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Coast and Geodetic Survey

During the past year all facilities of the Coast and Geodetic Survey were employed in supplying products and services required for national defense and the prosecution of the war. The essential nature of the Bureau's part in the war effort is indicated by the following summary of activities, which include extensive projects for the armed forces under specific requests.

Nautical and aeronautical charts.—The issue of nautical charts during the year totaled 1,081,000 copies—over 3 times the number issued in any year prior to the inauguration of the defense program. About 60 percent of these was furnished to the Navy, while the greater part of the remainder was utilized by merchant-marine vessels engaged in war transportation. The distribution of some 3,000,000 aeronautical charts was nearly 8 times the prewar issue. Approximately 90 percent of these charts was supplied to the air forces of the Army and Navy. In addition to the production and distribution of these charts, the Bureau constructed a number of special nautical charts for naval operations and carried on a large aeronautical charting program for the Army Air Force. In the interests of national security, the distribution of all aeronautical charts and planimetric maps, as well as nautical charts for certain strategic areas, was placed on a restricted basis. Various steps were taken to insure the availability of charts and related publications under any conditions which may occur.

Coastal surveys.—These surveys are the principal source of data for the production of nautical charts. All equipment available for this work was fully employed during the year in expediting the charting of strategic areas, providing data for special charts required for naval operations, and accomplishing special projects for the Army and Navy. The volume and variety of the latter taxed the Bureau's facilities to the utmost, necessitating careful planning and frequent revision of its program of operations.

Geodetic control surveys.—This activity provides accurately determined and suitably distributed monuments and bench marks which serve as basic reference points for topographic mapping, nautical and aeronautical charting, and other engineering and industrial projects. During the past year all work of this nature was carried on to provide control for topographic mapping in strategic areas as required by the War Department and for other military purposes, including surveys for the development of continental and island bases, establishment of artillery fire-control systems, control for mine sweeping, and other war activities.

Tide and current surveys.—These surveys are required for nautical chart construction and for the compilation of annual tide and current

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

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tables which are essential for sea navigation. They also provide data, in considerable demand during the year, for planning the launching of ships, military construction projects along the coasts, submarine net installations, and other war purposes.

Geomagnetics.—This work is essential for the procurement of magnetic data for nautical and aeronautical charts. The earth's magnetic forces are applied in a number of war operations and the Bureau conducted investigations and furnished much special data for these purposes.

Seismological investigations.—The principal earthquake data disseminated by the Bureau are past records of the frequency and severity of earthquakes, the nature and extent of stresses for which structures in earthquake regions must be designed to withstand, and the measurement of periods of vibrations of structures. A considerable amount of such information was required during the year in connection with the location of shipbuilding, airplane, and munitions plants, and the construction of dams, barracks, hospitals, hangars, and other military structures.

Transfer of Personnel and Equipment

In time of national emergency the President is empowered by law to transfer personnel and equipment of the Coast and Geodetic Survey to the War and Navy Departments. Under this authority 56 commissioned officers were transferred during the past year. Several additional officers were detailed to temporary duty with special units of the armed services. In general, the officers transferred have been assigned to special duties for which they are particularly qualified by reason of their training and experience in the technical work of the Bureau. Thirty-two civilian members holding reserve commissions in the armed forces, and specially trained in their duties, were furloughed to join their respective organizations on a war basis.

Early in the year the survey ships *Discoverer*, *Pioneer*, and *Guide* were transferred to the Navy Department. The Bureau was provided with three substitute vessels. Later in the year these vessels were returned to the Navy Department. Near the end of the year, two additional survey ships, the *Oceanographer* and the *Hydrographer*, were transferred to that Department. The transfer of these vessels was a handicap to planned chart extension and reduced the effective areas of completed surveys in waters now hazardous for passage or without available detailed hydrographic information. Recommendations to restore the latter two vessels to surveying assignments in foreign waters have been approved.

Training of Personnel

In the expansion of the activities of the Bureau, the standard of accuracy and prompt distribution of results were maintained in spite of the many changes of personnel in both field and office. This was accomplished in the office through in-service training of new employees, the selection of assignments after instruction periods, the shifting of members from one section to another, and the elimination of those not qualified or temperamentally unfit for the technical work. In the field, over 100 college students were recruited and received training which should be of further benefit to them and to the Bureau.

Selection of candidates for employment was deemed an essential provision and administrative officers devoted much time to overcoming handicaps inherent in the service of Government personnel procurement. New methods for advancing both field and office work were constantly under consideration and many time-saving improvements were adopted.

Philippine Islands

When war was declared, five commissioned and two civilian officers of the Bureau were on duty in the Philippine Islands. The remainder of the force engaged in surveying and charting the archipelago—some 200 in number and all but two being Filipinos—were employees of the Insular Government. Commander George D. Cowie, Coast and Geodetic Survey, the representative of the Department in charge of all coastal surveys in the Philippines, was killed during a bombing raid on Manila on December 24, 1941. Two other commissioned and one civilian officer were stationed in Manila and presumably are interned there. One commissioned and one civilian officer escaped to Corregidor and served with Army forces there until the island was captured. Official communications ceased with Manila on December 30 and, except for brief reports up to the fall of Corregidor, no information has been received from the personnel of the Bureau in these Islands.

The two survey ships, the *Fathomer* and *Research*, operating in the Philippines, were badly damaged by bombing and other war activities and are assumed to be lost. The *Fathomer* was owned and maintained by the Insular Government. The *Research* (formerly the *Pathfinder*), owned by the United States, was an old ship which was built in the United States in 1899. This vessel was laid up to be disposed of several years ago. Subsequently it was recommissioned at the request of the Insular Government, which has since provided funds for her maintainance and operation.

Upon occupation of Manila by the enemy it became necessary for the Bureau's Washington office to undertake the publication of the nautical charts of the Philippine Archipelago which formerly were printed in Manila. This was accomplished without delay. Arrangements had been made for this emergency by maintenance of prepared copies of the latest Manila chart editions in anticipation of their use for this purpose.

Cooperation With American Republics

The Coast and Geodetic Survey continued its participation in the program of the State Department for cooperation with the American Republics. Extensive magnetic surveys were accomplished in those countries bordering on the Caribbean Sea and in the West Indies. The results of this work are of immediate importance for nautical and aeronautical charting and other war purposes. The number of stations occupied in each of these countries is tabulated in the section of this report covering magnetic work. Gravity observations were carried on in Colombia and 13 base stations had been completed up to the outbreak of the war when this work was discontinued.

Two field parties serviced instrumental equipment at the eight ports where tide stations were previously established and installed six additional stations in Mexico and on the west coast of South America. The countries cooperating maintained these stations and

forwarded the records to the Coast and Geodetic Survey for analysis. These records have supplied data for the calculation of tidal predictions at a number of ports in the American Republics, thus providing information of considerable value for sea navigation.

All countries cooperating in these programs have contributed to the cost of the work and are interested in the continuation of the various projects.

CHART PRODUCTION

Throughout the year practically the entire effort of the Chart Division was devoted to war work. To meet the increasing demands of the armed forces for charts, maps, survey data, and related material, the personnel of the Chart Division was increased 300 percent; in common with other office divisions the hours of work were lengthened and the major portion of the personnel and facilities of the Division was placed on a two- or three-shift basis.

The importance of nautical and aeronautical charts in the war effort is indicated in the following table which gives the number of charts issued annually and the percentage increases for the past 3 years. The 1940 and 1941 issues reflect the development of the defense program. The 1942 issue indicates the heavy additional demand for charts after the United States had entered the war.

Charts issued	1939	1940	1941	1942
Nautical	350,062	407,186	621,663	1,081,072
Aeronautical	366,353	463,917	912,339	3,135,297
Total	716,415	871,103	1,534,002	4,216,369
Increase over preceding year:				
Number		154,688	662,899	2,682,367
Percent		22	76	175

The increase of 74 percent in the issue of nautical charts over the preceding year reflects the rapid growth of the Navy and Merchant Marine. Through close contact and cooperation with the Navy, the Bureau was able to meet all demands for existing charts and to effect the prompt construction and delivery of new special charts needed to meet changing requirements as the war was brought closer to our coasts.

The number of individual nautical charts published at the end of the year was 821. To produce these charts, there were 1,165 printings as follows: 10 new charts, 107 new editions, 788 new prints, and 260 reprints. Of the 10 new charts, 7 were constructed for the Navy. Although a considerable percentage of these charts was reprinted at least twice during the year, it was necessary, due to rapid changes in important navigational information, to apply 4,685,074 hand changes to correct the charts to the date of issue. The principal data received during the year for the improvement and correction of nautical charts consisted of 116 topographic surveys, 110 hydrographic surveys, 987 surveys from other organizations, and 798 reports containing charting data.

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.

The standard series of aeronautical charts of the United States and its possessions, consisting of 126 charts, was completed during the year. In addition, 67 new charts were compiled and printed for the Army Air Forces. To produce the charts published during the year there were 681 printings, as follows: 70 new charts, 90 new editions, 42 revisions, 51 new prints, 170 reprints, and 258 base printings. The increase of 244 percent in the annual issue of aeronautical charts reflects the military expansion in aviation.

In addition to this remarkable increase, the Bureau was called upon to undertake a world-wide program of aeronautical charting required by the Army Air Forces. The development of special methods reduced the time required for a new chart compilation about 50 percent. At the same time the cartographic quality was maintained in spite of a large number of inexperienced workers.

While not reflected in the increased issue of standard charts, many special compilation and reproduction projects, which in the aggregate constitute a very substantial contribution to the war effort, were completed or are in progress. Among these is the production of a series of airport charts for the Army, Navy, and Civil Aeronautics Administration. This project, which includes field surveys of some 350 airports, will result in safe-landing and approach charts. A series of 37 radio facility charts was completed during the year for the Civil Aeronautics Administration.

Reproduction of detailed topographic and hydrographic surveys, for the use of war agencies, reached large proportions during the year. Copies of surveys were furnished for a wide variety of projects in connection with military activities along the coasts, ranging from the construction of shipyards and airports to research into methods of combatting submarines.

A precise mechanical projection ruling machine, developed by Bureau engineers, was utilized to good advantage both in meeting the Bureau's extensive needs and, by operation on extra shifts, in supplying some 300 projections and military grids for other Federal agencies engaged in war mapping.

Other assistance rendered to governmental agencies included special reproduction work for the Army Map Service, Bureau of Naval Operations, Office for Emergency Management, Board of Economic Warfare, Office of Production Management, Maritime Commission, Civil Aeronautics Administration, Federal Power Commission, Bureau of the Census, and Forest Service.

COASTAL SURVEYS

Results accomplished during the year in hydrographic and topographic surveys and coastal triangulation are summarized in the following table. The volume of this work was less than in the previous year because of disruption of Alaskan surveys at the height of the season in order to effect an early transfer of three ships to the Navy Department and the necessity for executing a large number of widely scattered projects to meet special needs of the armed forces.

Locality	Hydrography			Topography		Coastal triangulation		
	Sounding lines	Area	Soundings	Shoreline	Area	Length of scheme	Area	Geographic positions
	Miles	*Square miles*	*Number*	*Miles*	*Square miles*	*Miles*	*Square miles*	*Number*
Coast of Maine	5,705	[1] 267	323,955	82				2
South coast of Massachusetts	288	16	5,994	10	1			
Atlantic coast: Block Island to Charleston, S. C	7,362	[2] 1,545	102,608	413	1,262	4	5	13
James River, Va	427	16	18,799	17	4	12	25	54
Southern Florida				1,094	698	270	160	34
Gulf of Mexico	10,755	9,709	93,793					
Interior United States areas	55	[3] 20	1,554			5	11	13
Puerto Rico				61	12	13	140	32
San Francisco Bay and tributaries	1,080	46	32,676	28	17	19	7	31
Puget Sound	771	64	18,390	34	14	10	26	51
Strait of Juan de Fuca	1,590	86	35,238	22	4	135	1,902	109
Southeastern Alaska	982	113	39,066	52	27	52	70	31
Central Alaskan coast	400	16	9,663	12	4			
Cook Inlet	140	90	4,696					
Alaskan Peninsula	1,451	[4] 69	30,942	6			24	33
Aleutian Islands	8,320	4,103	54,805	64	17	11	19	18
Hawaiian Islands	4,742	44	22,739	20	2	12	20	41
Total	44,068	16,204	794,918	1,915	2,062	543	2,409	462

[1] Includes 132 square miles of wire drag.
[2] Includes 123 square miles of wire drag.
[3] Wire drag.
[4] Includes 22 square miles of wire drag.

NOTE.—Philippine Islands statistics not available.

On the Atlantic coast the *Oceanographer* was engaged on hydrographic surveys along the coast of Maine, including extensive wire-drag investigations. The launches *Mitchell*, *Ogden*, *Marindin*, and *Rodgers* assisted in this work. A winter project of hydrographic surveys off the coast of South Carolina was discontinued after the outbreak of hostilities.

The *Lydonia*, assisted by the motor vessel *Gilbert*, completed a deep wire-drag survey south of Block Island and a special wire-drag survey east of the Isle of Shoals, and in addition extended hydrographic surveys along the coast of Maine. Extensive wire-drag surveys, on which the *Marindin* and *Rodgers* cooperated, were made of this area. At the end of the year, current surveys by the *Mitchell* and *Ogden* and inspection of air photographs were in progress.

The *Gilbert* executed a small project in Great Salt Pond, Block Island, and during the winter season was engaged in a survey of the James River, Va. Surveys in Nantucket Sound and Buzzards Bay, Mass., were in progress at the end of the year.

The *Cowie*, acquired in the fall of 1941, executed a small scheme of triangulation in the James River and established speed trial courses for ships and aircraft off the north shore of Long Island. Special hydrographic investigations off the south Atlantic coast were begun.

The *Hydrographer*, assisted by the motor vessel *Faris*, continued hydrographic surveys in the eastern part of the Gulf of Mexico. The *Faris* completed triangulation, traverse, and leveling in the vicinity of Pensacola Bay, Fla. A special triangulation survey at Eglin Field, Fla., was in progress at the end of the year.

A shore party under the direction of the officer in charge of the magnetic observatory at San Juan, P. R., completed detailed topographic surveys of the east end of the island.

On the Pacific coast, during the period between Alaska field seasons, the *Surveyor* continued hydrographic surveys in the vicinity of the San Juan Islands and undertook a triangulation project in the

Strait of Juan de Fuca. After the *Surveyor* discontinued work to prepare for the Alaska season, the triangulation project was continued by the motor vessels *E. Lester Jones* and *Patton*. The motor vessel *Westdahl* completed a triangulation project at the upper end of San Juan Island. Several other small projects in the Puget Sound area were completed.

Three vessels acquired from the Navy Department, and later returned, were available for a few months during the year. These ships carried on projects in Admiralty Inlet and Port Townsend, Wash., and executed surveys, including field inspections of air photographs, in San Francisco and Suisun Bays, Calif.

The *Explorer* began surveys in the vicinity of Midway Island which were discontinued after the attack on the Hawaiian Islands. En route to Honolulu this ship rescued the crew of a plane which had landed in the ocean with fuel exhausted.

In Alaska the ships *Guide, Discoverer,* and *Pioneer* began surveys in the Aleutian Islands but were recalled early in the year for transfer to the Navy Department. The *Explorer* continued surveys westward along the Aleutian Islands. Triangulation control was extended to the eastern end of Atka Island and hydrography was extended to Seguam Island. Special surveys were made in the vicinities of Captains Bay and Dutch Harbor.

The *Surveyor* continued resurveys of Yakutat Bay during July 1941 and then took up surveys of Cold Bay and approaches, assisted in the latter project by the tender *Wildcat*. The *Westdahl* was engaged in surveys of Sitka Sound while the *E. Lester Jones* continued resurveys of the approaches to Anchorage and completed original surveys in Raspberry Strait.

In the Philippine Islands the *Research* and *Fathomer* continued surveys in the Sulu Sea area. Early in November these vessels took up operations in the vicinity of Manila Bay which were continued until the outbreak of hostilities when they were placed at the disposal of the military authorities.

Offices for the processing of field records continued in operation at Norfolk, Va., Pensacola, Fla., Oakland, Calif., and Seattle, Wash.

Air photographs of the coastal area of Maine, the navigable portion of the James River in Virginia, the northern part of San Francisco Bay, the south shore of the Alaska Peninsula and other selected areas in Alaska, were made with the Bureau's 9-lens camera. Field inspection of air photographs was in progress in these areas, except in Alaska; and in the vicinity of Tampa and Lake Okeechobee, Fla. Air photographic compilation units continued in operation in Baltimore, Md., and Tampa, Fla.

With funds provided by the War Department, an extensive mapping program was undertaken in areas adjacent to the coast of South Carolina, North Carolina, Maryland, Delaware, and Virginia, which States were photographed with the 9-lens camera. Rapid progress was made in field and office work connected with this project.

The field stations of the Bureau 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. Three supplements were issued during the year and a new edition of the Atlantic Coast Pilot, Section A, was published. The manuscript for a supplement to the Alaskan Coast Pilot, Part II, was prepared, and field data collected for a new edition of the Alaskan Coast Pilot, Part I.

Construction was continued on the new survey ship *Pathfinder* by the Lake Washington Shipyards at Houghton, Wash. The vessel was scheduled for completion in August 1942. The motor vessel *Patton*, a sturdy 88-foot tender of wooden construction, was completed in January and was assigned immediately to field work. Contracts were let for the construction of two 65-foot Diesel-powered wooden wire-drag launches, the *Hilgard* and *Wainwright;* and two 30-foot Diesel-powered tenders. These boats were scheduled for completion in the fall of 1942. The *Cowie*, a 103-foot diesel-powered vessel of wooden construction, was acquired by purchase and assigned to surveys along the Atlantic coast.

GEODETIC CONTROL SURVEYS

Activities carried on during the year in this branch of work are summarized in the following tables:

Locality	Length of scheme	Area
First-order triangulation	*Miles*	*Square miles*
Goodridge to Pinecreek and Warroad to Hallock, Minn	150	1,800
Crookston, Minn., to Earl, N. Dak	355	4,150
Blain to Johnstown, Pa., and Philipsburg, Pa., to Cumberland, Md	165	2,075
Chadron, Nebr., to Lusk, Wyo	90	1,260
Goldendale to Leavenworth, Wash	155	2,790
Pittsfield to Ashland, Maine	235	2,820
Seattle to Bellingham, Wash	65	790
Wilton to Warren, Ark	120	1,440
Marlinton, W. Va., to Washington, Pa., and Clarksburg, W. Va., to Winchester, Va	260	3,120
Lost Valley to Long Creek, Oreg	60	1,080
Williamsburg, Va., to St. George Island, Md	100	1,500
Maydelle to Oakhurst, Tex	85	1,105
Evergreen to Houston to Rosenberg, Tex	100	1,000
Clayton to Oswego, N. Y	115	1,150
Cortland to Laurens, N. Y	50	500
Total	2,105	26,580
Second-order triangulation		
Portland to Cape Small, Maine	25	250
Richmond to Port Royal and Beaverdam to King William, Va	80	800
Vicinity of Mare Island, Calif	7	25
Hopewell to Boykins, Va	75	990
Vicinity of Rogersville, Tenn	10	80
Valdez to Fairbanks, Alaska	200	2,345
Vicinity of Fairbanks, Alaska	25	325
Dinwiddie to Oilville, Va	50	900
Louisa to Culpeper to Fredericksburg, Va	55	670
Big Bend area, Tex	165	2,750
Mobile, Ala., to Wiggins, Miss	65	880
LaPlata to Point Lookout, Md	70	610
Cambridge to Wingate, Md	35	300
Remington, Va., to Brunswick, Md	70	1,020
Columbia River, The Dalles, Oreg., to Pasco, Wash	130	650
Berlin to Pocomoke City, Md	40	370
New Church to Eastville, Va	50	250
McKittrick to Avenal, Calif	165	2,110
Nicholson to Honesdale, Pa	35	315

Locality	Length of scheme	Area
Second-order triangulation—Continued	*Miles*	*Square miles*
Wilmington to Tabor City, N. C	120	770
Doylestown to Easton, Pa., to Culvers Lake, N. J	75	650
Sloatsburg to Otisville, N. Y	35	465
Manlius to De Ruyter, N. Y	25	220
Vicinity of Arcata, Calif	30	390
York to Mercersburg and Carlisle to Liverpool, Pa	140	2,135
Hershey to Reading, Pa	40	700
Vicinity of Grays Harbor, Wash	40	900
Special areas	75	335
Total	1,932	22,205
First-order base lines		
Wortmann, Alaska	1.1	
Worthington, Alaska	1.1	
Tsina, Alaska	0.8	
Stuart, Alaska	1.1	
Willow Creek, Alaska	4.2	
Miller, Alaska	1.9	
Chena, Alaska	3.7	
Ladd, Alaska	1.4	
Beales, Alaska	5.0	
Patten, Maine	6.8	
Prescott, Ark	4.4	
Houston, Tex	5.3	
Total	36.8	
Second-order base lines		
Three special bases	1.8	
First-order reconnaissance		
Spokane base net, Wash	20	240
Lovelock base net, Nev	10	75
Lake Champlain to Oswego, N. Y	260	3,500
Moapa, Nev., to Wendover, Utah, and Caliente to White Blotch Spring, Nev	380	9,170
Williamsburg, Va., to St. George Island, Md	100	1,500
Total	770	14,485
Second-order reconnaissance		
Newhalem to Skykomish, Wash	85	1,410
Hopewell to Boykins and McKenney to Smithfield, Va	125	1,450
Rapids to Fairbanks to Broad Pass, Alaska	300	2,970
Fairbanks to Circle, Alaska	80	950
Portland to Cape Small, Maine	25	250
Dinwiddie to Oilville, Va	50	900
LaPlata to Mechanicsville, Md	25	230
Vicinity of Bracketsville, Tex	85	1,755
Louisa to Culpeper to Fredericksburg, Va	55	670
Mobile, Ala., to Merrill, Miss., to Pascagoula, Miss	90	1,080
Leonardtown to Point Lookout, Md	30	260
Morganza to St. Leonard, Md	15	120
Remington, Va., to Brunswick, Md	70	1,020
Lost Hills to Parkfield, Calif	100	1,130
Cambridge to Wingate, Md	35	300
Pocomoke to Berlin, Md	40	370
New Church to Eastville, Va	50	250
York to Mercersburg, Pa	90	1,540
Big Bend area, Tex	40	400
Wilmington to Tabor City, N. C	120	770
Carlisle to Liverpool, Pa	50	595
Poplarville to Merrill to Biloxi, Miss	85	980
Doylestown to Easton, Pa	25	275
Vicinity of Easton, Pa	20	125
Washington to Culvers Lake, N. J	30	250
Hershey to Quakertown, Pa	75	1,500
Vicinity of Mare Island, Calif	7	25
Special areas	75	335
Humboldt Bay, Calif., to Oregon State line	100	1,110
Warwick to Phoenicia, N. Y	90	1,380
Garberville to Willits, Calif	75	1,675
Manlius to Leonardville, N. Y	70	645
Prince Frederick to LaPlata, Md	30	350
Alexandria Bay to Cranberry Lake to Massena, N. Y	180	2,975
Margaretville to Greenville, N. Y	90	1,155
Utica to Gloversville to Cobleskill, N. Y	120	1,850
Total	2,632	33,050

State	First-order	Second-order
Leveling	*Miles*	*Miles*
California	191	1,384
Colorado	74	404
Delaware		44
Idaho	358	2
Maryland	49	365
New Jersey	64	184
New Mexico	233	693
New York	746	1,178
North Carolina	9	449
Oklahoma	5	12
Oregon	779	8
Pennsylvania	696	1,143
Texas	167	2,099
Virginia	84	911
Washington	88	
Total	3,543	8,876

State or region	Determinations		
	Latitude	Longitude	Azimuth
Astronomy			
Alaska	3	3	3
Arkansas	1	1	
Idaho	1	1	1
Louisiana	2	2	
Maine	1	1	1
Michigan		1	1
Midway Island	1	1	1
Minnesota	1	1	
Nevada	1	1	
North Dakota	1	2	2
West Virginia	1	1	1
Total	13	15	10

State or region	Determinations	
	New	Repeat
Gravity		
Maryland	22	2
North Carolina	1	
Pennsylvania	11	
Virginia	3	
Colombia, South America	12	
Total	49	2

The work was accomplished by 5 double-unit triangulation parties, 3 six-unit leveling parties, and 6 triangulation reconnaissance parties, operating throughout the year, and by 2 triangulation, 1 astronomic and 2 gravity parties which operated during a part of the year. These units carried on surveys in 24 States and in Alaska. One of the gravity parties conducted investigations in Colombia as mentioned previously in connection with the program for cooperation with the American Republics. Variation of latitude observatories at Ukiah, Calif., and Gaithersburg, Md., were maintained throughout the year.

While geodetic surveys in the United States were carried on chiefly to provide control for military mapping, a number of other projects, necessary for or related to the war effort, were accomplished. The more important of these projects are mentioned below.

Triangulation, traverse, and leveling were extended over several

coastal defense areas for the purpose of coordinating military installations in those areas. This work was carried on in cooperation with the Engineer Corps of the Army, which defrayed the cost of the work. Geodetic control was provided in several Army and Navy reservations to furnish data required for study and training in bombing, air photographic, and artillery operations.

The Coast and Geodetic Survey cooperated with the Weather Bureau by determining elevations at all airports adjacent to the lines of leveling run during the year. This information was required for calibration of barometric instruments. All air beacons which could be sighted in connection with triangulation observations were located for the Civil Aeronautics Administration. Assistance was rendered to the National Grazing Service in establishing reconnaissance for triangulation required for mapping in eastern Nevada and to the Massachusetts Institute of Technology in connection with research on certain problems of navigation. Surveys in Alaska were carried on with funds provided by the War Department—primarily to provide control for war mapping.

The work involved in the computation, adjustment, and distribution of geodetic data in the Washington office was especially heavy on account of the greater output of field surveys, the increasing needs for such data for war purposes, and the necessity for completing the processing of unfinished records accumulated from 1932 to 1935. While much of the latter work is being accomplished by computing offices in New York and Philadelphia, the work must be laid out and distributed by the office force in Washington, which in itself is a considerable task. During the fiscal year, 8,285 adjusted geographic positions were added to the files.

The computation and adjustment of leveling in the alluvial valley of the Mississippi River were completed during the year and a summary of elevations was furnished to the Mississippi River Commission. This cooperative project between the Commission and the Coast and Geodetic Survey was undertaken about 3 years ago in order that lines of leveling, necessary to coordinate thoroughly all levels in that region, could be completed and the resulting records processed.

Computing offices at New York and Philadelphia, maintained by the Work Projects Administration and sponsored jointly by the Office of the Chief of Engineers and this Bureau, continued in operation throughout the year with an average of about 160 employees at each office. These offices were engaged in the processing of field records obtained through many of the State local control surveys as well as the basic triangulation required in the adjustment of the former work. These offices assisted in the work of other divisions of the Bureau.

Advantage was taken of extensive building operations in the District of Columbia and vicinity to investigate the effects of such operations on the elevations of nearby bench marks. This study and the information obtained will be of interest to all organizations which establish or utilize bench marks throughout the country.

During the year three members of the Division of Geodesy gave lectures and courses of instruction at George Washington University, Howard University, and the College of the City of New York, in connection with the Engineering, Science and Management Defense Training.

At the request of the Turkish Legation, made through the State Department, four officers of the Turkish Navy were assigned to temporary duty in the Division of Geodesy for the purpose of studying methods of field and office work. Each of these officers spent about 4 months in the Bureau and visited several triangulation, leveling, and astronomical parties during the period.

TIDE AND CURRENT WORK

During the year a large part of the tide and current work of the Bureau was devoted to war activities. Detailed tide and current surveys were made, special predictions were calculated, and information concerning the action of tides and currents in various theaters of the war was furnished for military and naval operations. Correlated assistance, including the compilation of tidal data and information pertaining to tidal bench marks, was extended to engineers, contractors, and others engaged in the construction and operation of shipyards, air fields, and other war developments in coastal areas.

In addition to these special services there was a material increase in the demand for tide and current tables and tidal current charts, necessitating several reprints and resulting in the issue during the year of nearly 60,000 copies as compared with a maximum annual issue of about 38,000 copies prior to the inauguration of the defense program.

During the fiscal year, 46 primary and 52 secondary tide stations were in operation—41 on the Atlantic coast, 43 on the Pacific coast, and 14 in Central and South America. Sixty-seven of these stations were conducted in collaboration with other agencies, including the U. S. Engineers, the Navy Department, Territory of Hawaii, city of New York, city of Santa Monica, port of Willapa Harbor, Los Angeles Harbor Department, Oxnard Harbor district, Woods Hole Oceanographic Institution, Chesapeake Biological Laboratory, the Oceanographic Laboratories of the University of Washington, and Central and South American Republics.

Observations from these stations supply basic data for tide predictions, hydrographic surveys, reduction of the results of short series of observations to mean values, accurate determination of datum planes, and study of changes in the mean level of the sea. Shorter periods of observations at approximately 100 additional stations were obtained in connection with hydrography and other activities.

The tide survey of the Columbia River was continued throughout the fiscal year in cooperation with the U. S. Engineer Office at Portland, Oreg.

Data received from tide stations estabished in cooperation with the American Republics enabled the Bureau to calculate and include in its tide tables for 1943 tide predictions for the ports of Salina Cruz, Mexico; La Union, El Salvador; Punta Arenas, Costa Rica; Buenaventura, Colombia; Guayaquil, Ecuador; and Matarani, Peru.

The motor vessel *E. Lester Jones*, using a newly developed radio current meter, measured the currents at 12 stations in Puget Sound, Wash. Current observations were also secured by hydrographic parties at a number of locations in other important waterways.

Through the continued cooperation of the Coast Guard, a 12-month series of hourly current observations was completed at *Portland* light-

ship, and similar observations covering a period of 7 months were secured at *Frying Pan Shoal* lightship.

Reciprocal agreements for the exchange of tide predictions between the United States and England, Canada, and India remained in effect. The lapse of similar agreements with France, The Netherlands, and Germany necessitated the prediction of tides by the Coast and Geodetic Survey for the eight ports in those countries for which predictions are published in the tide tables. Data were available for five of these ports which permitted direct prediction by means of the Bureau's mechanical tide predictor. Special calculations were necessary for the other three ports.

MAGNETIC INVESTIGATIONS

The primary purpose of magnetic observations is to obtain information concerning the constantly changing magnetic forces of the earth to promote safety in navigation on the sea and in the air. This information is used extensively for other purposes by land surveyors, prospectors for oil and mineral resources, by radio and telegraph companies, and by scientific investigators. It also has a number of applications in military operations.

Magnetic observatories, at which continuous observations are recorded, were maintained throughout the year at Cheltenham, Md.; Tucson, Ariz.; Honolulu, T. H.; Sitka, Alaska; and San Juan, P. R. During the first half of the year a field party obtained supplemental observations in Virginia, North Carolina, and South Carolina. Observations of declination—the angle between true and magnetic north—were made at numerous additional points during the course of other field surveys. A number of special projects was accomplished for the armed forces.

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

Location	Repeat stations				Other stations		Total
	New		Old				
	Complete	Declination only	Complete	Declination only	Declination only	Other	
Alabama						1	1
California			3			1	4
Delaware						1	1
Florida			2			4	6
Louisiana						2	2
Maine					5	1	6
Massachusetts	1						1
Maryland	2						2
New York						1	1
North Carolina		3					3
Oregon						1	1
Pennsylvania						1	1
Rhode Island	1					1	2
South Carolina	1			1		1	3
Texas						1	1
Vermont					1		1
Virginia	1	1	1			2	5
Washington			1		3	2	6
Alaska					36		36
Hawaii					6	1	7
Mexico	2						2
Canal Zone	1					1	2
Costa Rica			1			1	2
El Salvador	1		2				3
Guatemala	1		1				2
Honduras	1		1				2
Nicaragua		1	2				3
Panama	2		1				3
Brazil	1		1				2
Colombia	2	1	1				4
British Guiana	2		1				3
Uruguay			1				1
Venezuela	3		5				8
British West Indies	1		1			2	4
Cuba	2		2	1		3	8
Dominican Republic	1		1				2
Haiti	1						1
Jamaica	1		1			2	4
Trinidad	1		1			2	4
Total	29	6	30	2	51	32	150

The following geophysical activities were continued with the cooperation of the Department of Terrestrial Magnetism, Carnegie Institution of Washington: Operation of a cosmic ray meter at Cheltenham Observatory; maintenance at Cheltenham Observatory of international magnetic standards; and observation of atmospheric and earth electric currents at Tucson Observatory (with the Mountain States Telephone & Telegraph Co. and Bell Telephone Laboratories also cooperating).

In the office, isogonic maps for the United States and Alaska were completed and published. The former map, showing magnetic declination and annual rate of change throughout the country, is published at intervals of 5 years, while the Alaska map is issued at 10-year intervals. A special office unit was organized to furnish magnetic data for a world-wide series of aeronautical charts. An office

in New York City maintained by the Work Projects Administration continued to assist in the processing of magnetic data. Ionosphere observations were continued at San Juan, P. R., in cooperation with the University of Puerto Rico.

SEISMOLOGICAL 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 information of this character was furnished during the year to war agencies and to engineers and contractors engaged in war construction. Several special investigations were made for this purpose.

Seismographs were operated at magnetic observatories, with the exception of Cheltenham, and at the Ukiah latitude observatory. Assistance was afforded to several colleges in the maintenance of seismographs, and to a number of independent stations through study and interpretation of their records.

Sixty strong-motion seismographs were in operation during the year at 52 stations in Western States and the Canal Zone. Thirty-six strong-motion records were obtained for ten earthquakes. A special analysis was made of the ground motions recorded at El Centro, Calif., during the destructive Imperial Valley earthquake of May 18, 1940.

Vibration tests were made in six buildings for the study of earthquake effects on buildings. Ground vibration tests were made at five locations for the study of probable action of certain soil response to earthquakes, and two special tests were made.

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-utilities organizations, the Weather Bureau, a number of seismological organizations, and several universities. Postmasters and hundreds of other individuals assisted in this service. Building owners furnished free space for 50 strong-motion seismographs. Questionnaire coverage was made for 10 earthquakes which approached destructive character. In all, more than 3,000 reports were received for some 300 earthquakes.

Science Service paid for the transmission of foreign and domestic earthquake code messages needed to locate immediately important earthquakes from instrumental data. Thirty-two epicenters were located in this way and results were furnished to all cooperating stations.

The Bureau was closely associated with the seismological laboratory of the California Institute of Technology in the study of seismological problems. The Massachusetts Institute of Technology cooperated in problems relating to the design of structures. Much of this engineering research at the California Institute of Technology was sponsored by the county of Los Angeles.

Operation of seismographs in the Lake Mead region was continued as a joint undertaking of the Bureau of Reclamation, National Park Service, and the Coast and Geodetic Survey.

INSTRUMENTAL WORK

The Bureau's Instrument Division completed the development of a new and improved signal lamp for night triangulation observations and redesigned the portable tide gage to simplify this instrument and reduce construction costs. Experiments were continued in developing better theodolite bearings and circles. This division cooperated in the design and construction of new instruments required for war purposes. A course of instruction in the use and care of precision instruments was given to personnel of the U. S. Engineers.

The Bureau's Electrical Laboratory developed the Dorsey chronograph, a precision instrument operated by a quartz crystal, for use in radioacoustic position finding. The use of this instrument in the field demonstrated that time intervals can be scaled from tapes in about one-fourth the time formerly required. A new type of current meter, permitting remote control of current observations, was devised by the Bureau's field personnel. This instrument, named the Peters-Roberts radio current meter, was used with good results in Puget Sound, Wash., during the year.

A number of improvements in instrumental equipment at magnetic observatories were effected during the year, including the installation of new magnetographs at San Juan and Sitka. Assistance was also extended to other agencies in testing new types of magnetic instruments.

PERSONNEL AND FINANCES

The number of persons in the service of the Coast and Geodetic Survey at the close of the fiscal year 1942 was 2,250, distributed as follows:

	Commissioned	Civilian	Total		Commissioned	Civilian	Total
Washington office:				Field service:			
Regular appropriations	19	415	434	Regular appropriations	93	691	784
Emergency funds	--------	22	22	Working funds	--------	498	498
Working funds	--------	512	512	Total	112	2,138	2,250

Acquisitions by the library and archives included 110 hydrographic and 116 topographic sheets; 953 blueprints (mostly by the U. S. Engineers); 21,962 maps; 7,302 charts; 11,409 field, office, and observatory records; 150 negatives; 1,078 prints; 44 lantern slides; 1,612 books; and 1,860 periodicals.

Collections covering miscellaneous receipts, including nautical and aeronautical charts and related publications, totaled $158,126, as compared with $144,864 during the preceding year.

The following funds, from the sources indicated, were available to the Bureau during the fiscal year 1942:

Regular appropriation	$3, 859, 000. 00
Supplemental appropriation, Second Deficiency Act, 1941	361, 000. 00
Third Supplemental National Defense Appropriation Act, 1942	182, 705. 00
Total appropriations	4, 402, 705. 00
Transfers and reimbursements to credit of appropriation for:	
Salaries, office	9, 688. 09
Aeronautical charts	51, 472. 11
Office expenses	4, 297. 47
Total transfers and reimbursements	65, 457. 67
Working funds received from:	
Bureau of Reclamation (seismological work, Boulder Dam)	10, 000. 00
War Department (aeronautical charts)	472, 500. 00
Navy Department (magnetic work)	4, 649. 86
War Department (control surveys in Alaska)	75, 000. 00
Navy Department (magnetic work)	2, 500. 00
War Department (mapping of strategic areas)	750, 000. 00
War Department (aeronautical charts)	413, 700. 00
War Department (harbor defense developments)	9, 000. 00
War Department (aeronautical charts)	31, 500. 00
War Department (surveys of bombing areas)	10, 000. 00
War Department (harbor surveys)	16, 000. 00
War Department (control surveys for harbor defenses)	9, 130. 00
State Department (cooperation with American Republics):	
Gravity surveys	9, 000. 00
Tidal investigations	13, 000. 00
Magnetic surveys	10, 000. 00
Total working funds	1, 835, 979. 86
Allotments from:	
Work Projects Administration (administrative expenses)	35, 000. 00
Civil Aeronautics Administration (aeronautical charts)	19, 000. 00
Civil Aeronautics Administration (aeronautical charts)	171, 360. 00
Department of Commerce (travel)	25, 900. 00
Department of Commerce (printing and binding)	50, 400. 00
Department of Commerce (contingent expenses)	2, 850. 00
Total allotments	304, 510. 00
Total funds available	6, 608, 652. 53

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