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U. S. COAST AND GEODETIC SURVEY

Achievements of 1962

and

Goals for 1963

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## U. S. COAST AND GEODETIC SURVEY

### Achievements of 1962 and Goals for 1963

This report is designed to provide summary information about the U. S. Coast and Geodetic Survey's various activities, its accomplishments in 1962, and its goals for 1963.

Many aspects of the Nation's defense, the day-to-day operations of much of its business, and the standard of living of its people are greatly dependent upon the varied activities of the Coast and Geodetic Survey, a bureau of the U. S. Department of Commerce. The Bureau's principal products and technical services are required for safe and expeditious transportation on the sea and in the air, for communications, for the development of natural resources, for agriculture and land reclamation, for public works, and for urban planning.

Nautical and aeronautical chart production, airport surveys, specialized oceanographic, hydrographic, and geodetic surveys of great accuracy and precision, earthquake studies, and a sea-wave warning system provide support in both civilian and military activities. A reorganization of the Coast and Geodetic Survey made in 1960 has served to extend and exploit the Bureau's scientific and technological potential in these areas.

In 1962, accomplishments by the Coast and Geodetic Survey reflected the increased emphasis that the Department of Commerce has placed on measures to step up the Nation's economic growth. Principal industries deriving great benefit from the Bureau's work included those of shipping, aviation, fishing, petroleum, and construction. In addition, the accomplishments resulted in positive contributions to the scientific community that included advances in research and development.

The scientific work that produced the 1962 accomplishments was performed by divisions in the Bureau's four technical Offices--Cartography, Oceanography, Physical Sciences, and Research and Development--and by supporting divisions under the Office of Administration and the Director's Office. The work was conducted at the Coast and Geodetic Survey's main office in Washington, D. C., at 13 district offices in the United States, across land areas by about 40 field parties, and in oceanic and inshore waters by a fleet of 14 ships.

The activities of the various organizational units and their accomplishments in 1962 and goals for 1963 are summarized below.

## THE OFFICE OF CARTOGRAPHY

Charts for ships and for aircraft are basic tools in the maintaining of the Nation's sea and air transportation--so indispensable to the economic welfare and to the defense of all Americans.

Rapidly expanding sea and air commerce coupled with technological advances in navigation aids and methods are greatly increasing the demand for the construction of new types of charts and for the modernization of existing ones.. It is the responsibility of the Coast Survey's Office of Cartography to meet this demand, which it does through the work of its four divisions: Nautical Chart, Aeronautical Chart, Reproduction, and Distribution.

### Nautical Chart Division

This Division constructs and revises charts from data accumulated principally by the Bureau's field surveys but supplemented by data from other Government agencies. Tangible products of this Division are its official nautical charts; intangible products are more economy and safety for the shipping and fishing industries and for the boating public, lower marine insurance rates, and increased scientific knowledge of our marginal seas.

Nautical charts show all available information necessary for safe marine navigation. On these charts vertical data give depth and elevation figures, and horizontal data locate features by latitude and longitude. In general, the data refer to soundings, depth curves, shoals, reefs, underwater dangers to navigation, artificial aids to navigation, topographic and cultural features, and land installations adjacent to the shore. These charts are lithographed in color. A descriptive listing of the Division's different series of nautical charts is given in Table 1.

Table 1.--Nautical Charts

<u>Classification (and scale)</u>	<u>Description</u>	<u>No. on issue</u>
Sailing Charts (1:600,000 and smaller)	For fixing position when approaching coast from ocean or for sailing between distant coastwise ports.	27
General Charts (1:100,000 to 1:600,000)	For coastwise navigation outside of outlying reefs and shoals.	62
Coast Charts (1:50,000 to 1:100,000)	For inshore navigation leading to bays and harbors and for navigating large inland waterways.	148
Harbor Charts (larger than 1:50,000)	For use in harbors, anchorage areas, and small waterways.	467
Intracoastal Waterway Charts (1:40,000)	For inside route in New Jersey and from Norfolk, Va., to Key West, Fla., and Carrabelle, Fla., to Brownsville, Tex.	69
Small-Craft Charts (1:40,000)	Designed for easy reference in close quarters. Information: such as large-scale insets of small-boat harbors, blue tints to critical depth curves, tides, currents, whistle signals, weather, marinas, anchorages, magnetic courses and distances between points of interest, and availability of facilities and supplies.	6
Special Charts	In this category are maps and charts of inland lakes, those issued for training and general information purposes, and those classified for security purposes.	52

In 1962, the Nautical Chart Division--

- Maintained with up-to-date corrections the 831 nautical charts on issue.
- Published 35 emergency chartlets of the storm-damaged Atlantic coast to supplement the conventional charts until formal revisions are completed.
- Constructed three new harbor charts, three new intracoastal waterway charts, and one new small-craft chart.
- Reconstructed one coast chart, three harbor charts, and two small-craft charts.
- Published new editions of charts as follows:
  - General, 23; coast, 44; sailing, 8; special, 1; harbor, 95; intracoastal waterway, 35; and small-craft, 2.
- Compiled an experimental small-craft chart by adapting the conventional chart format to meet small-boat requirements. The conventional chart is to be overprinted with facility and tidal data and to be accordion-folded in a neat cover for convenient use in small cockpits. This program will supplement, at a minimal cost, the regular small-craft chart program in areas of low priorities.
- Instituted a program to convert all charts in the Intracoastal Waterway series to an accordion-folded format and to issue them in a handy jacket for small-boat operators. The new Chart 857 A/B, Charlotte Harbor to Tampa Bay, Fla., is the first major alteration in the format of the series since its inception 25 years ago.
- Conducted research in the use of consol and designed a convenient format for consol charts. (Consol is a long-range navigation aid that transmits low-frequency dot-and-dash signals representing definite bearings. The signals can be received on a radio communication set or any low-frequency receiver equipped with a beat-frequency oscillator. The bearings are determined by plotting the audio count of the dots and dashes directly on special consol charts.)
- Coordinated a research project under commercial contract to study present and future needs for nautical charts by an unbiased canvass of the

maritime public. Two comprehensive reports have been completed: "Phase I - Present Needs," and "Phase II - Future Needs."

Provided more than 3,000 photostatic copies of original hydrographic and topographic surveys to various Government agencies, universities, oceanographic institutions, commercial firms, engineers, and others.

Furnished more than 100 certifications to corporations, attorneys, and private individuals for copies of surveys and charts used in litigations.

Provided educational exhibits at five national boat shows.

Participated in the Council of State Governments, the 20th International Navigation Congress, the U. S. Coast Guard Auxiliary Annual Conference, and the U. S. Power Squadrons Annual Meeting.

Cooperated with the U. S. Coast Guard Auxiliary and U. S. Power Squadrons by exchanging nautical charts and publications for charting information. This is part of the Bureau's cooperative program to enhance chart surveillance and to promote boating safety by increasing the dissemination of up-to-date charts and publications.

In 1963, the Nautical Chart Division expects to--

Convert more intracoastal waterway charts to the folded format.

Increasingly intensify cooperation with the U. S. Coast Guard Auxiliary and the U. S. Power Squadrons.

Promote boating safety by displaying educational exhibits at national boat shows and at various conferences.

Conduct research for the standardizing of chart formats and production procedures to provide more economical and superior products.

#### Aeronautical Chart Division

This Division provides charts that show and describe the Federal airways, navigation facilities, airports, landing patterns, safe operating procedures,

and air traffic rules as determined by the Federal Aviation Agency. These charts are necessary for timesaving routes and schedules and for lower operations costs; even more important, they are required for the greater safety of air travelers.

The aeronautical charts are in three major series--Instrument Approach Procedure Charts, Visual Charts, and Radio Facility Charts. These series are descriptively listed in Table 2. Miscellaneous charts and projections also are produced by the Division.

The charts in the major series are supplemented by graphic "NOTAM's" (notices to airmen) and by "Special Notices." The "NOTAM's" inform pilots of emergency conditions when navigational facilities are inoperable because of maintenance requirements or weather. They publicize, on short notice, substitute route structures based on temporary facilities. The "Special Notices" are issued to publicize temporary hazardous conditions in certain areas--such as where extensive military maneuvers are being held, routes over which the Air Force is conducting practice flights, and restricted areas.

In 1962, the Aeronautical Chart Division--

- Established production schedules on a weekly basis for the Instrument Approach Procedure (IAP) Chart series, with the dates coinciding with those of Federal Aviation Agency instrument procedures. Also, achieved refinements in this series to keep abreast of new advancements in aircraft engineering.
- Compiled approximately 260 new and reinstated IAP charts, and produced about 2,400 IAP charts in all.
- Designed, compiled, and drafted a special series of Standard Instrument Departure (SID) charts.
- Completed revision of the U. S. Airfield Directory, a 158-page section of the Army Preflight Manual.
- Prepared a special IAP chart of the San Francisco Airport and adjacent area for the Federal Aviation Agency.



Table 2.--Aeronautical Charts

<u>Classification (and scale)</u>	<u>Purpose and coverage</u>	<u>No. in series</u>
<u>Visual Charts</u>		
Planning (1:5,000,000)	For planning flights between distant points. Conterminous U. S.	1
Aircraft Position (1:5,000,000 and 1:6,250,000)	For plotting lines of position obtained from celestial observations and electronic aids for long-range flights over ocean or desert.	6
Jet Navigation (1:2,000,000)	For long-range, high-altitude, high-speed navigation. Conterminous U. S.	4
Route (1:2,000,000)	Strip charts for long-range, high-altitude, high-speed navigation between selected important terminals.	
United States	Conterminous U. S.	3
Alaska	For routes from conterminous U. S. to Alaska and coverage of most of Alaska, including the Aleutian Islands.	2
World Aeronautical (1:1,000,000)	Covering land areas of the world at a size and scale convenient for navigation by moderate-speed aircraft in contact flight.	
United States	Conterminous U. S.	43
Alaska	Alaska.	19
Sectional Aeronautical (1:500,000)	For contact flying by slow to medium-speed aircraft. Conterminous U. S. and Hawaii.	88
Local Aeronautical (1:250,000 and 1:125,000)	For visual navigation over highly congested metropolitan areas. Conterminous U. S., Hawaii, and Puerto Rico.	23

Table 2 (continued).--Aeronautical Charts

<u>Classification (and scale)</u>	<u>Purpose and coverage</u>	<u>No. in series</u>
<u>Radio Facility Charts</u>		
Enroute Charts	For enroute instrument navigation.	
Low Altitude (1 in.=10 n.m. to 1 in.=20 n.m.)	Conterminous U. S. (28); Alaska (4)	32
Intermediate Altitude (1 in.=28 n.m., 1 in.=20 n.m.)	Conterminous U. S.	8
High Altitude, (1 in.=32 n.m.)	Conterminous U. S.	4
Area Charts (Arrival and Departure) (1 in.=5 n.m., 1 in.=6 n.m.)	Major terminal areas of U. S.	34
Standard Instru- ment Departure Charts (Scale varies)	Charts for departures from 17 U. S. airports, simplifying air traffic control clearances and relay and delivery procedures.	17
<u>Instrument Approach Procedure Charts</u> (1:500,000)	Data for instrument approach and landing procedure at airports. Airport sketch portrays runway pattern. This series consists of four types of charts: for aircraft using (1) low medium frequency, 4-course, radio-range equipment; (2) automatic direction-finding equipment; (3) omnirange equipment; and (4) FAA instrument landing system equip- ment. Covers U. S. and its possessions.	1,525

Forwarded to the Air Force Aeronautical Chart and Information Center, in St. Louis, reproduction copy for 2,640 IAP chart drawings of 1,142 charts.

Compiled, and made final color separation drawings for, a book titled "Symbols for Enroute High Altitude Charts."

Made a canvass of airports with scheduled airline stops to determine needs for obstruction charts.

Began combining Civil Minima drawings with the Primary Aeronautical drawings, and revised approximately 40 percent of the chart drawings. This reduced the cost of preparation of color separation drawings and the cost of laboratory processing in the Reproduction Division.

Revised the weekly publication "Revision Notices" to furnish subscribers with more pertinent information in an easier-to-read format. This publication is distributed with the new and revised charts issued for the two IAP chart manuals.

Cancelled unsafe IAP charts without waiting for the publication of procedure cancellation by the FAA. This method of prompt cancellation was welcomed by FAA officials because of the legal aspects involved.

Began issuing a special listing titled "Instrument Approach Procedure Charts--New Charts and New Editions." This list furnishes copy of all IAP charts printed over a 2-week period. It will be published on a continuing basis in "Airman's Guide," an FAA publication.

Devised a form to furnish weekly target dates on official FAA instrument procedures with the completion dates for compilation, drafting, and review. This innovation marks the first time that advance notice of chart scheduling and programming has been given.

Condensed compulsory and noncompulsory IAP reporting points on cards for ready references. Only those reporting points required by official procedure were listed. In addition to the description of the reporting point, each card shows the IAP charts that use the data.

Inaugurated a standard IAP reference system to eliminate duplication of items for the same airport and to save time in the production

- procedure. All items common to the same airport are carried on the same standard.
- Began the application of revised IAP chart specifications as requested by the FAA. Also, took steps to relieve congestion on the charts and to eliminate many so-called obstructions that need not be included.
- Established liaison with the FAA and the USAF Air National Guard for the requisitioning of airport plans.
- Revised, in the Sectional Aeronautical Chart series, 57 charts twice and 31 charts once, for a total of 145 issues. The revisions included new portrayals of airports where the FAA has established traffic areas or provides advisory service.
- Began the construction of six new pilotage charts covering parts of Alaska.
- Revised each of the 62 charts in the World Aeronautical Chart series.
- Revised, in the Local Aeronautical Chart series, the 21 charts of the conterminous United States twice, the one chart of Honolulu once, and the one chart of San Juan once. The revision of the Atlanta local chart included extensive changes in airspace portrayal because of the establishment by the FAA of a terminal radar service there.
- Revised, in the Route Chart series, the three charts covering routes in the conterminous United States and the two covering parts of Alaska.
- Revised Planning Chart AP-9, which covers the conterminous United States.
- Revised each of the four charts in the Jet Navigation Chart series, covering the conterminous United States. Each revision included separate aeronautical overprints for civil and for military use.
- In the Aircraft Position Chart series, reconstructed Chart 3073 (Caribbean Sea) to extend limits to meet FAA requirements; revised Chart 3096 (Pacific Ocean) and Chart 3097 (North America-Europe); and began an extensive reconstruction of Chart 3071 (North Atlantic) to meet requirements of the aviation industry and the FAA.
- Recompiled and produced, under FAA specifications, the high-altitude charts in the Enroute Radio Facility series. The present four

high-altitude charts replace the eight charts produced under specifications developed by the Coast and Geodetic Survey. The Division issued 20 charts in the 8-chart series (through May) and 16 in the new 4-chart series.

Constructed and issued a new enroute radio facility chart (Miami-Nassau-Puerto Rico), and, on the back of this new chart, printed the previously issued terminal area charts of the Bahama Islands and Puerto Rico.

Recompiled and produced, under FAA specifications, the radio facility charts for Alaska. These comprise four enroute charts and the area charts of the Fairbanks, Anchorage, and Vancouver terminals.

Produced 17 charts in the new Area Charts (Arrival and Departure) series, replacing the 17 charts of the Terminal Area Chart series.

Produced a new multiple-area chart in the Standard Instrument Departure series.

Issued 47 chartlets with "NOTAM's."

Compiled and issued 11 "Special Notices" with 87 chartlets.

Continued, until March, to distribute low-altitude and intermediate-altitude radio facility charts, instrument approach procedure charts, and the "Preflight Manual" to 500 U. S. Army pilots for evaluation. The "Preflight Manual," of approximately 400 loose-leaf pages, provided pilots with information on many subjects pertinent to preflight operations. The Army reimbursed the Bureau for the cost of this program.

In conjunction with the FAA, designed a new type of chart for use by air traffic controllers in FAA air route traffic control centers. This series of 36 charts, referred to as the Controller Chart series, will depict the low-altitude and intermediate-altitude airways and will supply all related data and information as to radio navigational aids. Since the controllers will refer to these charts from distances up to 8 feet, the symbols and type will be shown in bold sizes. These charts will be reissued every 28 days, in the same manner as all other radio facility charts. They will be printed in two colors--black for the low-altitude airways system and red for the intermediate-altitude system. The 36 charts will cover the

conterminous United States at a scale of 1:500,000 on sheets measuring 38 by 59 inches. The FAA will reimburse the Bureau for the cost of these charts.

Constructed and issued 25 new charts depicting "Oil Burner" (Air Force practice flight) routes.

In 1963, the Aeronautical Chart Division expects to--

Revise 77 sectional charts twice and 11 sectional charts once, making a total of 165 issues. The revision of 86 charts will include portrayal of the variable floors of controlled airspace designated by the FAA.

Reconstruct 20 sectional charts.

Construct eight new sectional charts of Alaska.

Revise each of the world aeronautical charts, for a total of 62 issues.

Revise 21 local charts twice and five local charts once, a total of 47 issues. These revisions will include portrayal of the variable floors of controlled airspace designated by the FAA.

Construct eight new local charts.

Revise each of the route charts once, for a total of five issues.

Revise Planning Chart AP-9.

Construct a new visual flight rule planning chart, scale 1:3,000,000, covering the conterminous U. S., to meet a requirement of the FAA.

Revise each jet navigation chart once, a total of four issues. Separate aeronautical overprints will be issued for civil and military use.

Reconstruct the following aircraft position charts: 3071, North Atlantic; 3094, North Pacific; and 3097, North America-Europe.

Revise the following aircraft position charts: 3073, Caribbean Sea; 3095, Shannon-Cairo-Bombay; and 3096, Pacific Ocean.

Construct two new charts to cover the Central Pacific westward from Honolulu, and Hawaii to northeastern Australia.

Continue to revise and issue all radio facility charts every 28 days. The charts will be maintained currently, with all changes in FAA

airspace amendments and revisions to navigational aids and communication data.

Produce four radio facility charts covering the Caribbean area and depicting all oceanic routes and navigational data needed for safe instrument flight operations. These charts will be issued every 28 days.

Increase the multiple-area standard instrument departure charts from 5 to 10, a total of 145 charts. The additional charts are required because of increasing need to simplify departure communications.

Schedule about 3,100 instrument approach procedure charts (an increase of about 700 charts over 1962). Additional charts and revisions will be required to better serve the accelerated program of air traffic control, new uses of existing radio navigation facilities, and new airports.

#### Reproduction Division

This Division maintains and operates a complete lithographic printing establishment for the printing of charts, maps, and related data. This work includes negative engraving, type composition, photography, platemaking, and the operation of multicolor presses. In addition, this Division conducts research and development in the graphic arts.

In 1962, the Reproduction Division--

Printed more than 1,700,000 copies of 480 nautical charts, more than 45,700,000 copies of about 4,000 aeronautical charts, and more than 1,500,000 copies of about 400 miscellaneous maps, charts, and related data.

Increased the efficiency of operations by reorganizing the management staff. This reorganization included the establishment of the positions of program manager and production manager.

Replaced obsolete equipment by acquiring a new Multilith press, a 40-by-52-in. camera, and a power paper cutter.

Formally trained ten employees in graphic arts reproduction.

- Extended the use of a pin register system to the processing of small-craft and intracoastal waterway charts.
- Successfully adopted the use of rub-on plates in the printing of all charts in the Radio Facility Chart series.
- Successfully developed techniques for producing consistent-quality photomechanical vignette negatives.
- Conducted studies in paper use that, so far, have resulted in a partial realignment of stock requirements. The Division expects that results of the completed study will effect economies in paper costs, in man-hours, and in machine time.
- Significantly reduced the overtime required to print charts in the Radio Facility Chart series, which are committed on a compressed schedule. This reduction is attributed to reorganization, added experience, and procedural studies.

In 1963, the Reproduction Division expects to--

- Achieve closer adherence to schedules and significantly reduce back-orders as a result of office reorganization in the previous year.
- Facilitate production scheduling by installing three new presses to replace those now using plates of nonstandard size.
- Install large processing sinks and other new equipment in a newly built darkroom. These new installations will measurably increase production capacity in the photographic branch and will greatly ease the handling of the extremely large materials becoming more and more in demand.
- Reproduce a substantially greater number of charts to meet the increased requirements of the Nautical Chart and Aeronautical Chart Divisions, including a new air-traffic controller series consisting of 36 charts.

#### Distribution Division

This Division distributes charts, maps, tide and current tables, and other publications to other Government agencies, contract agents, and the public.

It hand-corrects nautical charts to keep them up to date; and maintains records pertaining to the receipt, sale, free distribution, and inventory of the Bureau's charts and publications. In addition, the Division trims, folds, punches, collates, and packages the charts preparatory to issue.

In 1962, the Distribution Division--

Distributed more than 45,400,000 nautical and aeronautical charts and more than 165,000 maps and other publications of the Bureau. In addition, it distributed more than 900,000 U. S. Air Force charts.

Acquired an Addressograph machine that automatically prints out addresses in duplicate, thus furnishing a proof of mailing lists.

Increased the efficiency and the economy of chart-order processing by replacing the rubber address stamps of authorized chart agents with plastic (charge-type) plates.

Lessened danger of mail-damage to charts by acquiring multiwall shipping bags.

Improved the exchange of critical information with the Reproduction Division by establishing new procedures.

Installed a wall-type bulletin board in the chart salesroom to provide latest information on back-ordered charts.

Designed a combination subscription renewal form and order blank that can be addressed by Addressograph machine and can be mailed in a windowed envelope. The subscription Addressograph plates are tabbed by expiration month and can be selected for any month.

Established automatic distribution of new and revised publications to key personnel to provide them with up-to-date information.

Achieved economy in stitching by acquiring a new stitcher that operates on both boxes and packages of charts.

Established a rotation system for several employees to meet peak loads of priority work.

In 1963, the Distribution Division expects to--

Begin issuing a monthly publication of "Dates of Latest Editions" of nautical charts.

Initiate automatic data processing of all chart transactions to provide more current inventory and statistical information on total chart distribution.

Distribute a substantially greater number of maps, charts, and other publications to meet the increased requirements of the users of nautical and aeronautical charts.

## THE OFFICE OF OCEANOGRAPHY

Oceanographic surveys off the coast and in the deep sea contribute to the advancement of science and to the national economy and defense. The analyzed data collected on these surveys are put to use on nautical charts and in other publications that aid navigation. In addition, such information is used in research that leads to the utilization of the sea as a natural resource.

Through its Marine Data Division, Operations Division, and Facilities Division, the Office of Oceanography collects, analyzes, and disseminates information on the sea's bottom topography, water temperature, magnetic intensity, and gravity; on its tides; and on its currents. Also, it operates, jointly with the Office of Physical Sciences, our seismic sea wave warning system; collaborates with the Weather Bureau in the study of the interrelationships between oceanic environment and weather phenomena; and conducts research in accordance with the Bureau's over-all research and development program.

### Marine Data Division

This Division analyzes and processes data from oceanographic surveys; maintains a system of control tide stations along the U. S. coasts and in certain islands in the Western Pacific; and, with the Geophysics Division of the Office of Physical Sciences, maintains and operates our seismic sea wave warning system.

Also, this Division prepares several series of publications of major importance to navigators of both large and small craft.

The "Coast Pilot" series consists of eight cloth-bound quarto volumes (by coastal areas) that furnish information that cannot be shown conveniently on the nautical charts. Such information includes detailed data of the coastline, port information, directions for coasting, directions for entering harbors, general weather conditions, radio services, and so forth. These volumes are completely revised as often as about every five years. Supplements containing changes and new information are published annually and distributed free to purchasers of the "Coast Pilots." The following books comprise the series:

- Coast Pilot 1: Atlantic Coast--Eastport to Cape Cod
- Coast Pilot 2: Atlantic Coast--Cape Cod to Sandy Hook
- Coast Pilot 3: Atlantic Coast--Sandy Hook to Cape  
Henry
- Coast Pilot 4: Atlantic Coast--Cape Henry to Key West
- Coast Pilot 5: Atlantic Coast--Gulf of Mexico, Puerto  
Rico, and Virgin Islands
- Coast Pilot 7: Pacific Coast--California, Oregon,  
Washington, and Hawaii
- Coast Pilot 8: Pacific Coast--Alaska, Dixon Entrance  
to Cape Spencer
- Coast Pilot 9: Alaska--Cape Spencer to Arctic Ocean

"Tide Tables" give annual advance information about the rise and fall of the tide, including the predicted times and heights of high and low waters at a number of reference stations for each day in the year. Differences are given for obtaining similar predictions for numerous other locations. The annual "Tide Tables" are for "East Coast, North and South America"; "West Coast, North and South America"; "Europe and West Coast of Africa"; and "Central and Western Pacific Ocean and Indian Ocean."

"Tidal Current Tables" supply annual advance information about the periodic horizontal flow of the water accompanying the rise and fall of the tide. Included are daily predictions of the times of slack water and the times and velocities of flood and ebb currents for a number of waterways, together with differences for obtaining predictions for numerous other places. These annual tables are for "Atlantic Coast of North America" and "Pacific Coast of North America and Asia."

"Tidal Current Charts" are publications that consist of a set of 12 charts depicting the direction and velocity of the tidal current for each hour of the tidal cycle. These charts, which may be used for any year, show tidal current movement in the respective waterways as a whole; in addition, they give a ready means of determining, for any time, the direction and velocity of the current at various localities throughout the water areas covered. The following "Tidal Current Charts" are on issue:

Boston Harbor  
 Narragansett Bay to Nantucket Sound  
 Long Island Sound and Block Island Sound  
 New York Harbor  
 Delaware Bay and River  
 San Francisco Bay  
 Puget Sound--Northern Part  
 Puget Sound--Southern Part

The Division also publishes a book giving "Distances Between United States Ports." This book, last revised in 1961, gives the distances between some 10,000 ports along the shortest routes marked by navigational aids, and it includes a timetable for various distances at different speeds.

In 1962, the Marine Data Division--

Prepared charts of the bathymetry and the magnetic and gravity fields of waters between Hawaii and the Aleutians from data obtained from the PIONEER's observations in 1961.

Inaugurated geological echo profiling studies, with investigations being conducted in the Florida Straits, Gulf of Maine, and lower Chesapeake Bay. In these studies, earth structure was determined as deep as 500 feet below the bottom.

Conducted a study of the water masses in the vicinity of Cay Sal Bank in the Florida Straits region, where an area of possible upwelling was found.

Conducted an oceanographic and magnetic reconnaissance along tracklines between Norfolk, Va., and Puerto Rico.

Verified about 50 hydrographic survey sheets.

Conducted research on a new method for the harmonic analysis of tides and initiated a program to develop the new method and check it out on a computer.

Initiated a research study of the tidal regime of Chesapeake Bay and prepared co-tidal charts.

Continued to maintain the system of over 100 control tide stations.

- Completed processing of data from a current survey of 51 stations in Charleston Harbor.
- Began processing of data from a comprehensive current survey of Chesapeake Bay, the first of its kind in 30 years.
- With the Photogrammetry Division of the Office of Physical Sciences, initiated a program supporting current surveys in harbors and estuaries by aerial photography and floats. The purpose was to provide current data for areas not covered by current meters.
- Operated five tide gages during the survey of the Hackensack River in New Jersey and furnished tidal data to the Photogrammetry Division in establishment of high-water lines by aerial photography.
- Made progress in the study of methods for predicting tides and currents by IBM 7090 computer.
- Published four volumes of tide tables and two volumes of tidal current tables.
- Prepared tide tables for five small-craft charts and special Arctic tide tables for the U. S. Naval Oceanographic Office.
- Completed and distributed seismic sea wave travel time charts for Hualien, Taiwan, and for La Punta (Calao); Peru.
- Negotiated to bring Marcus Island or Iwo Jima Island, and Easter Island, Galapagos Islands, and Dixon Entrance into the seismic sea wave warning system.
- Made shore-based inspections of Puerto Rico and Virgin Islands (for 1962 edition of "United States Coast Pilot 5: Atlantic Coast"), and the coasts of California, Oregon, and Washington (for 1963 edition of "United States Coast Pilot 7: Pacific Coast").
- Released new editions of "United States Coast Pilot 8: Pacific Coast--Alaska" and of "United States Coast Pilot 5: Atlantic Coast"; and published supplements, totaling 108 pages, for six nonactive "Coast Pilots."
- Published a special tide table on "Selected Places in Greenland and Canada."

In 1963, the Marine Data Division expects to--

- Prepare data and construct tidal current charts for Charleston Harbor, S. C., and prepare a report on Charleston Harbor currents.
- Field test new instruments.
- Add four new stations to the seismic sea wave warning system.
- Install and begin operating one or more open-ocean deep-sea wave recorders.
- Publish supplements for all eight "Coast Pilots."
- Prepare for press new editions of "United States Coast Pilot 7: Pacific Coast," and "United States Coast Pilot 9: Alaska."
- Make a partial field inspection of Hawaii to complete data needed for the 1963 edition of "United States Coast Pilot 7: Pacific Coast"; and conduct shore-damage studies of the Atlantic coast and inspect coast and intracoastal waterways from Cape Henry to Key West for the 1964 edition of "United States Coast Pilot 4: Atlantic Coast."
- Reduce, interpret, and present data resulting from the 1961 and 1962 work of the PIONEER in the Pacific between Hawaii and the Aleutians.
- Continue planning for and processing data from oceanographic surveys, including geological echo profiling and bathymetry on the East Coast shelf of the United States.
- Prepare and present reports and papers on the 1962 Florida Straits studies and the Norfolk to Puerto Rico survey.
- Complete the research study of the tidal regime of Chesapeake Bay.
- Check the procedure for the new method of harmonic analysis of tides until definitive results are obtained.

#### Operations Division

This Division plans and executes oceanographic and related control surveys involving the operation of 14 ships and numerous shore-based parties.

In 1962, the Operations Division--

- Operated the C&GSS PIONEER on the Bureau's systematic, well-controlled surveys in the deep sea between Hawaii and the Aleutians. The oceanographers made observations of currents, gravity, the magnetic field, temperature, and salinity, and made deep dredge hauls. Checks were made on annual and seasonal variations and the reproducibility of "nonvariables." In this cooperative effort, visiting scientists aboard represented the Weather Bureau, Bureau of Commercial Fisheries, Scripps Institution of Oceanography, and the University of Hawaii.
- Operated the PIONEER to make surveys in support of atomic tests in which scientists from Woods Hole Oceanographic Institution, Texas A & M University, Naval Ordnance Laboratory, and Lamont Geological Observatory were embarked.
- Continued hydrographic surveys along the Connecticut coast, along the coast of Maui Island, Hawaii, and in the Potomac River, Puget Sound, Sumner Strait and Clarence Strait of southeastern Alaska, and in the Chukchi Sea off northwestern Alaska.
- Started new surveys along the eastern end of Puerto Rico; along the coast of Maine; offshore at Sabine Bank and Galveston, Tex., and at Thorne Arm in southeastern Alaska; and in areas of storm damage along the coasts of New Jersey, Delaware, Maryland, and Virginia.
- Conducted wire-drag investigations at Ambrose Lightship; in approaches to New York Harbor; at Stepping Stones Light, East River, New York; at Mattituck Inlet and Flanders Bay, Long Island; in Narragansett Bay, R. I.; and off Smith Island, Wash., in the Strait of Juan de Fuca.
- Completed sounding lines for cable route surveys between Point Buchon, Calif., and Okinawa by way of Midway, Wake, and Guam; between Hawaii and Port Alberni, Canada; between Kingston, Jamaica, and Colon, Canal Zone; between Canal Zone and Cartagena, Colombia; between Macuto, Venezuela, and St. Thomas; and between St. Thomas and Florida.

Occupied current stations in waters of the continental United States, Puerto Rico, Hawaii, and Alaska.

Completed current surveys in Charleston Harbor, S. C. These surveys included the Ashley, Cooper, and Wando Rivers.

Started current surveys in the lower Chesapeake Bay.

In 1963, the Operations Division expects to--

Cooperate in the International Cooperative Investigations of the Tropical Atlantic through use of the C&GSS EXPLORER.

Operate two new survey ships on beginning surveys along the Atlantic Shelf and two survey ships on deep surveys in the North Pacific.

Continue inshore hydrographic surveys with limited oceanographic observations in southeastern Alaska, Puget Sound, Aleutian Islands, Galveston Bay, Tex., Florida Keys, and Long Island Sound.

Continue surveys of currents in Tampa Bay and Biscayne Bay, Fla., and in Chesapeake Bay.

#### Facilities Division

This Division provides and maintains the operating facilities of the Office of Oceanography. These facilities include ships and smaller vessels and ship bases.

In 1962, the Facilities Division--

Continued routine maintenance, updating, and repair of 14 ships and two ship bases on a long-range basis.

Invited U. S. Coast Guard inspection of U. S. Coast and Geodetic Survey vessels to receive guidance on the repair program so that it complied with regulations pertaining to fire-fighting equipment, watertight integrity, and other safety precautions. Such inspections also are an approach toward limited certification for international voyages.

Installed on ships additional oceanographic equipment such as gravity meters, deep-sea anchoring winches, oceanographic winches, and magnetometers.

Installed, on two ships, wet and dry oceanographic laboratories and weather observation facilities.

In the development of the new operating base and laboratory facility at Norfolk, Va.: completed (1) structural alterations to the existing building, (2) a bulkhead on the south side of the base, and (3) some area surfacing; and acquired approximately one-half acre of land north of York street, thus completing the property requirement.

Prepared initial specifications for use by General Services Administration in securing a long-term lease to provide a ships' operating base and oceanographic laboratory at Seattle, Wash. The contract is to provide for laboratory space, instrument repair space, warehousing, facilities for small-boat repair, and facilities to accommodate eight ships.

In 1963, the Facilities Division expects to--

Continue progress on the maintenance, repair, and updating of ships and bases.

Continue the outfitting and instrumentation of ships to increase their oceanographic capabilities and efficiency.

Continue to develop the ships' base at Norfolk, Va., by dredging, constructing a bulkhead along the west side of the base, constructing dock-side utilities, and filling and surfacing. This will be the third year in the 5-year construction program of this base.

Place in operation, on a limited basis, a new ships' base and oceanographic facility on Lake Union in Seattle, Wash.

Plan a small base at Savannah, Ga., for the berthing of new ships.

Initiate a program of cost evaluation to improve and facilitate engineering management.

## THE OFFICE OF PHYSICAL SCIENCES

This Office provides the geodetic, geophysical, and cartographic data for charting, for scientific purposes, and for defense needs. It directs the Bureau's geodetic control network and operates 11 magnetic and seismological observatories and two latitude observatories. This work is carried out by the Office's operating Divisions--Geodesy, Geophysics, Photogrammetry, and Electronic Computing. Through these Divisions, the Office of Physical Sciences also conducts research in accordance with the Bureau's over-all research and development program.

### Geodesy Division

This Division conducts field geodetic surveys that include astronomic observations and triangulation, traverse, leveling, and base measurements. It also operates two astronomic observatories for determining the variation of the pole, and it makes gravity determinations. It processes the data acquired from all these activities and compiles the data in reports and other publications.

In 1962, the Geodesy Division--

- Continued to extend the horizontal and vertical control network throughout the continental United States.
- Completed long-line azimuth ties between the islands of Hawaii.
- Completed first priorities for re-establishing control surveys along the storm-damaged Atlantic coast from Cape Fear, N. C., to Montauk Point, N. Y.
- Completed numerous geodetic control surveys for missile installation sites, including the Malmstrom AFB Minuteman sites in Montana, and continued to survey other missile installation sites for the U. S. Air Force.
- Developed instruments and techniques for and trained personnel in the use of ballistic camera systems for geodetic determinations by satellite.
- Initiated high-accuracy geodimeter traverses to upgrade the accuracy of the geodetic network to meet increased requirements of the military and of space scientists.

Published an additional part to Publication 65-1, "Plane Coordinate Intersection Tables (2 1/2-Minute)": Part 51, Alaska, Zone 10.  
 Published a revised edition of Special Publication 240, "Manual of Leveling Computation and Adjustment," by Howard S. Rappleye (1948).

In 1963, the Geodesy Division expects to--

Continue to extend the national geodetic network. Locate oil structures off the Louisiana coast to assist in the development of offshore petroleum resources and to furnish nautical charting data.  
 Complete the Atlantic coast storm-damage replacement surveys.  
 Continue the surveys of missile sites to meet the schedules required by the U. S. Air Force.  
 Continue to develop the operational satellite triangulation system.

#### Geophysics Division

This Division conducts magnetic and seismological investigations. It operates 11 magnetic and seismological observatories and laboratories, and 14 seismological stations; determines the location of earthquakes and analyzes their wave motions; calibrates magnetic and seismological instruments; and maintains the international magnetic standards. It also collaborates with other countries in the study and exchange of geomagnetic and seismological data, and it serves as the international depository in the United States for such data.

The Geophysics Division publishes the results of its activities, and its publications are used by both the Government and the public for defense and scientific purposes. In collaboration with the Marine Data Division of the Office of Oceanography it operates the seismic sea wave warning system, consisting of 16 seismograph stations and about 30 tide stations.

In 1962, the Geophysics Division--

Made progress in developing a method of analytical production of magnetic charts.

- Established the superiority of nuclear precession instruments and began a program to equip the magnetic observatories with that type of instrumentation.
- In cooperation with the U. S. Antarctic Research Program, operated two standard magnetic and seismological observatories in the Antarctic and, near the end of the year, established a third such observatory there.
- Acquired a large quantity of magnetic survey data from the Naval Oceanographic Office's airborne magnetic survey project.
- Continued magnetic repeat surveys in the United States for use in compiling a new series of magnetic charts.
- Published a revised edition of "U. S. Magnetic Tables," used principally by surveyors.
- Published 13 volumes of statistical results of magnetic observatory operations.
- Conducted a considerable amount of basic and applied research in geophysics.
- Published the results of the GNOME atomic explosion in 1961 at Carlsbad, N. Mex. One of the most important results noted from these studies was the large range of earth-wave propagation velocity about +8 seconds to the east and -4 seconds to the west.
- Installed approximately 57 standardized seismograph sets in 35 countries and on large oceanic islands. These modern seismographs will provide first-class seismic records for use by seismic research scientists throughout the world.
- Continued work on the establishment of a seismological data analysis center where records can be scanned by investigators and where copies can be made at a reasonable price and distributed to other research centers.
- Expanded the seismic sea wave warning system to several countries and islands of the Pacific Ocean area.
- Contracted with ITEK Corporation of Boston to produce a precision camera and enlarger for copying photo-sensitive seismograms. These units, with other new photo equipment, will be assembled in the new seismological data analysis center and will be used for miniaturizing seismograms on 35-mm. and 70-mm. film and

duplicating on photographic paper. With this equipment, it will be possible for the first time to copy seismograms in their entirety with no loss of resolution or contrast.

Prepared, with the cooperation of the Hawaiian Volcano Observatory and the Institute of Geophysics of the University of Hawaii, two technical papers on special seismic studies.

Planned, with the Scripps Institution of Oceanography, investigations of refractive studies of the Island of Hawaii and of ocean-bottom seismometers.

Conducted special seismic investigations at: Naval Air Station, Pensacola, Fla., to measure industrial-type vibrations; Cape Canaveral, Fla., to measure ground thrust by Saturn II, Saturn III, and Moon Probe rockets; Lake Mead, Nev., to measure the effects of high explosives on Hoover Dam; Cashe Valley, Utah, to study significant earthquake aftershocks; Nevada Test Site to make extensive measurements of nearly all the nuclear explosions.

Made preliminary arrangements for a new observatory at and with the cooperation of the Graduate Research Center of the Southwest, near Dallas, Tex., and for a new observatory at Boulder, Colo., in cooperation with the Bureau of Standards.

In 1963, the Geophysics Division expects to--

Expand the scope of the geomagnetic Data Center to include results from ship-towed magnetic measurements, rocket and satellite observations, fixed-point recordings of variations in the magnetic field, and all aspects of data accumulated in the World Magnetic Survey.

Complete plans for compiling the 1965 series of magnetic charts of the United States and of the world.

Continue the policy of consulting and cooperating with the Royal Greenwich Observatory (England) on the world magnetic charts.

Continue plans to equip magnetic observatories with nuclear precession magnetometers to achieve greater accuracy.

- Expand the scope of observatory work to include the investigation and study of rapid oscillations in the magnetic field and of earth currents.
- Increase cooperative efforts with technical and scientific groups of other organizations-- both private and Government--in the operation of additional magnetic observatory facilities and the study of resulting records.
- Inaugurate the new seismological Data and Analysis Center as a completely operational unit, thereby providing a unique service for the study of first-class seismograms and the distribution at very low cost of seismogram copies to research institutions.
- Conduct special studies at the seismological Data and Analysis Center on travel times of elastic waves produced by earthquakes and explosions; on the characteristics of certain earthquake waves; on the standardization of magnitude scales for normal and deep-focus earthquakes; and on the energy distribution, transmission, and detection at near and distant stations.
- Construct new seismograph vaults and other buildings in Guam, in Puerto Rico, and in Alaska at Fairbanks and possibly at Point Barrow or vicinity.
- Increase the number of tide detectors for the seismic sea wave warning system by installing such instruments on the Galapagos Islands, Marcus Island, Easter Island, and at Dixon Entrance, Alaska.
- Facilitate the study of earthquake belts and provide source data for wave propagation studies by increasing the number of earthquakes located.
- Increase the production of and upgrade the seismological service by more efficient handling of earthquake data from the observatories and by using computer methods for processing the data.
- Release, along with the earthquake location information, additional data such as earthquake magnitudes, azimuths, distances to each station, and a relative accuracy factor.
- Design and develop a modern accelerograph and vibration measuring instruments for seismological use.

- Design specifications for modern shaking tables to calibrate all types of seismic equipment.
- Test and redesign many units employed in the standardized seismograph system.
- Collaborate with private industry in the testing and calibration of new instruments.
- Inaugurate as completely operational the World Wide Standardized Seismograph System, with stations in approximately 65 foreign countries. The Washington office will administer the system and the seismological laboratory at Albuquerque, N. Mex., will provide all maintenance service.
- Install at Cape Canaveral a modern seismograph station with periphery vibration measuring equipment to provide continuous monitoring of ground vibrations caused by natural and industrial phenomena. This equipment will supplement the special instruments that the Bureau has temporarily installed to monitor special missile launches and sources of background noise.
- Extensively cooperate in the training of technical personnel who will operate seismographs installed in foreign countries under the auspices of the Coast and Geodetic Survey and international agencies such as UNESCO and AID.

#### Photogrammetry Division

This Division makes photographic surveys and compiles planimetric and topographic maps for the location of aids to air and marine navigation, for support of oceanographic surveys, and for the construction and maintenance of nautical charts, aeronautical charts, and airport obstruction charts. It provides and distributes technical data, aerial photographs, and copies of maps for use by the Government and the public in airport and coastal development.

In 1962, the Photogrammetry Division--

- Photographed more than 31,500 linear miles of terrain.
- Operated shore-based mobile parties along the Atlantic, Gulf, and Pacific coasts from Cape Cod to Hawaii, surveying more than 1,000 linear miles in support of hydrographic operations.

- Completed 1,325 square miles of coastal mapping in support of nautical charts.
- Completed 136 charts in the airport survey program for the Federal Aviation Agency. This was reimbursable work.
- Obtained the first photos of the initial signals from the geodetic satellite ANNA.
- Furnished, on a crash basis, all necessary information to the Nautical Chart Division for the production of emergency charts of the storm-damaged Atlantic coast.
- Made the first practical application of photogrammetry to the study of currents.

In addition to its routine surveying and mapping activities in support of the Bureau's charting, satellite, and current programs, the Photogrammetry Division in 1963 expects to--

- Continue to prepare airport obstruction charts for the Federal Aviation Agency.
- Investigate the use of a camera designed to utilize the sun for orientation in photographic charting controlled by precision aerotriangulation.
- Conduct photographic surveys of urban areas.
- Use photography in the study of the earth's upper crustal movements.
- Provide special maps for use in storm warnings and evacuation along coastal areas.

#### Electronic Computing Division

This Division, inaugurated during 1962, operates electronic computing systems for the Bureau's scientific and administrative divisions. It analyzes and compiles technical data, solves complex mathematical problems, and processes accounting data.

In 1962, the Electronic Computing Division--

- Completed a feasibility study on the acquisition of a computer for processing seismological data.
- Installed an IBM 1620 computer with 100,000 decimal digit storage. This is the largest IBM 1620 computer in the United States.

- Developed, on a production basis, programs for the computation of epicenters (latitude, longitude, and depths) of earthquakes.
- Developed programs for the solution of large sets of simultaneous equations on the IBM 1620 computer. As many as 160 equations can be eliminated at one loading of the computer.
- Developed programs for computing loran "C" and other hyperbolic systems on the IBM 1620 computer.
- Developed a computer program for reducing automatic magnetometer data, which are continuous recordings on paper tape.
- Initiated the "open shop" concept of technical training for employees of the various scientific and engineering divisions of the Bureau. Two FORTRAN (formula translation) classes were offered to interested employees.
- Assigned personnel to the Ballistics Research Laboratory, Aberdeen, Md., to study geodetic satellite computational methods and to develop programs applicable to the IBM 1620.
- Developed computer programs for the precision plotting of hydrographic survey data.
- Developed a new system of time and attendance reporting for payroll and leave accounting.
- Exchanged the two IBM 402 tabulators for two IBM 407 tabulators, as the latter have larger capacity and greater flexibility.

In 1963, the Electronic Computing Division expects to--

- Develop a full set of programs for geodetic satellite computations.
- Develop computer programs for spectral analysis and related research techniques as applied to seismic, gravimetric, tidal, and other scientific data.
- Process world-wide geomagnetic data in preparation for the 1965 Isogonic Chart series.
- Revise the cost accounting system as applied to the electronic computers.
- Develop a statistical reporting system for the distribution and sale of charts by the Office of Cartography.
- Hold classes at intervals throughout the year for the further training of employees in other divisions in line with the "open shop" training program.

Recruit employees with a knowledge of advanced mathematics and train present employees in the use of advanced mathematics.

Conduct a study on the feasibility of acquiring a larger computer that would be compatible with existing equipment but that would be capable of (1) processing magnetic data acquired from terrestrial instrumentation and satellites, (2) processing oceanographic data, and (3) computing geodetic satellite data.

Develop a system to supply reports for the various organizational units as soon as they are required. The personnel roster would be maintained on punched cards.

## THE OFFICE OF RESEARCH AND DEVELOPMENT

This Office coordinates the research and development efforts of the Coast and Geodetic Survey in the fields of cartography, oceanography, geodesy, gravimetry, photogrammetry, geomagnetism, and seismology. Such activities include basic and applied research in instrumentation, and projects in operations research, systems analysis, electronics, computer service and technology, solid-state physics, and other related fields.

The Office of Research and Development promotes the exchange of scientific information; and it encourages closer Bureau cooperation with other Governmental agencies and with academic, industrial, and nonprofit research organizations, both in the United States and abroad.

In 1962, the Office of Research and Development--

- Inaugurated a continuous 5-year advance planning period for scientific research and development in the Bureau.

- Formulated long-term plans for data-processing and computer facilities within the Bureau.

- In seismology, conducted extensive studies of hydrodynamical problems in transmission of tsunamis across the ocean. The theoretical studies, which included the effects of compressibility, viscosity, and the curvature of the earth, were experimentally complemented by a statistical examination of maximum tsunami amplitudes recorded at tide stations in North America and Hawaii.

- In oceanography, conducted physiographic and geologic studies in several undersea areas. These studies involved sedimentation in estuaries, coastal and near-shore changes, characteristic formations on the continental shelf, and a unique formation on the continental slope.

- In geomagnetism, theoretically demonstrated that the major features of the great Arctic anomaly can be reproduced by eight radial magnetic dipoles located at the core-mantle interface. Also, constructed and tested the first model of an automatic standard magnetic observatory.

- In geodesy, participated in the formulation of the optical tracking part of the program of the geodetic satellite project ANNA.
- In photogrammetry, established a computer method for the simultaneous analysis of five aerial photographs.
- In cooperation with the National Academy of Sciences, participated in the development of (1) a 10-year plan for research in the solid-earth sciences; and (2) a 3-year program of international research on the earth's upper mantle.
- Drew up a 10-year plan of cooperation with the National Oceanographic Program in which the Coast and Geodetic Survey's participation is to include both operational and research support.
- Actively cooperated with the National Aeronautics and Space Administration, the National Weather Satellite Center of the U. S. Weather Bureau, and other agencies in developing plans for using artificial satellites--including geodetic and similar satellite systems--in earth-science research.
- Entered into preliminary cooperative relations with Japanese scientists for the study of tsunamis.

In 1963, the Office of Research and Development expects to--

- Apply methods of operations research to Coast and Geodetic Survey activities, leading to possible improvement of instrumentation and procedures.
- Apply techniques of systems analysis to the evaluation of mechanical and man-machine systems used by the Bureau.
- Develop plans for data centers in geodesy and seismology and for an improved data center in geomagnetism.
- Investigate revolutionary new and more accurate procedures for distance measurements, paralleling the development of concentrated light and microwave (laser-maser) beam systems.
- Apply artificial satellite tracking techniques to a broad new concept of geodetic control.

Contribute to the preliminary planning for the International Quiet Sun Year (1964-1965) in areas of close scientific interest such as geomagnetism and artificial satellite geodesy.

Cooperate with Japanese geophysicists through the U. S.-Japan Committee on Scientific Cooperation to promote oceanographic research and the joint calibration of geophysical instruments.

Cooperate with international scientists in the Indian Ocean Expedition.

Enhance the working relationships with universities, nonprofit research organizations, and private industry by (1) inaugurating in-training education to assist promising geophysicists; (2) instituting Bureau-sponsored chairs or professorships at universities; (3) encouraging research projects conducted jointly with university staff members and the co-authorship of papers based on such research; and (4) awarding research grants and contracts to qualified organizations.

Stimulate the exchange of scientific information by (1) encouraging the scientific staff to contribute to technical journals; (2) publishing a new scientific annual report for widespread distribution to scientists, research workers, and academic, industrial, and Government libraries; (3) augmenting staff participation in professional conferences dealing with pertinent areas of interests; (4) sponsoring seminars to which prominent outside scientists would be invited; and (5) inviting foreign and domestic scientists to become visiting staff personnel of the Bureau.

## THE OFFICE OF ADMINISTRATION

In 1962, the administrative divisions--

- Launched a 2-year management improvement program in which 18 areas were delineated for potential improvement.
- Established a central-review control system for better utilization of manpower.
- Improved fiscal procedures and effected savings by: (1) recording all invoices of \$10 or less only at the time of payment, thus eliminating obligation, accrual, and adjustment entries that formerly required as many as four or more punched cards each; (2) eliminating 34 of 88 classification codes; (3) dispensing with identification slips on travel vouchers; (4) eliminating duplication in the handling of delivery tickets; and (5) consolidating purchases through centralized funding and procurement.
- Established on a continuing basis the auditing of fiscal, distribution, and instrumentation functions at headquarters and conducted audits of selected field parties and installations. These audits pointed out ways to decrease costs and increase efficiency.
- Exceeded by 30 percent the Bureau's quota (assigned by the Department) of records to be discarded or transferred to Federal records centers.
- Further refined the forms control program and established a reports control program.
- Developed training courses for quartermaster surveyors, cartographic draftsmen, and electronic technicians.
- Prepared for display at international airports special 3-dimensional exhibits demonstrating instrument landing procedures.
- Repeatedly observed the processes of erecting and dismantling of Bilby steel towers (used in triangulation work) in order to develop safety standards and efficient techniques for these dangerous and complicated jobs. On the basis of these studies, changes will be made in the

physical features of the towers and a program will be developed to train employees in the proper method of erecting and dismantling them.

Received more than 81,000 items of map and chart source material; distributed more than 72,000 items of map and chart material to the public and Government agencies; and destroyed more than 12,000 superseded maps and charts.

In 1963, the administrative divisions expect to--

Continue the far-reaching study to increase the efficiency of field operations by decentralizing operational control and support activities to specific areas.

Continue to implement internal audit recommendations; also, audit additional functions in headquarters and the field, using improved techniques learned from past experience.

Complete the following phases of the financial management improvement program: Review of the accounting system, review of financial reports from the field, review of accounting reports to management, and extension of the job-order cost system in the entire cartographic function.

Review the vessel employees' compensation plan. This will include the improvement of the career ladder, revision of qualification requirements, improvement of recruitment, and development of training.

Expand the recruiting program to attract high school students for lithographic and cartographic positions and junior physical scientists to career professional positions. Recruiting literature will be developed and improved to cover the various occupational areas, and contacts will be developed for the recruiting of personnel in the scarce categories.

Develop a 2-year training program for junior physical scientists and a middle management training program for supervisors at the branch level and above.

Establish an economic order quantity system for warehouse stocks.

Issue a new forms catalog.

- Review all internal reports and issue a recurring reports list.
- Review all records holdings and apply disposition schedules.
- Refine and improve the manpower control and utilization system.

### Instrument Division

This Division, under the Office of Administration, invents, tests, and repairs instruments used in the Bureau's varied activities.

In 1962, the Instrument Division--

- Equipped a hydrographic ship with an automatic system to collect survey data. This was the first step in the installation of a completely automatic system to collect such data. The data are processed by computers and then are used to control the production of a survey sheet by an automatic precision plotter. The plotter has been completed and is now undergoing tests.
- Completed a new stabilized deep-water echo sounding system that will permit accurate soundings in deep water over irregular bottom. The system will be used on the new oceanographic vessel USC&GSS OCEANOGRAPHER.
- Developed an acoustic system to determine the structure and composition of the earth for many hundreds of feet below the ocean bottom while the vessel is in motion. The system may be transferred from ship to ship as needed.
- Successfully anchored a buoy 100 feet below the surface in water 500 feet deep. Because the buoy is below surface wave action, it will remain in a stable position. It will house a magnetic observatory to record data in ocean areas where none is now available.

## THE DIRECTOR'S OFFICE

### District Offices

The Coast and Geodetic Survey's 13 district offices supervise the Bureau's activities within the respective districts. The offices are located in Boston, New York, Baltimore, Norfolk, Tampa, New Orleans, Fort Worth, Kansas City (Mo.), Los Angeles, San Francisco, Portland (Oreg.), Seattle, and Honolulu.

The district offices are responsible for maintaining liaison with other Government agencies, private organizations, and the public, and for overseeing the technical and field operations in their areas. Their activities include assisting field parties, collecting data for revisions of nautical and aeronautical charts, disseminating survey data and technical information to local engineers and the public at large, supervising the sale and distribution of charts, processing hydrographic data, computing geodetic data, and compiling photogrammetric data. They also help recruit officer candidates and technical personnel. All offices are not assigned each of these activities, but every office is organized to carry on selected phases of the over-all program.

### New Ship Staff

This staff, under the Director's Office, is responsible for developing the basic concept of a new ship and for specifying her specialized requirements. It reviews contract bids for new ship construction and recommends to the Maritime Administration the award of the construction contract. It inspects work in progress; assists in coordinating ship design and construction as carried out by the Maritime Administration and the contractor; and requisitions ship-items furnished by the Government and monitors the delivery of such items to the shipyard.

The New Ship Staff also works out the complete design for smaller vessels, such as wire-drag boats, and it prepares all plans for converting existing ships to Coast and Geodetic Survey uses.

In 1962, the New Ship Staff--

Assisted the Maritime Administration in inspecting the construction of two new Class III hydrographic survey replacement ships at Marietta Manufacturing Co., Point Pleasant, W. Va.

Reviewed contract bids and recommended that contracts be awarded to Marietta Manufacturing Co. for the construction of two Class II hydrographic survey replacement ships and to Gibbs Shipyards, Inc., of Jacksonville, Fla., for the construction of two Class I oceanographic survey ships.

In 1963, the New Ship Staff expects to--

Approve the completed construction of two new Class III hydrographic survey replacement ships.

Continue to assist in the inspecting and coordinating of the construction of two Class I oceanographic survey ships and two Class II hydrographic survey replacement ships.

#### International Technical Cooperation Staff

This staff, under the Director's Office, administers the technical training of foreign nationals for the Bureau and plans and schedules foreign visitor programs. The visitors include scientists, engineers, technicians, and administrators concerned with Coast and Geodetic Survey activities.

Most of the training participants are under the auspices of the Agency for International Development (IAD), Department of State. Other sponsors include the Bureau of Educational and Cultural Affairs, Department of State; the fellowship program of the Specialized Agencies, United Nations; the Military Assistance Programs; and the Department of State and participating foreign governments under bilateral arrangements.

In 1962, the International Technical Cooperation Staff--

- Arranged Coast and Geodetic Survey instruction for 21 foreign trainees in photogrammetry (Cambodia, 1; Indonesia, 1), geodetic surveying (Indonesia, 1; Korea, 2; Liberia, 1; Sudan, 2; Venezuela, 1), map and chart construction (Argentina, 1; Colombia, 1; Liberia, 1), aeronautical charts (Argentina, 1; Sudan, 1), reproduction (Sudan, 3), tides and currents (Venezuela, 1), geomagnetism (Bolivia, 1), seismology (Israel, 1), and electronic computations for geodetic surveying (Japan, 1).
- Gave instruction on Bureau activities to two AID training officers prior to their departures to assignments in Ghana and Indonesia.
- Received 115 foreign representatives from 36 countries as visitors to the Coast and Geodetic Survey for technical consultation and exchange of opinions.
- Initiated plans for and contacted pertinent member agencies and organizations to raise funds for a symposium to be conducted in 1963 by the Committee on Surveys of Urban Areas, Commission on Cartography, Pan American Institute of Geography and History. This symposium was ordered by a resolution adopted by the Committee in 1961.
- Participated in five departmental conferences on international technical assistance; a 2-day national conference on the international training programs, sponsored by the Agency for International Development; a meeting of the U. S. Cartographic Working Committee; and the 5-day annual meeting of the American Society of Photogrammetry and the American Congress on Surveying and Mapping.
- Cooperated in the production of a short movie film on the technical training of a Sudanese at the Coast and Geodetic Survey. The film, sponsored by the Agency for International Development, was included in a longer film depicting the activities of Sudanese trainees in the United States.
- Completed numerous translations of correspondence for the various divisions of the Bureau.
- Prepared a paper on "Planning the City of the Future" for the Bureau.

In 1963, the International Technical Cooperation Staff expects to--

Train 40 foreign participants in the theoretical and practical aspects of the Bureau's scientific, engineering, and cartographic activities.

Plan and schedule the activities of 200 foreign representatives who are expected to visit the Coast and Geodetic Survey for technical consultation and exchange of opinions on cooperation and methods.

Organize and conduct a symposium on "Surveys of Urban Areas" in one of the Latin American countries.

Effect a new working agreement with the Agency for International Development, Department of State.

#### Addresses and Publications

In 1962, the following technical papers by the Director were presented at scientific conferences:

"Hydrographic Automatic Data Processing," presented at the 18th International Hydrographic Conference, held in Monaco in May. This paper was presented by the Deputy Director. Limited copies were made available.

"Plans for Geodesy in the Next Decade," presented by the Director at the 1962 Annual Conference of the Division of Earth Sciences, National Academy of Sciences and National Research Council, held in Washington in May. Limited copies were made available.

In 1962, the Director gave the following addresses:

"The PIONEER's Recent Surveys in the North Pacific," at Western Regional Meeting of the Institute of Navigation, in San Diego in January.

"The Engineer in the Coast and Geodetic Survey," at a panel meeting of the District of Columbia Society of Professional Engineers, in Washington in April.

On the subject of "Engineering for Space," the theme of the 42nd Annual Meeting of the Society of American Military Engineers, held in Washington in May.

"Oceanographic Programs of the Coast and Geodetic Survey," at meeting of the Anchor Club in Washington in May.

"Survey and Mapping in Support of Economic Development," keynote address at joint meeting of the American Congress on Surveying and Mapping and the American Society of Photogrammetry in St. Louis in September.

A talk at the groundbreaking ceremony of Dallas Magnetic Observatory in Dallas in December.

Publications issued in 1962 include--

"Shore and Sea Boundaries," by Aaron L. Shalowitz. This book, consisting of 444 pages and 53 illustrations, is the first of a 2-volume documented treatise on the engineering and legal aspects of shore and sea boundaries, with special reference to the use and interpretation of Coast and Geodetic Survey data.

The following Technical Bulletins: No. 17, "On the Time Interval between Two Consecutive Earthquakes," by Tokuji Utsu (5 pp., illus.); No. 18, "Submarine Physiography of the U. S. Continental Margins," by G. F. Jordan (28 pp., 21 illus.); No. 19, "Analytic Absolute Orientation in Photogrammetry," by G. C. Tewinkel (18 pp.); No. 20, "The Earth as Viewed from a Satellite," by Erwin Schmid (21 pp., 11 illus.).

Two special booklets: "Engineering Responsibilities" (8 pp., illus.); and "Satellite Triangulation" (18 pp., illus.).

Revised editions of "United States Coast Pilot 5: Atlantic Coast--Gulf of Mexico, Puerto Rico, and Virgin Islands" (264 pp.), and "United States Coast Pilot 8: Pacific Coast--Alaska, Dixon Entrance to Cape Spencer" (246 pp.).

"Oceanographic Cruise Report, USC&GS Ship EXPLORER--1960. Seattle, Washington, to Norfolk, Virginia, February 2-April 27, 1960," by Harris B. Stewart, Jr. (162 pp., illus.).

"Surface Water Temperature and Salinity, Pacific Coast" (71 pp., 1 map).

"Plane Coordinate Intersection Tables (2 1/2-Minute)--Part 51, Alaska, Zone 10" (87 pp., 1 map).

A new part to Special Publication 277, "Plane Coordinate Projection Tables": Utah-Lambert (32 pp.).

- A revised edition of Special Publication 240, "Manual of Leveling Computation and Adjustment," by Howard S. Rappleye, 1948 (178 pp., 53 illus.).
- The following in the Tide Tables series: "West Coast of North and South America, Including the Hawaiian Islands, 1963" (224 pp., 1 map); "East Coast of North and South America, Including Greenland, 1963" (285 pp.); "Europe and the West Coast of Africa, Including the Mediterranean Sea, 1963" (210 pp., 1 map); "Central and Western Pacific Ocean and Indian Ocean, 1963" (386 pp., 1 map).
- A special tide table, "Selected Places in Greenland and Canada" (24 pp.).
- The following in the Tidal Current Tables series: "Pacific Coast of North America and Asia, 1963" (238 pp.); "Atlantic Coast of North America, 1963" (184 pp.).
- Nine issues of Seismological Bulletin, totaling 249 pages.
- Two issues of Antarctic Seismological Bulletin, totaling 47 pages.
- Two "Abstracts of Earthquake Reports for the Pacific Coast and the Western Mountain Region," for October-December 1960 (26 pp.) and for January-March 1961 (25 pp., 1 illus.).
- "United States Earthquakes, 1960" (90 pp., 8 illus.).
- In the Magnetograms and Hourly Values series: data at Fredericksburg, Va., 1958 (150 pp.); at Sitka, Alaska, 1958 (160 pp.); at Honolulu, Hawaii, 1958 (160 pp.); at San Juan, Puerto Rico, 1958 (97 pp.); at College, Alaska, 1958 (177 pp.); at Byrd Station, Antarctica, 1957-1958 (189 pp.); at Fredericksburg, Va., 1959 (153 pp.); at Tucson, Ariz., 1958 (144 pp.); at Sitka, Alaska, 1959 (160 pp.); at Tucson, Ariz., 1959 (144 pp.).
- "Seismic Waves from an Underground Explosion in a Salt Bed (Project Gnome, PNE-150F)," by D. S. Carder, W. K. Cloud, W. V. Mickey, J. N. Jordan, and D. W. Gordon (66 pp., illus.).

The Director's Office prepared and issued 61 news releases relating to the Bureau's activities in 1962.