coast Survey building, the erection of two walls only being demanded.

It is of the utmost importance that this should be done, and the amount asked for is necessary and sufficient for the purpose.

Respectfully yours,

T. C. MENDENHALL,
Superintendent.

THE HONORABLE THE SECRETARY OF THE TREASURY,
Washington, D. C.

ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

For every expenditure requisite for and incident to the survey of the Atlantic, Gulf, and Pacific Coasts of the United States and the coast of the Territory of Alaska, including the survey of rivers to the head of tide water or ship navigation; deep sea soundings, temperature, and current observations along the coast and throughout the Gulf Stream and Japan Stream flowing off the said coasts; tidal observations; the necessary resurveys; the preparation of the Coast Pilot; continuing researches and other work relating to terrestrial magnetism and the magnetic maps of the United States and adjacent waters, and the tables of magnetic declination, dip, and intensity usually accompanying them; and including compensation not otherwise appropriated for of persons employed on the field work, in conformity with the regulations for the government of the Coast and Geodetic Survey adopted by the Secretary of the Treasury; for special examinations that may be required by the Lighthouse Board or other proper authority, and including traveling expenses of officers and men of the Navy on duty; for commutation to officers of the field force while on field duty, at a rate to be fixed by the Secretary of the Treasury, not exceeding $2·50 per day each; outfit, equipment, and care of vessels used in the Survey, and also the repairs and maintenance of the complement of vessels, to be expended in accordance with the regulations relating to the Coast and Geodetic Survey from time to time prescribed by the Secretary of the Treasury, and under the following heads. *Provided*, That no advance of money to chiefs of field parties under this appropriation shall be made unless to a commissioned officer, or to a civilian officer who shall give bond in such sum as the Secretary of the Treasury may direct:

FOR PARTY EXPENSES:

For the survey of unfinished portions of the Atlantic Coast from Maine to Florida, including the eastern boundary of Maine to the International Boundary Monument; the coast of New Brunswick eastward to Pt. Lepreau; Grand Manan Island; Portsmouth Harbor and Piscataqua River; Newburyport Harbor and Merrimac River to Haverhill; Connecticut River to Hartford; Hudson River to Troy; Delaware River from Philadelphia to Trenton; Bogue Inlet and interior waters along the coast of North Carolina, and Cooper and Ashley Rivers, South Carolina, and for necessary resurveys, including Boston Harbor, Buzzards Bay, Nantucket Sound, Chesapeake Bay and tributaries, the coast of New Jersey from Sandy Hook to Cape May, St. Johns River to Jacksonville, and Fort George Inlet. $20 000

FOR PARTY EXPENSES—Continued.

To continue the primary triangulation from the vicinity of Montgomery towards Mobile, and for triangulation, topography, and hydrography of unfinished portions of the Gulf Coast, including Lake Pontchartrain and the resurvey of Pensacola Bay	$10 000
To make offshore soundings along the Atlantic Coast and current and temperature observations in the Gulf Stream, and for the maintenance of the steamer *Blake* at Chicago during the continuance of the Columbian Exposition, and her transportation to New York	8 000
For continuing the survey of the coasts of California, Oregon, and Washington, including offshore hydrography, and to continue the survey of the Columbia River to the Cascades, triangulation, topography, and hydrography	20 000
For continuing explorations in the waters of Alaska, and making hydrographic surveys in the same, and for the establishment of astronomical, longitude, and magnetic stations	10 000
For continuing the researches in physical hydrography relating to harbors and bars, including computations and plottings, and for continuing tidal observations on the Atlantic, Gulf, and Pacific Coasts	13 000
For examination into reported dangers on the Atlantic, Gulf, and Pacific Coasts, and to continue the compilation of the Coast Pilot, and to make special hydrographic examinations for the same	4 000
To continue magnetic observations, including the maintenance of the Magnetic Observatory	3 000
For continuing the line of exact levels westward and southward from the vicinity of Kansas City, Missouri; westward from Old Point Comfort, Virginia; eastward from San Francisco, California; eastward from Vicksburg, Mississippi; between Jacksonville and Cedar Keys, Florida; and from the vicinity of Chicago, Illinois, to Lake Erie	5 000
For furnishing points to State Surveys, to be applied as far as practicable in States where points have not been furnished, and for surveying and distinctly designating with permanent monuments that portion of the eastern boundary of the State of California commencing at and running southeastward from the intersection of the thrity-ninth degree of north latitude with the one hundred and twentieth degree of longitude west of Greenwich	17 500
For determinations of geographical positions and to continue gravity determinations	5 000
For continuing the transcontinental geodetic work on the line between the Atlantic and Pacific Oceans, including a primary base in the vicinity of Salt Lake and the necessary check bases	15 000
For traveling expenses of officers and men of the Navy on duty, and for any special surveys that may be required by the Lighthouse Board or other proper authority, and contingent expenses incident thereto	3 500
For objects not hereinbefore named that may be deemed urgent, including the actual necessary expenses of officers of the field force temporarily ordered to the office at Washington for consultation with the Superintendent, to be paid as directed by the Superintendent, in accordance with the Treasury regulations	6 000

FOR PARTY EXPENSES—Continued.

[For contribution to the International Geodetic Association for the measurement of the earth, $550, or so much thereof as may be necessary, to be expended through the office of the American Legation at Berlin; and for expenses of the attendance of the American delegate at the general conference of said Association $550, or so much thereof as may be necessary. *Provided*, That such contribution and expense of attendance shall be payable out of the item "for objects not hereinbefore named;" and 20 per centum of the foregoing amounts shall be available interchangeably for expenditure on the objects named.]

In all for party expenses	$140 000

ALASKA BOUNDARY SURVEY:

Towards the joint survey of the territory adjacent to the boundary line of the United States of America and the Dominion of Canada between the Territory of Alaska and the Province of British Columbia, and the Northwest Territory of Canada, from the latitude of fifty-four degrees and forty minutes north, to the point where said boundary line encounters the one hundred and forty-first degree of west longitude, with a view to the ascertainment of the facts and data necessary to the permanent delimitation of said boundary line in accordance with the spirit and intent of the existing treaties in regard to it between Great Britain and Russia and between the United States and Russia, $25 000, to be available until expended $25 000

[And the whole expense of this survey on the part of the United States shall not exceed the sum of $60 000.]

FOR REPAIRS AND MAINTENANCE OF VESSELS:

For repairs and maintenance of the complement of vessels used in the Coast and Geodetic Survey $35 000

PAY OF FIELD OFFICERS:

For Superintendent	$6 000
For two assistants, at $4 000 each	8 000
For one assistant	3 600
For one assistant	3 200
For four assistants, at $3 000 each	12 000
For two assistants, at $2 800	5 600
For two assistants, at $2 600	5 200
For six assistants, at $2 400	14 400
For four assistants, at $2 200 each	8 800
For seven assistants, at $2 000 each	14 000
For nine assistants, at $1 800 each	16 200
For six assistants, at $1 600 each	9 600
For five subassistants, at $1 400 each	7 000
For two subassistants, at $1 200 each	2 400
For aids temporarily employed at a salary not greater than $900 per annum each	3 600
In all	$119 600

PAY OF OFFICE FORCE:

For one disbursing agent	$2 200
For one general office assistant	2 200
For one chief of division of library and archives	1 800
For clerical force, namely:	
For two, at $1 650 each	3 300
For two, at $1 600 each	3 200
For three, at $1 400 each	4 200
For four, at $1 200 each	4 800
For four, at $1 000 each	4 000
For chart correctors, buoy colorists, stenographers, writers, typewriters, and copyists, namely:	
For one	1 200
For three, at $900 each	2 700
For one	800
For ten, at $720 each	7 200
For one	600
For topographic and hydrographic draughtsmen, namely:	
For one	2 400
For one	2 200
For two, at $2 000 each	4 000
For three, at $1 800 each	5 400
For two, at $1 400 each	2 800
For three, at $1 200 each	3 600
For two, at $1 000 each	2 000
For three, at $900 each	2 700
For astronomical, geodetic, tidal, and miscellaneous computers, namely:	
For three, at $2 000 each	6 000
For two, at $1 600 each	3 200
For two, at $1 400 each	2 800
For three, at $1 200 each	3 600
For two, at $1 000 each	2 000
For copperplate engravers, namely:	
For three, at $2 000 each	6 000
For three, at $1 800 each	5 400
For two, at $1 600 each	3 200
For one	1 200
For one	1 000
For additional engravers, at not to exceed $900 per annum each	4 000
For electrotypers and photographers, plate printers and their helpers, instrument makers, carpenters, engineer, janitor, and other skilled laborers, namely:	
For two, at $1 800 each	3 600
For two, at $1 600 each	3 200
For two including a janitor, at $1 200 each	2 400
For nine, at $1 000 each	9 000
For two, at $900 each	1 800
For seven, at $700 each	4 900

PAY OF OFFICE FORCE—Continued.

For watchmen, firemen, messengers and laborers, packers and folders, and miscellaneous work, namely:

For three, at $880 each	$2 640
For six, at $820 each	4 920
For two, at $700	1 400
For three, at $640	1 920
For four, at $630 each	2 520
For four, $550 each	2 200
For two, at $365 each	730
	$142 930

PUBLISHING OBSERVATIONS:

For the discussion and publication of observations $1 000

OFFICE EXPENSES:

For the purchase of new instruments, for materials, supplies, and labor required in the instrument shop, carpenter shop, drawing division, and library and archives, and for books, maps, charts, and subscriptions	9 000
For copperplates, chart paper, printer's ink, copper, zinc, and chemicals for electrotyping and photographing; engraving, printing, photographing and electrotyping supplies; for extra engraving and drawing, and for photolithographing charts and printing from stone and copper for immediate use	18 000
For stationery for the office and field parties, transportation of instruments and supplies, when not charged to party expenses, office wagon and horses, fuel, gas, telegrams, ice, and washing	6 500
For miscellaneous expenses, contingencies of all kinds, office furniture, repairs, and extra labor, and for traveling expenses of assistants and others employed in the office, sent on special duty in the service of the office	5 500
Total general expenses of office	$39 000

That no part of the money herein appropriated for the Coast and Geodetic Survey shall be available for allowance to civilian or other officers for subsistence while on duty at Washington (except as hereinbefore provided for officers of the field force ordered to Washington for consultation with the Superintendent), or to officers of the Navy attached to the Survey, except as now provided by law.

PRINTING AND BINDING, COAST AND GEODETIC SURVEY:

The estimate for printing and binding is the same as for the present year.

Total Coast and Geodetic Survey (exclusive of printing and binding) for the fiscal year ending June 30, 1894 ..... $502 530

OFFICE OF CONSTRUCTION OF STANDARD WEIGHTS AND MEASURES:

Salaries, Office of Standard Weights and Measures:

For construction and verification of standard weights and measures, including metric standards; for the customhouses, other offices of the United States, and for the several States, and for mural standards of length in Washington, D. C.: one adjuster, at $1 500; one mechanician, at $1 250; one assistant messenger and one watchman, in all $4 190

OFFICE OF CONSTRUCTION OF STANDARD WEIGHTS AND MEASURES:

Contingent Expenses, Office of Standard Weights and Measures:

For purchase of materials and apparatus and incidental expenses	$500
For expenses of the attendance of the American member of the International Committee on Weights and Measures at the general conference provided for in the convention signed May 20, 1875, the sum of $600, or so much thereof as may be necessary	600
For one double quartz compensating polariscope	275
For enclosing space between Butler building and Coast and Geodetic Survey building with walls and roof to provide a suitable place for a balance of precision and mounting same	1 800
	$3 175

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1892.

EASTERN DIVISION.

STATES EAST OF THE MISSISSIPPI RIVER.

1. Maine.
2. New Hampshire.
3. Vermont.
4. Massachusetts.
5. Rhode Island.
6. Connecticut.
7. New York.
8. New Jersey.
9. Pennsylvania.
10. Delaware.
11. Maryland.
12. District of Columbia.
13. Virginia.
14. North Carolina.
15. South Carolina.
16. Georgia.
17. Florida.
18. Alabama.
19. Mississippi.
20. Michigan.
21. Wisconsin.
22. Ohio.
23. Indiana.
24. Illinois.
25. West Virginia.
26. Kentucky.
27. Tennessee.

Progress Sketches No. 1, Nos. 4 to 9, inclusive, and Nos. 14, 15, and 16, show the localities of field work in the Eastern Division. A list of Progress Sketches is given at the close of this volume.

Continuation of the topographic survey of the Schoodic Lakes toward the Northeastern Boundary Monument.—The topographical survey of the Schoodic Lakes from the limits of topography executed in preceding seasons towards the Northeastern Boundary Monument having been assigned to Assistant Stehman Forney, by instructions issued June 10, 1892, he proceeded to Vanceboro, Maine, where he organized his party, obtained canoes and camp equipage, which had been stored there, and then started for Forest City at the eastern end of Grand Lake. Here he went into camp, and having adjusted two of the signals of the triangulation, and put up forty-eight signals for the topography, he was ready to take up plane-table work, but stormy weather from June 17 to 30, prevented actual operations in the field.

His progress later in the season will be stated in the next annual report.

Under subsequent headings will be found notices of the survey of the Kennebec River, Maine, and of the reconnaissance along the Rio Grande boundary between the United States and Mexico, executed by Mr. Forney during the fiscal year.

Topographic and hydrographic survey of the Schoodic Lakes from Grand Lake northwardly.—In continuation of the survey of the Schoodic Lakes, which form a prominent part of the northeastern boundary between the United States and the Dominion of Canada, Assistant Joseph Hergesheimer proceeded in pursuance of instructions to Forest City, Maine, and on July 1, 1891, began preparations for a shore line survey of Grand Lake.

For this purpose he was furnished with three projections, each on a scale of 1–10 000, or 6·34 inches to the statute mile. Having moved his party across the lake to Weston, he began the survey from this place July 10, and on August 5, having finished the first topographical sheet, he transferred his headquarters two days later to Orient, at the head of the lake, and from this point carried on the topography of the north shore. The second plane-table sheet was finished September 10, and the third one begun the next day. Work upon this sheet was partly completed, when, on September 19, Mr. Hergesheimer's illness made it necessary for him to postpone the further prosecution of the survey till another season.

Before closing operations, signal flags in trees had been put up on the Monument stream between station Hornet and the Initial Boundary Monument so that points might be determined to facilitate the survey of the topography of the stream.

Unfavorable weather retarded the work greatly, nearly one-half of the whole number of working days being stormy.

The statistics are:

Triangulation:

Number of stations erected	5
Number of geographical positions determined	2

Topography:

Number of miles of lake shore surveyed	71·75

Mr. James H. Van Horn served acceptably as recorder in the party.

During part of the following winter and spring, Mr. Hergesheimer had charge of a party on the west coast of Florida, and after his return north, he was instructed early in June to proceed to Forest City and resume the survey of Schoodic Lakes from the vicinity of Grand Lake northwardly.

The progress of this work will be adverted to in the next annual report.

Topographical survey of Chipuneticook Lake, the lower lake of the Schoodic Lakes, Maine and New Brunswick.—Reference was made in the last annual report to the beginning of a topographical survey of the lower Schoodic Lakes to the north of Vanceboro, Maine. A plane-table survey of the lower lake, locally known as Chipuneticook (or Spednic) Lake, began June 14, 1891, by Subassistant J. A. Flemer, was completed September 19, the work having been executed on three topographical sheets, each on a scale of 1–10 000.

Mr. Flemer remarks that the first, or lower, of this chain of lakes trends mainly from west to east, although the numerous coves (some of which were probably separate lakes in former times) trend in a direction from northwest to southeast. Some of these coves are quite deep, and more or less enclosed by shores detached from those of the main lake. Only a narrow thoroughfare connects Lake Palfrey with the main lake, and hence it appears as a distinct and separate body of water.

Numerous islands, and rocks forming attenuated islands which resemble sea walls, indicate the course of the shore line in years gone by. The appearance is as though the lower lake had been divided by narrow dikes or walls of land into many distinct bodies of water, and that the action of the winds and waves, together with the rising of the level of the lake some eight feet by means of a dam at Vanceboro, had combined to wash out and eat away the narrow barriers, thus permitting the waters to join. The heads of nearly all of the coves are filled with dead boles of large trees still standing erect and indicating plainly that the area covered by these dead forests was formerly dry land, the forest growth thereon having been gradually killed by the raising of the water level.

Over the entire area under survey numberless bowlders are found scattered, many being large enough to appear above water in the coves and in the main lake, and also along the shores of the lake and islands, forming silent reminders of the drift or glacial period.

All of the country surrounding this lake is wooded, excepting a few clearings tentatively established for farming purposes, all of which, however, at this date have been abandoned. The old clearings known as the "Musquash settlement," between Musquash Stream and Deadman's Cove, and the Todd Farm, south of Muncy Cove, still yield some hay, but nobody lives on either place. The woods consist chiefly of white and yellow birch, rock and sugar maple, poplar or bass wood, white cedar, hemlock, spruce, fir, and a few pines.

Chipuneticook Lake contains good fish, chiefly pickerel, white and yellow perch, and white fish. These are caught in nets and shipped to Boston for market. The woods abound in deer; bears are frequently captured, and wild ducks frequent the low and marshy grounds in the heads of the coves in great numbers. The general abundance of game is no doubt due to the wise game laws of this section, and to the fact that enough game wardens are employed by the State for their enforcement.

With regard to his survey, Mr. Flemer observes that the shore line was accurately delineated, and that the positions of all single rocks when above water were carefully determined, but that the contour lines from the Upper Cutting-off Place above Vanceboro to Forest City Landing were mostly sketched in. These hypsometrical lines give a fair representation of the topography as far as the wooded character of the country would permit the work to be carried on without giving too much time to it.

Mr. Flemer reports a commendable performance of duty by Messrs. James F. Mitchell, Edward Sandford, and Sprigg Chesley, who served as general aids during the season.

Following are the statistics:

Topography:

Area surveyed in square statute miles	12·4
Length in statute miles of shore line of lake and island	98·8

During the winter of 1891–92 Mr. Flemer took part in a Topographical Conference called by the Superintendent, and after its close was assigned to field duty, reference to which is made later in this volume.

Detailed topographic survey of the east and west shores of the Kennebec River from Gardiner to Augusta, including the cities of Augusta and Gardiner and the towns of Hallowell, Chelsea, and Randolph.—The work of Assistant Stehman Forney on the Kennebec River during the season of 1890 included the shore line survey and hydrography of the river from Gardiner to Augusta, as stated in the last annual report.

In July, 1891, Mr. Forney re-organized his party under instructions to make a detailed topographical survey of the country on both sides of the river, going back far enough from the shores to take in the cities of Augusta and Gardiner and the towns of Hallowell, Chelsea, and Randolph as also all of the prominent topographical features on the east and west shores.

This work was executed on one plane-table sheet, scale 1–10 000. It was begun July 18, and finished October 31, 1891. The contours are shown for every 20 feet of elevation above the mean high-water level of the river. Mr. Forney states that in and around the cities of Augusta and Gardiner, the contouring involved difficult and tedious work.

Much valuable information was obtained by Mr. Forney in the course of a trip which he took down the river to its mouth on one of the towing company's tugboats with one of the river pilots, and such data as he deemed would be useful he communicated in a special report to the Superintendent. Among the suggestions which he makes for Aids to Navigation greatly needed by shipmasters and pilots are these: A steam whistle on Pond Island; a fog bell on the southwest end of Perkins Island; and a red light on Doubling Point.

Mr. J. L. Merrill, of Dartmouth College, rendered efficient service as recorder in the party.

The statistics are:

Topography:

Area surveyed in square statute miles	15
Length in statute miles of shore line of creeks and ponds	8
Length in statute miles of roads	31·5

Duty assigned to Mr. Forney on the survey of the Rio Grande during the winter of 1891–92 is referred to later in this volume.

Hydrographic examinations for the Coast Pilot between Cape Ann and Point Judith.—For the purpose of verifying the manuscript of the Atlantic Coast Pilot, Part III, covering that part of the coast and approaches between Cape Ann and Point Judith, Ensign E. H. Tillman, U. S. N., Chief of the Coast Pilot Division of the Hydrographic Inspector's Office, was directed, towards the end of June, 1892, to proceed to Boston, Massachusetts, and report to Lieut. L. K. Reynolds, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*. Instructions were at the same date given to that officer to move the *Endeavor* to such points as were desired by Ensign Tillman from time to time to facilitate the progress of his examinations. Mr. Eugene Veith, a compiler in the Coast Pilot Division, was directed to report to Lieut. Reynolds for duty as Mr. Tillman's assistant.

At the close of the fiscal year, examinations had been made of Gloucester and Salem Harbors and an examination of Boston Harbor begun.

In Gloucester Harbor, a bowlder, bare at low water, was found lying half way between red buoy No. 8 and the southern end of the wharf, to the eastward of it; but it is of little importance, as it lies near the side of the harbor and wharf which is seldom used.

In Salem Harbor, a shoal spot, reported by Capt. Phillips, of Beverly, to the northward of Little Haste Beacon, was found and located by Mr. Tillman. It is a small spot, having over it a least depth of 17 feet with from 4 to 4½ fathoms around it. Its position, as determined by angles and bearings to prominent objects in the vicinity, will be marked on the charts.

Other examinations leading to developments of importance will be adverted to in the report for the next fiscal year.

Topographical resurvey of Boston Bay and Harbor.—In pursuance of instructions, dated June 13, 1892, Assistant R. Meade Bache proceeded soon after that date to Boston and conferred with Assistant Henry L. Whiting with regard to the proposed topographical resurvey of Boston Bay and Harbor, examining the original plane-table sheets and the maps on record in Boston. A report of the results of this conference, stating what limits would be desirable for the resurvey and the scales recommended for the prosecution of the work was transmitted to the Superintendent.

During the week that remained before the close of the fiscal year Mr. Bache was occupied in preparations for field work. The progress of his survey will be adverted to in the next annual report.

Field work executed by Mr. Bache in completing the detailed topographical resurvey of the Philadelphia City Front is referred to under a subsequent heading.

Between January 18 and March 11 he was on duty in Washington as a member of the Topographical Conference convened by direction of the Superintendent.

Hydrographic resurvey of Boston Bay and Harbor.—A resurvey of Boston Bay and Harbor having become necessary in the interests of commerce and navigation, owing to changes from causes both natural and artificial, which had taken place since the publication of the chart of 1867, based upon surveys executed between 1846 and 1864, instructions were issued to Lieut. W. F. Low, U. S. N., Assistant Coast and Geodetic Survey, commanding the schooner *Eagre*, to take charge of the hydrographic portion of the resurvey.

For this work he was furnished with seven projections, each on a scale of 1–10 000, and one projection, scale 1–2 500. Five of these projections were intended for the commanding officers of the steamers *Blake*, *Bache*, and *Endeavor*, these vessels having been assigned to the Boston Bay work, and their commanders directed to report to Lieut. Low upon their arrival in the harbor.

Lieut. Low has submitted a summary report of progress up to the close of the fiscal year.

He anchored in Nantasket Roads on the evening of May 26, 1892; was towed up to the Navy Yard next day, and at once took up work on projection No. 8, scale 1–2 500, covering the inner harbor of Boston. His survey was in active progress at the close of the fiscal year.

The following named officers were attached to the party on the *Eagre:* Lieut. C. S. Ripley, U. S. N.; C. H. Deetz, draughtsman, United States Coast and Geodetic Survey; Paymaster's Yeoman R. W. Stevens, U. S. N., and Ship's Writer Wm. B. Proctor, U. S. N.

Up to June 30, Lieut. Low reports the following statistics:

Hydrography:

Number of miles run in sounding	43
Number of angles measured	1 355
Number of soundings	5 433

Topographical survey of a specified area south of Plymouth, Massachusetts.—A report with sketch showing work accomplished in the spring and summer of 1892 up to June 30, has been submitted by Subassistant J. A. Flemer, who went to Plymouth, Massachusetts, under instructions to make a topographical survey of a selected area on a scale of 1–30 000 to the south of that town. Before beginning the survey, Mr. Flemer was directed to confer with Assistant H. L. Whiting, whose familiarity with the country would enable him to give information that would facilitate field operations.

Between May 28, when a reconnaissance for the work was begun, and the end of the fiscal year, the party under charge of Mr. Flemer had surveyed an area of 6·6 square miles, bounded on the north by the southern county road from Plymouth to Manomet; on the east by the road leading from the Manomet Grammar School through Nichol's farm to Fresh Pond, thence along Island Pond Road to Island Pond; thence in a northwesterly direction to Wright's clearing; and after taking in Telegraph Hill, the western boundary follows the Sandwich Road to Eel River.

Mr. Flemer observes that the country is wooded except in the immediate neighborhood of Eel River and Manomet; the woods are of a mixed growth mainly, but on the Pine Hills south of Manomet Hill pines predominate. The undergrowth is dense, and consists chiefly of scrub oak. Very little farming is done in this section, the sale of wood for fuel, and the raising of cranberries on artificially made bogs, being the main sources of income to the land owners.

The section surveyed contains three ponds—Beaver Dam, Little Island, and Ford's Pond —which are all well stocked with bass, perch, and pickerel.

All roads intersecting the area surveyed were traversed, and the shore lines of the ponds were run out with the plane table. After the elevations and geographical positions of the hill tops had been determined, and the topography along the roads had been mapped, the topographical details remaining were sketched in. The work was controlled by 247 plane-table stations, giving an average of 37·4 stations to a square mile. Its progress after June 30 will be stated in the next annual report.

Mr. Flemer reports the following statistics up to the end of the fiscal year:

Topography (scale 1–30 000):

Number of miles of roads run	20
Number of miles of creeks run	2
Number of miles of shore line of ponds run	10

Service assigned to Mr. Flemer earlier in the fiscal year is referred to under headings in the States of Maine and Rhode Island, and in the District of Columbia.

Continuation of the surveys of town boundaries for the State of Massachusetts.—Service as a member of the Mississippi River Commission and as a Commissioner of the Massachusetts Topographical Survey.—Assistant Henry L. Whiting, in the general report which he has submitted of the duties performed by him during the fiscal year, states that in accordance with the general tenor of his instructions and orders he has regarded his official service to the Coast and Geodetic Survey as his first duty, and next in order his service when called for by the Mississippi River Commission, and, lastly, his service to the State of Massachusetts as one of the Commissioners of the Topographical Survey of that State.

In addition to personal attendance on special occasions at the office and in field duty of the Coast and Geodetic Survey, and at meetings of the Mississippi River Commission, and at Boston and elsewhere in Massachusetts in connection with his office as Secretary of the State Commission, his time and services have been conjointly given throughout the year to the studies and correspondence incidental to his several official relations.

Mr. Whiting attended the following-named meetings of the Mississippi River Commission: From July 13 to 19, 1891, at New York City; November 1 to 20, on the Mississippi River, including travel and an inspection of the river with the Commission; May 1 to 12, 1892, a second trip of inspection of the river; and from June 20 to 24 in New York City.

During the first part of July and again from July 20 to October 31, 1891, he was engaged in directing, supervising, and inspecting the field and office work of the Massachusetts State Survey, including the town boundary work, the immediate execution of which was, as for some years past, in charge of Assistant C. H. Van Orden.

The town boundary survey was carried forward with substantially the same force and organization in field and office as during the preceding year. The party assigned to the charge of Mr. E. E. Peirce was in the field from May 4 to October 22, 1891; the party of Mr. J. B. Tolley took the field and closed operations on the same dates. This part of the work was done chiefly in Essex and Middlesex counties, and was carried on in the manner and according to the methods heretofore described in the annual reports. The revision of the large body of work which had been left unfinished by the late Mr. Walling was again assigned to Mr. E. G. Chamberlain, who had been his chief assistant, and whose familiarity with all of its details made his services of special value. Mr. Van Orden, in addition to the supervision of the field work and the computation of results, executed some special field work in determining points in the boundary line between Massachusetts and Rhode Island, the town authorities of Fall River having asked that certain points in this line should be verified and in part determined. He states that this proved to be a complicated piece of work. The part of the boundary line to be determined begins at Mount Hope Bay and passes in an easterly direction over high ground, thickly built up with factories and houses, to a point in the middle of one of the city streets, but well marked; thence in the same direction to an undefined point in the waters of a mill pond some 500 or 600 feet from its shore, thence southward to marked points in the line, and thence eastward to Watuppa Pond. In order to determine the location of the corner point in the pond, a triangulation had to be made which would furnish data for computing the azimuth of the line; the determination of special stations was required also to locate the end of the line on the shore of Buzzards Bay.

All of the field work of this State survey down to and including that of 1890 has been submitted to examination and verification in the office of the Coast and Geodetic Survey.

For the season of 1891 the following statistics are reported by the Commissioners as showing the total results:

Number of townships surveyed	21
Number of boundary points determined	241
Number of stations occupied	318
Number of traverse lines run	80
Number of signals put up	271

After returning from the second meeting of the Mississippi River Commission, already referred to, Mr. Whiting resumed his duties in Massachusetts. From January 17 to March 16, 1892, including time of travel, he was on duty at the office of the Coast and Geodetic Survey as chairman of the Topographical Conference convened by order of the Superintendent. (See the proceedings of this Conference as published in the Report for 1891, Part II, Appendix No. 16.)

Returning thence to Massachusetts he was in conference from April 2 to 9 with Assistant H. G. Ogden, who had been instructed by the Superintendent to serve the State Commission as an inspector of an edition of the atlas sheets of the topographical map of Massachusetts, printed by the Forbes Lithograph Manufacturing Company of Boston. Mr. Whiting states that by this inspection, a report of which was made to the Superintendent, Mr. Ogden rendered most valuable service to the State of Massachusetts and to the Commission.

During the remainder of the fiscal year, with the exception of the time occupied in attendance at the meetings of the Mississippi River Commission, Mr. Whiting continued on duty in connection with the Massachusetts State survey. Towards the end of June, 1892, he was instructed to confer with Assistant R. Meade Bache in regard to the proposed topographic resurvey of Boston Harbor, and to report the results of the conference to the Superintendent.

Completion of the hydrographic resurvey of Nantucket Shoals.—The methods adopted by Lieut. Edward M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, to overcome the difficulties incidental to the resurvey of Nantucket Shoals, were outlined in the last annual report. This important work, begun in the summer of 1890, was resumed by Lieut. Hughes in June, 1891, his party having been organized as before on the steamer *Bache*. Under instructions by the Superintendent, supplemented by detailed instructions from the Hydrographic Inspector, Lieut. C. E. Vreeland, U. S. N., Assistant Coast and Geodetic Survey commanding the steamer *Blake*, and Lieut. L. K. Reynolds, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, were directed to coöperate with Lieut. Hughes in his capacity as senior officer of the resurvey.

For this work the parties were furnished with four projections, three of which, Nos. 14, 11, and 15, each on a scale of 1–40 000, included the waters lying to the south, to the east, and to the southeast of Nantucket; and the fourth, No. 16, on a scale of 1–20 000, included the approaches to Nantucket Harbor and the shoal areas to the north and northeast of it in the vicinity of Monomoy Light.

It was decided, with the approval of the Hydrographic Inspector, that advantage would be gained by granting to each commanding officer authority to act upon his personal judgment in everything relating to his own hydrographic sheets. The report made by Lieut. Hughes deals at length, therefore, with the work of the *Bache* only, and separate reports upon their respective resurveys have been made by Lieutenants Vreeland and Reynolds.

The general method of procedure was to develop first the leading features of the shoals as a whole by a fairly regular system of lines, and afterwards to make a more careful examination of the channels, rips, and shoal spots thus found.

On sheet No. 11, scale 1–40 000, the work was done by the *Bache*, with the exception of 75 miles by the *Endeavor*, just south of Bass Rip, and 161 miles by the *Blake* over the shoal lying to the southward and westward of Davis's South Shoal Light Vessel.

For offshore signals the old Coast Survey schooner *Scoresby*, the light vessel just named, and a number of buoys put in position by the tender *Azalea*, of the Second Lighthouse District under Lieut. Vreeland's supervision, were used. Nine of these were first-class can buoys and six first-class spars, and they were placed on the shoals within the limits of the western half of sheet No. 11. Upon the completion of the hydrography in their vicinity, eight of the can and two of the spar buoys were shifted early in September to positions in which they formed a line of signals extending nearly north and south along the eastern edge of the same sheet. The can buoys, regardless of depth of water, were anchored with 30 fathoms of chain and heavy granite sinkers weighing from 2 000 to 3 000 pounds each; the spar buoys were anchored with sinkers somewhat lighter, and length of wire rope so cut with reference to depth of water that the spars would "watch" properly. It was found by experience that a mean distance apart of two geographic miles for the water signals was desirable, and that evergreen boughs supported on flagstaves secured to them were much more easily distinguished than flags. The positions of the floating signals were verified whenever practicable, and but two were found to have dragged.

Lieut. Hughes, upon a review of the accuracy of lines of soundings depending on offshore buoys, concludes that the general results obtained by their use may be considered as satisfactory.

His report contains full data derived from careful observations of the tides and currents on Nantucket Shoals, and notices of the changes of formation in the shoals. Of these the principal are the extension to the northward from Old South Shoal; the growing of the Rose and Crown to the northward; the deepening of the water on Davis's South Shoal; the disappearance of lumps on McBlair Shoal; and the disappearance of shoal lumps to the southward of Bass Rip. The least water found on Davis's South Shoal was 15½ feet.

During the summer of 1891 the weather experienced was in marked contrast to that of the corresponding season of the previous year, being extremely unfavorable. The month of

August was unusually hazy and foggy, September was fair, and October and November very stormy.

Assistance was rendered by the *Bache* to the Chatham life-saving crew on October 24.

On September 21 and 22, in the middle of a fortnight of fine weather, a phenomenally heavy swell prevailed on the shoals, in connection with a glassy sea and entire absence of wind, the barometer standing at about 30 inches.

The officers attached to the *Bache* were Lieut. W. L. Burdick, U. S. N., and Ensigns W. W. Buchanan, W. B. Hoggatt, and J. W. Oman, U. S. N.

For the season the statistics of hydrography executed, and the results of which are shown on sheet No. 11, scale 1–40 000, are as follows:

Hydrography:

Area sounded in square geographical miles	700
Number of miles (geographical) run while sounding	1 225
Number of angles measured	4 317
Number of soundings	20 382
Number of specimens of bottom preserved	58

These statistics include 236 miles run in sounding, 666 angles measured, and 3 443 soundings taken by the steamers *Blake* and *Endeavor* within the limits of projection of sheet No. 11.

After closing field work November 4, Lieut. Hughes proceeded under instructions with the *Bache* to the Navy Yard, New York, where she was prepared for work in the Gulf of Mexico. Reference to this service is made under a subsequent heading.

Lieut. Vreeland, commanding the *Blake*, refers at the outset of his report to that of Lieut. Hughes as describing fully the scope of the season's operations, and states that he will therefore confine himself to an account of the work of his own party and the results he attained. The hydrography assigned to him was included in sheets Nos. 14 and 15, scale 1–40 000, No. 14, covering the area to the southward of Nantucket, and between the limits of latitude 40° 52′ to 41° 14′ north and longitude 69° 58′ to 70° 18′ west; No. 15 between the limits of latitude 40° 55′ to 41° 28′ north and longitude 69° 18′ to 69° 42′ west.

As soon as the arrival of the Lighthouse tender *Azalea* made it possible to begin the work of fixing into position the can and spar buoys intended for offshore signals, her commander reported on board of the *Blake*, and by July 11 they were all in place. On July 30, the Hydrographic Inspector having been informed by Lieut. Vreeland that the hydrography included in the limits of sheet No. 14 had been practically finished, he was ordered to report to Lieut. Hughes for such duty as he might assign in connection with the work on sheet No. 11. This accomplished, the *Blake* awaited the removal of the buoys from the limits common to sheets Nos. 11 and 14 on the west, to the limits common to sheets Nos. 11 and 15 on the east; Lieut. Vreeland then, on September 5, took up the hydrography on sheet No. 15, with limits as just stated. On September 25 the last line of soundings on this sheet was run, after which the *Blake* returned to Nantucket, and early in October her commander received telegraphic orders to return to New York.

Lieut. Vreeland observes that while the survey of the shoals and rips on sheet No. 15 is not by any means a thorough development but rather in the nature of an examination, he believes that all dangerous water has been located, and that the general outlines of the shoals have been fairly indicated.

His report is accompanied by a tabular statement of the times of observations, velocities, and directions of the currents observed during the season from on board the *Blake*. Specimens of bottom were obtained and examined frequently, but being found to correspond in every instance with the kind of bottom indicated on the chart, it was not thought necessary to preserve them.

Following is a list of the officers attached to the party: Lieut. H. Kimmell, U. S. N.; Ensigns W. C. P. Muir, J. H. Rohrbacher, and Benj. Wright, U. S. N.; Assistant Engineer W. W. White, U. S. N., relieved July 30 by Assistant Engineer W. H. Creighton, U. S. N.; and

Assistant Surgeon E. S. Bogert, Jr., U. S. N. Lieut. Vreeland observes that while all the officers performed their parts with zeal and intelligence he desires especially to commend the services of Ensigns Rohrbacher and Wright. Pay Yeoman W. S. Crosby rendered acceptable assistance both as observer and recorder.

For the work done on sheets Nos. 14 and 15, the statistics are as follows:

Hydrography:

Area sounded in square geographical miles	772
Number of miles (geographical) run while sounding	1 048
Number of angles measured	1 316
Number of soundings	7 805

On October 16, Lieut. Vreeland was directed to bring the *Blake* to the Washington Navy Yard, and on reporting there on the 19th, the steamer was turned over temporarily to the Navy Department, and on October 30 and again on November 13, she conveyed the Honorable Secretary of the Navy and his guests to Indian Head on the Potomac to witness the important armor trials then in progress at that point.

Subsequently, on her retransfer to the Treasury Department, the *Blake* was ordered to Baltimore for repairs to fit her for work on the coast of South Carolina. Reference to hydrography executed by Lieut. Vreeland in the winter of 1891–92 is made later in this volume.

After the completion of his hydrographic work in southern waters, he was instructed to proceed to Nantucket Shoals and execute the hydrography required to connect the work of the *Bache*, *Endeavor*, and *Blake* during the seasons of 1890 and 1891, in an area included approximately between the limits of latitude 41° 25′ and 41° 30′ north and longitude 69° 38′ to 69° 52′ west. Arriving at Nantucket in the *Blake* on June 16, he began at once the work of sounding over this area, and at the end of the fiscal year but a few days of favorable weather were needed to complete it.

During the season of 1892, the officers attached to the *Blake* were Lieut. John Gibson, U. S. N.; Ensigns W. C. P. Muir and M. K. Eyre, U. S. N., and Assistant Surgeon J. A. Guthrie, U. S. N. Pay Yeoman W. S. Crosby continued to serve as observer and recorder.

Up to June 30, 1892, the statistics are:

Hydrography:

Number of miles (geographical) run in sounding	202
Number of angles measured	554
Number of soundings	3 118

Lieut. L. K. Reynolds, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, after having completed in the spring of 1891, an examination of a shoal reported off Smith Point, at the mouth of the Potomac, and a survey of Horseshoe Shoal, near Chesapeake Entrance, proceeded under instructions to Nantucket, Massachusetts, and began that portion of the resurvey of Nantucket Shoals which had been assigned to him on June 23.

After establishing a siphon tide-gauge in position outside of Great Point, soundings were begun off Monomoy Point with the steam launch, and were continued whenever the weather would permit until November 5, when work was closed for the season. The hydrography executed by the party of Lieut. Reynolds included the channels at the eastern entrance to Nantucket Sound. The lines were run generally a quarter of a mile apart, except where shoal spots were found, and then the lines were run as closely as was required to develop the shoal. The great irregularities of the bottom made it necessary to multiply largely the number of lines run, and the strength of the tides and the varying directions rendered the work one of great difficulty, especially when using the steam launch. Consequently the greater part of the work was done by the *Endeavor*.

The shoal to the southward of Shovelful Shoal Light Vessel was carefully developed; also Great Point Rip, and the entrances to the channels to the north and to the east of Pollock Rip Light Vessel.

The positions of each light vessel and buoy included within the limits of the projection were carefully located, also the positions of all wrecks, which were very numerous during the progress of the season's work.

In September, under the direction of the Hydrographic Inspector, assistance was given by Lieut. Reynolds, in the planting and location of a line of buoys to the eastward of the Island of Nantucket, intended to be used as signals by the *Bache* and *Blake* in a survey of the outlying shoals.

The following named officers were attached to the party on the *Endeavor:* Ensigns Thomas W. Ryan, John Gibson, and Hugh Rodman, U. S. N.; Pay Yeoman J. McC. Tiffany, U. S. N., and Seaman Emory Stineman, recorders. Lieut. Reynolds commends heartily all of the officers for their faithful work, and their excellence as observers.

He reports the statistics of the season as follows:

Hydrography:

Number of miles run in sounding	755
Number of angles measured	6 084
Number of soundings	32 540

Reference to service rendered by Lieut. Reynolds while commanding the *Endeavor* in the summer of 1892, in aid of hydrographic examinations for the Coast Pilot, has been referred to under a preceding heading.

Detailed topographical survey of the north shore of Nantucket Sound from Falmouth Heights to Hyannis Light.—The need of a shore line survey for the use of hydrographic parties working in Nantucket Sound and vicinity having been met during the summer and autumn of 1890 by Assistant D. B. Wainwright, he took up under instructions in June, 1891, a detailed topographic survey back of the shore line from Falmouth Heights to Hyannis Light. Begun June 19, this work on a scale of 1–10 000 was finished November 1, the distance between the two points along the coast line being 18 miles.

Within the area of topography are included the villages of Teaticket, East Falmouth, Waquoit, South Mashpee, Cotuit, Osterville, Centerville, Craigville, and Hyannisport. Outside of these Mr. Wainwright remarks that the country is sparsely inhabited and largely covered on the high dry land with a growth of oaks and pines.

The fresh water bearing stratum seems to coincide with the low water line of the sound, and, owing to the fact that the seepage or ooze of fresh water along the banks of the salt ponds and bays is plentiful and continuous, and also to the absence of freshets, very favorable conditions exist for oyster culture.

Mr. Wainwright refers to a very remunerative industry which has sprung up on this coast since the time of the earliest survey, 1846. This is the cultivation of the cranberry on what was formerly almost worthless cedar swamp. The plants are set in a layer of sand which is deposited upon the swamps to a depth of from 12 to 18 inches after they have been cleaned of all growths, leveled, and ditched. The most valuable bogs are those which can be most easily and quickly flooded. They are kept flooded, in order to protect the plants, from November until May, when the water is drawn off.

Owing to the generally flat and wooded character of the country, but little plane-table triangulation could be done, hence the detail of a large portion of the area surveyed had to be determined from traverse lines run back from the coast. Great care was taken to check these lines by connecting them with others determined from interior points situated on the main road. To facilitate the contouring and to increase its accuracy, a line of levels was carried from Falmouth Heights along this road to the Mashpee River. The survey was expedited whenever practicable by a division of the party, Mr. Wainwright taking the large plane table with two aids, and the smaller one being assigned to his foreman and recorder.

The old survey gave no contour lines, the bluffs and abrupt changes in elevation being shown by hachuring. Comparison with the present survey indicates but slight changes along the sound in view of the unstable material (sand) which forms the beaches and bluffs. The loss from erosion was found to have averaged but 10 metres in forty-five years.

Mr. Walter B. Hindmarsh served as foreman in the party, Mr. R. J. McAdory as recorder, and Messrs. W. T. Oliver and L. W. Cottman as rodsmen. Mr. Wainwright reports that during this and the two previous seasons, Messrs. Hindmarsh and McAdory have become quite proficient in the use of the plane table, and they executed the survey of a large portion of the shore line and roads.

The statistics are:

Topography (four plane-table sheets on 1–10 000):

Area surveyed in square statute miles	33
Length of general coast in statute miles	18
Length of shore line of rivers, creeks and bays in statute miles	94
Length of shore line of ponds in statute miles	5
Length of shore line of marshes in statute miles	58
Length of roads in statute miles	70·5

During the winter and spring of 1891-92, Mr. Wainwright participated in a Topographical Conference organized at Washington by direction of the Superintendent. Early in March he was instructed to take charge of the preparations then in progress for an exhibit by the Survey at the World's Columbian Exposition.

Completion of the physical hydrographic survey of the south coast of the island of Nantucket from Weeweder to Smiths Point, and similar survey begun on the south coast of Marthas Vineyard.—Reference was made in the last annual report to the progress of the physical hydrographic survey of the south coast of Nantucket, under the direction of Assistant Henry L. Marindin, who had established his party in camp at the end of June, 1891, in the vicinity of Great Neck Life-Saving Station.

From this camp the survey was carried as far as Smiths Point at the western end of the island. Cross-sections of the south shore, averaging one in each 600 metres of shore line, with levels, were taken; new shore line was determined by plane table, and lines of levels were run connecting the sections with the previous work, and with the bench-marks established as the work advanced.

The results of the Nantucket survey, which was finished by the end of July, are shown on two hydrographic sheets, scale of each 1–10 000, No. 1 from Miacomet Rip to Long Pond, Nantucket; No. 2 from Long Pond to Smiths Point.

Early in August, Mr. Marindin transferred his party to Marthas Vineyard, and established his camp at a point near the western end of Katama Bay. From this locality all parts of the bay and shore line could be reached by boat, and the outer shore in the vicinity afforded a safe place for fixing in position the siphon tide-gauge.*

Before deciding finally upon the plan of survey that would best suit the conditions of work in Katama Bay and Edgartown Harbor, Mr. Marindin conferred with Assistant Whiting, who had made some observations during the early part of the summer in continuation of his studies of the changes on the south shore of the island. Since the inlets through Katama Beach had increased to three, an examination of the tides and currents throughout the bay and inlets became desirable, the régime of these phenomena having materially changed, so that vessels entering the inner harbor of Edgartown found greater difficulty than formerly, both in entering and in lying at anchor. The field work was carried on, therefore, with a view of obtaining some data bearing on the question, while at the same time the observations of cross-sections with soundings and levels were continued on the outer shore.

In addition to the siphon tide-gauge on the outer beach (No. 1) three other tide stations were located—No. 2 within Katama Bay, just inside the west point of the western inlet; No. 3 at the "Swimming Place," so called, which is the narrowest part of the passage between the bay proper and the inner harbor of Edgartown; and No. 4 at Edgartown Harbor Light, so as to obtain the Sound tide. These gauges were of the box pattern. The strength and

*See description of this form of gauge in Bulletin No. 12, "A siphon tide-gauge for the open seacoast."

direction of the tidal currents were observed at points near the tide stations, but the attempt to secure a full series of these observations within the inlets through Katama Beach was not successful, because of the difficulty of holding boats in position during the tide. The results from the current and tidal observations which were made indicate that it will be well to have a larger series observed at some future time.

Within the bay the lines of soundings were run so as to serve both as cross-sections and as longitudinal sections at any part of it, and to enable comparison to be made with any former surveys. During the greater part of the season, very turbulent seas interfered with soundings off the south shore, and a thorough examination of the bars off the inlets had therefore to be deferred.

On October 11 a severe gale struck the camp and somewhat hastened preparations for closing. The gale increased in force till the night of October 13, when nearly all the tents were rendered uninhabitable, those not blown down being deluged with rain. Care had been taken, however, to store the records and instruments in a small depot house, where they were secure from damage by the storm.

Field operations were closed for the season in accordance with instructions on October 19.

Mr. Marindin acknowledges his indebtedness for faithful services to all of the members of his party, but especially to Mr. Homer P. Ritter, expert in physical hydrography; to Messrs. M. V. Safford and C. E. Mendenhall, recorders, and to Louis Brigham. He commends highly Mr. James A. Gould, coxswain of the surf boat, and Elmer E. Snow, quartermaster, both of whom had been members of parties in his charge for three years previous.

During the following winter and spring, until early in May, 1892, Mr. Marindin was on duty at the office in Washington, engaged on the computation of the results of his field work and in the preparation of tables and drawings to accompany his reports, Mr. Ritter assisting him. Before resuming field operations, he submitted a report on the tides and currents in the harbor of Edgartown and in Katama Bay, based upon observations made during the summer of 1891. This will be published as an appendix to the Report of the Superintendent for 1892, Part II. It will precede a report to be made subsequently on a comparison of the changes in the shores and bottom of the harbor since former surveys.

Instructions having been received to proceed to Marthas Vineyard and continue the physical hydrography of its south shore, Mr. Marindin re-organized his party, and by the middle of May was in camp at Pahgonet, near Jobs Neck, about 7 miles southwestwardly from Edgartown. The work was then taken up at the west end of Katama Bay, where it had been left off at the close of the preceding season. Cross-sections of the south shore laid out at even distances apart of 1,000 feet were sounded out to a depth of 36 feet. Lines of spirit leveling were run from low water across the beach to points inland varying in distance with the features to be delineated; the cross-sections were then connected with each other by a double line of levels, and by reference to the bench marks and tide-gauges. A siphon tide-gauge was set up, the float-pipe being sunk at a point on the beach off the camp at Pahgonet; this gauge was used in connection with one of Stierle's automatic gauges, the only form that could have been maintained on that exposed shore. The positions of the sections and the shore line were delineated with a plane table.

Mr. Marindin remarks that a definite opinion of the extent of the changes which take place on the south shore of the island can not be given without a comparison with previous surveys, but there is abundant proof that erosion is the rule. Mr. Smith, of Pahgonet, states that during his lifetime many hundred feet of his valuable meadow land have been cut away by the encroachments of the sea, and other testimony is to the same effect.

A feature of this locality lies in the periodic opening of outlets through the beaches to allow a flow of the water from the numerous ponds scattered along the shore; this being done either to maintain the herring fishery or to drain the water off the salt marshes so that salt hay may be made and harvested. For a successful opening of the outlets the favorable

conditions are the time of spring tides, a smooth sea, and the moment of low water for the final cut on the seaward side. The available head of water in the ponds for inducing the necessary velocity of current is nearly 5 feet. On June 23, 1892, the surface of Herring Pond was ascertained to be 4·9 feet above mean low water, that of Jobs Neck Pond 4·6 feet and that of Oyster Pond 4·4 feet. None of these ponds had been opened at the date specified with the exception of Herring Pond, which has a permanent outlet into Katama Bay through a long ditch.

The outlets which have been opened artificially, when maintained by favorable conditions for any length of time, follow the general rule along this shore of traveling to the eastward, their history being a reproduction of that of the outlets opened by the sea through Katama Beach.*

Among the characteristics of the south shore, so far as examined, may be mentioned the existence of an almost continuous bar a short distance from the shore, upon which the seas almost always break at low tide. Whatever the direction of the wind, it has been observed also that the waves approach the beach in a line parallel to it and break simultaneously for a long distance.

Mr. Homer P. Ritter, was attached to the party during this as during the last field season, and Messrs. Victor Safford, and George O. Glavis, Jr., served as recorders.

At the close of the fiscal year, the party was actively engaged in the prosecution of the work to the westward. For the seasons 1891 and 1892, the statistics reported are as follows:

Topography:	
Length of general coast surveyed in statute miles	20
Physical hydrography:	
Number of soundings on cross-sections	8 502
Number of cross-sections laid out	94
Number of miles of shore line determined for cross-sections	19·5
Number of cross-sections sounded	73
Number of angles on cross-sections	2 175
Number of levels run	35
Number of bench marks established	9
Number of observations of currents made at stations	1 331

The results of the work are shown on four hydrographic sheets, each on a scale of 1–10 000 the limits of which are No. 1, from Miacomet Rip to Long Pond, Nantucket; No. 2, from Long Pond to Smiths Point, Nantucket; No. 3, Katama Bay and Edgartown Harbor, Marthas Vineyard, and No. 4, Katama Bay to Tisbury Great Pond.

Hydrographic examination in the vicinity of Squipnocket Ridge Shoal.—A question having arisen in regard to the least water upon the detached shoal in the vicinity of the dangerous ledge of rocks known as Squipnocket Ledge in the channel between No Man's Land and Marthas Vineyard, Lieut. Edward M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Bache*, was directed to make the desired soundings.

This work was accomplished while he was *en route* from Edgartown to New York on November 9, 1891. One boat ran a system of parallel lines over the shoal and the other a system of lines radiating from the red spar buoy No. 2, each system completely covering the detached shoal with lines close enough to develop any danger except a detached "pinnacle" rock.

As soon as a sounding of but three fathoms was obtained, a barrel buoy was dropped and the ground in the vicinity carefully gone over. The least water found was 16 feet, which afterwards reduced to a little less than 15 feet, at a point 50 metres east of the barrel buoy.

The sounding book, and a sketch showing the vicinity of the shoal and the two systems of lines run, was delivered to the Hydrographic Inspector November 14, and a verbal report

*See Annual Reports for 1886, App. No. 9, and for 1889, App. No. 14.

of the examination made to him. The sketch showed also the position of the barrel buoy, and the positions of the other buoys, etc., in the locality.

For this work the statistics are:

Hydrography:

Number of miles (geographical) run in sounding	10
Number of angles measured	5
Number of soundings	777

Automatic tide-gauge record continued at Bristol, Rhode Island.—Reference was made in the last annual report to the acceptance by the Superintendent of the liberal offer of Mr. Nathaniel G. Herreshoff, of Bristol, Rhode Island, to set up and keep in operation, without charge to the Survey, an automatic tide-gauge at that port, provided the gauge were furnished by the Survey.

The record from this gauge, which was begun August 6, 1890, has been continued without interruption, and has supplied valuable data for the study of the complicated tides of Narragansett Bay.

Establishment of an automatic tidal station at Fort Adams, Newport, Rhode Island.—It being very desirable to strengthen the tidal data upon which the tide tables for Newport, Rhode Island, are based, the officers of the Corps of Engineers stationed at Fort Adams kindly consented to superintend the establishment and operation of an automatic tide-gauge at that post. Accordingly a gauge forwarded from the office of the Survey was set up and put in motion March 31, 1892, and its records have been received to the end of the fiscal year.

Detailed topographical survey of Coasters Harbor Island for the Navy Department.—The extensive improvements on Coasters Harbor Island in connection with the Naval War College and Naval Training Station, which were projected or in progress in November, 1891, led the Navy Department to request the Superintendent to have made a detailed topographical survey of that island. In pursuance of this request, received through Commodore F. M. Ramsay, U. S. N., Chief of the Bureau of Navigation, Subassistant J. A. Flemer was directed to confer with Capt. F. M. Bunce, U. S. N., commanding the training station, and to execute the survey upon the scale deemed desirable.

Mr. Flemer arrived at Newport November 12, and, after conferring with Capt. Bunce, began the work on a scale of 1–600 or 50 feet to 1 inch. Three projections upon this scale were furnished by the Coast and Geodetic Survey office, but, as only one of the old triangulation points could be plotted upon them, a base line of 270 metres (885·8 feet) was measured and a plane-table triangulation made. The line of mean low water, which was adopted as the plane of reference for the altitudes, was established by tidal observations, and was carefully run out as shore line. Topographical contour lines were run at vertical intervals of 2 feet, and were located with a level.

Frequent plane-table stations were made necessary by the large scale of this survey, and Mr. Flemer found it convenient to take charge personally of both the plane table and level, keeping both instruments close together.

The plane-table sheets show every tree, each telegraph and electric light pole, etc., in correct positions.

On December 21, the survey was completed, and a tracing of that part of the island where some engineering work was in progress had been furnished to Capt. Bunce.

Mr. D. S. Chesley rendered faithful service as rod and telemeter man.

The statistics are:

Topography (scale 1–600):

Area surveyed in square statute miles	0·16 (in acres 101)
Length of general coast in statute miles	2

During the winter of 1891–92, Mr. Flemer took part in a Topographical Conference called by the Superintendent, and subsequently did field work in the District of Columbia, which is referred to elsewhere in this volume.

Topographic and hydrographic survey of the Connecticut River from Chester to Hartford.—At the beginning of the fiscal year, the party of Assistant W. I. Vinal had been in the field since June 15, 1891, occupied in carrying forward from Chester, Connecticut, the topographic survey of the Connecticut River to the northward and northwestward. This topographic work had been taken up by Mr. Vinal while waiting for the survey of the shore line north from the town of Cromwell to be advanced sufficiently to enable him to resume the hydrography.

On August 4, this shore line having become available, the party and outfit were removed to South Glastonbury, and a hydrographic survey of the river was begun which was extended to 2½ miles north of the bridge at Hartford. Tide-gauges were placed at South Glastonbury Wethersfield, and Hartford, and connected by a series of simultaneous readings. As the stage of the river differed from that of the preceding year, tidal observations were repeated at Higganum and Middletown. Assistant Hodgkins, who had charge of a topographical party on the river between Middletown and Hartford, ran a line of levels in connection with his survey, and at Mr. Vinal's request he connected the tidal bench marks by lines of spirit leveling

Upon the completion of the hydrography, September 24, the plane-table survey was resumed in the vicinity of East Haddam, and continued till November 17, when field operations were closed.

Mr. Vinal has submitted a descriptive report for file with his topographic and hydrographic sheets in the archives. To his season's report he has appended copies of letters and legal opinions relative to a question which is exciting great interest in Hartford and other cities and towns on the Connecticut, namely, whether the navigation of the river is not unlawfully obstructed above Hartford by a bridge having a draw which the Bridge Commissioners refuse to have opened.

Following are the statistics of the season:

Topography (scale 1–10 000):	
Area surveyed in square statute miles	7·5
Length of shore line of creeks and ponds in statute miles	22·5
Length of roads in statute miles including railroad	32·25
Hydrography (scale 1–10 000):	
Area sounded in square geographical miles	7
Number of miles (geographical) run while sounding	102
Number of angles measured	972
Number of soundings	10 558
Number of tidal stations established	3

On returning to Washington Mr. Vinal was occupied in inking his topographical sheet, and in January, 1892, was assigned to duty in the party of Assistant J. B. Baylor, who was charged with making a connection between the surveys of Perdido and Mobile Bays.

Topographical survey of the Connecticut River and triangulation incidental thereto carried from Middletown to Hartford.—Having resumed the topographical survey of the Connecticut River from Middletown northward early in June, 1891, Assistant W. C. Hodgkins had reached Cromwell at the beginning of the fiscal year. The completion of the shore line of the Connecticut to the northern limit of the survey was the first object aimed at so that the hydrographic party of Assistant Vinal might proceed without delay.

At the outset it was found necessary to occupy such stations of the old triangulation as could be recovered, and to establish new stations for horizontal angle measurements in order to obtain additional points for the topography. The station Westfield of the secondary triangulation in the western part of Middletown was recovered, and from this point and Schoolhouse Hill, in the town of Rocky Hill, the position of Taylor was located and the station reëstablished. Other points were determined in position for use on the plane-table sheet, including Hartford and the river above and below that city, a subordinate scheme of

triangulation having been laid out in continuation of the one just referred to. By September 17, notwithstanding delays from very hazy and smoky weather throughout August, the shore line survey was completed and tracings of it, with the positions of numerous points, were furnished to Assistant Vinal.

The remainder of the season was divided between the completion of the triangulation and the continuation of the topography, both being hindered by constant haze and smoke, and by the remarkable drought which almost exhausted the supply of drinking water. In Hartford, during October and November, drinking water of good quality sold at the rate of twenty-five cents per gallon, and the ordinary supply for the city was obtained from the Connecticut.

Field operations were closed November 25. Mr. W. P. Bullock, who had served as levelman for two years in the survey of the District of Columbia, was foreman in the party and rendered diligent service. Mr. L. L. Stevens served acceptably from the middle of June to the middle of September. Mr. A. C. Gray reported for duty as recorder on June 22 and served until July 31, when at his own request he was discharged.

Mr. Hodgkins acknowledges the facilities afforded him by the postmaster at Middletown, Mr. J. Harris Warner, and his assistant, Mr. F. D. Scranton, in giving him the use of rooms in the post office building. Also similar courtesies on the part of John J. Hutchinson, collector of internal revenue at Hartford and custodian of the Government building in that city, who placed a spacious apartment at his disposal for office purposes and for the storage of instruments.

The statistics reported are:

Triangulation:	
Area of in square statute miles	186
Number of signal poles erected	17
Number of stations occupied for horizontal measures	9
Number of geographical positions determined	60
Leveling:	
Number of elevations determined by spirit-leveling	50
Length of lines of leveling in miles	45
Topography (scale 1–10 000):	
Area surveyed in square statute miles	3
Length of shore line of rivers in statute miles	435
Length of shore line of creeks in statute miles	1·5
Length of shore line of ponds in statute miles	7
Length of roads in statute miles	35

During the following winter Mr. Hodgkins was a member of the Topographical Conference called by the Superintendent to meet at the office in Washington, and after its adjournment he made a survey of a square mile area in the District on a scale of 1–20 000 for comparison with other surveys of the same area on scales of 1–30 000 and 1–40 000 respectively.

Special duty assigned to him later in the year in connection with a survey of the boundary line between Pennsylvania and Delaware is referred to elsewhere in this volume.

Topographic and hydrographic resurveys on the south coast of Long Island extended from Southampton towards Montauk Point.—For the continuation of the topographic and hydrographic resurveys on the eastern part of the south coast of Long Island, Assistant C. T. Iardella was furnished with three projections, scale 1–10 000, with limits as follows: from Southampton to Fairfield Pond; from Fairfield Pond to Amagansett; and from Amagansett to Napeague Life-Saving Station, at the west end of Montauk Point.

Between July 1, 1891, and October 30, when field operations were suspended for the season, Mr. Iardella completed two topographical sheets and about one-half of the third sheet. In this work was included the hydrography of Mecox Bay and Georgica Pond, the two

principal bodies of water; this hydrography is plotted on sheets Nos. 1 and 2. A number of smaller lakes and ponds are delineated, the shores of which are populated chiefly by summer residents.

With regard to Mecox Bay, he observes that it has an area of 3¼ square miles, and it is supplied or fed entirely by springs or small streams from the high hills of Long Island. The soundings showed depths varying from 2 to 11 feet. The bay has seven tributary creeks, and there are many residents on the broad roads which surround it on the north, the east, and the west.

Georgica Pond is 1½ miles long and is very narrow. The greatest depth of water is but 6 feet. Some twelve or fifteen cottages have been built on its banks within the past two years.

Amagansett is the most eastern village on the south coast of Long Island, and retains the old Indian name of the locality. It has now about four hundred inhabitants, and stretches for a mile in length along a single street.

Mr. Iardella reports the following statistics:

Topography:	
Area surveyed in square statute miles	30
Length of general coast in statute miles	26
Length of shore line, rivers, creeks, and ponds in statute miles	40
Length of roads in statute miles	38
Hydrography:	
Area sounded in square geographical miles	3
Number of miles (geographical) run while sounding	19
Number of soundings	1 772

For the six months following November 1, 1891, Mr. Iardella was on duty at the office in Washington, and on May 6, 1892, having received instructions for field duty, he resumed the topographic survey of the south coast of Long Island from the limits of the preceding season at Promised Land. But of the eleven triangulation stations plotted upon his projections only five could be found; a redetermination of the remaining stations had therefore to be made, and the additional topographic signals needed had to be determined. The topography was then advanced towards Montauk Point, and at the close of the fiscal year was in active prosecution. From May 12 up to June 30, 1892, Mr. Iardella reports the following statistics:

Topography (scale 1–10 000):	
Area surveyed in square statute miles	7·75
Length of general coast in statute miles	16
Length of shore line of ponds in statute miles	2
Length of roads in statute miles	9

Hydrographic surveys in Shelter Island Sound, Great and Little Peconic Bay, and approaches.—At the beginning of the fiscal year, the party in charge of Lieut. W. P. Elliott, U. S. N., Assistant Coast and Geodetic Survey, commanding the schooner *Eagre*, had been in the field since June 4, engaged in a hydrographic survey of Sag Harbor, Shelter Island Sound and its approaches, and of Great and Little Peconic Bays and the adjacent waters.

Lieut. Elliott has submitted a full descriptive report of his surveys, the results of which are shown on five hydrographic sheets, each on a scale of 1–10 000, or 7·3 inches to a nautical mile, and with limits as follows: Shelter Island Sound, Sag Harbor and approaches; Noyack Bay and entrance to Little Peconic Bay; Great Peconic Bay and entrance to Little Peconic Bay; Great Peconic Bay, eastern and central parts, and the western part and Peconic River.

Within the Sound, lines of sounding were run, following the general direction of the shore, eight lines to the mile, and these were crossed by lines at right angles, sixteen to the mile, and by as many extra lines as were found necessary to determine properly the 6, 12, and 18 foot curves. In the tributaries of the Sound the lines of soundings were run so as to develop

fully these curves and also all shoal spots. Special attention was given to the examination of certain shoal spots outside of the limits of the survey, and of a break in the sand spit which makes out to the northward of Gardiners Island and terminates in Gardiners Point.

Lieut. Elliott reports that a depth of 1 fathom can be carried through this cut, and from the swiftness of the tidal current he infers that the channel will deepen.

With regard to Sag Harbor he states that it is not a desirable anchorage in any respect, his experience having been that absolute safety is only to be had alongside of one of the wharves. Should the effort be successful which is now being made to induce Congress to provide for the construction of a breakwater, to start from the eastern part of the town, run out over the shoal bank "Gull Island" and curve to the westward towards the bar, only a limited area with 12 or 13 feet of water would be sheltered, but the shelter would be perfect. During the summer months there is daily communication to and from New York by a line of fine steamers, and triweekly in winter.

The details given in Lieut. Elliott's report in regard to the bays, harbors, channels, and anchorages in this part of Long Island will have great value for the United States Coast Pilot, Atlantic Coast, Part IV, from Point Judith to New York. A large and increasing body of navigators frequent these waters in summer; the yachtsmen to whom they are a favorite cruising ground, and the steam fishing vessels that scour the coast from Maine to Cape May.

All of the hydrography laid out on the projections having been completed by October 16, field operations were then closed.

The following named officers were attached to the party on board the *Eagre:* Lieut. Hiero Taylor, U. S. N.; Ensigns C. P. Eaton and E. T. Witherspoon, U. S. N. Pay Yeoman R. W. Stevens and Ship's Writer W. B. Proctor served as recorders and observers. Lieut. Elliott commends the zeal and intelligence shown by all of the members of his party.

At the close of the season the vessel was laid up in winter quarters in New London, and early in January, 1892, upon the reporting of his relief, Lieut. W. F. Low, U. S. N., Lieut. Elliott was detached from the command of the *Eagre* and directed to report to the Hydrographic Inspector for temporary duty at the office in Washington.

The statistics of his work are as follows:

Hydrography:

Area sounded in square geographical miles	52
Number of miles (geographical) run in sounding	1 491
Number of angles measured	16 661
Number of soundings	132 257

Determination by exchanges of telegraphic signals of the longitude lines Albany–Detroit, Detroit–Chicago, and Chicago–Minneapolis.—Observations for latitude at Chicago.—The progress made by the telegraphic longitude parties in charge respectively of Assistant C. H. Sinclair and Aid G. R. Putnam, in the determination of the longitude line Albany–Detroit up to June 30, 1891, was stated in the last annual report. A set of exchanges of signals for longitude between those cities had been completed in the first position of the observers, Mr. Sinclair being at Albany and Mr. Putnam at Detroit. The observers had then changed places, and one exchange had been made (June 29) in the second position of the observers. Exchanges of longitude signals on the nights of July 4, 9, 10, and 11 finished the determination of the line.

Thereupon Mr. Putnam moved the instruments, apparatus, etc., from Albany to Chicago, and established a longitude station in the grounds of the city waterworks on Chicago Avenue by permission of the superintendent of the works. The longitude station of 1883, in the grounds of the Chicago University, was no longer available, the University having been removed to Evanston, and the ground sold for building purposes. The water tower had been connected trigonometrically with the Chicago University by the United States Lake Survey, and the new longitude station having been referred by Mr. Putnam to the water tower, a connection was thus obtained between the two longitude stations. A check connection was obtained by measuring a base on the permanent breakwater, and from this base the new

longitude station was referred to the shot tower and to the lighthouse near the mouth of Chicago River, both of which points are known with reference to the Chicago University through the Lake Survey.

Longitude signals were exchanged between Mr. Sinclair at Detroit and Mr. Putnam at Chicago on five nights between July 16 and 22, and after an exchange of places by the observers, on five more nights between July 23 and 28, completing the longitude line Detroit–Chicago. While in Chicago Mr. Sinclair determined the latitude of the station by ninety-three observations on nineteen pairs of stars on five nights with zenith telescope No. 6.

The Detroit instruments were then moved to Minneapolis, Minnesota, and Mr. Putnam re-occupied the station of 1890 in the grounds of the University of Minnesota. For the determination of the longitude line Chicago–Minneapolis he exchanged telegraphic signals with Mr. Sinclair on five nights between August 3 and 14, and after the observers had changed places, the line was completed by a second set of exchanges on five nights between August 16 and 25.

Minneapolis having been determined in longitude by exchanges with stations on the Pacific Coast and thence eastward, which were completed in September, 1890, it now became possible to compare the results then obtained with those derived from the Atlantic Coast and stations thence westward.

Mr. Sinclair reports the following very satisfactory agreement in the results of the field computations:

	h.	*m.*	*s.*
Minneapolis west of Greenwich via San Francisco, Portland, Walla Walla, Helena, and Bismarck (1890)	6	12	56·815
Minneapolis west of Greenwich via Washington, Cape May, Albany, Detroit, and Chicago (1891)	6	12	56·822
Difference			0·007

Under a heading in the Middle Division will be given an abstract of Mr. Sinclair's report of the redetermination of the longitude line, Minneapolis–Omaha, which was undertaken in accordance with instructions issued August 6, 1891.

Topographical survey of the Hudson River continued.—Determination of position for lighthouse proposed to be erected on Old Orchard Shoal.—The preliminary operations undertaken by Assistant John W. Donn upon resuming the topographical survey of the Hudson River in June, 1891, were referred to in the last annual report.

After an examination of the ground, Mr. Donn decided that greater facility for advancing the work would be obtained by beginning it on the east side of the river at Breakneck Mountain, where the work of 1879, by Assistant H. L. Whiting, was ended. From this mountain, the Highlands recede from the river, and with the Butterhills opposite, from its northern gateway. Over and beyond Breakneck the topography was carried to a point a mile below the south limits of Fishkill. On the western side of the river, the small creek on the north limits of Cornwall was made the upper margin of the work, and during parts of July and August, the survey was carried over that village and along the slopes of Butterhill and Crow Mountains, and the intermediate hills, down to a junction with the work of Assistant Whiting in 1881, joining on the West Point reservation. Over these mountains the work was of a difficult character, because of a dense growth of scrub oak and timber that had been growing undisturbed for ten or more years.

In September the party was moved to Highland Falls, a short distance below the West Point Reservation, and thence the work was advanced southward. The margin of accessible lands between the densely wooded foothills of the mountains and the river was very narrow, and the mountain tops afforded no proper outlooks for satisfactory determinations of these foothills. As it was important to advance the survey as rapidly as possible so as to close the gap existing between West Point and Tompkins Cove, the margin of topography was limited

to the river and the highway lying back of it about ⅓ mile. There was much work to be done in this margin, however, as there were many highly cultivated and adorned grounds to be passed over between Highland Falls and Popolopen Creek. The highway just mentioned was maintained as the western boundary of the survey until the foot of Dunderberg, back of Iona Island, was reached, when the margin was widened so as to embrace all of that mountain occupied by the line of the spiral railway.

The month of October was occupied in completing the work lying between Fort Montgomery and Tompkins Cove, the party being stationed at Jones Point. The line of the spiral railway was followed throughout its length, about 11 miles, although in many places marked only by stakes or lines cut through the woods. It afforded many stations which permitted the contouring of the mountain with much facility.

Field operations were suspended for the season October 31.

Following are the statistics:

Topography (scale 1–10 000):

Area surveyed in square statute miles	17·5
Length of shore line of rivers in statute miles	23·4
Length of shore line of creeks in statute miles	17·3
Length of shore line of ponds in statute miles	8·9
Length of roads in statute miles	46·9

Mr. A. L. Baldwin served as acting aid in the party, and showed a lively and intelligent interest in the survey which is highly commended by his chief.

Mr. Donn participated in the Topographical Conference called by the Superintendent to meet in Washington in January, 1892, and at its close was one of the officers charged with a comparative topographical survey of a selected square mile of area in the District of Columbia, a service which is referred to under a subsequent heading in this volume.

On the first of June, 1892, he was instructed to proceed to New York City and determine, for the Lighthouse Board, the position of the lighthouse to be erected on Old Orchard Shoal, Staten Island Flats. The central point of this proposed structure was to be accurately located in the prolongation of a line through the axis of the Gedney Ship Channel. A projection specially prepared for this purpose having been furnished to Mr. Donn by the office, he selected range points on the high lands of Staten Island, about 2 miles back from the shores, and of sufficient prominence to be easily seen from the proposed site; he then determined these points by the plane table. Between these points and the plotted position of the proposed lighthouse, lines were drawn, and on the shore range stakes were placed in these lines by careful determinations. The lines intersected at the point desired, and subsequently, at the request of Maj. D. P. Heap, U. S. Engineer, on duty as Engineer of the Third Lighthouse District, Mr. Donn marked this position by a buoy.

Directly after the completion of this service, he went to Newburg, on the Hudson, and organized his party under instructions for resuming the topographical survey of the Hudson River. Finding, after receiving his projection, that but two of the triangulation points marked upon it could be recovered, and that these were so placed that they could not be used in connection with each other, he employed his party in selecting positions and erecting signals for the execution of a subsidiary triangulation, and was thus occupied at the close of the fiscal year.

Establishment of an automatic tidal station at Willet's Point, New York.—More tidal observations at the western end of Long Island Sound being desired, the officers of the Corps of Engineers, U. S. Army, stationed at the military post at Willet's Point, Long Island, very kindly put into operation one of the automatic tide-gauges of the Survey, sent to them for the purpose on July 1, 1891, and the series has been continued throughout the year under the immediate superintendence of Lieutenants C. A. F. Flagler and Herbert Deakyne, U. S. Engineers.

Determination of points on ranges in use by New York Harbor pilots.—In compliance with a request made by Mr. D. A. Nash, Secretary of the Board of Commissioners of Pilots, New York, Assistant F. D. Granger was instructed to determine in position certain range objects in the city of Brooklyn which are constantly employed by pilots and others as aids to navigation in New York Harbor.

These ranges are as follows:

No. 1. Trinity Spire—Cupola Pierrepont Hotel.

No. 2. Central Elevator—Middle Tower of the Arbuckle Flat.

No. 3. Trinity Spire—Central tower of Dow's Elevator.

Range 1 is used for passing to the north of Diamond Reef.

No. 2 gives the best water for passing between the East and the North Rivers, and No. 3 the best water in Buttermilk Channel.

Mr. Granger completed this work during the month of January, 1892. His service in Kansas is referred to under a heading in the Middle Division.

Continuation of the tidal record at the automatic tidal station, Sandy Hook, New Jersey.—The series of observations of the tide by means of an automatic gauge at Sandy Hook, New Jersey, which was commenced December 1, 1886, has been continued throughout the year, with Mr. J. G. Spaulding, tidal observer, in charge of the station.

Geodetic operations.—Continuation of reconnaissance and triangulation in the southwestern part of the State of New Jersey.—Prof. E. A. Bowser, Acting Assistant, having resumed field work in continuation of geodetic operations in the southwestern part of the State of New Jersey before the beginning of the fiscal year, had completed by July 15 a reconnaissance of the lines from station Colsons to stations Bridgeton and Taylors to determine where vistas should be cut through the tree tops to make these stations and Colsons intervisible.

Measurements of horizontal angles were then begun at Colsons, signals having been erected at Taylors, Williamstown, Newfield, and Bridgeton. Many of the trees on the lines from Colsons to Bridgeton and Taylors were very large and from 90 to 125 feet high. Careful search was made for markings, surface or subsurface, at the old primary stations, Lippincott, Burden, and Pine Mount, but none could be found. Signals were, however, put up at Lippincott and Burden as near to the old stations as could be ascertained, and these were observed from Colsons.

This station was marked on August 7 by a granite monument 4 feet long, dressed 6 inches square on top and for a length of 6 inches, with the letters "U. S." cut on each of the four sides, and on top a triangle, the center of which marks the point of observation. The monument was set in hydraulic cement to a depth of 3 feet and 6 inches.

Similar monuments secured in position in the same way were set at stations Bridgeton, Taylors, Kellogg, and Russia. These marks were all in place by September 10, after which field operations were suspended for the season. All of the observations needed at Colsons had been obtained by September 3.

The statistics are:

Triangulation:

Area of in square statute miles	400
Days occupied in opening and verifying lines of sight	12
Geographical positions determined	7

Prof. Bowser took the field again in April, 1892, and built an observing tripod and signal 50 feet high at station Taylors, but as this was unfortunately destroyed by a tornado early in May, it is doubtful whether any other work than the rebuilding of this signal can be done before the end of the fiscal year.

Assistant George A. Fairfield, who is in immediate charge of State surveys, prepared detailed instructions for Prof. Bowser.

Topographic and hydrographic surveys on the coast of New Jersey, between Atlantic City and Cape May.—Instructions issued to Mr. R. A. Marr, United States Coast and Geodetic Survey service, early in July, 1891, directed him to organize a party on board the barge *Beauty* for the execution of the inside hydrography of the coast of New Jersey between Atlantic City and Cape May, and of the topography of Great Egg Harbor within limits indicated on a projection furnished to him.

Mr. Marr took up this work without delay and had made fair progress in it, when an unforeseen exigency compelled him to ask to be relieved from field service and Mr. E. E. Haskell, expert in physical hydrography, was ordered to relieve him in the charge of the party.

On September 4, Mr. Haskell proceeded to Anglesea, New Jersey, and found that the work remaining to be done was the survey of all the inlets lying between Atlantic City and Cape May, together with the coast hydrography as far out as the 3-fathom curve of the reach lying between Absecon Inlet and Pecks Beach Life-Saving Station. Also the survey of that portion of Great Egg Harbor lying to the westward of Beesleys Point, including the mouths of the tributary streams.

Mr. Haskell began his work by a survey of Hereford Inlet, between Leamings and Five-Mile Beaches. This being one of the most important inlets on the New Jersey coast by reason of its good channel entrance, the bar was carefully sounded out, and the shore line of the inlet and outside coast for some distance north and south was run.

On Turtle Gut Inlet, the one next south of Hereford Inlet, no more time was spent than was required to run a few lines of soundings and locate the shore line. It is of no importance except to small sailboats, launches, and rowboats, and there were no indications that the bar in front of it had materially changed in form since former surveys.

In Cold Spring Inlet, the next one to the south, and the first one north of Cape May, enough soundings were taken to locate the channel through its bar, and the shore line in the vicinity was run. This inlet is of importance to local fishing vessels only.

The barge was then moved to Townsend Inlet between Leamings and Ludlams Beaches, and the weather being exceptionally fine and the sea smooth, the bar and channel through it were carefully sounded out. The depth of water is not enough, however, to permit any craft larger than a sailboat or launch to cross the bar. The harbor inside is shoal and greatly obstructed by the railroad bridge recently built across it. The wreck of the steamer *Neuphar* on the outer edge of the bar in front of the inlet was located and its position is marked on the hydrographic sheet.

Corsons Inlet, the next one to the north, is evidently filling up, and Mr. Haskell thinks it probable that in the course of a few years it will be entirely closed. A few lines of soundings were taken in what appeared to be the deepest water, and the shore line was run.

The reach from Pecks Beach Life-Saving Station to Absecon Inlet, including Great Egg Harbor Inlet, was next sounded and the shore line run. Great Egg Harbor Inlet is one of the most important on this coast. In the channel across the bar there was found a depth of 8 feet at low water, the average rise and fall of the tide being about $4\frac{3}{10}$ feet. Coasting vessels of considerable draft can enter in safety.

The currents in and out of all the inlets surveyed were found to be very strong, more than 4 knots per hour at strength in the larger inlets. Mr. Haskell observes that the six inlets surveyed offer excellent examples in proof of the statement that "the depth of water over the bar in front of an inlet is directly proportional to the tidal volume passing in and out."

In completing the survey of Great Egg Harbor, four triangulation stations were established and measurements made of the angles needed to connect them with the chain of triangulation along the coast. The topography and hydrography of the area covered by the new triangles was executed; in this area were included the mouths of the four tributary streams—Cedar Swamp Creek, Great Egg Harbor River, Middle River, and Tuckahoe River.

After this part of the work had been finished and all needed inventories of property taken, the party was disbanded November 7, and Mr. Haskell, having reported under instructions to the Superintendent, resumed duty at the office.

He expresses his thanks to the keepers and crews of the life-saving stations at Turtle Gut, Holly Beach, Hereford Inlet, Townsend Inlet, Corsons Inlet, Pecks Beach, Ocean City, Great Egg and Absecon Inlets for assistance rendered in taking the outside soundings in their respective districts.

The statistics of the season are as follows:

Reconnaissance:	
Area in square statute miles	12
Number of points selected for scheme	4
Triangulation:	
Area of, in square statute miles	12
Number of signal poles erected	8
Number of stations occupied for horizontal measures	6
Number of geographical positions determined	12
Topography (scale 1–20 000):	
Area surveyed in square statute miles	20
Length of general coast in statute miles	22
Length of shore line of rivers in statute miles	7
Length of shore line of creeks in statute miles	2
Hydrography (2 sheets 1–10 000; 2 sheets 1–20 000):	
Area sounded in square geographical miles	17
Number of miles (geographical) run while sounding	73
Number of angles measured	1 776
Number of soundings	3 974
Number of tidal stations established	6

Establishment of an automatic tidal station on South Wharves, Philadelphia.—Additional tidal data being required upon which to base the tide predictions for the port of Philadelphia, an automatic tide-gauge was put up and set in operation on July 18, 1891, at Pier No. 54, South Wharves, near the old Navy Yard. The record has been continuous since that date throughout the fiscal year. Assistant S. C. McCorkle, who established the gauge, has general supervision of it; Mr. George B. Thomas is the tidal observer.

The International Navigation Company has very kindly allowed the gauge to stand on their premises without cost to the Government and affords every facility for its successful operation.

Completion of the topography of the Delaware River water front of the City of Philadelphia.—The triangulation needed for bringing to completion the topographical resurvey of the Delaware River water front having been finished by Assistant R. Meade Bache, he resumed plane-table work on August 5, 1891, between Greenwich Point and Fort Mifflin.

Soon after passing that Fort, finding that the municipal front, continuing along the line of Bow Creek, departed farther and farther from the Delaware, Mr. Bache closed the survey at a good boundary line made by a road just below Fort Mifflin. Upon representing to Samuel L. Smedley, Esq., chief engineer and surveyor of the city, that the survey, as related to the Delaware water front, should be regarded as legitimately finishing there, that officer wrote to him stating officially that he fully coincided in the view that the boundary Mr. Bache had reached at Black's house, just below Fort Mifflin, was the legitimate termination of triangulation and topography held to relate solely to the water front of the city, since from that point southward for over 2 miles the municipal front recedes farther and farther from the shore of the Delaware.

The statistics of the season, which closed November 12, are as follows:

Topography (scale 1–2 400):

Area surveyed in square statute miles	3·2
Length of shore line of rivers in statute miles	8·5
Length of shore line of creeks in statute miles, including League Island Back Channel	13·3
Length of shore line of ponds in statute miles	0·6
Length of roads in statute miles	5·1

During most of the following winter and spring Mr. Bache was occupied in drawing the maps showing the results of his surveys. Of these he has made two copies—one for the Coast and Geodetic Survey archives and one for the city of Philadelphia.

In January, February, and March, 1892, he took part in a Topographical Conference organized in Washington by direction of the Superintendent, and in June he proceeded to Boston under instructions to organize a party for the topographical resurvey of Boston Harbor.

Reconnaissance and triangulation for the location of the boundary line between the States of Pennsylvania and Delaware.—Application having been made to the Secretary of the Treasury by the Joint Boundary Commission of the States of Pennsylvania and Delaware for the detail of an officer of the Survey to execute the reconnaissance and triangulation required for the location of the boundary line between these States, which had been originally surveyed in 1701 under the authority of William Penn, and which was intended to be defined by a circle of 12 miles radius around New Castle Courthouse, the Superintendent, in March, 1892, instructed Assistant W. C. Hodgkins to communicate with Messrs. Benj. H. Smith, of Pennsylvania, and Daniel Farra, of Delaware, surveyors for the Joint Commission, and report to him the understanding finally arrived at. Action was eventually taken by Mr. Hodgkins in pursuance of a resolution passed at a meeting of the Joint Commission, which contemplated a complete survey, including the marking of the line upon the ground.

He reports the following statistics of his reconnaissance and triangulation from May 13 to the close of the fiscal year:

Reconnaissance:

Area of, in square statute miles	200
Lines of intervisibility determined	49
Number of points selected for scheme	17

Triangulation:

Number of signal poles erected	75

Reference to this service is made more fully under the heading of Special Operations.

Connection of the astronomical station at Rockville, Maryland, with the transcontinental arc of the triangulation.—The station at Rockville, Maryland, at which observations for the variations of latitude were being made by Assistant Edwin Smith, was connected trigonometrically with the transcontinental arc of the triangulation by Mr. John B. Boutelle, of the Computing Division of the office, in pursuance of instructions dated March 22, 1892.

Upon reaching Rockville, Mr. Boutelle found that neither from the observatory nor from any point in the town could the primary stations to the westward be seen, but a further reconnaissance showed that Baileys Hill, about 2½ miles west of the observatory and visible from it, would see the two primary stations, Bull Run Mountain, in Fauquier County, Virginia, distant 30·6 miles, and Sugar Loaf Mountain, Frederick County, Maryland, distant 16·1 miles, and also the Washington Monument, and that by measuring a short base, the distance from Baileys Hill to the observatory could easily be obtained. Accordingly he recovered both of the old station points at Sugar Loaf and Bull Run, finding all of the marks at the last mentioned station intact and the signal put up in 1869 still standing. At Sugar Loaf the station marks, except the drill hole in the rock, had disappeared. Since the Washington Monument was visible from both these stations, the quadrilateral, Bailey–Monument–Bull

Run–Sugar Loaf, could be obtained, and after opening lines and posting heliotropers, measurements of horizontal directions were begun April 12 at Bull Run. Much delay was caused by a season of storms followed by cloudy weather and thick smoke, so that observations at this station and at Sugar Loaf, which was afterwards occupied, were not finished till May 24.

After completing observations at Baileys Hill, Mr. Boutelle laid out a base line 560 metres (1 337·3 feet) in length in a field about ¾ mile north of that station. This base he measured twice with a steel tape, 25 metres in length, the two measures differing but 0·0047 metre.

After the completion of the field work by occupying East Base, West Base, and the observatory for measurements of horizontal angles, Mr. Boutelle finished the records and computations of his work, and on June 9 reported for duty in the Computing Division.

He reports the following result from his field computation:

Rockville observatory, astronomical latitude	39°	05′	10″·37
Rockville observatory, geodetic latitude	39	05	11 ·21
Difference, a — g			— 0 ·84

The statistics are:

Reconnaissance:

Area of, in square statute miles	496·3
Number of lines of intervisibility determined	10
Number of points selected for the scheme	5

Base line:

Secondary, length of in metres	560·71

Triangulation:

Area of, in square statute miles	496·3
Number of stations occupied for horizontal measures	6
Number of geographical positions determined	5

Observations for investigating the variations of latitude at a station in Rockville, Maryland.—Under the heading "Special Operations," towards the close of this volume, will be found a notice of the observations for the variations of latitude made at a station in Rockville, Maryland, by Assistant Edwin Smith, in coöperation with the work of the International Geodetic Association. This work was assigned to Mr. Smith in March, 1891. The latitude station was located in the garden of his residence on Forest Avenue, Rockville, Montgomery County Maryland, and about 16½ miles from Washington, D. C. Observations were made every favorable night from early in June, 1891, till the middle of July, 1892. They were not allowed to interfere with Mr. Smith's official duties as Chief of the Instrument Division, a report of which appears as part of the annual report of the Assistant in charge of the Office. (Report for 1892, Part I, Office Report No. 1.)

During the absence of Assistant O. H. Tittmann, on field duty between July 20, and October 10, 1891, the charge of the office of Standard Weights and Measures was assigned to Mr. Smith. In November he was instructed to proceed to New York City and to Hoboken, New Jersey, to assist the Superintendent in swinging the half-second pendulums of the Survey at the Stevens Institute, Hoboken.

Establishment of an automatic tidal station at the Navy Yard, Washington, D. C.—Commodore Joseph S. Skerrett, U. S. N., Commandant of the Navy Yard, Washington, D. C., having courteously granted permission, an automatic tide-gauge was set up in the boat-house south of the Commandant's office, and put in operation July 31, 1891.

Mr. Alex. S. Christie, Chief of the Tidal Division, Coast and Geodetic Survey office, by whom the gauge was established, has kept it in operation, the record being continuous to the end of the fiscal year. This series of observations will afford improved data for

predicting the Potomac tides, and also for engineering purposes. It will be used when required as a training station for tidal observers.

Topographical surveys of a designated area of 1 square mile in the District of Columbia on scales of 1–20 000, 1–30 000, and 1–40 000 for purposes of comparison.—One of the results of the Topographical Conference, organized at the office by direction of the Superintendent in January, 1892, was the execution of a plan agreed upon at his suggestion for experimental topographical work in the District of Columbia.

A square mile of area in the District, the topography of which had already been delineated on the 1–4 800 scale of its detailed topographical survey, was selected for comparative surveys on scales of 1–20 000, 1–30 000, and 1–40 000 respectively. The 1–20 000 (3·168 inches to the statute mile) scale was assigned to Assistant W. C. Hodgkins, the 1–30 000 scale (2·112 inches to the statute mile) to Subassistant J. A. Flemer, and the 1–40 000 scale (1·584 inches to the statute mile) to Assistant John W. Donn.

From the reports submitted by these officers the following abstracts have been made:

After conference with Messrs. Donn and Flemer, Mr. Hodgkins made arrangements to begin work on Monday, March 28. But little could be done the first day owing to very high winds and the bad condition of the roads from continued heavy rains, but on the 29th work was taken up in the west corner of the square mile on the Brentwood road and was carried along that road to the northeastward. On the 30th, the survey was prosecuted in the south corner of the square mile at the junction of Hickey Lane with the Bladensburg Road and was carried to the Reform School at the east corner of the square mile.

Both of the following days were very unfavorable for work, being foggy with frequent showers, and the ground so soft and muddy as to be difficult to walk over. On Monday April 4, the day was oppressively hot, but no rain fell, and a full day's work was done between Winthrop Heights and the north corner of the square mile, nearly completing it. The remaining portion was finished in about five hours' work on the 5th, a very sultry day with frequent showers. The total number of hours occupied in the work was thirty, in which time forty plane-table stations were made and a large number of points were taken by telemeter.

Mr. Hodgkins observes that for so small an area the results he reached can hardly be considered as a fair test of either the scale or the topographer, owing partly to the very unfavorable weather conditions and partly to the fact that a certain amount of practice is needed to attain facility in sketching on an unfamiliar scale.

With his report he submits a sketch showing the location in the District of the area surveyed, and gives the following statistics:

Topography (scale 1–20 000):

Area surveyed in square miles	1
Length of streams in statute miles	4·25
Length of roads in statute miles	10·63

On April 6, Mr. Flemer took charge of the party which had been organized by Mr. Hodgkins, and began his survey of the same area on a scale of 1–30 000. This scale for field topography being unfamiliar to Mr. Flemer, it took about a day for him to accustom himself to the degree of generalization desirable or permissible, and he observes that even a greater degree might have been adopted without impairing the value of the map, and that time could have been saved had he delineated only the main valleys and ridges.

The contour lines at vertical intervals of 20 feet were determined by vertical angles and distances which were based upon the elevations derived from the bench mark stones within the area covered by the survey. The fact that four suburban divisions were included in this area rendered the same unfavorable for comparison with the survey of a square mile of similar topography on the same scale.

In actual field work nineteen hours were consumed, and forty-two plane-table stations occupied.

The sketch which Mr. Flemer submits with his report is a tracing of his plane-table sheet, showing every detail of the topography.

The statistics are:

Triangulation :

Number of stations occupied for horizontal measures	1
Number of geographical positions determined	2

Topography (scale 1–30 000):

Area surveyed in square statute miles	1
Length of roads in statute miles	9·6

The locality is described as lying at the intersection of Queens Chapel Road and the Baltimore & Ohio Railroad, and including part of South Brookland, Winthrop Heights, Langdon Park, Avalon Heights, and Mills Station.

Mr. Flemer having finished his survey on April 11, Mr. Donn took charge of the party on the 12th, and began work on the 1–40 000 scale. He observes that the area selected was probably as nearly typical of a country capable of delineation on this scale as could be found in the District of Columbia, but it was still very far from possessing the characteristics of an ideal locality. A bolder, larger featured region, with fewer cultural details would have been better suited to so large a scale.

In making the survey, however, he endeavored to lose sight of all but the essential features of the field, and to carry out the idea of a typical 1–40 000 survey, which of course involved a very great generalization of the features of the relief with rapid execution.

A little longer practice would have given greater facility in sketching to scale, but that would have occupied time, and in a measure defeated the purpose of these experimental surveys. The completed plane-table sheet represented the work of nine and one-half hours, and the occupation of fourteen stations. Very few telemeter readings were taken, nearly all of the work having been done by intersections and sketching. Only the most prominent houses were shown, as well as the general courses of streams, outlines of woods, etc. No station was made outside of the area delineated, and no extra care expended in closing on boundaries.

The statistics are:

Topography (scale 1–40 000):

Area surveyed in square statute miles	1
Length of shore line of creeks in statute miles	1·5
Length of railroad in statute miles	1
Length of roads in statute miles	5

Other field duty assigned to Assistants Donn and Hodgkins, and to Subassistant Flemer, is adverted to under previous and subsequent headings in the Eastern Division.

Location in position of the astrophysical station of the Smithsonian Institution.—In compliance with a request made by Prof. S. P. Langley, Director of the Smithsonian Institution, Subassistant J. A. Flemer was directed by the Superintendent to determine in geographical position a temporary observatory erected for astrophysical research to the south of the main Smithsonian building.

Availing himself of the services of his topographical party in the field on April 11, and with the aid of one of the plane-table sheets of the District of Columbia survey, Mr. Flemer first determined graphically the center of the pier of the astrophysical station, thus obtaining for immediate use, if so desired, a good approximation to its geographical position.

A point named Mall was then selected from which the Washington Monument, the main flagpole of the State Department building, and the lightning rod on main tower of the Smithsonian building could be seen, and three sets of horizontal angles were measured from this point to the three points just named, and also to a point vertically above the center of pier of the astrophysical observatory, and called "Cupola."

The geographical position of station Mall having been then computed by the three point problem, the distance Mall–Cupola was measured, and the corrected geographical position of the center of pier ascertained.

Mr. Flemer has transmitted his record and results to the office.

Hydrographic resurvey of part of the upper end of Washington Channel, Potomac River.—A hydrographic resurvey of part of the upper end of the Washington Channel, Potomac River, having become desirable owing to changes occasioned by the construction of a new bridge across it, and by dredging done by the United States Engineers, Assistant E. E. Haskell was directed to make the soundings required.

These were for a length of about ¼ mile at the extreme upper end of the channel, and occupied Mr. Haskell but one day only, December 30, 1891.

The statistics are:

Hydrography:

Number of miles run in soundings	1·25
Number of angles measured	152
Number of soundings	190

Triangulation, topography, and hydrography of the Appomattox River, Virginia.—A resurvey of the Appomattox River, Virginia, between City Point, at its junction with the James River, and Petersburg, having become necessary, owing to the great changes in the channel and the construction of a cut-off since the survey of 1852–53, Assistant C. H. Boyd was instructed to organize a party for the execution of that work.

Mr. Boyd left Washington, April 11, 1892, and immediately after reaching Petersburg began a search for points of the old triangulation, but not one of them could be found, the majority of the stone posts marking them having doubtless disappeared during the military operations between 1861 and 1865. The granite piers at Roslyn astronomical station were, however, found in fair condition and had been apparently undisturbed. From these and the Presbyterian Church spire and Courthouse in Petersburg, an available base was obtained for the triangulation which was carried to City Point.

Upon its completion, preliminary computations were made for the geographical positions of enough points to begin work upon the upper sheet of the topography, and the plane-table and hydrographic surveys were pushed forward until June 25, when the allotment of funds having become exhausted, field operations were suspended for the season.

Mr. Boyd remarks that since the former survey the regimen of the river has been essentially changed; 1½ miles of the channel in one part of it has been abandoned and the Puddlecock Cut substituted; many wing dams and closure dams and more than one hundred jetties have been built. These structures have narrowed the channels and caused the silting up of large areas of water basin, hence a much less quantity of tide water finds its way into the channels upon which the navigation of the river to Petersburg depends. Only small vessels can now reach that city and but few attempt it. In 1852, Port Walthall below the city was a shipping port, with a railroad, wharves, storehouses, etc.; these have all disappeared, the channel leading by Port Walthall having been abandoned.

Mr. Boyd acknowledges his obligations to Commander G. W. Pigman, U. S. N., in charge of the *Monitor* fleet at Richmond, for the loan of a steam launch, which was of great service in facilitating the movements of the party.

Mr. C. L. Gardner rendered acceptable service as recorder.

The statistics of the survey are as follows:

Reconnaissance:

Area of, in square statute miles	16
Lines of intervisibility determined	90
Number of points selected for scheme	33

Triangulation:

Area of, in square statute miles	16
Number of stations occupied for horizontal measures	15
Number of geographical positions determined	33

Topography (scale 1–10 000):

Area surveyed in square statute miles	3·5
Length of shore line of rivers in statute miles	22·5
Length of shore line of creeks in statute miles	6

Hydrography:

Number of miles (geographical) run while sounding	20
Number of angles measured	270
Number of soundings	6 123

From the beginning of the fiscal year until January 16, 1892, Mr. Boyd was on detached duty with the Chickamauga and Chattanooga National Military Park Commission in charge of surveys and of engineering work generally.

Hydrographic examinations of the shoal off Cape Charles, Virginia.—Some discrepancies which had been found in lines of soundings run during different years on the shoal off Cape Charles, Virginia, were reconciled in the course of two examinations of this shoal made by Lieut. C. E. Vreeland, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Blake*. In his final examination, which was completed on May 11, 12, and 13, 1892, under the favorable conditions of fair weather and smooth sea, Lieut. Vreeland occupied Cape Henry Lighthouse and Cape Charles Light Ship, and in sounding used the ordinary hand and deep-sea leads. His first examination had been made in February, 1892.

For this work he reports statistics as follows:

Hydrography:

Area sounded in square geographical miles	300
Number of miles (geographical) run while sounding	334
Number of soundings	2 020

At the beginning of the fiscal year and again towards its close, Lieut. Vreeland was engaged on the resurvey of Nantucket Shoals; from October 20, to November 16, the *Blake* was under orders of the Honorable Secretary of the Navy; during part of the winter she was laid up for repairs, and from March 3 to May 4 was on the Beaufort River resurvey.

Line of leveling of precision run between Old Point Comfort and Richmond, Virginia.—Assistant Isaac Winston has submitted a report, of which the following is an abstract, relating to the line of check levels of precision which he was directed to run from Old Point Comfort to Richmond, Virginia, by instructions issued November 28, 1891.

Having organized his party at the office in Washington early in December, he began leveling work on the 5th of that month at the bench mark which was already established on the lighthouse at Old Point Comfort. Connection was made with the line run in 1883–84 by Mr. Weir (formerly Assistant) at Newport News, a distance of 10 miles from Old Point, and also at Williamsburg, 35 miles, at Providence Forge, 60 miles, and at Richmond, 85 miles distant, the bench marks at these places being the only permanent ones established by Mr. Weir.

On the section from Old Point to Newport News, Mr. Winston reports that the difference of height which he obtained agreed very closely with Mr. Weir's; on the section of 25 miles between Newport News and Williamsburg, there was a considerable difference; on the section of 25 miles between Williamsburg and Providence Forge there was a close agreement; and on the 25-mile section between Providence Forge and Richmond the difference was too large to be admissible. Mr. Winston was instructed therefore to run a line in the reverse direction over the sections in which the large differences occurred. In the whole line of

139 kilometres in length, the height of the Richmond bench mark as determined by Mr. Winston exceeded the height of the same bench mark as found by Mr. Weir but 0·032 of a metre.

The route followed the Chesapeake & Ohio Railroad for the whole distance, except between Old Point Comfort and Newport News, where it was taken across the country to connect with a bench mark at the National Soldiers' Home near Hampton and thence through Hampton, returning to the railroad about 2 miles east of Newport News. Long portions of the railroad pass through swamps and marshes, making it difficult in many places to secure firm ground for the foot plates; there were also many times during the progress of the leveling when the ground was either freezing or thawing, all of these conditions being unfavorable to accuracy of results.

Field operations were suspended for the season on February 25, and the party returned to Washington.

Mr. George W. Stevens, General Manager of the Chesapeake & Ohio Railway, kindly gave Mr. Winston permission to use velocipede cars on the track of the road, and this aided greatly in advancing the progress of the work. Twelve miles an hour could readily be made with these cars; hence much time was saved and the cost of transportation greatly lessened. Mr. C. E. Doyle, Division Superintendent of the road, and Mr. H. W. Fuller, its General Passenger Agent, also extended courtesies to Mr. Winston and his party.

The services of Mr. A. L. Baldwin, recorder, who had had experience in leveling work, were extremely valuable, as were also those of Mr. R. L. Faris who served as rodman.

Other duty assigned to Mr. Winston is referred to under headings in the States of Florida and Missouri.

Topographical additions and revisions in the vicinity of Old Point Comfort, Newport News, and of Lambert Point, Elizabeth River, Virginia.—In order to obtain the latest data available for the publication of a new edition of the chart of Hampton Roads, Mr. Homer P. Ritter, expert in physical hydrography, was instructed in February, 1892, to examine the old topography from Fort Monroe to Newport News, and that of the Elizabeth River in the vicinity of Lambert Point, and to locate upon the original topographic sheets, covering the localities indicated, all important changes and improvements affecting navigation. Also to obtain from the local authorities plats of the towns of Hampton and Newport News, and place them upon the sheets.

Mr. Ritter reached the field February 17, his party consisting of himself and two rodmen, and by March 25, had completed the work, notwithstanding the prevalence of stormy weather during two-thirds of the time.

He reports the following statistics:

Topography:

Area examined in square statute miles	25
Area surveyed in statute miles	12·25
Length of general coast examined in statute miles	20
Length of general coast surveyed in statute miles	11·8
Length of roads in statute miles	152·8

Additions and corrections were made to five topographic sheets—two upon a scale of 1–20 000 and three upon 1–10 000. The number of buildings and blocks put upon these sheets was five hundred and seventy-three and the number of piers located was fifty-four.

Hydrographic survey of Beaufort River, South Carolina, and vicinity.—In pursuance of instructions from the Superintendent dated January 21, 1892, supplemented by detailed instructions of even date and of April 12 from the Hydrographic Inspector, Lieut. C. E. Vreeland, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Blake*, began a hydrographic survey of Beaufort River early in March. To obtain a plane of reference for the soundings, he established a tide-gauge at the new Naval Station the day of his arrival, and kept up a

continuous tidal record during two lunar months. Much difficulty was experienced in recovering the stations of the triangulation which had been made in 1859, many of them having been doubtless destroyed during the war. Upon the two projections (scale 1–10 000) furnished by the office to Lieut. Vreeland, but four of the points plotted could be recovered.

Where the nature of the ground would admit of the erection of front and rear signals, the soundings were run on ranges, the positions of the front range signals being determined by measurements from an established point with a twenty-metre chain, and every fifth signal, as well as every signal marking a change in the course of the river, was cut in by theodolite. The soundings were made in the ship's whaleboat and in a steam launch placed at Lieut. Vreeland's disposal by Capt. L. A. Beardslee, U. S. N., the Commandant of the Naval Station. For this act of courtesy, whereby the work was greatly facilitated, Lieut. Vreeland expresses his high appreciation to the Commandant.

Lieut. Vreeland observes that much of the river bed is composed of phosphate rock affording poor holding ground, and since this rock is irregularly distributed, vessels should use the lead carefully and note the nature of the bottom before coming to. The usual anchorage for vessels lying in the stream and awaiting their turn at the locks is the pocket above the Naval Station, but care should be taken not to let go too near the eastern shore, where the bottom is a hard rock.

There are a number of phosphate mining companies situated in the vicinity of Port Royal, on Beaufort and Coosaw Rivers and Battery Creek. A list of these with depths of water at their docks is given by Lieut. Vreeland in his report.

The results of his survey are shown on two hydrographic sheets, scale of each 1–10 000, the work on which was completed May 4. The *Blake* then proceeded to Hampton Roads and took up a hydrographic examination of the shoal off Cape Charles, Virginia, reference to which has been made under a preceding heading.

The following named naval officers were attached to the party: Lieut. John Gibson, U. S. N.; Ensigns W. C. P. Muir, J. H. Rohrbacher, M. K. Eyre, and B. Wright, U. S. N.; Assistant Surgeon E. S. Bogert, U. S. N. Ensign Wright was detached March 29.

Lieut. Vreeland reports statistics as follows:

Hydrography:

Area sounded in square geographical miles	12·5
Number of miles (geographical) run while sounding	247
Number of angles measured	3 091
Number of soundings	29 271

Duty assigned to Lieut. Vreeland earlier and later in the fiscal year is referred to under a heading in the State of Massachusetts.

Close of the tidal record at the automatic tidal station on Tybee Island, Georgia.—The series of tidal observations, begun September 29, 1889, at the automatic tidal station established on Tybee Island, Savannah River Entrance, Georgia, was closed June 8, 1892, enough observations having been secured. The tidal observer, Mr. Arthur J. Collyer, was taken seriously ill in the spring of 1892, and died on May 21. He had had charge of the station since September 14, 1891, having relieved Mr. Eugene Veith at that date.

Hydrographic examination at the entrance to St. Simon Sound, Georgia.—Upon his way north in the spring of 1892, Lieut. Edward M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Bache*, was instructed to stop at Brunswick, Georgia, and make such an examination of the bar at the entrance to St. Simon Sound as would show the greatest depth that could be carried over it at mean low water, and enable the office to determine whether a future detailed survey would be necessary.

Much difficulty was experienced at the outset of the survey, owing to a lack of triangulation points and the unfavorable trend of the shore line, but finally a close approximation

to the correct development of the outer bar was obtained, and the soundings plotted show that 13 feet can be carried over the bar at mean low water; that from buoy No. 4 to buoy No. 4½ the channel is extremely narrow, and that the shoalest water is abreast of buoy No. 4.

To obtain a plane of reference for the soundings, a box tide-gauge was established at the steamboat wharf near St. Simon Lighthouse, and connected with the bench mark established on that lighthouse by Lieut. J. E. Pillsbury, U. S. N., in 1888.

Much rain and rough water on the bar was encountered, retarding the progress of the work, but the examination of the outer bar was finished June 9, having occupied thirteen days.

The statistics are:

Hydrography:

Number of miles (geographical) run in sounding	65
Number of angles measured	1 438
Number of soundings	8 209

Ensigns G. W. Kline, W. W. Buchanan, and J. W. Oman, U. S. N., were attached to the party. Mr. J. L. Dunn served as observer and recorder.

Hydrographic surveys executed earlier in the fiscal year by Lieut. Hughes, are referred to under headings in the States of Massachusetts, Alabama, and Florida.

Geodetic leveling—Line of leveling of precision carried from St. Augustine to Cedar Keys.—Assistant Isaac Winston has submitted a report, of which what follows is an abstract, in relation to the line of geodetic leveling carried by the party in his charge from St. Augustine to Cedar Keys, in the spring and summer of 1892. Mr. Winston organized his party under instructions dated March 10, and left Washington for St. Augustine two days later with Subassistant F. A. Young and Mr. J. L. Bartlett.

Leveling work began at St. Augustine on March 16. The route selected followed the Jacksonville, St. Augustine & Halifax River Railroad to Palatka, and thence over the Florida Southern Railroad to Gainesville. From Gainesville the line of the Florida Central & Peninsula Railroad was followed to Cedar Keys.

At the crossing of the St. Johns River at Palatka it was necessary to sight 1 300 metres at one station. This could not well be avoided, an intended crossing 3 miles above Palatka, where the river is but a third of the width, having been prevented by an impassable swamp on the west bank.

The work was much delayed by the refusal of the general manager of the Jacksonville, St. Augustine & Halifax River Railroad to allow the party to use velocipede cars on the line of road under his control; hence, as the schedule from Palatka was not one favorable to the movements of the leveling party, and quarters could not be obtained at any of the intermediate stations, the work had to be advanced from St. Augustine. Between Palatka and Gainesville, transportation by wagon had to be resorted to, but from Gainesville to Cedar Keys, Mr. D. E. Maxwell, general manager of the Florida Central & Peninsula Railroad kindly acceded to Mr. Winston's request to use velocipede cars on the track.

Upon reaching Palatka, Mr. Winston applied to the Superintendent for permission to organize a second party, with Mr. Young in charge, in order to make more rapid progress with the work. This request having been approved, Mr. Young started from Palatka towards Cedar Keys and Mr. Winston from Cedar Keys towards Palatka early in May, and the two parties reached their respective destinations on the same day, June 8.

Upon a comparison of results it was found that the discrepancies between the two lines at various points were of a magnitude sufficient to demand the remeasurement of a number of sections of the line. These remeasurements were begun June 13, and continued until June 27, at which date they had been completed to Hawthorn, Alachua County, distant about 77 miles from Cedar Keys. Mr. Winston attributes the discrepancies partly to abnormal

differential refraction, produced by the white sand of the roadbeds for almost the entire distance, and partly to the difficulty of finding stable places in this sand for the leveling instrument and rods. There were many marshes along the route, and in all places a passing train shakes the ground some distance from the track with more or less violence.

Mention has been made under a previous heading of the establishment of automatic tide-gauges at St. Augustine and Cedar Keys, under Mr. Winston's direction, and to the maintenance of tidal records at those stations, in order to refer the elevations on the line to the mean sea level of the Atlantic and the Gulf respectively. In addition to the permanent bench marks established at St. Augustine and Cedar Keys, one or more were marked in each town and village on the route.

Field operations were suspended for the season on June 28. Mr. Winston acknowledges the energetic and able service rendered in the work by Subassistant Young. Messrs. J. L. Bartlett and J. W. Thompson were attached to the party as recorders.

The statistics reported are:

Geodetic leveling:

Number of elevations of permanent bench marks determined	35
Length in kilometres of lines of precise leveling	216

Reference to other geodetic leveling work executed by Mr. Winston, is made under headings in the States of Virginia, Missouri, and Kansas.

Establishment of automatic tidal stations at St. Augustine and Cedar Keys, east and west coasts of Florida.—In connection with the work of carrying a line of leveling of precision across the peninsula of Florida, between St. Augustine and Cedar Keys, Assistant Isaac Winston, in charge of that work, was directed to refer the ends of the line to the mean sea level of the Atlantic and the Gulf respectively. It was necessary, therefore, to establish automatic tidal stations at St. Augustine and Cedar Keys. The self-registering gauges at these stations were put up in suitable buildings by Mr. Winston, and at each station also was fixed an ordinary staff gauge graduated to feet and tenths. Once a month each observer was required to determine the relation between his tide staff and a bench mark near the station by a level and leveling rod.

At St. Augustine the record was begun March 27, 1892, with Mr. Charles C. Yates as observer, and at Cedar Keys, April 10, with Mr. Frederick V. Moss as observer.

It is the intention to continue the gauges at these stations in operation for a year, so as to obtain well-determined tidal planes of reference for the geodetic leveling stations, and also to provide additional data for prediction purposes.

Hydrographic examinations in Key West Harbor, Florida.—After completing the hydrographic work which had been assigned to him in Mobile Bay and Entrance, Lieut. Edward M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Bache*, was instructed in May, 1892, to proceed with the steamer to New York, stopping on the way at Key West, Florida, and later at Brunswick, Georgia, to make certain hydrographic examinations which would be indicated to him in detailed instructions from the Hydrographic Inspector.

His work at and in the vicinity of Brunswick has been referred to under a previous heading.

At Key West the work desired was a determination of the positions of the buoys numbered 8, 15, and 17 on the chart, and an examination of that part of the harbor extending from buoy No. 17 towards the position on shore formerly occupied by Tifft's Observatory. This building, as also the Philbrick Observatory, had been destroyed by the fire of 1886, and, as most of the wharves had been rebuilt or extended since the survey on which the chart (No. 469) was based, data for a later edition of this chart were required.

Having established in geographical position three stations from which to fix the positions of the buoys just named, and put up a tide-gauge to obtain a plane of reference for his

soundings, Lieut. Hughes finished his examination on May 24 and 25, and transmitted to the office a record book containing the soundings and angles taken and the tidal observations recorded.

No indications of a shoal were found between buoy No. 17 and the water front of Key West.

The positions of the buoys, as corrected by Lieut. Hughes, have been indicated on the charts.

On February 14 and 15, 1892, while on his way to Mobile, Lieut. Hughes, in accordance with special instructions, put into Key West Harbor and determined the positions of Northwest Passage Lighthouse and of beacons numbered 3, 4, and 5.

Triangulation and topography of the Caloosahatchee River, west coast of Florida.—By instructions issued in January, 1892, Assistant Joseph Hergesheimer was directed to proceed to Punta Gorda, on the west coast of Florida, and organize a party for the survey of the Caloosahatchee River from the limits of the completed work to Twelve Mile Creek, at the head of navigation.

After arriving at Punta Gorda January 25 he overhauled the schooner *Spy*, which had been laid up at that place, organized his party on board of her, and, after obtaining lumber and provisions, began the triangulation of the river from the base Middle Point–Point Ybel 2 on Sanibel Island On March 31 the triangulation had been completed to Beautiful Island, a distance of about 20 miles up the river. The topography was then commenced, and at the close of field operations, May 14, for the season, one topographic sheet, scale 1–10 000, including that part of the river from Shell Point to Travers Bend, had been finished and a second sheet begun.

Mr. Hergesheimer observes that the Caloosahatchee River is an important water course, being the outlet of the everglades and of the phosphate lands. Many steamers ply upon it from the coast up to the town of Myers, and thence up through the rivers and lakes to Kissimee.

Upon closing operations in the field the naphtha launch and whaleboat belonging to the party were stored in a boathouse which had been built in Myers by permission of the Mayor upon land belonging to the town, while the schooner was left in charge of a ship keeper.

Mr. M. A. Coles served as recorder in the party during the season.

Following are the statistics reported:

Triangulation:

Area of, in square statute miles	40
Number of observing tripods built	22
Number of days occupied in opening and verifying lines of sight	9
Number of stations occupied for horizontal measures	20
Number of geographical positions determined	30

Topography:

Area surveyed in square statute miles	20
Length of shore line of rivers in statute miles	33
Length of shore line of creeks in statute miles	5·5
Length of shore line of ponds in statute miles, also of marsh and woodline	55·5
Length of roads in statute miles	3·1

Service assigned to Mr. Hergesheimer earlier in the fiscal year, and again after his return from Florida, is referred to under a heading in the State of Maine.

Triangulation, topography, and hydrography of Blackwater Bay, Yellow River, and Weaver River in continuation of the survey of Pensacola Bay and tributaries.—In pursuance of instructions for the continuation of the survey of Pensacola Bay and tributaries, Subassistant P. A. Welker proceeded to Pensacola, Florida, towards the end of January, and after having overhauled the schooner *Quick* and repaired the naphtha launch intended for the service of his party, he took up the triangulation preliminary to a topographic and hydrographic survey of

Blackwater Bay, Blackwater River, and adjacent waters early in February. As a base, the line Red Fish Point–Sand String at the entrance to East Bay was made available, and there being no geographical positions determined in the locality, it became necessary to carry a triangulation across East Bay and Blackwater Bay over a country low, flat, heavily timbered, and with soil either marshy or composed of drifting sand.

Unusually bad weather delayed the work, and since water was found at most of the stations on digging to a depth of 3 feet, it became difficult to mark them securely. Drain tiles filled with concrete were chiefly used for station marks; at one point an iron screw pile 5 feet long was put down, and a few stations were marked by stone posts 28 inches long and 8 inches square on top.

On March 30, the triangulation having been finished as far as the mouth of the Blackwater, the topography of Blackwater Bay and its tributaries was begun. The chief obstacles to rapid progress were encountered in the swamps of the Yellow River, the Weaver River, and their tributaries; the entire country through which these rivers flow is densely wooded and is flooded with water at high tide. Much of the work had to be executed while officers and men were moving or standing in mud and water waist deep.

On April 30, the plane-table survey having been completed to the limits of the triangulation, and signals erected for the hydrography, this branch of the work was taken up, and was pushed to completion on May 14, the actual time occupied in its execution being eight working days.

On May 19 the schooner *Quick* was laid up at Milton, Florida, and two days later the naphtha launch at the Pensacola Navy Yard. On May 22 the party was disbanded.

Mr. H. L Stidham, who served as recorder in the party, is commended highly by Mr. Welker for faithful performance of duty. Mr. George O. Glavis joined the party May 1, and rendered acceptable aid in the hydrography.

Following are the statistics of the season:

Reconnaissance:	
Area of, in square statute miles	35
Lines of intervisibility determined	50
Number of points selected for scheme	19
Triangulation:	
Area of, in square statute miles	35
Number of stations occupied for horizontal measures	19
Number of geographical positions determined	32
Topography (scale 1–10 000):	
Area surveyed in square statute miles	24
Length of general coast in statute miles	24
Length of shore line of rivers and creeks in statute miles	41
Length of roads in statute miles	10
Hydrography (scale 1–10 000):	
Area sounded in square geographical miles	10
Number of miles (geographical) run while sounding	229
Number of angles measured	824
Number of soundings	14 301

After completing the office work of his survey, Mr. Welker was instructed to join the primary triangulation party of Assistant Eimbeck in Utah.

Triangulation, topography, and beach measurement for the connection of the surveys of Perdido and Mobile Bays.—The trigonometrical connection of the surveys of Perdido and Mobile Bays, Florida and Alabama, having been assigned to Assistant J. B. Baylor by instructions issued in January, 1892, he organized his party soon after the middle of that month upon the schooner *Transit* at Pensacola, Florida, and proceeded thence by sea to Mobile Bay.

His first work was to search for points of the old triangulation in the vicinity of Mobile Bay Entrance, but all had been destroyed with the exception of the station established in 1846 by Assistant Gerdes, the pioneer on this coast, at Fort Morgan. The cone marking this point was found embedded in the solid masonry of the northwest bastion, where it had been fixed during the early survey. The lighthouses had all been rebuilt since that survey; hence, in the absence of triangulation points, a site for a base line had to be selected. The southeastern shore of Dauphin Island was chosen; the ground was first cleared of all obstructions and the direction of the line marked by heavy wooden pegs 2·5 feet long, which were set in line with a small theodolite. The pegs having been driven solidly in the ground, zinc plates were tacked to their tops and the measures carried forward from fine lines marked upon these plates at right angles to the direction of the base. Two entirely independent measurements were made with a 25-metre steel tape, which had been standardized at the office, and which was kept at a uniform tension by a spring balance. The ends of the base were securely marked by lines upon iron rods set in cylinders of solid hydraulic cement, each cylinder about the size of an ordinary flour barrel and sunk into the ground flush with its surface. Tripods having been erected at each end of the base, it was then connected by triangulation with the station at Fort Morgan and with the several lighthouses at the entrance to Mobile Bay, and the triangulation was extended eastward to Perdido Bay.

At Fort Morgan an astronomical azimuth was determined by observations for five nights on Polaris at elongation. The triangulation having been carried as far to the eastward as it was possible to go without incurring heavy expense in cutting lines or in building high signals, the last 20 miles of connection with the triangulation at the entrance to Mobile Bay was carried forward by a beach measurement along the outer beach.

In this work a 50-metre wire and spring balance were used, the tension and temperature being carefully noted for each length of wire, and frequent comparisons made with the standard steel tape. Azimuth was carried forward by six triangulation stations established on the sandhills near the beach and connected with the shore stations used in the beach measures, a junction being finally effected with the line Cotton–Perdido Range, which had been established by Assistant Mosman near the entrance to Perdido Bay.

Assistant W. I. Vinal reported for duty in the party at the beginning of the season and made a complete plane-table survey of all the ground covered by the triangulation, which included the battle fields around Fort Morgan and Fort Gaines, and also the shore line and adjacent hills of the outer beach between Mobile and Perdido Bays. The results of this work are shown on three topographical sheets, two on a scale of 1–20 000 and one on 1–10 000.

Mr. Octave Jacob, Jr., served as recorder, and Mr. E. E. Torrey as foreman, both rendering efficient service.

Field operations were closed May 16. The statistics reported are as follows:

Base line:	
Secondary, length of in metres	1 952·4
Beach measurements, length of, in miles	21
Triangulation:	
Area of, in square statute miles	32
Number of stations occupied for horizontal measures	7
Number of geographical positions determined	6
Azimuth work:	
Number of nights of observations for azimuth	6
Topography:	
Area surveyed in square statute miles	4
Length of general coast in statute miles	41·5
Length of roads in statute miles	1

Earlier in the fiscal year, Mr. Baylor occupied a number of magnetic stations in the western states, reference to which will be found under previous headings. After his return

north in May, 1892, he was instructed to report to the Governor of the State of Virginia to execute a survey of parts of the waters of that State for the location of oyster beds, etc.

Hydrographic survey of the lower part of Mobile Bay, Alabama, including the main entrance, Grants Pass, and the dredged channel.—The steamer *Bache* having been prepared for service in the Gulf of Mexico, her commander, Lieut. Edward M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, organized his party on board of her, and left New York February 3, 1892, under instructions to make a hydrographic resurvey of the lower part of Mobile Bay, including the main entrance, Grants Pass, and the dredged channel leading from the Lower Fleet to the city of Mobile.

Lieut. Hughes has made an elaborate report of this survey which covers all details of the hydrography executed between February 20 and May 21, at which latter date the work was completed. To obtain planes of reference for the soundings he employed one principal tide-gauge and four auxiliary ones. The principal gauge, a plain wooden one, was fixed to the Government wharf at Fort Morgan; the auxiliary gauges were established at Grants Pass, Sand Island, and Mobile Bay Lighthouse. At Fort Morgan, by a comparison of the means of fifty-eight high and fifty-one low waters, the mean rise of tide was found to be 1·16 feet. The zero mark on the gauge was referred to a bench mark, for which was taken the horizontal upper surface of a rectangular block of granite which stands on a brick foundation on the eastern side of the head or shore end of the wharf. A similar block stands on the western side, and each block supports a heavy mortar as an ornament.

The reductions for all soundings taken during the survey of Mobile Bay and its entrances (except the ship's work inside of the bay and the soundings in the dredged channel) were obtained directly from the readings of the gauge of Fort Morgan wharf.

For the dredged channel, the soundings taken were reduced directly from the readings of the gauge at Mobile Bay Lighthouse, with the exception of soundings, made on May 5 between clusters 38 and 50 of the piles marking the channel. For these soundings, corrections were deduced from a tidal curve constructed from later comparisons of corresponding readings of the gauges at Fort Morgan and Mobile Bay Lighthouse.

Within the bay, where practicable, soundings were made from the *Bache*, east and west lines being run from the Middle Ground to the upper limit of the work, and north and south lines from Grants Pass and Dauphin Island to its eastern limit. The general depth of water in the lower part of the bay being but 2·5 fathoms, these lines were required to indicate the same depths at their crossings, or to "cross" within ½ foot, and this result was obtained in about 75 per cent of the crossings on this part of the sheet. The differences of depth exhibited in the remaining cases were finally reconciled by Lieut. Hughes after a close investigation of the causes that led to them, the method adopted being fully elucidated in his report.

The examination of the dredged channel leading from the Lower Fleet to the wharves at Mobile was made by running a series of zigzag lines sufficient in number to ascertain what depth of water could be carried through the channel.

Lieut. Hughes observes that the length of this dredged cut from the lower channel Beacon, on the eastern side of the Lower Fleet, Mobile Bay, to the southernmost wharves of the city is about 24·1 miles, and at the time his examination was made, between May 5 and 20, the channel was plainly outlined for a distance of 20·5 miles from its lower entrance to the Upper Channel Beach by two parallel lines of clusters of piles between which it ran, and thence to Mobile by a single line of similar clusters and by three beacons, on the eastern and northern side.

The lane in which the channel is cut is about 300 feet wide; the channel itself is much narrower, varying in width from 67·5 to 130 feet. The zigzag lines run across this lane from one line of piles to another were sixty to the geographical mile, giving one cross section for each 101 feet of the channel's length. The alternate cross sections are normal to the axis of the channel, and between the Lower Channel Beacon and Mobile Bay Lighthouse, the

positions of the ends of each cross section were accurately fixed. Above Mobile Bay Lighthouse the ends of cross sections were not fixed by angles, the lines of soundings being simply carried across the channel from one line of piles to the other, each turn being numbered and recorded as a position, and the cross sections being separated by an average distance of about 100 feet. This spacing was verified as successive clusters of piles were reached.

The deepest water is generally about 100 feet from the eastern line of piles. For portions of the channel extending from one cluster of piles to another in regular succession Lieut. Hughes furnishes a tabular statement showing the mean width of the channel, the number of contained cross sections, the average maximum depth at mean low water, and the maximum depth of the shoalest cross section. He gives also a résumé of some of the more important corrections and changes desirable to be indicated on the charts.

The results of his very elaborate survey are shown on two projections, each on a scale of 1–20 000, covering lower Mobile Bay and its approaches—one projection on the same scale showing the dredged channel from its lower entrance to a little above Mobile Bay Lighthouse, and one small sheet, scale 1–13 333, showing the upper end of the dredged channel. The hydrographic records, original and duplicate, accompanying these sheets, have been forwarded to the office.

Lieut. Hughes acknowledges assistance most cordially rendered by Mr. J. B. Baylor, Assistant Coast and Geodetic Survey, in furnishing tracings of shore line, and preliminary positions of a number of points derived from his work in the vicinity.

The officers attached to the *Bache* were Lieut. W. L. Burdick, U. S. N.; Ensigns W. W. Buchanan, Hugh Rodman, W. B. Hoggatt, Geo. W. Kline, and J. W. Oman, U. S. N.

Master-at-arms J. L. Dunn took part in the work as observer.

Following are the statistics of the Mobile Bay survey:

Hydrography:

Number of miles (geographical) run while sounding	943
Number of angles measured	12 298
Number of soundings	63 358

Duty assigned to Lieut. Hughes earlier and later in the fiscal year is referred to under headings in Massachusetts, Florida, and Georgia.

Continuation of the primary triangulation in Alabama southward and southwestward towards a connection with the triangulation of the Gulf Coast.—The reconnaissance for the extension of the primary triangulation in Alabama having been well advanced towards the coast of the Gulf of Mexico by the party of Assistant F. W. Perkins, that officer was instructed early in January, 1892, to resume field operations by the erection of signals, by opening lines of sight, and by the occupation of stations for the observation of horizontal directions.

As soon as practicable, Mr. Perkins sent his foreman, Mr. R. E. Duvall, to take immediate charge of the signal building party, and to complete all preparations needed to begin observations. Upon the arrival of the instruments, Station Wetumpka was occupied by Mr. Perkins, and Station Bargenier by Mr. Walter B. Fairfield, Subassistant, who had been ordered to report to him for duty. It was found, however, that the innumerable fires in forests and in clearings which are frequently burning at that season of the year would prevent observations on the longer lines; accordingly the station at Wetumpka was abandoned temporarily, and on March 22 Mr. Perkins moved to Lowndesboro, where the lines were shorter and the fires less numerous. By the end of April the conditions had improved and work was resumed at Wetumpka.

The months of May and June having proved, as usual, very favorable for observations, two more stations, Ethridge and Lovers Leap, were completed, after which the party was disbanded for the season.

Mr. W. B. Fairfield was practically in charge of a detached party, having directed much of the work of signal building, opening lines, etc., and having occupied three of the seven primary stations. Of his skill and efficiency Mr. Perkins speaks in terms of high commendation.

Mr. H. B. von der Trenck served as recorder during the season, and acquitted himself creditably in the execution of the various classes of work assigned to him.

Mr. Perkins states that another season's reconnaissance will carry the work to a junction with the Gulf Coast triangulation at Mobile.

The statistics reported are as follows:

Triangulation:

Area of, in square statute miles	2 800
Number of observing stands built	7
Number of days occupied in opening and verifying lines of sight	25
Number of stations occupied for horizontal measures	7
Number of stations occupied for vertical measures	3
Number of geographical positions determined	14
Number of elevations determined trigonometrically	10

From the beginning of the fiscal year until early in the month of December, 1891, Assistant Perkins was in charge of a triangulation party in western Kansas and eastern Colorado, a report of which will be found under a subsequent heading in this volume.

Magnetic observations at stations in Michigan, Wisconsin, Ohio, Indiana, and Illinois, and also in Washington, D. C., and Richmond, Virginia.—After having completed a magnetic tour in the spring and early summer of 1891 by the occupation of stations for the determination of the magnetic elements in North and South Carolina, Assistant James B. Baylor, proceeded under instructions to Columbus, Ohio, and begun a series of determinations in the interior States.

Between July 1 and August 12, and between September 17 and December 31, observations of the magnetic declination, dip, and intensity, with determinations of time and azimuth were made at the following named stations in the States east of the Mississippi River:

At Columbus, Ohio, in the grounds of the University of Ohio; at Fort Wayne, Indiana, in the fair grounds as near the Bache Fund Station of 1874 as the changed surroundings would permit; at Michigan City, Indiana, on the beach as near as was practicable to the Lake Survey Station of 1873; at Grand Haven, Michigan, in the Courthouse Square, the station of 1880 having been re-occupied; at Sault de Ste. Marie, Michigan, the station of 1880 adjoining the United States Cemetery, was re-occupied; at Marquette, Michigan, on the beach, about 800 feet northwest of the lighthouse, and as near as practicable to the Lake Survey Station of 1873; at Green Bay, Wisconsin, in the fair grounds in the suburbs of the city; at Prentice, Wisconsin, in the western suburbs of the town, on the banks of the river. At the two stations last named approximate determinations of latitude were made.

The observations at Prentice were finished August 12, and Mr. Baylor then took up the occupation of a number of stations in States west of the Mississippi River; these will be referred to under a heading in the Middle Division.

On September 17 he was again east of the Mississippi, and between that date and October 1 completed determinations of the magnetic elements, of time, and of azimuth at the following named stations:

At Rockford, Illinois, at a station established in a cemetery in the eastern suburbs of the city; at Ottawa, Illinois, at a station in a cemetery in the southern suburbs of the city; at Bloomington, Illinois, at a station established in the grounds of the Normal State College; at Springfield, Illinois, at the station of 1878, which was re-occupied. At Rockford, Ottawa, and Bloomington, observations for latitude were made in connection with those for time and azimuth.

On October 5 Mr. Baylor was directed to proceed to Washington, D. C., and make the annual three days' determinations at the magnetic station in the grounds south of the office of the Survey. This done, he was authorized to take up the office work of his season at his home in Richmond, Virginia. While there he observed in December for magnetic intensity and dip at a station in the State fair grounds, and determined the induction coefficient and moment of inertia of one of the magnets of his magnetometer.

Reference to service on the Gulf Coast assigned to Mr. Baylor in January, 1892, is made under a subsequent heading in this volume.

Geodetic operations—Occupation of stations in continuation of the triangulation of the State of Wisconsin.—Prof. J. E., Davies, Acting Assistant, was in the field at the beginning of the fiscal year, having just begun the occupation of station Fitzsimmons in continuation of the triangulation of the State of Wisconsin. From this station, measurements of horizontal directions were made upon nine primary and secondary stations, the series being finished on August 11. Three days later he was ready for observations at Observatory Hill, from which measure-directions were made to five primary and secondary stations. Having completed work at ments of horizontal Observatory Hill August 31, Bald Bluff Station was then occupied September 3, and by September 9 measurements of horizontal directions had been obtained on four stations, after which field operations were suspended for the season.

Assistant George A. Fairfield, in immediate charge of State surveys, has included in his annual report (Office Report No. 4) a notice of the work undertaken by Prof. Davies.

Determinations of the geographical positions of stations in Ohio and Indiana as a measure preliminary to the correct location of the boundary line between those States.—Under the heading "Special Operations" following the abstracts of reports from field parties will be found a notice of action taken by the Superintendent at the request of the Governor of Ohio with reference to the preliminary investigation of a disputed boundary line between that State and the State of Indiana.

Early in October, 1891, Assistant C. H. Sinclair and Aid G. R. Putnam were instructed to ascertain how far the boundary line deviated from a true meridian line by determining the longitude of three points upon it—one near the south end, one about the middle, and one near the north end—these longitudes to be determined by exchanges of telegraphic signals, with St. Louis as a base station. Observations for the latitude of these points were to be made also.

The results reached by these observations as embodied in the reports of Messrs. Sinclair and Putnam, and communicated by the Superintendent to the Governor of Ohio are stated under the heading just named.

The following are statistics of the field operations which were completed October 31:

Latitude and longitude work:

Latitude stations occupied, number of	3
Number of pairs of stars observed for latitude	55
Average number of observations on a pair	3
Longitude stations, telegraphic, number of	4
Number of nights on which longitude signals were exchanged	9

Determinations of geographical position—telegraphic for longitude and astronomical for latitude—made by Messrs. Sinclair and Putnam earlier and later in the fiscal year, are elsewhere referred to in this volume.

Measurement of a primary base line at Holton, Ripley County, Indiana.—Preparations for beginning the measurement of a primary base of verification at Holton, Indiana, had been well advanced at the commencement of the fiscal year, the line having been cleared, the section stones established in place, and their heights relative to the ends of the base determined. Full reference to these and other preliminary operations was made in the last annual report.

Owing to unforeseen delays in preparing the standard bars in the office, it was not till July 25 that they reached Holton.

The general charge of the measurement had been assigned by the Superintendent to Assistant A. T. Mosman. The direction of all measurements made with the steel tapes and the standard bar and of all experiments conducted with them in the comparing house and on the base line was committed to Assistant R. S. Woodward. To Assistant O. H. Tittmann was given full charge of all measurements and experiments made with the secondary apparatus on the base line and in the comparing house.

Each one of these officers has submitted a complete report of the work entrusted to him. Abstracts only of these reports are here presented, the reports themselves being published as Appendix No. 8 to Part II of this annual report.

Assistants Woodward and Tittmann, with Mr. John F. Hayford, arrived in camp July 22. Before they left Washington, the 5-metre steel bar, which was to serve as a standard for all of the Holton base work had been standardized by two series of comparisons made on the office comparator, its length at the temperature of melting ice having been determined in terms of the National Prototype Metre No. 21.

For purposes of comparison in the field, a comparing house had been built with railroad and track 110 metres long and posts for microscopes had been set. The actual measurement of the base line (approximate length 5 500·8 metres) was begun July 28 by Mr. Tittmann at station South Base with the 5-metre contact-slide rods Nos. 13 and 14 of the new secondary base apparatus, the construction of which had been finished at the office early in July. His party consisted of four officers besides himself and four men, and they were employed 13½ days in making two complete measurements of the base, in addition to two measures of the kilometre between the section stones 3 900 and 4 900 metres from South Base, this kilometre having been laid out to be measured by the standard bar in ice. After the measurements had been finished, the lengths of the rods were determined on the Standard 100-Metre Comparator, the length of which in terms of the 5-metre standard steel bar had been found by Mr. Woodward, and the relation of the thermometer indications to the actual temperatures of the bars was investigated.

Mr. Tittmann's report treats first of the results of this investigation and its bearing on the length of the base, after which the details of the measurements of the line and of the apparatus are described.

The work accomplished by Mr. Woodward is outlined as follows in a preliminary report submitted by him after his return to Washington:

1. Determination of the length of the 5-metre steel bar, etc., as already referred to.

2. Determination of length of interval between spheres of the 100-metre comparator of the base in terms of the 5-metre bar in ice. This interval was measured twelve times.

3. Determination of lengths and expansions or equations of the metallic tapes. Of these, there were two of steel and two of bronze, each 100 metres in length; and one of steel and one of bronze, each 25 metres in length.

4. Measurement of kilometre with bar No. 17 in ice. Four such measures were made.

5. Measurement of the base with the tapes. The several sections of the base were measured from six to thirty times with the tapes, the greatest number of measures being made of the kilometre section which had been measured with the iced bar.

The operations just referred to occupied Mr. Woodward's time from the date of his arrival until October 12, when he returned to Washington.

Upon the completion of all the measurements Mr. Mosman placed underground and surface marks at North Base and South Base. The underground mark at each end of the base was a copper bolt set in a limestone post 6 inches square and 2 feet long, which was sunk into the earth till its top was three feet below the surface. At the intersection of cross lines cut on the top of the bolt a fine hole ¼ of an inch deep was drilled to mark the station point. Above and around the post, except for a space 1 foot square immediately over it, is a layer of Portland cement concrete 1 foot thick and 4 feet square. On this foundation rests a block of limestone 3 feet square and 30 inches high, having a copper bolt with cross and fine drill hole sunk into its top at the center, this hole being the surface mark of the end of the base.

To protect this mark from injury and to indicate conspicuously the ends of the base, a limestone shaft was placed in position over it, having at North Base inscriptions on three of its faces as follows: On its south face, "U. S. Coast and Geodetic Survey;" on its east face, "North Base;" and on its west face, "Holton Base Line, 1891."

At South Base, the underground and surface marks and monuments were similarly arranged.

In the various operations pertaining to the measurement the following-named persons took part: Prof. J. H. Gore, who joined the party June 20 and left it September 14, having rendered very efficient service in assisting in the measurements with the secondary apparatus and in those made with the tapes. At the outset of the work he had charge of the leveling party. Mr. John F. Hayford aided very acceptably in the measurements under the charge of Mr. Tittmann and in the computations pertaining thereto; he assisted also in the measurements made with steel tape and in the computation of results.

Mr. John S. Siebert took part in the preliminary operations, assisted in building the comparing house and in setting the station stones; had charge of the leveling from the bench mark at Delaware to stations North Base and Glasgow, and assisted in all the measurements and experiments made with tapes and standard bar in ice, and in the computations.

Messrs. Th. Gjertsen, Robert Penington, and Frank B. Cope were attached to the party as recorders, and served satisfactorily in the leveling operations and in the measurements with the secondary apparatus.

Mr. E. E. Torrey, foreman, rendered most valuable service during the entire season.

All of the operations connected with the measurement of the Holton Base having been completed about the middle of October, and Mr. Mosman having been instructed to connect the Kanawha Base line near St. Albans, West Virginia, with the transcontinental triangulation, he left for that locality on October 19, arriving on the 22d. But having been soon after that date detached for duty as one of the Commissioners of the United States and Mexican Boundary Survey, he was relieved by Subassistant W. B. Fairfield.

Mr. Woodward upon being relieved, October 12, from duty at Holton, returned to Washington and made the computations incident to his preliminary report; he then took up the work of determining a definitive length for the 5-metre bar No. 17 of the iced bar apparatus. This involved a large amount of observation and computation, and ultimately an elaborate series of comparisons with an auxiliary bar, the results of which led to the construction of a comparator designed specially to meet the needs of the iced bar apparatus. In all of this work he acknowledges faithful and efficient aid rendered by Mr. Siebert.

Mr. Tittmann left for Washington October 8, and on October 11 resumed the charge of the office of Standard Weights and Measures, which had been assigned during his absence to Assistant Edwin Smith.

Connection of the Kanawha Base Line, St. Albans, West Virginia, with the transcontinental triangulation.—The work of connecting the Kanawha Base Line, near St. Albans, West Virginia, with the transcontinental triangulation and of permanently marking its ends, had been assigned to Assistant A. T. Mosman, after his completion of the measurement of the Holton Base, Indiana, and considerable progress had been made by that officer when he was detached for duty as a member of the United States and Mexican Boundary Commission. The officer detailed to relieve him, Subassistant W. B. Fairfield, arrived at St. Albans November 12, and found the party temporarily in charge of Foreman E. E. Torrey. Assuming direction of the work laid out by Mr. Mosman, he completed the building of all the signals, and the opening of all the lines by the end of November, and on the 30th of that month began the measurement of horizontal directions at Big Rocks Station.

Between November 14 and 28, Mr. J. S. Siebert, Aid in the party, had been employed in running a line of spirit levels from West Base Station to Big Rocks Station and return, and had also leveled over the base line. He was then relieved from duty in the party, and directed to report at the office. Mr. Fairfield retained his foreman and continued the occupation of stations until February 15, when the conditions of the weather having become very unfavorable he suspended work for the season, Stations Piney and Simms having been occupied in addition to Big Rocks.

Both ends of the base line were permanently marked by stone monuments, and also the stations connecting with the base.

Mr. Fairfield then proceeded under instructions to join the triangulation party of Assistant Perkins in Alabama.

Geodetic operations.—Extension of the triangulation in eastern Tennessee to connect with the triangulation of the State of Kentucky.—Acting under general instructions from the Superintendent, and detailed instructions from Assistant George A. Fairfield, in immediate charge of State surveys, Prof. A. H Buchanan, Acting Assistant, at the beginning of the fiscal year, was occupying Cross Station in eastern Tennessee, and observing lines of horizontal direction to seven stations of the triangulation laid out in the eastern part of the State. Two more stations, Clinch and English, were occupied before field operations were closed on September 21.

From Clinch Station, ten points were observed upon—one of them, White Rock, being upon the boundary line between Kentucky and Virginia. This point forms a triangle with Station McLean in northeastern Tennessee, observed from Clinch and King Stations, in southeastern Kentucky. From Station English, five points were observed.

For this work Prof. Buchanan reports statistics as follows:

Triangulation:

Number of stations occupied for horizontal measures	3
Number of stations occupied for vertical measures	3
Number of geographical positions determined	3
Number of elevations determined trigonometrically	3

Early in June, 1892, he took the field to make a reconnaissance for the extension of the triangulation from the line Clinch–English toward the mountain region of North Carolina and Tennessee, and had nearly completed it at the close of the fiscal year, his most easterly stations being Roan High Knob, 6 300 feet high, on the Tennessee and North Carolina boundary line, and White Top, 5 700 feet high, in Virginia, near the northeastern corner of Tennessee.

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1892.

MIDDLE DIVISION.

STATES AND TERRITORIES BETWEEN THE MISSISSIPPI RIVER AND THE ROCKY MOUNTAINS.

28. Minnesota.	32. Nebraska.	36. Indian Territory.
29. North Dakota.	33. Missouri.	37. Oklahoma Territory.
30. South Dakota.	34. Kansas.	38. Louisiana.
31. Iowa.	35. Arkansas.	39. Texas.

Progress Sketches No. 2, Nos. 4, 5, and 6, and Nos. 10, 15, and 16, show the localities of field work in the Middle Division. The numbers and titles of the Progress Sketches are given in a list at the close of this volume.

Geodetic operations.—Reconnaissance for connecting the triangulation of the State of Minnesota with that of Wisconsin, and occupation of stations in those States.—Connection of the Snelling Avenue Base and the azimuth station at the University of Minnesota with a bench mark of precise leveling established on the St. Paul City Courthouse by the Mississippi River Commission.—Under general instructions from the Superintendent, supplemented by detailed instructions from Assistant George A. Fairfield, in immediate charge of State surveys, Prof. W. R. Hoag, Acting Assistant, had made good progress at the beginning of the fiscal year in carrying a reconnaissance down the Mississippi River from a point near the mouth of the St. Croix to New Hartford, Minnesota, just above Lacrosse, Wisconsin, towards which, during a preceding season, Prof. Davies had carried a reconnaissance from the vicinity of Dubuque.

Under the date of July 11, 1891, Prof. Hoag has made a full report of his reconnaissance, accompanied by a sketch showing the scheme of triangulation developed by it. Starting from the line Prescott–Hampton, seven quadrilaterals were laid out to the line Kings Bluff–New Hartford, which crosses the Mississippi River about 9 miles above Lacrosse. Fourteen stations were included in this scheme.

After the completion of this reconnaissance, Prof. Hoag built an observing tripod and scaffold 40 feet high at Vasa station, Minnesota, and another of 64 feet in height at Ellsworth station, Wisconsin. At Hampton, Minnesota, an observing tripod and scaffold 24 feet high was built. During August, measurements of horizontal and vertical angles were made at stations Prescott, Hampton, Ellsworth, Cannon Falls, and Vasa, and were finished August 29.

The Mississippi River Commission having established a precise bench mark on the Courthouse at St. Paul, Minnesota, instructions were issued to Prof. Hoag in the autumn of 1891 to connect that bench mark by lines of geodetic leveling with the Snelling Avenue Base and with the astronomical station of the Coast and Geodetic Survey in Minneapolis. These lines he was directed to run in opposite directions, and as an additional check, the lines South Base to St. Paul Courthouse and North Base to Minneapolis were also to be leveled by the nearest practicable route, thus forming two loops connected at Middle Base.

This work was undertaken and carried on at such short intervals of time as Prof. Hoag could spare from his duties at the University until winter set in, about November 10.

Between December 25, 1891, and January 4, 1892, Prof. Hoag was in Washington, where he had been directed by the Superintendent to report for conference in regard to the work in his charge.

The statistics for the field operations of the season 1891, beginning June 8 and ending August 27, for the first part, and for the second part beginning October 11 and ending November 9, are as follows:

Reconnaissance:	
Area of, in square statute miles (approximate)	1 675
Lines of intervisibility determined as per sketch	32
Number of points selected for scheme	14
Triangulation:	
Area of, in square statute miles	248
Signal poles erected, number of	4
Number of stations occupied for horizontal measures	5
Number of stations occupied for vertical measures	5
Number of geographical positions determined	12
Number of elevations determined trigonometrically	11
Geodetic leveling:	
Number of elevations determined by spirit leveling of precision	4
Length of lines of geodetic leveling in kilometres	65

In June, 1892, Prof. Hoag resumed the leveling of precision left unfinished in 1891, and carried it to completion.

Determination by exchanges of telegraphic signals of the primary longitude line, Minneapolis–Omaha.—In the longitude triangle Chicago–Minneapolis–Omaha, the determination of the side Minneapolis–Omaha, made in 1873, having been only a preliminary one, instructions were given early in August, 1891, to Assistant Sinclair to redetermine it in a primary manner. Mr. Sinclair and his associate, Mr. Putnam, had just completed the determination of the primary line Chicago–Minneapolis, as stated under a heading in the Eastern Division.

Mr. Putnam accordingly moved the Chicago instruments to Omaha and occupied the station in the grounds of the High School, which had been first established by Assistant Edward Goodfellow in 1869, and which was recovered and reëstablished by Subassistant Carlisle Terry, Jr., in 1883.

Telegraphic longitude signals were exchanged between Minneapolis and Omaha on five nights between August 29 and September 4, after which the observers changed stations, and a second set of exchanges, completing the determination was obtained on five nights between September 8 and 14.

Mr. A. C. Pease was attached to Mr. Sinclair's party as recorder, and assisted acceptably in the computations.

Mr. Sinclair observes that the results for personal equation derived from the five primary lines determined by Mr. Putnam and himself during the season, beginning in May and ending in September; namely, $0^s.193$, $0^s.135$, $0^s.187$, $0^s.174$, and $0^s.189$, show as close an agreement as can be expected from even experienced observers.

The statistics are:

Latitude and longitude work:

Number of latitude stations occupied	2
Number of stars observed for latitude	41
Average number of observations on a pair	4
Number of telegraphic longitude stations	6
Number of nights on which longitude signals were exchanged	50

Service assigned to Messrs. Sinclair and Putnam later in the fiscal year is noticed under headings in the Eastern and Western Divisions respectively.

Magnetic observations at stations in the States of Minnesota and Iowa.—The magnetic stations in the States east of the Mississippi river, which were occupied by Assistant James B. Baylor in the summer and autumn of 1891, have already been referred to under a heading in the Eastern Division.

Between August 14 and 31 he determined the magnetic declination, dip, and intensity at St. Paul, Duluth, and Glyndon, Minnesota, and between September 1 and 17 at Sioux City, Sibley, Fort Dodge, Waterloo, and Dubuque, Iowa, observing also for time and azimuth at all of these stations, and for latitude at St. Paul, Sioux City, Fort Dodge, and Waterloo, the sun being the object observed.

These stations were located as follows: At St. Paul, in the cemetery in the northwestern suburbs of the city; at Duluth, on the property of the United States, just in rear of the lighthouse, and as near as practicable to the Lake Survey Station of 1873; at Glyndon, in the town park, previously occupied in 1880; at Sioux City, in the grounds of the Methodist University.

At Sibley, the station of 1877, in the grounds of the City Hotel, was re-occupied; at Fort Dodge, a station was established in the yard of the Catholic Church; at Waterloo, in the small park in front of the cemetery, in the northwestern suburbs of the town, and at Dubuque, the Bache Fund Station of 1872, on Seminary Hill, and the station established by Mr. Baylor in 1881, were re-occupied.

Upon closing his magnetic work at the end of December, 1891, Mr. Baylor received instructions for duty on the coast of the Gulf of Mexico, and after his return north he was directed to report to the Governor of Virginia, to execute some special surveys for the location of oyster beds, requested by the authorities of that State.

Determination of the longitude of Macon City, Missouri, by exchanges of telegraphic signals with St. Louis, and observations for latitude at Macon City.—In pursuance of instructions issued in December, 1891, Assistant C. H. Sinclair went to Macon City, Missouri, early in January, 1892, and made arrangements for the erection of a temporary wooden observatory for longitude and latitude work. The station selected was in the grounds of the Courthouse. The observations at St. Louis were to be made at the Washington University Observatory by its Director, Prof. H. S. Pritchett.

On account of the intense cold, the temperature varying from eight to sixteen degrees above zero of Fahrenheit at night during the observations, and falling as low as four degrees below zero on some mornings, the temporary building at Macon City was divided into two rooms, in one of which the transit was mounted, while the other, which contained the recording apparatus, was heated by an oil stove to keep the chronograph ink from freezing.

The determination of the longitude of Macon City was completed by the exchanges of signals on three nights, January 14, 15, and 16, these being sufficient for the degree of precision demanded. The results were corrected for personal equation between the observers which had been determined by observations made at the Washington Observatory in November, 1890.

For latitude fifty-one observations were made by Mr. Sinclair on fifteen pairs of stars, with zenith telescope No. 6.

A meridian line was laid out in the Courthouse grounds, the ends of which were marked by stone posts sunk into the ground—one under the center of the transit and one to the south of it. The position of the station was referred to the tower of the Macon City Courthouse.

On January 18, Mr. Sinclair left for St. Louis, where, in connection with Prof. Pritchett, he completed the record and reduction of the observations.

He then proceeded to Los Angeles, California, under instructions to determine the geographical positions required for the use of the United States and Mexican Boundary Commission.

Extension of the transcontinental line of geodetic leveling to the westward from Jefferson City, Missouri.—Line of leveling of precision carried southward from Holliday, Kansas, toward Fort Smith, Arkansas.—Reference was made in the last annual report to the extension westward from Jefferson City, Missouri, of the transcontinental line of geodetic leveling by the party in charge of Assistant Isaac Winston. At the beginning of the fiscal year 1892, Mr. Winston had been in the field since April 20, 1891, and had reached Dresden, Pettis County, Missouri, nearly 78 miles from the point of starting.

From Jefferson City to Dresden, and thence to Kansas City, Missouri, the line follows the Missouri Pacific Railway. From Kansas City it was carried over the Atchison, Topeka & Santa Fe Railroad to Holliday, Kansas, 13 miles west of Kansas City. This was the terminal point for the season of the transcontinental line of geodetic leveling, the work being then turned to the southward along the Emporia branch of the Atchison, Topeka & Santa Fe Railway as far as Olathe, Kansas. From this town it will be ultimately extended to Fort Smith, Sebastian County, Arkansas, where connection will be made with the line of geodetic leveling brought up from the Gulf of Mexico via New Orleans, Arkansas City, and Little Rock, Arkansas.

Permanent bench marks were established as the work advanced in all the towns and villages on the route; one of these was placed on the corner stone of the State Capitol building at Jefferson City at the request of the State Geologist; connection was also made with four bench marks of the Missouri River Commission—one at Jefferson City and three at Kansas City. Nine bench marks of the Missouri Pacific Railway between Jefferson City and Kansas City were connected with the line, and also nine stations of the Coast and Geodetic Survey transcontinental triangulation. These having been determined in height by trigonometrical leveling, means were afforded for a comparison of results, and the field computations indicated a close agreement.

The method of work was that employed for several years past in spirit leveling of precision, the forward or western measure being made with one instrument by Mr. Winston, and the backward or eastern measure by his aid, Mr. F. A. Young. When the difference between the two measures exceeded 5 millimetres per kilometre, as ascertained by comparisons made on temporary bench marks, the measurments were repeated once at least in each direction.

During the extreme heat of the summer the radiation from the broken rock or gravel with which the railroad track was ballasted rendered the work extremely fatiguing and difficult. About the middle of August Mr. Irving Hitz, who had been assigned to duty in the party as recorder, was overcome by the heat while in the field, and was not able to return to the party during the season.

At Holliday, where the line turned towards the south, three permanent bench marks were established, and three also at Olathe, Kansas, where, on October 18, the party was disbanded.

Mr. Winston acknowledges the very faithful and willing service rendered by Mr. F. A. Young, aid, both in field and office work.

He reports that during the season forty elevations were determined by geodetic leveling, and that the total length of the lines run was 315 kilometres.

Other duty assigned to Mr. Winston is noticed under headings in the States of Virginia and Florida.

Extension to the westward in Kansas of the transcontinental triangulation near the thirty-ninth parallel.—The advance to the westward in Kansas of the transcontinental triangulation near the thirty-ninth parallel by the party in charge of Assistant F. D. Granger up to June 30, 1891, was stated in the last annual report. At that date Mr. Granger was in camp at station Heath about 12 miles northwest of the town of Ellsworth, and had begun the erection of an observing tripod and signal 57 feet high, the line to Wilson station requiring this elevation of the theodolite in order to obviate the effect of the disturbed strata of air on lines passing near the surface of the ground.

On July 8, the tripod having been finished, the theodolite was mounted, and observations were begun as soon as the weather permitted. The atmospheric conditions at the outset were less favorable than usual at that season of the year, work being frequently interrupted by thunderstorms of much severity, accompanied by violent gusts of wind. These electrical disturbances were occasionally followed in a day or two by an atmosphere so clear and steady that Mr. Granger found it practicable to observe horizontal directions up to and soon after noon of each day. This was the case by noon of July 23, and for two consecutively clear days from sunrise to sunset at the next station occupied. He states that he had never before been able to do this during an experience of thirteen years in triangulation, eleven of which had been passed in Missouri and Kansas.

After the completion of the work at station Heath, and while a transfer of the party to station Thompson was in progress, Mr. Granger went to Ellsworth for the purpose of connecting the astronomical station at that point with the triangulation. Its latitude and longitude had been determined in 1886.

The town being in the valley of the Saline River, the only point in it that could be observed from any of the main points of the scheme was the Water Tower, which formed with stations Heath and Wilson a well conditioned triangle. The measurement of a short base and the determination of the angles of this triangle gave data for the connection desired. The results of his field computations indicated an excess of the geodetic latitude over the astronomical of $5''.75$.

Camp having been moved to station Thompson, Ottawa County, observations were begun there August 6, and completed August 11. The following named stations were then occupied in succession: Lincoln, Lincoln County; Golden Belt, Lincoln County; Meades Ranch, Osborne County, and Wilson, Russell County.

Mr. Granger observes that Meades Ranch, which contains over 1 200 acres of cultivated and pasture land, is well known in both Osborne and Russell Counties. His station of that name was situated on the highest point of a prominent ridge in Freewill Township, about 12 miles north of Lucas, a small town on the Lincoln branch of the Union Pacific Railway. The ridge lies about midway of the Saline and Solomon Rivers, and from its summit, which is nearly 2 000 feet above sea level there are very fine views of the valleys of these rivers. No observing tripod and scaffold was required at Meades Ranch. Except at this station and three others, it had been necessary to build tripods and scaffolds of heights varying from 20 to 105 feet at the stations along the line of triangulation through Missouri and Kansas.

At the last point occupied during the season, Wilson, situated about 3 miles to the northwest of the town of that name in Ellsworth County, the theodolite was mounted upon an observing tripod 50 feet high in order to observe the 50-foot tripod and pole at station Heath, and to see the Ellsworth Water Tower. On November 9, 1891, the observations

having been completed, the instruments and camp equipage were stored for the winter, and on the 17th, the party started out with a signal building outfit to put up the signals that would be needed in advance of the occupation of additional stations another season. Having erected two observing tripods of 25 feet in height, one at station Allen and one at station Hays, and one of 40 feet at station Trego, the party returned to Wilson, December 5, and was there disbanded.

After returning to Washington, Mr. Granger proceeded under instructions to New York to complete the preparation of the records and results of his season's work, and while in that city made a determination in position of certain range marks used by New York Bay pilots Reference to this service has been made under a previous heading.

Upon reporting the completion of his office work he received instructions to resume field operations in Kansas, and after reörganizing his party at the town of Wilson, April 15, 1892, he took up the work of signal building and selected a site for a primary base line of about 3·3 miles in length, lying between the towns of Bunker Hill and Russell, in Russell county. A sketch showing profile of proposed base and its connection with the triangulation was forwarded to the Superintendent.

Arrangements were also made for the occupation of Station Bunker Hill. Observations were begun here May 26 and closed June 16. His party was then transferred to Station Waldo, in Osborne County, about 5 miles northwest of the town of Waldo, in Russell County. Observations were begun here on June 23 and were making good progress at the close of the fiscal year.

Mr. Granger reports that he was efficiently assisted in the work by Mr. M. A. Coles, recorder.

The statistics for the fiscal year are as follows:

Base line:	
Primary, length of in miles	3·3
Triangulation:	
Area of, in square statute miles	1 365
Observing tripods and scaffolds built	10
Number of stations occupied for horizontal measures	8
Number of stations occupied for vertical measures	8
Number of geographical positions determined	20
Number of elevations determined trigonometrically	18

Triangulation along or near the thirty-ninth parallel continued in western Kansas and eastern Colorado.—Upon reaching his field of work in western Kansas and eastern Colorado in May, 1891, under instructions to extend the triangulation along the thirty-ninth parallel in those States, Assistant F. W. Perkins took up a search for points established by the reconnaissance of 1882. Some progress had been made in this search by his foreman, R. E. Duvall, who had been put in charge of a construction party a few days before Mr. Perkins arrived at Wallace, Kansas.

In spite of all the changes which had occurred during ten years in the western part of the State, which from a purely grazing region has become an agricultural one, and although every vestige of the signals had disappeared, fifteen of the sixteen old points were recovered, and the signals having been built as fast as they could be identified, Mr. Perkins began measurements of horizontal angles at Wallace Bluff, Kansas, on May 29. Subassistant W. B. Fairfield and Recorder H. L. Stidham reported for duty July 1, and became immediately available as a second observing party. Mr. Fairfield was directed to occupy Station "Pond."

Delays occurred during the work of the first two weeks owing to several causes, foremost among which were the tremors caused by continuous high winds, and by the covering of gritty dust brought by them over the theodolite. It became necessary to build a circular wall of sod, 9 feet in diameter and 4½ feet high about the observing tent.

Mr. Perkins observes that the conditions which affect observations in this region are peculiar, but on the whole favorable. The air is dry, and except on rare occasions extremely transparent, but an extraordinary distortion of objects and an extremely tremulous condition of the atmosphere is common, so that while to the naked eye, and often to glasses of moderate magnifying power, the appearance is encouraging, the time available for observations of precision is confined to very short intervals, sometimes, though rarely, in the morning, and generally every afternoon. The work of observing was rendered very arduous by the fact that "good seeing" lasting perhaps five minutes, perhaps for an hour or more, was liable to occur at any time between sunrise and 10 o'clock in the morning and between two o'clock in the afternoon and sunset, and to be followed by a tremulous condition of the atmosphere which would entirely blot out all signals.

Besides the points in the regular scheme of quadrilaterals, and many prominent natural and artificial objects that were observed, measurements were made for connecting the astronomical station of 1885, at Wallace, Kansas, with the triangulation, and for determining in geographical position, four boundary marks on the Kansas and Colorado State line. Mr. Perkins calls attention to the report of his foreman, Mr. Duvall, in regard to the condition of the surface marks for these points on the boundary. Very few remain, and the underground marks will scarcely survive many seasons. He suggests that they should be re-marked while it is still possible to identify them.

On November 8, Mr. Fairfield was detached from duty in the party, an exigency having arisen which required his assignment to the charge of work in western Virginia. Mr. Duvall was thereupon directed to occupy two points in Colorado for the determination of boundary monuments, and later was relieved by Mr. Stidham, who measured angles for the same purpose at boundary mark No. 73½ and at McLane station in Kansas.

By the middle of December, storms of a serious nature had increased in frequency to such a degree that a suspension of field operations became imperative, and on the 16th of that month the party was disbanded.

The work of the season, which extended over two degrees of longitude, has furnished the following statistics:

Reconnaissance:	
Area of, in square statute miles	400
Lines of intervisibility determined, as per sketch submitted	19
Number of points selected for scheme	6
Triangulation:	
Area of, in square statute miles	1 640
Number of signal poles erected	22
Observing tripods and scaffolds built	4
Number of days occupied in opening and verifying lines of sight	34
Number of stations occupied for horizontal measures	15
Number of geographical positions determined	38

Mr. Perkins observes that the very satisfactory results of the season, both in amount and in quality, are due to the industry and hearty coöperation of each member of his party. Mr. Fairfield's experience and skill as a rapid observer enabled him to complete the measurement of angles at six primary stations. Mr. Stidham and Mr. Duvall made excellent records in their respective capacities of recorder and foreman.

He expresses his obligations to Superintendent H. G. Clarke and Chief Engineer James W. Way, of the Missouri Pacific Railway, for their courtesy in furnishing valuable data, and to Mr. H. A. Clark, of Wallace, who, in addition to numerous courteous attentions to the officers and facilities afforded for the work, placed at the disposal of the party commodious quarters for storerooms, workingrooms, etc.

In January, 1892, Mr. Perkins was instructed to resume the extension of triangulation in Alabama towards the Gulf of Mexico.

Examinations and surveys at the mouth of the Brazos River, Texas, to locate the new channel and other recent improvements.—For the purpose of making an examination with reference to the effect of recent improvements on the channel at the mouth of Brazos River, Texas, and to make such topographic surveys as would be necessary to locate the new channel on the chart, Assistant H. G. Ogden was instructed towards the end of November, 1891, to proceed to that locality and execute the surveys required.

Mr. C. L. Gardner, who was assigned to duty as recorder in his party, left Washington November 30, and upon his arrival a few days later made preparations for the inauguration of the work, so that on the afternoon of Mr. Ogden's arrival, December 9, he was enabled to measure a base line, and on the next day determined with the plane table a sufficient number of points to enable him to proceed with the hydrography as soon as the weather would permit.

The U. S. Revenue Marine steamer *Galveston* had been kindly placed at Mr. Ogden's disposal to assist in the work. The weather proved unfavorable for hydrography until the 16th, when soundings were made on the bar and additional ones secured the next day. On the 18th, the sea being too heavy for boat work, a few lines were run with the steamer normal to the coast to develop the 5-fathom curve off the entrance. To determine the general depth in the river between its mouth and the new city of Velasco, 4 miles above, a single line of soundings was run with the steamer.

The topographical work was confined to running the shore line from the entrance to about a mile above, but the general course of the river was plotted upon the projection from surveys which had been made by the engineers in the employ of the Brazos River Channel and Dock Company, a private corporation having a charter from the State of Texas, and authorized by act of Congress to improve the river channel. There is another corporation interested in this improvement, the Texas Land and Emigration Company, chartered under the laws of Texas, and owning valuable interests in the land adjacent to the river.

Signals used by the United States Engineers in the survey made by officers of that corps in 1887 were still standing, and as data referring to these signals had been furnished by the Chief of Engineers, the measurement of a check base enabled Mr. Ogden to identify them. He was able also to recover the old triangulation station Brazos, by occupying which for measurements of horizontal angles and also the dome of the Hotel Velasco, he connected his plane-table triangulation satisfactorily with the old work.

His survey showed a depth at mean low water over the shoalest spot between the jetties of 14½ feet, and he found no less depth up to Velasco.

Mr. Ogden acknowledges the many courtesies received from the officers of the improvement companies while he was engaged in the work, and expresses also his indebtedness to Lieut. David H. Hall, commanding the Revenue Marine steamer *Galveston* and to the officers of that vessel for their very zealous and efficient assistance in the prosecution of the work.

Mr. Gardner, as recorder, rendered very acceptable service, without which the survey could not have been finished within the short space of twelve days.

The statistics are:

Triangulation:	
Area of, in square statute miles	5
Number of stations occupied for horizontal measures	2
Number of geographical positions determined	4
Topography (scale 1–10 000):	
Area surveyed in square statute miles	0·5
Length of general coast in statute miles	4
Length of shore line of river in statute miles	3
Length of shore line of creeks in statute miles	1·1
Length of roads in statute miles	1

Hydrography:

Area sounded in square geographical miles	10
Number of miles (geographical) run while sounding	60
Number of angles measured	621
Number of soundings	3 613

Upon returning to Washington, toward the end of December, Mr. Ogden resumed the charge of the Engraving Division of the office, which had been assigned during his absence to his clerk, Mr. John H. Smoot.

Completion of the reconnaissance for a triangulation of the boundary line between the United States and Mexico along the Rio Grande from El Paso, Texas, to Sanderson Peak.—In continuation of the reconnaissance for a triangulation of the United States and Mexican boundary line along the Rio Grande, Assistant Stehman Forney took the field under instructions issued in January, 1892, and proceeded to El Paso del Norte (Ciudad Juarez) in Mexico. Having obtained here such passports as were required by the Mexican authorities, he joined his party at Sierra Blanca, Texas, a station to which he had previously sent his foreman, and on February 17 began the occupation of Sierra Blanca Peak in the Quitman Mountains. Upon the completion of observations at this station he went to Viejo Peak and continued the reconnaissance along the Rio Grande to the southward and eastward of the Viejo Mountains, carrying it to Pico Terio on the Mexican side of the river and to Sanderson Peak on the United States side. This carried the work to the end of the mountainous region of the Rio Grande in Texas, with strong and well-conditioned figures, from which any number of points on both sides of the Rio Grande can be determined for plane-table work.

In the primary scheme developed by the reconnaissance the longest line was 85 miles and the shortest 40 miles; in the secondary scheme the longest line was 82 miles and the shortest 12 miles. The reconnaissance extends 380 miles south and east from El Paso in a direct line; it embraces 400 miles of river line and covers an approximate area of 17 500 statute miles.

From Sanderson Peak to the mouth of the Rio Grande, Mr. Forney reports that from the most trustworthy information he was able to obtain, the country is low, with rolling sand hills, and covered with a dense growth of cactus and chapparal reaching from 10 to 15 feet in height, and impenetrable to man or beast outside of the regular wagon roads and cattle trails.

The region yet to be covered by reconnaissance lies between the Chisos Mountains and the mouth of the Rio Grande. It is 400 miles in a direct line to the Gulf Coast, and has 520 miles of river line.

From his experience of the two seasons in the field and from his observations of the climatic and atmospheric conditions of the country, Mr. Forney is of opinion that in order to obtain satisfactory measurements of horizontal directions over the long lines which will have to be observed, it will be advisable to select the period from about May 1 to February 1, and to make all of the observations at night.

He concludes his report by submitting recommendations relating to the best means for overcoming the various difficulties arising from the nature of the country, the want of water, the scarcity of labor, etc., and acknowledges the courteous manner in which he was received and furnished with liberal passports by the Mexican authorities.

The Commissioner of the General Land Office of the State of Texas and Prof. Von Streeruwitz of the State Geological Survey, addressed letters to Mr. Forney expressing their sense of the great value and importance of the proposed triangulation of the Rio Grande to the State of Texas in the establishment of true meridian lines and well-determined geodetic points throughout the State.

For the season beginning February 17 and ending April 30, 1892, the statistics are as follows.

Reconnaissance:

Area of, in square statute miles	17 500
Lines of intervisibility determined	87
Number of points selected for scheme	35
Average length in miles of primary lines	62
Average length in miles of secondary lines	47
Number of miles traveled with wagon	1 000
Number of miles traveled on horseback	1 120
Number of miles of river line included in reconnaissance	400

Other surveys executed by Mr. Forney, earlier and later in the fiscal year, are referred to under headings in the State of Maine.

Record of the differential values of the magnetic elements continued, and absolute values of these elements determined monthly at the automatic registry station, San Antonio, Texas.—Assistant R. E. Halter has submitted his annual report of work accomplished during the fiscal year at the magnetic observatory, San Antonio, Texas. The record of the differential values of the magnetic declination, dip, and intensity has been maintained with the Adie magnetographs; but, as the disturbances arising from the proximity of a line of electric railway, built since the site for the observatory was selected, still continued, Mr. Halter was directed to examine sites that would in all probability be free from similar disturbances for years to come. In April the Superintendent visited San Antonio and decided to have the observatory moved to Vance's Ranch, about 4 miles northwest of its first location. Mr. L. G. Schultz, Mr. Halter's assistant, was directed to take charge of the erection of the new building and to remove and set up the instruments, the record meanwhile being maintained as long as practicable by Mr. Halter. At the end of the fiscal year this work was well advanced.

The usual semiannual determinations of the scale values of the bifilar and vertical force magnets were made by Mr. Halter, as also the observations for the absolute values of the magnetic declination, dip, and intensity. Throughout the year he was ably assisted by Mr. Schultz.

An abstract of statistics is as follows:

Whole number of hourly scale readings from the unifilar, bifilar, and vertical force traces (8 757 from each)	26 271
Number of observations for absolute declination	1 308
Number of observations for absolute intensity	1 080
Number of observations for absolute dip	3 520
Number of hourly readings from thermograph trace	8 760
Number of observations for scale values	576

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1892.

WESTERN DIVISION.

STATES AND TERRITORIES BETWEEN THE ROCKY MOUNTAINS AND THE PACIFIC.

40. California.
41. Oregon.
42. Washington.
43. Idaho.
44. Montana.
45. Wyoming.
46. Nevada.
47. Utah Territory.
48. Colorado.
49. Arizona Territory.
50. New Mexico Territory.

Progress Sketches No. 2, Nos. 4, 5, and 6, Nos. 11 to 13 inclusive, and No. 17 exhibit the localities of field work in the Western Division. See list of Progress Sketches at the close of this volume.

Boundary line between the United States and Mexico. Its re-location and marking by the International Boundary Commission.—Under the heading of "Special Operations" is given an abstract of a

report submitted by Assistant A. T. Mosman, who was appointed in November, 1891, one of the members on the part of the United States of the International Boundary Commission, which was organized under the provisions of the treaties of 1882 and 1889 for the re-location and marking of the boundary line between the United States and Mexico.

At the end of the fiscal year, the field work, which had been begun in February, 1892, had made good progress. Its advance after June 30 will be adverted to in the next annual report.

Mr. John F. Hayford, aid, was given leave of absence without pay in order that he might report for duty as assistant astronomer under the direction of Mr. Mosman.

Determinations of latitude, longitude, and the magnetic elements at points on the Boundary Line between the United States and Mexico for the International Boundary Commission.—The International Boundary Commission, organized in 1891 for the more accurate location and marking of the boundary line between the United States and Mexico, having requested that certain points on that boundary should be determined in geographical position by the Coast and Geodetic Survey, the Superintendent instructed Assistant C. H. Sinclair and Aid G. R. Putnam to proceed to Los Angeles and San Diego, California, and make the arrangements needed for carrying to the eastward from those points as base stations the operations needed. Los Angeles had been determined in longitude from San Francisco in 1889; the first work to be done, therefore, was the connection of San Diego with Los Angeles by exchanges of telegraphic signals for longitude, observations for the latitudes of Los Angeles and San Diego, and determinations of the magnetic elements.

Under the heading of "Special Operations" towards the end of this volume is given a report of the progress of this important work, which was begun in January, 1892, and which by the energy and skill of the officers in charge of it was completed to El Paso, Texas, on May 23, in a month less than the time estimated. The longitude lines determined were Los Angeles–San Diego; San Diego–Yuma, Arizona; Yuma–Los Angeles; Yuma–Nogales, Arizona; Nogales–El Paso, Texas; and El Paso–Boundary Corner, New Mexico. Latitude observations with zenith telescope were made at all stations except at the Corner, where the Commission had already made a determination. At Los Angeles, latitude was determined by Mr. Sinclair; at San Diego and El Paso, by Mr. O. B. French, whose work as an observer and computer throughout the season was highly satisfactory; at Nogales Mr. Putnam observed for latitude, and at Yuma observations were made by both Mr. Putnam and Mr. French All boundary marks or monuments were connected trigonometrically with the main stations. At all of these stations, except at the Corner, the magnetic declination, dip, and intensity were determined, and two additional stations were occupied.

Mr. Putnam gives in his report a comparison of longitudes of boundary marks from the field computations, with the longitudes as determined by Maj. Emory from moon culminations, 1843 to 1853, the differences ranging from + 22·1 seconds of time to — 3·83 seconds, or in miles, from — 0·93 to + 5·44. These longitudes, though subsequently corrected, were those actually used in marking the boundary.

Following are the statistics of the work:

Latitude and longitude work:

Number of latitude stations occupied	5
Number of pairs of stars observed for latitude	108
Average number of observations on a pair	5
Number of telegraphic longitude stations	6
Number of nights on which signals were exchanged for longitude	53

Magnetic work:

Number of stations occupied for observations of the magnetic declination, dip, and intensity	8
Number of days on which magnetic observations were made	21

Reference to work of a similar character assigned to Messrs. Sinclair and Putnam is made under headings in the Eastern and Middle Divisions.

Completion of the topographical survey of the coast of California from Cape San Martin to Point Sur.—Triangulation for completing the topographical survey of San Francisco Entrance.—At the beginning of the fiscal year Assistant A. F. Rodgers had been in the field since early in May, 1891, engaged in advancing towards completion the topographical survey of the coast of California between Cape San Martin and Point Sur. For this purpose he had organized a double party; Subassistant John Nelson having been detailed for detached work under the direction of Mr. Rodgers.

On September 22, Mr. Nelson, having completed the field work assigned to him, was directed to proceed to San Francisco, and took up the inking of his plane-table sheets, and the preparation of tracings, preparatory to forwarding the sheets to Washington.

Mr. Rodgers finished the last topographical sheet of the Point Sur project on November 3, and after occupying Sierra Hill Station to strengthen the trigonometric determination of Point Sur Lighthouse, he disbanded his party and proceeded to San Francisco, where he took up the office work resulting from the field work of the season. This occupied both Mr. Rodgers and Mr. Nelson until early in January, 1892, when Mr. Rodgers left for Washington under instructions to report at the office as a member of the Topographical Conference convened by direction of the Superintendent.

He remained on duty with the Conference until its adjournment early in March, and then returned to San Francisco, where Mr. Nelson had continued on duty during his absence. Between April 26 and June 14 the six original topographical sheets of the Cape San Martin–Point Sur project were forwarded to Washington, tracings of them having been completed partly by Mr. Rodgers and partly by Mr. Nelson. The officer just named was detached and ordered to report for duty at the office early in April.

In June Mr. Rodgers took up under instructions the erection of signals and determination of geographical positions designed to facilitate the completion of his unfinished topographical sheet of San Francisco Entrance. He occupied twelve stations and observed a sufficient number of directions to determine prominent headlands, points, and rocks with precision.

For the field work of the fiscal year 1892 the following statistics are reported:

Triangulation:

Area of, in square statute miles	25
Number of signal poles erected	20
Number of stations occupied for horizontal measures	12
Number of geographical positions determined	70

Topography (scale 1–10 000):

Area surveyed in square statute miles	58
Length of general coast in statute miles	9
Length of shore line of creeks in statute miles	40
Length of roads and trails in statute miles	50
Number of topographic sheets finished during year	4

Occupation of a station in continuation of the primary triangulation of the Pacific Coast.—Observations for the variation of latitude.—Charge of the sub-office at San Francisco, etc.—Assistant George Davidson has submitted a report of the various operations of the Survey on the Pacific Coast which have been committed to his charge. They may be summarized under the following headings:

Primary triangulation.—Reference was made in the last annual report to the occupation of Mount Conness, which was completed in the autumn of 1890 by Mr. Davidson's party. In the spring of 1892 arrangements were begun preparatory to the occupation of Mount Diablo, another station of the main series of triangles on the Pacific Coast. Mr. Frank W. Edmonds, who had accompanied the party to Conness in 1890, was directed to proceed to that station to post the heliotropers; Assistant James S. Lawson volunteered to post the two needed at

Mocho Station, and Mr. Davidson and his party proceeded to Diablo, arriving at the summit early in June.

It was only by most indomitable effort that Mr. Edmonds finally reached the summit of Conness. Starting June 1 from San Francisco, and obtaining pack mules at Oakdale, he reached the snow about 15 miles beyond Crockers, and 37 miles from Soda Springs, the site of the lower camp of 1890. Thence the distance is 11 miles over a very rough trail to the summit; the snow was very deep and soft, the animals sinking in it to their saddle girths, and it took nine days to force his way through it and mount the heliotrope. For eight days he was weatherbound at White Wolf by snowstorms, and had to return to Crockers and get extra supplies of forage and provisions. On June 27 he showed his heliotrope signal to Conness, but on account of smoke its flash was not seen till next day.

At Mount Diablo the coast fogs came on unusually heavy and were high enough at times to envelope the whole mountain, the summit of which has an elevation of 3 849 feet above the sea. The smoke of the San Joaquin and Sacramento Valleys was also very thick, and not unfrequently the Sierra was invisible for days.

Mr. Davidson succeeded, however, in finishing the observations of horizontal directions and of vertical angles needed at Mount Diablo in twenty-two observing days. From his previous experience on lines over 100 miles in length, he decided to make about sixty or sixty-five observations for direction, and, in order to cover the circle as much as possible, he made but one observation direct and one reverse in a position. For horizontal directions he observed on two stations in sixty-one positions. On returning from Conness Mr. Edmonds began measurements of vertical angles, and made eighty-three observations on seven objects.

Mr. G. J. Kammerer served as recorder in the field and afterwards in San Francisco.

After the completion of the occupation of Diablo and the return of the party to San Francisco, Mr. Davidson, at the request of Assistant E. F. Dickins and with the approval of the Superintendent, instructed Mr. Edmonds to post heliotropers at Scott Mountain, one of the stations of the primary triangulation of the north coast of California.

This mountain of 9 200 feet elevation had never been occupied by any Coast Survey party. It is 100 miles from any access by rail and 40 miles from stage. After much arduous labor the heliotropers were posted on a ledge, 10 feet by 4 feet, which forms the top of the mountain. This ledge has precipitous sides of 300 feet. Mr. Edmonds returned to the Sub-office after an absence of twenty days.

Completion of the series of systematic observations for the variation of latitude at the Lafayette Park astronomical station.—Under the heading of "Special Operations" is given an abstract of that part of Mr. Davidson's annual report relating to the elaborate series of observations made by him between May 27, 1891, and August 25, 1892, at the Lafayette Park astronomical station, San Francisco, for investigating the variation of latitude in coöperation with the work of the International Geodetic Association.

United States Post Office site at San Francisco, and Board of Engineers, to devise a system of sewerage for the city and county of San Francisco.—Service rendered to the United States and to the city and county of San Francisco in the matters indicated in the above heading is reported under "Special Operations."

Automatic tidal station at Sausalito.—The work at this station, which remained as heretofore under Mr. Davidson's direction, is referred to under a heading following.

Coast Pilot.—Pacific coast.—A large amount of material was gathered during the year supplementary to the fourth edition (1889) of the Pacific Coast Pilot, California, Oregon, and Washington, but time was not available to collate it for publication.

Charge of the Sub-office at San Francisco.—The operations of the Sub-office at San Francisco, which remained as heretofore under Mr. Davidson's direction, will be referred to under a notice of Sub-offices towards the close of this part of the annual report.

Tidal record continued at the automatic tidal station at Sausalito, Bay of San Francisco.—Under the direction of Assistant Davidson, Mr. Emmet Gray, observer, has maintained the tidal

record throughout the fiscal year at the automatic tidal station, Sausalito, Bay of San Francisco. After the record for each month has been completed, and the tabulations of the half-hourly height of sea level, and of the times and heights of high and low water have been made by the observer, they are sent with the maregram to the Sub-office, and after having been examined there are forwarded to Washington.

The time used for the tidal observations is that of the Lafayette Park astronomical station; a table of daily errors of the chronometer used to check the gauge clock being furnished by Mr. Edmonds from his observations of the sun. He makes also the levelings between the tide staffs and the bench marks at the Sausalito station.

Trial course for steam vessels laid off in San Francisco Bay for the use of the Union Iron Works.—In January, 1892, a letter was received from the President of the Union Iron Works, San Francisco, Mr. H. T. Scott, stating that the company was desirous of having a speed course laid off in San Francisco Bay, and that it would be esteemed a great favor if the work could be done by the Commander of the Coast and Geodetic Survey steamer *Hassler*.

Lieut. D. Delehanty, U. S. N., Assistant Coast and Geodetic Survey, was accordingly instructed to confer with Mr. Scott, and it was finally decided that a course of about 2 miles would be satisfactory, since one of that length could be run over during slack water, whereas on a longer course the speed trials would be influenced by the tidal currents in the bay, which are strong and irregular. The location of the course having been left to Lieut. Delehanty's judgment, he selected the points between Point Avisadero and Spreckels' Sugar Refinery as affording the deepest water, the least interference on the part of the shipping, and the most available location for range signals.

The distance between the ranges, as determined by Lieut. J. B. Blish, U. S. N., was found to be 1.785 miles. A closer approximation to 2 miles could not be obtained owing to the configuration of the shore line.

Lumber for building the range signals was furnished by the Union Iron Works.

Two tracings of the projection showing the special course were made—one for the Union Iron Works, the other for deposit in the Sub-office of the Survey in San Francisco. Lieut. Delehanty reported the completion of this special service under date of March 3, 1892.

Reference is made under a subsequent heading to hydrography executed by him on the coast of the State of Washington in September and October, 1891.

Reconnaissance and occupation of stations in continuation of the primary triangulation north of San Francisco Bay.—The primary triangulation party, in charge of Assistant E. F. Dickins, at the beginning of the fiscal year, was in camp on Ross Mountain, Sonoma County, California. Measurements of horizontal directions and of vertical angles were made between July 4 and July 20, 1891. At the last named date, arrangements were begun for the movement of the party across the country by teams and railroad to Mount Helena station, on the boundary of Napa, Lake, and Sonoma Counties. After reaching Mount Helena Toll House at the end of July, a trail had to be cut to the summit of the mountain and the camp outfit and instruments packed up to the top. This was accomplished by August 8, and after camp had been pitched, heliotropers stationed, and instrument piers built, observations were begun. Between August 14 and 26 all work at this station was completed, and, after a journey across the country, of about 60 miles, the party arrived at the foot of the next station, Mount Sanhedrin, in Mendocino County, on the evening of September 6.

The distance up this mountain was about 8 miles, and, as the trail was very rough and steep, it took five days to get all instruments, camp outfit, etc., to the top. Observations were delayed at the outset by a severe storm of rain, snow, and hail, which lasted for several days, but a season of good observing weather followed and enabled Mr. Dickins to complete the station by September 26. Camp was broken on the 28th, and the party then started for Cold Spring Station in charge of Mr. F. Westdahl, draughtsman and assistant observer, while Mr. Dickins went to San Francisco to obtain repeating theodolites for use in connecting the tertiary triangulation in the vicinity of Point Arena with the primary.

Piers were built, observing tents put up, and instruments mounted, and when Mr. Dickins arrived he began observations, and detached Mr. Westdahl to erect signals at Stations Fisher, Dunn, and Clark for connection with the tertiary work.

Cold Spring Station is located on a large rock or bowlder about 20 feet in diameter at the base, rounding on top, and rising about 20 feet above the surface of the ridge; on top of this rock was built the pier for the theodolite, and, to support the platform for the observing tent, and the tent itself, a tripod signal was erected and its braces bolted securely to the rock. Owing to severe storms observations were not finished here until November 6; the party was then divided, Mr. Westdahl being sent to occupy Clark, Dunn, and Fisher stations, while Mr. Dickins occupied stations Arena Astronomical (1870), Point Arena Astronomical (1889), Smith, High Bluff, Marr, Sinclair, and Lane. All observations required were completed November 22, and on the 30th the party was disbanded at San Francisco, Mr. Westdahl having been instructed to report to Assistant Davidson for duty in the Sub-office.

During the ensuing winter and spring until May 1, 1892, Mr. Dickins was engaged at the Sub-office in the preparation of the records and results of his field work for transmission to the archives, and at that date he re-organized his party under instructions to resume the main triangulation in northern California. Mr. Westdahl having been again assigned to duty with him, preparations were made for the occupation of Snow Mountain, a station having an elevation of about 7 000 feet above sea level. The party rendezvoused at Touts Springs, at the foot of the mountain, and distant from its summit about 8 miles by trail. A succession of storms and deep snows delayed the party at the outset of operations, so that it was not till May 25 that all of the camp equipment could be brought up. The mercury fell nearly every morning to below 30° F., and on June 8 and 9 there was a snowstorm, with the thermometer at 24° F. Observations were completed, however, on June 11, and between that date and the end of the fiscal year Mr. Dickins was occupied in making transfers of instruments not needed in subsequent operations, in storing camp outfit at the Sub-office, and then in traveling with his party to Ukiah, Mendocino County, to complete the quadrilateral Fisher–Cold Spring–Paxton–Two Rock, and thereby strengthen the connection of the tertiary with the main series.

Mr. Dickins acknowledges the valuable service rendered by Mr. Westdahl while attached to his party.

The statistics for the fiscal year are as follows:

Triangulation:

Area of, in square statute miles (approximate)	4 400
Number of signal poles erected	14
Number of miles traveled in posting heliotropers—	
(*a*) by stage and horseback	1 337
(*b*) by railroad	1 542
Number of stations occupied for horizontal measures	15
Number of stations occupied for vertical measures	5
Number of geographical positions determined	23
Number of elevations determined trigonometrically	11

Triangulation and topography of the Columbia River from above Vancouver towards the Cascades.—Reference was made in the last annual report to the completion of the triangulation and topography of the Columbia River in the spring of 1891 by Assistant Cleveland Rockwell. At the beginning of the year Mr. Rockwell was in camp at Fishers Landing above Vancouver and was carrying the triangulation and topography forward at the same time. On September 4 he moved his camp to the village of Washougal, and thereafter until the close of the season advanced the triangulation. The first topographical sheet had been completed to the head of Government Island, and it was his intention to take up a second one, but unexpected delays occurring to retard progress in the triangulation, he was unable to do so. After the rains of the earlier part of the season had ceased, smoke interfered

greatly with the visibility of the signals. The river was at a freshet stage during a large part of the summer, and the currents very swift; hence much time was occupied in going to and from the different points of work, the only means of communication being a rowboat.

On October 19 field operations were closed, the weather having become so inclement that the work could not be prosecuted longer to advantage.

Mr. Rockwell has transmitted to the office with his topographical sheet a descriptive report which gives full details relating to the geological formations, the flora and fauna and the agricultural products of the region under survey. He observes that the most prominent topographical feature is Prune Hill, an elevation of about 500 feet, which may be said to be the beginning of the foothills of the Cascade Mountains. The hill is a solid mass of very red basaltic rock, but the cliffs immediately west of it along the river are quite different in formation, being of a variety of basalt known as augite. These cliffs have been worked very extensively as quarries, great quantities of stone having been taken to build the jetty or dike at the mouth of the Columbia River.

The whole north side of the river bears evidence of being the lateral moraine of a great glacier which once filled its basin, though no striæ have yet been observed in the rocks.

The river is subject to an annual rise which reaches its greatest height in the latter part of June. At this time the water is generally confined within its banks, but floods of extraordinary extent occur at intervals of years when every foot of land which has been formed by the currents is submerged and the river spreads out to the bases of the hills on either side.

For the season, beginning May 12 and ending October 19, 1891, the statistics are as follows:

Triangulation:

Number of signal poles erected	18
Number of stations occupied for horizontal measures	19
Number of geographical positions determined	32

Topography (scale 1–10 000):

Area (approximate) surveyed in square statute miles	17
Length of shore line of river in statute miles including islands	34
Length of marsh line in statute miles	29
Length of shore line of creeks and ponds in statute miles	36
Length of roads in statute miles	35

Mr. J. C. Carruthers rendered acceptable service as a recorder in the party until August 25, when he resigned.

Mr. Rockwell reported at the office in January, 1892, under instructions to serve as a member of the Topographical Conference convened by direction of the Superintendent.

After the adjournment of the Conference in March, he returned to the Pacific Coast and soon after tendered his resignation as an assistant in the Survey, to take effect June 1, 1892. In forwarding to him a letter from the Secretary of the Treasury accepting his resignation, the Superintendent took occasion to express to Mr. Rockwell his appreciation of the great value of his services during the long period, nearly thirty-six years, of his connection with the Survey, the high esteem in which he was held by his brother officers being justified by the unvarying excellence of his work, ranking always among the best of its kind.

Hydrographic surveys on the coast of Oregon between Cape Meares and Cape Kiwanda, and in Willapa Bay and Grays Harbor, coast of Washington.—Lieut. J. M. Helm, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Gedney*, has submitted descriptive reports to accompany the hydrographic sheets of his survey on the coasts or Oregon and Washington, executed in the summer and autumn of 1891.

His first work during the fiscal year was the inshore and offshore hydrography of the coast of Oregon from Cape Meares to Cape Kiwanda. This is a comparatively desolate stretch of coast, there being no settlements except the scattering ranches along the beach

and about Natarts Bay. The only channel is the one leading into this bay; it is very narrow and has a depth of but 5 or 6 feet, which will be indicated more closely when the soundings have been plotted. No vessel visited the bay during the stay of the *Gedney* in the vicinity.

In the neighborhood of Cape Meares, the shore is high and precipitous with an outlying group of rocks a little to the southward and eastward of the Cape, of which the Three Arch Rocks are the most prominent. In summer, vessels can find anchorage under these rocks, under Cape Lookout and inside Haystack Rock, finding fair shelter against prevailing winds, but a heavy swell is apt to be encountered. In winter, there are no anchorages.

The results of this survey, which was completed between July 5 and 22, 1891, are shown on two hydrographic sheets, scale of each 1–20 000, and the statistics are:

Hydrography:

Area sounded in square geographical miles	237
Number of miles (geographical) run while sounding	396
Number of angles measured	2 924
Number of soundings	5 751
Number of specimens of bottom preserved	50

After proceeding to Astoria, Oregon, to take on stores, water, coal, etc., Lieut. Helm took the *Gedney* to Willapa Bay, and on July 28 began the work assigned to him in that locality. For this hydrography he was provided with four projections, with limits and scales as follows: Willapa Bay, the whole of the main bay from North Bay and Toke Point to the southern end (scale 1–20 000); Willapa Bay Bar, North and South Channels (1–20 000); Willapa River from the Narrows to Willapa City (1–10 000); and Willapa River from its mouth to the Narrows (1–10 000). Certain changes of shore line were also to be investigated, and topographical surveys made of the shore line of Willapa River, and of the adjacent country. This incidental topography is shown on the projections above named.

Lieut. Helm has given in his descriptive report details of changes noted since the work of the preceding season; of these the most important, a change in the position of the buoy formerly shown on the north side of the upper channel entrance to the bay, was published in Notice to Mariners, No. 147, for November, 1891. The length of Willapa River to the present head of navigation, Willapa City, which is the outlet for the agricultural district of the Willapa Valley, is 10⅔ miles. There is a depth of water alongside the wharf at the mean of lower low waters of from 8 to 9 feet.

For the hydrographic surveys of Willapa River and in Willapa Bay, which were completed September 24, 1891, the statistics are as follows:

Hydrography:

Area sounded in square geographical miles	76
Number of miles (geographical) run while sounding	673
Number of angles measured	9 512
Number of soundings	43 713
Number of tidal stations established	7

For the topography delineated on the hydrographic sheets of Willapa Bay and Willapa Bay Bar the following statistics are given:

Topography:

Area surveyed in square statute miles	5
Length of general coast in statute miles	9
Length of shore line of rivers in statute miles	38

The *Gedney* then steamed to Grays Harbor, and Lieut. Helm began on October 4 the hydrography of Grays Harbor Bar, and an examination of Hoquiam Channel, as shown on the published chart. The locality of the survey of the bar was to the westward of a line joining Point Brown and Point Chehalis. There is but one channel across the bar. This has a depth of 15 feet at the average lower low water and 24 feet at the average high water at the time of the survey, but possibly more in winter and spring. Lieut. Helm appends to his

report a list of vessels, twenty-eight in number, that had entered or left the harbor during his stay there. Towards the end of October there were in the harbor twelve vessels ready for sea, representing 5 000 000 feet of lumber, and two vessels in the offing. The channel across the bar is comparatively straight and is buoyed, and in ordinary weather and with light draft a pilot is not needed. If, however, the weather is thick, or if there is any doubt about the condition of the bar, a stranger should take a pilot.

Acknowledgment is made in the report of the interest shown in the work, and efforts made to facilitate it by Mayor Arnold, of Hoquiam, Mr. Geo. H. Emerson, General Manager of the Hoquiam Mills, and Capt. Lawson of the pilot tug *Traveler*.

The officers attached to the party were Ensign A. N. Mayer and J. M. Poyer, U. S. N. Mr. W. W. Joynes served as pay yeoman.

For the Grays Harbor survey, which was completed October 30, the statistics are:

Hydrography (scale 1–20 000):

Area sounded in square geographical miles	16
Number of miles (geographical) run while sounding	101
Number of angles measured	848
Number of soundings	4 485

During the winter of 1891–92 and part of the ensuing spring, the *Gedney* was at Portland, Oregon, under repair. On January 30, 1892, Lieut. Helm was detatched, and on June 6 Lieut. Lucian Flynne, U. S. N., was assigned to the command of the steamer, and received instructions to coöperate with Assistant J. J. Gilbert in the survey of the Strait of Fuca.

On May 11 the *Gedney*, under the command of Ensign Mayer, took part in the celebration at Astoria, Oregon, of the centennial of the discovery of the Columbia River.

Hydrographic survey of the coast of Washington south of Cape Flattery, between James Island and Osett Island.—Lieut. D. Delehanty, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Hassler*, has submitted a descriptive report to accompany the hydrographic sheet of his survey of the coast of Washington between James Island off the mouth of the Quilihute River and Osett Island off Cape Alava.

He observes that the general character of this portion of the coast seen from seaward is low, rolling, and hilly, with the Vancouver and Olympus range of mountains in the background. Numerous rocks and islands lie off the coast and extend out in places over 2 miles. Inside of this distance the ground is very foul, and while sounding with the boats, great caution was necessary on the part of the officer to avoid disaster. During stormy weather the appearance of the coast is wild and forbidding, the high seas rolling in and breaking with great violence.

Many of the rocks, on account of their peculiar shape, form excellent landmarks. The views of them given in the fourth edition of the Pacific Coast Pilot, Lieut. Delehanty found admirable. On approaching this part of the coast in thick weather a vessel should not get in less than 25 fathoms. There are no safe anchorages, and the currents were found to be extremely irregular in strength and direction. The observations of currents which Lieut. Delehanty was able to make served but to show the great need of extended series of current observations on that part of the coast.

The hydrography, begun September 2, was finished October 31, 1892. Following are the statistics:

Hydrography (scale 1–40 000):

Area sounded in square geographical miles	138
Number of miles (geographical) run while sounding	184
Number of angles measured	1 231
Number of soundings	1 655

The officers attached to the *Hassler* were Lieut. J. B. Blish, U. S. N., and Ensigns L. J. Clark and J. G. Doyle, U. S. N.

Special hydrography executed by Lieut. Delehanty in the Bay of San Francisoo has been referred to under a preceding heading. On March 2, 1892, the Survey lost the services of this able officer by his detachment.

Reconnaissance and triangulation for resurvey of the harbor of Seattle and for the survey of Shilshole Bay.—The need of a resurvey of the harbor and city of Seattle, due to the fire of 1889, which had destroyed the entire water front and the business portion of the city, was referred to in the last annual report. Besides which, the rapid growth of the city since the fire, the changes caused by improvements, and the probable changes and encroachments of the tide flats since the survey of 1874–'75, all made it apparent that the commercial importance of Seattle demanded the publication of a chart of its harbor based upon recent surveys. Assistant J. F. Pratt was accordingly instructed towards the end of June, 1891, to organize a party for the execution of this work, and to include in his survey Shilshole Bay, the city of Ballard on the north side of this bay having become quite an important manufacturing locality.

Mr. Pratt had made arrangements for beginning his survey early in July, but after a few days' trial of the steam launch *Tarry Not*, which he was to use as quarters and a means of transportation for his party, he found that the boiler showed dangerous weakness; that to repair it would cost more than it was worth; and that a new boiler more adapted to the size of the launch was a necessity. The launch was also greatly in need of repair. Advantage was taken of the delay thus incurred to establish a self-registering tidal station, at which a record was kept during eleven months without cost to the Survey.

Mr. Pratt states that in 1884 the city of Seattle had a population of about eleven thousand, and that in 1891, at the time of the commencement of his survey it had nearly fifty thousand. This does not include the city of Ballard. Four and a half years ago there was but one cabin where the town now stands, and only five settlers on the entire bay; in 1891 it had a population of nearly four thousand, its principal industries being saw and shingle mills and shipyards.

He observes further that the rapid advance of improvements will probably make it necessary to place important corrections on the local charts every two or three years; hence, to avoid the cost of frequent new triangulations, he deemed it well to determine as many prominent objects, such as spires, cupolas, chimneys, etc., as practicable. The points of the former triangulation had mostly disappeared, and Mr. Pratt found it necessary to resort to the long lines Restoration–Zeomoalt and Meadow–Zeomoalt for bases at a season when smoke interfered greatly with the visibility of the signals. In the course of the work the Seattle latitude and longitude astronomical station was doubly connected with the main scheme of the triangulation of Admiralty Inlet.

Field work was suspended for the season January 15, 1892.

Following are the statistics:

Reconnaissance:

Area of, in square statute miles	48
Lines of intervisibility determined	320
Number of points selected for scheme	110

Triangulation:

Area of, in square statute miles	48
Number of signal poles erected	46
Number of stations occupied for horizontal measures	20
Number of geographical positions determined	110

Towards the end of March Mr. Pratt was assigned to duty in Tacoma, a report of which appears under the next heading.

Transportation of chronometers for difference of longitude between Tacoma, Washington, and Sitka, Alaska.—Triangulation for the revision of the shore line and resurvey of the hydrography of Tacoma Harbor.—In coöperation with the astronomical parties established in the summer of 1892 at a point in Yakutat Bay, and at Sitka, Alaska, Assistant Pratt was directed to prepare an astronomical station at Tacoma for the determination of the errors and rates of the

chronometers to be transported between Sitka and Tacoma. Assistant Fremont Morse was directed to take charge of the Sitka station, and Assistant J. E. McGrath of the station on Yakutat Bay.

It was arranged that the steamer *Hassler*, carrying the Sitka and Yakutat parties from San Francisco, should touch at Port Townsend, at which point Mr. Pratt was directed to confer freely with Messrs. McGrath and Morse, and arrange all details relating to the plan of operation.

Mr. T. D. Davidson, who had been designated as recorder in the party of Mr. Morse, was directed to proceed first to Tacoma and report to Mr. Pratt in order to receive detailed instructions respecting the carrying of the chronometers which were to be transported between Sitka and Tacoma by the passenger steamer *Queen*.

Through the courtesy of the secretary and members of the Commercial Club, and by permission of the president and secretary of the Park Commission, Mr. Pratt selected a site for his astronomical station in Wright Park. The number of chronometers on hand not being enough, Mr. Pratt made application for five more to Assistant Davidson; these were received by the steamer *Queen* June 3, making the whole number available eleven. They were distributed as follows: seven as time keepers on the *Queen*, one as a "hack" between the steamer and the observatory, and three at Tacoma.

The observatory was in readiness and time observations were begun June 1.

The following is a summary of the exchanges up to June 30, 1892:

First exchange.—The steamer *Queen* left at 4 a. m., June 6. Time observations were obtained on June 1, 6, 7, 8, and 9; the 2d, 3d, 4th, and 5th being cloudy. The chronometer corrections at time of departure depended on the rate of three observatory chronometers from June 1, five nights before comparison, and on June 6, one night after.

Second exchange.—The steamer *Queen* arrived June 17 at 9 p. m., and left for Sitka June 21, at 4 a. m. Observations for time were obtained on seven nights between the 13th and 24th, the errors at time of departure depending on the rate of three observatory chronometers from June 17, the night of arrival, and on June 21, the night after departure.

The progress of these exchanges after June 30 will be referred to in the next annual report.

In addition to the time observations and chronometer comparisons for differences of longitude, Mr. Pratt was charged with a revision of the shore line of Tacoma Harbor and a partial hydrographic resurvey for the purpose of obtaining data upon which a new chart of the harbor could be based, it having been reported to the office that considerable changes in the depth of water at various points had taken place, and that certain important improvements were in progress.

Before these branches of the resurvey could be undertaken, a reconnaissance for a scheme of triangulation was necessary, all of the old triangulation stations on the south end of Vashon Island having been destroyed.

For this reconnaissance the statistics are:

Area of, in square statute miles	35
Lines of intervisibility determined	70
Number of points selected for scheme	28

At the date Mr. Pratt closed his report, no measurements of horizontal angles had been made, but a number of signals had been erected, and observing tripods and scaffolds built.

Triangulation, topography, and hydrography of harbors on Puget Sound, for the Harbor Line Commission of the State of Washington.—Assistant J. J. Gilbert, who was on special service during the greater part of the fiscal year with the Harbor Line Commission of the State of Washington, has submitted a report, an abstract of which will be found under the heading "Special Operations."

His work included triangulation, topography, and hydrography, executed for the survey of the following-named harbors: Olympia, Port Townsend, Port Angeles, and Anacortes;

the completion of the reduced drawings of charts of these harbors, and also of the harbors of Whatcom and Fairhaven from previous surveys, and the transmission of duplicate drawings of the charts to the Commission.

For the fiscal year Mr. Gilbert reports the following statistics:

Base line (tertiary):	
Length of, in metres	1 516·1
Triangulation:	
Number of signal poles erected	66
Number of stations occupied for horizontal measures	45
Number of geographical positions determined	140
Topography (scale 1–4 800):	
Area surveyed in square statute miles	5
Length of general coast line in statute miles	60
Length of railroads in statute miles	17
Number of topographic sheets finished	9
Hydrography:	
Area sounded in square geographical miles	14
Number of statute miles run while sounding	396
Number of angles measured	3 154
Number of soundings	23 810
Number of tidal stations established	4

The hydrography is plotted on the topographical sheets.

Continuation of the shore line and hydrographic survey of Washington Sound.—Under instructions dated June 13, 1891, issued in pursuance of an order of the Secretary of the Navy reducing the number of men allowed to the Coast Survey, Lieut. J. N. Jordan, U. S. N., Assistant Coast and Geodetic Survey, commanding the schooner *Earnest*, who had been charged with the continuation of the survey of Washington Sound, was directed to turn over to Lieut. W. P. Ray, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *McArthur*, all unfinished projections, with the data pertaining thereto, also the steam launch and such instruments as could be spared, in order that Lieut. Ray could proceed with all possible dispatch to take up the work of the *Earnest*.

As soon as this transfer could be accomplished, Lieutenant Jordan was instructed to proceed in the *Earnest* to Olympia, discharge his crew, and transmit to the office the completed records of his work.

On July 1, Lieut. Ray began the shore line and hydrographic surveys included in the limits of the two projections which had been furnished to him; namely, the Straits of Georgia and Canal de Haro, and East, West, and Lopez Sounds and vicinity. Such triangulation was executed as was needed to furnish points for the shore line survey of the several islands covered by the projections, and for the accurate location of lines of soundings. Field operations were closed November 15. The brief abstract of progress submitted by Lieut. Ray is accompanied by a sketch of the triangulation, and reports the following statistics:

Triangulation:	
Number of stations occupied	117
Topography:	
Number of miles of shore line surveyed	50
Hydrography:	
Number of miles run in sounding	1 177
Number of soundings	17 357

Ensigns Albert L. Key, Harry George, and Edward Moale, Jr., U. S. N., rendered efficient service in the work.

During the winter the *McArthur* was laid up in Butler Cove, Budds Inlet, and in March, Lieut. Ray was directed to proceed to Barclay Sound, Vancouver Island, to obtain information

desired by the Department of State. After performing that duty, he received instructions to execute the hydrography of Dixon Entrance north of the boundary and between Cape Chacon and Cape Fox. Reference to this service, in which he was still engaged at the close of the fiscal year, will be found under a heading in the Division of Alaska.

Shortly before the date of transmission of this report to the Department, two descriptive reports were received from Lieut. Ray relating to the work executed in Washington Sound, in the summer and autumn of 1891. These will be filed with his hydrographic sheets.

Exchanges of telegraphic signals for determining the longitude of a station in the Yellowstone National Park.—Observations for the latitude of this station, and for the magnetic elements.—Upon the completion of the work which had been assigned to them on the boundary line between the United States and Mexico, Assistant C. H. Sinclair and Aid G. R. Putnam were directed to make arrangements for the determination in latitude and longitude of a point in the Yellowstone National Park which should be designated by Lieut. H. M. Chittenden, U. S. Engineers, who was in charge of the roads in the park.

For the longitude operations, Helena, Montana, was the base station, the observatory being located in the north corner of the grounds of the United States Assay office. At Yellowstone Park the station was located as requested by Lieut. Chittenden, near the shore of Yellowstone Lake, about ½ mile northeast of the Lake Hotel, and 1 mile southwest of the outlet of the lake. This station is about 60 miles from Cinnabar, the nearest railroad station on a branch of the Northern Pacific.

On reaching the Mammoth Hot Springs Hotel, May 30, Mr. Putnam, who had charge of the advance party, learned that the road between Norris and the lake had not yet been opened through the snow; he had to wait therefore till June 7, when, the quartermaster at Fort Yellowstone having furnished a wagon and driver, he started with the instruments for the lake 52 miles distant, and reached it after a difficult journey of three days; the roads being in very bad condition, and on one day twelve hours having been consumed in going forward 11 miles. The day after his arrival, Mr. Putnam had the station in readiness, but owing to the bad weather and broken telegraph lines, no exchange of signals with Mr. Sinclair at Helena, Montana, could be obtained until June 23.

Five nights' exchanges having been secured by June 30, Mr. Putnam then took up the determination of the latitude and the magnetic elements, making eighty-five observations for latitude on thirty-five pairs of stars, and determining the magnetic declination, dip, and intensity at one station on three days, and the declination at another station on two days. He found that at the second station occupied, distant ¼ mile from the first, the declination was less by over four degrees, showing some unusual disturbance in the locality.

On July 6, Mr. Putnam proceeded to Helena and took up latitude and magnetic computations till July 15, when he was advised that Mr. Sinclair, who had been unavoidably absent for a time, had arrived at Yellowstone Lake Station, and was ready for exchanges of longitude signals. Final exchanges were obtained on five nights between July 17 and 24, completing the determination of the primary longitude line Helena–Yellowstone Lake.

Before leaving the station Mr. Sinclair marked a meridian line by two stone posts, south of the brick pier of the transit, and distant apart about 330 metres. These were rough stones of obsidian, the tops worked rudely into shape, with cross lines cut on top. No stone cutters could then be had. Later Mr. Sinclair sent to Lieut. Chittenden designs for two stones, one to mark the transit pier and the other for the south meridian mark. These were to have suitable inscriptions and were to be cut in St. Paul and transported to the park as early as practicable.

Reference has been made under the headings "Special Operations" and "Eastern, Middle, and Western Divisions" to other field operations assigned to Messrs. Sinclair and Putnam during the fiscal year.

Occupation of stations in eastern Utah and western Colorado for the extension to the eastward of the transcontinental triangulation near the thirty-ninth parallel.—Field operations in eastern central Utah for advancing to the eastward the transcontinental triangulation near the thirty-ninth

parallel were in active progress under the direction of Assistant William Eimbeck, at the beginning of the fiscal year. His party had completed the re-occupation of Ogden Peak, (referred to in the last annual report) and had begun the preparations needed for the transfer of their instruments and equipments to Mount Ellen, the most northern peak of the Henry Mountains. This station is at an elevation above sea level of 11 300 feet, and by the roads and trails to be traveled is distant 375 miles from Ogden Peak.

Owing to the uncommonly rough and desolate character of the country adjacent to the Henry Mountains and lying to the eastward of Rabbit Valley, the whole of the month of July was required to effect the transfer and establish the party in camp upon the summit of Mount Ellen in readiness to proceed with the observations. The pack trails up the mountain, which were located and opened by the party, were 5 miles in length.

The actual occupation of Mount Ellen lasted until August 25. Frequent and violent thunderstorms tended from the beginning of the observations to delay progress. The work done was strictly confined to the requirements of the geodetic triangulation; that is, to observations of horizontal directions, zenith distances, astronomical latitude, and azimuth, the magnetic declination, dip, and intensity, and a topographical survey of the stations sufficiently comprehensive to aid in the study of disturbances of the plumb line due to local causes.

Upon finishing the work at station Mount Ellen, the party struck camp without delay and on August 30, started on a dreary journey across the blazing deserts from Blue Valley northward to Green River station; thence on the Rio Grande Western Railway to Fruita, and Grand Junction, in Colorado, thence by freight teams via Crevasse to the base of the Book Cliffs near the Utah and Colorado boundary line. For lack of palatable drinking water many trials and privations had to be endured on this journey of about 300 miles over a desert country. The Muddy River, a stream of bitter alkaline water, abounding in dangerous quicksands, had to be crossed and recrossed nine times. Much grading was done in cutting away banks and removing obstructions, and on two occasions the party narrowly escaped being swamped in the quicksands.

It had been originally intended to occupy East Peak of the Book Cliffs, but the extension of the triangulation eastward into Colorado required the selection of another station, and the point actually occupied was named Taraputs. It is located upon the principal summit of the cliffs, about a mile from East Peak, and affords perfectly open and favorable lines in all directions, but especially towards the Elk Mountains. At Taraputs pack trails about 8 miles in length had to be opened.

The advanced state of the season on the completion of Taraputs station, October 26 1891, made it desirable to suspend further field operations. Before leaving the station, a base line of 287 metres in length was measured, and a small local triangulation executed in order to refer East Peak, which had been observed upon during the previous season while Patmos Head was being occupied, to Taraputs.

In the triangulation of this summer and autumn is included the longest line yet attempted as a necessary element in the main scheme in Utah-Colorado. This line, Mount Ellen-Uncompahgre, is 295 kilometres, or 183 miles, in length. The altitude of Uncompahgre Peak is 14 200 feet, and the light observed upon was from an ordinary heliotrope with a 4½-inch square reflector.

Subassistant P. A. Welker, and Messrs. O. B. French and R. L. Faris, recorders, all of whom had rendered efficient service, having been detached, Mr. Eimbeck reported under instructions in December to the Superintendent, and during the winter and part of the spring was occupied at the office in completing the records and results of his observations. He served also by direction of the Superintendent as a member of the Board on Instruments.

Early in April, 1892, having received instructions to resume field work in Utah, he began the preparations needed, and after reaching Salt Lake City, May 5, he was joined there by Mr. Faris. The season's campaign was opened by the occupation of Waddoup, a station in

the net of triangulation connecting the primary base line in Salt Lake Valley with the main work at Ogden and Deseret Peaks. Much cloudy weather occurred at Waddoup, so that it was June 20, before the observations could be finished. Mr. Eimbeck then arranged for the transfer of his party and equipments across Great Salt Lake to Promontory Station; located upon one of the principal mountain peaks near the southern part of the Promontory Peninsula. At the close of the fiscal year, the party was encamped on the summit of this peak, busy with the setting up of the instruments and other preparations for observing.

Mr. O. B. French, recorder, had reported for duty May 27, and the arrival of Subassistant Welker was expected daily.

Progress after June 30, 1892, will be adverted to in the next annual report.

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1892.

DIVISION OF ALASKA.

Under this heading are included the coasts of Alaska which border on the North Pacific Ocean, on Bering Sea, and on the Arctic Ocean; also the inlets, sounds, bays, and rivers. (See Progress Sketch No. 3.)

Base measurement, triangulation, shore line, and hydrographic surveys in Behm Canal and vicinity, southeastern Alaska.—The movements of the steamer *Patterson*, Lieut. Comdr. H. B. Mansfield, U. S. N., Assistant Coast and Geodetic Survey, commanding, from the time of her leaving San Francisco for Alaska, April 12, 1891, until her arrival at her working ground, Rudyard Bay, June 18, were summarized in the last annual report.

For the survey of Behm Canal, with which Lieut. Comdr. Mansfield was charged, he had measured a primary base line between two points on the main land to the westward on Burroughs Bay, finding the length from a mean of five measurements to be 3 054·26 metres. With this base-length a triangulation was carried up and down the canal, and for two check bases, the measured and computed lengths agreed very satisfactorily. This triangulation covered a distance of 162 statute miles; in addition to this a sextant triangulation was carried on through inlets and narrow passages covering a distance of 204 miles.

Astronomical stations were established at Walker Cove, Mary Island, and Point Francis, each station being occupied long enough to get a good rate for the chronometers, after which the base station at Port Simpson was occupied for at least one night.

The following inlet and harbor hydrographic sheets were made of the general hydrography falling upon the projection sheet of Behm Canal and vicinity: Carroll Inlet and George Inlet, 1–40 000; Thorne Arm, 1–40 000; Walker Cove, Rudyard Bay, Shoalwater Pass, Smeaton Bay Anchorage, Bell Arm, Convenient Cove, and McDonald Bay, each on a scale of 1–20 000; and Fitzgibbon Cove, Saks Cove, Gnat Cove, and Tsa Cove, each on a scale of 1–10 000.

Lieut. Comdr. Mansfield observes that it was with the greatest difficulty that places to build signals and set up theodolites could be found on the precipitous shores, densely wooded to the water's edge; and the ingenuity of the signal builders and the observers was taxed to the utmost to carry the main triangulation through Behm Canal.

For the surveys of Carroll Inlet and George Inlet, a base was measured 8 737·16 metres in length on the shore of Revillagigedo Channel.

Tidal observations were carried on night and day for a lunar month at Burroughs Bay, and tide staffs were erected also during the season at the following anchorages of the *Patterson:* Walker Cove, Rudyard Bay, Shoalwater Pass, Bell Pass (Anchor Pass), and Convenient Cove. These gauges were connected with the one at Burroughs Bay through periods of three low and two high waters. Additional observations were made at tide staffs erected at McDonald Bay, Great Cove in Carroll Inlet, and Thorne Arm.

A descriptive report has been submitted by Lieut. Comdr. Mansfield, giving full details in regard to the topographic and hydrographic characteristics of the various inlets, bays, channels, and harbors in Behm Canal and vicinity. Among the many rocks, ledges, and other obstructions to navigation described, the space here available will permit of reference to but one rock of singular formation—the New Eddystone Rock, which rises from a sand bar a little to west of midchannel at a distance of 7¼ miles north northwest of Smeaton Island. The diameter of this rock at the base is about 210 feet, and it rises to a height of 230 feet, decreasing irregularly in size towards the apex, which appears flat. The 10-fathom curve runs at a distance of about 1 500 feet from the rock, and it should not be approached closer. Its geographical position is approximately 55° 30′ north latitude, 130° 57′ longitude west from Greenwich.

The following named naval officers were attached to the party during the season: Lieut. E. J. Dorn, U. S. N.; Ensigns H. C. Poundstone, W. L. Howard, F. L. Chapin, W. G. Miller, and W. H. Faust, U. S. N.; Passed Assistant Surgeon H. T. Percy, U. S. N., and Assistant Engineer T. F. Carter, U. S. N. Messrs. W. L. Ford, J. G. Smith, and J. C. Dornin, U. S. N., served as draughtsmen.

On September 18, the survey of Thorne Arm having been finished and the hydrographic work brought up to Mary Island, the work laid out for the season was completed and the *Patterson* left for San Francisco, stopping at Port Simpson, Departure Bay, Victoria, and Port Townsend, and reaching her destination October 7, 1891.

The statistics of the season are as follows:

Triangulation:	
Number of stations occupied with theodolite	224
Number of stations occupied with sextant	646
Topography:	
Approximate area of country surveyed in square miles	1 100
Number of miles run of shore line	741
Hydrography:	
Number of miles run in sounding	1 601
Number of angles measured	10 465
Number of soundings	11 348
Astronomical work:	
Number of stations occupied for observations of latitude, longitude, and azimuth	3
Number of stations at which chronometer corrections were determined	4
Number of pairs of stars observed for latitude	71

On February 2, 1892, Lieut. Comdr. Mansfield was detached from the command of the *Patterson*, being relieved by Lieut. Comdr. W. I. Moore, U. S. N. During the winter the steamer was under repair in San Francisco Harbor, and after having been refitted for service in Alaska, she left San Francisco April 12 for Port Townsend. Instructions had been issued in March to Lieut. Comdr. Moore, assigning to his charge the survey of Boca de Quadra, of Dixon Entrance, Clarence Strait, and Revillagigedo Channel. Also a survey to begin at the south end of Keku Straits, and be carried northward, connecting with previous work in Frederick Sound and continuing to Chatham Strait.

In the survey of Dixon Entrance and the adjacent waters, Lieut. W. P. Ray, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *McArthur*, was directed to coöperate with Lieut. Comdr. Moore.

Both of these officers have submitted brief reports of progress from the dates of their reaching the localities of their work till the end of the fiscal year 1892. The *Patterson* anchored in Vixen Bay, Boca de Quadra, on May 12, and on June 16 the survey of Boca de Quadra having been completed, the ship was moved to Port Simpson, where astronomical

observations were made. On June 24, she was taken to Keku Straits and anchored in Conclusion Harbor. Progress after this date will be stated in the next annual report.

At the end of the year Lieut. Ray was engaged on the hydrography of Dixon Entrance north of the boundary and between Cape Chacon and Cape Fox.

The following named naval officers were attached to the party of Lieut. Comdr. Moore: Lieut. C. W. Jungen, U. S. N.; Ensigns H. C. Poundstone, W. L. Howard, F. L. Chapin, and Glennie Tarbox, U. S. N.; Passed Assistant Surgeon, C. J. Decker, U. S. N., and Assistant Engineer, T. F. Carter, U. S. N.

To the party on the *McArthur*, Ensigns C. P. Eaton, Harry George, and E. T. Witherspoon, U. S. N., were attached.

Chronometric longitude work, and observations for latitude and the magnetic elements at Sitka, Alaska.—The charge of a party to be organized at Sitka, Alaska, for the purpose of coöperating with the parties of Assistant McGrath on Yakutat Bay, and Assistant Pratt at Tacoma, in exchanges of chronometers for longitude determinations was assigned to Subassistant Fremont Morse. He was directed also to determine the latitude of his station and observe the magnetic elements.

Mr. Morse, accompanied by Mr. B. H. Randolph, recorder in his party, left San Francisco April 16 on the Coast and Geodetic Survey steamer *Hassler*, but owing to certain necessary stoppages at Port Townsend, Departure Bay, and Port Simpson, he did not reach Sitka until May 13. On the trip up, all of the chronometers on the ship, the eight that were to be carried back and forth between Sitka and Yakutat during the season, and six others to be used by the parties on shore at those stations, were rated at Port Townsend by noon signals sent by telegraph from the Mare Island Observatory, and at Port Simpson by transit observations. Daily comparisons were made of all the chronometers.

Finding upon his arrival that the ground upon which had stood the astronomical station of 1867 was no longer suitable for the foundation of a stable pier, Mr. Morse selected a station in another location in front of the Presbyterian Church where a solid rock foundation was secured. A temporary observatory was at once put up, and the meridian transit mounted and adjusted, but owing to rainy weather no observations could be made before May 22. After that date they were made on every favorable night.

The programme of the season's work involved the transportation of chronometers between Tacoma and Sitka on the passenger steamer *Queen*, and between Yakutat and Sitka on the *Hassler*, it having been arranged that the *Hassler* should meet the *Queen* upon the arrival of the latter at Sitka on each trip.

Mr. T. D. Davidson was assigned to Mr. Morse as recorder in his party and charged with the care and comparison of the chronometers on board of the *Queen*. He left Tacoma on his first trip June 6, and arrived at Sitka on the 11th, when comparisons were made with her chronometers. The *Hassler* had arrived from Yakutat the day before, and her chronometers had then been compared. Both steamers left on June 12 for their respective ports, and returned to Sitka near the end of the month, thus making two longitude determinations before the close of the fiscal year.

For the latitude of his station, Mr. Morse observed eighteen pairs of stars on four nights, determining the value of micrometer by observations for three nights on Polaris near eastern elongation.

For the magnetic declination, dip, and intensity, observations were made on May 19, 20, and 21 at the Parade Ground Station in Sitka, and on finding that the declination observed differed about 1° from that given on the chart, Mr. Morse made a second series of observations at a station on Japonski Island June 14 and 15, which gave the same result. Later in the season, a series of independent determinations by Mr. McGrath gave results practically identical.

The progress of the chronometric longitude work will be adverted to in the next annual report.

Trigonometrical operations for the determination of the geographical position of the peak of Mount St. Elias.—Observations for latitude, azimuth, and the magnetic elements, and determinations of longitude by exchanges of chronometers between Yakutat Bay and Sitka, Alaska.—The primary object of the expedition assigned to the charge of Assistant J. E. McGrath in the spring of 1892, was the determination of the geographical position of the peak of Mount St. Elias. This work involved the establishment of an astronomical station on the shore of Yakutat Bay; observations for latitude and azimuth; the measurement of a base and the development from it of the necessary triangulation; measurements of vertical angles at each triangulation station for the determination of the height of the mountain, and a chronometric determination of longitude by exchanges of chronometers with coöperating parties at Sitka, Alaska, and Tacoma, State of Washington. Observations were to be made also for the magnetic elements.

Assistant J. H. Turner and Recorders A. L. Baldwin and R. J. McAdory were instructed to report for duty to Mr. McGrath, and Lieut. Giles B. Harber, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Hassler*, was directed to furnish transportation for his party and coöperate with him in the chronometric determination of difference of longitude between Sitka and Yakutat.

In pursuance of these instructions, Mr. McGrath left San Francisco with his party on the *Hassler* April 16, 1892, arrived at Sitka May 13, and anchored in Yakutat Bay off the Mission grounds May 19. A reconnaissance for a site for a base line was begun without delay, and a location finally selected on the northwestern shore at the base of the Malaspina glacier. Stations were selected that would connect well with the ends of the base and a temporary observatory was built on Khantaak Island.

The line was in two sections, the length between the two end stations being a little over 6 800 metres or about $4\frac{1}{5}$ miles. It ran across a sandy plain close to high water mark, and its proximity to the Malaspina glacier made the air always cooler than the surface of the ground, hence a number of measurements with the steel tape were necessary in order to diminish as much as possible the errors due to the failure of the thermometers to indicate the temperature of the tape.

These measurements, the erection of signals at the stations of the triangulation, the observations for time and latitude, etc., were in active progress at the close of the fiscal year.

Chronometer comparisons had been kept up since April 25, and between June 8 and 29, the *Hassler* had made two trips with the chronometers between Yakutat Bay and Sitka, meeting at Sitka the steamer *Queen* with chronometers from Tacoma.

Further progress will be stated in the next annual report.

Shore line and hydrographic surveys in Yakutat Bay and vicinity, Alaska.—Upon assuming command of the steamer *Hassler* in March, 1892, Lieut. Giles B. Harber, U. S. N., Assistant Coast and Geodetic Survey, had her prepared at the Navy Yard, Mare Island, California, for work in Alaska during the ensuing season. His instructions directed him to obtain such data as would be needful for a shore line and hydrographic survey of Yakutat Bay, to be begun as soon as practicable after his arrival in that bay with the civilian party in charge of Assistant J. E. McGrath, and to be carried forward without interference with the main object of the expedition, which was the determination in geographical position of Mount St. Elias.

Lieut. Harber has submitted a brief report detailing the movements of his vessel and the progress made to the close of the fiscal year.

Leaving San Francisco April 16, with the civilian party of the Survey, and also with the representatives of the Agricultural Department who were to take passage in the *Hassler*, Port Townsend was reached April 21; Port Simpson, British Columbia, May 6; on May 10, the steamer *Cosmos* was turned over to Lieut. Harber by Lieut. Comdr. Moore; on the 13th, the *Hassler* and *Cosmos* arrived at Sitka, where an observatory was built for Assistant Morse, and on the 19th, the two steamers anchored off Yakutat Village in De Monti Bay.

Lieut. Harber accompanied Mr. McGrath on his reconnaissance for a site for a base line referred to under the preceding heading, and finding that some weeks must necessarily elapse before he could get data from the civilian party, he measured a short base line on Khantaak Island, from which at the end of the fiscal year, his triangulation, shore line survey, and hydrography were proceeding. He had, however, during the month of June made two trips to and from Sitka, carrying the chronometers of the expedition, and meeting there the steamer *Queen* carrying the chronometers between Sitka and Takoma.

The following named officers were attached to the party under Lieut. Harber's command:

Lieutenants H. S. Chase and J. B. Blish, U. S. N.; Ensigns L. J. Clark, J. G. Doyle, and Benj. Wright, U. S. N., and Assistant Surgeon G. T. Smith, U. S. N. Master-at-Arms C. W. Fitzgerald, served as draughtsman, and G. S. Gregson as recorder.

SPECIAL OPERATIONS: FISCAL YEAR 1892.

Survey of the boundary line between the States of Pennsylvania and Delaware.—A Joint Commission having been organized by the States of Pennsylvania and Delaware for the adjustment of the boundary line between those States, the Hon. Thomas F. Bayard, representing the Commission, addressed a letter to the Secretary of the Treasury asking that its labors might be facilitated by such aid as could be given by the Superintendent of the Coast and Geodetic Survey. In compliance with this request, and as a result of conferences on the subject, Assistant W. C. Hodgkins was detailed by the Superintendent to coöperate with Messrs. Benj. H. Smith and Daniel Farra, surveyors for the Joint Commission, and to organize a party to make a complete survey of the line and provide for its marking upon the ground.

Having obtained from Messrs. Smith and Farra a list of points in the circular boundary the geographical positions of which the Commission wished to have determined, Mr. Hodgkins left Washington May 11, 1892, and reached Newark, Delaware, on the same day. This town was selected as a base of operations, as it is within convenient distance of a considerable portion of the boundary line which was intended to be defined by a circle described with a radius of 12 miles from Newark as a center. A reconnaissance for a scheme of triangulation was taken up from the western boundary of Delaware and search made for stations of the triangulation of 1840. Of these Grays Hill was recovered, a point of importance as commanding a view of Newcastle, Delaware, the position of its Courthouse being desired by the Commission.

The reconnaissance was one of much difficulty, owing to the nature of the country, and the limitations in regard to opening lines through woods which the Commission found it necessary to impose. Intervisible points it was hard to secure in a rolling country with a very large number of separate rounded hills nearly of the same height and having heavy masses of lofty woods on their summits or slopes. These obstacles were, however, eventually overcome, and by June 30 the scheme of triangulation had been laid out to Centerville, a small village 7 miles north northwest of Wilmington.

Mr. Hodgkins has submitted with his report a sketch showing the progress of his reconnaissance up to the close of the fiscal year. A statement of its advance after that date, and of further work relating to the location of the boundary line, will be given in the next annual report.

Special survey for the State of Virginia.—The Legislature of the State of Virginia having passed an act approved February 29, 1892, authorizing a survey of the natural oyster beds, rocks, and shoals in the waters of that State, and a request having been made by committees of the State Senate and House of Delegates for the detail of an officer of the Survey to make the observations required, Assistant James B. Baylor was directed by the Superintendent to proceed to Richmond as soon as he could be relieved from other duties and report to the Governor of Virginia for this service.

Between May 25, the date of the instructions issued to Mr. Baylor, and the end of the fiscal year, he was actively engaged in organizing his party and in making needed repairs to and obtaining an outfit for the schooner *Drift*, loaned by the Survey. The United States Commission of Fish and Fisheries kindly agreed to furnish a steam launch and crew.

The plans upon which this work was carried forward and its progress after July 1, 1892, will be referred to in the next annual report.

Completion of the surveys for the preparation of detailed maps of the grounds included in the Chickamauga and Chattanooga National Military Park.— In the last annual report reference was made to the detail of Assistant C. H. Boyd to make the surveys needed for the preparation of topographical maps of the grounds included in the Chickamauga and Chattanooga National Military Park.

Mr. Boyd was engaged in this duty in the field from early in October, 1890, till the middle of June, 1891. He then took up the office work relating to it and resumed field operations in the autumn, remaining in charge of the surveys and engineering work generally until January 16, 1892, when, the surveys having been essentially completed, he was relieved from further duty with the Commission.

Boundary line between the States of Ohio and Indiana.—Determination of the longitude of three points on this line by exchanges of telegraphic signals with St. Louis, Missouri, and observations for latitude at these points.—In compliance with a request received from the Governor of Ohio, Hon. James E. Campbell, the Superintendent took action early in October, 1891, to investigate the questions at issue between the States of Ohio and Indiana relating to the disputed boundary line between those States.

This boundary line, it was known, was intended to be run as a true north and south line passing through the mouth of the Big Miami River, hence it became desirable to ascertain how far it deviated from such a line, and the method of procedure was based upon the well-established fact that the longitude of all points on a true meridian line is the same.

Assistant C. H. Sinclair and Aid G. R. Putnam were directed to examine certain towns on the line in or near which some of the old boundary marks might be found and connected geodetically with a telegraph station.

Upon conference with Assistant A. T. Mosman with regard to boundary monuments and marks which he had examined near the south end of the line, Mr. Sinclair learned that the initial stone of the old survey, set near the mouth of the Big Miami River, had been covered by deposits from the overflow of the river previous to 1855, and that some time between that year and 1860 it was unearthed by railroad engineers, who dug 10 or 15 feet below the surface of the ground. Since then it has been lost to sight.

On the turnpike leading to Lawrenceburg, Dearborn County, Indiana, nearly a mile southwest of Elizabethtown, Hamilton County, Ohio, at the State line crossing, is a large round stone, 2 feet in diameter at the base and fully 8 feet above ground, tapering to about 14 inches in diameter near the top, which terminates in a conical cap, the entire monument being one stone. The date 1837 was exposed, and as the probability is that this monument, which is within 2¼ miles of the south end of the line, can not be out of position materially, it was selected as the initial station for the longitude work.

The longitude station was located at Elizabethtown, within convenient distance from the telegraph office, and a geodetic connection made between the station and the line monument by measuring a short base and observing the horizontal angles needed.

Mr. Putnam, having established himself at St. Louis, Missouri, interchanges of telegraphic signals for longitude were obtained with him on October 14, 16, and 17. The degree of precision demanded for the work did not require exchanges of stations by the observers; their personal equation, derived from five primary lines during the preceding season, was applied to each result.

Latitude was determined at Elizabethtown by seventy-four observations with a zenith telescope on twenty-one pairs of stars during four nights.

Two stones marking a true meridian line were placed in Wyne Street 130·65 metres apart, and the latitude and longitude station was referred to the Presbyterian Church, to the Methodist Church, and to the cupola of the Public School.

Similar work was accomplished at Union City, Randolph County, Indiana, a town which is partly in Ohio also, the boundary being shown by the State line pike and by a prominent

post at the railroad crossing. Signals for longitude were exchanged with St. Louis on October 22, 24, and 25, and the latitude was determined by fifty-two observations on sixteen pairs of stars during four nights. The astronomical station was referred to the State line post on the railroad, to the cupola of the Public School erected in 1841, to the Methodist Episcopal Church, and to the Disciples Church. Upon transferring the meridian by measurements with a theodolite to the State line road, the deviation of the center line of the road was found to be nearly 1¼° to the east of north.

While Mr. Sinclair had been occupied in the early part of the month on the southern part of the boundary line, Mr. Putnam had begun his examinations at the extreme northern part and had advanced southward.

On October 5 he was at Montgomery, Michigan, the northern extremity of the boundary line, his plan being to start there and proceed south, visiting the towns nearest to the boundary on each successive railway, and making inquiries respecting boundary marks. He reports that no distinctive and original boundary marks were found, and that three classes of marks exist, all of which must be deemed approximate only. These are: First, section corners, placed on the line in recent years by county surveyors; second, State Line posts, placed at the crossings by the various railway lines for their own convenience; and third, the State Line highway, which follows the boundary for the greater part of the distance examined.

Mr. Putnam having recommended Butler, Dekalb County, Indiana, as a point sufficiently near the northern end of the line, and one where access could be had to the boundary along two lines of railway, Mr. Sinclair made his third station there, locating it on the grounds of the Lake Shore and Michigan Southern Railroad, about 80 metres north and a little west of the passenger station, and conveniently near the telegraph office.

Longitude signals were exchanged with St. Louis October 28, 29, and 31. For latitude of the observatory fifty-four observations were made on eighteen pairs of stars. Two boundary posts near the railroad crossing were connected with the station by measurements with a 30-metre steel tape, and the point of observation for latitude and longitude was referred to the Methodist, Lutheran, Disciples, and Winebrennarian Churches.

Mr. Sinclair has included in his report an abstract of results from his field computations, showing the deviation of the line to the eastward at Union City and Butler, the station at Elizabethtown being taken as the starting point. He observes that it is evident that the line is an irregular one, at times tending east and again west, as would probably be the case with any of the meridians traced out by the needle many years ago.

Should the line be traced out as a true meridian from the south end, Mr. Sinclair states that it would cut from the State of Indiana a strip of territory amounting to nearly 100 square miles in area.

Field operations were completed October 31, and on November 3, Messrs. Sinclair and Putnam had reached Washington. Mr. C. J. Dixon rendered efficient service in Mr. Sinclair's party as recorder.

The work was greatly facilitated by the promptness of the officials of the Western Union Telegraph Company in connecting the astronomical stations with their wires, and making up the circuits for exchange of longitude signals. To them the thanks of the Survey are due, and also to the citizens of Union City for assistance rendered in the preparation of the observing station.

At St. Louis Prof. Pritchett kindly proffered all the facilities of the Washington University Observatory to Mr. Putnam, and he occupied the east pier in the transit room.

In November, 1891, the Superintendent transmitted copies of the reports of Messrs. Sinclair and Putnam to the Governor of Ohio, with the recommendation that the States of Ohio and Indiana should seek an early settlement of the boundary line question through the organization of a Joint Commission, empowered to establish and mark with suitable and permanent monuments the line separating those two great States.

Detail of an officer of the Survey as a member of the International Boundary Commission organized by the United States and Mexico to relocate the monuments marking the boundary line between the two countries.—To carry into effect provisions of the treaties of 1882 and 1889 between the United States and Mexico a Commission was organized by the Department of State on the part of the United States to coöperate with a Commission appointed by the Mexican Government for the relocation of the monuments marking the boundary line between the United States and Mexico, and in pursuance of a request made by the Secretary of State to the Secretary of the Treasury, Assistant A. T. Mosman was directed by the Superintendent to report for duty to the State Department as a Commissioner on the International Boundary Survey.

Early in November, 1891, Mr. Mosman received a telegram directing him to report in Washington, and proceed thence to El Paso, Texas, to meet the Mexican Commission. Arriving in Washington, November 9, and finding there the two other Commissioners, Lieut. Col. John W. Barlow, U. S. Engineers, and Lieut. D. D. Gaillard, of the same corps, the United States Commission was soon after formally organized; Lieut. Col. Barlow being elected engineer in chief.

Upon application made by the Commission to the Secretary of State, and by direction of the Superintendent, Assistant C. H. Sinclair and Aid G. R. Putnam of the Coast and Geodetic Survey, were instructed to determine the latitudes and longitudes of certain points upon the boundary line, as follows:

1. The initial monument (No. 1) on the west bank of the Rio Grande, near El Paso, Texas.

2. The monument (No. 27) at the intersection of the parallel 31° 20′ of latitude with the one hundred and eleventh meridian of longitude west from Greenwich, near Nogales, Arizona.

3. The monument (No. 6) at the junction of the Gila and Colorado Rivers, near Yuma.

4. The initial monument (No. 1) on the Pacific Ocean, south of San Diego, California.

5. The monument (No. 8) on the parallel of 31° 47′ latitude 100 miles west of initial point (No. 1).

Mr. Mosman has made from time to time to the Superintendent reports of the progress of this important work.

He observes that the country crossed by the United States and Mexican Boundary Line from the Rio Grande to the Pacific is probably the most sterile and desert-like of any boundary line of equal length to be found in any part of the world; all of it being in the arid belt and almost destitute of water and grass. What little water is found is of very poor quality, mostly alkaline, and at long distances apart. It was necessary, therefore, to locate the main camps near water, and to supply the detached parties by tank wagons.

Determinations of the geographical positions of points on the boundary line between the United States and Mexico for the International Boundary Commission.—In compliance with a request addressed to the Secretary of State by the United States and Mexican Boundary Commission, to the effect that the determinations of certain points along the boundary line in latitude and longitude should be made by the Coast and Geodetic Survey, the Superintendent, in January, 1892, instructed Assistant C. H. Sinclair to proceed to Los Angeles, California, and Aid G. R. Putnam to go to San Diego, and begin at those points the observations required by the Commission. These involved exchanges of telegraphic signals for longitude, observations for latitude of the stations occupied and their trigonometrical connection with the boundary marks or monuments. The magnetic elements were to be determined also.

The longitude work was to be primary; that is, telegraphic signals were to be exchanged upon ten nights for the determination of each longitude line, the observers changing stations after five exchanges had been obtained. On each night of exchange two independent chronometer corrections were determined by means of twenty stars arranged in two sets of ten stars each, each set consisting of two groups of five stars, four of them time stars and

one an azimuth star, with reversal of the transit after each group. One complete primary line determination of ten nights' work involved 4 400 single time observations, about 600 arbitary signals and 320 readings of level.

The station at Los Angeles was in the grounds of the Normal School, to the flagstaff of which it was referred as at the time of its first determination in longitude in 1889. Mr. Sinclair had a temporary observatory ready for exchanges of signals with San Diego on January 30, but owing to cloudy and rainy weather no longitude work was accomplished till February 9.

At San Diego Mr. Putnam selected a station in the public park. Assistant Davidson's station of 1871 could not be re-occupied, as the street in which it was located had, since that date, been graded. The center of the transit, the point of reference for latitude and longitude, was connected trigonometrically with the boundary monument, and a meridian line was laid out for the city engineer.

The primary longitude line Los Angeles–San Diego was determined by exchanges of telegraphic signals on ten nights between February 9 and March 5, the observers exchanging places after the observations of February 15. For the latitude of the Los Angeles Station, Mr. Sinclair made sixty-nine observations on fifteen pairs of stars during six nights with zenith telescope No. 6. At San Diego Mr. O. B. French, aid, determined the latitude of the station by one hundred observations on twenty-five pairs of stars during eight nights.

Upon the completion of the line Los Angeles–San Diego, the following named primary longitude lines were taken up and completed:

San Diego, California–Yuma, Arizona; Los Angeles, California–Yuma, Arizona; Yuma, Arizona–Nogales, Arizona; Nogales, Arizona–El Paso, Texas, and El Paso, Texas–Boundary Corner, New Mexico. At this point the pier for the transit had been built of rock and cement by the Boundary Commission, and was found to be 35·9 metres south and 0·8 metres east of Monument No. 10, which marks the western terminus of the boundary line on the parallel of 31° 47′, and was intended to be 100 miles from the initial point on the Rio Grande. For the line El Paso–Corner no exchanges of places by the observers was deemed necessary, their personal equation having been well established by the five longitude determinations preceding.

Other boundary marks or monuments with which the longitude stations were trigonometrically connected were as follows: at Yuma, Arizona, a mesquite post surrounded by stones on Penitentiary Hill and at Nogales, Arizona, the boundary monument on the north side of International Street. This had been evidently once a pyramid of stone, but had become a mere pile of loose stones.

At El Paso, Texas, the longitude station, located in the United States Military Cemetery Reservation, was connected by triangulation with the Courthouse, Federal Building, and with the Cathedral at Ciudad Juarez, Mexico. The Boundary Commission had already connected these points with the initial monument No. 1 on the bank of the Rio Grande.

At station Yuma the latitude observations were made in part by Mr. Putnam and in part by Mr. French, and at Nogales by Mr. Putnam. At the Boundary Corner the latitude had been determined by the Boundary Commission.

Magnetic observations for declination, dip, and intensity were made at all stations except at the Corner, and two additional stations were occupied, La Playa, near San Diego, and Boundary magnetic station, near El Paso.

All of the work executed by Messrs. Sinclair and Putnam for the use of the International Boundary Commission was completed on May 23, and they were then assigned to duty in Montana involving the determination in geographical position of a station in the Yellowstone National Park.

They express their appreciation of the liberality of the Western Union Telegraph Company as constantly manifested in giving the longitude parties the free use of its lines, and in promptly connecting their offices with the longitude stations.

United States Post Office site, San Francisco.—Acting under instructions from the Superintendent, Assistant George Davidson advised with Col. Geo. H. Mendell, of the Corps of Engineers, U. S. Army, with regard to the sinking of four artesian wells on the United States Post Office site at Seventh and Mission Streets, which had been reported upon favorably by three United States Commissioners. Conferences were held during the progress of the work with Assistant Secretary of the Treasury Crounse and Secret Service Agent Brooks. A report of this work was made to the Assistant Secretary, and a copy furnished to the Superintendent.

Board of Engineers to devise a system of sewerage for San Francisco.—In February, 1892, two of the chairmen of committees in the Board of Supervisors of San Francisco consulted Mr. Davidson on a plan for organizing a Board of Engineers to devise a system of sewerage for the city and county of San Francisco, an area of 27 000 acres, or 42·188 square miles. Mr. Davidson was familiar with this subject, having made a partial report to the Board of Supervisors in April, 1886, in compliance with a resolution of that body, upon the main features needed in such a system, and having given some of his time to other investigations and studies relating to it. This report had been published in pamphlet form and a copy sent to the Superintendent.

On March 7, the Board of Supervisors passed a resolution directing that Prof. George Davidson of the United States Coast and Geodetic Survey, Col. Geo. H. Mendell, Corps of Engineers, U. S. Army, and Hon. Irving M. Scott of San Francisco, select two civil engineers, and that these five persons shall then constitute a board of engineers to devise a system of sewerage for the City and County of San Francisco.

The Superintendent having, by authority of the President, authorized Mr. Davidson to undertake this service, which was mainly one of advice and direction, he formally accepted the position July 21, and towards the end of August the Board was organized by the selection of two other engineers. It was decided to use the Coast Survey topographical map of San Francisco peninsula as a basis for their duties, which involved decisions upon proposed changes of grades of streets, studies for a comprehensive system of sewerage, etc.

Surveys for the Harbor Line Commission of the State of Washington.—Reference was made in the last annual report to the detail of Assistant J. J. Gilbert to execute certain special surveys requested by the Harbor Line Commission of the State of Washington. This detail took effect May 11, 1891.

At the beginning of the fiscal year 1892 Mr. Gilbert had completed the surveys of the water fronts of the cities of Whatcom, New Whatcom, and Fairhaven, on Bellingham Bay; he then proceeded to Olympia, where he prepared maps of these surveys for the use of the Commission.

On July 14, he began the survey of Olympia Harbor. The triangulation, topography, and hydrography of this harbor were pushed to completion by August 15, the soundings were then plotted, and a map of the harbor furnished to the Commission. He also, during this period, located the harbor lines on the Whatcom and Fairhaven maps and described them by courses and distances.

During the remainder of the season, which closed December 30, 1891, he completed the triangulation, topography, and hydrography of the harbor of Port Townsend, and all of the office work resulting from this and previous field work. Five copies of the chart of Port Townsend were made for the use of the Commission; the harbor lines were located on these copies, described by courses and distances and adjusted by latitudes and departures. This was done also for the additional copies of the map of Olympia Harbor made for the Commission.

On January 1, 1892, having been relieved from service with the Commission, Mr. Gilbert returned to Coast Survey duty, and was engaged until early in April in inking and tracing original sheets of his surveys for deposit in the archives, and in the preparation of records, revision of computations, and other office work.

In February, the Harbor Line Commission, through its President, Wm. F. Prosser, Esq., transmitted to the Superintendent a series of resolutions expressing its high appreciation of the valuable services rendered to it in the discharge of its official duties by Mr. Gilbert, and asking that he should be again detailed to aid it in work yet to be done.

This request having been complied with, and Mr. Gilbert having formally reported to the Chairman of the Commission, he left Olympia April 18 for Port Angeles, where upon arrival, he measured a preliminary base line nearly a mile long with a steel tape, and from this base developed the triangulation. All other operations of the field work for this survey were finished May 17, and on the 20th he took up the triangulation, topography, and hydrography required for the survey at Anacortes.

This work he completed at the end of June, and early in July, 1892, he began a similar survey of the town and harbor of La Conner, reference to which will be made in the next annual report.

Observations for the variations of latitude at a station in Rockville, Maryland; at a station in San Francisco, California, and at a station in Honolulu, Oahu, in cooperation with the work of the International Geodetic Association.

I. Observations at Rockville, Maryland.

In conformity with a request from the International Geodetic Association that the Coast and Geodetic Survey should aid it in its researches on the variations of latitude. Assistant Edwin Smith was instructed in March, 1891, to make the preparations needed for mounting a zenith telescope and transit, and fitting up a temporary observatory near his residence in Rockville, Maryland, and as soon as practicable to begin the observations required, the understanding being that this work was to be done as far as possible without interference with his official duties as Chief of the Instrument Division, Coast and Geodetic Survey office.

Early in June, 1891, after all arrangements for the work had been completed, regular observations were begun, and were kept up on every night, when weather permitted, until the middle of July, 1892.

Eighty-eight pairs of stars were selected for observation from the Coast and Geodetic Survey catalogue of stars for observations of latitude (App. 7, 1876). These pairs, which extended over the twenty-four hours of right ascension, were arranged in fifteen groups. A complete list of them, with the dates of observation, will be found in the report of the results of the work which has been made by Assistant Charles A. Schott, Chief of the Computing Division, and which follows the report submitted by Mr. Smith, describing the instruments and methods employed, and accompanied by illustrative drawings. These two reports are published as Appendix No. 1, 1892, Part II. A preliminary report, prepared by Assistants Schott and Smith, has been published as Bulletin No. 25.

II. Observations at San Francisco, California.

The observations begun at Lafayette Park astronomical station, San Francisco, in May, 1891, by Assistant George Davidson, for investigating the variations of latitude were continued by him until after the close of the fiscal year 1892.

The duration of a night's work was always six hours, with the number of pairs of stars and triplets ranging from fourteen to eighteen in each of the eight groups, and two groups were observed each night. When the season would permit, from two to three hours a night additional were occupied by observations of close circumpolars for the value of the micrometer.

Until December 13, 1891, zenith telescope No. 1 was used, and after that date No. 3, which had been put in good order, and is a better instrument than No. 1.

The series of observations extends from May 27, 1891, to August 25, 1892, and includes 5 308 observations upon 283 stars, arranged in 121 pairs and triplets. Special care was taken to determine the values of the micrometer for each telescope; for No. 1, λ Ursæ Minoris

was observed on four nights near the beginning of the series, through twenty turns of the micrometer at each fifth of a turn; near the middle of the series, λ Ursæ Minoris was observed on three nights through thirty turns at each quarter of a turn; and at the end of November, λ Ursæ Minoris on four nights through twenty-six turns at each quarter of a turn, making in all 1 205 observations for micrometer value of No. 1. In this work Mr. Davidson was assisted by Mr. Edmonds, who noted and recorded the times and levels, and by Mr. T. D. Davidson, who read the two levels at each turn. These micrometer observations were reduced by Subassistant Fremont Morse, who had completed the reduction before leaving to take charge of a chronometric longitude party at Sitka, Alaska.

Early in February, 1892, Mr. Davidson made the first set of observations for value of micrometer of zenith telescope No. 3. On two nights at each one-third turn, and on two nights at each quarter turn, through fifteen turns the star B. A. C. 4165 was observed. Also, α Ursæ Minoris on two nights at each quarter turn, and on two nights at each one-fifth turn, through thirty turns. In the latter part of April and early in May, δ Ursæ Minoris was observed at each half turn through thirty turns, and λ Ursæ Minoris through thirty turns at each one-fifth turn, and on one night through ten turns at each one-tenth turn, Mr. Edmonds noting the times and making the records, and Mr. T. D. Davidson reading the levels.

As forming part of the latitude variation work, reference is here made to the close of the observations in August, and to the final observations for micrometer value of zenith telescope No. 3, in September. These consisted of seven full nights on α Ursæ Minoris at each one-fifth turn for thirty-two turns, and five full nights on λ Ursæ Minoris for thirty-two turns at each one-fifth turn. For a closer determination of the irregularity of one turn, there were included in the series on α Ursæ Minoris observations made on three nights at each one-tenth turn for ten whole turns, and on each night in the series on λ Ursæ Minoris observations at each tenth of a turn for ten turns. The total number of micrometer observations for zenith telescope No. 3, is 4 402, to which must be added over one thousand determinations by the method of collimation and by the microscope.

The observations for correction of the chronometer used in the latitude work were made almost wholly by Messrs. Morse and Edmonds, and, in the absence of the latter, by Mr. Kammerer.

As a means towards ease, accuracy, and rapidity of reading, Mr. Davidson adopted micrometer heads of black vulcanite, with white divisions, and large milled heads of the same material. In March he proposed certain modifications to existing zenith telescopes, with descriptions and sketches. In all of his experiments for new methods of detecting irregularities in the micrometer screw, he acknowledges having received assistance and advice from Mr. T. D. Davidson.

A part of the records of the San Francisco work has been received at the office, and, as soon as all have been received and the necessary force of computers can be made available, the reduction and discussion of the observations will be begun.

III. Observations at Honolulu, Oahu.

Assistant E. D. Preston, who was detailed to make the observations for investigating the variations of latitude at Honolulu, island of Oahu, has submitted a report of his work, which is published as Appendix No. 2, to Part II, of this volume. It includes a reduction and discussion of his results.

Mr. Preston was accompanied to Honolulu by Dr. Marcuse, who represented the International Geodetic Association, and was charged with making observations of a similar character.

Between June 6, 1891, and June 25, 1892, which included the entire period of his latitude work, Mr. Preston observed on 220 nights, and obtained 2 434 observations of latitude with the zenith telescope. At intervals between the pairs of latitude stars, he observed for

gravity with one of the sets of the new half-second pendulum apparatus of the Survey, and was thus enabled to obtain at his latitude station, and simultaneously with his latitude observations, upwards of 800 measures of the force of gravity.

Observations were made also at this station on three days for the determination of the magnetic elements.

Details of observations made for latitude, gravity, and the magnetic elements at eleven other stations occupied by Mr. Preston, are given in his report. The most difficult of these stations, and where the observations were of great importance, were those occupied on the ascent to and at the summit of Mauna Kea, the highest peak of the Hawaiian Islands, which has an elevation of nearly 14 000 feet.

ABSTRACTS OF ANNUAL REPORTS FROM THE ASSISTANT IN CHARGE OF THE OFFICE, THE HYDROGRAPHIC INSPECTOR, THE DISBURSING AGENT, THE ASSISTANT IN CHARGE OF STATE SURVEYS, AND THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE.

The annual report of Mr. B. A. Colonna, Assistant in charge of the Office, is given in full in Office Report No. 1 towards the close of this volume. It is accompanied by the annual reports of the chiefs of the several divisions of the office.

Reference is made in the report to the great need of additional force in the Computing, Tidal, and Drawing Divisions, in order that no delays may occur in publishing the results of the operations of the Survey in the forms of charts, coast pilots, and tide tables, the demand for which has for some years been steadily on the increase. The decrease in the number of charts issued for public use, as compared with the number for the fiscal year 1890, is due to the policy adopted, after careful examination, of economizing in the free distribution whenever practicable to do so without injury to the public service.

Great facilities have been gained for carrying on the work of chart printing by putting into operation the new presses in the building on South Capitol Street, which was refitted for the purposes of the printing office. With these presses, which are run by power supplied by a gas engine, and with the new roller calendering press, all demands for charts have been promptly supplied. The work of chart correcting, whereby all corrections in Aids to Navigation are placed on the chart up to the dates of their issue, has been perfected by the cordial coöperation of the Hydrographic and Engraving Divisions with the Chart Division.

Preparations for the exhibit of the Survey at the World's Columbian Exposition are in active progress.

The acquisition by the United States at the beginning of the fiscal year of the buildings Nos. 201 and 203 New Jersey Avenue, known as the Butler buildings, and of No. 205, the Coast and Geodetic Survey building, with the land adjoining it on the south, has greatly facilitated the work of the office by providing additional room for field officers temporarily assigned to office duty, by making it practicable to introduce much needed improvements in heating and in sanitary arrangements, and by the erection of small buildings to be used as observatories, and for the testing of field instruments.

The operations of the Boards organized by the Superintendent during the previous fiscal year, on charts, on the library and archives, and on instruments and their construction, have been very satisfactory.

On July 21, 1891, the Superintendent being absent on official business in Alaska, the Assistant in charge of the Office was directed by the Secretary of the Treasury to perform the duties of Superintendent during the absence of Dr. Mendenhall.

Assistant Charles A. Schott, in charge of the Computing Division, in addition to the direction and supervision of the labor of the several computers, has submitted some special

reports of value, among which may be mentioned that relative to the completion of the computations covering the triangulation of the State of Massachusetts, 1885 to 1889 inclusive, comprising the determination in geographical position of 2 098 stations; the discussion of the observations made at Rockville, Maryland, in 1891–92 by Assistant Smith for investigating the variations of latitude, and the reduction and discussion of the differential observations for the horizontal component of the magnetic force at Los Angeles, California, recorded from 1882 to 1889.

Mr. Schott continued to act as examiner of computers for the Civil Service Commission.

Under the direction of Mr. A. S. Christie, Chief of the Tidal Division, the tidal reductions and discussions have been kept up to date; a card index of the publications relating to tides has been begun; the harmonic analysis of a year's tides at eight stations has been in progress or completed; tide tables for the Atlantic Coast for the year 1893 were prepared and published, and those for the Pacific Coast sent to press; and methods of abbreviating the labor of tabulation in the harmonic analysis of the tides have been studied and will soon be introduced in the reductions.

Mr. Christie has given much attention to the question of a periodical fluctuation of sea level, having a period identical with that of the variation of latitude now under investigation by astronomers. Upon this subject he will make a special report.

Assistant W. H. Dennis, Chief of the Drawing Division, reports a considerable increase in calls from the various Departments of the Government and from the public for tracings from the original sheets of surveys and for other information. The tabular statement of information furnished in response to these calls, which accompanies his report, will be incorporated in Table No. 3 towards the end of this volume. Eleven drawings of charts to be engraved on copper and twenty drawings of charts to be published by photolithography were finished. Drawings for new editions of twenty-one charts were revised and corrected.

The most important engravings finished during the year, as reported by Assistant H. G. Ogden, Chief of the Engraving Division, were those of the general coast charts of the Pacific Coast from Point St. George to Cape Lookout, scale 1–200 000, and the general coast chart Mobile Bay to Atchafalaya Bay, scale 1–400 000. The publication of this chart will complete the first edition of the general charts of the Gulf Coast. A large number of plates of important charts were materially advanced, including the new sailing charts of the Atlantic Coast; the chart of Nantucket Shoals, on the Mercator projection, extending westward to Montauk Point; the remaining coast and harbor charts of the coast of Maine, and the coast charts of Florida Bay.

Mr. Ogden refers in terms of much gratification to the improvements in and additions to the plate printing office, which have brought it up to a high standard of efficiency. The interruption of work incident to the removal and refitting of the printing establishment would have been the cause of much delay in the issue of charts under the conditions prevalent a year ago.

In the electrotyping and photographing rooms, under the immediate charge of Mr. D. C. Chapman, the thorough overhauling of the batteries a year ago has resulted in an increased ratio of deposit of copper for the quantity of zinc consumed.

Mr. Ogden has continued to serve as a member of the United States Board on Geographic Names, and in questions referred to this Board, and in matters of detail relating to engraving and photolithographing he acknowledges very satisfactory aid rendered by Mr. Eugene Rhodes.

The Chart Division has continued in charge of Assistant Gershom Bradford. The total issue of charts, which represents the work of the division, was practically the same as that of the last year, and about 2 per cent larger than the average issue of the four years preceding. The issue of 1890 was anomalous in regard to free distribution; were this omitted, the increase over the average would be about 10 per cent. The net sales, which are the indication of the popular demand, as compared with the average of the four years, have decreased

in the number of copies less than 2 per cent, and have increased in value 4 per cent. Mr. Bradford suggests that as the tendency in commerce is towards the use of vessels of larger size, and of steamers in place of sailing vessels, the number of charts required may be expected to be proportionally less.

A new edition of the Catalogue of Charts for 1892 was published in April. It contains 489 titles.

A list of new charts published during the year from engraved plates and by photolithography accompanies Mr. Bradford's report.

Mr. M. W. Wines, Chief of the Miscellaneous Division, and as such in charge of the supply of the publications of the Survey to sales agents, the receipt and distribution of the annual reports, coast pilots, and tide tables, the making up of requisitions for printing and binding, etc., submits with his annual report a tabular statement showing the aggregate in number and value of the charts, coast pilots, and tide tables transmitted to sales agents during the fiscal year; a statement of the publications of the Survey sent to press, and of those received from the Public Printer; and a table showing the distribution, domestic and foreign, of the annual reports of the Superintendent.

Among the papers of value, of which separate editions were published during the year and made available for distribution without charge to applicants, may be named the following: Appendix No. 10—1890, The Gulf Stream, Methods of the Investigation and Results of the Research; Appendix No. 16—1890, The relation of the Yard to the Metre; Appendix No. 17—1890, Address of Assistant Davidson, Delegate from the United States at the Ninth Conference of the International Geodetic Association; and Appendix No. 18—1890, The National Prototypes of the Standard Metre and Kilogramme.

Assistant Edwin Smith, Chief of the Instrument Division, submits with his annual report tabular statements for file in the archives showing what instruments were repaired during the fiscal year, what were reconstructed, what were wholly made in the instrument shop, and what instruments and apparatus were repaired or constructed for the Office of Standard Weights and Measures. Also a list of instruments and apparatus purchased for the use of the Survey.

Special attention was given by Mr. Smith and by Mr. E. G. Fischer, chief instrument maker, to the reconstruction of zenith telescope No. 3, intended for the use of Assistant Davidson in his observations for investigating the variations of latitude. Before it was forwarded to San Francisco, Assistants Schott, Woodward, and Tittmann, a committee appointed by the Superintendent to examine the instrument, reported very favorably upon it.

Progress was made in the construction of the duplex base bars from designs by Assistant Eimbeck, and these bars will be completed, it is expected, for exhibition at the World's Columbian Exposition.

Much time was given to changes in and additions to the half-second pendulum apparatus which had been used by the Superintendent on the Pacific Coast and in Alaska; these changes involved experimental work which was in progress throughout the year. A great gain in time and facilities for pendulum experiments was effected by the transfer of the base pendulum station of the Survey from the Smithsonian Institution to a room in the basement of the office. This pendulum room, the laboratories, and the comparing vault have now ample illumination by the electric light.

In the Library and Archives Division, under the direction of its chief, Mr. Francis H. Parsons, a number of improvements have been begun or completed during the year, intended to facilitate access to the records and results of the Survey. Portfolios have been provided for the collection of maps, and over a thousand pamphlets have been arranged by the decimal system, and placed in tin cases duly labeled. Nearly nine hundred volumes of books and atlases were prepared for binding and sent to the Government bindery. All books purchased were selected by the library committee, and of these the greater part were works of reference

of a valuable character. It is anticipated that the increased space soon to be gained by the transfer of the library to a much larger room in the Butler building, and by the compilation of a complete catalogue, which will then become practicable, will add greatly to the usefulness of the library.

During the year Mr. Parsons visited, by direction of the Superintendent, a number of public libraries in the principal cities of the New England and Middle States, and attended the conferences of the Association of American Librarians at Lakewood, New Jersey, Baltimore, Maryland, and Washington, D. C.

In the Office Division, under the immediate direction of Assistant in charge, the following-named persons continued to serve: Dr. W. B. French as executive and financial clerk; Mr. E. B. Wills as registry and file clerk; Miss Kate Lawn, Miss Ida Peck, and Miss Sophie Hein as typewriters and copying clerks. Miss F. Cadel served also as typewriter and copying clerk until her transfer to the Indian Department, July 31. In the office of the Superintendent, Mr. W. B. Chilton continued to act as clerk. He prepared the indexes to the annual reports, and aided in proof reading, in addition to his other duties.

ABSTRACT OF THE ANNUAL REPORT OF THE HYDROGRAPHIC INSPECTOR.

Lieut. Comdr. Seth M. Ackley, U. S. N., Hydrographic Inspector, Coast and Geodetic Survey, in his annual report to the Superintendent of hydrographic operations in the field and in the office, published as Office Report No. 2, summarizes briefly the work executed by hydrographic parties in charge of naval officers on the Atlantic and Pacific Coasts; refers to the annual reports of the Hydrographic and the Coast Pilot divisions of his office, and urges strongly the need of two new steamers to take the place of the old and worn-out vessels on the Atlantic and Pacific Coasts.

Alluding to the recent completion of the hydrography of Nantucket Shoals, Lieut. Comdr. Ackley observes that it was one of the most difficult pieces of work of that nature that the Survey ever accomplished. Other resurveys of importance, made necessary by changes, natural and artificial, since the surveys of upwards of forty years ago, were those of Mobile Bay and Entrance, completed in the spring of 1892, and of Boston Bay and Harbor begun towards the close of the fiscal year.

Appended to the reports of the Hydrographic Inspector is a tabular statement giving full statistics of hydrographic surveys executed during the year. Also lists of naval officers attached to the Survey during the fiscal year and of those in the service at its close.

Lieut. Robert T. Jasper, U. S. N., Chief of the Hydrographic Division, in submitting his annual report, acknowledges the steady industry of the hydrographic draughtsmen, Messrs. W. C. Willenbucher and F. C. Donn, who have made special efforts to keep the work up to date in the absence of Mr. E. Willenbucher on account of illness. Mr. E. Wyvill continued to serve as clerk and draughtsman in Lieut. Jasper's office in a highly satisfactory manner. All of the Notices to Mariners issued during the year were compiled and read in proof in this Division.

The annual report of the Coast Pilot Division is submitted by Lieut. E. H. Tillman, U. S. N., who was assigned to duty as its chief on October 8, 1891. He expresses his gratification at the prompt publication of Part IV, United States Coast Pilot, Atlantic Coast, Point Judith to New York, second edition. He began the revision and correction of the first edition of this work as one of his earliest duties; the manuscript was completed and sent to the printer in March, 1892; all proof was read and final proofs returned towards the end of June, and the edition was received at the office a month later. Progress was made in the preparation of the manuscript of Part III, of the same series, including the coast from Cape Ann to Point Judith. For the purpose of verifying sailing directions and making examinations of reported dangers within these limits, Lieut. Tillman took the field June 23, accompanied by Mr. Eugene Veith, who had been assigned to the Division September 19.

Mr. J. H. Roeth continued to serve as clerk in the office of the Hydrographic Inspector, and Mr. Talbot Pulizzi as copyist in the Coast Pilot Division.

ABSTRACT OF THE ANNUAL REPORT OF THE DISBURSING AGENT.

The annual report of the disbursing agent, Mr. John W. Parsons (Office Report No. 3), indicates that the accounts of the Survey have been examined and adjusted, and settlements effected during the year with the system and promptness characteristic of that officer. With but few exceptional cases the vouchers for expenditures were made up and forwarded to the accounting officers of the Treasury during the month next following that in which the expenditures were incurred.

A thorough investigation of the books, accounts, and vouchers of the office, made in October, 1891, by an examining committee appointed by the Secretary of the Treasury, proved that the accounts were in exact balance entirely to the satisfaction of the Department.

Mr. Parsons is now preparing, and has well advanced towards completion, the annual report of the expenditures of the Survey for the fiscal year, to be forwarded to the Secretary of the Treasury for transmission to Congress. This document, which is always a work of great labor, is printed in connection with Office Report No. 3.

Mr. N. G. Henry served during the year as confidential clerk and cashier; Mr. A. B. Simons, as clerk since January 4, 1892; Miss Paula E. Smith, as writer until her resignation, February 29, 1892; Mrs. A. C. Sturges, as clerk from April 26, 1892, and Miss A. F. Carlisle, as writer during the year, when not occupied as a confidential typewriter to the Superintendent.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF STATE SURVEYS.

Assistant George A. Fairfield, who has been on duty during the year in immediate charge of State surveys, by assignment of the Superintendent, has submitted a report of the work executed since the date of his assignment, March 27, 1891, to June 30, 1892, by the several parties under his charge operating under that paragraph of the Sundry Civil Act which provides for furnishing points to State surveys, etc. (Office Report No. 4).

Mr. Fairfield states concisely the progress made in the triangulation of the States of New Jersey, Tennessee, Wisconsin, and Minnesota. He recapitulates the expenditures made for these State surveys during the fiscal year, and the total amounts expended in the same States since geodetic operations were begun in them.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES.

The annual report of Assistant O. H. Tittmann, in charge of the office of Standard Weights and Measures is published as Office Report No. 5.

During Mr. Tittmann's absence on field duty from July 20 to October 11, 1891, this office was in charge of Assistant Edwin Smith.

In addition to the comparisons of length, of weight, and of thermometers, called for by several branches of the Government service, and by private corporations and individuals, which constituted much of the current work, verifications of alcoholometers and saccharometers were made for the Internal Revenue Bureau; a set of customary and metric weights and measures was furnished to the State of Idaho; a redetermination of the bench standard, a steel bar 100 feet long, used for comparison of surveying and engineering tape measures, was made; and observations were begun for determining the relation between two British Standard Yards and the National Prototype Metre No. 11. Since these comparisons were completed it has been found that their result will not change the legal relation, established for commercial purposes in the United States, of the yard to the metre; namely,

$$1 \text{ metre} = 39.3700 \text{ inches}.$$

During the year a balance of precision, constructed for this office by Rueprecht, of Vienna, was received. It will be mounted permanently as soon as a suitable balance room can be built for it.

Mr. Tittmann has submitted for publication as an appendix to the annual report for 1892 a paper, prepared at his request by Mr. John F. Hayford, on the symbolic solution by least squares of equations for determining the coefficients of weights, the cases considered being such as arise constantly in determining the values of series of weights in use in the office and in commerce.

Mr. L. A. Fischer, adjuster, was on duty throughout the year, and made all of the observations and computations required during Mr. Tittmann's absence.

SUB-OFFICES.

Sub-office in Philadelphia.—The charge of this office was continued with Assistant S. C. McCorkle throughout the fiscal year. Information was supplied as heretofore to several departments of the United States Government represented by officers on duty in the city, and also to the city authorities. Copies of charts, tide tables, annual reports and appendices were furnished in compliance with requests from the Engineer Corps, U. S. Army, the Light-house Inspector, the Branch Hydrographic Office of the Navy, the Weather Bureau, the Navy Pay Corps, the officers of the Circuit Court, and District Attorney, and the custodian of the Post Office building. Also to the City Bureau of Surveys, the Philadelphia Maritime Exchange, the Franklin Institute, the Engineers Club, etc. Many applicants for information called in person. The number of visitors during the year was 734.

In March a visit was made to the office by the Superintendent. Facilities were afforded during the year to the following officers of the Survey on duty at various periods in Philadelphia: Assistants H. L. Whiting, R. Meade Bache, H. G. Ogden, Andrew Braid, R. A. Marr, E. E. Haskell, and Mr. F. H. Parsons, Chief of the Library and Archives Division of the office.

Reference has been made under a preceding heading to the establishment of an automatic tide gauge on South Wharves, Philadelphia, the general supervision of which was assigned to Mr. McCorkle.

Sub-office in San Francisco.—At the Sub-office in San Francisco, which has been as heretofore in charge of Assistant George Davidson, the many inquiries from various sources were answered, and data supplied to numerous applicants. Mr. Davidson attended to all official correspondence, and conferred with his colleagues whenever they desired. He furnished part of the equipment of his party to Assistant Dickins for his triangulation towards Cape Mendocino, and loaned him a 20-inch theodolite. Assistants McGrath and Turner of the Alaska parties were largely outfitted from his party equipment; a vertical circle for time observations was loaned to Mr. Turner and one to Subassistant Morse for use at Sitka. Chronometers were supplied to Assistant Pratt at Tacoma and to Mr. Morse at Sitka. Some of those used by Mr. T. D. Davidson on trips between Tacoma and Sitka were also furnished from the Sub-office equipment.

Assistant James S. Lawson was on duty in the Sub-office throughout the year, and had charge of it during Mr. Davidson's absence on field duty.

Mr. F. W. Edmonds, clerk, assisted Mr. Davidson in the Lafayette Park Observatory; observed for time for the latitude observations and for the Sausalito tidal station, and referred the tide staff at that station to the bench marks by spirit-leveling. In June he executed the very arduous duty of posting two heliotropers on Mount Conness, reaching the summit after an ascent through more than 50 miles of snow. In August, he posted two heliotropers on Scott Mountain for the party of Mr. Dickins.

Mr. Ferdinand Westdahl, draughtsman, was on duty at the Sub-office during most of the year, part of the time in assisting Mr. Dickins in the reduction of his season's work and in making such drawings and tracings as were needed, and part of the time in filing and arranging all of the tracings in the office. In May, 1892, he was directed to join Mr. Dickins in the field.

The charge of the equipments of the Survey in the office storeroom was continued with Vicente Denis, messenger and porter. He assists in all transfers of instruments and equipments, and winds the observatory chronometers and astronomical clock.

Subassistant Morse made out in December the annual inventory of Coast and Geodetic Survey property in Mr. Davidson's charge.

CONCLUDING STATEMENT.

The following-named officers were specially employed under the direction of the Superintendent: Assistant George A. Fairfield in the immediate supervision of State Surveys; Assistant R. S. Woodward in studies and investigations relating to improved forms of base-measuring apparatus and their efficiency in the field; Assistant Andrew Braid as executive officer to the Superintendent; Assistant O. H. Tittmann in charge of the office of Standard Weights and Measures, and Assistant Edward Goodfellow in the preparation for publication and the editing of the annual reports and bulletins of the Survey.

Questions of international importance now pending, the adjustment of which depends partly upon a satisfactory definition and delineation of the shore lines of Alaska, and upon the correct location of its boundary lines as related to those of the British Possessions in North America, have made it incumbent upon the Superintendent to advance the surveys of that Territory to the extent of the means afforded by Congress, and to provide for the publication of their results at the earliest dates practicable.

During the year a third edition of the Pacific Coast Pilot of Alaska from Dixon Entrance to Yakutat Bay was published, the text having been revised and corrected by Mr. Charles Junken, civilian expert, from the latest surveys. He compiled also a chart of Behm Canal, southeastern Alaska, and a sailing chart of the Entrance to Bering Sea, and is now collecting material for Part II of the Alaska Coast Pilot, to cover the coast of that Territory from Yakutat Bay, westward, including the Aleutian Chain, Bering Sea, and the Arctic Ocean.

In order to reach a settlement of the points of difference between Great Britain and the United States in the matter of the boundary line between Alaska and the British Possessions in North America, the President has appointed the Superintendent as United States Commissioner to confer with the British Commissioner, Hon. W. F. King, chief astronomer of the Dominion of Canada, and to devise plans and methods for organizing and sending to the field at an early date the surveying parties whose joint operations will be satisfactory to both Governments.

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U. S. COAST AND GEODETIC SURVEY REPORT FOR 1892.

PART I.

FIELD AND OFFICE DETAILS.

TABULAR STATEMENTS AND ANNUAL OFFICE REPORTS.

TABLE No. 1.

Distribution of the field parties of the Coast and Geodetic Survey upon the Atlantic, Gulf of Mexico, and Pacific Coasts, and in the interior of the United States during the fiscal year ending June 30, 1892.

TABLE No. 2.

Statistics of field and office work of the Coast and Geodetic Survey for the fiscal year 1892, and total to June 30, 1892.

TABLE No. 3.

Information furnished to Departments of the Government in reply to special requests, and to individuals upon application, during the fiscal year ending June 30, 1892.

OFFICE REPORT No. 1.

Report of the Assistant in charge of the Office for the fiscal year ending June 30, 1892.

OFFICE REPORT No. 2.

Report of the Hydrographic Inspector for the fiscal year ending June 30, 1892.

OFFICE REPORT No. 3.

Report of the Disbursing Agent for the fiscal year ending June 30, 1892.

OFFICE REPORT No. 4.

Report of the Assistant in charge of State Surveys for the fiscal year 1892.

OFFICE REPORT No. 5.

Report of the Assistant in charge of the Office of Standard Weights and Measures for the fiscal year ending June 30, 1892.

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TABLE No. 1—1892.

Distribution of the Field Parties of the Coast and Geodetic Survey upon the Atlantic, Gulf of Mexico, and Pacific Coasts, and in the interior of the United States during the fiscal year ending June 30, 1892.

1.—EASTERN DIVISION—STATES EAST OF THE MISSISSIPPI RIVER.

1. Maine.
2. New Hampshire.
3. Vermont.
4. Massachusetts.
5. Rhode Island.
6. Connecticut.
7. New York.
8. New Jersey.
9. Pennsylvania.
10. Delaware.
11. Maryland.
12. District of Columbia.
13. Virginia.
14. North Carolina.
15. South Carolina.
16. Georgia.
17. Florida.
18. Alabama.
19. Mississippi.
20. Michigan.
21. Wisconsin.
22. Ohio.
23. Indiana.
24. Illinois.
25. West Virginia.
26. Kentucky.
27. Tennessee.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Maine	No. 1	Topography	Stehman Forney, assistant	Continuation of the topographic survey of the Schoodic Lakes towards the Northeastern Boundary Monument. (See also subsequent headings in Maine and in Texas.)
Maine	2	Topography	Joseph Hergesheimer, assistant; H. T. Marshall and B. H. Griswold, recorders, season of 1892; James H. Van Horn, recorder, season of 1891.	Topographic and hydrographic survey of the Schoodic Lakes from Grand Lake northwardly. (See also Florida, west coast.)
Maine	3	Topography	J. A. Flemer, subassistant; James F. Mitchell, Edward Sanford, and Sprigg Chesley, recorders.	Topographical survey of Chipuneticock Lake, the lower lake of the Schoodic Lakes, Maine and New Brunswick. (See also Massachusetts and District of Columbia.)
Maine	4	Topography	Stehman Forney, assistant; J. L. Merrill, recorder.	Detailed topographic survey of the east and west shores of the Kennebec River from Gardiner to Augusta, including the cities of Augusta and Gardiner and the towns of Hallowell, Chelsea, and Randolph. (See also previous heading in Maine, and later one in Texas.)
Massachusetts	5	Hydrography	Lieut. L. K. Reynolds, U. S. N., assistant; Ensign E. H. Tillman, U. S. N., in charge of Coast Pilot examinations; Eugene Veith, recorder.	Hydrographic examinations for the Coast Pilot between Cape Ann and Point Judith. (See also notice of hydrography of Nantucket Shoals.)
Massachusetts	6	Topography	R. M. Bache, assistant	Topographical resurvey of Boston Bay and Harbor. (See also Pennsylvania.)
Massachusetts	7	Hydrography	Lieut. W. F. Low, U. S. N., assistant; Lieut. C. S. Ripley, U. S. N.; C. H. Deetz, draftsman; Paymaster's Yeoman R. W. Stevens, U. S. N.; Ship's Writer Wm. B. Proctor, U. S. N.	Hydrographic resurvey of Boston Bay and Harbor.
Massachusetts	8	Topography	J. A. Flemer, subassistant	Topographical survey of a designated area in the vicinity of Plymouth, Mass. (See also Rhode Island and District of Columbia.)
Massachusetts	9	Town boundary surveys	Henry L. Whiting, assistant; C. H. Van Orden, assistant.	Continuation of the surveys of town boundaries for the State of Massachusetts. Service as a member of the Mississippi River Commission.

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Massachusetts	10	Hydrography	Lieut. Edward M. Hughes, U. S. N., assistant; Lieut. W. L. Burdick, U. S. N.; Ensigns W. W. Buchanan, W. B. Hogatt, and J. W. Oman, U. S. N.	Completion of the hydrographic resurvey of Nantucket Shoals. (See also Georgia, Florida, and Alabama.)
Massachusetts	11	Hydrography	Lieut. C. E. Vreeland, U. S. N., assistant; Lieut. H. Kimmell, U. S. N.; Ensigns W. C. P. Muir, J. H. Rohrbacher, and Benj. Wright, U. S. N.; Assist. Engr. W. W. White, U. S. N., until July 30; Assist. Engr. W. H. P. Creighton, U. S. N.; Assist. Surg. E. S. Bogart, Jr., U. S. N., season of 1891; for the season of 1892, Lieut. John Gibson, U. S. N.; Ensigns W. C. P. Muir and M. K. Eyre, U. S. N.; Assist. Surg. J. A. Guthrie, U. S. N.	Completion of the hydrographic resurvey of Nantucket Shoals. (See also Virginia and South Carolina.)
Massachusetts	12	Hydrography	Lieut. L. K. Reynolds, U. S. N., assistant; Ensigns Thos. W. Ryan, John Gibson, and Hugh Rodman, U. S. N.; Pay Yeoman J. Mc C. Tiffany, U. S. N., and Seaman Emory Stineman, recorder.	Completion of the hydrographic resurvey of Nantucket Shoals. (See also preceding heading in State of Massachusetts.)
Massachusetts	13	Topography	D. B. Wainwright, assistant.; Walter B. Hindmarsh, foreman; R. J. McAdory, recorder; W. T. Oliver and L. W. Cottman, recorders.	Detailed topographical survey of the north shore of Nantucket Sound from Falmouth Heights to Hyannis Light. (See also District of Columbia.)
Massachusetts	14	Physical hydrography	Henry L. Marindin, assistant; Homer P. Ritter, expert observer; M. V. Safford and C. E. Mendenhall, recorders (season of 1891); H. P. Ritter, expert observer; M. V. Safford and George O. Glavis, recorders, 1892.	Physical hydrography. Completion of the physical hydrographic survey of the south coast of the island of Nantucket from Weeweder to Smiths Point, and similar survey begun on the south coast of Marthas Vineyard.
Massachusetts	15	Hydrographic examination.	Lieut. Edward M. Hughes, U. S. N., assistant; Lieut. W. L. Burdick, U. S. N.; Ensigns W. W. Buchanan, W. B. Hoggatt, and J. W. Oman, U. S. N.	Hydrographic examination in the vicinity of Squipnocket Ridge Shoal. (See also Georgia, Florida, and Alabama.)
Rhode Island	16	Tidal observations	N. G. Herreshoff, voluntary observer.	Automatic tide-gauge record continued at Bristol, R. I.
Rhode Island	17	Tidal observations	Officers of the U. S. Corps of Engineers.	Establishment of an automatic tidal station at Fort Adams, Newport, R. I.
Rhode Island	18	Topography	J. A. Flemer, subassistant; D. S. Chesley, rodman.	Detailed topographical survey of Coasters Harbor Island for the Navy Department. (See also Maine and District of Columbia.)
Connecticut	19	Topography and hydrography.	W. I. Vinal, assistant	Topographic and hydrographic survey of the Connecticut River from Chester to Hartford. (See also Florida and Alabama.)
Connecticut	20	Triangulation and topography.	W. C. Hodgkins, assistant	Topographical survey of the Connecticut River and triangulation incidental thereto carried from Middletown to Hartford. (See also District of Columbia and Special Operations.)
New York	21	Topography and hydrography.	C. T. Iardella, assistant	Topographic and hydrographic resurveys on the south coast of Long Island, extending from Southampton towards Montauk Point.
New York	22	Hydrography	Lieut. W. P. Elliott, U. S. N., assistant; Lieut. Hiero Taylor, U. S. N.; Ensigns C. P. Eaton and E. T. Witherspoon, U. S. N.; Pay Yeoman R. W. Stevens, and Ship's Writer W. B. Proctor.	Hydrographic surveys in Shelter Island Sound, Great and Little Peconic Bay, and approaches.

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
New York	23	Longitude determinations and observations for latitude.	C. H. Sinclair, assistant; G. R. Putnam, aid.	Determination by exchanges of telegraphic signals of the longitude lines Albany–Detroit, Detroit–Chicago, and Chicago–Minneapolis. Observations for latitude at Chicago. (See also Ohio and Indiana, Minnesota and Nebraska, Missouri and California, Arizona and Texas.)
New York	24	Topography and triangulation.	John W. Donn, assistant; A. L. Baldwin, acting aid.	Topographical survey of the Hudson River continued. Determination of position for lighthouse proposed to be built on Old Orchard Shoal. (See also District of Columbia.)
New York	25	Tidal operations	Under direction of Lieuts. C. A. F. Flagler and Herbert Deakyne, Corps of Engineers U. S. A.	Establishment of an automatic tidal station at Willets Point, Long Island, N. Y.
New York	26	Triangulation	F. D. Granger, assistant	Determination of points on ranges in use by New-York Harbor pilots. (See also Kansas.)
New Jersey	27	Tidal observations	J. G. Spaulding, tidal observer	Continuation of tidal record at the automatic tidal station at Sandy Hook, N. J.
New Jersey	28	Geodetic operations	Prof. E. A. Bowser, acting assistant	Geodetic operations. Continuation of reconnaissance and triangulation in the southwestern part of the State of New Jersey.
New Jersey	29	Topography and hydrography.	R. A. Marr; E. E. Haskell, expert observer.	Topographic and hydrographic surveys on the coast of New Jersey between Atlantic City and Cape May. (See also District of Columbia.)
Pennsylvania	30	Tidal observations	S. C. McCorkle, assistant; G. B. Thomas, tidal observer.	Establishment of an automatic tidal station on south wharves, Philadelphia. (See also suboffice at Philadelphia.)
Pennsylvania	31	Topographical additions and revisions.	R. M. Bache, assistant	Completion of the topography of the Delaware River water front of the City of Philadelphia. (See also Massachusetts.)
Pennsylvania and Delaware.	32	Reconnaissance and triangulation.	W. C. Hodgkins, assistant	Reconnaissance and triangulation for the location of the boundary line between the States of Pennsylvania and Delaware. (See also Connecticut, District of Columbia, and Special Operations.)
Maryland	33	Trigonometrical connection.	J. B. Boutelle, computer	Connection of the astronomical station at Rockville, Md., with the transcontinental arc of the triangulation.
Maryland	34	Variations of latitude	Edwin Smith, assistant	Observations for the variations of latitude at a station in Rockville, Md., in coöperation with the work of the International Geodetic Association.
District of Columbia	35	Tidal observations	A. S. Christie, chief of tidal division U. S. C. and G. S. office.	Establishment of an automatic tidal station at the Navy Yard, Washington, D. C.
District of Columbia	36	Topography	John W. Donn, assistant	Topographical surveys of a designated area of 1 square mile in the District of Columbia on scales of 1–20 000, 1–30 000, and 1–40 000 for purposes of comparison. (See also New York.)
District of Columbia	37	Topography	W. C. Hodgkins, assistant	Topographical surveys of a designated area of 1 square mile in the District of Columbia on scales of 1–20 000, 1–30 000, and 1–40 000 for purposes of comparison. (See also Connecticut, Pennsylvania, and Delaware, and Special Operations.)
District of Columbia	38	Topography	J. A. Flemer, subassistant	Topographical surveys of a designated area of 1 square mile in the District of Columbia on scales of 1–20 000, 1–30 000, and 1–40 000 for purposes of comparison. (See also Maine, Massachusetts, and Rhode Island.)
District of Columbia	39	Determination of geographical position.	J. A. Flemer, subassistant	Location in position of the astrophysical station of the Smithsonian Institution. (See also Maine, Massachusetts, and Rhode Island.)
District of Columbia	40	Hydrography	E. E. Haskell, assistant	Hydrographic resurvey of part of the upper end of Washington Channel, Potomac River.
Virginia	41	Physical hydrography	J. B. Baylor, assistant	Surveys of parts of the waters of the State of Virginia for the location and delineation of the limits of oyster beds. (See also Middle Division.)

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Virginia	42	Triangulation, topography, and hydrography.	C. H. Boyd, assistant; C. L. Gardner, recorder.	Triangulation, topography, and hydrography of the Appomattox River, Va. (See also Georgia.)
Virginia	43	Hydrographic examinations.	Lieut. C. E. Vreeland, U. S. N., assistant.	Hydrographic examinations of the shoal off Cape Charles, Va. (See also Massachusetts and South Carolina.)
Virginia	44	Geodetic leveling	Isaac Winston	Line of leveling of precision run between Old Point Comfort and Richmond, Va. (See also Florida and Missouri.)
Virginia	45	Topographical additions and revisions.	Homer P. Ritter, expert observer	Topographical additions and revisions in the vicinity of Old Point Comfort, Newport News, and of Lambert Point, Elizabeth River, Va.
South Carolina	46	Hydrography	Lieut. C. E. Vreeland, U. S. N., assistant; Lieut. John Gibson, U. S. N.; Ensigns W. C. P. Muir, J. H. Rohrbacher, M. K. Eyre, and B. Wright, U. S. N.; Asst. Surg. E. S. Bogert, U. S. N.	Hydrographic survey of Beaufort River, S. C., and vicinity. (See also Massachusetts and Virginia.)
Georgia	47	Tidal observations	Eugene Veith and Arthur J. Collyer, tidal observers.	Close of the tidal record at the automatic tidal station on Tybee Island, Ga.
Georgia	48	Hydrography	Lieut. E. M. Hughes, U. S. N., assistant; Ensigns G. W. Kline, W. W. Buchanan, and J. W. Oman, U. S. N.; J. L. Dunn, observer and recorder.	Hydrographic examination at the entrance to St. Simon Sound, Ga. (See also Massachusetts, Alabama, and Florida.)
Florida	49	Geodetic leveling	Isaac Winston, assistant; F. A. Young, subassistant; J. L. Bartlett and J. W. Thompson, recorders.	Line of leveling of precision carried from St. Augustine to Cedar Keys. (See also Virginia, Missouri, and Kansas.)
Florida	50	Tidal observations	Isaac Winston, assistant; C. C. Yates and F. V. Moss, tidal observers.	Establishment of automatic tidal stations at St. Augustine and Cedar Keys, east and west coasts of Florida. (See also Virginia, Missouri, and Kansas.)
Florida	51	Hydrographic examination.	Lieut. E. M. Hughes, U. S. N., assistant.	Hydrographic examination in Key West Harbor, Fla. (See also Massachusetts, Georgia, and Alabama.)
Florida	52	Triangulation and topography.	Joseph Hergesheimer, assistant; M. A. Coles, recorder.	Triangulation and topography of the Caloosahatchee River, west coast of Florida. (See also Maine.)
Florida	53	Triangulation, topography, and hydrography.	P. A. Welker, subassistant; H. L. Stidham, recorder; George O. Glavis.	Triangulation, topography, and hydrography of Blackwater Bay, Yellow River, and Weaver River in continuation of the survey of Pensacola Bay and tributaries.
Florida and Alabama	54		J. B. Baylor, assistant; W. I. Vinal, assistant; O. Jacob, Jr., recorder; E. E. Torrey, foreman.	Triangulation, topography, and beach measurement for the connection of the surveys of Perdido and Mobile Bays. (See also Michigan, Wisconsin, Indiana, Ohio, Illinois, Virginia, and District of Columbia.)
Alabama	55	Hydrography	Lieut. E. M. Hughes, U. S. N., assistant; Lieut. W. L. Burdick, U. S. N.; Ensigns W. W. Buchanan, Hugh Rodman, W. B. Hoggatt, Geo. W. Kline, and J. W. Oman, U. S. N.; J. W. Dunn, master-at-arms, observer.	Hydrographic survey of the lower part of Mobile Bay, Ala., including the main entrance, Grant's Pass, and the dredged channel. (See also Massachusetts, Florida, and Georgia.)
Alabama	56	Triangulation	F. W. Perkins, assistant; W. B. Fairfield, subassistant; H. B. vonder Trenck, recorder; R. E. Duvall, foreman.	Continuation of the primary triangulation in Alabama southward and southwestward towards a connection with the triangulation of the Gulf coast. (See also Kansas and Colorado.)
Michigan, Wisconsin, Ohio, Indiana, and Illinois.	57	Magnetic observations	J. B. Baylor, assistant	Magnetic observations at stations in Michigan, Wisconsin, Ohio, Indiana, and Illinois, and also in Washington, D. C., and Richmond, Va.

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Wisconsin	58	Geodetic operations	Prof. J. E. Davies, acting assistant	Occupation of stations in continuation of the triangulation of the State of Wisconsin.
Ohio and Indiana	59	Longitude determinations.	C. H. Sinclair, assistant; G. R. Putnam, aid.	Determinations of the geographical position of stations in Ohio and Indiana as a measure preliminary to the correct location of the boundary line between those States.
Indiana	60	Measurement of primary base line.	A. T. Mosman, assistant; R. S. Woodward, assistant; O. H. Tittmann, assistant; Prof. J. H. Gore, Mr. J. T. Hayford, and Mr. John S. Siebert, acting aids; Messrs. Th. Gjertsen, Robert Penington, and F. B. Cope, recorders; Mr. E. E. Torrey, foreman.	Measurement of a primary base line at Holton, Ripley County, Ind.
West Virginia	61	Connection of base with triangulation.	A. T. Mosman, assistant; W. B. Fairfield, subassistant; J. S. Siebert, aid; E. E. Torrey, foreman.	Connection of the Kanawha base line, St. Albans, W. Va., with the transcontinental triangulation.
Tennessee	62	Geodetic operations	Prof. A. H. Buchanan, acting assistant.	Geodetic operations. Extension of the triangulation in eastern Tennessee to connect with the triangulation of the State of Kentucky.

II.—MIDDLE DIVISION—STATES AND TERRITORIES BETWEEN THE MISSISSIPPI RIVER AND THE ROCKY MOUNTAINS.

28. Minnesota.
29. North Dakota.
30. South Dakota.
31. Iowa.
32. Nebraska.
33. Missouri.
34. Kansas.
35. Arkansas.
36. Indian Territory.
37. Oklahoma Territory.
38. Louisiana.
39. Texas.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Minnesota	63	Geodetic operations	Prof. W. R. Hoag, acting assistant	Geodetic operations. Reconnaissance for connecting the triangulation of the State of Minnesota with that of Wisconsin, and occupation of stations in those States. Connection of the Snelling Avenue Base and the azimuth station at the University of Minnesota with a bench mark of precise leveling established on the St. Paul City Courthouse by the Mississippi River Commission.
Minnesota and Nebraska	64	Longitude determinations.	C. H. Sinclair, assistant; G. R. Putnam, aid; A. C. Pease, recorder.	Determination by exchanges of telegraphic signals of the primary longitude line, Minneapolis–Omaha. (See also New York, Ohio, Indiana, Missouri, California, Arizona, and Texas.)
Minnesota and Iowa	65	Magnetic observations	J. B. Baylor, assistant	Magnetic observations at stations in the States of Minnesota and Iowa. (See also Eastern Division.)
Missouri	66	Longitude determinations.	C. H. Sinclair, assistant; Prof. H. S. Pritchett, director of the Washington Observatory, St. Louis, Mo.	Determination of the longitude of Macon City, Mo., by exchanges of telegraphic signals with St. Louis, and observations for the latitude of Macon City. (See also New York, Ohio, Indiana, California, Arizona, and Texas.)
Missouri and Kansas	67	Geodetic leveling	Isaac Winston, assistant; F. A. Young, subassistant; Irving Hitz, recorder.	Extension of the transcontinental line of geodetic leveling to the westward from Jefferson City, Mo. Line of leveling of precision carried southward from Holliday, Kans., towards Fort Smith, Ark. (See also Virginia and Florida.)
Kansas	68	Triangulation	F. D. Granger, assistant; M. A. Coles, recorder.	Extension to the westward in Kansas of the transcontinental triangulation near the thirty-ninth parallel. (See also New York.)
Kansas and Colorado	69	Triangulation	F. W. Perkins, assistant; W. B. Fairfield, subassistant; H. L. Stidham, recorder; R. E. Duvall, foreman.	Triangulation along or near the thirty-ninth parallel continued in western Kansas and eastern Colorado. (See also Alabama.)

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Texas	70	Triangulation, topography, and hydrography.	H. G. Ogden, assistant; C. L. Gardner, recorder.	Examinations and surveys required at the mouth of Brazos River, Tex., to locate the new channel and other recent improvements.
Texas	71	Reconnaissance	Stehman Forney, assistant	Completion of the reconnaissance for a triangulation of the boundary line between the United States and Mexico along the Rio Grande from El Paso, Tex., to Sanderson Peak. (See also Maine.)
Texas	72	Magnetic observations	R. E. Halter, assistant; L. G. Schultz.	Record of the differential values of the magnetic elements continued, and absolute values of these elements determined monthly at the automatic registry station, San Antonio, Tex.

III.—WESTERN DIVISION—STATES AND TERRITORIES BETWEEN THE ROCKY MOUNTAINS AND THE PACIFIC.

40. California.
41. Oregon.
42. Washington.
43. Idaho.
44. Montana.
45. Wyoming.
46. Nevada.
47. Utah Territory.
48. Colorado.
49. Arizona Territory.
50. Territory of New Mexico.

States or Territories.	Parties.	Operations.	Persons conducting operations.	Localities of work.
California, Arizona, and New Mexico.	72	Relocation and remarking of the United States and Mexican boundary line.	A. T. Mosman, assistant, and member of the International Boundary Commission.	Boundary line between the United States and Mexico. (See Special Operations).
California, Arizona, and New Mexico.	73	Determinations of latitude, longitude, and the magnetic elements.	C. H. Sinclair, assistant; G. R. Putnam, aid; O. B. French, observer and recorder.	Determinations of latitude, longitude, and the magnetic elements at points on the boundary line between the United States and Mexico. (See also headings in Eastern and Western Divisions.)
California	74	Topography and triangulation.	A. F. Rodgers, assistant; John Nelson, subassistant.	Completion of the topographical survey of the coast of California from Cape San Martin to Point Sur. Triangulation for completing the topographical survey of San Francisco Entrance.
California	75	Primary triangulation and observations for the variation of latitude.	George Davidson, assistant; Jas. S. Lawson, assistant; Fremont Morse, subassistant; F. W. Edmonds, T. D. Davidson, G. J. Kammerer.	Occupation of a station in continuation of the primary triangulation of the Pacific Coast; observations for the variation of latitude, etc.
California	76	Tidal observations	George Davidson, assistant; F. W. Edmonds; Emmet Gray, tidal observer.	Tidal record continued at the automatic tidal station at Sausalito, bay of San Francisco.
California	77	Marking of a trial course for steam vessels.	Lieut. D. Delehanty, U. S. N., assistant; Lieut. J. B. Blish, U. S. N.	Trial course for steam vessels laid off in San Francisco Bay for the use of the Union Iron Works.
California	78	Primary triangulation	E. F. Dickins, assistant; F. Westdahl, draftsman and observer.	Reconnaissance and occupation of stations in continuation of the primary triangulation north of San Francisco Bay.
Oregon and Washington	79	Triangulation and topography.	Cleveland Rockwell, assistant; J. C. Carruthers, recorder (part of season).	Triangulation and topography of the Columbia River from above Vancouver toward the Cascades.
Oregon and Washington	80	Hydrography	Lieut. J. M. Helm, U. S. N., assistant; Ensigns A. N. Mayer and J. M. Poyer, U. S. N.; W. W. Joynes, Pay Yeoman.	Hydrographic surveys on the coast of Oregon, between Cape Meares and Cape Kiwanda, and in Willapa Bay and Grays Harbor, coast of Washington.
Washington	81	Hydrography	Lieut. D. Delehanty, U. S. N., assistant; Lieut. Jas. B. Blish, U. S. N.; Ensigns L. J. Clark and J. G. Doyle, U. S. N.	Hydrographic survey of the coast of Washington south of Cape Flattery between James Island and Osett Island. (See also California.)
Washington	82	Reconnaissance and triangulation.	J. F. Pratt, assistant	Reconnaissance and triangulation for a resurvey of the harbor of Seattle, and for the survey of Shilshole Bay.

TABLE No. 1.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Washington	83	Chronometric longitudes and triangulation.	J. F. Pratt, assistant	Transportation of chronometers for difference of longitude between Tacoma, Washington, and Sitka, Alaska. Triangulation for the revision of the shore line and resurvey of the hydrography of Tacoma Harbor.
Washington	84	Triangulation, topography, and hydrography.	J. J. Gilbert, assistant	Triangulation, topography, and hydrography of harbors in Puget Sound, for the Harbor Line Commission of the State of Washington. (See also Special Operations.
Washington	85	Topography and hydrography.	Lieut. W. P. Ray, U. S. N., assistant; Ensigns Albert L. Key, Harry George, and Edward Moale, Jr., U. S. N.	Continuation of the shore line and hydrographic survey of Washington Sound. (See Division of Alaska.)
Wyoming	86	Telegraphic longitudes; latitude and magnetic observations.	C. H. Sinclair, assistant; G. R. Putnam, aid.	Exchanges of telegraphic signals for determining the longitude of a station in the Yellowstone National Park. Observations for latitude and the magnetic elements.
Utah and Colorado	87	Primary triangulation	William Eimbeck, assistant; P. A. Welker, subassistant; O. B. French and R. L. Faris, recorders.	Occupation of stations in Utah and Colorado for advancing to the eastward the transcontinental triangulation near the thirty-ninth parallel.

IV.—THE DIVISION OF ALASKA, INCLUDING ITS COASTS BORDERING ON THE PACIFIC OCEAN, ON BERING SEA, AND ON THE ARCTIC OCEAN; ALSO ITS INLETS, SOUNDS, BAYS, RIVERS, AND THE ALEUTIAN AND PRIBILOF ISLANDS.

Territory.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Southeastern Alaska	No. 88	General survey	Lieut. Comdr. H. B. Mansfield, U. S. N., assistant (season of 1891); Lieut. E. J. Dorn, U. S. N.; Ensigns H. C. Poundstone, W. L. Howard, F. L. Chapin, W. G. Miller, and W. H. Faust, U. S. N.; Passed Assistant Surgeon H. T. Percy, U. S. N., and Assistant Engineer T. F. Carter, U. S. N.	Base measurement, triangulation, shore line and hydrographic surveys in Behm Canal and vicinity, southeastern Alaska.
Southeastern Alaska	89		Lieut. Comdr. W. I. Moore, U. S. N., assistant (season of 1892); Lieut. C. W. Jungen, U. S. N.; Ensigns H. C. Poundstone, W. L. Howard, F. L. Chapin, and Glennie Tarbox, U. S. N.; Passed Assistant Surgeon C. J. Decker, U. S. N., and Assistant Engineer T. F. Carter, U. S. N.	Triangulation and shore line and hydrographic surveys in Boca de Quadra, Clarence Strait, and Revillagigedo Channel, and Keku Straits.
			Lieut. W. P. Ray, U. S. N., Assistant; Ensigns C. P. Eaton, Harry George, and E. T. Witherspoon, U. S. N.	Dixon Entrance north of the boundary and between Cape Chacon and Cape Fox.
Southeastern Alaska	90	Chronometric longitudes; latitude and magnetic observations.	Fremont Morse, subassistant; T. D. Davidson and B. H. Randolph, recorders.	Chronometric longitude work, and observations for latitude and the magnetic elements at Sitka, Alaska.
Southeastern Alaska	91	Base measurement, triangulation, latitude, and magnetic observations, longitudes by chronometer and moon culminations.	J. E. McGrath, assistant; J. H. Turner, subassistant.	Trigonometrical operations for the determination of the geographical position of Mt. St. Elias; observations for latitude and the magnetic elements and determinations of longitude by chronometer expeditions and by moon culminations at a station on Yakutat Bay.
Southeastern Alaska	92	Hydrographic and shore line surveys.	Lieut. Giles B. Harber, U. S. N., assistant; Lieut. H. S. Chase, U. S. N.; Lieut. J. B. Blish, U. S. N.; Ensigns L. J. Clark, J. G. Doyle, and Benj. Wright, U. S. N.; Assistant Surgeon G. T. Smith, U. S. N.	Hydrographic and shore line surveys of Yakutat Bay.

TABLE No. 1.

SPECIAL OPERATIONS.

Parties.	Persons conducting operations.	Localities and nature of work.
No. 1	W. C. Hodgkins, assistant, in coöperation with Benj. H. Smith and Daniel Farra, surveyors for the Joint Commmission.	Survey of the boundary line between the States of Pennsylvania and Delaware.
2	James B. Baylor, assistant	Physical hydrography; surveys of parts of the waters of the State of Virginia for the location and delineation of oyster beds.
3	C. H. Boyd, assistant	Completion of surveys for the Chickamauga and Chattanooga National Park.
	A. T. Mosman, assistant; C. H. Sinclair, assistant; G. R. Putnam, aid	Preliminary investigation of the meridian boundary line between the States of Ohio and Indiana.
5	A. T. Mosman, assistant and United States Commissioner; C. H. Sinclair, assistant, and G. R. Putnam, aid.	Determinations in latitude and longitude of points on the boundary line between the United States and Mexico, selected by the International Boundary Commission.
6	George Davidson, assistant	Examinations relating to the United States post office site, San Francisco, and service as a member of a Board of Engineers to devise a system of sewerage for the city and county of San Francisco.
7	J. J. Gilbert, assistant	Surveys for the Harbor Line Commission of the State of Washington.
8	Edwin Smith, assistant; George Davidson, assistant, and E. D. Preston, assistant.	Observations at Rockville, Md., at San Francisco, Cal., and at Honolulu, Hawaiian Islands, for investigating the variations of latitude in coöperation with the work of the International Geodetic Association.

TABLE No. 2—1892.

Statistics of field and office work of the Coast and Geodetic Survey for the fiscal year 1892, and total to June 30, 1892.

	Total to June 30, 1891.	During fiscal year 1892.	Total to June 30, 1892.
RECONNAISSANCE.			
Area in square statute miles	403 150	18 180	421 330
Parties, number of	----------	3	----------
BASE LINES.			
Primary, number of	15	1	16
Primary, length of, in statute miles	101	4	105
Subordinate, number of	138	1	139
Subordinate and beach measures, length of	528	22	550
TRIANGULATION.			
Area in square statute miles	264 977	22 209	287 186
Stations occupied for horizontal measures, number of	13 416	205	13 621
Geographical positions determined, number of	25 274	499	25 773
Stations occupied for vertical measures, number of	931	47	978
Elevations determined trigonometrically, number of	2 327	72	2 399
Heights of permanent bench marks by spirit-leveling, number of	841	89	930
Lines of spirit leveling, length of, in statute miles	4 285	339	4 624
Triangulation and leveling parties, number of	----------	23	----------
ASTRONOMICAL WORK.			
Azimuth stations, number of	232	4	236
Latitude stations, number of	366	15	381
Longitude stations, telegraphic, number of	161	9*	170
Longitude stations, chronometric or lunar, number of	114	1†	115
Astronomical parties, number of	----------	10	----------
MAGNETIC WORK.			
Stations occupied, number of	857	29‡	886
Magnetic observatories in operation	----------	1	----------
Magnetic parties, number of	----------	5	----------
GRAVITY MEASURES.			
Home stations occupied, number of	26	1§	27
Foreign stations occupied, number of	24	1**	25
Parties, number of	----------	2	----------

* In addition to these nine stations, two old stations were redetermined.
† In addition to this station, two old stations were redetermined.
‡ There were also fourteen old stations re-occupied.
§ There were also three former stations re-occupied.
** One old station also was re-occupied.

TABLE No. 2.

	Total to June 30, 1891.	During fiscal year 1892.	Total to June 30, 1892.
TOPOGRAPHY.			
Area surveyed, in square statute miles	36 393	1 022	37 415
Length of general coast, in statute miles	9 841	1 024	10 865
Length of shore line, in statute miles, including rivers, creeks, and ponds	97 613	816	98 429
Length of roads, in statute miles	47 692	581	48 273
Topographical parties, number of		23	
HYDROGRAPHY.			
Parties, number of, in charge of naval officers		10	
Parties, number of, in charge of civilian officers		8	
Number of miles (geographical) run while sounding	472 914	11 355	484 269
Area sounded, in square geographical miles	153 569	3 474	157 043
Miles run additional of outside or deep-sea soundings	92 [illegible]95		92 955
Number of soundings	20 322 8[illegible]6	431 772	20 754 658
Deep-sea soundings	13 270		13 270
Deep-sea temperature observations	17 955		17 955
Current stations, number of, occupied by hydrographic parties		184	
Deep-sea current stations, number of			
Deep-sea subcurrent observations, number of			
Deep-sea surface current observations, number of			
Specimens of bottom, number of	13 683	196	13 879
Automatic tide gauges established	99	4	103
Automatic tide gauges discontinued	93	1	94
Parties doing tidal work exclusively		9	
Parties doing tidal work in connection with hydrographic work		18	
Staff and box gauges established	2 152	62	2 214
Staff and box gauges discontinued	2 150	63	2 213
RECORDS.			
Triangulation, originals, number of volumes	6 021	200	6 221
Triangulation, originals, number of cahiers		8	
Astronomical observations, originals, number of volumes	1 981	25	2 006
Astronomical observations, originals, number of cahiers		4	
Magnetic observations, originals, number of volumes	681	2	683
Magnetic observations, originals, number of cahiers		49	
Pendulum observations, originals, number of volumes		8	
Duplicates of above, number of volumes	6 523	221	6 744
Duplicates of above, number of cahiers		88	
Geodetic leveling observations, number of vols., originals		73	
Geodetic leveling observations, number of vols., duplicates		58	
Computations, number of volumes	4 345	7	4 352
Computations, number of cahiers		156	
Hydrographic soundings and angles, originals, number of volumes	11 926	330	12 256
Hydrographic soundings and angles, duplicates, number of volumes	3 714	236	3 950

TABLE No. 2.

	Total to June 30, 1891.	During fiscal year 1892.	Total to June 30, 1892.
Tidal and current observations, originals, number of vols	4 660	82	4 742
Tidal and current observations, duplicates, number of vols	3 050	91	3 141
Aggregate years of record from automatic tide gauges	276 1/2	8 1/2	285
Tidal stations for which reductions have been made	1 553	43	1 596
Aggregate years of record reduced	296	12	308
MAPS AND CHARTS.			
Topographic maps, originals	2 020	66	2 086
Hydrographic charts, originals	2 256	54	2 310
ENGRAVING AND PRINTING.			
Finished charts published from engraved plates, total number of	494	15	509
Engraved charts withdrawn from circulation	173	9	182
Engraved plates of preliminary charts and diagrams for the Coast and Geodetic Survey reports, number of	724	5	729
Electrotype plates made	2 228	53	2 281
Charts published by photolithography, number of	169	21	190*
Charts published by photolithography withdrawn from circulation		33	
Engraved plates of Coast Pilot charts	80		80
Engraved plates of Coast Pilot views	104		104
Printed sheets of maps and charts distributed	835 577	52 675	888 252
Printed sheets of maps and charts deposited with sale agents	401 198	25 620	426 818
Printed sheets of maps and charts sold at Coast and Geodetic Survey office		604	

* Beginning July 1, 1884, to and including June 30, 1892.

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TABLE No. 3—1892.

Information furnished to Departments of the Government in reply to special requests, and to individuals upon application during the fiscal year ending June 30, 1892.

Date.	Name.	Data furnished.
1891.		
July 2	O. M. Carter, Captain U. S. Engineers	Tracing from hydrographic sheets of survey of bar at St. Simon Sound, Ga.
3	B. E. Cobley, St. Ignace, Mich	Change of magnetic declination at Mackinac Island between 1828 and 1840, and the present time. Annual change in 1891, and approximate declination at the island.
7	W. N. Whelan, Philadelphia	Height above the ocean of the bench mark at the Great Bridge, St. Louis, Mo.
9	H. S. Hains, Surveyor General, N. J	Date of maximum annual change in the secular variation for Jamestown, N. J., with reference for the State.
9	Dr. F. E. Stewart, Wilmington, Del	Difference in time of Sandy Hook and Cape May Lighthouses.
9	For steamer Macalester, Washington, D. C	Table of distances on the Potomac River.
10	J. B. Kaufman, County Surveyor, Franklin County, Pa	Copy of Appendix No. 11, 1889. The distribution of the magnetic declination in the United States for the epoch, 1890.
11	W. W. Duffield & Son, Civil Engineers, Pineville, Ky	Pamphlets relating to terrestrial magnetism, four; bulletins two and charts two.
13	Rev. C. W. Baldwin, Secretary of the American University	Drawing and tracing of the site of the American University, in the District of Columbia.
16	C. J. Reed, 224 High St. Orange, N. J	Five pamphlets and two charts relating to magnetic observations and results.
16	Warren, Chapman, and Farquhar, Newport, R. I	Tracings from topographic sheets of the shore line of Staten Island from Rossville to Port Richmond.
18	Amos Roman, Anacortes, Wash	Tracing from hydrographic sheet of survey of Anacortes or Ship Harbor, Washington.
21	E. E. Ely, Surveyor, Fredonia, N. Y	Change of magnetic declination between 1790 and 1895 at Fredonia and at Dunkirk, N. Y.
23	H. W. Clarke, Syracuse, N. Y	Astronomical latitude of nine stations on Boundary line between New York and Pennsylvania as determined in 1879.
24	Peter C. Hains, Lieut. Col. U. S. Engineers	Tracings from surveys of the hydrography of parts of the Potomac River.
25	Aspenwall and Lincoln, Boston, Mass	Blue prints from tracings of topographical survey of Vinalhaven and North Haven, Me.
25	G. B. Kenniston, Boothbay	Blue prints from tracings of topographical survey of Boothbay and vicinity Me.
25	U. S. Engineers	Tracing of hydrography, vicinity of Valiant Rock, and channels at Plum Gut Island and Gardiners Bay, Long Island Sound.
28	United States Fish Commission	Projection on scale 1-40 000 of parts of the coast of South Carolina.
29	W. C. Church, N. Y	Heights of three trigonometrical stations in Westchester County, N. Y.
29	W. S. Stanton, Major U. S. Engineers	Magnetic declination at Tennant Harbor, Me., in 1855, and change since that date.
30	Henry Mitchell, Nantucket, Mass	Tracing of topography of part of Nantucket Island.
30	Peter C. Hains, Lieut. Col. U. S. Engineers	Description of bench mark, Lynnhaven Inlet, Va.
Aug. 4	Peter C. Hains, Lieut. Col. U. S. Engineers	Tracings from hydrographic sheet of survey of Lynnhaven Roads, Va.
4	G. L. Gillespie, Lieut. Col. U. S. Engineers	Description of bench mark, Holland Landing, Jamaica Bay, N. Y.
6	A. W. Rice, New Britain, Conn	Expression for and diagram of the secular variation of the magnetic declination in vicinity of Hartford, Conn.
8	J. P. Bogart, Engineer Connecticut Fish Commission	Tracing of the topography and hydrography of the Connecticut shore from Greenwich Point to Long Neck Point.
9	Miles Rock, Engineer of Guatemala Boundary	Fifteen projections on a scale of 1-200 000, and one on scale of 1-500 000.
10	U. S. Engineers	Tracings from original topographical sheets of parts of Narragansett Bay, R. I.
10	United States Geological Survey	Projection on the Clarke spheroid, plotted on the charts of the Louisiana coast.
14	J. N. McClintock, Concord, N. H	Geographical position of five stations in New Hampshire and Massachusetts.
16	United States Fish Commission	Tracings of topographical and hydrographical sheets of the survey of Stono River, S. C.

TABLE No. 3.

Date.	Name.	Data furnished.
1891.		
Aug. 21	State of North Carolina	Tracings of original hydrographic sheets Nos. 1871 and 1877, showing location of oyster beds.
22	J. K. Abbott, South Mills, Camden County, N. C	Magnetic declination on North River for 1704, 1785, and 1891, with bearings former and present, of an old line.
22	W. S. Stanton, Major U. S. Engineers	Magnetic declination at Narraguagus Bay, Pond Island, Me., in 1851 and 1891.
24	C. E. Hopkins, Civil Engineer	Analytical expression for the magnetic declination at Rome, N. Y., for the period 1790–1890.
24	S. B. McKee, Port Henry, New York, Iron Ore Company	Reports on magnetic declination in Essex County, N. Y.
25	S. H. Rice, Ukiah, Cal	Latitude of Black Rock, Round Rock, and Chemise Mountain.
29	W. K. Nottingham, Civil Engineer and County Surveyor, Eastville, Va.	Difference between local and standard time at Eastville. Times and azimuth of Polaris at elongation.
29	A. W. Shearer, Philadelphia	Magnetic declination at Philadelphia for the period 1884 to 1891.
31	S. K. Rice, County Surveyor, Ukiah, Cal	Geographical positions of six stations near Shelter Cove, Cal.
Sept. 3	J. N. McClintock, Civil Engineer, Concord, N. H	Azimuth and distance State House, Boston, to station Powderhorn 2; appendices 6 and 7 of 1884: 8 of 1885; 8 of 1888.
3	F. J. Baker, Civil Engineer, San Francisco, Cal	Geographical positions and geodetic data for thirty-six points in or near Golden Gate Park, San Francisco.
4	M. D. Meriwether, Secretary Board of Trade, Jackson, Tenn.	Heights from spirit-leveling of several bench marks from the Memphis–Charleston and Mobile & Ohio Railroads.
7	L. Turner, Washington, D. C	Distance (air line) from Washington, D. C., to Pensacola, Fla.
7	W. H. Tinker, City Engineer, Coronado, Cal	Description of bench mark, San Diego, Cal.
8	J. W. Powell, Director United States Geological Survey	Geographic positions and descriptions of stations, vicinity of Poughkeepsie, N. Y.
15	T. G. Hazard, Narragansett Pier, R. I	Description of Station Meeting House Hill, 2.
16	J. E. Harriman, Civil Engineer, Corpus Christi, Tex	Twenty-one geographic positions, descriptions of stations, and geodetic data, triangulation of part of Laguna Madre, Tex.
18	P. B. Hood, Pestigo, Wis	Projection Tables.
18	A. G. Cox, Surveyor, Grafton, Va	Appendices 7 of 1888; 11 of 1889, and Bulletin No. 14 relating to terrestrial magnetism.
25	W. Starswood, Boyden, N. C	Height of Moores Mountain, N. C.
28	J. N. McClintock, Civil Engineer, Boston, Mass	List of 127 geographical positions, distances, and azimuths, vicinity of Boston.
Oct. 1	Peter C. Hains, Lieut. Col. U. S. Engineers	Tracing of shore line of Lynnhaven Bay, Va.
2	N. H. Farquhar, Commodore U. S. N., Chief of Bureau of Yards and Docks.	Geographical positions of trigonometrical stations, Port Orchard and Sinclair Inlet, Oregon.
8	State of North Carolina	Duplicate and tracings of original hydrographic sheets Nos. 1871 and 1877. (Oyster bed surveys.)
10	D. Lane, Bellair, N. C	Three pamphlets on terrestrial magnetism, and three isogonic charts for 1885 and 1890.
10	Hon. John Goode	Boundary line between Maryland and Virginia, plotted on chart.
10	Dr. W. B. Scaife	Copies of maps in the Kohl collection at the State Department.
10	C. M. Hendley, W. Va., Central & Pittsburg R. R. Co	Distances from New York City to Delaware Breakwater, and to Philadelphia, Norfolk, and Newport News.
13	C. H. Haswell, Civil Engineer, New York	Instructions for making magnetic observations and pamphlets relating thereto.
16	J. W. Powell, Director Geological Survey	Descriptions of twenty-two trigonometrical stations in southern Louisiana.
19	J. Wooldridge, Washington, D. C	Geographical positions of prominent points in the District of Columbia, and historical notes on the same.
20	E. S. Starr, Philadelphia	Latitude and longitude of Odenton and Edgewood, Md., and Barbourville, Va.
21	F. A. Mahan, Capt. U. S. Engineers	Descriptions of twelve bench marks, New Jersey, Delaware, and Virginia.
22	D. C. Houston, Col. U. S. Engineers	Tracing of topography and hydrography of Guilford Harbor, Conn.
23	F. A. Mahan, Capt. U. S. Engineers	Description of bench mark, Delaware Breakwater.
24	State of North Carolina	Duplicate and tracing of original hydrographic sheet 1869. (Oyster bed survey.)
24	James Wickersham, Tacoma, Wash	Copy of Zaltier's map of America from the Kohl collection.
24	H. N. Howard, Washington, D. C	Distance between the Capitol, Washington, D. C., and Weems Windmill, Md.
26	T. W. Symons, Capt. U. S. Engineers	Description of bench mark, Bandon, Oregon.
28	Carter, Macy & Co., New York, N. Y	Copy of Appendix No. 15, 1887, with tables of temperature and density of sea at points in New York Harbor.
28	J. C. Brauner, State Geologist, Ark	Estimate of cost of a magnetic survey of the State.

TABLE No. 3.

Date.	Name.	Data furnished.
1891.		
Oct. 30	A. B. Thurston, Engineer, Sedalia, Mo	Height above sea of bench mark at Sedalia Courthouse.
30	E. S. Starr, Lyons, Wayne Co., N. Y	Geographical position of Lyons.
Nov. 1	U. S. Engineers	Tracing of part of the hydrography of the Potomac River from original sheets.
2	G. W. Hayes, Lebanon, Pa	Geographical position and height of bench mark at Lebanon; also magnetic charts for the State of Pennsylvania.
5	J. Wooldridge, Washington, D. C	Description of the Wilkes meridian monument north of the Capitol.
6	Hermann Trott, Sea Haven, Wash	Tidal data, Willapa Bay.
9	United States Senate Commission on Printing	Drawings of maps of the several States, showing the Congressional Districts.
12	G. E. Ladshaw, Engineer, Spartanburg, S. C	Several pamphlets and charts on the magnetic declination.
13	W. A. Cattell, Assistant Chief Engineer, R. R. Co., Long Island City, N. Y.	Descriptions of twenty-seven bench marks, Long Island, N. Y.
16	W. A. Cattell, Assistant Chief Engineer, R. R. Co., Long Island City, N. Y.	Description of bench mark, Shinnecock Bay, Long Island, N. Y.
16	C. L. Woodbury, Civil Engineer, Plattsburg, N. Y	Geodetic results at four trigonometrical stations vicinity of Plattsburg, with descriptions of base monuments.
23	Jacob M. Clark, Civil Engineer, Elizabeth, N. J., for Central R. R. of New Jersey.	Tracing of topography and hydrography of part Staten Island Sound, from Rahway River to Corner Stake Light.
24	W. T. Rossell, Capt. U. S. Engineers and Eng'r Comm'r, D. C.	Descriptions of 186 trigonometrical points in (or close to) the District of Columbia.
25	Hon. Lynde Harrison, New Haven, Conn	Tracing of topography and hydrography in the vicinity of Guilford, Conn.
27	W. J. L. Wharton, Captain R. N	Tracing of hydrographic examination of Seattle Rock, Guemes Channel, Wash.
27	Prof. F. Bigelow, U. S. Weather Bureau	Copies of photographic traces of the Adie magnetographs and tabular results of differential measures of declination, horizontal and vertical force for June 15 to 20, 1889, at Los Angeles, Cal., and hourly readings of traces for the month of June, 1883, for each of the three magnetographs.
28	S. H. Brackett, teacher, St. Johnsbury, Vt	Geographical position of place. Also three magnetic papers and isogonic chart for 1885.
30	W. O. B. Dixon, Sedalia, Mo	Height of bench mark at Sedalia above the level of the Gulf.
30	United States Census Bureau	Map of Alaska, corrected and title drawn, for photolithographing. Also the same for map of southeast Alaska.
30	Horace Litchfield, Kendall Green, Mass	Tracing of topography in the vicinity of Scituate, Mass.
Dec. 1	T. E. Newbold, Assistant Engineer, D. C	Height of bench mark on Massachusetts Avenue extension.
1	G. W. Hayes, Civil Engineer, Lebanon, Pa	Distance and azimuth of line Governor Dick to church spire, Lebanon.
1	R. A. Camm, Surveyor, Newcastle, Craig Co., Va	Magnetic declination at a place in West Virginia for 1892, 1781, and 1794, with table of change of declination, two pamphlets, two isogonic charts for 1885, and a copy of Bulletin No. 14.
2	R. B. Fulton, Professor, University of Mississippi	Magnetic blank forms 1 to 5 inclusive, and copies of Appendix 9 of 1887 and Appendix 10 of 1888.
4	L. Wilson, Engineer, Haverstraw, N. Y	Geographical position of mouth of Poplopen Creek.
8	State of North Carolina	Duplicates and tracings of original hydrographic sheets Nos. 1867 and 1868 (Oyster survey.)
9	L. Wilson, Engineer, Haverstraw, N. Y	Geographical position of southeast end of boundary line, New York and New Jersey, description of Station High Torne, N. Y. Also suggestion how to survey the boundary line between Orange and Rockland Co., N. Y.
10	J. S. Boulton, Staff Commander, R. N., Marine Department, Canada.	Copy of Appendix 7, Report for 1888, and of Appendix 11, Report for 1889.
10	Board of Commissioners of Pilots, New York, N. Y	Tidal data, Governors Island, N. Y.
11	L. Wilson, Civil Engineer, Haverstraw, N. Y	Tracing of the triangulation of the northern boundary of New Jersey.
14	G. L. Gillespie, Lieut. Col. U. S. Engineers	Tracing of the hydrography in New York Bay, from Fort Hamilton to Coney Island and in the vicinity of South Amboy.
14	W. A. Jones, Major U. S. Engineers	Latitude and longitude of Helena, Mont., and descriptions of astronomical station.
16	A. P. Davis, Los Angeles, Cal	Description of the base ends, Los Angeles Base and its length.
17	J. C. Branner, State Geologist of Arkansas	Modification of tides in the Gulf of Mexico under a certain geological condition.
18	Hon. John Goode, Washington, D. C	Map showing boundary line between Maryland and Virginia.
19	E. C. Whaley, Engineer, Wakefield, R. I	Description of three stations, survey in Rhode Island.
19	J. W. Powell, Director United States Geological Survey	Seven geographical positions on the coast of Louisiana.
28	United States Geological Survey	Position of three astronomical stations in Texas.

TABLE No. 3.

Date.	Name.	Data furnished.
1891.		
Dec. 29	Mr. Panuel, Norfolk, Va	Tracing of hydrography of Willoughby Bay, near entrance to the Chesapeake.
30	M. F. Libbey, Surveyor, Whitefield, N. H	Two magnetic charts, 1855, two Appendices on secular variation of the magnetic needle, and one Appendix, distribution of magnetic declination, 1890.
1892.		
Jan. 2	State of North Carolina	Duplicates and tracings of hydrographic sheets Nos. 1865 and 1866, parts of Pamplico Sound (oyster bed survey).
2	W. D. Wade, La Monte, Mo	Height above the sea and description of bench mark at La Monte.
4	Jacob M. Clarke, Elizabeth, N. J	Tracing of topography of Staten Island Sound, vicinity of Elizabeth River, N. J.
5	R. U. Goode, United States Geological Survey	Position of magnetic station at Spofford Junction, Kinney Co., Tex., and magnetic declination in February, 1890.
7	H. M. Chittenden, Lieut. U. S. Engineers	Geographical positions of Helena and Bozeman, Mont.
11	G. E. Hyde, Washington, D. C	Heights of Stations Mount Mansfield, Camel's Hump, and Styles, Vt.
11	J. W. Powell, Director United States Geological Survey	Heights of Cross and Brushy Stations, Tenn.
11	T. T. Young, County Surveyor, Jonesboro, Tenn	Two isogonic charts for 1885 and three Appendices on magnetic declination, and Bulletin No. 14.
11	W. McCulloh	Geographical position of Boston State House and New York City Hall.
11	J. H. Willard, Capt. U. S. Engineers	Descriptions of the monuments marking the Lums Point base line, La., with length of base and height above the Gulf.
12	Hon. Jas. H. O'Neil, M. C	Blue print of hydrography—Entrance to Grays Harbor, Oregon.
12	James B. Upton, Oreton, Tillamook Co., Oregon	Blue print of Entrance to Grays Harbor.
12	J. H. Nehf, Ocasta, Wash	Blue print of Entrance to Grays Harbor.
13	C. L. Shaw, Astoria, N. Y	Geographical position and height of six trigonometrical points in southwest Vermont and vicinity.
16	Wilson, C. E., Haverstraw, N. Y	Geographical positions and descriptions of Bear Mountain, High Tor, Stony Point Lighthouse and Fort Montgomery.
20	M. A. Hanford, Lewisboro, Westchester Co., N. Y	Geographical positions of Bald Hill and Hanford, and height of Bald Hill.
21	Henry Breed, Lynn, Mass	Tracing of topography of Lynn Harbor.
23	W. F. Smith, Major (retired) U. S. Engineers, U. S. Agent	Tracing of topography of upper course of Lewes Creek, from Delaware Breakwater to Rehoboth Bay.
24	United States Geological Survey	Tracings of topography vicinity of Bath and of Boothbay, Me.
26	D. C. Houston, Col. U. S. Engineers	Descriptions of bench mark, Greenport Harbor, N. Y.
26	J. W. Powell, Director United States Geological Survey	Fifteen geographical positions in Kansas, between 98° and 99° west longitude; also heights of the stations.
26	H. V. Winchell, Assistant State Geologist, Minnesota	Information relating to the theory and use of the magnetic dipping needle.
28	L. N. Christensen, Attalla, Ala	Geographical position of Fort Wayne, Dekalb Co., Ala.
30	John Olberg, Indian Office, Washington, D. C	Geographical position of Fort Smith, Ark., and Texarkana, Ark.
Feb. 1	Missouri River Commission	Copy of the geodetic results of the main triangulation between St. Louis and Kansas City. Height of bench marks of spirit-leveling and their descriptions between the same cities. Height of the St. Louis standard bench mark.
3	Arthur Winslow, State Geologist, Missouri	Result of the determination of the longitude of Macon, Mo.
3	N. H. Farquhar, Commodore U. S. N., Chief of Bureau of Yards and Docks.	Tracings of topography and hydrography of the site of Naval station on Puget Sound.
4	D. W. Hyde, Engineer, Brighton, Mass	Geographical position of Mt. Auburn, Mass., and distances and azimuths to Boston State House and Powderhorn.
5	John C. Soley, Boston, Mass	Information regarding the length of coast line of the State of Massachusetts.
5	U. S. Engineers	Tracing of topography of North Point, Patapsco River, Md.
5	U. S. Engineers	Tracing of Jones Island, Savannah River, Ga.
5	U. S. Engineers	Tracing of topography of parts of Puget Sound.
5	United States Commission of Fish and Fisheries	The boundary line between Maryland and Virginia plotted on Chart No. 133.
6	Henry C. Barbour, Boston, Mass	Blue print of recent survey of Grays Harbor, Wash.
8	W. A. McKay, Utica, Pa	Magnetic chart for 1885 and Appendix No. 12, Report for 1886, Appendix No. 7, Report for 1888, Appendix No. 11, Report for 1889, and Bulletin No. 1.
9	J. W. Powell, Director United States Geological Survey	Six geographical positions in Maryland near latitude 39° 20′ and longitude 76° 30′.
10	Arthur Winslow, State Geologist, Missouri	Result for the latitude of Macon, Mo.
11	J. W. Powell, Director United States Geological Survey	Seven geographical positions based upon the Los Angeles base line of 1889–90
11	John Tatlock, Jr., New York	Geographical positions of five points in the vicinity of Patchogue, L. I.
16	B. H. Smith, Boundary Commission, Maryland and Pennsylvania.	Twenty-five geographical positions and descriptions of stations situated near the curved boundary about Newcastle as center.
16	W. W. Carson, Professor of Engineering, University of East Tennessee.	Astronomical bearing of azimuth mark at Knoxville, Tenn.

TABLE No. 3.

Date.	Name.	Data furnished.
1892.		
Feb. 16	A. B. Nowell, Engineer, South Bend, Pacific County, Wash.	Geographical positions of eight trigonometrical stations on Shoalwater Bay, and their description.
17	W. W. Carson, Professor of Engineering, University of East Tennessee.	Geographical position of the College and three pamphlets bearing on magnetic results.
17	A. B. Nowell, Engineer Harbor Line Commission, Washington.	Descriptions of two bench marks, Willapa River.
18	W. D. Johnson, Geologist, Berkeley, Cal.	Results of the triangulations in the vicinity of San Francisco Bay, made accessible to him at the San Francisco suboffice.
18	State of North Carolina	Duplicates and tracings of original hydrographic sheets Nos. 1862, 1863, 1864. (Oyster survey of Pamplico Sound, N. C.)
19	Benjamin H. Smith, Boundary Commission, Pennsylvania.	Tracing of topography of part of Delaware Bay.
19	Eugene G. Blackford, President Fish Commission, New York.	Copies of hydrographic sheet No. 1664, and of topographical sheets Nos. 1724, 1726, 1727, 1728, and 1730, north shore of Long Island, N. Y.
20	G. W. Ray, M. C.	Appendices No. 7, Report of 1888, No. 11, Report of 1889, and Bulletin No. 14.
20	C. Manly, Attorney-at-Law, Winston, N. C.	Appendices No. 7, Report for 1888, and No. 11, Report for 1889.
23	J. V. Jackson, Marlboro, Mass.	Information regarding the greatest depth of deep-sea sounding.
24	A. N. Damrell, Major U. S. Engineers	Description of three bench marks, Mobile, Ala.
26	A. M. Ford, Salem, N. J.	Tidal data for the Bahamas and Bermudas.
27	C. Manly, Attorney-at-Law, Winston, N. C.	Explanation of manner of using an isogonic chart, and declination at Greensboro and at Salisbury, N. C., for February, 1892.
27	John Tatlock, Jr., New York	Distance, position, and direction of line Fire Island Lighthouse to Long Cove, L. I.
Mar. 2	W. E. McClintock, Boston, Mass.	Description of bench mark at Bath, Me.
2	Alex. E. Kastl, Vicksburg, Miss.; Maj. Chas. J. Allen, U. S. Engineers; Lieut. D. A. Hall, U. S. R. M.; Lieut. S. M. Landrey, U. S. R. M.; Capt. L. G. Shepard, Chief of U. S. R. M.; Hector Von Bayer, U. S. Life-Saving Service; O. W. Crawford, New Orleans, La.; G. W. Angle, Velasco, Tex.	To each person named in list a copy of the late survey of entrance to Brazos River.
3	D. MacCashin, Passaic and Elbow Beacon Light, N. J.	Description of three bench marks, Newark Bay.
5	W. G. Russell, County Surveyor, Russell, Kans.	Geographical positions of Ellsworth, Great Bend, and Wallace, Kans., and magnetic declination and annual change for each of these places, together with three magnetic pamphlets, Bulletin No. 14, and two isogonic charts for 1885.
9	Chas. Rostaetter, War Records Office.	Tracings from Chickamauga battle field.
10	J. W. Powell, Director United States Geological Survey.	Nine geographical positions with descriptions of stations, Hillsboro Bay, Fla.
11	Walter E. Meserole, Civil Engineer, Brooklyn, N. Y.	Copies of the topographical sheets of the north shore of Jamaica Bay, N. Y.
12	J. C. Williams, Baltimore *Sun* office.	Information regarding the greatest depths of the oceans.
14	Eugene G. Blackford, President of New York State Fish Commission.	Copies of original topographical sheets Nos. 1577*a*, 1577*b*, and 1729, north shore of Long Island.
16	C. W. Rolfe, Urbana, Ill.	Description and height of twenty-four bench marks in Illinois.
18	Col. John Willet, Phœnix Bridge Company, N. Y.	Copy of the late survey of the entrance to Brazos River, Tex.
18	J. E. Childs, General Manager, O. & W. R. Co., New York.	Description of bench mark at West Point, N. Y.
18	S. L. Smedley, City Engineer, Philadelphia, Pa.	Four geographical positions, vicinity of Philadelphia, with description of stations.
19	S. B. Strong, Setauket, Suffolk County, N. Y.	Tracing of part of topographical sheet No. 52.
23	F. C. McMinn, New York.	Appendix No. 11, Report for 1889, and two isogonic charts for 1885.
25	H. N. Savage, National City, Cal.	Two isogonic charts for 1885 and three pamphlets on terrestrial magnetism.
26	H. G. Welty, Civil Engineer, 18 Fayette St., Baltimore, Md.	Two magnetic charts for 1885 and a copy of Appendix No. 12, Report for 1886; No. 7 of 1888, and No. 11 of 1889.
28	J. W. Powell, Director United States Geological Survey.	Twenty-four geographical positions in New York and Vermont, vicinity of the Adirondack Mountains, with azimuths, distances, and abstracts of angles.
28	J. S. Davis, Holyoke, Mass.	Information relating to heights and distances in Massachusetts.
28	Chas. S. Bunnell, New Haven, Conn.	Copy of late survey of entrance to Brazos River, Tex.
28	Benj. Thompson, Chairman Committee on Maps and Library, Chamber of Commerce, Chattanooga, Tenn.	Copies of topographic sheets Nos. 926, 934, 966, and 973, vicinity of Chattanooga, Tenn.
28	Hon. C. S. Randall, M. C., Massachusetts.	Base map of the United States, brought up to date, with State boundaries colored, etc.
29	United States Senate Committee on Printing.	Drawing of a map of Missouri, showing Congressional Districts.
30	Dr. W. C. Hatch, Stark, Somerset County, Me.	Geographical position of Bannock, Somerset County, Me.
31	Prof. M. W. Harrington, Chief of Weather Bureau.	One dozen magnetic traces, showing variations of declination of horizontal and vertical component of the magnetic force, at San Antonio, Tex., during two disturbance periods in January last.

TABLE No. 3.

Date.	Name.	Data furnished.
1892.		
April 1	United States Geological Survey	Tracing of topography of parts of Chesapeake Bay.
2	Josiah Pierce, Jr., Washington, D. C	Tracing of topography, vicinity of Ocean City, Md.
2	W. Nelson, Laconia, N. H	Geodetic data, positions, and descriptions of stations for locating a meridian line at Laconia, and two pamphlets on the secular variation of the declination, with two magnetic charts for 1885.
2	J. L. Peters, City Surveyor, Corpus Christi, Tex	Geographical positions on Corpus Christi Bay, with descriptions of stations; three magnetic pamphlets and two magnetic charts.
9	H. A. Hazen, Washington, D. C	Appendices 8 and 9, Report for 1890.
9	H. J. Buehly, Washington, D. C	Six magnetic pamphlets and five isogonic charts for 1885.
11	Prof. J. C. Brunner, Leland Stanford University	227 geographical positions of the Peninsula of San Francisco and of the coast southward to Monterey Bay.
11	Col. R. M. Thompson, Terre Haute, Ind	Information as to lengths of coast line United States, of the Atlantic, Gulf, Pacific, and Alaska Coasts.
12	S. and W. Scott, Floyd, Va	Three magnetic pamphlets and two isogonic charts for 1885.
12	F. R. Rathbun, Auburn, N. Y	Information about triangulation, vicinity of Lake Owaska, N. Y.
12	Chas. Graves, Meadville, Pa	Information respecting latitude and longitude of Meadville.
13	Thomas F. May, Brooklyn, N. Y	Tracing of parts of the north shore of Sheepshead Bay, L. I.
13	Gaston Fay, Center Moriches, L. I	Tracing of a part of topographical sheet, Moriches Bay.
14	W. M. Echols, Simmonsville, Va	Change of magnetic declination since 1794 in Craig and Giles Counties, and three magnetic pamphlets, two isogonic charts for 1885, and Bulletin No. 14.
14	E. Hais, Ozark, Ark	Height of a bench mark in Ozark.
14	National Academy of Sciences	Nine wall diagrams to illustrate paper on magnetics.
16	Senate Committee on Printing	Map of the State of Ohio, showing Congressional Districts.
18	W. Scott, Floyd, Va	Change of magnetic declination between 1782 and 1796.
20	P. Forman, Surveyor, Manalapan, N. J	Three magnetic pamphlets and three isogonic charts for 1885.
20	W. F. Lee, Piedmont, S. C	Three magnetic pamphlets and three isogonic charts for 1885.
22	J. W. Lockhart, Civil Engineer, Bluff City, Tenn	Magnetic declination at Bristol, Tenn., in 1881, and its annual change at Bristol.
22	J. E. Thayer, Surveyor, Port Lavaca, Tex	Secular variation of the magnetic declination on the coast of Texas; three pamphlets and two isogonic charts for 1885.
22	F. W. Palmer, Public Printer	Map of the State of Missouri, showing Congressional Districts.
22	J. C. Mallery, Major U. S. Engineers	Copies of topographical sheets of the St Johns River below Jacksonville, Fla.
23	J. C. Nagle, A. & M. College, Texas	Four magnetic pamphlets, three isogonic charts for 1885, and Bulletin No. 14.
23	Albert Lord, Surveyor, Eliot, Me	Three magnetic pamphlets and two isogonic charts.
25	Chas. R. Street	Tracing of topography of Fort Pond Bay and vicinity, Long Island.
26	W. S. Stanton, Major U. S. Engineers	Tracing of the south shore of South Island, Winyah Bay, S. C.
27	Chas. A. Abbott, Ottawa, Canada	Area of the United States and Alaska.
27	J. W. Powell, Director United States Geological Survey	Four geographical positions in New York (Catskill region) and their descriptions.
28	H. L. Laning, Penington, N. J	Two magnetic pamphlets and Bulletin No. 14.
29	Prof. Henry Mitchell, Roxbury, Mass	Copy of the survey of the entrance to Brazos River, Tex.
30	Senate Committee on Printing	Map of the State of New York, showing Congressional districts.
May 2	D. C. Imboden, Manager of the Galveston Export Commission Co.	Copy of the survey of the entrance to Brazos River, Tex.
2	W. E. Turford, Principal of the Centennial School, Trenton, N. J.	Data concerning the highest land on the eastern coast of the United States.
5	Fiff's College Library	One copy each of Appendix 14, Report for 1880, Appendix 8, Report for 1881, and Bulletin No. 14, all bearing on the determination of an astronomical azimuth.
5	Col. Marshall McDonald, United States Commissioner of Fish and Fisheries, Washington, D. C.	Geographical positions and descriptions of twenty-one stations, Mobjack Bay and vicinity, Va.
6	G. M. Donham, Portland, Me	Proof of tide predictions 1893, for Eastport and Portland, Me.
7	Hon. C. S. Randall, M. C., Mass	Base map of the United States, brought up to date, colored and mounted.
7	Sumner H. Bodfish, Civil Engineer, Washington, D. C	Copy of Section V, Survey of the District of Columbia.
7	Hon. Wm. F. Parrett, M. C., Ind	Distance, etc., from Pittsburg to mouth of Ohio River.
7	Dr. J. Newmayer, Director of Naval Observatory, Hamburg, Germany.	Copies of magnetic traces (declination, horizontal and vertical force) and hourly readings of ordinates during the magnetic storm of February 12–14, 1892, as recorded at San Antonio.
7	United States Weather Bureau	Copies of magnetic traces (declination, horizontal and vertical force) and tables of hourly ordinates during the magnetic storm of February 12–14, 1892, as recorded at San Antonio.

TABLE No. 3.

Date.	Name.	Data furnished.
1892.		
May 9	Annabel Jassen, Wahoo, Nebr	Length of general seacoast of the United States.
10	J. A. Ockerson, United States Assistant Engineer Mississippi River Commission.	Geodetic data of the triangulation in Wisconsin in the vicinity of Dubuque, Iowa.
12	R. H. Croskey, Surveyor, Boerne, Kendall County, Tex	Magnetic declination of Boerne and its annual change; two pamphlets on secular change and distribution of magnetism; also isogonic charts of 1885 and 1890.
13	Francis Winslow, Lieut. U. S. Navy	Tracing of hydrography of Neuse River from Union Point to northern limit of Newbern, N. C.
14	J. Biddle, Lieut. U. S. A	Geodetic data for nine stations in the vicinity of Chattanooga, Tenn., with descriptions of stations.
16	C. L. Shaw, Astoria, N. Y	Heights of Mt. Washington, of Mt. Monadnock, and Prospect Mount, with explanatory remarks.
16	J. H. Jennings, Palenville, N. Y	Three pamphlets on secular variation and distribution of the magnetic variation and isogonic chart for 1885.
17	J. W. Powell, Director United States Geological Survey	Four geographical positions and descriptions of stations near the southern end of Lake Champlain.
17	E. S. Loomis, Berea, Ohio	Five magnetic pamphlets, Bulletin No. 14, and three isogonic charts for 1885.
18	J. C. Mallery, Major U. S. Engineers	Copy of the hydrographic survey of the St. Johns River from the bar to Jacksonville, Fla.
21	M. A. Shaw, Philadelphia, Pa	Two copies of the chart No. 369 with several triangulation points on Staten Island plotted thereon.
21	G. M. Derby, Capt. U. S. Engineers, Instructor at West Point Academy.	Forty-two geodetic positions and descriptions of stations.
21	A. Cheney, Trenton, N. C	Four magnetic and surveying pamphlets and isogonic chart for 1885.
23	F. A. Cudworth, Burlington, Vt	Magnetic declination at Shoreham, Vt., in 1873; two pamphlets on secular change of the declination and isogonic chart for 1885, also Bulletin No. 14.
24	El Merito Pharmacy, Dallas, Tex	Longitude of Dallas and of ten other cities.
24	U. S. Commission of Fish and Fisheries	Hydrographic projection of Mobjack Bay, Va., on scale 1-40 000.
24	W. C. Dodge, Washington, D. C	Area of the District of Columbia.
26	Daniel S. Robeson, Boston, Mass	Data concerning width, depth, and character of bottom of Connecticut River in the vicinity of Cromwell, Conn.
26	B. F. Haynes, Marion, Md	Present bearing of a line originally run in Somerset County magnetically in 1855; annual change of the needle between 1855 and 1892; three magnetic pamphlets and an isogonic chart for 1885.
June 1	J. Kittel & Co., New York City	Information concerning Coney Island Creek.
3	F. Brotherhood, Beaufort, S. C	Tracing of the topography and hydrography of the Coosaw River, S. C.
4	E. P. Doyle, New York City	Geographical positions and descriptions of sixteen stations on Long Island, between Crane Neck and Mt. Sinai.
7	H. W. Brewer, Surveyor, Georgetown, D. C	Information about a bench mark near the distributing reservoir in the District.
8	Harry Fielding Reid, Case School of Applied Science, Cleveland, Ohio.	Description of six bench marks in Alaska.
11	Geo. W. Coffin, Commander U. S. N., Secretary of Light House Board.	Tracing of topography of Delaware Bay between Listons Point and Reedy Island.
16	H. G. Welty, Engineer, Baltimore, Md	Thirteen geographical positions and descriptions of stations, vicinity of Baltimore.
17	Henry Lefferman, Secretary, Quarantine Commission of Pennsylvania.	Tracing of hydrography of Delaware Bay from Schooner Ledge to below Claymont.
18	S. E. Bates, Assistant City Engineer, Richmond, Va	Heights of three stations in Richmond above the mean sea level.
20	Hart Vance & Co., Civil Engineers and Surveyors, Louisville, Ky.	Isogonic charts for 1885 and 1890, and discussion of secular change of declination.
20	James L. Lusk, Lieut. U. S. Engineers, Assistant Engineer Commissioner, District of Columbia.	Data from Washington Navy Yard, D. C.
27	H. P. Cochran, Staunton, Va	Magnetic bearing of a line in Augusta County, Va., at various epochs.
28	L. Turner, Washington, D. C	Distances from Washington, D. C., to Morganton, N. C.
29	Peter C. Hains, Lieut. Col. U. S. Engineers	Description of twelve bench marks on Kennebec River, Me.
30	Wm. S. Alley, 70 Broadway, New York City	Copy of chart No. 361[a] with many additions from recent information.
30	United States Department of State	Map of Bering Sea with logs of British schooners *Ada* and *Alfred Adams* plotted thereon; map of Bering Sea with logs of American schooners *Ellen* and *Annie* plotted thereon. All made and prepared for photolithography.

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OFFICE REPORT No. 1—1892.

REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

U. S. COAST AND GEODETIC SURVEY OFFICE,
Washington, D. C., October 28, 1892.

SIR: I have the honor to submit the annual report of the Office for the fiscal year ending June 30, 1892, and along with it the annual reports of the various Divisions thereof, as follows:

The Computing Division, by Assistant Charles A. Schott.
The Tidal Division, by Mr. Alexander S. Christie.
The Drawing Division, by Assistant William H. Dennis.
The Engraving Division, by Assistant Herbert G. Ogden.
The Chart Division, by Assistant Gershom Bradford.
The Miscellaneous Division, by Mr. Marshall W. Wines.
The Instrument Division, by Assistant Edwin Smith.
The Library and Archives, by Mr. Francis H. Parsons.

In the Computing Division there is occupation for any of the field force skilled in the astronomical and geodetic work of the Survey. The services of the younger men are particularly desirable.

In the Tidal Division the force should be strong enough to insure our Tide Tables being ready for issue at least nine months in advance of the beginning of the calendar year that they cover. The arrangement of the tidal records in the archives, which began some months ago, should be continued as rapidly as practicable to completion. This work the Tidal Division has undertaken for the archives and in the interest of the office generally; it can not be done as well by any other Division of the office, and I sincerely regret the necessity of delay on account of other work.

In the Drawing Division there is most urgent necessity for more draughtsmen, and for a good clerk or assistant chief of the Division. The calls on the chief of this Division and his force are continuous and exacting; no chart publication takes form except through their labors; the various extracts from the plane-table and hydrographic sheets made for parties outside of the office are made there; the answers to various geographical questions are prepared there; and the progress sketches and illustrations for the Coast Survey Report are there put into shape and to a large extent prepared; to this add the miscellaneous drawing which arises every day, such as chart corrections and revisions, etc., and a fair estimate of the amount of work required, may be formed. Six additional draughtsmen, whose salaries should range from $1 200 to $1 600 per annum, could be profitably employed.

In the Engraving Division there is now every needed facility for carrying on the work assigned to it. The young men taken in as engravers have made such excellent progress that they are earning more money than we are able to pay them, and I recommend that fair wages be provided for them, or we will eventually lose them, for they will in a few years be compelled to seek more remunerative occupation elsewhere.

The presses provided for by the appropriation for the fiscal year 1892, the new gas engine for running them, and a calendering press of superior construction to take the place of the old knuckle-joint machine, are all in successful operation in the brick buildings on the west side of Nos. 201 and 203 New Jersey Avenue SE.

In the Chart Division every care has been taken to see that orders were promptly filled. There has been a considerable decrease in the number issued for public use as compared with the fiscal year 1890; this is the result of a careful examination into the matter, and of economizing in the free distribution wherever practicable to do so without injury to the public service. There is, as there should be, a very limited free distribution of charts outside of the public service. There is, however, occasionally an inquirer who should be supplied free; for instance, one writing from afar and perchance from an obscure place for a chart, or for information best given by a chart, etc. Many such inquiries are from poor students or teachers who are far away from our agencies for the sale of charts, and their only hope is through the mail. To answer such an inquiry by a letter asking that the price of the chart be first sent, will cause much delay and perchance inconvenience, and is not so satisfactory as it is to send the inquirer promptly the chart conveying the information desired and a letter saying it is sent with the compliments of Hon. ———, M. C., which, owing to the generosity of members, we are happily able to do in most instances, the distribution of their quotas having been authorized by them. To members so placing their charts, our thanks are due, and I beg you to extend them to various members of Congress from interior districts who, through having no occasion to distribute charts themselves, have, in response to your request, placed their quotas at your service for distribution in their name. The acknowledgments received from recipients are frequently complimentary and always expressive of thanks for the courtesy.

In the Miscellaneous Division, the system of orders, etc., our communications with the Government Printing Office, the management of our agencies, the discipline and work of the messengers and laboring force of the office, and various other duties have been performed with ability and to my entire satisfaction.

In the Instrument Division the work has progressed along the lines laid out by the Board on Instruments and approved by you. A pendulum room has been constructed in the southwest corner of the basement, thus enabling us to transfer our pendulum station from the Smithsonian Institution to this office, where it is most readily accessible to us at all hours and always under our complete control and care. Two small dynamos have been introduced which enable us to have suitable light for carrying on such operations as require a light giving out little or no heat and producing no smoke or dirt. The carpenter shop has been further equipped by the addition of a band saw. The variety of work executed and its increasing amount prompt the chief of this Division to recommend the employment of another carpenter.

In the Library and Archives the work of cataloguing, binding, marking, etc., of the various records and books, has progressed as rapidly as it could under the circumstances. The effort has been to proceed in such a way that the work accomplished shall be complete and satisfactory. The librarian is competent and his services very satisfactory.

During the fiscal year ending June 30, 1892, the following named persons have been employed under my immediate direction:

Dr. Wm. B. French has continued to assist me in matters of executive detail, to receive and account to me for all moneys from sales of charts and other publications, old property, etc., has aided in the office correspondence, received all office bills, adjusted and arranged them on vouchers in proper form for my approval and filed a copy of each bill. He has prepared quarterly statements of moneys received and they have been rendered to the Treasury Department and the money deposited with the Treasurer of the United States.

Mr. Eugene B. Wills has remained on duty during the year—registering mail, receipting for and forwarding express matter, filing the office correspondence, keeping the leave of absence account, and attending to various miscellaneous duties.

Miss Kate Lawn continued to use her typewriter, principally in preparing copy for the annual reports of the Survey, under the direction of the editor. Her work has been quite satisfactory.

Miss F. Cadel was occupied with miscellaneous copying on the typewriter until July 31, when she was transferred to the Interior Department.

Miss Ida M. Peck remained attached to the office during the year. She was diligently occupied in miscellaneous copying on the typewriter and by hand, and in copying the Superintendent's instructions and preparing the monthly reports of the office.

Miss Sophie Hein reported for duty August 3, transferred from the Chart Division of the office. She has addressed wrappers for Notices to Mariners, and assisted in various ways the work of the office, especially in miscellaneous correspondence.

At the beginning of the fiscal year, you were in Alaska on official business of the Bureau and of the State Department; during this absence, which began about April 1, 1891, and ended about September, 1891, I acted under instructions as Superintendent of the Survey, carrying out the work strictly along the lines laid out by you.

Congress, in the Sundry Civil Act approved March 3, 1891, had provided for the purchase of original lots numbered 11 and 12 in square No. 689, and the improvements thereon, consisting of three substantial granite buildings, generally known as the Butler buildings, and also of original lots numbered 8, 9, 10, 13, 14, 15, 16, and part of lot 7 in the same square, and the improvements thereon, consisting of a large brick building, generally known as the Richards building. Gen. Benjamin F. Butler took steps to turn the first over as soon as practicable, and it was formally transferred to the United States on April 1, 1891. The warrant No. 6001, for the purchase money, being delivered to Gen. Butler on April 7. Our last rent to Gen. Butler was paid to include March 31, 1891. The Richards heirs did nothing, however, to facilitate the transfer of the property purchased of them, and it was not until after overcoming many obstacles placed in the way by them that we were able to close the business and deliver the warrant, No. 1456, for the purchase money on September 21, 1891. Under an arrangement with the Richards heirs, our last rent was paid June 30, 1891.

It was intended at the time of purchase to turn the whole of the Butler buildings over for the use of the Coast and Geodetic Survey, but in order to reduce expenses it was later decided to utilize the north building facing B Street SE., by converting it into offices, etc., for the Supervising Surgeon General of the Marine Hospital Service. Important changes were made under the direction of the Supervising Architect of the Treasury which enabled us to use the small brick buildings in rear of Nos. 201 and 203 New Jersey Avenue SE., for our chart printing establishment. He also had an iron door put in connecting 201 and 203, and constructed a covered bridge connecting 203 and the Richards building (No. 205 New Jersey Avenue SE. This connecting door and the connecting bridge are in themselves quite small matters, but the work of the office has been wonderfully facilitated by them.

We began to make use of the vacant ground on the south of No. 205, New Jersey Avenue SE., as soon as it came into our possession, by establishing thereon small wooden houses to be used as observatories, and for the testing of field instruments, and now we wonder how we ever got along without some such place; but the property is roamed over by men and boys after nightfall and even during the day, and although we have lost nothing so far, the safety and privacy of the property make it desirable to inclose this vacant space by a high wooden fence

One of the standing annoyances of the office has been the impossibility of keeping it warm enough in winter for the employés to remain constantly at their work; draughtsmen mechanics, and engravers have had to work with their overcoats on, and occasionally to be sent home, sometimes for two or three days in succession. I finally concluded that the trouble was that the indirect radiators in the back building were not high enough above the boiler to make the water, condensed from the steam in the radiators, force its way back to the boilers even when only three pounds of steam were on. In this Mr. Richards, the owner of the building, agreed with me, but he could not be persuaded to expend the money necessary to remedy the defect. As soon as the building came into the possession of the United States, I determined to remedy the evil, and for this purpose removed all the indirect system of steam pipes and replaced them with direct radiators in each room. The supply and the return pipes were enlarged, and the result was satisfactory to the extent of our

saving about fifty tons of coal, and having the office sufficiently warm throughout this winter. About the time these improvements were being completed, and just in time to take charge of the work which I had found would be necessary to be done to the heating apparatus of No. 201 New Jersey Avenue SE., we were fortunate enough to secure by detail from the Department the services of Mr. J. A. Watts, an efficient mechanical and steam engineer, and he took charge of the repairs and of the heating apparatus generally, managing the whole to my entire satisfaction.

I beg to call your attention to the plumbing in No. 201, which is not sanatory, and is in fact very poor, and needs to be entirely removed and replaced by good work. In No. 203 there should be neither heat nor water, it being fireproof and used for the preservation of the archives. The roofs of Nos. 201 and 203 must have a thorough overhauling and painting in a short time, or they will be ruined. The building No. 201 is now entirely occupied by the Survey, and during the past winter it was filled by officers of the field force, who were gathered here in accordance with your policy of having them do their office work under your own especial direction, allowing them at the same time, by intercourse with one another and familiarity with office methods, to become more efficient.

The operations of the Bureau have been facilitated in every practicable way by the Civil Service Commissioners; positions of computer, clerk, writer, etc., have been filled from time to time with but little trouble, the Commission having ordered special examinations free to all applicants, whenever it was necessary. In filling positions as draughtsman at a salary of $900 per annum, however, we have been less fortunate; the difficulty seems to be that the small salary that we are able to offer is not sufficient inducement for men of technical education in this line, their services readily commanding more elsewhere, and their chances outside of this service being better for promotions.

The President's instructions of December 4, 1891, which had been in part anticipated by this Bureau, were put into force by the Secretary's circulars, Department Nos. 194 and 195 of 1891, and at the various meetings of the chiefs of Divisions called and presided over by you, the matter of rating and marking has been carefully considered in all its details. We began to mark the various employés of the Bureau, February, 1892, in accordance with Department Circular No. 194 of 1891; and up to June 30 you had called the chiefs of the various Divisions together five times for discussion and direction.

Opportunity offered toward the close of the fiscal year to take up the publication of the topographical survey of the District of Columbia, and enough plates will be ready to admit of sixteen square miles in the north corner being displayed at the World's Columbian Exposition. In detail and accuracy, this work challenges the finest, and its publication will be creditable to the United States and an honor to the Bureau.

In the Sundry Civil bill, under the appropriation for printing and binding for the Treasury Department, there is provided each year the sum of not exceeding $20 935 for the Coast and Geodetic Survey. Some arrangement by which we should know just how much each job chargeable to this item of the appropriation was estimated to cost, is very desirable; an understanding might then be arrived at that would be advantageous to the public service, and the necessity of obtaining a special order for the printing of the Tide Tables to continue, or submitting to the discontinuing the printing of such important works as our Coast Pilots, etc., might be avoided. It seems desirable that the Coast Survey Bureau itself should be able to render an account of the expenditures of the appropriation at any time, and finally to know the cost of each piece of work.

About October, 1890, the leave of absence account of the Bureau was transferred to the Appointment Division of the Treasury Department, and the system which we had followed up to that time was changed. The change was made gradually, however, the Treasury system not being fully enforced until January 1, 1891, since which time it has been fully in operation on the Department plan. A careful comparison of the absence account for the year ending September 30, 1889, with the year ending September 30, 1892, after throwing out

the case of Mr. E. Willenbucher, who has had a substitute, shows a decided increase of absence, both with leave and on account of sickness. The periods are too short, however, to decide absolutely which rule will work best in practice.

The operations of the several Boards designated by you have continued to be highly satisfactory. The meetings that you have called, under Department Circulars Nos. 194 and 195, of the chiefs of Divisions and others for consultation about ratings and marking of employés, have come to be practically another Board, although you have not specifically so designated it.

The results of the operations of the Coast and Geodetic Survey, are the production and issue of Charts and Coast Pilots for the use of navigators, the furnishing of the magnetic declinations thoughout the United States, and off its coasts for the use of navigators and surveyors, the supplying of geodetic data to the various persons requesting it, and the gradual extension of the standard levels along the transcontinental and other lines where the want of standard information is most urgent, and these are all eminently of a practical nature. It is true that in developing these results we pursue the most exact and scientific methods, and it is because of our scientific methods of work that the Bureau has been regarded by some persons as purely an institution for scientific research. Its methods are scientific, but its results are distinctly and eminently practical. I believe that more unintentional injustice is done the Bureau through misconception in this matter than in any other respect.

The performance of my duties in the office has in the main been a source of great pleasure to me, and I beg to extend my thanks for the efficient support that I have received from those with whom I have been associated.

Respectfully yours,

B. A. COLONNA,
Assistant in charge of the Office.

Dr. T. C. MENDENHALL,
Superintendent U. S. Coast and Geodetic Survey.

REPORT OF THE COMPUTING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

COMPUTING DIVISION, *June* 30, 1892.

SIR: In conformity with the regulations of the Survey, I have the honor to submit herewith the usual annual report of work done in this Division of the office during the fiscal year ending June 30, 1892.

The charge of the Computing Division was continued with the undersigned. The only change in the personnel was the resignation of Mr. J. Page, December 15, 1891; his place has not yet been filled, and but little aid was afforded by temporary assignment of members of the field force. Mr. J. B. Boutelle reported for duty in the Computing Division August 17, 1891, and remained until March 28, 1892, when he was assigned to field duty; on June 9, 1892, he returned to this Division. Subassistant F. A. Young was attached to this Division on special duty from December 18, 1891, to March 4, 1892. This special force was strengthened by placing under my direction Mr. A. Bonnot and Mr. L. W. Reid from Assistant E. Smith's astronomical party, their temporary assignments dating from January 8 and January 18, 1892, respectively. Mr. D. L. Hazard, also a computer on special duty and temporarily attached, remained from the beginning of the fiscal year till March 1, 1892, when his work was completed. Subassistant J. Nelson reported for duty May 13, 1892, and remained to the close of the fiscal year. Miss I. M. Peck assisted as copyist during sixteen days in July, and again during September up to October 23, 1891.

Besides directing and supervising the computations and reporting the results, I was engaged in preparing and furnishing such scientific or professional information as was

demanded in connection with the general correspondence of the office, or for the use of the field parties. Under date of March 4, 1892, I submitted a report announcing the completion of the computations covering the triangulation made in Massachusetts in the years 1885 to 1889, inclusive; they comprise no less than 2 098 geographical positions, and the results are now ready for publication; it was this special coöperation which consumed a large part of the time of the geodetic computers and of the copyist. Mr. Hazard, the computer for the Massachusetts State survey, remained here to the close of the fiscal year engaged in the reduction of the triangulation made in 1890.

The question of the variability of the latitude of a place, and if confirmed, the assignments of the length of the period and of the range of the variation are of such paramount importance in astronomy and geodesy that it was highly desirable to bring out at the earliest moment the results deducible from the three stations occupied for that purpose by the Survey. Early in January the party of Assistant E. Smith, who commenced his observations June 13, 1891, at Rockville, Maryland, supplied two extra computers to attend to the work under my direction; more than a thousand individual results for latitude have been secured, and a preliminary report was submitted by me under date of April 19, 1892; the combination and deduction of results were attended to by myself.

The reduction and discussion of the differential observations for the horizontal component of the magnetic force at Los Angeles, California, have been completed, and the results from this seven-year series were reported by me on December 31, 1891. The discussion of the secular variation of the magnetic declination has been kept up to date, and the results were at once available for the compasses placed on the charts. I also gave attention to proof-reading of the annual report, supplied approximate mean places of stars observed for latitude, and attended to the duty of examiner of computers for the Civil Service Commission. Between September 20 and 27 I was absent from the office on field duty.

A specification of the work performed by each computer during the fiscal year is herewith presented; it is made up from the daily and monthly reports.

Edward H. Courtenay brought to a close the final adjustment of the secondary triangulations of Massachusetts made between 1885 and 1889, inclusive, under the direction of and in coöperation with the State. The results are ready for the printer. These computations demanded great attention on account of the interlacing of the old and new stations and consequent adjustments; 4 109 triangles were formed, and the geographical positions of 1 230 stations were computed. In February Mr. Courtenay took up the secondary and tertiary or coast triangulation of Monterey County, California, from 1871 to 1891, which comprises the region between Point Sal and Point Pinos. This work is well advanced. Mr. Courtenay also directed part of the labors of Mr. Kummell, Mr. Page, Mr. Boutelle, and of the clerk to the Division. I regret to say that the state of his health was so precarious that during two and one-half months his work was suspended.

Myrick H. Doolittle continued and completed the adjustment of the horizontal directions at the principal stations in eastern Tennessee, comprising the triangulation between Nashville, Tennessee, and Cohutta, Georgia, from 1877 to 1891, inclusive. The main triangulation involves sixty-eight geometrical conditions to be satisfied. This was done by subdivision in five parts. The total number of positions computed is forty-one. Mr. Doolittle also assisted in the computation of apparent places of stars for the Rockville latitude. It is gratifying to state that since January Mr. Doolittle's good health has been fully restored, he having been disabled for work by sickness for nearly four months after the beginning of the fiscal year.

Henry Farquhar completed the computation of latitude of San Francisco, 1888, and of Mocho, California, 1887, and advanced that for the latitude of Ironton, Missouri, 1890. He was mainly engaged in collating and discussing star places inclusive of the proper motion and basing his resulting mean places on the systems of declinations of Boss and Auwers. The places supplied refer to the three stations, Rockville, Maryland, San Francisco, California, and Waikiki, Hawaiian Islands, selected by the Survey for the purpose of developing

the law of the variation of latitude. Star places were also supplied for the reduction of the latitudes observed in connection with the meridional boundary survey between Alaska and the Northwest Territory of the Dominion of Canada.

Louis A. Bauer completed the computations of the magnetic observations made by Assistant Baylor in the Southern States in 1890, also reduced his magnetic observations made in the same year in the New England States; computed the magnetic observations made by Prof. Reid in Alaska and in Ohio in 1890 and 1891, and for other stations made by the longitude party during 1890 and 1891; also computed the magnetic observations made in Alaska by Assistants McGrath and Turner 1889, 1890, and 1891. He also assisted in the final reduction and tabulation of the differential observations for the horizontal component of the magnetic intensity at Los Angeles during the years 1882 to 1889, and supplied the temperature correction to the differential observations of the vertical component for the first year. Mr. Bauer also attended to some miscellaneous geodetic computations, checked some reductions for latitude at Rockville, and of the micrometer value for latitude of Waikiki, and directed the reduction of certain spirit-level observations by other computers.

Charles H. Kummell was engaged in miscellaneous geodetic computations, including abstracts of angles or directions, triangle side and position computations, and in revising or checking geodetic computations and abstracts of results copied for transmission to field or other parties; made a preliminary computation for the position of the Los Angeles base line of 1889 and 1890; prepared abstracts of angles for the survey of Minnesota, vicinity of Minneapolis, for the years 1887, 1888, and 1889; computed the positions of lighthouses and buoys in the vicinity of Key West, 1892, and solved a number of normal equations in connection with Mr. Courtenay's adjustment of secondary triangulations, or with my discussion of the secular variation of the magnetic declination.

John B. Boutelle computed geographical positions of the survey of Massachusetts; attended to miscellaneous computations and revisions; gave assistance in the reduction of spirit-levels in Tennessee and Mississippi, 1889, and computed geographical positions on the coast of California, vicinity of Point Pinos, and on Hudson River, near Newburg. Mr. Boutelle also attended to copying of reports on professional or scientific subjects. During four months he was on field duty.

James Page.—During the five and one-half months of his connection with the Computing Division, Mr. Page was mainly engaged in assisting Mr. Courtenay in the adjustment of the triangulation of Massachusetts, 1885 and 1889, revising angles and directions and triangle sides and making position computations; he also solved a number of sets of equations in connection with the above work, and attended to some miscellaneous computations.

William C. Maupin was mainly engaged in furnishing copies of descriptions of stations and of lists of geographical positions called for by field and other parties; he also made duplicates of records, and attended to the various duties of clerk to this Division.

Some temporary assistance was given by Miss I. M. Peck in copying geodetic results and descriptions of stations. Her services in this Division continued for two and a quarter months. Subassistant F. A. Young served in the Computing Division for two and a half months engaged in the computation of apparent places (declinations only) of stars and for latitude of Rockville, Maryland, 1891 and 1892. Mr. Young also computed the value of micrometer of zenith telescope No. 2, used at Waikiki.

Yours respectfully,

CHAS. A. SCHOTT,
Assistant, and Chief of the Computing Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE TIDAL DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

TIDAL DIVISION, *June 30, 1892.*

SIR: I have the honor to submit my report of the Tidal Division for the fiscal year ending June 30, 1892:

SUMMARY OF THE WORK DONE DURING THE YEAR.

1. An aggregate of six years five months of record from automatic tide gauges, with the corresponding tabulated half hourly heights of the sea, high and low waters, temperature and density of the sea and meteorological data, eighty-four original and eighty-eight duplicate volumes of observations from staff and box gauges, have been received, examined, and registered.

2. The original and duplicate tide books in the archives and in this Division have been indexed preparatory to re-arrangement and binding.

3. A card index of the literature relating to tides has been commenced, about 1 000 references having been secured during the year.

4. The harmonic analysis of a year's tides at Eastport, Boston, Bristol, R. I., and Providence has been finished and the results reported. The analysis of a year at Sausalito and a year at Portland, Maine, has been continued; the analysis of a year each at Willets Point and Washington, and fifty-four days at St. Michael, Alaska, has been commenced. The work done on all is the equivalent of the complete analysis of three years.

5. Non-harmonic "1st reductions" have been made of thirty-seven series, the equivalent of four years of continuous observations; phase reductions of ten series, the equivalent of two years of continuous observations; and a declination reduction of one year.

6. The Tide Tables for the Pacific Coast for the year 1892, with 120 pages of the corresponding volume for the Atlantic Coast, have been read and revised in proof. The two volumes for 1893 have been prepared and that for the Atlantic Coast read and revised in proof.

7. Tide notes have been prepared and furnished for ninety-six stations for publication on twenty-nine charts, and a few current notes for the same.

8. Eighteen requisitions from field parties have been filled, involving the preparation of fifty-six descriptions of bench marks with references to the tidal planes.

9. Tidal information, including the description of seventy-four bench marks with references to the tidal planes, has been furnished in response to twenty-two calls from persons not connected with the Survey.

10. Two hundred and eighty letters have been prepared, many of them technical and requiring research in their preparation.

11. I was convinced several years ago that the employment in the harmonic analysis of the tides of half-hourly instead of hourly ordinates was unnecessary, but the preparation of a new set of summation stencils was no light matter, and time was wanting. We have, however, this year commenced a set in the hourly system, and in future we will use them in our reductions, thus saving about one-half of the labor of tabulation. It is to be remarked in this connection that the most scientific procedure, and the one that would give the best practical results in the hands of mathematicians, is one which I explained to my colleagues some two years ago, and which I will mention here as involving a conception possibly worthy of note, for it applies not only to tides, but to all other periodic phenomena. It consists in tabulating the ordinates in a fictitious time, differing from the time of any and all of the component tides; that is, at a common interval which is not a submultiple of the complete period of any component tide. The advantage of this method would consist in its enabling us to tabulate the tidal curve at much greater intervals than an hour and obtain

equally good results for the several tides. I may at some future time have occasion to recur to this method.

12. During the last half of the year considerable labor has been spent in an endeavor to find a periodical fluctuation of sea level having a period identical with that of the variation of latitude noted by astronomers. As a special report upon this investigation and its results is in an advanced stage of preparation, it is the less necessary to enter upon an extended discussion of it here.

PERSONS EMPLOYED IN THE TIDAL DIVISION.

Computers: Messrs. Alex. S. Christie, L. P. Shidy, F. M. Little, and R A. Harris throughout the year.

Writers: Miss A. G. Reville and Mrs. Virginia Harrison throughout the year; Mrs. M. E. Nesbitt, July 1–13; Miss Florence Brower, October 13–April 19, and June 18–31; Miss Fannie A. Weeks, May 12–June 20.

Copyist: Mr. Rollo S. Jackson, July 1–6.

Clerk: Mrs. Ada C. Sturges, April 21–25.

Substitute Clerk: Mr. W. D. Fales, June 27–30.

Yours respectfully,

ALEX. S. CHRISTIE,
Chief of the Tidal Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE DRAWING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

DRAWING DIVISION, *June 30, 1892.*

SIR: I have the honor to submit the report of the Drawing Division for the fiscal year ending June 30, 1892.

The only change in the personnel of the division was occasioned by the death of Mr. E. J. Pond on January 23.

The general assignment of work has been the same as that of the previous year.

Mr. A. Lindenkohl has been employed in collecting and compiling data for additions and corrections to the published charts, reducing hydrography from the field sheets to the scale of publication, and in drawing projections on copperplates.

Mr. H. Lindenkohl, in drawings for charts to be engraved or photolithographed, in making corrections and additions to the published charts, and in drawing projections on copperplates.

Mr. E. H. Fowler, in the reduction and fair drawing of the survey of the District of Columbia to scale of 1–9 600, in architectural drawings and plans called for by changes and repairs in the office building, and in making and verifying projections for field use.

Mr. E. J. Sommer, in making drawings for uniform scale progress sketches along or near the thirty-ninth parallel, from the Atlantic to the Pacific Ocean, and in constructing and verifying projections for field use. Mr. Sommer was absent from April 18 to June 30.

Mr. D. M. Hildreth, on drawings for charts to be photolithographed, in touching up full scale photographs of the District survey for engraving, and in making projections for field use.

Mr. C. H. Deetz, on tracings, projections for field use, and in reductions for photolithographing. He was ordered on field duty on June 8.

Mr. G. F. Pohlers has made the drawings for the illustrations to the annual report of the Superintendent, and for charts to be photolithographed.

Mr. C. Mahon was employed on drawings of charts of the 1–80 000 series, along the Gulf Coast, between the Mississippi River and Galveston.

Mr. P. von Erichsen, in inking topographical field sheets, and on tracings.

Mr. E. J. Pond, to January 22, in making drawings for photolithographing, and in revising and correcting drawings for new editions of charts.

Mr. E. P. Ellis, and Mr. E. S. Mitchell, in making tracings of original surveys, in response to requests from the several Departments of the Government and from persons not connected with the Survey.

The general work of the Division may be summarized as follows: Drawings for eleven engraved charts and for twenty photolithographic charts were completed. Drawings were revised and corrected for new editions of twenty-one charts. Two hundred and ninety-six corrections or additions were made to the engraved charts. Thirty-one topographic and fifty-one hydrographic projections were constructed, and twenty-one topographical sheets were inked.

Calls from the various Departments of the Government and from the public for tracings or information, a list of which is appended for incorporation in Table No. 3, were more numerous than during the previous year. The time consumed in answering these requests was equivalent to four hundred and ninety-two days' work of one person.

Since January 23 there has been one vacancy in the corps of draughtsmen, the Civil Service Commission having failed thus far to certify an acceptable person.

In the death of Mr. E. J. Pond the Division met with a serious loss. Although he had been in the service but fifteen months his quick perception and aptitude made him one of its most valued workers.

I have pleasure in testifying to the zeal and efficiency of all the employés of the Division.

Respectfully yours,

W. H. DENNIS,
Assistant, and Chief of the Drawing Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE ENGRAVING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

ENGRAVING DIVISION, *June 30, 1892.*

SIR: I respectfully submit the following report on the operations of the Engraving Division during the fiscal year ended June 30, 1892. The statistics are as follows:

ENGRAVING.

Number of plates of new charts completed	7
Number of plates of new editions of charts completed	8
Number of plates of sketches and illustrations completed	5
Number of plates of new charts commenced	9
Number of plates of new editions of charts commenced	7
Number of plates of sketches and illustrations commenced	6
Number of plates of charts corrected for printing	535
Number of plates printed for chart room	680
Number of plates of sketches and illustrations corrected for printing	18
Number of plates in progress during the year but not completed	32
Number of unfinished plates on hand at the close of the year, viz:	
New charts	29
New editions of charts	11
Sketches and illustrations	14

ELECTROTYPING.

Number of pounds of copper deposited	2 150
Number of square inches on which deposit was made	81 952
Number of plates made:	
Basso	30
Alto	40

Of these seventy electrotypes, three basso and fourteen alto plates were made for the Hydrographic office, Navy Department.

PHOTOGRAPHING.

Number of negatives made	162
Number of prints made (blue 687)	881

PRINTING.

Number of impressions for chart room	40 401
Number of impressions for the Assistant in charge of the Office	3 418
Number of impressions for the Hydrographic Inspector	1 265
Number of impressions for the Engraving Division	1 306
Number of impressions of lithographer's transfer proofs	79
Total number of impressions	46 469

The force of engravers has remained substantially the same as during the preceding year, the personnel having changed only through the resignation of Mr. John A. Williams, and the appointment of Mr. F. G. Würdemann, as additional engraver, in his place. The expert engravers have been employed, as heretofore, on the branches of work they have made specialties, with the exception of such interruptions as were necessary through the corrections arising from resurveys and work of similar character. The young men who have been under instruction have all made satisfactory progress, and add very materially to the strength of the Division.

No contracts for engraving were given out during the year, for reasons specified in my last annual report, until the close of the year, when it was found advisable to enter into an engagement with Messrs. Evans & Bartle of this City to engrave twelve plates of the topographical survey of the District of Columbia. This work is now well in hand, and there is every prospect that eight sheets will be published within sixty days.

The most important engravings completed during the year were Chart No. 19—"Mobile Bay to Atchafalaya Bay"—scale 1–400 000, completing the first edition of the General Charts of the Gulf Coast; Charts Nos. 5 900 and 6 000, embracing the Pacific Coast from Point St. George to Cape Lookout, on a scale of 1–200 000; and material advance was also made on the next chart of this series, No. 6 100, extending northward to include Grays Harbor.

In the new editions, the revised plate of Chart No. 376—"Delaware and Chesapeake bays," scale 1–400 000, was issued. This is an entirely new engraving, embracing more favorable limits and greater detail than was shown on the former edition of the chart. New editions were also published of Sailing Chart No. 5—"Gulf Coast of the United States," embracing the most recent surveys, and Chart No. 137—"Cape Henry to Currituck Beach," scale 1–80 000, showing the water routes of communication between Chesapeake Bay and Albemarle Sound. The engraving of the new edition of Chart No. 112, embracing a part of Nantucket Sound, Massachusetts, showing the resurveys of the locality, was sufficiently advanced to permit the engraved work being transferred to stone, which, with additions by photolithography from the old surveys, made a satisfactory preliminary edition of this chart.

A large number of important plates were materially advanced, including the new sailing charts of the Atlantic Coast, the Mercator Chart of Nantucket Shoals, extending westward

to Montauk Point, the remaining coast and harbor charts of the coast of Maine, and the coast charts of Florida Bay.

The total output of the Division, in the number of plates completed, is smaller than has been the case for several years; but the actual work in advancing the engravings has been most satisfactory. Through the operations of the Chart Board, certain plates are selected to be advanced as rapidly as circumstances will permit, under the general rule that the plates selected will furnish charts more desirable to publish than others that may be on the list. But during the year past, the large majority of the plates that were selected involved a quantity of work that it was impracticable to accomplish before the close of the year, thus reducing the apparent output of the chart publication from engravings.

The registration of the photolithograph work has continued in this Division. Forty-three new charts, new editions, and reprints, were furnished during the year, making an aggregate of 13 155 sheets. The most important of these were Chart No. 384—"Baltimore Harbor," on large scale; Charts Nos. 8 200 and 8 300, completing the publication of the Inland Passages, Southeast Alaska; Chart S—"The Northwest Coast of America, from San Francisco to Bering Sea;" Chart No. 8 990—"Pribilof Islands," Alaska; and new editions of San Diego Harbor, California, and the General Chart of Alaska on a small scale.

The plate printing office has continued under the direction of Mr. F. Moore, foreman. The force of printers has remained unchanged, with the exception that the helpers formerly employed on the extra roll have been transferred to the permanent roll, under the appropriation providing for an increased number of printers.

The printing office has been transferred to the building on South Capitol Street which was refitted for this purpose. Two new presses, run by power generated by a gas engine, have been supplied, and one of the old hand presses converted into a power press. A second one of the old hand presses is now being converted into a power press. A new roller calendering press, run by power, to take the place of the old knuckle-joint press, has also been set up. These improvements and additions have supplied the Bureau with a plate printing office that is probably not surpassed by any other establishment in the city. Two of the rooms of the old printing office in the fireproof building, that were vacated, have been utilized for the storage of our copperplates. Four other rooms and a cellar have been made available for the use of other Divisions of the office.

The requisitions for printing from the chart room have fallen off during the year about 10 000 copies, reducing the number of copies furnished for distribution to 40 401. This decrease in the demand for the charts is also shown in the reduction of the number of plates it was necessary to correct for printing, there having been only 535 corrected for this purpose, against 734 during the preceding year. These corrections consumed time equivalent to the constant employment of three and one-half men during the whole year, and show the average correction to each plate to have been materially increased. The number of plates printed for the chart room was also reduced to 680, against 884 for the preceding year. This great reduction in the requisitions, together with the increased facilities and improvements the new printing office affords, have enabled us to keep up with the work required, so that the back orders, which have been so annoying for several years past, have rarely been reported during the year. This is the more gratifying, as the interruption of the work incident to the removal and refitting of the printing office would have been, under the prevailing circumstances of a year ago, a most serious annoyance in delaying the issue of the charts to the public.

The electrotype and photograph department has continued under the charge of Mr. D. C. Chapman, assisted by Mr. L. P. Keyser. The average quantity of work has been turned out, and at a somewhat reduced cost, as the thorough overhauling of the batteries, referred to in my annual report of a year ago, has resulted in an increased ratio of deposit of copper for the quantity of zinc consumed. Eighty-eight per cent of the zinc is now utilized in actual work, being an increase of 20 per cent on the average of preceding years.

The general clerical work of the division has been performed by Mr. John H. Smoot in his usual acceptable manner; and since February I have had the assistance of Mr. Eugene Rhodes. Mr. Rhodes has been engaged, under my personal supervision, in many details relating to the photolithographing, and questions arising from my connection with the United States Board on Geographic Names, and, to some extent, in proof-reading and verification of engraved work. It gives me pleasure to say that his services have been most satisfactory, and are of material assistance to me in the many details requiring my attention.

I also desire to express my gratification at the interest the expert engravers in the Division have evinced in the young men who have recently been employed in the office to learn the art of engraving. These young men have shown, without exception, a marked aptitude, and, I believe, with the necessary experience, will become proficient engravers.

I transmit herewith the usual statement of charts completed, commenced, and continued during the year for file in the archives.

Respectfully yours,

HERBERT G. OGDEN,
Assistant, and Chief of the Engraving Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE CHART DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

CHART DIVISION, *June 30, 1892.*

SIR. I have the honor to submit the following report of the Chart Division, for the fiscal year ending June 30, 1892:

This Division has been under my charge during the year, and the following named persons have been attached to it, whose general duties have been as noted:

Miss L. A. Mapes, bookkeeping and correspondence.
Mr. H. R. Garland, issuing and correcting charts.
Mr. J. H. Barker, correcting charts.
Mr. J. W. Whitaker, correcting charts.
Mr. C. W. Childs, correcting and coloring charts.
Mr. T. V. Walker, correcting and coloring charts.
Mr. Ivy Hill, correcting and coloring charts.
Miss Sophie Hein, correcting and coloring charts.
Mrs. Jennie H. Fitch, coloring charts and correcting catalogues.
Miss M. L. Handlan, coloring charts.
Mr. Neil Bryant, receiving and stamping charts.
Mr. R. T. Bassett, mounting and joining charts.
Mr. C. A. Harbaugh, miscellaneous.

The changes in the force were as follows:

Miss Sophia Hein, transferred to Office Division on August 2.
Mr. C. W. Childs, transferred to Interior Department on November 23.
Mr. C. A. Harbaugh, assigned to this Division on July 25, and transferred to the Division of Library and Archives on October 27.
Mr. T. V. Walker, assigned to the Division on December 2.
Mr. Ivy Hill, assigned to the Division on February 11.

With the exception of the transfers above noted, the persons named are still on duty here.

The following table is given with a view of representing in brief the more important features of the relation of the chart issue of this year to that of the four years next preceding:

Comparison of issues of charts during the fiscal years noted below.

		1888.	Change. + or −	1889.	Change. + or −	1890.	Change. + or −	1891.	Change. + or −	1892.	Change from average + or −
Totals	Copies	41 322	+7 990	49 312	+13 840	63 152	−10 193	52 959	−284	52 67	+989
	Values	$17 104	+$2 992	$20 096	+$6 082	$26 178	−$2 721	$23 457	−$416	$23 041	+$1 332
Free	Copies	15 407	+5 681	21 088	+9 024	30 112	−9 301	20 811	+2 640	24 451	+1 597
	Values	$6 164	+$2 102	$8 266	+$3 855	$12 121	$3 275	$8 846	+$985	$9 831	+$982
Gross sales	Copies	25 915	+2 309	28 224	+4 816	33 04 0	−892	32 148	−2 924	29 224	−608
	Values	$10 940	+$890	$11 830	+$2 227	$14 057	−$554	$14 611	−$1 402	$13 209	+$350
Net sales	Copies	23 885	+2 655	26 540	+5 206	31 806	−3 333	28 473	−1 259	27 214	−462
	Values	$10 169	+$1 111	$11 280	+$2 295	$13 575	−$434	$13 141	−$635	$12 506	+$465

The total issue which represents the work of the Division is practically the same as that of last year and about 2 per cent larger than the average of the four previous years. If the issue for 1890, which was anomalous in regard to free distribution, be omitted, the increase over the average would be about 10 per cent. But this increase is absorbed by the free distribution, since the gross sales in copies are less than last year by 9 per cent and less in copies than the average of the four previous years by 2 per cent. The net sales, *i. e.*, the gross sales, less charts returned by sale agents, have decreased in copies 4 per cent and in value 5 per cent as referred to last year, but, as compared with the average of the four years, have decreased in copies less than 2 per cent and have increased in value 4 per cent. It will be noticed that the net sales, which are the indication of the popular demand, show an increase to 1890 and a decrease, though less in amount, since then.

It is possible that the number of vessels engaged in commerce may have decreased with the tendency to use vessels of larger size and steamers in place of sailing vessels, and the number of charts required would be proportionately less. At all events, be the cause of the lessened demand what it may, no effort should be spared to maintain, and raise if possible, the standard of excellence of our charts in all respects, in the clearness of the print, the quality of the paper, and the accuracy and sufficiency of the information, especially in regard to changes in Aids to Navigation, so that if the demand continues to decrease, the Survey may not be in fault.

That the result of the work of the Survey, as shown by the charts, may become better known, a distribution was made during the winter, through the Lighthouse Board, of some 2 000 copies to the principal lighthouses throughout the United States, and it is intended that a distribution shall be made this autumn or winter to a number of libraries.

In April last a new edition of the Chart Catalogue dated 1892, was published, after a long delay owing to the pressure of work at the Public Printing Office. It is believed that it will facilitate the very desirable object of a yearly edition of the Catalogue if the copy be made ready for the printer by the end of the fiscal year, when, for various reasons, greater dispatch in the printing may be expected.

The catalogue number of a chart should, in my opinion, be its official designation, aside from its title, being brief and convenient for reference in correspondence, etc., and should in a general way serve to define its location in reference to that of other charts, and the plan of numbering should be so comprehensive that it would never be necessary to apply an old number, however long in disuse, to a new chart. This idea, the truth of which is now generally acknowledged, was not sufficiently considered when numbers were first given, and the result has been an application of the same number to different charts, and a lack of order

and arrangement noticeable to a certain extent on the Atlantic Coast, but especially marked on the Pacific. With a view to a reform in this respect, even at the cost of some present trouble, a plan of renumbering the Pacific Coast charts has been recommended by the Chart Board and approved by the Superintendent. To carry the change into effect with as little friction as possible the numbers were altered by hand on the copies in stock simultaneously with the distribution, to sale agents and others, of the catalogues containing the new numbers. The system is now working smoothly. Of the new catalogue 2 150 copies have been distributed out of an edition of 2 500, and 500 copies more have been ordered to meet demands before the edition of 1893 is received.

The correspondence for the year has amounted to 2 550 letters written.

The discipline of the Division has been good, and it gives me pleasure to note the interest shown by all the members in keeping the work of correction and issue up to its past standard of rapidity and accuracy. Our relations with the Hydrographic and Engraving Divisions have been cordial and mutually helpful in the perfecting of the routine of chart correction.

Eleven new charts from copperplates and twenty-one new lithographic charts, thirty-two in all, have been published during the past year, as shown in the following list:

Date.	Catalogue No.	Title.
		ENGRAVED.
1891.		
July 7	6456	Admiralty Inlet and Puget Sound to Seattle, Wash.
July 7	6460	Puget Sound, Seattle to Olympia, Wash.
July 25	6122	Nehalem River, Oregon.
Aug. 8	8	Approaches to New York, Gay Head to Cape Henlopen.
Aug. 8	5800	Cape Mendocino to Point St. George, Cal.
Sept. 10	304	Cross Island to Nash Island, Me.
Sept. 23	5909	Chetko Cove, Oregon.
Dec. 7	5906	Point St. George to Umpqua River, California and O gon.
Dec. 15	5128	Catalina Harbor and Isthmus Cove, Cal.
1892.		
Feb. 8	6000	Umpqua River to Cape Lookout, Oregon.
Mar. 14	19	Mobile Bay to Atchafalaya Bay.
		LITHOGRAPHED.
1891.		
July 18	8100	Clarence Strait, Revillagigedo Channel, etc., Alaska.
July 22	298	Gardiners Bay, Long Island, N. Y.
July 22	6180	Willapa Bay, part of, Washington.
July 22	8451	Harbors in the Gulf of Alaska.
July 22	8881	Islands and Harbors off the Alaska Peninsula.
July 22	8891	Harbors off the Alaska Peninsula.
July 22	8901	Harbors and Islands off Alaska.
Aug. 21	3615	Long Island Sound, Throgs Neck to New Rochelle, N. Y.
Aug.	3[illegible]6	Long Island Sound, New Rochelle to Manursing Island, N. Y.
Aug. 21	0	Washington to Norfolk, Chesapeake Bay.
Sept. 17	8072	Harbors in Revillagigedo Channel, etc., Alaska.
Oct. 24	101	Calais to Little River, Me.
Oct. 24	8200	Sumner Strait and Frederick Sound, Alaska.
1892.		
Jan. 14	6405	Port Townsend, Wash.
Feb. 3	565	Passaic River, Newark Bay to Belleville Bridge, N. J.
Mar. 16	345	Robinsons Hole and Quicks Hole, Mass.
Mar. 23	384	Baltimore Harbor and approaches.
Mar. 23	8	San Francisco to Bering Sea.
Apr. 15	8990	Pribilof Islands, Bering Sea, Alaska.
May 9	9191	Harbors and anchorages in southwestern Alaska.
June 28	8300	Lynn Canal and Stephens Passage, Alaska.

I should remark that the term "new charts," as used above, has a general signification and refers to charts never before issued in that form. The same term is applied by other

Divisions to charts which have required new work on the plates, drawings, etc., and which may have been issued before; and there may consequently, for this and other reasons, be a discrepancy between their lists of new charts and mine.

The receipts, issues, and general distribution of charts during the year are given in a table which accompanies this report, and which is submitted for file in the archives.

Yours respectfully,

GERSHOM BRADFORD,
Assistant, and Chief of the Chart Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE MISCELLANEOUS DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

MISCELLANEOUS DIVISION, *June 30, 1892.*

SIR: I have the honor to submit herewith the report of the Miscellaneous Division for the fiscal year ending June 30, 1892.

The volume of work done in the Divison, so far as it is susceptible of tabulation, is shown by the following figures:

Letters written (sales agents, 2 600; miscellaneous, 539)	3 139
Ledger accounts kept (sales agents)	95
Quarterly statements of sales agents examined and verified	281
Circulars to sales agents issued	30
Charts sent to sales agents	28 620
Orders for purchases issued	780
Requisitions made for printing and binding	86
Requisitions for stationery filled	510
Requisitions for miscellaneous supplies and repairs filled	531
Annual Reports distributed (see tabulated statement)	3 873
Tide Tables issued	5 485
Atlantic Coast Pilots issued	34
Subdivisions Atlantic Local Coast Pilot issued	268
United States Coast Pilots, Atlantic Coast, issued	289
Pacific Coast Pilots, Alaska, Part I, issued	136
Pacific Coast Pilots, "California, Oregon, and Washington," issued	68

The number of charts sent to sales agents during the year, namely, 28 620, was 2 845 copies less than were issued during the previous fiscal year.

Twelve agencies for the sale of publications—nine on the Atlantic and Gulf Coasts and three on the Pacific Coast—were established during the year; and ten were discontinued—seven on the Atlantic and Gulf Coasts and three on the Pacific Coast. The total number of agencies on June 30, 1892, was eighty-eight—seventy on the Atlantic and Gulf Coasts and eighteen on the Pacific Coast.

The aggregate of business done through the agencies from July 1, 1891, to June 30, 1892, is shown by a table which is submitted for file in the archives.

The following publications were sent to press: Annual Report of the Superintendent for the year ended June 30, 1891; United States Coast Pilot, Atlantic Coast, Part IV, "From Point Judith to New York," Second Edition; Tide Tables for the Atlantic Coast of the United States for the year 1893; Catalogue of Charts and other Publications, 1892; Laws and Regulations relating to the Coast and Geodetic Survey of the United States (reprint); and Notices to Mariners Nos. 143 to 154, inclusive.

The usual distribution was made of the Annual Reports of the Superintendent, the Appendices to the same printed separately in pamphlet form, Bulletins, and Notices to Mariners, and they were also furnished in large numbers in response to numerous special applications. The distribution of Annual Reports was as follows:

Date of report.	Domestic distribution.		Foreign distribution.		Totals.
	To institutions.	To individuals.	To institutions.	To individuals.	
1851	3				3
1852	3				3
1853	3				3
1854	3				3
1855	3				3
1856	3	1			4
1857	3				3
1858	2				2
1859	3				3
1860	3				3
1861	3	1			4
1862	3				3
1863	3				3
1864	2				2
1865	4		1		5
1866	3	1	1		5
1867	4	1	1		6
1868	4	1	1		6
1869	3		1		4
1870	3	1	1		5
1871	5		1		6
1872	7	2	3		12
1873	11	6	3		20
1874	14	9	3		26
1875	11	11	3		25
1876	13	8	3		24
1877	12	8	3		23
1878	16	10	4		30
1879	19	20	4		43
1880	25	52	3	1	81
1881	24	48	4		76
1882	24	43	4		71
1883	24	48	4		76
1884	25	37	4		66
1885	27	36	4		67
1886	26	39	4		69
1887	26	43	5		74
1888	28	80	6	2	116
1889	667	618	234	14	1 533
1890	662	457	230	13	1 362
Totals	1 727	1 581	535	30	3 873

Following is a list of the publications of the Survey, with the number of copies of each received during the year from the Public Printer:

Name of publication.	No. of copies.
Annual Report of the Superintendent for the year ended June 30, 1889.	1 432
Annual Report of the Superintendent for the year ended June 30, 1890.	2 000
United States Coast Pilot—Atlantic Coast, Parts I–II, "From the St. Croix River to Cape Ann."	1 500
Pacific Coast Pilot—Alaska, Part I, "Dixon Entrance to Yakutat Bay with Inland Passage from Strait of Fuca to Dixon Entrance." Third edition, 1891.	433
Tide Tables for the Atlantic Coast of the United States for the year 1892.	2 010
Tide Tables for the Atlantic Coast of the United States for the year 1893.	2 025
Tide Tables for the Pacific Coast of the United States for the year 1892.	3 525
Catalogue of Charts, and other publications, 1892	2 535
Laws and Regulations relating to the Coast and Geodetic Survey of the United States, 1887.	300
Tables for converting customary and metric weights and measures.	10 000
Appendix No. 8, Report for 1890—"Results of Magnetic Observations recorded at Los Angeles, California, 1882–1889. Part I—Absolute Measures."	500
Appendix No. 9, Report for 1890—"Results of the Magnetic Observations recorded at Los Angeles, California, 1882–1889. Part II—Differential Measures."	500
Appendix No. 10, Report for 1890—"The Gulf Stream. A Description of the Methods Employed in the Investigation, and the Results of the Research."	999
Appendix No. 11, Report for 1890—"Report on a Part of the Boundary Line between the States of Maryland and Virginia."	100
Appendix No. 12, Report for 1890—"Determinations of Gravity and of the Magnetic Elements in connection with the United States Scientific Expedition to the West Coast of Africa, 1889–1890."	500
Appendix No. 13, Report for 1890—"On an Approximate Method of Computing Probable Error," and "On the determination by Least Squares of the Relation between two Variables."	200
Appendix No. 14, Report for 1890—"On the use of Observations of Currents for Prediction Purposes."	200
Appendix No. 15, Report for 1890—"Tides at Sandy Hook. Observed and Predicted Times and Heights during the year 1889."	200
Appendix No. 16, Report for 1890—"The Relation of the Yard to the Metre."	500
Appendix No. 17, Report for 1890—"International Geodetic Association. Ninth Conference."	500
Appendix No. 18, Report for 1890—"The National Prototypes of the Standard Metre and Kilogramme."	4 991
Appendix No. 19, Report for 1890—"Early Expeditions to the Region of Bering Sea and Strait."	500
Appendix No. 20, Report for 1890—"Notes on an Early Chart of Long Island Sound and its Approaches."	200
NOTICES TO MARINERS.	
No. 142, June, 1891—Chart corrections during the month	10 000
No. 143, July, 1891—Chart corrections during the month	10 000
No. 144, August, 1891—Chart corrections during the month	10 000
No. 145, September, 1891—Chart corrections during the month.	10 000
No. 146, October, 1891—Chart corrections during the month	10 000
No. 147, November, 1891—Chart corrections during the month.	10 000
No. 148, December, 1891—Chart corrections during the month	10 000
No. 149, Index to Chart corrections, January 1, to December 31, 1891.	10 000
No. 150, January, 1892—Chart corrections during the month	10 000
No. 151, February, 1892—Chart corrections during the month	10 000
No. 152, March, 1892—Chart corrections during the month	10 000
No. 153, April, 1892—Chart corrections during the month	10 000
No. 154, May, 1892—Chart corrections during the month	10 000

Mr. Freeman R. Green has, as heretofore, kept the sales agents' ledger accounts, in addition to the performance of other clerical duties. Mr. Green is entitled to special commendation for the faithful, intelligent, and accurate manner in which he has performed all the duties assigned to him.

Mr. Harry J. Van Der Beek, who received a probationary appointment as stenographer on January 20, 1892, has served acceptably in the Division since that date.

Mr. Eugene Rhodes performed duty as stenographer and typewriter until January 21, 1892, when he was transferred to the Engraving Division.

The duties of janitor were performed by Mr. W. M. Long until January 25, 1892, when his connection with the Survey ceased. Mr. Calvin Shurtleff was appointed to succeed Mr. Long on January 26, 1892, since which date he has discharged the duties of janitor.

The duties of watchmen were faithfully performed during the year by Messrs. David Parker, Wm. H. Keith, and David Somerville.

Mr. J. A. Watts was detailed from the Treasury Department on December 2, 1892, for duty as an engineer in this office. Since that date he has had charge of all the heating apparatus, and, in addition to the performance of his duties as engineer, has rendered other valuable services of a miscellaneous character.

Mr. Wm. G. Finney was appointed messenger September 18, 1891, and employed until February 10, 1892, and S. T. A. Van Sciver was appointed messenger September 23, 1891, and employed until March 15, 1892.

Messrs. William H. Butler, chief messenger; C. H. T. Over, Sandy Bruce, Charles H. Jones, William Savoy, Attrell Richardson, Peter Page, and John F. Grinage, messengers; Wm. R. McLane, driver; Horace Dyer and Harrison Murray, firemen; and Mrs. S. E. Flynn, William P. Young, John H. Brown, Hans Bowdwin, Samuel L. Eubank, and Dennis E. White, laborers—all performed their respective duties in a faithful and satisfactory manner.

Respectfully yours,

M. W. WINES,
Chief of the Miscellaneous Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE INSTRUMENT DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

INSTRUMENT DIVISION, *June 30, 1892.*

SIR: I have the honor to submit the following report of the work of the Instrument Division for the fiscal year ending June 30, 1892:

This Division has to send out, receive, and account for all instruments and general property used in the field and in the various Divisions of the office; make the needed repairs to instruments; plan and construct new instruments; determine their constants so far as it is practicable to do so at the office, and purchase new instruments and all material needed for carrying on its work. The Division may be said to have three sections—the office of the Instrument Division, the instrument shop, and the carpenter shop. The force employed during the year was as follows:

OFFICE.

Edwin Smith, assistant, and chief of the Instrument Division.
Frank A. Cook, clerk.
William West, messenger.

INSTRUMENT SHOP.

E. G. Fischer, chief instrument maker.
Otto Storm, instrument maker from July 1 to September 30.
William Gaertner, instrument maker.
Jacob Schwarz, instrument maker from October 1 to June 30.
C. E. Regennas, instrument maker.
W. R. Whitman, instrument maker.
S. A. Kearney, instrument maker.
M. Lauxmann, instrument maker.
Jacob Schwarz, mechanician for the office of Weights and Measures, assigned to duty in instrument shop, from July 1 to September 30.
Otto Storm, mechanician for the office of Weights and Measures, assigned to duty in instrument shop from October 1 to June 30.

CARPENTER SHOP.

H. O. French, carpenter.
George W. Clarvoe, carpenter.
C. N. Darnall, carpenter.

The instrument and carpenter shops are essentially repair and experimental shops, and the construction of new instruments is incidental to this work, being mostly confined to such

instruments as can not be purchased in stock or made to order except at very much greater cost and delay.

Tables I to V* accompanying this report and submitted for file in the archives, give statistics of some of the work of this division. Two hundred and fifty-five requisitions have been filled, many requiring several days' work of several men. The division has also done a great deal of work for the office in the care of the clocks, electric bells, fitting up of the reading room in the library, making file cases, drawing boards, etc., and such general repairs about the building as could be done by men of the instrument and carpenter shops. In such work the carpenter shop has been particularly hard pressed, and I would recommend that its force be increased by at least one more carpenter at as early a date as possible.

Early in the year the facilities of the carpenter shop were materially increased by mounting the band saw purchased at the close of the last fiscal year.

The reconstruction of zenith telescope No. 3 was begun in June, 1891. It was intended to be made similiar to zenith telescope No. 4, which had been reconstructed a short time before as mentioned in last year's report. At a later date zenith telescope No. 3 was assigned to Assistant Davidson, and at his request the Superintendent directed that a new objective by Brashear and three new eyepieces by Kahler be furnished, and that many details should be made in accordance with Assistant Davidson's wishes. This caused much delay, and the instrument was not ready for shipment to Assistant Davidson at San Francisco until November 19, 1891. At the request of the Chief of the Instrument Division, made through you, the Superintendent appointed a special committee, consisting of Assistants Schott, Woodward, and Tittmann, to examine this instrument before it was sent from the office. They reported it to be very satisfactory.

Base bars Nos. 15 and 16 are the duplex bars designed in the Instrument Division from specifications given by Assistant Eimbeck. They were begun during the last fiscal year, but as they could not be completed in time to be used at the Holton base they were set aside for more pressing work. They will soon be taken up again and will be completed in time to be exhibited at the World's Columbian Exposition.

Base bar No. 18, is a 5-metre steel bar similar to No. 17, which was made last year. It is divided into 5-metre spaces by plugs with their faces in the neutral axis. The ruling of the lines on these plugs was done by the chief instrument maker. The bar was constructed after the return of the Holton base party from the field and used as an intermediate bar to determine the length of No. 17 from the prototype metre.

The reconstruction of theodolites Nos. 145 and 146 was begun about two years ago. There has been but one man at work upon these instruments and he has so frequently been called off for more pressing work that they are not yet completed. They will be finished, however, in a very short time and one of them will be exhibited at the World's Columbian Exposition.

Four new magnetometers, Nos. 17, 18, 19, and 20, to be made from designs prepared in the Instrument Division, were begun in September, 1891. On these instruments there has also been but one man at work, who has frequently been called off for other duties. They are now nearing completion and will be ready for issue in a short time. One of them will also be exhibited at the World's Columbian Exposition.

Transit No. 2 is one of the Troughton & Simms 45-inch transits. It is an instrument that has been little used and was reconstructed to meet the needs of the Survey and with a special view to being exhibited at the World's Columbian Exposition as a type of the larger transits used in the longitude work of the Survey.

The six comparator micrometers mentioned in Table III were made for the universal comparator proposed to be constructed nearly two years ago for the use of the Survey and the office of Standard Weights and Measures. These micrometers have been made with

*These tables give lists of instruments repaired, of those reconstructed, and of those made made in the shop; also of instruments purchased, and of work done for the office of Standard Weights and Measures.

special care. It is to be regretted that the work on this comparator can not progress more rapidly, but it has had to be set aside for the same reasons that have caused delay in other new work.

Early in the year a model of a half-second reversible pendulum was made from designs made in the Instrument Division under the direction of the Superintendent. This model was exhibited before the National Academy of Sciences at its April meeting by the Superintendent. The consideration of the construction of the pendulum itself has been unavoidably delayed.

On the return of the Superintendent from Alaska with pendulum apparatus A in the autumn of 1891, the pendulums were swung at the Smithsonian Institution, in which work the chief instrument maker assisted. In November these pendulums were swung at the Stevens Institute, Hoboken, New Jersey, by the Superintendent, assisted by the chief of the Instrument Division. Since the return of this apparatus to the office, many changes and additions have been made involving experimental work which consumed much time in the Instrument Division. For the planes in the receiver, knife edges have been substituted; and for the knife edges in the three pendulums, planes have been substituted. A microscope and lamp for reading the amplitude have been added. Throughout the whole year experimental work with the apparatus has been in progress, under the direction of the Superintendent, in which the Instrument Division has been called upon to take part.

It was found desirable, and in fact necessary, to have the base pendulum station of the Survey at the office in Washington, and for this purpose the southwest room in the cellar of the office was selected. By direction of the Superintendent this station was prepared under the supervision of the Chief of the Instrument Division, and its care has since rested with that Division. A description of this pendulum station more properly belongs with the pendulum work under the immediate direction of the Superintendent.

The twelve compass declinometers mentioned in Table V were made under contract by Fauth & Co., the lowest bidders, from designs and specifications made in the Instrument Division. They are designed for the purpose of rapidly determining the magnetic declination by triangulation, topographical, and other parties at places where the true azimuth of a line is known. An illustration of this instrument will soon appear, and a further description is thought unnecessary.

A large amount of work has been done in the preparation of apparatus for exhibition at the World's Columbian Exposition, but as most of the work is not completed it will more properly be mentioned in next year's report.

For many years the Survey has had in its possession a machine for engraving numbers on circles, etc., which has been practically useless. This machine has been reconstructed and will be used for numbering every degree on the circles of theodolites Nos. 145 and 146 and other instruments.

In the latter part of the previous fiscal year a small dynamo (½ K. W.) was purchased. This was mounted in the instrument shop towards the close of the year 1891, and has been used to illuminate the pendulum room, the laboratories, and the comparing vault, and also the microscopes of the universal comparator. This required 1800 feet of wiring and all the work was done by the force of this Division. This dynamo was soon found to be too small, and in June, 1892, a larger one (1½ K. W.) was purchased. It will be mounted as soon as possible so that the current from the two may be used separately or combined.

The Division has been pushed to its utmost capacity during the whole year, and I must express my gratification with the industry of all its employés.

Respectfully yours,

EDWIN SMITH,
Assistant, and Chief of the Instrument Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE LIBRARY AND ARCHIVES DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

LIBRARY AND ARCHIVES DIVISION, *June 30, 1892.*

SIR: I transmit herewith tables* showing the accessions made to the Library and Archives of this office during the fiscal year ending June 30, 1892, together with this general report of the work performed in this Division during that time.

Improvements have been made in the building (1) by connecting it by a covered bridge with the main office, and (2) by cutting a doorway between it and No. 201, thus making all three buildings directly connected, and providing ready passage from any one to the others without exposure of men or records to the weather.

The principal works accomplished are as follows:

Numbers have been placed on all original sheets in the archives, thus facilitating the rapid handling of them; descriptions of the most of these sheets have been filled out on the cards on which the current charges are made, and their history is preserved.

Several volumes of "descriptive reports" which accompany the original sheets have been sent to the bindery. But the most of the work, other than that which may be regarded as necessary current work of receiving, registering, and the daily issuing and crediting of sheets and records, has been done for the library proper, and its collection of maps; both of which very much needed attention to render them effective and useful as tools for the office force, and others who have need to consult them.

In March, 1891, it was assumed that the library consisted of 10 000 volumes, and accessions were numbered upward from that; and, for ready identification, I had placed in each volume in the library a stamp showing it to be the property of the Survey, and numbered the volumes then in the library backward from 10 000. Slips were prepared for the volumes known to be on our vessels and sent to the commanding officers to be inserted: thus we now have a list of numbers from 3 000 to 11 618, each representing a volume belonging to the Survey.

There are a large number of books belonging to the library in the office and in the hands of field officers which will be placed on this list as they are handled by the library, and in this way a comparatively accurate estimate of the books belonging to the Survey will be obtained in time. Such a list has long been needed.

The additions to the library during the past year by purchase, exchange, and binding, (of books already in the library, but stored and inaccessible owing to their not being bound) amount to over 1 200. Cards have been made out and placed in the catalogue for all of these.

The "purchases" have been selected by the library committee, and are of a character which, if maintained, will make this a very valuable library of reference upon the subjects allied to the work done by this office, and bearing upon it.

Pamphlets (the problem of every librarian) had accumulated, and over 1 000 have been arranged (by the decimal system) and placed in tin cases. From two to five cards have been written on the typewriter for each.

Portfolios have been provided for our collection of maps, and many of them have been arranged in them, and the proper cards made out.

Wherever sets have been found to be complete they have been sent to the bindery, as "atlas form" is considered the best to preserve the maps and prevent loss, and is quite as convenient for reference.

During the year 895 volumes of books and atlases have been prepared and sent to the bindery, while only about one-half that number have been returned.

A circular was sent to all field officers calling attention to the desirability of sending in copies of all photographs and the negatives taken, which illustrate the field work of the

*These tables are filed in the archives. A summary statement of records received in the archives, and of accessions to the library, accompanies this report.

service, and it is thought from the replies received that this will be a very valuable as well as interesting feature of the archives in the future.

Considerable correspondence has been carried on in trying to complete files of the proceedings of scientific societies and scientific publications, portions of which were already in our library; so far we have been quite successful, but a number of "sets" which are out of print have gaps in them which I can only hope to see filled in the future.

Special reports have been made to the Superintendent as follows:

October 1, 1891. Relative to the purchase of manuscript maps from M. de Tragoff, in New York.

October 2, 1891. Report of visits to the libraries and other institutions from Boston to New York.

May 24, 1892. Relative to the conference of the American Librarians' Association at Lakewood, New Jersey, Baltimore, Maryland, and Washington, D. C.

The total allotment for the library for the year was $1 040. The exact amount expended can not be stated until the bills are all rendered, but it will come within the amount allotted.

In closing this report it may be proper for me to enumerate some of the wants of this Division to carry forward successfully the work to the desired goal, viz: An arrangement of our archives and library, and a complete index of each, so that any inquiry that may be made concerning any record or book that has once been here may be readily answered, and immediate reference to the said work made.

First, we need the shelving put up in No. 201 so that the books of the library can be moved and arranged thereon systematically; this will give the room now occupied by these books in the fireproof building for the records of the archives. The cost of this shelving will of course depend upon the kind of shelves put up. Iron is preferable, but if wood is used I would recommend those in the new reading room for style, as they are as cheap as should be erected when you take into consideration the requirements.

The geodetic records should be divided by States, each class of work in any State be arranged and bound, and index cards made out. To accomplish this a supply of index cards and a case will be needed. I would recommend the standard card of the Library Bureau, and one of their cases which will cost (complete with 18 000 cards) about $58.

There are also required six more tin boxes, quarto size, for pamphlets, and twelve more of the intermediate size, which are used both for pamphlets and for manuscript records. These cost about $18 and $22 per dozen respectively, making the cost about $30.

The sounding books should be prepared for binding, as much room would be saved thereby, and I would recommend that the volumes be numbered to correspond with the sheet on which they are plotted, as it will be much more convenient then to find them than under the present system.

After the records have been arranged, a new catalogue of the library should be made, which would include an index of the subjects contained in our various serials which bear upon our work. With sufficient force these could be made simultaneously, but not without the increased help of one expert cataloguer.

Our collection of maps should be brought down from the fourth story of the fireproof to make them more accessible, and I would suggest that cases for them might be placed on the landing of the second story of No. 201 (just outside of the Board room) if it is thought to be a proper place for them.

What is proposed above will give a great sufficiency of work for the new fiscal year, and, unless the return of books from the bindery is greatly expedited, considerably more.

The force of the Division during the past fiscal year was as follows: F. H. Parsons, chief, and Artemas Martin, clerk, during the entire year; A. Upperman and John Dale, writers, during parts of the year; A. E. Young and W. A. Caldwell, copyists, each for a few days, and W. G. Finney and Chas. Harbaugh as messengers during parts of the year.

Summary of records received in the archives during the fiscal year 1892.

Original observations:
- 771 volumes.
- 74 cahiers.
- 1 172 Maregrams, chronograph sheets, traces, etc.
- 209 Bottom specimens.
- 75 Photographs.
- 100 Photograph negatives.
- 69 Topographic sheets (three only additions.)
- 54 Hydrographic sheets.

Duplicate observations:
- 607 volumes.
- 93 cahiers.
- 11 Photographs.

Field computations:
- 7 volumes.
- 137 cahiers.

Office computations:
- 15 cahiers.

Accessions to the library, 1891–1892.

Books purchased	350 volumes.
Books donated and by exchange	478 volumes.
Pamphlets purchased	8
Pamphlets donated and by exchange	99
Serials purchased	684
Serials donated and by exchange	2 265
Maps purchased	3
Maps donated and by exchange	3 195
Books sent to bindery	895 volumes.
Books received from bindery	441 volumes.

Very respectfully yours,

FRANCIS H. PARSONS,
Chief of the Library and Archives Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

OFFICE REPORT No. 2—1892.

REPORT OF THE HYDROGRAPHIC INSPECTOR FOR THE FISCAL YEAR, 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE HYDROGRAPHIC INSPECTOR,
Washington, D. C., October 5, 1892.

SIR: I have the honor to make the following report of hydrographic progress for the fiscal year ending June 30, 1892, including a synopsis of the movements of, and repairs made to, Coast Survey vessels, with a list of their officers and a table showing the various changes among the officers of the Navy attached to the Survey during the year. I also append the reports of the chiefs of the Hydrographic and Coast Pilot Divisions:

HYDROGRAPHY—ATLANTIC COAST.

Nantucket and Monomoy Shoals.—As soon as the necessary officers were available, the hydrographic parties were sent to the field, and the beginning of the fiscal year found the steamers *Blake*, *Bache*, and *Endeavor* in the vicinity of Nantucket Shoals, where they had been since the early part of June in order to take advantage of the clear weather that usually prevails during that month. Unfortunately the weather was unusually bad for hydrographic work and continued so during the most of the season. The work was pushed as rapidly as possible, but was much delayed by an accident to the boilers of the *Bache* which necessitated her being towed to New York for repairs, so that her services were lost for a month, besides diverting the services of the *Blake* for a number of days while towing the *Bache*.

The hydrography of Nantucket Shoals is one of the most difficult pieces of work of that nature that the Survey has ever accomplished. The adjacent land is low, so that the most conspicuous signals could not be seen more than 15 miles under the most favorable circumstances, and a considerable part of the ground covered lies beyond the range of visibility of shore signals. The currents are very strong and constantly varying in their direction, and the atmospheric condition is frequently unfavorable for seeing more than a few miles. To assist in overcoming these difficulties, the Lighthouse Board kindly placed for our use nine first class can and five spar buoys. Advantage was taken of exceptionally clear days to locate these buoys, and from them the work was carried on many days when shore signals were not visible. The Coast Survey schooner *Scoresby* was also used as a floating signal in connection with the buoys. During the first week in September, by the assistance of a lighthouse tender, these buoys were shifted from their first position to the westward of the South Shoal, to a line extending from the eastward of McBlairs Shoal, outside of the Rose and Crown, nearly 25 miles to the southward. This line of buoys in connection with the *Scoresby*, enabled accurate determinations to be made over the eastern part of the work, and enabled the parties to carry on boat work on the Rose and Crown and Old South Shoal when shore signals were not visible.

During the northeast gale of September 7, the *Scoresby* dragged on to the Old South Shoal, and on the night of the 11th, she probably filled and was carried over the shoal by the strong current and sank in the deep water to the southward of it. On the following day search was made for her by Lieut. E. M. Hughes, U. S. N., commanding the *Bache*, but only some small articles belonging to her were found.

This vessel was of very little value to the Government except for this purpose, and was not worth repairing. It is rather remarkable that without any one on board, she rode out the storms of two seasons on these shoals with her ordinary ground tackle to hold her, and only succumbed to the elements when her mission was about at an end.

Work was continued on Nantucket Shoals until their respective parts were finished. The *Blake's* work was closed September 27, the *Bache's* and *Endeavor's* November 4. November 9, on her way to New York, the *Bache* made an examination of Squipnocket Ridge Shoal.

On June 16, 1892, the *Blake* returned to Nantucket to execute hydrography off the eastern entrance to Nantucket Sound, and was engaged on this work at the end of the year.

Early in June, 1891, the schooner *Eagre*, with party under the command of Lieut. W. P. Elliott, U. S. N., Assistant Coast and Geodetic Survey, proceeded to Shelter Island Sound and began work. Owing to not having the necessary officers, very little was done until after the commencement of this fiscal year, when the work was pushed as rapidly as possible with the small number of officers available. The work was closed October 16, Lieut. Elliott having finished the survey of Shelter Island Sound and Great and Little Peconic Bays. The *Eagre* was laid up at New London, Connecticut, for the winter, and Lieut. Elliott, who was detached from the Survey, was succeeded in command by Lieut. W. F. Low, U. S. N. On May 24 Lieut. Low proceeded to Boston, Massachusetts, and on June 1 began work in Boston Harbor, where his vessel was at the end of the fiscal year.

COAST OF VIRGINIA—OFF CAPE CHARLES.

Owing to shoal water having been reported some 20 miles to the eastward of Cape Charles, Lieut. C. E. Vreeland, U. S. N., Assistant Coast and Geodetic Survey, commanding steamer *Blake*, on February 5, was directed to make an examination, and found a depth of 10 fathoms, only a few fathoms less than shown near by on Coast Survey charts. This was confirmed by a reëxamination made by the same officer on May 10–13.

BEAUFORT RIVER—SOUTH CAROLINA.

On January 2, 1892, Lieut. C. E. Vreeland, U. S. N., commanding the steamer *Blake*, was directed to proceed to Beaufort River, South Carolina, and execute the hydrography from Station Creek to a point above the new United States Naval Station, and the northern limit of this work was at a later date extended up the river 3 miles. Work was commenced March 3, and a very satisfactory survey was completed May 4, 1892, when the *Blake* was ordered north.

ENTRANCE TO ST. SIMON SOUND, GA.

Lieut. E. M. Hughes, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Bache*, was directed to stop on his way north from the Gulf of Mexico and make an examination of the shoal part of the bar at the entrance to St. Simon Sound, it being an obstruction to commerce entering the port of Brunswick, Georgia. The party was engaged in this work between May 28 and June 9. This examination developed no material change either in the depth of water or position of the bar, nowithstanding the fact that private parties claimed that a much greater depth of water had been obtained by the explosion of dynamite on this bar.

GULF OF MEXICO.

Mobile Bay, Alabama.—Acting under your instructions of January 16, 1892, the steamer *Bache*, Lieut. E. M. Hughes, U. S. N., commanding, proceeded to Mobile Bay, and on March 2, began a hydrographic survey.

So many of the triangulation points in this vicinity had disappeared entirely, and the topography had so changed, that new points and shore line had to be determined by Assistant J. B. Baylor. In addition to the development of the bar and entrance of the bay, Lieut. Hughes made an examination of the dredged channel leading to Mobile, completing his work May 21, 1892, when the *Bache* proceeded north and almost immediately began work in Boston Harbor, where this party was at work at the end of the fiscal year.

COAST PILOT WORK.

On May 24, Lieut. L. K. Reynolds, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, was directed to make an examination of Boo-hoo Ledge and the Brambles near Salem Harbor, Massachusetts, and on June 24 the field officers of the

Coast Pilot Division having joined him, proceeded to verify the new sailing directions for the Atlantic Coast Pilot, Part III, and was engaged in this work at the end of the fiscal year.

Hydrography was also executed on the Atlantic Coast by Assistant H. L. Marindin on the south shore of Nantucket Island; by Assistant C. T. Iardelia, in Mecox and Georgica Ponds, Long Island; by Assistant W. I. Vinal, from Cromwell to Hartford, Connecticut River, Connecticut; by Assistant E. E. Haskell and Mr. R. A. Marr, in Absecon Inlet, coast of New Jersey; by Assistant E. E. Haskell, in Potomac River, near the city of Washington; by Assistant P. A. Welker, in Blackwater Bay, Florida, and by Assistant H. G. Ogden, at the mouth of Brazos River, Texas.

HYDROGRAPHY—PACIFIC COAST.

Coasts of Oregon and Washington.—The steamer *Hassler*, Lieut. D. Delehanty, U. S. N., Assistant Coast and Geodetic Survey, commanding, having been detained on account of necessary repairs, did not leave San Francisco for her working ground until September 2. From September 7 until October 20 this party was engaged in hydrographic work off the coast of Washington. This work is most difficult to execute, and there was no place within its limits where it was possible to make a landing, so that the tide gauge had to be kept near Cape Flattery, more than 60 miles to the northward. The numerous outlying rocks and ledges made it very dangerous to approach the coast with the ship, and the almost constant heavy swell made the boat work most difficult.

On March 2, Lieut. Delehanty was detached from the command of the *Hassler*, the Survey thus losing the services of a most intelligent and successful commanding officer.

Willapa Bay.—The steamer *Gedney*, Lieut. J. M. Helm, U. S. N., Assistant Coast and Geodetic Survey, commanding, resumed work in these waters on April 16, 1891, and from that time on until October 30, an unusually large season's work was accomplished by this party. The hydrography of Willapa Bay was completed and a plane-table survey of the Willapa River with the necessary hydrography was made from South Bend to Willapa City. During the month of September, Lieut. Helm executed the hydrography of the outside coast from Cape Meares to Hay Stack Rock and a resurvey of Grays Harbor Bar. On October 30 the season's work was closed and Lieut. Helm was directed to proceed to San Francisco. After filling with coal at Astoria he started south, but encountering a most violent southeast gale during which the most of his coal was consumed, and with no hope of reaching San Francisco with what was left, he finally returned to Astoria, when permission was given him to take the vessel to Portland for the winter.

I deem it most fortunate and much to the credit of her officers that a vessel of the *Gedney's* size and with so little steam power should have successfully weathered one of the most violent gales that has been known for years on the coast of Oregon, which caused a number of most disastrous wrecks, and severely tried the endurance of some of the best steamers on the Pacific Coast.

Lieut. Helm commanded the *Gedney* on her voyage from the Atlantic Coast to the Pacific, and his services have since been of the greatest value to the Survey. His term of service having expired, he was detached on February 1. The *Gedney* remained at Portland in command of Ensign A. N. Mayer, U. S. N., until April 26, when she went to Astoria to take part in celebrating the discovery of the Columbia River. At the end of the year she was still at Portland, not having the officers necessary to carry on work.

Gulf of Georgia and Washington Sound.—On April 2, 1891, the schooner *Earnest*, Lieut. J. N. Jordan, U. S. N., Assistant Coast and Geodetic Survey, commanding, began work in the Gulf of Georgia, north of Orcas Island. Owing to the reduced number of men allowed to Coast Survey vessels by the Navy Department, it was necessary to lay this vessel up and discharge her crew. The steamer *McArthur*, Lieut. W. P. Ray, U. S. N., Assistant Coast and Geodetic Survey, commanding, being short of officers, was directed to proceed to the waters of Washington and take up the work commenced by the *Earnest's* party. The officers of the *Earnest*, with the exception of Lieut. Jordan, were transfered to the *McArthur;* and thus reinforced,

Lieut. Ray accomplished a most creditable season's work. He finished all the hydrography of Washington Sound as far as the triangulation and topography had been executed, and in addition to this he executed enough triangulation to enable him to run in by the plane table a number of miles of shore line adjoining his hydrography.

He closed his season's work on November 15, and the vessels in the waters of Puget Sound—the *Earnest*, *Fuca*, and *Helen*—were towed to Olympia, where they wintered in Butler Cove.

Alaska explorations.—The steamer *Patterson*, Lieut. Comdr. H. B. Mansfield, U. S. N., Assistant Coast and Geodetic Survey, commanding, having been refitted at San Francisco, sailed from that port on April 5, 1891, and on May 5 began work near the southern entrance of Behm Canal. This work was successfully carried on, and before the close of the season had connected with the work of Lieut. R. Clover, U. S. N., entirely encompassing Revillagigedo Island and demonstrating that what had been formerly known as Hassler Island was a part of the former.

This work was conducted under great natural difficulties and has very greatly changed the shore line of Revillagigedo Island as formerly indicated.

After completing the survey of Carroll Inlet, the season's work was closed on September 18, and the *Patterson* returned to San Francisco, and from that time forward the party was engaged in office work. On February 2, Lieut. Comdr. Mansfield was detached from the command of the *Patterson* and his successor, Lieut. Comdr. W. I. Moore, U. S. N., Assistant Coast and Geodetic Survey, took command; the vessel was refitted and on April 10, sailed for Alaskan waters, where work was commenced in Boca de Quadra on May 11, and at the end of the year the party was at work in this vicinity.

The steamer *McArthur*, Lieut. W. P. Ray, U. S. N., commanding, was also made ready for work in Alaskan waters. Before starting, on March 19, Lieut. Ray was directed to proceed to Barclay Sound, Vancouver Island, to obtain information desired by the State Department. This duty was most satisfactorily performed, but unfortunately, while preparing for it, the *McArthur* was accidently sunk alongside of the coal dock at Seattle, Washington. Through the energy of her officers she was raised the following day, and, after a short delay, enabled to carry out instructions, not having been injured by a twenty-four hours' immersion.

By great exertion she was made ready in time and proceeded to the working ground in company with the *Patterson* and *Hassler*. Advantage was taken of the services of one pilot, Mr. Francis, to carry the three ships through the waters of British Columbia.

Lieut. Ray was directed to execute the hydrography of Dixon Entrance north of the boundary and between Cape Chacon and Cape Fox. At the end of the year he was still engaged on this work. The schooner *Earnest*, although not in commission, took a not unimportant part in this season's work. Lieut. Comdr. Moore was directed to use her as a coaling base for the ships. She was accordingly towed to Departure Bay, where 125 tons of coal were put on board of her, and then towed to Port Simpson, from which point she will be returned to Eagle Harbor, Washington, at the end of the season.

Alaska boundary.—The steamer *Hassler*, Lieut. Giles B. Harber, U. S. N., Assistant Coast and Geodetic Survey, commanding, sailed from San Francisco on April 16, having in addition to her usual complement a civil party on board under the command of Assistant J. E. McGrath, charged with the determination of the position of Mount St. Elias and other work. Lieut. Harber was directed to give such assistance as required in this work, and in addition to make a hydrographic survey of Yakutat Bay. From Port Townsend the *Hassler* accompanied the *Patterson* and *McArthur* as far as Port Simpson, from which point Lieut. Harber was directed to take the steamer *Cosmos* to assist in the work in Yakutat Bay, on which they were engaged at the end of the year.

In addition to the above mentioned work on the Pacific Coast, Assistant J. J. Gilbert executed the hydrography of the harbors of Whatcom, Fairhaven, Olympia, Port Townsend, Port Angeles, and Anacortes for the Harbor Commission of the State of Washington.

The following list gives the statistics of the hydrographic work executed in 1891–1892:

Statement of Hydrographic Surveys executed during the fiscal year ending June 30, 1892.

Parties.		Localities.	Surveyed by—	Sheets.	Scale.	Number of—					Remarks.
Naval.	Civilian.					Vols.	Angles.	Soundings.	Miles.	Square miles.	
1	----	Monomoy Shoals and Passage	L. K. Reynolds, U. S. N.	1	20 000	18	6 084	32 540	755	79	
5	----	Eastern entrance, Nantucket S'nd.	C. E. Vreeland, U. S. N.	1	40 000	3	842	3 891	260	70	
2	----	Nantucket Shoals, Davis Bank, and Fishing Rip.	C. E. Vreeland, U. S. N.	1	40 000	3	400	4 688	639	562	
3	----	Nantucket Shoals, principal sheet.	E. M. Hughes, U. S. N.	1	40 000	13	4 225	20 139	1 215	700	
2	----	South of Nantucket Island	C. E. Vreeland, U. S. N.	1	40 000	3	916	3 115	435	210	
	1	South shore of Nantucket Island.	H. L. Marindin, Ass't	1	10 000	5	814	2 669	25	1¼	
	1	Katama Bay and Edgartown Harbor.	H. L. Marindin, Ass't	1	10 000		1 778	7 393	66	3	
3	----	Squipnocket Point, outer shoal	E. M. Hughes, U. S. N.	----	20 000	1	5	777	10	0	Examination.
4	----	Shelter Island Sound, Great and Little Peconic Bays.	W. P. Elliott, U. S. N.	5	10 000	62	16 591	131 986	1 482	52	
4	----	Gardiners Bay, off Acabonack Harbor.	W. P. Elliott, U. S. N.	----	20 000	1	48	243	3	0	Examination.
4	----	Break in North Point of Gardiner's Island.	W. P. Elliott, U. S. N.	----	20 000		26	128	2	0	Examination.
	2	Mecox and Georgica Ponds, Long Island.	C. T. Iardella, Assistant	1	10 000	2	168	2 278	26	1½	
	3	Connecticut River, Cromwell to Hartford.	W. I. Vinal, Assistant	2	10 000	4	925	10 558	102	3	
	4	Coast of New Jersey, Absecon Inlet to Pecks Beach Life-Saving Station.	E. E. Haskell, Assistant	1	10 000	3	1 776	3 974	73	17	
	5	Inside waters, coast of New Jersey.	R. A. Marr, Assistant	4	----	----	----	----	----	----	No data in yet.
	4	Head of Washington Channel, Potomac River.	E. E. Haskell, Assistant	1	1 600	1	146	190	1¼	0	
5	----	Search for reported shoal off Cape Charles, Va.	C. E. Vreeland, U. S. N.	----	200 000	1	----	732	121	50	Examination.
5	----	Surv. of shoal off Cape Charles, Va.	C. E. Vreeland, U. S. N.	1	100 000	1	118	1 288	213½	66	
5	----	Beaufort River, S. C., Bay Point to Old Fort.	C. E. Vreeland, U. S. N.	2	10 000	19	3 091	29 271	267	12¼	
6	----	St. Simon Entrance, Outer Bar	E. M. Hughes, U. S. N.	1	20 000	4	1 432	8 209	65	1	
6	----	Key West Harbor	E. M. Hughes, U. S. N.	----	----	1	11	125	1	0	Examination.
	6	Blackwater Bay, Fla	P. A. Welker, Assistant	1	10 000	7	824	14 301	229	10	
6	----	Entrance to Mobile Bay, Ala.	E. M. Hughes, U. S. N.	2	20 000	31	12 298	63 358	943½	99	
	7	Mouth of Brazos River, Tex.	H. G. Ogden, Assistant	1	10 000	2	621	3 613	60	2	
7	----	Speed Course, San Francisco Bay.	D. Delehanty, U. S. N.	1	10 000	----	----	----	----	----	
8	----	Cape Meares to Cape Kiwanda, Oregon.	J. M. Helm, U. S. N.	2	20 000	6	2 924	5 751	396	237	
8	----	Grays Harbor Entrance, Wash.	J. M. Helm, U. S. N.	1	20 000	4	848	4 485	101	16	
8	----	Willapa Bay and River	J. M. Helm, U. S. N.	4	2–10 000 / 2–20 000	10	3 333	12 296	195	39	
7	----	Coast of Washington, James Island to Osett Island.	D. Delehanty, U. S. N.	1	40 000	4	1 231	1 655	184	36	
9	----	Washington Sound and Gulf of Georgia, Wash.	W. P. Bay and J. N. Jordan, U. S. N.	4	20 000	26	6 995	20 064	1 362	90	
9	----	City of Seattle Rock, Ship Harbor, Wash.	W. P. Bay, U. S. N.	1	10 000	1	66	159	2¼	0	
10	----	Customhouse Cove, Mary Island, southeastern Alaska.	H. B. Mansfield, U. S. N.	1	5 000	4	197	560	12	0	
10	----	Behm Canal, southeastern Alaska.	H. B. Mansfield, U. S. N.	10	Various.	15	10 465	11 348	1 601	1 100	
	8	Harbors of Whatcom, Fair Haven, Olympia, Port Townsend, Port Angeles, and Anacortes.	J. J. Gilbert, Assistant	11	5 000	15	4 290	29 988	507¼	17	For Harbor Commission of State of Washington.
10	8										
18		Grand total for year ending June 30, 1892		65	Various.	270	83 488	431 772	11 355	3 474	

No deep-sea work. Number of specimens of bottom, 196. Current stations occupied by hydrographic parties, 184.

HYDROGRAPHIC DIVISION.

The Hydrographic Division of this office has been for the past year under the charge of Lieut. Robt. T. Jasper, U. S. N. There has been no change in the force of this Division except that Mr. E. Willenbucher is suffering from a serious illness which threatens to incapacitate him for further work. Mr. Willenbucher would be a great loss to this office, having been connected with the Survey for thirty years or more, and his experience as a hydrographic draughtsman is most valuable.

By more thoroughly systematizing the methods of making chart corrections, Lieut. Jasper has greatly improved the results obtained, and they are now so carefully executed and verified that I can safely say that the Coast Survey charts were never before so nearly correct in all their details.

Lieut. Jasper's report is forwarded herewith, and his recommendations are worthy of earnest consideration.

COAST PILOT DIVISION.

There was no officer in charge of this Division from the beginning of the fiscal year until October 8, when Lieut. E. H. Tillman, U. S. N., was ordered to rejoin this office and resume his former work. Before Mr. Tillman came to this office the final proofs of the Atlantic Coast Pilot, Parts I and II, passed through, and the book was given to the public during the summer, but not as early as it might have been had it not been so long delayed in the Government Printing Office.

This Division suffered in the loss of Mr. John Ross, who had been connected with it for five years. Besides having been a mariner by profession, he had served a number of years as a member of Coast Survey parties, and was thoroughly familiar with all its workings in addition to being a very fair draughtsman.

For an account of the work executed by this Division after October 8, I would refer you to Mr. Tillman's report, which is appended.

ALASKA COAST PILOT.

The manuscript of the Coast Pilot, covering the coast from Cape Flattery to Yakutat Bay, prepared by Comdr. H. E. Nichols, U. S. N., having been verified and corrected according to the latest surveys by Mr. Charles Junken, has been published. Steps are now being taken to secure all possible information in regard to western Alaska with a view of publishing a second volume covering these waters.

REPAIRS AND MAINTENANCE OF VESSELS.

Atlantic Coast.—During the winter season of 1892 the steamer *Blake* was taken to the ship yard of W. E. Woodall & Co., Baltimore, Maryland, and in addition to a number of minor repairs, the spar deck was renewed from the engine room hatch aft. On the lower deck a new ice room and men's watercloset was built and deck renewed under them. On removing the old covering board the heads of a number of stern frames were found to be rotten; these were scarfed, and the *Blake* will only require some slight additional repairs to hull during the coming year.

The steamer *Endeavor* was put in the hands of Woodall & Co. and thoroughly rebuilt inside. The spar deck and deck house were renewed as far aft as the wardroom, the upper deck entirely renewed, pilot house enlarged, and two new masts put in. The engine was thoroughly overhauled, including one new "A" frame and a new condenser. This vessel was built for the Confederate Government during the late civil war. In all these years the spar deck had not been renewed, and was only covered by a thin sheathing. Upon taking this sheathing up the tracks for a forward pivot gun were still visible.

Such small incidental repairs as were due to the usual wear of the service were made to the steamer *Bache* and the schooners *Eagre*, *Transit*, *Spy*, and *Quick*.

The schooner *Ready* having been laid up at Charleston, South Carolina, for some time, it was found that her bottom was badly eaten by worms and it was with difficulty that she

could be kept afloat; and, as the amount of money available for repairs was not sufficient to put her in order, she was sold at public auction.

The steamer *Daisy*, an old vessel transferred from the Lighthouse Department to the Coast Survey, being unfit for further use, was also sold.

The schooner *Drift* having been borrowed by the Lighthouse Department for use as a light ship, is still in their hands.

Pacific Coast.—The steamers *Patterson* and *Cosmos*, which are engaged in the Alaska explorations, were given such minor repairs as their service and condition required.

The steamer *Hassler*. This vessel is now about twenty-five years old. It was found necessary to replace the after part of her spar deck from the engine room hatch aft. On removing the wood work the upper or stringer plates of her iron hull were found so entirely rusted out that it was necessary to renew them very generally.

The steamers *Gedney*, *McArthur*, *Fuca*, and *Helen*, and the schooner *Earnest* received such minor repairs as their condition required.

NEW VESSELS.

It is a perfectly well-known fact that spending large sums of money to keep old and worn out steamers going is not economy, yet for the want of money the Coast Survey is obliged to do this.

The steamer *Bache* on the Atlantic Coast and the *Hassler* on the Pacific are neither of them worthy of further extensive repairs. Their engines are of an antiquated type and not of sufficient power to do the work properly that they are called on to do; neither of them can steam against a moderate gale.

I would recommend that a new steamer of modern design of about two hundred and fifty tons, which would cost about $65 000, be built to take the place of the *Bache*.

For the Pacific Coast I would recommend, to replace the *Hassler*, a vessel that could be used in the survey of western Alaska. On account of the great danger from sunken rocks, which are so numerous on this coast, this vessel should be built with a cellular double bottom. She should be of at least one thousand tons displacement and able to carry a large supply of provisions and coal.

Whenever the survey of this part of our country is to begin, one or more vessels of this class are absolutely necessary, our vessels on that coast, with the exception of the *Patterson*, being entirely inadequate for work in western Alaska and Bering Sea.

As for a number of years past, the clerical work of the Hydrographic Inspector's office has been done by Mr. J. H. Roeth.

Very respectfully,

SETH M. ACKLEY,
Lieut. Comdr., U. S. N.,
Hydrographic Inspector Coast and Geodetic Survey.

Dr. T. C. MENDENHALL,
Superintendent U. S. Coast and Geodetic Survey.

REPORT OF THE HYDROGRAPHIC DIVISION FOR THE FISCAL YEAR 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE HYDROGRAPHIC INSPECTOR,
Washington, D. C., September 14, 1892.

SIR: I have the honor to submit the usual report of the work done by the Hydrographic Division during the fiscal year ending June 30, 1892.

Of those employed in the work assigned to this Division, Messrs. E. Willenbücher, W. C. Willenbücher, F. C. Donn, draughtsmen, and E. H. Wyvill, chart corrector, I can only speak in terms of the highest praise. The continued absence of Mr. E. Willenbücher, due to illness, would have seriously crippled the Division were it not for the industry and perseverance of the other two draughtsmen, who have diligently struggled to keep the work up to date.

Mr. Wyvill continues to perform the miscellaneous duties of draughtsman and clerk in the office of the chief of the Division to my entire satisfaction, and I again recommend that his present appointment as chart corrector be changed to one as draughtsman, as that rating more nearly represents the nature of the work he performs.

I have to repeat the recommendations contained in my last annual report in regard to the issue of supplements to the Alaska Coast Pilot, compiled from the reports of the surveys made in the interior waters of southeastern Alaska since the date of the present edition. These supplements should certainly be ready for issue contemporaneously with the publication of the charts based upon those surveys.

I beg also to call your attention to that portion of my last year's report that bears upon the relation of the work done by the U. S. Engineers in our harbors to the publication of Coast Survey charts, and urgently suggest that the recommendation therein made be carried out, if possible.

The following represents approximately the class and amount of work performed by the draughtsmen of the Division during the year:

Plotting of original sheets	57
Verifications of reduced drawings	119
Verification, correction, and revision of proofs	113

together with the work of plotting and verifying the aids to navigation, and furnishing the usual notes for all new charts, and a vast amount of miscellaneous work. For the detailed work of the Division, you are respectfully referred to the monthly reports during the year.

Very respectfully,

ROBT. T. JASPER,
Lieut., U. S. N.,
Chief of Hydrographic Division

Lieut. Comdr. S. M. ACKLEY,
U. S. Navy,
Hydrographic Inspector Coast and Geodetic Survey.

REPORT OF THE COAST PILOT DIVISION FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., August 5, 1892.

SIR: I have the honor to submit the following report of the work of the Coast Pilot Division during the fiscal year ending June 30, 1892:

On July 15, 1891, Mr. John Ross, who had been employed in the Division for nearly five years, and rendered valuable services, resigned his position. From that time until October 8, the only work done in this Division was that performed by the copyist, posting files and copying.

On October 8 I reported for duty, assumed charge of the Division, and immediately began revising and correcting the first edition of Atlantic Coast Pilot, Part IV, "Long Island Sound with Approaches and Adjacent Waters," preparatory to the publication of the second edition. On March 24, 1892, this work was completed and the manuscript sent to the printer. On April 25, the first galley proofs were received, and on June 24 the final proofs of the index were corrected and returned to be printed, and the volume is now being issued. It is very gratifying to have a volume published so promptly after the preparation of the manuscript; it saves much labor in reading the proofs, avoids the necessity of many corrections in the proofs, and makes it more valuable to the mariner, as it is much more accurate and correct than when so long delayed in the press. The Coast Pilot volumes previously issued have

been from nine to fifteen months in passing through the press, while the last one was ready for issue in less than three and a half months from the time the manuscript was sent to the printing office.

The first edition of Atlantic Coast Pilot, Part IV, included "Long Island, with Approaches and Adjacent Waters," the second includes the same, and also the south coast of Long Island and New York Bay and Harbor.

From March 24 until June 22, the Division, when not engaged in reading and correcting proofs, was employed in the preparation of manuscript for a volume to cover the coast and waters between Cape Ann, Massachusetts, and Point Judith, Rhode Island. While much of the manuscript for this volume is prepared, a considerable amount of work is yet to be done before it will be ready for publication.

From June 23 to the end of the fiscal year, accompanied by Mr. Veith, I was engaged in Coast Pilot work afloat, in verifying sailing lines and descriptive matter and making examinations of reported or supposed dangers to navigation.

Mr. Eugene Veith was employed in the Division from September 19, 1891, until the end of the fiscal year. While his work has been of a peculiar and special character and new to him, he has, by his zeal, energy, and close attention to duty, been of great assistance.

Mr. Talbot Pulizzi has been employed in the Division during the entire fiscal year as a copyist, and his work has been very satisfactory.

Very respectfully,

E. H. TILLMAN,
Lieut. U. S. Navy,
Assistant Coast and Geodetic Survey,
Chief of Coast Pilot Division.

Lieut. Comdr. S. M. ACKLEY,
U. S. Navy,
Hydrographic Inspector Coast and Geodetic Survey.

List of Naval Officers attached to the United States Coast and Geodetic Survey during the fiscal year ending June 30, 1892.

Name.	Date attached.	Date detached.	Remarks.
LIEUTENANT COMMANDERS.			
S. M. Ackley	Oct. 2, 1889 Reattached Mar. 17, '92		Still in service.
W. I. Moore	Nov. 10, 1891		Still in service.
H. B. Mansfield	May 10, 1888	Feb. 2, 1892	
LIEUTENANTS.			
D. Delehanty	Mar. 20, 1889	Mar. 7, 1892	
Robt. T. Jasper	Dec. 3, 1889		Still in service.
Giles B. Harber	Jan. 26, 1892		Still in service.
W. F. Low	Aug. 1, 1891		Still in service.
E. M. Hughes	June 25, 1890		Still in service.
Chas. E. Vreeland	Oct. 25, 1889		Still in service.
W. P. Ray	Nov. 5, 1890		Still in service.
Wm. P. Elliott	Mar. 19, 1889	Jan. 28, 1892	
Lucian Flynne	June 6, 1892		Still in service.
E. J. Dorn	Apr. 1, 1889	Apr. 11, 1892	
J. M. Helm	Sept. 4, 1888	Feb. 1, 1892	
L. K. Reynolds	July 26, 1890		Still in service.
LIEUTENANTS—JUNIOR GRADE.			
Hiero Taylor	July 2, 1891	Sept. 21, 1891	
J. N. Jordan	June 13, 1889	Sept. 8, 1891	
W. L. Burdick	Aug. 17, 1890		Still in service.
Harry Kimmell	Dec. 18, 1888	Dec. 16, 1891	
H. S. Chase	Apr. 5, 1892		Still in service.
J. B. Blish	Nov. 5, 1890		Still in service.
C. W. Jungen	Mar. 31, 1892		Still in service.
T. W. Ryan	Mar. 21, 1891		Still in service.
Chas. S. Ripley	May 17, 1892		Still in service.
John Gibson	Mar. 18, 1891		Still in service.
J. H. Gibbons	Aug. 23, 1890	Aug. 31, 1891	
E. H. Tillman	Oct. 8, 1891		Still in service.
ENSIGNS.			
H. C. Poundstone	Feb. 5, 1890		Still in service.
W. C. P. Muir	July 27, 1890		Still in service.
J. H. Rohrbacher	July 17, 1890	May 29, 1892	
W. W. Buchanan	Aug. 5, 1890		Still in service.
A. N. Mayer	July 30, 1890		Still in service.
M. K. Eyre	Nov. 21, 1891		Still in service.
ENSIGNS—continued.			
John F. Luby	Dec. 14, 1888	July 9, 1891	
L. J. Clark	Sept. 18, 1891		Still in service.
Hugh Rodman	Apr. 1, 1891		Still in service.
H. B. Wilson	Oct. 6, 1890	July 9, 1891	
J. L. Jayne	June 24, 1892		Still in service.
J. G. Doyle	July 9, 1891		Still in service.
A. L. Key	Sept. 15, 1890	Nov. 16, 1891	
W. L. Howard	Feb. 23, 1891		Still in service.
J. M. Poyer	Sept. 15, 1890	Nov. 5, 1891	
Chas. P. Eaton	June 23, 1891		Still in service.
Harry George	May 2, 1890		Still in service.
F. L. Chapin	Feb. 17, 1891		Still in service.
W. B. Hoggatt	Feb. 14, 1891	Apr. 17, 1892	
W. G. Miller	Feb. 20, 1891	Oct. 30, 1891	
G. W. Kline	Apr. 26, 1892		Still in service.
G. Tarbox	Mar. 17, 1892		Still in service.
Benj. Wright	Feb. 20, 1891		Still in service.
J. W. Oman	July 18, 1891		Still in service.
W. H. Faust	Aug. 1, 1888	Oct. 20, 1891	
E. T. Witherspoon	May 31, 1891		Still in service.
E. Moale, Jr	Aug. 9, 1889	Jan. 15, 1892	
PASSED ASSISTANT SURGEONS.			
H. T. Percy	Mar. 10, 1889	Apr. 2, 1892	
C. J. Decker	Apr. 1, 1892		Still in service.
ASSISTANT SURGEONS.			
P. H. Bryant	Dec. 13, 1889	Dec. 5, 1891	
G. T. Smith	Mar. 28, 1892		Still in service.
E. S. Bogert	Nov. 10, 1890	June 1, 1892	
J. A. Guthrie	June 1, 1892		Still in service.
PAYMASTERS.			
H. T. Wright	Oct. 22, 1890		Still in service.
ASSISTANT ENGINEERS.			
E. H. Scribner	July 9, 1889	July 21, 1891	
Thos. F. Carter	Mar. 25, 1890		Still in service.
G. Kaemmerling	July 25, 1891		Still in service.
W. W. White	Dec. 19, 1888	July 30, 1891	
W. H. P. Creighton	July 30, 1891	June 30, 1892	
J. C. Leonard	Jan. 21, 1889	Mar. 31, 1892	
W. C. Herbert	Mar. 24, 1892		Still in service.

RECAPITULATION.

Lieutenant Commanders	3
Lieutenants	12
Lieutenants (Junior Grade)	12
Ensigns	27
Passed Assistant Surgeons	2
Assistant Surgeons	4
Paymasters	1
Assistant Engineers	7
	68

NOTE.—From the statement immediately following it appears that of the 68 officers above named, 43 were on duty in the Survey at the close of the fiscal year.

List of Naval Officers attached to the United States Coast and Geodetic Survey June 30, 1892.

COAST AND GEODETIC SURVEY OFFICE.

Lieut. Commander S. M. Ackley.
Lieut. Robt. T. Jasper.
Lieut. E. H. Tillman.
Paymaster H. T. Wright.

Steamer Bache (Atlantic Coast).—Lieut. E. M. Hughes, commanding; Lieut. W. L. Burdick; Ensign W. W. Buchanan; Ensign Hugh Rodman; Ensign G. W. Kline; Ensign J. W. Oman; Assistant Engineer G. Kaemmerling.

Steamer Blake (Atlantic Coast).—Lieut. Chas. E. Vreeland, commanding; Lieut. John Gibson; Ensign W. C. P. Muir; Ensign M. K. Eyre; Assistant Surgeon J. A. Guthrie.

Steamer Endeavor (Atlantic Coast).—Lieut. L. K. Reynolds, commanding; Lieut. T. W. Ryan.

Schooner Eagre (Atlantic Coast).—Lieut. W. F. Low, commanding; Lieut. Chas. S. Ripley.

Steamer Patterson (Pacific Coast).—Lieut. Commander W. I. Moore, commanding; Lieut. C. W. Jungen; Ensign H. C. Poundstone; Ensign W. L. Howard; Ensign F. L. Chapin; Ensign G. Tarbox; Passed Assistant Surgeon C. J. Decker; Assistant Engineer Thos. F. Carter.

Steamer Hassler (Pacific Coast).—Lieut. Giles B. Harber, commanding; Lieut. H. S. Chase; Lieut. J. B. Blish; Ensign L. J. Clark; Ensign J. G. Doyle; Ensign Benj. Wright; Assistant Surgeon G. T. Smith.

Steamer McArthur (Pacific Coast).—Lieut. W. P. Ray, commanding; Ensign Chas. P. Eaton; Ensign Harry George; Ensign E. T. Witherspoon; Assistant Engineer W. C. Herbert.

Steamer Gedney (Pacific Coast).—Lieut. Lucian Flynne, commanding; Ensign A. N. Mayer; Ensign J. L. Jayne.

Names of Vessels, their tonnage, etc., in the service of the United States Coast and Geodetic Survey, during the fiscal year ending June 30, 1892.

No.	Name of vessels.	Tonnage.	Complement of—	
			Officers.	Men.
1	Steamer *Patterson*	453	12	46
2	Steamer *Hassler*	243	10	34
3	Steamer *Blake*	218	10	38
4	Steamer *Bache*	186	10	38
5	Steamer *Gedney*	133	8	29
6	Steamer *McArthur*	112	7	30
7	Steamer *Endeavor*	105	7	23
8	Steamer *Hitchcock*	83	5	14
9	Steamer *Cosmos*	25	3	7
1	Schooner *Eagre*	202	6	26
2	Schooner *Drift*	87	5	14
3	Schooner *Earnest*	80	5	18
4	Schooner *Yukon*	78	6	14
5	Schooner *Matchless*		5	14
6	Schooner *Quick*	38	4	12
7	Schooner *Transit*	43	3	9
8	Schooner *Spy*	35	3	9

RECAPITULATION.

Steamers	9
Schooners	8
Total	17

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OFFICE REPORT No. 3—1892.

REPORT OF THE DISBURSING AGENT FOR THE FISCAL YEAR 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE DISBURSING AGENT,
Washington, D. C., November 30, 1892.

SIR: I have the honor to submit herewith the report of the Disbursing Office for the fiscal year ending June 30, 1892.

The accounts of the Survey have been examined and adjusted, and settlements effected during the year, as promptly as was consistent with accuracy and a thorough analysis of the innumerable items of expenditure. With few exceptions, the accounts of the Bureau have been made up and forwarded to the accounting officers of the Treasury during the month next following that in which the expenditures were incurred.

An examining committee, appointed by the Secretary of the Treasury, made a thorough investigation of the books, accounts, and vouchers of the office, during the month of October, 1891. The result proved the accounts to be in exact balance and was entirely satisfactory to the Department.

The aggregate of advances to chiefs of field parties during the year was $133 376·69. The total disbursements on adjusted accounts for the same period were $606 654·73. The number of vouchers, bills, etc., adjusted and paid was 21 043. Additional statistics of the work accomplished will be found in the files of the office.

The annual report of expenditures of the Coast and Geodetic Survey for the fiscal year ending June 30, 1891, was completed on March 1, 1892, and on the same date was forwarded to the Secretary of the Treasury for transmission to Congress. The report for the fiscal year just ended is in an advanced stage of completion and will be ready for transmission to Congress early in the coming month. As heretofore, I beg that it may be considered as forming part of this report.

Explanations as to various items in the accounts of the Bureau have been submitted by me from time to time, as called for by the accounting officers of the Treasury, with satisfactory results.

The force of the office has been as follows for the periods named:

Mr. N. G. Henry, confidential clerk and cashier, during the year.

Mr. A. B. Simons, clerk, from January 4, 1892, prior to which date he had been serving, by special detail, in the office of the First Comptroller of the Treasury.

Miss Paula E. Smith, writer, until February 29, 1892, when she tendered her resignation. Miss Smith's withdrawal from the service created a vacancy which it will be hard to fill.

Mrs. A. C. Sturges, clerk, by special detail from the Sixth Auditor's office, from April 26, 1892.

Miss Alice F. Carlisle, writer, during the year, when not engaged as a confidential typewriter to the Superintendent.

Respectfully yours,

JOHN W. PARSONS,
Disbursing Agent, U. S. Coast and Geodetic Survey.

The SUPERINTENDENT,
U. S. Coast and Geodetic Survey.

[House Ex. Doc. No. 253, Fifty-second Congress, second session.]

EXPENDITURES, COAST AND GEODETIC SURVEY, FISCAL YEAR 1892.

Letter from the Secretary of the Treasury, transmitting a statement of expenditures on account of the Coast and Geodetic Survey for the fiscal year ended June 30, 1892.

TREASURY DEPARTMENT, OFFICE OF THE SECRETARY,
Washington, D.C., March 1, 1893.

SIR. In compliance with section 264 of the Revised Statutes, I have the honor to transmit herewith a statement of expenditures made on account of the Coast and Geodetic Survey for the fiscal year ending June 30, 1892.

Respectfully yours,

CHARLES FOSTER,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

STATEMENT OF EXPENDITURES OF THE U. S. COAST AND GEODETIC SURVEY FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

[Prepared pursuant to act approved March 3, 1853.]

Salaries—Pay of field officers.

To whom paid.	Time employed.	Amount.
SUPERINTENDENT.		
Thomas C. Mendenhall	One year	$6 000·00
ASSISTANTS.		
George Davidson	One year	4 000·00
Charles A. Schott	do	4 000·00
Benjamin A. Colonna	do	3 600·00
Augustus F. Rodgers	do	3 200·00
Charles S. Peirce	Six months	1 500·00
George A. Fairfield	One year	3 000·00
Alenzo T. Mosman	do	3 000·00
Robert S. Woodward	do	3 000·00
William H. Dennis	do	2 800·00
John W. Donn	do	2 722·84
Cleveland Rockwell	Eleven months	2 385·70
William Eimbeck	One year	2 522·83
Henry L. Whiting	do	2 400·00
Edward Goodfellow	do	2 400·00
James S. Lawson	do	2 400·00
Herbert G. Ogden	do	2 400·00
Otto H. Tittmann	do	2 400·00
Richard M. Bache	do	2 200·00
Charles H. Boyd	do	2 200·00
John J. Gilbert	do	2 322·83
Henry L. Marindin	do	2 200·00
Andrew Braid	do	2 122·82
Gershom Bradford	do	2 000·00
Frank Walley Perkins	do	2 000·00
Spencer C. McCorkle	do	2 000·00
Frank D. Granger	do	2 000·00

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Salaries—Pay of field officers.

To whom paid.	Time employed.	Amount.
ASSISTANTS—continued.		
Edwin Smith	One year	$2 000·00
John F. Pratt	do	1 922·81
Cephas H. Sinclair	do	1 922·81
Richard E. Halter	do	1 800·00
Stehman Forney	do	1 800·00
Edmund F. Dickins	do	1 800·00
Joseph Hergesheimer	One year (waiting instructions twenty-six days)	1 768·14
Dallas B. Wainwright	One year	1 800·00
William C. Hodgkins	do	1 800·00
Erasmus D. Preston	do	1 800·00
James B. Baylor	do	1 722·81
John E. McGrath	do	1 708·68
Charles T. Iardella	do	1 600·00
Washington Irving Vinal	do	1 600·00
Charles H. Van Orden	do	1 600·00
Isaac Winston	do	1 600·00
John Henry Turner	Six months, seven days	830·43
Eugene E. Haskell	Seven months	934·80
SUBASSISTANTS.		
John Henry Turner	Five months, twenty-four days	673·40
Philip A. Welker	One year	1 400·00
Fremont Morse	do	1 400·00
John A. Flemer	do	1 400·00
Walter B. Fairfield	do	1 322·81
John Nelson	do	1 200·00
Fred. A. Young	Seven months	701·10
AIDS.		
Fred. A. Young	Five months	374·20
George R. Putnam	One year	900·00
James H. Gore	Two months, fifteen days	188·28
John F. Hayford	Sixteen days	39·13
John S. Siebert	One year	818·85
Expenditures		113 205·27
Appropriation		119 600·00
Expenditures		113 205·27
Unexpended balance		6 394·73

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
DISBURSING AGENT.		
John W. Parsons	One year	$2 200·00
GENERAL OFFICE ASSISTANT.		
Marshall W. Wines	One year	2 200·00
CHIEF OF DIVISION OF LIBRARY AND ARCHIVES.		
Francis H. Parsons	One year	1 800·00
CLERK TO SUPERINTENDENT.		
Martin Hensel	One year	1 200·00
CLERK TO ASSISTANT IN CHARGE OF OFFICE.		
Adelbert B. Simons	Eleven months, twenty-nine days	997·28

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
CLERKS.		
William B. French	One year	$1 650·00
William B. Chilton	Eleven months, twenty-nine and a half days	1 613·28
John H. Smoot	One year	1 400·00
William C. Maupin	——do	1 400·00
Artemas Martin	——do	1 400·00
Freeman B. Green	——do	1 200·00
Eugene B. Wills	——do	1 200·00
Nicholas G. Henry	——do	1 200·00
Frank A. Cook	——do	1 200·00
John W. Whitaker	——do	1 200·00
John Henry Roeth	——do	1 000·00
Frank W. Edmonds	——do	1 000·00
Eugene Rhodes	Nine months, three days	758·15
CHART CORRECTORS.		
James H. Barker	One year	1 200·00
Edward H. Wyvill	——do	1 200·00
Archie Upperman	——do	900·00
WRITERS.		
Virginia Harrison	One year	900·00
Lily A. Mapes	——do	900·00
Mary E. Nesbitt	Thirteen days	28·26
Kate Lawn	Eight months, twenty-five days	586·95
Alice F. Carlisle	One year	720·00
Ida M. Peck	Eleven months, twenty-six days	710·22
Alice G. Reville	One year	720·00
Fannie A. Weeks	One month, twenty-three days	87·41
Florence Brower	Eight months, nineteen days	516·57
Paula E. Smith	Seven months, twenty-seven days	472·83
Thacker V. Walker	Six months, thirty days	418·70
John Dale	Six months, thirty days	418·70
Ivy Hill	Six months, twenty-two days	363·28
W. A. Caldwell	Six days	11·74
Albert E. Young	Eleven days	21·52
STENOGRAPHERS.		
Eugene Rhodes	Two months, twenty-seven days	145·02
Harry J. Van Der Beek	Five months, twelve days	322·44
BUOY COLORISTS.		
Sophie S. Hein	Eleven months, twenty-nine days	716·08
Jennie H. Fitch	One year	720·00
Creed W. Childs	Four months, twenty-two days	283·64
TYPEWRITERS.		
Kate Lawn	Three months, six days	191·74
Fannie Cadel	One month	60·60
DRAUGHTSMEN.		
Adolph Lindenkohl	One year	2 400·00
Henry Lindenkohl	——do	2 200·00
Eugene Willenbücher	——do	2 000·00
Edwin H. Fowler	——do	2 000·00
Ferdinand Westdahl	——do	1 800·00
Ernest J. Sommer	Ten months, twelve and a half days	1 560·11
William C. Willenbücher	One year	1 800·00
Francis C. Donn	——do	1 400·00
David M. Hildreth	——do	1 400·00
Charles H. Deetz	——do	1 200·00
George F. Pohlers	——do	1 200·00

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
DRAUGHTSMEN—continued.		
Charles Mahon	One year	$1 000·00
Paul Erichsen	do	1 000·00
Edwin J. Pond	Six months, twenty-three days	506·87
Everett S. Mitchell	One year	900·00
Edmund P. Ellis	do	900·00
COMPUTERS.		
Alexander S. Christie	One year	2 000·00
Edward H. Courtenay	Eleven months, twenty-seven days	1 983·70
Myrick H. Doolittle	Eleven months, thirty days	1 994·57
John B. Boutelle	One year	1 600·00
Leland P. Shidy	do	1 600·00
Henry Farquhar	do	1 400·00
Louis A. Bauer	do	1 400·00
Charles H. Kummell	do	1 200·00
Frank M. Little	do	1 200·00
John F. Hayford	Five months, fifteen days	547·81
Rollin A. Harris	One year	1 085·17
James Page	Five months, fifteen days	456·56
COPPERPLATE ENGRAVERS.		
Henry M. Knight	One year	2 000·00
William A. Thompson	do	2 000·00
John G. Thompson	do	2 000·00
August Petersen	do	1 800·00
Theodore Wasserbach	do	1 800·00
Edward J. Enthoffer	do	1 800·00
Edward H. Sipe	do	1 600·00
William H. Davis	do	1 600·00
William F. Peabody	do	1 125·00
Henry L. Thompson	do	1 000·00
Alfred H. Sefton	do	825·00
William A. Van Doren	do	825·00
Emil A. Kuber	do	825·00
George Hergesheimer	do	525·00
John M. Williams	Two months, three days	42·36
Harry R. McCabe	One year	412·50
Gilbert F. Dawson	do	255·00
INSTRUMENT MAKERS.		
Ernst G. Fischer	One year	1 800·00
Otto Storm	Three months	300·00
William Gaertner	Ten months, twenty-nine days	1 040·17
Stephen A. Kearney	One year	1 000·00
William R. Whitman	do	1 000·00
Clarence E. Begennas	do	1 000·00
Jacob Schwarz	Nine months	750·00
Michael Lauxmann, Jr.	One year	700·00
ELECTROTYPER AND PHOTOGRAPHER.		
Daniel C. Chapman	One year	1 800·00
ELECTROTYPER.		
L. P. Keyser	One year	900·00
CARPENTERS.		
Horace O. French	One year	1 600·00
George W. Clarvoe	do	900·00
Charles N. Darnall	do	700·00

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Salaries—Pay of office force.

To whom paid.	To whom paid.	Amount.
PLATE PRINTERS.		
Frank Moore	One year	$1 600·00
Richard S. Bright	Eleven months, thirty days	997·28
Thomas A. Sullivan	One year	1 000·00
Charles J. Harlow	Eleven months, thirty days	997·28
Eberhard Fordan	Eight months	665·80
PLATE PRINTERS' HELPERS.		
Eberhard Fordan	Four months	234·00
James F. Dickson	One year	700·00
Otto Kemmler	Four months, seventeen days	267·29
William H. Waddington	Eight months	466·00
Charles F. Locraft	do	466·00
William H. Horne	Seven months, twenty-six days	458·46
Jerome F. Dandelet	Two months, fourteen days	145·23
JANITORS.		
William M. Long	Six months, twenty-five days	682·42
Calvin Shurtleff	Five months, six days	517·58
SKILLED LABORER.		
Robert T. Bassett	Eleven months, thirty and a half days	998·64
WATCHMEN.		
David Parker	One year	880·00
William H. Keith	do	880·00
MESSENGERS.		
William H. Butler	One year	880·00
Charles Over	do	820·00
Vicente Denis	do	820·00
Neil Bryant	do	820·00
Sandy Bruce	do	820·00
Charles H. Jones	do	820·00
William R. McLane	do	820·00
William G. Finney	Four months, twenty-two days	276·64
S. T. A. Van Sciver	Five months, twenty-three days	334·47
John W. Reed	Four months, twenty days	273·09
George Newman	Three months, thirteen days	200·00
William Savoy	One year	640·00
Peter Page	do	640·00
William West	do	640·00
Attrell Richardson	do	630·00
John F. Grinage	Eleven months, thirty days	548·51
John H. Brown	Four months, twenty days	245·72
LABORERS.		
John W. Reed	Seven months, nine days	384·28
George Newman	Eight months, eighteen days	449·96
John H. Brown	Seven months, nine days	335·40
William Young	One year	550·00
Samuel L. Eubank	Three months, thirteen days	157·10
Hans Bowdwin	One year	437·23
Dennis E. White	Four months, twenty days	142·37
Sarah E. Flynn	One year	365·00
FIREMEN.		
Horace Dyer	One year	630·00
Harrison Murray	do	572·94
Expenditures		137 132·92
Appropriation		143 130·00
Expenditures		137 132·92
Unexpended balance		5 997·08

EXPENDITURES OF THE COAST AND GEODETIC SURVEY, 1892.

Salaries—Pay of field and office force.

SUMMARY.	
Pay of field officers	$113 205·27
Pay of office force	137 132·92
Total expenditures	250 338·19
Total sum appropriated for salaries	262 730·00
Total sum expended for salaries	250 338·19
Unexpended balance	12 391·81

Party expenses, 1892.

COAST OF MAINE.

To whom paid.	On what account.	Amount.
S. H. Calligan	Storage	$9·00
J. A. Flemer	Topography	931·48
Stehman Forney	——do	1 740·26
W. F. Grant	Storage	60·00
J. E. Haley	——do	2·33
Joseph Hergesheimer	Combined operations	1 235·89
Horace Kellogg	Storage	8·00
Expenditures		3 986·96
Appropriation		3 000·00
Add 7 per cent from Gulf Coast		1 050·00
		4 050·00
Expenditures		3 986·96
Unexpended balance		63·04

NANTUCKET SHOALS, ETC.

To whom paid.	On what account	Amount.
R. M. Bache	Topography	$1 600·43
J. J. Becket	Storage	34·13
John W. Donn	Topography	1 781·15
Wm. P. Elliott, U. S. Navy	Hydrography, schooner *Eagre*	1 108·11
J. A. Flemer	Topography	280·26
W. C. Hodgkins	——do	1 375·99
E. M. Hughes, U. S. Navy	Hydrography, steamer *Bache*	1 774·02
C. T. Iardella	Topography and storage	1 967·70
W. F. Low, U. S. Navy	Hydrography, schooner *Eagre*	1 227·97
W. O. Luscombe	Storage	20·00
James Patten	Services	250·00
Philadelphia & Reading Coal and Iron Co	Coal, steamer *Bache*	711·67
L. K. Reynolds, U. S. Navy	Hydrography, steamer *Endeavor*	1 547·18
W. Irving Vinal	Topography and hydrography	1 922·75
D. B. Wainwright	Topography	1 489·04
Expenditures		16 990·40
Appropriation		15 000·00
Add 8 per cent from Oregon and Washington		2 000·00
		17 000·00
Expenditures		16 990·40
Unexpended balance		9·60

EXPENDITURES OF COAST AND GEODETIC SURVEY.

Party expenses, 1892.

TRIANGULATION—ALABAMA.

To whom paid.	On what account.	Amount.
F. Walley Perkins	Triangulation and storage	$3 619·64
Appropriation		3 500·00
Add 1·25 per cent from Triangulation—West		125·00
		3 625·00
Expenditures		3 619·64
Unexpended balance		5·36

GULF COAST.

To whom paid.	On what account.	Amount.
M. W. Bateman	Storage	$2·50
J. B. Baylor	Combined operations	2 929·73
John Brown	Services	408·07
Bureau of Equipment and Recruiting, Navy Department.	Coal, steamer *Bache*	110·80
E. Collins	Services	600·00
Delaware and Hudson Canal Co	Coal, steamer *Bache*	275·40
Joseph Hergesheimer	Combined operations and storage	1 764·95
E. M. Hughes, U. S. Navy	Hydrography, steamer *Bache*	2 693·23
Herbert G. Ogden	Topography and hydrography	405·54
George Olsen	Services	408·06
F. Walley Perkins	Storage	7·50
P. A. Welker	Combined operations and sale of property	2 525·85
Expenditures		12 131·63
Appropriation		15 000·00
Less 7 per cent transferred to Coast of Maine	$1 050·00	
Less 8 per cent transferred to Alaska Explorations	1 200·00	
Less 4 per cent transferred to Transcontinental Work	600·00	
Expenditures	12 131·63	
		14 981·63
Unexpended balance		18·37

OFFSHORE SOUNDINGS, ETC.

To whom paid.	On what account.	Amount.
C. E. Vreeland, U. S. Navy	Hydrography, steamer *Blake*	$6 398·70
Appropriation		8 000·00
Less 20 per cent transferred to Transcontinental Work	$1 600·00	
Expenditures	6 398·70	
		7 998·70
Unexpended balance		1·30

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

TOPOGRAPHY—CALIFORNIA.

To whom paid.	On what account.	Amount.
John Nelson	Traveling expenses	$81·50
Aug. F. Rodgers	Topography, triangulation, pasturage, and sale of property	3 547·87
Amount disbursed		3 629·37
Railroad accounts referred for settlement		227·91
Expenditures		3 857·28
Appropriation		5 000·00
Less 20 per cent transferred to Transcontinental Work	$1 000·00	
Expenditures	3 857·28	
		4 857·28
Unexpended balance		142·72

TRIANGULATION—WEST.

To whom paid.	On what account.	Amount.
George Davidson	Triangulation	$2 060·39
E. F. Dickins	Triangulation and pasturage	5 834·53
Amount disbursed		7 894·92
Railroad accounts referred for settlement		58·95
Expenditures		7 953·87
Appropriation		10 000·00
Less 1·25 per cent transferred to Triangulation—Alabama	$125·00	
Less 0·25 per cent transferred to Magnetic Observations	25·00	
Less 10 per cent transferred to Transcontinental Work	1 000·00	
Less 1 per cent transferred to Transportation (Navy), etc	100·00	
Expenditures	7 953·87	
		9 203·87
Unexpended balance		796·13

OREGON AND WASHINGTON.

To whom paid.	On what account.	Amount.
W. S. Allen	Services	$309·25
Bureau of Equipment, Navy Department	Standard ship's compass and attachments for steamer *Hassler*	334·11
D. Delehanty, U. S. Navy	Hydrography, steamer *Hassler*	3 490·57
E. F. Dickins	Storage, etc	48·00
R. Dunsmuir & Sons	Coal and water for steamer *McArthur*	169·50
Lucian Flynne, U. S. Navy	Hydrography, steamer *Gedney*	236·33
J. J. Gilbert	Care of property	60·00
Giles B. Harber, U. S. Navy	Hydrography, steamer *Hassler*	2 840·57
J. M. Helm, U. S. Navy	Hydrography, steamer *Gedney*	2 886·18
C. J. Hendry's Son & Co	Stores for steamer *McArthur*	224·53
J. N. Jordan, U. S. Navy	Hydrography, schooner *Earnest*	97·93
A. N. Mayer, U. S. Navy	Hydrography, steamer *Gedney*	1 031·41
A. Newhall	Lumber for steamer *McArthur*	29·43
Oregon Improvement Co	Coal for steamer *McArthur*	114·45
J. F. Pratt	Combined operations	2 866·68
W. P. Ray, U. S. Navy	Hydrography, steamer *McArthur*	3 857·29
Cleveland Rockwell	Combined operations and storage	1 383·73
James Ryan	Services	33·50

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

OREGON AND WASHINGTON.

To whom paid.	On what account.	Amount.
John F. Rany	Services	$25·00
Ship Owners and Merchants' Tug Boat Co	Towing steamer *McArthur*	50·00
Expenditures		20 088·46
Appropriation		25 000·00
Less 8 per cent transferred to Nantucket Shoals, etc	$2 000·00	
Less 11 per cent transferred to Alaska Explorations	2 750·00	
Expenditures	20 088·46	
		24 838·46
Unexpended balance		161·54

ALASKA EXPLORATIONS.

To whom paid.	On what account.	Amount.
George Davidson	Transportation	$400·00
Giles B. Harbor, U. S. Navy	Hydrography, steamer *Hassler*	1 162·06
H. B. Mansfield, U. S. Navy	Hydrography, steamer *Patterson*	4 294·85
J. E. McGrath	Astronomical	1 589·78
W. I. Moore, U. S. Navy	Hydrography, steamer *Patterson*	5 392·39
Fremont Morse	Astronomical	470·28
W. P. Ray, U. S. Navy	Hydrography, steamer *McArthur*	526·91
Amount disbursed		13 836·27
Railroad accounts referred for settlement		25·00
Expenditures		13 861·27
Appropriation		10 000·00
Add 8 per cent from Gulf Coast		1 200·00
Add 11 per cent from Oregon and Washington		2 750·00
		13 950·00
Expenditures		13 861·27
Unexpended balance		88·73

PHYSICAL HYDROGRAPHY.

To whom paid.	On what account.	Amount.
E. E. Haskell	Services	$300·00
Knox's express	Transportation of outfit	12·24
Henry L. Marindin	Physical surveys and computations	5 895·95
Expenditures		6 208·19
Appropriation		8 000·00
Less 20 per cent transferred to Magnetic Observations	$1 600 00	
Expenditures	6 208 19	
		7 808·19
Unexpended balance		191·81

REPORTED DANGERS.

To whom paid.	On what account.	Amount.
Delaware and Hudson Canal Co	Coal for steamer *Bache*	$399·50
Appropriation		500·00
Expenditures		399·50
Unexpended balance		100·50

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

MAGNETIC OBSERVATIONS.

To whom paid.	On what account.	Amount.
J. B. Baylor	Magnetics	$820·85
George Davidson	do	15·05
R. E. Halter	do	1 500·23
T. C. Mendenhall	do	135·20
L. G. Schultz	Constructing observatory	1 643·85
Expenditures		4 121·18
Appropriation		2 500·00
Add 0·25 per cent from Triangulation—West		25·00
Add 20 per cent from Physical Hydrography		1 600·00
		4 125·00
Expenditures		4 121·18
Unexpended balance		3·82

EXACT LEVELING.

To whom paid.	On what account.		Amount.
Isaac Winston	Precise leveling		$3 912·82
Appropriation			5 000·00
Less 20 per cent transferred to Transcontinental Work		$1 000·00	
Expenditures		3 912·82	
			4 912·82
Unexpended balance			87·18

TIDAL OBSERVATIONS.

To whom paid.	On what account.		Amount.
Alex. S. Christie	Tidal observations and contingencies		$42·22
Arthur J. Collyer	Services and contingencies		677·95
George Davidson	Sausalito tidal		1 140·31
David Hamilton	Subsistence		45·50
E. E. Haskell	Traveling expenses		16·35
Spencer C. McCorkle	Observing tides		352·39
Francis S. Patton	Rent of cottage		96·00
J. G. Spaulding	Services, contingencies, and traveling expenses		971·63
Eugene Veith	do		318·67
Isaac Winston	Cedar Keys and St. Augustine tidal		786·94
Expenditures			4 447·96
Appropriation			5 000·00
Less 10 per cent transferred to Objects not Named		$500·00	
Expenditures		4 447·96	
			4 947·96
Unexpended balance			52·04

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

GRAVITY EXPERIMENTS.

To whom paid.	On what account.	Amount.
George Davidson	Hauling	$0·75
R. L. Faris	Services	102·58
T. C. Mendenhall	Pendulum observations	199·45
T. S. & J. D. Negus	Chronometers	1 275·00
C. S. Peirce	Traveling expenses and packing boxes	48·30
Royce & Marean	Connecting signals	2·00
Edwin Smith	Preparing station and traveling expenses	315·99
United States Express	Expressage	17·60
Wells, Fargo & Co	——do	13·50
Western Union Telegraph Company	Labor and materials	21·20
Frank A. Wolff, Jr	Services	63·87
Expenditures		2 060·24
Appropriation		2 500·00
Less 16 per cent transferred to Objects not Named	$400·00	
Expenditures	2 060·24	2 460·24
Unexpended balance		39·76

STATE SURVEYS.

To whom paid.	On what account.	Amount.
E. A. Bowser	Triangulation	$1 426·14
A. H. Buchanan	Triangulation, reconnaissance, and storage	1 320·36
John E. Davies	Triangulation and storage	1 137·87
Stehman Forney	Reconnaissance	3 001·35
W. R. Hoag	Triangulation, leveling, and services	1 725·09
C. H. Sinclair	Longitudes and latitudes	189·06
W. H. Winn	Pasturage	67·00
Expenditures		8 866·81
Appropriation		10 000·00
Less 10 per cent transferred to Objects not Named	$1 000·00	
Expenditures	8 866·81	9 866·81
Unexpended balance		133.19

GEOGRAPHICAL POSITIONS.

To whom paid.	On what account.	Amount.
G. R. Putman	Longitudes	$1 100·35
C. H. Sinclair	——do	969·20
Amount disbursed		2 069·55
Railroad accounts referred for settlement		59·75
Expenditures		2 129·30
Appropriation		3 000·00
Less 20 per cent transferred to Objects not Named	$600·00	
Expenditures	2 129·30	2 729·30
Unexpended balance		270·70

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

TRANSCONTINENTAL WORK.

To whom paid.	On what account.	Amount.
J. B. Boutelle	Triangulation	$298·32
John S. Cunningham	Board of horses	142·50
Wm. Eimbeck	Triangulation, pasturage, etc	11 640·58
W. B. Fairfield	Triangulation	1 302·48
O. B. French	Traveling expenses	18·25
F. D. Granger	Triangulation, storage, etc	4 958·42
A. T. Mosman	Base measurement	3 912·78
F. Walley Perkins	Triangulation, storage, etc	3 909·17
Charles A. Schott	Traveling expenses	39·55
W. H. Simms	Storage	9·00
R. S. Woodward	Base measurement	232·11
Amount disbursed		26 463·16
Railroad accounts referred for settlement		673·05
Expenditures		27 136·21
Appropriation		22 000·00
Add 4 per cent from Gulf Coast		600·00
Add 20 per cent from Offshore Soundings, etc		1 600·00
Add 20 per cent from Topography—California		1 000·00
Add 10 per cent from Triangulation—West		1 000·00
Add 20 per cent from Exact Leveling		1 000·00
		27 200·00
Expenditures		27 136·21
Unexpended balance		63·79

COAST PILOT.

To whom paid.	On what account.	Amount.
A. J. Collyer	Services and traveling expenses	$86·22
Jens Petersen	Services	125·00
Talbot Pulizzi	do	900·00
L. K. Reynolds, U. S. Navy	Hydrography, steamer *Endeavor*	1 950·33
John Ross	Services	60·48
Eugene Veith	Services and traveling expenses	990·57
Expenditures		4 112·60
Appropriation		4 500·00
Less 7 per cent transferred to Objects not Named	$315·00	
Expenditures	4 112·60	
		4 427·60
Unexpended balance		72·40

TRANSPORTATION (NAVY), ETC.

To whom paid.	On what account.	Amount.
S. M. Ackley, U. S. Navy	Mileage	$116·00
A. F. Berryhill, U. S. Navy	Traveling expenses	131·10
L. J. Clark, U. S. Navy	Mileage	286·32
W. H. P. Creighton, U. S. Navy	do	90·48
George Davidson	Special surveys	15·35
John W. Donn	Special survey	52·02
Jas. G. Doyle, U. S. Navy	Mileage	254·00
C. P. Eaton, U. S. Navy	do	272·72
Wm. P. Elliott, U. S. Navy	do	28·40

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

TRANSPORTATION (NAVY), ETC.

To whom paid.	On what account.	Amount.
Lucian Flynne, U. S. Navy	Mileage	$59·68
J. A. Guthrie, U. S. Navy	do	55·84
Giles B. Harber, U. S. Navy	do	256·56
W. C. Herbert, U. S. Navy	do	356·24
E. M. Hughes, U. S. Navy	do	109·44
Jos. L. Jayne, U. S. Navy	do	59·68
C. W. Jungen, U. S. Navy	do	251·36
G. W. Kline, U. S. Navy	do	96·80
A. Lindenkohl	Traveling expenses	16·85
W. F. Low, U. S. Navy	Mileage	68·56
W. I. Moore, U. S. Navy	do	37·04
J. W. Oman, U. S. Navy	do	13·44
W. P. Ray, U. S. Navy	do	21·44
C. S. Ripley, U. S. Navy	do	8·48
Hiero Taylor, U. S. Navy	do	26·48
E. H. Tillman, U. S. Navy	do	54·88
Glennie Tarbox, U. S. Navy	do	253·36
E. T. Witherspoon, U. S. Navy	do	272·72
Benj. Wright, U. S. Navy	do	212·08
Expenditures		3 509·32
Appropriation		3 500·00
Add 1 per cent from Triangulation—West		100·00
		3 600·00
Expenditures		3 509·32
Unexpended balance		90·68

OBJECTS NOT NAMED.

To whom paid.	On what account.	Amount.
R. M. Bache	Traveling expenses	$148·13
J. B. Baylor	do	2·50
C. H. Boyd	Appomattox River survey	962·66
J. H. Dawson	Water for schooner *Ready*	5·00
John W. Donn	Traveling expenses and topography	219·09
J. A. Flemer	Topography—Coasters Harbor Island	288·22
F. D. Granger	Triangulation	26·55
John F. Hansen	Services	319·35
E. E. Haskell	Combined operations—New Jersey Coast	1 237·38
Jos. Hergesheimer	Traveling expenses	13·50
F. Kressel, Jr	Supplies, schooner *Ready*	35·46
R. A. Marr	Hydrography—New Jersey Coast	949·69
T. C. Mendenhall	Traveling expenses	35·15
A. T. Mosman	do	54·70
Jos. F. Prohaska & Co	Supplies, steamer *Hitchcock*	2·90
J. F. Redding	Services	24·00
Homer P. Ritter	Combined operations—vicinity of Norfolk, Va	151·89
Cleveland Rockwell	Traveling expenses	370·10
A. F. Rodgers	do	305·38
Edwin Smith	Latitude, Rockville, Md	728·32
O. H. Tittmann	Traveling expenses	21·30

EXPENDITURES COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

OBJECTS NOT NAMED.

To whom paid.	On what account.	Amount.
D. B. Wainwright	Topography	$24·00
Henry L. Whiting	Traveling expenses	199·00
Isaac Winston	Precise leveling, Florida	3 056·35
Amount disbursed		9 180·62
Annual contribution to the International Geodetic Association		449·82
Railroad accounts referred for settlement		16·61
Expenditures		9 647·05
Appropriation		7 000·00
Add 10 per cent from Tidal Observations		500·00
Add 16 per cent from Gravity Experiments		400·00
Add 10 per cent from State Surveys		1 000·00
Add 20 per cent from Geographical Positions		600·00
Add 7 per cent from Coast Pilot		315·00
		9 815·00
Expenditures		9 647·05
Unexpended balance		167·95

RECAPITULATION.

[Showing expenditures in gross (by sub-items) on account of the appropriation for Party Expenses, 1892.]

Sub-items.	Amount.
Coast of Maine	$3 986·96
Nantucket Shoals, etc	16 990·40
Triangulation—Alabama	3 619·64
Gulf Coast	12 131·63
Offshore Soundings, etc	6 398·70
Topography—California	3 629·37
Triangulation—West	7 894·92
Oregon and Washington	20 088·46
Alaska Explorations	13 836·27
Physical Hydrography	6 208·19
Reported Dangers	399·50
Magnetic Observations	4 121·18
Exact Leveling	3 912·82
Tidal Observations	4 447·96
Gravity Experiments	2 060·24
State Surveys	8 866·81
Geographical Positions	2 069·55
Transcontinental Work	26 463·16
Coast Pilot	4 112·60
Transportation (Navy), etc	3 509·32
Objects not Named	9 180·62
Amount disbursed	163 928·30
Railroad accounts referred to accounting officers for settlement	1 061·27
Annual contribution to the International Geodetic Association	449·82
Total expenditures	165 439·39
Total amount appropriated for Party Expenses, 1892	168 000·00
Total amount expended for Party Expenses, 1892	165 439·39
Unexpended balance	*2 560·61

*This balance will be slightly reduced by outstanding obligations not yet received for adjustment.

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1892.

CLASSIFICATION OF EXPENDITURES FOR PARTY EXPENSES, 1892.

On what account.	Amount.
Triangulation	$21 055·88
Topography	22 678·33
Hydrography	55 653·52
Transcontinental Geodetic Work	27 136·21
Points for State Surveys	8 866·81
Coast Pilot	4 112·60
Leveling	6 969·17
Magnetics	4 121·18
Physical Hydrography	6 208·19
Geographical Positions (longitudes)	2 129·30
Tidal Operations	4 447·96
Gravity Experiments	2 060·24
Total	165 439·39

Alaska Boundary Survey.

[From February 1, 1892, to January 31, 1893.]

To whom paid.	On what account.	Amount.
Alaska Commercial Company	Transportation, etc	$20 040·36
George Davidson	Astronomical determinations	800·00
Giles B. Harber, U. S. Navy	Coast work, steamer *Hassler*	5 123·82
Charles Junken	Services compiling data	1 837·00
John E. McGrath	Astronomical determinations	1 074·93
Thomas C. Mendenhall	Traveling expenses	58·25
Fremont Morse	Astronomical determinations	637·68
Amount disbursed		29 572·04
Railroad accounts referred for settlement		70·00
Expenditures		29 642·04
Unexpended balance on hand Feburary 1, 1892		839·68
Received from John E. McGrath and J. Henry Turner, for materials and stores used in trade, barter, and exchange with Indians and others for services, etc		3 261·51
Appropriations—Deficiency act May 13, 1892		48 900·00
Appropriation—Sundry civil act August 5, 1892		10 000·00
		63 001·19
Expenditures		29 642·04
Unexpended balance on February 1, 1893		*33 359·15

*Allotted for field work during the season of 1893.

Repairs of vessels, 1892.

To whom paid.	On what account.	Amount.
D. Delehanty, U. S. Navy	Steamer *Hassler*	$5 591·02
W. P. Elliott, U. S. Navy	Schooner *Eagre*	145·00
Lucian Flynne, U. S. Navy	Steamer *Gedney*	144·15
Giles B. Harber, U. S. Navy	Steamer *Hassler*	593·00
J. M. Helm, U. S. Navy	Steamer *Gedney*	36·81
Joseph Hergesheimer	Schooner *Spy*	25·75

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Repairs of vessels, 1892.

To whom paid.	On what account.	Amount.
J. Hoodless	Schooners *Quick* and *Transit*	$486·94
E. M. Hughes, U. S. Navy	Steamer *Bache*	1 308·91
F. Kressel, Jr	Schooner *Ready*	3·95
W. F. Low, U. S. Navy	Schooner *Eagre*	441·67
H. B. Mansfield, U. S. Navy	Steamer *Patterson*	753·05
R. A. Marr	Barge *Beauty*	106·74
A. N. Mayer, U. S. Navy	Steamer *Gedney*	737·93
W. I. Moore, U. S. Navy	Steamer *Patterson*	1 803·51
Mouan-Durie Supply Company	Steamers *Patterson* and *McArthur*	134·76
J. F. Pratt	Steam launch *Tarry-not*	569·97
S. J. Pregnall	Schooner *Ready*	110·00
W. P. Ray, U. S. Navy	Steamer *McArthur* and schooner *Earnest*	385·14
Reeves & Comstock	Steamer *Bache*	604·00
L. K. Reynolds, U. S. Navy	Steamer *Endeavor*	5 000·00
Screw Dock Co	Steamer *Bache*	110·00
The Morgan Iron Works	——do	2 015·37
C. E. Vreeland, U. S. Navy	Steamer *Blake*	1 270·70
W. E. Woodall & Co	——do	2 467·38
Expenditures		24 845·75
Appropriation		25 000·00
Expenditures		24 845·75
Unexpended balance		154·25

CLASSIFICATION OF EXPENDITURES FOR REPAIRS OF VESSELS.

Name of vessel.	Amount.	Name of vessel.	Amount.
Steamer *Bache*	$4 038·28	Schooner *Quick*	$287·69
Steamer *Blake*	3 738·08	Schooner *Ready*	113·95
Steamer *Endeavor*	5 000·00	Schooner *Spy*	25·75
Steamer *Gedney*	918·89	Schooner *Transit*	199·25
Steamer *Hassler*	6 184·02	Launch *Tarry-not*	569·97
Steamer *McArthur*	451·27	Barge *Beauty*	106·74
Steamer *Patterson*	2 587·19	Total	24 845·75
Schooner *Eagre*	586·67		
Schooner *Earnest*	38·00		

Publishing observations, 1892

To whom paid.	On what account.	Amount.
J. H. Gore	Indexing publications	$525·00
E. S. Holden	Computations	88·10
A. L. Updegraff	——do	190·00
Expenditures		803·10
Appropriation		1 000·00
Expenditures		803·10
Unexpended balance		196·90

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, BOOKS, MAPS, CHARTS, AND SUBSCRIPTIONS.

To whom paid.	On what account.	Amount.
Aluminum Brass and Bronze Co	Instrument shop	$11·24
American Shipmasters' Association	Books	15·00
D. Appleton & Co	Subscriptions	5·00
Astronomical Journal	do	5·00
Wm. Ballantyne & Sons	Instrument shop	17·88
D. Ballauf	do	89·50
Robert Beall	Books	3·00
Charles Becker	Instrument shop	2·08
Benedict and Burnham Manufacturing Co	do	30·99
Hugo Bilgram	do	379·85
John Bliss & Co	do	34·50
Wm. Bond & Son	do	82·90
Boston Type Foundry	do	55·26
R. R. Bowker	Books	20·00
W. Andrew Boyd	do	25·00
John A. Brashear	Instruments and instrument shop	160·00
Brentano's	Books	5·00
W. W. Brewer	Drawing division	7·05
E. W. Bullinger	Subscriptions	6·00
J. H. Bunnell & Co	Instrument shop	42·20
T. E. Butters	do	199·68
Charles T. Carter & Co	Carpenter shop	56·40
Cassino Art Co	Books	2·00
J. B. Chamberlain & Co	Instrument shop	15·00
James J. Chapman	Books	32·40
John Chatillon & Sons	Instrument shop	13·00
J. H. Chesley & Co	Carpenter shop	2·04
Frank H. Clement & Co	do	5·33
Charles L. Condit	Subscriptions	10·00
Edward Corbett	Instrument shop	13·25
Albert M. Crowell	do	129·00
Cushman Chuck Co	do	16·85
George Davidson	Instrument shop, subscriptions, etc	656·90
D. Delehanty, U. S. Navy	Instrument shop	2·50
Doremus & Co	do	1·50
G. S. Doremus	do	5·10
Edison General Electric Co	do	102·88
Wm. P. Elliott, U. S. Navy	do	8·75
M. D. Ewell	do	5·00
Fauth & Co	Instruments	1 655·00
Felt and Tarrant Manufacturing Co	do	125·00
M. L. Ferguson	Maps	12·50
M. N. Forney	Subscriptions	3·00
Stehman Forney	Instrument shop	2·25
General Electric Co	do	140·82
Geological Publishing Co	Subscriptions	3·50
F. W. Gesswein estate	Instrument shop	7·00
Z. D. Gilman	do	7·41
Henry J. Green	Instruments	180·50
Hanson Battery Light and Power Co	Instrument shop	20·30
Giles B. Harber, U. S. Navy	Instruments	9·00
Harris & Shearer	Instrument shop	129·70
Francis J. Hill	do	30·00
H. Hoffa	do	29·00
Hooe Bro. & Co	Instrument and carpenter shops	44·58
Johns Hopkins Press	Subscriptions	2·50
B. M. Jones & Co	Instrument shop	11·33
Jones & Laughlins (Limited)	do	34·65
M. E. Kahler	do	85·75
J. Karr	do	92·50

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, ETC.

To whom paid.	On what account.	Amount.
Keuffel & Esser Co	Instrument shop	$379·09
Kolesch & Co	do	80·97
Libbey, Bittinger & Miller	Carpenter shop	481·42
Library Bureau	Books	14·69
Melville Lindsay	Instrument shop	9·04
Lippincott & Co	Books	31·48
W. H. Lowdermilk & Co	do	34·70
Wm. Lukanitsch, Jr	Instrument shop	48·15
Manhattan Brass Co	do	302·40
F. P. May & Co	Carpenter shop	70·82
McFadden Co	Instrument shop	54·39
W. W. Mildrum	do	37·50
Edward Miller	Subscriptions	12·00
Francis Miller	Instrument and carpenter shops	48·60
J. H. Mills & Co	Instrument shop	9·30
Munn & Co.	Books	11·67
F. W. Murray	Instrument shop	4·50
National Geographic Society	Subscriptions	2·25
T. S. & J. D. Negus	Instrument shop	95·00
John C. Parker	Books and maps	58·90
Patapsco Oil and Grease Co	Instrument shop	44·63
W. W. Payne	Subscriptions	3·50
F. Walley Perkins	Instruments	3·75
James W. Queen & Co	Instrument shop	228·53
Henry Romeike	Subscriptions	4·95
Royce & Marean	Instrument shop	31·72
Geo. Ryneal, Jr	Carpenter shop	64·58
Scheller & Stevens	Instrument shop	29·80
Science, N. D. C. Hodges, publisher	Subscriptions	3·60
Fred A. Schmidt	Drawing division	134·28
L. H. Schneider's Son	Carpenter shop	60·14
Seth Thomas Clock Co	Instrument shop	65·40
Sidereal Messenger	Books	16·40
Thomas W. Smith	Carpenter shop	34·01
C. F. Staerke	Instrument shop	63·45
Gustav E. Stechert	Books	456·55
E. Steiger & Co	do	27·86
B. F. Stevens	Subscriptions	26·68
Ormond Storm	Books	3·13
Tice & Lynch	Instrument shop	2·70
United States Electric Lighting Co	do	15·84
United States Naval Institute	Subscriptions	3·50
W. Irving Vinal	Instrument shop	1·75
D. B. Wainwright	do	·30
John W. Walker	do	10·50
W. H. Warner	do	64·32
Charles Wassweiler	do	2·00
B. Westermann & Co	Books, etc	93·83
Williams & Hanks	Instrument shop	64·67
Isaac Winston	do	7·00
John C. Yorston & Co	Books	6·00
Joseph Zentmayer, by Katharine Zentmayer, administratrix.	Instrument shop	2·07
Expenditures		8 247·53
Appropriation		9 000·00
Expenditures		8 247·53
Unexpended balance		*752·47

*Subject to reduction on account of outstanding obligations.

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

COPPERPLATES, CHART PAPER, PRINTING INK; COPPER, ZINC, AND CHEMICALS FOR ELECTROTYPING AND PHOTOGRAPHING, ENGRAVING, PRINTING, PHOTOGRAPHING, AND ELECTROTYPING SUPPLIES; EXTRA ENGRAVING AND DRAWING; PHOTO-LITHOGRAPHING AND PRINTING FOR IMMEDIATE USE.

To whom paid.	On what account.	Amount.
Wm. Ballantyne & Son	Printing supplies	$21·75
Bausch & Lomb Optical Co	Photographing supplies	87·50
Chas. Becker	Printing supplies	11·13
C. M. Bell	Photographing supplies	·75
Bell Lithographing Co	Photolithographing	24·00
Julius Bien & Co	——do	208·50
A. Brown	Printing from stone	4·00
J. B. Bryan & Bro	Printing supplies	8·10
Bureau Engraving and Printing	——do	611·35
Charles T. Carter & Co	Engraving and printing supplies	21·90
J. B. Chamberlain & Co	Photographing supplies	41·60
Clendenin Bros	Copper plates	270·82
Owen Donnelly	Engraving supplies	70·00
Evans & Bartle	Extra engraving	1 540·00
E. Morrison Paper Co	Printing supplies	31·50
Forbes Lithographic Manufacturing Co	Photolithographing	25·00
Henry R. Garland	Extra drawing	694·00
Gibson Bros	——do	22·25
C. D. Gildersleeve	Printing supplies	80·00
Z. D. Gilman	Photographing and engraving supplies	120·43
Andrew B. Graham	Printing from stone	58·30
E. N. Gray & Co	Printing supplies	211·31
Mary L. Handlan	Extra drawing	492·60
Heliotype Printing Co	Photolithographing	10·00
A. Hoen & Co	——do	496·20
H. Hoffa	Engraving supplies	82·00
Charles P. Holden	Printing supplies	2 045·09
Hooe, Bro. & Co	——do	82·26
Isaac Friedenwald Co	Photolithographing	727·53
Kolesch & Co	Photographing supplies	4·20
Ernest Kubel	Copperplates	1 134·82
Charles F. Locraft	Printing from copper	180·00
M. Lukanitsch, Jr	Engraving supplies	7·10
Matthiessen & Hegler Zinc Co	Electrotyping supplies	210·56
Robert W. Maupin	Printing from copper	160·35
F. P. May & Co	Electrotyping supplies	9·21
Alex. McKie	Photographing supplies	1·75
W. H. Mehler	Printing and electrotyping supplies	30·50
Francis Miller	Engraving supplies	32·20
W. B. Moses & Sons	Photographing supplies	18·30
Moss Engraving Co	——do	25·00
Mount Holly Paper Co	Photolithographing	757·80
New York Steel and Copper Plate Co	Engraving supplies	20·00
Norris Peters Co	Photolithographing	1 125·40
Peter Adams Co	Chart paper	5 709·42
E. J. Pullman	Photographing supplies	1·10
William Rothwell	Printing supplies	280·00
George Ryneal, Jr	——do	142·44
Sanford & Co	Copperplates	25·38
Scheller & Stevens	Electrotyping supplies	227·87
Schindler Bros	Photographing supplies	36·60
Schleicher, Schumm & Co	Printing supplies	2·88
Fred A. Schmidt	Engraving supplies	2·88
L. H. Schneider's Son	Electrotyping supplies	·75
J. W. Shane	Printing supplies	748·00
Wm. H. Waddington	Printing from copper	175·64

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

COPPERPLATES, CHART PAPER, PRINTING INK, COPPER, ZINC, ETC.

To whom paid.	On what account.	Amount.
Williams & Hanks	Printing supplies	$8·75
O. L. Wolfsteiner & Co	Photographing supplies	160·00
Frank G. Wurdemann	Extra engraving	322·03
Expenditures		19 664·38
Appropriation		20 000·00
Received for electrotyping done for the Hydrographic Office, Navy Department		624·53
		20 624·53
Expenditures		19 664·38
Unexpended balance		*960·15

*Subject to reduction on account of outstanding obligations.

STATIONERY, TRANSPORTATION OF INSTRUMENTS AND SUPPLIES, OFFICE WAGON AND HORSES, FUEL, GAS, TELEGRAMS, ICE, AND WASHING.

To whom paid.	On what account.	Amount.
Adams Express Co	Transportation	$324·70
Wm. Ballantyne & Sons	Stationery	204·46
Baltimore & Potomac R. R. Co	Transportation	14·25
J. Baumgarten & Son	Stationery	41·40
James J. Chapman	do	19·08
James Connor	Office horses	33·00
George Davidson	Stationery, transportation, and washing	25·70
E. Morrison Paper Co	Stationery	19·25
Geo. W. Knox, estate of	Transportation	5·45
Z. D. Gilman	Office horses	1·20
Harriet E. Harrod	Washing	147·12
Hygienic Ice Co	Ice	248·73
R. J. Kennedy	Fuel	1 424·42
George W. Knox	Transportation	158·08
Library Bureau	Stationery	34·22
W. F. Low, U. S. Navy	do	2·31
Lutz & Bro	Office horses and wagon	12·75
Walter H. Marlow	Fuel	20·85
John McDermott & Bro	Office wagon	3·00
John F. Paret	Stationery	21·00
John C. Parker	do	40·95
Peoples Dispatch and Transfer Co	Transportation	30·70
Arthur W. Robson	do	3·00
George Ryneal, jr	Stationery	15·46
Fred. A. Schmidt	do	267·32
B. F. Shaw	Office horses	245·00
L. W. Sherman	Stationery	1·50
Smithsonian Institution	Transportation	7·55
Samuel Springman	do	1·00
Stationery Division, Treasury Department	Stationery	1 123·03
Stephenson's Express	Transportation	150·56
Tice & Lynch	do	9·22
S. W. Tucker	Stationery	4·55
United States Express Co	Transportation	101·10
William Walters' Sons	Office wagon	·70
Washington Gaslight Company	Gas	1 219·26
Wyckoff, Seamans & Benedict	Stationery	17·75
Expenditures		5 999·67
Appropriation		6 000·00
Expenditures		5 999·67
Unexpended balance		·33

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS, OFFICE FURNITURE, REPAIRS, EXTRA LABOR, AND TRAVELING EXPENSES (Office).

To whom paid.	On what account.	Amount.
C. W. Ahlenfeld	Extra labor	$103·55
Wm. Ballantyne & Sons	General office supplies	14·08
Chas. E. Barrick	Plumbing	1 467·99
J. W. Boteler & Son	Chimneys	·75
Boston Brown	Extra labor	32·50
Brooklyn Union Publishing Co	Advertising	10·50
J. B. Bryan & Bro	General office supplies	99·31
L. W. Burket	Typewriting machine	90·00
W. J. Caldwell	Advertising	3·88
Charles T. Carter & Co	General office supplies	39·29
Chesapeake & Potomac Telephone Co	Exchange rental	100·00
J. H. Chesley & Co	General office supplies	45·18
M. G. Copeland & Co	Window awnings and flags	140·50
Rufus H. Darby	Advertising	3·36
George Davidson	Sub-office expenses	81·58
Owen Donnelly	Glazing	2·78
Donnelly & Jennings	General office supplies	·80
Samuel L. Eubank	Extra labor	281·25
Evening Star Newspaper Co	Advertising	22·49
Wm. G. Finney	Extra labor	2·01
James F. Flynn	do	225·00
Frank Freeman	do	3·51
Z. D. Gilman	Feather dusters, etc	59·13
Israel Green	Extra labor	34·80
Mary L. Handlan	do	176·12
Hooe, Bro. & Co.	General office supplies	167·22
Carter Jackson	Extra labor	18·13
E. E. Jackson & Co	Sawdust	·50
Julius Lansburgh	Office furniture	449·07
Mail and Express, New York	Advertising	21·00
F. P. May & Co	General office supplies	8·76
W. H. Mehler	do	19·99
Francis Miller	Alcohol	1·15
J. H. Mills & Co	Type	3·75
Charles Montgomery	Extra labor	6·25
W. B. Moses & Sons	Office furniture	85·25
News and Courier Co	Advertising	4·16
New York Press Co., limited	do	26·00
Herbert G. Ogden	Traveling expenses	4·28
John C. Parker	Typewriting supplies	159·00
Francis H. Parsons	Traveling expenses	58·94
Wm. C. Peake	Glazing	30·70
Ratcliffe, Darr & Co	Extra labor	24·08
Royce & Marean	Repairing bells	1·25
George Ryneal, Jr	General office supplies	22·60
Savannah Press	Advertising	6·00
Louis Schade	do	5·33
J. Q. Thompson & Co	do	5·20
N. O. Towles	Office furniture	130·00
William Wagner	Combination ladder	1·75
Washington City post office	Box rent	16·00
Washington Post Co	Advertising	20·76
Washington Sentinel	do	4·33
E. G. Wheeler	Pump sucker	1·00
Dennis E. White	Extra labor	255·86
J. H. Wilkerson	Inspecting boilers	15·00
Wilmarth & Edmonston	General office supplies	14·55

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

General expenses, 1892.

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS, ETC.

To whom paid.	On what account.	Amount.
Wyckoff, Seamans & Benedict	Repairs to typewriters	$25·21
F. H. Youngs	Cleaning carpets	16·10
Expenditures		4 679·03
Appropriation		4 500·00
Received from Supervising Architect's Office, Treasury Department, for work done on Butler building		246·27
		4 746·27
Expenditures		4 679·03
Unexpended balance		*67·24

FOR INCREASING CHART PRINTING PLANT.

To whom paid.	On what account.	Amount.
A. T. Anderson, Jr	Chart printing	$60·00
Chas. E. Barrick	Plumbing	66·15
Chas. T. Carter & Co	Hardware	5·82
B. A. Colonna	Chart printing	19·32
Geo. W. Corbett	do	1 076·50
M. G. Copeland & Co	Awnings	64.70
Wm. C. Demain	Plate press	1 700·00
Owen Donnelly	Lumber	3·78
Geo. W. Knox Express	Labor, chart printing	46·56
E. N. Gray & Co	Ironwork, etc	305·71
Chas. P. Holden	Plate press, pulleys, etc	1 551·81
J. E. Hurley	Plumbing and repairing press	250·24
Jones & Laughlins (limited)	Shafting, etc	102·62
Julius Lansburgh	Shades	19·75
Libbey, Bittinger & Miller	Lumber	9·33
W. H. Mehler	Zinc	2·75
Samuel Moore	Chart printing	60·00
Wm. Rothwell	do	667·00
Schleicher, Schumm & Co	Gas engine	900·00
Washington Gas Light Co	Chart printing	37·90
Williams & Hanks	do	93·12
Expenditures		7 043·06
Appropriations		7 400·00
Expenditures		7 043·06
Unexpended balance		*356·94

*Subject to reduction on account of outstanding obligations.

RECAPITULATION.

[Showing expenditures in gross (by sub-items) on account of the appropriation for General Expenses, 1892.]

Instruments, instrument shop, carpenter shop, drawing division, books, maps, charts, and subscriptions	$8 247·53
Copper plates, chart paper, printing ink; copper, zinc, and chemicals for electrotyping and photographing; engraving, printing, photographing and electrotyping supplies; extra engraving and drawing; photolithographing and printing from stone and copper for immediate use	19 664.36
Stationery, transportation of instruments and supplies, office wagon and horses, fuel, gas, telegrams, ice, and washing	5 999·67
Miscellaneous expenses, contingencies of all kinds, office furniture, repairs, extra labor, and traveling expenses (office)	4 679·03
Additional facilities for chart printing and for increasing plant	7 043·06
Total expenditures	45 633·67
Total amount appropriated for General Expenses, 1892	$46 900·00
Received for electrotyping done for the Hydrographic Office, Navy Department	624·53
Received from the Supervising Architect's Office, Treasury Department, for work done on Butler building	246·27
	47 770·80
Total amount expended for General Expenses, 1892	45 633·67
Unexpended balance	†2 137·13

†This balance will be reduced in payment of outstanding obligations.

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

CLASSIFICATION OF EXPENDITURES FOR GENERAL EXPENSES, 1892.

On what account.	Amount.	On what account.	Amount.
Instruments	$2 033·25	Office wagon and horses	$295·65
Instrument shop	4 288·82	Fuel	1 445·27
Carpenter shop	815·64	Gas	1 219·26
Drawing division	141·33	Ice	248·78
Books, maps, and charts	870·11	Washing	152·82
Subscriptions	98·38	Miscellaneous expenses and contingencies of all kinds	1 224·83
Copperplates	1 431·02	Office furniture	725·20
Chart paper	5 709·42	Extra labor	1 163·06
Engraving, printing, photographing, electrotyping supplies	5 499·74	Repairs	1 502·72
Extra engraving	1 862·03	Traveling expenses (office)	63·22
Extra drawing	1 209·45	Additional facilities for chart printing and increasing plant	7 043·06
Photolithographing and printing for immediate use	3 952·72	Total	45 633·67
Stationery	1 827·28		
Transportation of instruments and supplies	810·61		

Salaries—Standard Weights and Measures, 1892.

To whom paid.	Time employed.	Amount.
ADJUSTER.		
Louis A. Fischer	One year	$1 500·00
MECHANICIANS.		
Jacob Schwarz	Three months	312·50
Otto Storm	Nine months	937·50
WATCHMAN.		
David Somerville	One year	720·00
ASSISTANT MESSENGER.		
Charles A. Harbaugh	Eleven months, eight days	675·05
Expenditures		4 145·05
Appropriation		4 190·00
Expenditures		4 145·05
Unexpended balance		44·95

Contingent expenses—Standard Weights and Measures, 1892.

MATERIALS AND INCIDENTAL EXPENSES.

To whom paid.	On what account.	Amount.
John Chatillon & Sons	Balance	$8·50
Nahum A. Cook	Chamois, etc	7·70
Eimer & Amend	Supplies	75.13
Geo. W. Knox Express	Transportation	47·46
*Z. D. Gilman	Materials	5·80
J. B. Hammond	Show case	225·00
Harriet E. Harrod	Washing	10·74
Hooe, Bro. & Co	Supplies	8·15
M. E. Kahler	Prism	2·00
Philipp Kropp	Packing boxes	9·00
Melville Lindsay	Tubing	6·45
W. H. Mehler	Water gauge	·75
Merchant & Co	Metal rod	9·60
Francis Miller	Contingencies	5·35

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Contingent expenses—Standard Weights and Measures, 1892.

MATERIALS AND INCIDENTAL EXPENSES.

To whom paid.	On what account.	Amount.
Charles S. Platt	Silver wire	$9·00
James W. Queen & Co	Thermometer, etc	55·50
George Ryneal, Jr	Lamp and coal oil	4·50
L. S. Starrett	Squares, etc	8·15
Whitall, Tatum & Co	Filter	3·00
Expenditures		501·78
Appropriation		500·00
Expenditures		501·78
Deficit		1·78

EXPENSES AMERICAN MEMBER INTERNATIONAL COMMITTEE.

To whom paid.	On what account.	Amount.
B. A. Gould	Traveling expenses	$416·73
Appropriation		600·00
Expenditures		416·73
Unexpended balance		183·27

RECAPITULATION.

[Showing expenditures in gross by sub-items, on account of the appropriation for Contingent Expenses—Standard Weights and Measures, 1892.]

Materials and incidental expenses	$501·78
Expenses American member international committee	416·73
Total expenditures	918·51
Total amount appropriated	1 100·00
Total amount expended	918·51
Unexpended balance	181·49

GENERAL RECAPITULATION.

[Showing appropriations, expenditures, and balances for the fiscal year ending June 30, 1892; also unexpended balances available on Alaska boundary survey from last report, and amounts received from other Government bureaus.]

Name of appropriation.		Appropriated.	Expended.	Balances.
Salaries—Pay of field officers		$119 600·00	$113 205·27	$6 394·73
Salaries—Pay of office force		143 130·00	137 132·92	5 997·08
Party expenses*		168 000·00	165 439·39	2 560·61
Alaska boundary survey:†				
Deficiency act May 13, 1892	$48 900·00			
Sundry civil act August 5, 1892	10 000·00	63 001·19	29 642·04	33 359·15
Received for materials and stores	3 261·51			
Unexpended balance Feb. 1, 1892	839·68			
Repairs of vessels		25 000·00	24 845·75	154·25
Publishing observations		1 000·00	803·10	196·90
General expenses:*				
Sundry civil act March 3, 1891	$46 900·00			
Received from Hydrographic Office	624·53	47 770·80	45 633·67	2 137·13
Received from Supervising Architect's Office	246·27			
Salaries—Weights and Measures		4 190·00	4 145·05	44·95
Contingent expenses—Weights and Measures		1 100·00	918·51	181·49
Total		572 791·99	521 765·70	51 026·29

*The balances on these appropriations are subject to reduction on account of outstanding obligations. The total unexpended balance will be correspondingly modified.

†The balance on this appropriation will be exhausted by its allotment for field work during the season of 1893.

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

GENERAL RECAPITULATION.

Amounts appropriated and available as follows:		
Appropriations for Coast and Geodetic Survey proper fiscal year ending June 30, 1892, Sundry Civil act March 3, 1891		$503 630·00
Appropriations for Office of Standard Weights and Measures, Legislative act March 3, 1891		5 290·00
Received from other Government bureaus for materials and work		870·80
Received for materials and stores used in barter and exchange with Indians and others for services and supplies on account of Alaska boundary survey		3 261·51
Appropriations for Alaska boundary survey, Deficiency act May 13, 1892, and Sundry Civil act August 5, 1892, and including unexpended balance available from last report on February 1, 1892		59 739·68
		572 791·99
Amounts expended as follows:		
For Coast and Geodetic Survey	$487, 060. 10	
For Standard Weights and Measures	5, 063. 56	
For Alaska boundary survey	29, 642. 04	
		521 765·70
Total unexpended balance		*51 026·29

*The balances on these appropriations are subject to reduction on account of outstanding obligations. The total unexpended balance will be correspondingly modified.

EXPENDITURES SINCE LAST REPORT ON ACCOUNT OF THE APPROPRIATIONS FOR THE SERVICE OF THE FISCAL YEAR ENDING JUNE 30, 1889.

Salaries—Pay of field officers.

To whom paid.	On what account.	Amount.
John E. McGrath	Pay for June, 1889	$115·40
J. Henry Turner	do	107·10
Expenditures		222·50
Appropriation—Deficiency act, July 28, 1892		222·50
Expenditures		222·50

EXPENDITURES SINCE LAST REPORT ON ACCOUNT OF THE APPROPRIATIONS FOR THE SERVICE OF THE FISCAL YEAR ENDING JUNE 30, 1891.

Party expenses, 1891.

FLORIDA—WEST COAST.

To whom paid.	On what account.	Amount.
Joseph Hergesheimer	Storage	$2·40
Balance on hand—Report for 1891		38·23
Expended since, as above		2·40
Present unexpended balance		35·83

TOPOGRAPHY—CALIFORNIA.

To whom paid.	On what account.	Amount.
Chicago, Rock Island and Pacific Rwy. Co	Transportation	$2·96
Southern Pacific Co	do	35·78
Expenditures		38·74
Balance on hand—Report for 1891		686·15
Expended since, as above		38·74
Present unexpended balance		647·41

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Party expenses, 1891.

COAST OF WASHINGTON.

To whom paid.	On what account.	Amount.
Northern Pacific R. R. Co	Transportation	$1·47
Balance on hand—Report for 1891		133·52
Expended since, as above		1·47
Present unexpended balance		132·05

TIDES—PACIFIC, ETC.

To whom paid.	On what account.	Amount.
George Davidson	Kadiak Tidal	$51·61
Balance on hand—Report for 1891		67·92
Expended since, as above		51·61
Present unexpected balance		16·31

TRANSCONTINENTAL WORK.

To whom paid.	On what account.	Amount.
Chicago, Rock Island and Pacific Rwy. Co	Transportation	$7·24
Union Pacific Rwy. Co	——do	40·00
Expenditures		47·24
Balance on hand—Report for 1891		389·09
Expended since, as above		47·24
Present unexpended balance		341·85

OBJECTS NOT NAMED.

To whom paid.	On what account.	Amount.
Chicago, Rock Island and Pacific Rwy. Co	Transportation	$4·75
Southern Pacific Co	——do	3·22
Expenditures		7·97
Balance on hand—Report for 1891		116·68
Received from United States Geological Survey for latitude and longitude work in Texas, Florida, and Georgia		962·11
		1 078·79
Expended since, as above		7·97
Present unexpended balance		1 070·82

RECAPITULATION.

[Showing expenditures in gross by sub-items.]

Florida—West Coast	$2·40
Topography—California	38·74
Coast of Washington	1·47
Tides—Pacific, etc	51·61
Transcontinental Work	47·24
Objects not Named	7·97
Expenditures	149·43
Balance on hand—Report for 1891	6 039·27
Received from United States Geological Survey for latitude and longitude work in Texas, Florida, and Georgia	962·11
	7 001·38
Expended since, as above	149·43
Present unexpended balance	6 851·95

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Publishing observations, 1891.

To whom paid.	On what account.	Amount.
E. S. Holden	Star reductions	$11·90
Balance on hand—Report for 1891		572·51
Expended since, as above		11·90
Present unexpended balance		560·61

General expenses, 1891.

INSTRUMENT SHOP, CARPENTER SHOP, BOOKS.

To whom paid.	On what account.	Amount.
Parvin & Co	Instrument shop	$8·00
C. Reichel	do	48·50
Gustav E. Stechert	Books	9·60
Richard H. Willet	Carpenter shop	84·43
Expenditures		150·53
Balance on hand—Report for 1891		399·77
Expended since, as above		150·53
Present unexpended balance		249·24

PRINTING FOR IMMEDIATE USE.

To whom paid.	On what account.	Amount.
Andrew B. Graham	Printing from stone	$18·00
Balance on hand—Report for 1891		866·50
Expended since, as above		18·00
Present unexpended balance		848·50

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS.

To whom paid.	On what account.	Amount.
Richard H. Willet	Map rollers	$13·30
Balance on hand—Report for 1891		117·47
Expended since, as above		13·30
Present unexpended balance		104·17

RECAPITULATION.

[Showing expenditures in gross by sub-items.]

Instrument shop, carpenter shop, books		$150·53
Printing for immediate use		18·00
Miscellaneous expenses, contingencies of all kinds		13·30
Total expenditures		181·83
Balance on hand—Report for 1891		3 333·32
Received for electrotyping done for the United States Geological Survey		30·56
		3 363·88
Expended since, as above		181·83
Present unexpended balance		3 182·05

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1892.

Contingent expenses—Standard Weights and Measures, 1891.

BALANCE OF PRECISION.

To whom paid.	On what account.	Amount.
Alb. Rueprecht	Balance of precision	$859·65
Balance on hand—Report for 1891		1 069·00
Expended since, as above		859·65
Present unexpended balance		209·35

RECAPITULATION.

[Showing expenditures in gross by sub-items.]

Balance of precision	$859·65
Balance on hand—Report for 1891	1 926·46
Expended since, as above	859·65
Present unexpended balance	1 066·81

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE DISBURSING AGENT,
Washington, D. C., February 28, 1893.

I certify that the foregoing statement is a complete exhibit in detail of the expenditures of the United States Coast and Geodetic Survey and of the office of Standard Weights and Measures for the service of the fiscal year ending June 30, 1892, and prior years (embracing all expenditures on account thereof to January 31, 1893, inclusive), as shown by the books, records, and accounts now on file in this office.

JOHN W. PARSONS,
Disbursing Agent U. S. Coast and Geodetic Survey.

Approved:
T. C. MENDENHALL,
Superintendent U. S. Coast and Geodetic Survey.

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OFFICE REPORT No. 4—1892.

REPORT OF THE ASSISTANT IN CHARGE OF STATE SURVEYS FOR THE FISCAL YEAR 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., September 23, 1892.

SIR: On March 27, 1891, just previous to your departure for Alaska, you placed me in charge of all the State Survey parties operating under the clause in the Sundry Civil Act, entitled "For furnishing points for State Surveys, etc."

I now have the honor to submit the following general report of the operations of the different parties under my charge from the above date to June 30, 1892.

Respectfully yours,

GEORGE A. FAIRFIELD,
Assistant in charge of State Surveys.

Prof. T. C. MENDENHALL,
Superintendent Coast and Geodetic Survey, Washington, D. C.

STATE OF NEW JERSEY.

The work in this State has been continued by Prof. E. A. Bowser.

No work was done between September, 1889, and April, 1891, Prof. Bowser being in Europe during the summer of 1890.

During the first half of April, 1891, a tripod and scaffold signal was built at Colsons station, and reconnaissance carried on.

On June 22 work was resumed and poles erected at two stations to be observed on. The work was actively in progress at the end of the fiscal year.

Expenses for the fiscal year ..... $439·94

On July 15 the reconnaissance was completed, and observing was commenced at Colsons station. While this was going on, lines were opened through the tree tops to Bridgeton and Taylors stations, the trees ranging from 90 to 125 feet in height.

A careful search was made for the old stations, Lippincott, Burden, and Pine Mount, but without success, all the old surface marks and reference trees having long since disappeared.

Signal poles were erected at the first two stations as near as possible to the former places, and observed on from Colsons.

The occupation of this station was completed on September 3, and on the 10th, after marking with granite monuments four stations, field work was closed.

Early in April, 1892, during the spring vacation, a tripod and scaffold signal was built at Taylors station. On May 6 this was blown down by a tornado. During the latter part of June it was rebuilt, and some of the lines were cleared of obstructing tree tops.

At the close of the fiscal year Prof. Bowser's party was in the field.

His expenditures for the fiscal year ..... $1 426·14

STATE OF TENNESSEE.

The work in this State has been continued by Prof. A. H. Buchanan.

On July 1, 1890, he was engaged in reconnaissance and the erection of signals in the eastern part of the State.

After erecting seven signals in July, he occupied Cockspur and Milton stations during August and September, closing his season's work on September 30.

On June 2, 1891, he resumed field work, re-occupying Luper station and moving camp to Cross station by the end of the fiscal year.

His expenditures for the year ..... $1 641·60

Operations during fiscal year 1891–1892.—From July 1 to September 18, when field work for the season was closed, he occupied three stations—Cross, Clinch, and English. I wished him to connect King station in Kentucky with Cross station in Tennessee, but after close examination it was found impracticable.

While at English station in September, he reports the finest weather for observing that he had ever experienced, frequently observing for ten hours a day.

On May 24, 1892, he was directed to confer with Dr. J. M. Safford, State Geologist, in regard to two schemes for continuing the triangulation in Tennessee—one to the east and the other to the west.

It was thought best to first continue the work along the northern boundary to the eastward and make a connection with the Blue Ridge triangulation, which was in accord with the views of the Superintendent. Accordingly he was instructed on May 31 to commence the reconnaissance for this work early in June, before taking up the observations at Short station.

He took the field on June 7, and at the end of the fiscal year was still engaged on this reconnaissance.

His expenses for the fiscal year ..... $1 320·36

STATE OF WISCONSIN.

The work in this State has been continued by Prof. John E. Davies.

On June 12, 1891, he took the field and commenced the observations at Fitzsimmons station, and was at work there at the close of the fiscal year.

Operations for the fiscal year 1891–1892.—As Prof. Davies has sent in no monthly reports and journals, it is hard to follow his movements. He worked in the field until about September 12, occupying Fitzsimmons, Observatory Hill, and Bald Bluff stations. He was instructed to occupy the first two only, and to observe on poles erected at Bald Bluff and Sheep Pasture. Instead of confining himself to this programme, he built a tripod and scaffold signal at Bald Bluff and occupied that station.

At Fitzsimmons he failed to see Bald Bluff, and at Observatory Hill he observed on the wrong hill entirely instead of on Sheep Pasture. Therefore, my intention of having him close the quadrilateral ending on the line Fitzsimmons–Observatory Hill, and at the same time measure the angles to the two stations ahead, was frustrated. He did close the quadrilateral, but should it at any time be deemed expedient to continue the triangulation to the northward, Fitzsimmons and Observatory Hill will have to be re-occupied, rendering it necessary to rebuild the tripods and scaffolds at those stations.

Had Prof. Davies followed out his instructions carefully, it would have been necessary to erect poles only at those stations to be observed on.

Owing to the uncertainty about the appropriation for the present fiscal year it was not thought advisable to continue the work in Wisconsin this season under Prof. Davies.

An additional reason for not sending him to the field lies in the fact that Wisconsin is being furnished with points by Prof. Hoag in his triangulation down the Mississippi River, one-half of his stations being in the State of Wisconsin.

The expenditures of Prof. Davies for the fiscal year ending June 30, 1892, were $1 137·87.

STATE OF MINNESOTA.

The work in this State has been continued by Prof. W. R. Hoag.

In accordance with the views of the Superintendent that the triangulation, not only in this State, but in all the States, should, so far as practicable, be carried along the boundaries

between the States, Prof. Hoag was instructed on May 14, 1891, to take the field June 1 and make a reconnaissance down the Mississippi River from the limits of his former work to Lacrosse, Wisconsin.

During the month of June he was engaged in preparing for the field and in extending the reconnaissance down river.

His expenditures during June $328

Operations during the fiscal year, 1891–1892.—By July 15, Prof. Hoag had completed the reconnaissance to Lacrosse, Wisconsin, submitted his report accompanied with a sketch, and commenced the construction of the signals. His scheme of reconnaissance was a very good one, and with a few slight alterations, was approved by me.

During the season, which closed about the last of August, he erected three tripod and scaffold signals, 24, 40, and 64 feet high respectively, and occupied five stations, completing one quadrilateral and connecting one outlying point of the new scheme down the river.

I think his season's work of three months, including the 90 miles of reconnaissance done in June, was very satisfactory indeed. He is a very energetic worker, and after he becomes thoroughly used to our methods of conducting operations, I think he will do first-class work, and will prove to be a very useful adjunct to our force.

On December 25 he left his home for Washington, where he was called for consultation, returning to Minnesota on January 4.

During the rest of the fiscal year he was engaged, at odd times when he could be spared from his duties at the University, in running a line of precise levels from a permanent bench mark established at St. Paul by the Mississippi River Commission, to each end of the Snelling Avenue base, and from there to the University azimuth station at Minneapolis. His records and report on this work have not yet been received.

A large portion of his spare time was taken up in office work connected with the triangulation and leveling work in the field.

His expenditures during fiscal year ..... $1 725·09

Recapitulation of the expenditures of the different parties during the fiscal year 1891–1892:

New Jersey, Prof. E. A. Bowser	$1 426·14
Tennessee, Prof. A. H. Buchanan	1 320·36
Wisconsin, Prof. J. E. Davies	1 137·87
Minnesota, Prof. W. R. Hoag	1 725·09
Total	5 609·46

TOTAL EXPENDITURES.

New Jersey, 1876 to 1892*, sixteen years	$25 951·76
Tennessee, 1877 to 1892, sixteen years	24 100·27
Wisconsin, 1874 to 1892, nineteen years	31 273·14
Minnesota, 1887 to 1892, six years	7 262·72

*No work done in 1889.

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OFFICE REPORT No. 5—1892.

REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES FOR THE FISCAL YEAR 1892.

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF STANDARD WEIGHTS AND MEASURES,
Washington, D. C., August 24, 1892.

SIR: A report on the operations of the office of Standard Weights and Measures during the fiscal year ending June 30, 1892, is hereby submitted.

From the beginning of the fiscal year until July 20, and from October 11, until its close, the office was in my charge. Between the dates above given, during my absence on field duty it was under the direction of Assistant Edwin Smith.

Mr. L. A. Fischer, adjuster, was on duty throughout the year except during a short period of absence enforced by sickness. On him alone devolved all the observing and computing during my absence in the field, above referred to.

Mr. John F. Hayford, computer, was attached to the office until July 20, when he also was ordered into the field. He was again assigned to duty here until October 27, and with the exception of about two weeks he served until the end of December, when he was permanently detached.

At my request Mr. Hayford compiled and prepared a paper giving the symbolic solution, with numerical coefficients, by least squares, of observation equations for determining the corrections of weights. The cases considered are such as rise continually in this office in determining the values of the series of weights in use in this office and in commerce. The usefulness of this paper induces me to submit it for publication. [See Appendix No. 10, Part II.]

Mr. H. B. von der Trenck was temporarily attached to the office between January 11 and the early part of February.

Mr. O. B. French was on duty for a brief period in December.

Mr. C. A. Harbaugh reported for duty December 11, and remained attached throughout the fiscal year.

The current work of the office, some details of which are given in the appended abstract, consisted in making length, weight, and thermometer comparisons, and, as a part of its regular functions, the office coöperated with the United States Internal Revenue Bureau by making for the latter verifications of alcoholometers and saccharometers; by comparing quartz plates; by graduating sugar flasks, and testing weights.

A new edition of the Conversion Tables of United States Weights and Measures was issued in November, 1891, to meet the public demand.

WEIGHTS AND MEASURES FOR THE STATES.

A set of Customary and Metric Weights and Measures was prepared and furnished to the State of Idaho.

STANDARDS OF LENGTH.

During the year a redetermination of the length of the United States Bench Standard was made by means of the 5-metre secondary base apparatus. By choosing the cold and

warm days of spring for this work, a satisfactory determination was obtained for its coefficient of expansion. This was found equal to ·0000114 per degree centigrade, a value not differing much from that of the standard steel tapes now used by this Survey for line measurement.

The Bench Standard is a steel bar 100 feet long, and it is used for the comparison of tapes for surveying and engineering purposes.

In May of this year, observations were begun for determining the relation between British Yards, Bronze No. 11, and Low Moor Iron No. 57 on the one hand, and National Prototype Metre No. 21 on the other.

The comparisons and computations were not quite finished at the end of the fiscal year, but the result, since computed, does not differ by as much as one unit in the fourth place of decimals from the legal relation established for commercial purposes in this country, namely, 1 metre = 39·3700 inches.

STANDARDS OF MASS.

The densities of the set of gilded metric weights referred to in my last annual report have been determined, as well as their masses, the latter by reference to National Prototype Kilogramme No. 4.

The metal used was taken from a rod of commercial rolled brass and the results are given below in order to show what may be expected under such circumstances. The masses of the weights are also given:

Densities and Masses of Metric Weights.

Designation of weights.	Density at 0° C.	Mass.	
		Grammes.	Milligrammes.
(1000 gm.) G	8·3976	1000	+ 0·42 ± 0·04
(500 gm.) G	8·3767	500	+ 0·42 ± 0·028
(400 gm.) G	8·3666	400	+ 0·32 ± 0·026
(300 gm.) G	8·3509	300	+ 0·44 ± 0·022
(200 gm.) G	8·3300	200	+ 0·66 ± 0·019
(100 gm.) G	8·3653	100	+ 0·35 ± 0·018
(50 gm.) G	8·3646	50	− 0·137 ± 0·012
(40 gm.) G	8·3819	40	− 0·226 ± 0·011
(30 gm.) G	8·3770	30	− 0·114 ± 0·009
(20 gm.) G	8·3638	20	+ 0·115 ± 0·009
(10 gm.) G	8·4317	10	− 0·251 ± 0·008
(5 gm.) G	8·399	5	+ 0·010 ± 0·005
(4 gm.) G	8·190	4	− 0·038 ± 0·005
(3 gm.) G	8·413	3	− 0·003 ± 0·004
(2 gm.) G	8·404	2	− 0·069 ± 0·004
(1 gm.) G	8·391	1	− 0·006 ± 0·003

The weighings for determining the foregoing masses were made before the balance of precision, constructed for this office by Rueprecht of Vienna, had been received. This balance was received on April 14, and temporarily mounted in the Standards room for lack of a suitable permanent place.

Yours respectfully,

O. H. TITTMANN,
Assistant Coast and Geodetic Survey,
in charge of Office of Standard Weights and Measures.

Dr. T. C. MENDENHALL,
Superintendent United States Coast and Geodetic Survey
and of Standard Weights and Measures.

OFFICE OF UNITED STATES STANDARD WEIGHTS AND MEASURES.

ABSTRACT OF VERIFICATIONS OF WEIGHTS AND MEASURES MADE DURING THE FISCAL YEAR 1892.

Date.	Name.	Service.
1891.		
July	Baker, W. C., Cleveland, Ohio	Information furnished.
	Reese, J. K., New London, N. H	Information furnished.
	United States Internal Revenue	Weights verified.
	Clark, J. C., Fort Smith, Ark	Information furnished.
	Littlejohn, A. M., Little Rock	Information furnished.
	Eureka Coat Pad Co., Baltimore	Information furnished.
August	United States Internal Revenue	Information furnished.
	State of Idaho	Standards compared with United States Standards.
	G. M. Eddy & Co., Brooklyn	Tape compared.
	Gardner, Albro., Seattle, Wash	Tape compared.
	United States Internal Revenue	Sugar flasks graduated and verified.
	United States Internal Revenue	Comparison of quartz plates.
	United States Internal Revenue	Information furnished.
	United States Internal Revenue	Comparison of iron weights.
September	Alberton & McFarland, Washington	Information furnished.
	Mentz, Lieut. G. W., Navy Department	Information furnished.
	Kaufman, C. H., Bridgeport, Ohio	Information furnished.
	United States Internal Revenue	Comparison of quartz plates.
	United States Internal Revenue	Sugar weights and saccharometers.
	G. M. Eddy & Co., Brooklyn	Two tapes compared.
October	Stewart, F. E., Wilmington, Del	Information furnished.
	United States Internal Revenue	Polariscope tubes compared.
	United States Internal Revenue	Sugar weights compared.
November	United States Internal Revenue	Verification of saccharometers.
December	United States Coast and Geodetic Survey	Tape compared.
	American Institute, Homeopathy	Information furnished.
	United States Internal Revenue	Eighteen polariscope tubes compared.
	United States Coast and Geodetic Survey	Thermometer corrections furnished.
	State of Idaho	Weights and measures furnished.
	George Davidson, assistant	Standards furnished.
	Agricultural Department	Quartz plates verified.
	National Brewing Co., Baltimore	Three alcoholometers compared.
	United States Geological Survey	Tape compared.
	Garrison Manufacturing Co., New York	Two-gallon vessels adjusted.
	United States Internal Revenue	Two quartz plates compared.
	J. A. Sherer & Bro., New York	Four sugar flasks verified.
	United States Internal Revenue	Sixty sugar flasks adjusted.
1892.		
January	Engineer Commissioner, D. C	Tape compared.
	United States Internal Revenue	217 flasks graduated.
	U. S. Coast and Geodetic Survey	Thermometers compared.
	Agricultural Department	Three litre measures compared.
	Agricultural Department	Two litre measures compared.
	United States Internal Revenue	Five alcholometers compared.
	United States Internal Revenue	400 saccharometers compared.
February	Heyman, Edward, New York	Information furnished.
	United States Mint	Set of grain weights compared.
	United States Internal Revenue	466 saccharometers compared.
	Agricultural Department	Two brass litres compared.
	Palmer, N. F., Brooklyn, N. Y	Information furnished.
	Decimal Association, London	Information furnished.
	State of Idaho	Troy pound adjusted.
	United States Customs Division, Treasury	Glass graduate verified.
	Petry, A., Cincinnati, Ohio	Tape compared.
	Wileman, E. D., Massillon, Ohio	Tape compared.
	E. & T. Fairbanks & Co	Weights adjusted.
	Baker & McNaughton, Cleveland, Ohio	Tape compared.
	Hartshorn, R. H., Washington	Information furnished.

ABSTRACT OF VERIFICATIONS OF WEIGHTS AND MEASURES—Continued.

Date.	Name.	Service.
1892.		
March	U. S. Coast and Geodetic Survey	Troy and avoirdupois pounds adjusted.
	Young & Son, Philadelphia	Tape compared.
	Whitall, Tatum & Co., Philadelphia	Burette compared.
	Ricker & Wing, Buffalo	Tape compared.
	United States Internal Revenue	100 sugar flasks graduated.
April	U. S. Coast and Geodetic Survey Office	Four thermometers compared.
	U. S. Coast and Geodetic Survey Office	Steel tape No. 132 compared.
	U. S. Coast and Geodetic Survey Office	Steel tape compared.
	U. S. Coast and Geodetic Survey Office	Steel tape compared.
	Customs Division, Treasury Department	131 glass graduates compared.
	United States Geological Survey	Two steel tapes compared.
	Van Hosen, E. F., Rochester, N. Y	Tape compared.
	Van Duzee, H., Philadelphia	Tape compared.
	Force, C. G., Cleveland, Ohio	Tape compared.
	Fairchild, D., Buffalo, N. Y	Tape compared.
May	Fairbanks & Co., Vermont	Information furnished.
	Both, A. C., Portland, Me	Tape compared.
	United States Internal Revenue	Six alcoholometers standardized.
	Collins, M. D., Boston, Mass	Information furnished.
	Oldberg, Oscar, Chicago, Ill	Information furnished.
	Bryan, R. W. D., New Mexico	Information furnished.
	U. S. Coast and Geodetic Survey	Twenty-four thermometers compared.
	City of Boston	Five yards compared.
June	U. S. Coast and Geodetic Survey	Tape compared.
	Roe & Sons, Troy, N. Y	Tape compared.
	Engineer Commissioner, D. C	Tape compared.
	Internal Revenue	215 alcoholometers compared.
	Guthrie & Rockwood, New York	Tape compared.
	Looker, H. B., Civil Engineer, District of Columbia	Tape compared.
	Bureau American Republics	Information furnished.

U. S. COAST AND GEODETIC SURVEY REPORT FOR 1892.

PART I.

PROGRESS SKETCHES.

No. 1. Sketch of general progress (eastern sheet).
No. 2. Sketch of general progress (western sheet).
No. 3. General chart of Alaska.
No. 4. Map showing longitude stations and connections determined by the electric telegraph between 1846 and June 30, 1892.
No. 5. Map showing positions of magnetic stations occupied between 1844 and June 30, 1892.
No. 6. Map showing lines of geodetic leveling run and positions of gravity stations to June 30, 1892.
No. 7. Progress of surveys and resurveys between the St. Croix and the Hudson rivers (with a sub-sketch showing survey of the Northeastern Boundary lakes).
No. 8. Triangulation between the Atlantic coast and West Virginia; also sub-sketch showing resurvey of Beaufort River, S. C.
No. 9. Triangulation between West Virginia and eastern Missouri along or near the thirty-ninth parallel.
No. 10. Triangulation between eastern Missouri and western Kansas along or near the thirty-ninth parallel.
No. 11. Triangulation between western Kansas and eastern Utah along or near the thirty-ninth parallel.
No. 12. Triangulation between eastern Utah and western Nevada along or near the thirty-ninth parallel.
No. 13. Triangulation between western Nevada and the Pacific coast along or near the thirty-ninth parallel.
NO. 14. Sketch showing the connection of the triangulations of Kentucky, Tennessee, Georgia, and Alabama, with extension of triangulation in Alabama towards the Gulf coast.
No. 15. Progress of the surveys and resurveys on the Gulf coast of Florida, Alabama, and Texas.
No. 16. Triangulation in the States of Wisconsin and Minnesota.
No. 17. Progress of the survey on the coasts of Oregon and Washington from Tillamook Bay to the Boundary.

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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