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ANNUAL REPORT

OF THE

DIRECTOR, UNITED STATES COAST AND GEODETIC SURVEY

FOR THE

FISCAL YEAR ENDED JUNE 30, 1944

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COAST AND GEODETIC SURVEY
LEO OTIS COLBERT, Director

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

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A REVIEW OF THE YEAR

The demands of the military services for nautical and aeronautical charts and for special surveys and investigations continued to require the full efforts of the field and office personnel of the Bureau. The rapid progress made by our armed forces on the several fronts was reflected in changing chart requirements, both as regards localities and types of charts. Whereas a year ago there existed a heavy demand for nautical and aeronautical charts of the Aleutian Islands, the emphasis has shifted to the nautical and special charts necessary in the reconquest of the Philippine Islands and to special aeronautical charts essential in bombing military and industrial objectives in the Japanese Empire.

Fortunately, as our military forces reenter Philippine waters they will have available excellent charts, the results of surveys made by the Coast and Geodetic Survey continuously over a period of 40 years. These surveys of Philippine waters, copied and stored in the United States before the Japanese occupation, make possible the preparation of the special types of landing charts and related information needed by the amphibious forces.

The growth of our Navy and merchant marine is shown in the demand for nautical charts, which increased during the past year to an issue of 2,900,000 copies, or seven times the annual requirement before the war. Likewise, the expansion of Army and Navy Air Forces is shown in the demand for aeronautical charts, which increased during the same period to 10,500,000 copies for operational and training purposes in the United States and to 10,000,000 foreign and special-purpose charts. These items represent increases of about 1,000,000 nautical and 9,000,000 aeronautical charts over the previous year.

Vessels and field parties of the service continued operations in areas of strategic importance. The greater part of the survey fleet was engaged on surveys in the Aleutian Islands. Major accomplishments in geodesy were the triangulation and leveling along the Alaska Military Highway and the location of battery emplacements along the New England coast. Special tide predictions were furnished the armed forces for navigation and landing operations in all combat zones. Of particular military importance were the magnetic data supplied our forces for use in compass adjustments and radio communication, and the reports on earthquake hazards furnished for military and war-plant installations in areas subject to seismic disturbances.

TRANSFER OF PERSONNEL AND EQUIPMENT

Thirty-seven commissioned officers of the service have been assigned by executive order to military duty with the Army, 25 with the Navy, and 11 with the Marine Corps. These officers occupy billets where expert navigational and surveying training are required. Their value to military operations has been recognized by awards of the Legion of

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Merit, the Silver Star, the Bronze Star, the Purple Heart, and numerous citations and letters of commendation. At the end of the year, 949 civilian members of the Bureau were serving with the armed forces.

Six ships have been transferred to the Navy since hostilities began. Three of these, on which Coast and Geodetic Survey officers are serving, are engaged on survey assignments in forward areas. Numerous items of instruments and equipment which are unobtainable from other sources have been loaned the Army and Navy.

PERSONNEL

The systematic training of new employees was continued by the Chart Division, principally to meet the demand for replacements for those who had resigned or transferred, or who were inducted into the military forces. In addition to elementary drafting courses, a program of specialized training was inaugurated to instruct employees in the more exacting phases of cartography.

A 10-hour course extending over a 5-day period was given to supervisors. As a result of this training, supervisors were able to reduce materially the time required to fit an employee for productive work. A series of weekly lectures, accompanied by home-work assignments, was given in theoretical and analytical photogrammetry for employees with demonstrated qualifications and aptitude for this work.

In January 1944 the National Institute of Public Affairs inaugurated an in-service internship program for the purpose of furthering the development of Government career service. Of the thousand candidates from Government agencies, the Bureau's selected applicant was one of the 30 interns chosen and is now assigned to a 6-month course of training. Refresher courses, sponsored by the Government, were given to a number of typists and stenographers.

On December 27, 1943, the Civil Service Commission rendered a decision that employees of the Coast and Geodetic Survey, Army Map Service, Hydrographic Office, Geological Survey, and Weather Bureau were craftsmen, engaged in the reproduction of charts and maps through lithographic processes, and should be excluded from the Classification Act. A committee appointed to study the situation made recommendations, which were accepted, as to the manner in which employees should be allocated. These allocations, which will be administered by Wage Boards in the various Departments, will become effective on July 3, 1944.

COOPERATION WITH AMERICAN REPUBLICS

The Coast and Geodetic Survey continued active participation in the program sponsored and financed by the State Department for cooperation with the American Republics. Participation in this program has already led to the establishment of cordial and helpful relations with military, naval, and scientific organizations in these countries. Plans have been formulated for the training in this country of qualified applicants from Central and South American Republics. Instruction will be given in geodetic surveying,

map and chart production, and hydrographic surveying, in the Washington office and on field parties and vessels of the Bureau.

Officers of the Bureau visited Venezuela, Colombia, Peru, and Chile to discuss problems and methods in geodetic and hydrographic surveying with officials of those countries and to inspect tide station installations. Instruments and equipment were loaned to the governments of Brazil, Uruguay, and Venezuela to expedite control surveys in those countries.

Thirteen tide stations in Central and South America were operated on a cooperative basis, the Coast and Geodetic Survey furnishing and installing the instrumental equipment and the cooperating countries furnishing the necessary structures and observers.

Extensive magnetic surveys were accomplished in eight Central and South American countries; viz., Brazil, Chile, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, and Peru, the results of which are of immediate importance to nautical and aeronautical charting and other war purposes. A representative of the Bureau who visited nine countries for the purpose of developing greater cooperation in the collection and exchange of earthquake information was able to aid materially in the maintenance and improvement of several seismological stations. In Chile and Peru strong-motion seismographs were installed to record the nature and magnitude of destructive earthquake motions. These records will be made available to engineers of this country and to those of other American Republics who are interested in the control of earthquake damage through improved building design. The Bureau furnished special seismological data and information to three countries and obtained data from one country in connection with a special research project.

The Central Translating Office of the State Department continued the Portuguese translation of the new edition of the Hydrographic Manual, and a contract was made with officials in Mexico City for the Spanish translation.

CHART PRODUCTION

The demands of our rapidly expanding Navy, merchant marine, and Air Forces for nautical and aeronautical charts required a considerable increase in personnel and equipment for chart production and the use of these facilities largely on a two- or three-shift basis. The major results attained are shown in the following table which gives the annual issues of navigational charts and related publications during the past 4 years.

Charts and related publications issued

Type of chart or publication	1941	1942	1943	1944
Nautical charts	621,663	1,081,072	1,916,599	2,913,666
Aeronautical charts	912,339	3,145,516	11,773,464	17,645,892
Coast Pilots	15,030	19,094	35,661	16,086
Tide Tables	32,755	35,496	56,109	81,449
Current Tables	16,007	21,826	36,698	86,038

Thirty-one new nautical charts were published. Of these,

21 covered areas in the Aleutian Islands; two, the Hawaiian Islands; two, the Pacific coast of the United States; and six, the Atlantic coast of the United States. Seventeen charts of the Aleutian Islands, formerly published by the Hydrographic Office, were taken over by the Coast and Geodetic Survey during the year. Four of these were canceled since the areas which they covered were adequately shown on Coast and Geodetic Survey charts. Of the 13 charts retained, all were revised, some extensively, from recent information, including the adjustment of datums.

The number of individual nautical charts published at the end of the year was 868. To produce the 2,850,000 copies printed during the year there were 1,532 printings, as follows: 31 new charts, 81 new editions, 930 new prints, and 490 reprints. Due to rapid changes in important navigational information, it was necessary to apply 6,380,693 hand changes to correct the charts to the date of issue. Dangers requiring hand corrections and other navigational information were supplied to the U.S. Coast Guard and Hydrographic Office for publication in the weekly Notice to Mariners. For the benefit of the military services special attention was directed to the prompt publication of advance information obtained by Coast and Geodetic Survey field parties.

Aeronautical chart production continued to increase, the heaviest demand for any series being for the sectional charts of the United States. A comprehensive revision of this important series was nearing completion at the end of the year. Further improvement in accuracy was achieved by the resumption of flight checking. The revision and issue of these charts on a published schedule has greatly increased the efficiency of distribution.

The wholehearted cooperation of personnel permitted heavy production, on short notice, of charts for what are now historic military operations. Assistance was given the War Department in indexing the thousands of aerial photographs acquired by our Air Forces in many theaters of operations and in the editing of maps for ground force use. Three hundred and fourteen standard 7½-minute quadrangles of strategic areas within the United States were completed for the War Department and a large number of special diagrams for use in planning amphibious operations were delivered to the fighting fronts.

Work was continued on airport charts which are of increasing importance to aviators. Of a scheduled total of 475 of these charts which cover the major civil and military airports of the country, 317 were available at the end of the year. Charts published in Air Navigation Radio Aids of the Civil Aeronautics Administration, and the format of this publication, have been improved.

A total of 580 special landing charts of the Philippine Islands was made for the armed services from original Coast and Geodetic Survey records. A number of war agencies, each working in its specialized field, made extensive use of the information found on the original survey and in the reports of the Philippine Islands. One such agency was furnished microfilm copies of 1,000 topographic descriptive reports. A comprehensive gazetteer of geographic names of the Philippine Islands, compiled from every source available to the Bureau, was nearing completion at the end of the year. Nearly 39,000 names will be included in this publication. Similar

gazetteers of Alaska and the coastal regions of the Pacific coast, containing 10,000 and 7,000 geographic names respectively, were published during the year.

The heavy demand for photographic reproduction of the detailed topographic and hydrographic surveys of the Coast and Geodetic Survey continued. These were used extensively by the military services and war agencies in prosecution of the war effort. A comprehensive file of maps and charts of the world, used in production of the many charts for war use, has been used extensively by agencies requiring geographic information about various parts of the world.

Demands for accurate projections constructed on the Bureau's precision projection-ruling machine increased 33 percent over the previous year and 730 percent over the last prewar year.

Not the least contribution during the year has been the advice and assistance given by the Survey's experts in cartography and charting in answer to numerous requests from war agencies. The Division of Charts is constantly called upon to answer questions or advise on matters ranging from special navigational problems to geological or geophysical investigation.

At the request of the Civil Aeronautics Administration, Mr. T. C. Lyon was assigned to that organization for a period of 6 months to revise Practical Air Navigation, which is now issued as Civil Aeronautics Bulletin No. 24.

Due to the tremendous load of chart printing, contracts were let with four commercial map lithographic companies to handle the printing beyond the capacity of the Coast and Geodetic Survey. These concerns printed approximately 3,000,000 charts. In addition to using these outlets to handle the demand, a critical situation was relieved in the later months of the year by omitting many color plates.

In the case of the Philippine charts, a method was devised to process the land tint on the black plate by means of a very fine halftone screen. This proved highly satisfactory and charts were produced at one printing with the land area emphasized as a light gray tint. To distribute the increased number of charts required considerable expansion in the Distribution Branch, particularly in the Finishing Section where the large quantities of charts furnished the Air Forces were folded.

During the latter part of the year the Secretary of War authorized the Secretary of Commerce to reestablish agencies for aeronautical charts under certain restrictions, the contracts with former dealers having been canceled in June 1942 by request of the War Department.

Branch units for the compilation of aeronautical charts were continued in connection with other Bureau activities at New York, Baltimore, Norfolk, and Tampa. The operation of these units has been of material advantage in relieving crowded conditions in the Washington office.

Numerous improvements in processes and instruments for chart production were made by employees of the Chart Division. A process for production of full-color relief maps was perfected and models were prepared in cooperation with the Civil Aeronautics Administration.

New humidity-control equipment for the pressroom, photograph gallery, plate-making room, and type-composition room was installed during the year. The two-color press, which

has now been in operation for over a year, proved to be especially efficient in handling the large runs of aeronautical charts.

COASTAL SURVEYS

Hydrographic, topographic, and coastal triangulation surveys were continued with four survey ships, eleven smaller vessels, and several shore-based units. One of these survey ships was added to the fleet late in the fiscal year and three of the smaller vessels were withdrawn from service during the winter season. Six major vessels of the Bureau are still assigned to the Navy. Since the beginning of the present hostilities, all field operations were directed to complying with requests from the Army and Navy for surveys and investigations in strategic areas. A summary of results accomplished is given in the following table:

Locality	Hydrography				Topography		Coastal triangulation		
	Sounding lines	Area	Wire drag	Area	Shoreline	Area	Length of scheme	Area	Geographic positions
	Miles	*Square miles*	*Miles*	*Square miles*	*Miles*	*Square miles*	*Miles*	*Square miles*	*Number*
Coast of Maine	6,156	261	345	101	*1,731	*1,897	----	----	----
Atlantic coast, Massachusetts to Cape Charles	495	11	15	5	*1,014	*669	3	4	20
Chesapeake Bay	5,487	250	5	2	*1,001	*1,431	10	25	46
James River	693	26	----	----	----	----	7	25	28
Atlantic coast, Cape Charles to Florida	79	2	----	----	*3,222	*3,769	----	----	----
Florida and Gulf coast	----	----	----	----	*1,723	*2,387	----	----	19
San Francisco Bay Area	----	----	----	----	*554	*283	----	----	----
Puget Sound	----	----	----	----	----	*200	----	----	6
Alaska	14,854	6,295	120	15	226	2	161	1,202	172
Total	27,764	6,845	485	123	9,471	10,696	181	1,256	291

*Air photographic compilation.

Along the coast of Maine the LYDONIA continued hydrographic surveys and wire-drag investigations. The motor vessel GILBERT and the launches FARIS, HILGARD, WAINWRIGHT, MARINDIN, and OGDEN assisted in this work. A winter project of hydrographic surveys was undertaken in Chesapeake Bay by the ship LYDONIA, the motor vessels COWIE and GILBERT, and the launches FARIS, HILGARD, and WAINWRIGHT. The launches MARINDIN and OGDEN assisted in this work until Jnauary 1944, when they were laid up. A measured mile was established in lower New York Harbor. Special magnetic investigations were made in the New York Harbor area.

The GILBERT completed a second-order scheme of triangulation along the James River between Hopewell and Richmond, Va. This vessel established a measured mile on the north shore of Block Island Sound, and accomplished special magnetic work for the Army in Massachusetts.

The COWIE completed a radio-current-meter survey and a hydrographic survey in Narragansett Bay, and a radio-current-meter survey in the vicinity of the Brooklyn Navy Yard. The vessel also accomplished hydrographic surveys in the lower Patuxent River and in the vicinity of Cape Henry.

The FARIS, assisted by the HILGARD, was engaged on hydro-

graphic surveys in the vicinity of the Norfolk Naval Operating Base, wire-drag investigations in Chesapeake Bay, and hydrography in the lower James River. A measured mile was established near Gloucester, Mass. The launches HILGARD and WAINWRIGHT made special wire-drag investigations at the entrance to Buzzards Bay.

An officer of the Bureau was assigned to the Navy for supervising wire-drag investigations of wrecks along the Atlantic coast.

On the Pacific coast, during the winter field season, the motor vessel WESTDAHL extended second-order triangulation through Saratoga Passage, Puget Sound. The motor vessel E. LESTER JONES continued radio-current-meter surveys in Puget Sound.

In Alaska, the ships EXPLORER and SURVEYOR and the motor vessels E. LESTER JONES and PATTON continued surveys of strategic areas. This group was joined by the motor vessel DERICKSON late in the fiscal year. The WESTDAHL continued surveys in southeast Alaska and assisted in geodetic operations along the Alaska Peninsula.

Offices for the processing of field records continued in operation at Norfolk, Va., and Seattle, Wash. The operation of these offices at the principal bases of our field parties not only expedites the transition of field surveys to finished charts, but permits close cooperation between the field engineer and the office draftsman. By being relieved of a great amount of office work, survey units are able to engage in a year-round program of field work.

Single-lens air photographs were made of large coastal areas in Maine and of other smaller areas along the North Atlantic seaboard, and photographs were taken for nautical chart revision. Field inspection of air photographs was in progress in Maine, Virginia, and Florida. Photogrammetric offices were continued at Baltimore, Md., and Tampa, Fla., where planimetric maps were compiled of coastal areas in Maine, Massachusetts, and Florida, and of the James River, Va., and of San Francisco Bay.

The Bureau completed its part in the domestic mapping program financed by the War Department. As a result of this cooperation 314 topographic map quadrangles were published, covering 13,844 square miles of hitherto inadequately mapped areas in the Eastern States. In addition, partial field surveys were completed for 44 quadrangles, covering 1,769 square miles in Virginia.

The field stations of the Bureau, located in the principal ports, continued to render valuable service in supplying information for the correction of charts, in disseminating nautical and engineering data in response to requests from local public and official sources, and in cooperating with naval and military authorities on matters pertaining to the war effort.

The 13 United States coast pilot volumes contain a wide variety of important information supplemental to that shown on nautical charts. These volumes are kept current by annual supplements and revisions. New editions of the coast pilots are published as often as is warranted by the number of changes that have been made and the amount of new information available. Nine supplements were issued during the year, and a new edition of the Alaska Pilot, Part I, was published. A new special Alaska Coast Pilot covering the Aleutian Islands

was prepared and published.

A new motor vessel, christened the Derickson in honor of a former officer of the Survey, was transferred to the Bureau from the Navy in May 1944. The vessel was immediately assigned to the execution of important surveys in the Aleutian Islands. The over-age launches Elsie III, Marindin, Rodgers, Ogden, and Mitchell were surveyed and disposed of.

GEODETIC CONTROL SURVEYS

Triangulation and leveling surveys were continued in priority areas in the United States and Alaska mainly through funds transferred by the War Department. Although these control surveys are made primarily for war purposes, they will prove of lasting value in fulfilling the needs of engineers and surveyors engaged on postwar construction and surveys. Activities carried on in 23 states, Alaska, and Yukon Territory, Canada, during the year are summarized in the following tables:

Locality	Length of scheme	Area
First-order triangulation	*Miles*	*Square miles*
Pontiac to Monroe, Mich.	55	900
Big Delta, Alaska to Beaver Creek, Canada	200	2,800
Seward Peninsula, Alaska	500	10,025
Paulding to Tiffin, Ohio and Adrian, Mich. to Bellefontaine, Ohio	235	2,350
Whitehorse to Beaver Creek, Canada	220	1,525
Albany Base Net, N.Y.	4	15
Vicinity of Meriden, Conn.	16	50
Cleveland to Canton, Ohio	65	715
San Antonio Base Net, Texas	30	340
Vicinity of Medford, Mass.	5	15
Moapa to Caliente, Nev.	100	2,485
Canton, Ohio to Parkersburg, W.Va. to Clarksburg, W.Va.	175	1,750
Cook Inlet, Alaska	55	870
Wide Bay to Port Wrangell, Alaska	30	150
Total	1,690	23,990
Second-order triangulation and traverse		
Vicinity of Saco Bay, Maine	15	100
Vicinity of Dover, N.H.	12	90
Vicinity of Grants Pass, Oreg.	160	2,720
El Paso, Texas to Orange, N. Mex.; Mayhill to Rincon, N. Mex., and Alamogordo to Orogrande, N. Mex.	275	3,865
Roswell to Queen, N. Mex.	135	2,350
Vicinity of Brownwood, Texas	35	360
Coleman to Bronte, Texas	95	855
San Angelo to Garden City, Texas	70	770
Waco to Stephenville, Texas	75	865
Mendota to Kettleman City to Visalia, Calif.	140	2,545
Wakefield to Smithfield and Surry to Whaleyville, Va.	70	665
Hayneville to Falco, Ala.	125	1,500
Flomaton to Uniontown, Ala.	195	1,950
Salinas River Valley, Calif.	140	2,390
Ozona to Harper, Texas	120	1,440
Vicinity of Fairbanks, Alaska	8	20
Kerrville to Rocksprings and Leakey to Uvalde, Texas	100	900
Total	1,770	23,385
Special areas	227	761
Vicinity of Manatee Co., Florida (second-order traverse)	90	

Locality	Length of scheme	Area
First-order base-line measurement	*Miles*	*Square miles*
Flint, Mich.	5.9	–
Unalakleet, Alaska	3.2	–
Delta, Ohio	9.1	–
White Pass, Canada	1.7	–
Bennett, Canada	2.4	–
Tana, Alaska	5.0	–
Burwash, Canada	3.1	–
Canyon Creek, Canada	4.2	–
White River, Canada	3.4	–
Ada, Ohio	5.7	–
Teller, Alaska	4.3	–
Albany, N. Y.	2.3	–
Canton, Ohio	3.9	–
Withers, Texas	5.0	–
Newman, Calif.	6.0	–
King City, Calif.	4.8	–
Belpre, Ohio	4.0	–
Solomon, Alaska	6.4	–
Satelite, Alaska	1.0	–
Hords, Texas	1.0	–
Total	82.4	–
First-order reconnaissance		
Albany Base Net, N.Y.	4	15
Renovo to Bloomsburg and Boalsburg to LeRoy, Pa.	145	1930
Paulding to Tiffin, Ohio	110	1110
White Pass, Alaska to Whitehorse, Canada to Big Delta, Alaska	530	4900
Pittsburgh to Brookville and Grove City to Saltsburg, Pa.	130	1560
Vicinity of Medford, Mass.	5	15
Cleveland, Akron and Canton, Ohio	55	225
Tohatchi, N. Mex. to Tuba City, Ariz. and Holbrook, Ariz. to Mexican Hat, Utah	320	7040
Seward Peninsula, Alaska	500	10025
Cook Inlet, Alaska	40	720
Glen Highway, Alaska	65	455
Wide Bay to Port Wrangell, Alaska	30	150
Ellwood City, Pa. to Bucyrus, Ohio	140	1680
Total	2074	29825
Second-order reconnaissance		
Elba to Gnatt, Ala.	35	400
Gnatt to Monroeville to Flomaton, Ala.	95	950
Brownwood to Hamilton, Texas	80	1100
Monroeville to Uniontown and Camden to Campbell, Ala.	110	1210
Vicinity of Brownwood, Texas	35	360
Coleman to Bronte, Texas	95	855
San Angelo to Garden City, Texas	70	770
Waco to Stephenville, Texas	75	865
Osyka to Jackson, Liberty to Edwards, Oakvale to Washington and Mendenhall to Port Gibson, Miss.	300	3000
Vicinity of Fairbanks, Alaska	8	20
Vicinity Saco Bay, Maine	15	100
Vicinity of Dover, N.H.	12	90
Total	930	9720
Special areas	227	761

Leveling	First-order	Second-order
State	*Miles*	*Miles*
Alabama	415	142
Alaska	235	–
California	556	372
Kentucky	17	107
Maine	18	130
Massachusetts	6	107
Mississippi	88	35
New Hampshire	4	27
New Mexico	–	61
New York	–	265
Ohio	203	18
Oregon	720	266
Rhode Island	30	90
Tennessee	121	74
Texas	160	757
Washington	167	11
West Virginia	173	2
Yukon Territory, Canada	402	–
Totals	3315	2464

State or region	Determinations		
	Latitude	Longitude	Azimuth
Astronomy			
Alabama	–	1	–
California	2	1	2
Ohio			3
Texas	1	1	1
Alaska	4	5	6
Yukon Territory, Canada	1	1	2
Total	8	9	14

The geodetic control surveys in progress in Alaska and Yukon Territory at the close of the last fiscal year were continued by four triangulation parties, one 3-unit leveling party, one astronomic party, and one reconnaissance party. The work included triangulation and leveling along the Alaska Military Highway to Big Delta where connections were made with previously established control points, and the continuation of an arc of triangulation from Ruby on the Yukon to Unalakleet on Norton Sound, thence north and west along the Seward Peninsula to Teller on Port Clarence.

Early in 1944 an astronomic party established stations on Attu and Amchitka Islands in the western Aleutian group. At the close of the year the party was operating on St. Matthews Island in the Bering Sea.

In the spring of 1944 triangulation was resumed on the Seward Peninsula. At the close of the year, work was in progress on an arc extending along the Alaska Peninsula from Wide Bay to Chignik Bay, and along the Glenn Highway to close a loop extending to Fairbanks. The completion of the surveys along the Alaska Military Highway and those along the Alaska Peninsula will provide for the extension of the North American 1927 Datum as far westward as Amchitka, Aleutian Islands.

In the states the adaptability of control surveys to a great variety of uses is aptly illustrated by the services rendered to the War Department. For the purpose of locating battery installations for the Coast Artillery Corps, triangulation, leveling, and traverse were extended along the Atlantic coast from Cape Cod, Mass., to Portland, Maine; on Gardiners Island, N. Y.; and from Montauk Point, N. Y., to

New Bedford, Mass. For flood control, triangulation and leveling were done in the vicinity of Brownwood and San Angelo, Tex. To meet the needs of the war mapping program, surveys were accomplished in the vicinity of Suffolk, Va., and Sarasota, Fla. Several projects were completed to locate stations for the U.S. Signal Corps for use in connection with experiments in electronics.

At the request of the Corps of Engineers, U.S. Army, triangulation was extended in the San Joaquin and Salinas River valley regions of California, and leveling projects were carried on in Texas, Mississippi, Oregon, Tennessee, West Virginia, Pennsylvania, Ohio, California, and Alabama.

Variation of latitude observatories at Ukiah, Calif., and Gaithersburg, Md., were continued in operation in accordance with an international program begun in 1899.

Through the processing of the field data by the office force in Washington, definitive values are derived for the latitude and longitude of the triangulation stations, the lengths and azimuths of the lines joining them, and the elevations of the bench marks. Success has been achieved in efforts to reduce to a minimum the time interval between the receipt and release of the data, and to prepare them in a form most convenient to the users.

Several special projects were carried on in the office to meet requests of the armed forces, including the extension to the Equator of the military grid tables on the transverse Mercator projection; the preparation of formulas for the conversion of military grid coordinates to geographic positions; the extension of special star tables for the rapid determination of azimuth from 10° to 60° north latitude and also 10° to 60° south latitude; and the computation of a special stereographic projection. The field computing office in New York was continued in operation during the year.

Three Turkish Army officers were attached to the Division of Geodesy for a considerable period for the study of geodetic methods and computations.

TIDE AND CURRENT WORK

The activities of the Bureau in the fields of tides and currents were directed primarily to war needs. Twenty-three special reports on the tides and currents in specialized areas in practically all theaters of the war were prepared on request from the Navy. A number of reports were supplied directly to Army and Navy units in combat zones. These reports involved research in several technical publications in foreign languages.

The increased need for daily tide and current predictions in various parts of the world has required the inclusion of 14 additional tide stations in the annual tide tables and one additional current station in the annual current tables. Special tide and current tables, restricted to the armed forces, were prepared for 17 tide stations and 16 current stations.

The increased demand for the tide and current tables is indicated by the fact that about 165,000 copies were issued during the year, in addition to 8,000 copies of special tide and current tables. This represents an increase of 78 percent over the issue for 1943 and an increase of 239 percent over the issue for 1941.

Reciprocal agreements for the exchange of tide predictions between the United States and Great Britain, Canada, India, and Argentina were continued in effect with mutual advantages.

During the year, 46 primary and 19 secondary tide stations were maintained--39 on the Atlantic and Gulf coasts and 26 on the Pacific coast. Thirteen additional stations were in operation in Central and South America under the State Department program of cooperation with American Republics.

Observations from these tide stations, in addition to furnishing necessary data for surveys and tidal predictions, provide basic data for the various datum planes required in the industrial development of coastal areas and in the study of coastal stability.

Further work was continued on the comprehensive current survey of Puget Sound by the occupation of 23 current stations. At the request of the Navy, detailed current surveys were carried out in Block Island Sound, Narragansett Bay, and New York Harbor.

Because of the need of basic elevation data by the Army and Navy in connection with shore installations, a party was organized to recover and level to old bench marks along the Atlantic seaboard.

During the year a revised edition of the mimeographed publication "Surface Water Temperatures, Tide Stations, Atlantic and Gulf Coasts" was issued and its usefulness extended by the addition of tables of expectancy range.

MAGNETIC INVESTIGATIONS

Observations are necessary in order to gage the constantly changing direction and strength of the earth's magnetic forces. The results have practical and humanitarian application in the promotion of safe navigation on the sea and in the air. They are of paramount importance in military operations. The information is also used extensively by land surveyors who must know the deviation of the compass needle, by prospectors in search of oil and mineral resources, by radio and telegraph companies whose operations are directly affected by magnetic conditions, and by scientific investigators in their researches in this little-known phenomemon.

Magnetic observatories, at which continuous observations are recorded, were maintained throughout the year at Cheltenham, Md.; Tuscon, Ariz.; Honolulu, T. H.; San Juan, P. R.; and Sitka, Alaska. Five field parties conducted observations at widely distributed points in the continental United States, two in South America, and one in Central America. Late in the fiscal year two parties began similar observations in Alaska, using a plane and pilot detailed to the work by the Army. A number of confidential projects were accomplished for the armed forces. At several airports observations were made for the determination of the magnetic meridian and for the location of suitable sites for compass-adjustment stations. Daily reports on the magnetic conditions were furnished the National Bureau of Standards, the Carnegie Institute of Washington, and Naval Communications.

With the cooperation of the Department of Terrestrial Magnetism of the Carnegie Institute of Washington a cosmic-ray meter was operated at the Cheltenham Observatory, inter-

national magnetic standards were maintained at the Observatory, and observations of atmospheric electricity were made at the Tucson Observatory.

Manuscripts were prepared for six volumes of biennium reports of the Magnetic Observatory Results. This production represents a net gain of 7 observatory years. The manuscript for Serial No. 663, "The Magnetism of the Earth," was completed. The publication is a revision of Special Publication No. 117, "The Earth's Magnetism," which has become obsolete since its printing in 1925.

Magnetic data were furnished for 393 aeronautical charts, 438 nautical charts, and 26 isogonic charts produced by the Coast and Geodetic Survey and for a large number of maps produced for war purposes. by other Government agencies.

The distribution of magnetic observations during the year is shown in the following table:

Location	Repeat Stations				Other stations	Total
	Old		New			
	Complete	Declination only	Complete	Declination only		
Alabama	2	-	-	-	-	2
Arizona	-	-	-	-	2	2
Arkansas	2	-	-	-	1	3
Colorado	1	-	-	-	-	1
Florida	4	-	-	-	2	6
Georgia	3	-	1	-	3	7
Idaho	-	-	-	-	2	2
Illinois	2	-	1	-	1	4
Indiana	2	-	-	-	-	2
Iowa	1	-	-	-	-	1
Kansas	5	-	-	-	2	7
Kentucky	2	-	-	-	1	3
Louisiana	2	-	1	-	1	4
Maine	6	-	2	-	5	13
Massachusetts	-	-	-	-	2	2
Michigan	3	-	-	-	1	4
Minnesota	1	-	-	-	1	2
Mississippi	1	-	3	1	-	5
Missouri	6	-	-	-	3	9
Montana	-	-	-	-	1	1
Nebraska	1	-	-	-	-	1
Nevada	-	-	-	-	1	1
New Hampshire	2	-	-	-	-	2
New Jersey	-	-	-	-	7	7
New Mexico	-	-	-	-	4	4
New York	6	-	4	-	8	18
North Carolina	1	-	-	-	2	3
North Dakota	-	-	-	-	1	1
Ohio	2	-	-	-	1	3
Oklahoma	1	-	-	-	-	1
Oregon	-	-	-	-	1	1
Pennsylvania	4	-	4	-	4	12
South Carolina	-	-	-	-	1	1
Tennessee	3	-	-	-	1	4
Texas	3	-	1	-	6	10
Utah	-	-	-	-	2	2
Vermont	3	-	-	-	14	17
Virginia	3	-	3	-	2	8
Washington	-	-	-	-	4	4
Wisconsin	3	-	-	-	2	5
Wyoming	-	-	-	-	1	1
Alaska	-	-	-	-	31	31
Canada	-	-	-	-	4	4
Mexico	1	-	-	-	-	1
Costa Rica	2	-	-	-	-	2
Guatemala	5	-	1	-	-	6
Honduras	2	-	2	-	-	4
Nicaragua	2	-	4	-	-	6
Panama	2	-	-	-	-	2
Brazil	7	-	7	-	-	14
Chile	1	-	3	-	-	4
Peru	2	-	3	1	-	6
Total	99	—	40	2	125	266

SEISMOLOGIC WORK

The program of the Coast and Geodetic Survey for cooperative seismologic studies continued to provide valuable information concerning areas affected by earthquakes in the United States and possessions, the nature and extent of earthquake motions, and the design of earthquake-resistant structures. A considerable amount of seismologic data was furnished to war agencies and to engineers and contractors engaged in war construction.

Seismographs were operated at all magnetic observatories except Cheltenham, and at the Ukiah latitude observatory. Assistance was afforded to nine colleges in the operation of seismographs, and to nine independent stations through the study and interpretation of their records. A new cooperative station was established at the South Dakota State School of Mines and Technology.

Sixty strong-motion seismographs were in operation during the year at 52 stations in Western States and the Canal Zone. Sixty records were obtained from these instruments for nine earthquakes. A special analysis was made of records obtained in a tall building specially designed to resist earthquakes, and a comprehensive investigation of the period-amplitude characteristics of a group of records of destructive earthquake motion was made. Assistance was given on a special project started by the Navy Department, using seismograph records.

Operations of seismographs in the Boulder, Shasta, and Coulee Dam regions were continued as a joint undertaking with the Bureau of Reclamation and the National Park Service. The purpose of the program is to record the frequency, intensity, and location of earthquakes in the areas of the dams.

Vibration tests were made in a building under construction and in a tower building to determine their natural periods of vibration. Ground vibration tests were made at three locations to obtain the effects of blasting, machinery vibration, and gunfire.

Three tilt meters were operated on a cooperative basis with the University of California and one at Long Beach, Calif., in cooperation with that city. They were operated near earthquake faults to observe any tilt effects preceding and following earthquakes which might occur in the vicinity of the instruments.

In collecting earthquake information, close contacts were maintained with many commercial agencies and public-utility organizations, seismologic organizations, universities, and the U.S. Weather Bureau. Postmasters and thousands of other individuals assisted in this service. Building owners furnished free space for 50 strong-motion seismographs. Questionnaire coverage was made for 20 earthquakes which approached destructive character. In all, 1,963 reports were received for 170 earthquakes. Thirty-eight epicenters were located with the cooperation of Science Service and the results furnished to cooperating stations and interested Government agencies.

INSTRUMENT WORK

The Instrument Division, though handicapped by the scarcity of material and skilled workmen, made substantial contribution to efficiency and economy by the redesign of instruments and appurtenances to utilize new alloys and plastics. A chronograph was lightened by 35 pounds and a signal lamp by 6 pounds. Reduction in weight is important as instruments must often be transported by airplane to field parties in isolated localities. Transparent plastic was used where possible to replace glass and thus reduce the danger of breakage.

The construction of separate rooms, with special ventilating facilities, for spray painting and heat treatment has improved the health conditions and contributed to the morale and efficiency of employees engaged in this work.

Special experimental apparatus was built for the Navy and the Marine Corps in the Bureau's electrical laboratory. Laboratory personnel also cooperated with the Army Engineers and the National Inventors Council in confidential experiments. A vibration meter was remodeled to increase its range of frequencies in the measurement of ground vibrations and the recording of earthquakes.

PUBLICATIONS

A new Hydrographic Manual, a 940-page volume covering the latest developments in equipment and methods used by the Bureau in hydrographic surveys, was published. The first edition of the Aleutian Islands Coast Pilot was issued to meet the needs of the naval forces. New editions of the Alaska Coast Pilot, Part I, and of Wartime Information to Mariners were published, as were the usual supplements to other United States and Alaska Coast Pilots.

The Bureau's annual Tide Tables and Current Tables were distributed and new editions prepared of Tidal Current Charts for San Francisco Bay and Long Island and Block Island Sounds, and descriptions and elevations of tidal bench marks in New Jersey and the District of Columbia. Results of magnetic observations at Cheltenham, Md., Tucson, Ariz., Sitka, Alaska, and San Juan, P.R., were put out in pamphlet form, as were miscellaneous earthquake reports. Other pamphlets published include directions for servicing theodolites in the field and gazetteers of Alaska and the west coast of the United States.

PERSONNEL AND FINANCES

Acquisitions by the library and archives included 81 hydrographic and 53 topographic sheets; 28 air photographic maps representing new surveys; 1,230 blueprints (mostly by the U.S. Engineers); 22,723 maps; 4,681 charts; 8,385 field, office, and observatory records; 228 negatives; 856 prints; 126 lantern slides; 1,317 books; and 3,373 periodicals.

The number of persons serving in the Coast and Geodetic Survey at the close of the year was 2,435, distributed as follows:

	Commissioned	Civilian	Total		Commissioned	Civilian	Total
Washington office:				Field service:			
Regular appropriation	21	640	661	Regular appropriation	97	551	648
Working funds	—	610	610	Working funds	—	516	516
				Total	118	2317	2435

Collections covering miscellaneous receipts, including nautical and aeronautical charts and related publications, totaled $145,061, as compared with $167,881 during the preceding year.

The following funds, from the sources indicated, were available to the Bureau during the fiscal year 1944:

Regular appropriation	$4,157,000.00
First Supplemental National Defense Appropriation Act, 1944	858,000.00
First Deficiency Appropriation Act, 1944	251,000.00
Total Appropriations	5,266,000.00
Reimbursements to credit of appropriation for:	
Salaries	13,646.58
Aeronautical Charts	49,703.29
Coastal Surveys	1,178.93
Office Expenses	8,020.38
Traveling Expenses	2,474.09
Total reimbursements	75,023.27
Working funds received from:	
Bureau of Reclamation (seismological work, Boulder Dam)	10,500.00
Bureau of Reclamation (seismological work, Coulee Dam)	1,500.00
Bureau of Reclamation (seismological work, Shasta Dam)	1,500.00
War Department (surveys for flood control)	25,000.00
War Department (aeronautical charts)	2,261,735.00
War Department (mapping of strategic areas)	815,000.00
War Department (control surveys in Alaska and certain strategic areas)	660,000.00
War Department (control surveys)	13,000.00
Navy Department (compilations of tidal data)	25,000.00
Navy Department (microseismic project)	800.00
Weather Bureau, Department of Commerce (seismological work)	4,900.00
Civil Aeronautics Administration, Department of Commerce (aeronautical charts)	50,000.00
State Department (cooperation with American Republics)	92,650.00
Total working funds	3,961,585.00
Allotments from:	
Department of Commerce (travel)	20,000.00
Department of Commerce (printing and binding)	42,200.00
Department of Commerce (contingent expenses)	5,500.00
Total allotments	67,700.00
Total funds available	$9,370,308.27