Summary of National Ocean Survey Technical Publications and Charts

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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration
James P. Walsh, Acting Administrator

National Ocean Survey
Rear Admiral H.R. Lippold, Jr., Director

SUMMARY OF NATIONAL OCEAN SURVEY TECHNICAL PUBLICATIONS AND CHARTS

An important goal of organized scientific or technical efforts is the compilation, analysis and distribution of knowledge gained. The National Ocean Survey (formerly the U.S. Coast and Geodetic Survey) traditionally conveys the results of its scientific and technical investigations to its user groups through processed data, reports and various publications.

Throughout its long history, the National Ocean Survey (NOS) has published numerous works covering its progress, developments and advances in science and technology. Certain classical documents representing the results of original research or irreplaceable effort are still in demand and have been reprinted from time to time. Others, because of the obsolescence of the data, or of the procedures or techniques used for their attainment, have been withdrawn from circulation and are no longer in print. The users needs, the accuracy, current reliability and serviceability of the data reproduced are the criteria for determining the continuing availability of this information.

Many of the early published works, as well as vast stores of archival data in the fields of the Survey's statutorily designated technical fields, are still available in Government repository libraries throughout the country, or through limited files copies in the appropriate technical office of the National Ocean Survey.

To provide a cumulative tabulation of these data sources and published works up to the time of the incorporation of the NOS publication program into the broader publication program of the National Oceanic and Atmospheric Administration in 1970, the following summary has been prepared.

Every effort has been made to present as complete a compilation of publications as possible, however, availability and prices listed are subject to change. Ordering information and addresses are provided for each of the distributing departments.

Obtaining NOS Publications

All requests must be addressed to the offices indicated. Office designations, and mailing addresses, are as follows:

GPO	Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402
Rockville	Director National Ocean Survey NOAA Attn: (office code) 6001 Executive Boulevard Rockville, Maryland 20852
Riverdale	Distribution Division (OA/C44) National Ocean Survey Riverdale, Maryland 20840
NTIS	National Technical Information Service Springfield, Virginia 22161 703-487-4600
GLERL	Great Lakes Environmental Research Laboratory 2300 Washtenaw Avenue Ann Arbor, Michigan 48104

Those items listed as available from NTIS may be purchased in full-size xerographed form or as microfiche copies. For price and purchase information contact:

U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161

Official distribution copies sought by other Government agencies may be obtained, as available, from:

Environmental Data Service
Library and Information Services Division (OA/D82)
NOAA
WSC-4
6009 Executive Boulevard
Rockville, Maryland 20852

All current nautical and aeronautical charts may be purchased (in the Washington, D.C. area) at 6501 Lafayette Avenue, Riverdale, Maryland 20840, or in room 101, WSC-1, 6001 Executive Boulevard, Rockville, Maryland 20852. Charts may be purchased by mail, from the Distribution Division, OA/C44, National Ocean Survey, Riverdale, Maryland 20840. Lists of other authorized sales agents throughout the country may be obtained free of charge at this same address.

Note: ALL PRICE LISTINGS ARE SUBJECT TO CHANGE WITHOUT NOTIFICATION. Updating or revisions of the NOS Summary of Technical Publications and Charts will be made as required.

TABLE OF CONTENTS

TECHNICAL BULLETINS

TECHNICAL REPORTS

SERIALS

CATALOGS

GEODESY

The National Geodetic Survey (NGS) is responsible for establishing and maintaining the National Networks of Geodetic Control. In relation to developing this national reference system, NGS conducts triangulation, traverse, precise leveling, gravimetric, astronomic, and satellite surveys. It carries out research investigations to improve the collection, accuracy, and understanding of geodetic data. In keeping with these functions, NGS is responsible for the mathematical study of the size and figure of the Earth. NGS maintains Federal leadership in coordinating geodetic surveys and related activities, developing and applying surveying instrumentation and procedures, and assists state, county, and municipal agencies through cost-sharing agreements.

PHYSICAL GEODESY

Subject matter includes deflections of the vertical, certain phases of the theory of isostasy, and the size and shape of the earth as determined by gravimetric, astronomic, and horizontal control data. Gravity intensity measurements and reductions are included under this heading.

Special Publications:

82. **The Figure of the Earth and Isostacy from Measurements in the United States** (1909)—NTIS (PB-275 349).

82. **Supplement. Supplementary Investigation in 1909 of the Earth and Isostacy** (1910)—NTIS (PB-257 350).

99. **Isostatic Investigations and Data for Gravity Stations in the United States Established Since 1915** (1924) by William Bowie—Out of Print.

199. **Tables for Determining the Form of the Geoid and Its Indirect Effect on Gravity** (1936) by Walter Lambert and Frederick Darling—Out of Print.

204. **A Determination of the Relative Values of Gravity at Potsdam and Washington** (1936) by E. J. Brown—Out of Print.

223. **Report on Earth Tides 1936-38** (1940) by Walter D. Lambert—One of a series of reports of worldwide research on the amount and significance of world tides. Out of Print.

229. **Deflections of the Vertical in the United States-1927 Datum** (1941) by J. A. Duerksen—Out of Print.

232. **Pendulum Gravity Measurements and Isostatic Reductions** (1942) by Clarence H. Swick—Out of Print.

243. **Fundamental Tables for the Deflections of the Vertical** (1949) by Frederic W. Darling—Out of Print.

244. **Pendulum Gravity Data in the United States** (1949) by J. A. Duerksen—Out of Print.

Numbered Publications:

63-1. **Gravity Control Measurements in North America** (1958) by Donald A. Rice—Out of Print.

G-53. **Theoretical Gravity at Sea Level for Each Minute of Latitude by the International Formula** (1942)—Out of Print.

Technical Bulletin:

9. **Gravity Measurement Operations in the Field** (1959) by Lt. Cdr. Hal P. Demuth—Describes the use of the Worden gravity meter in making area gravity surveys. Out of Print.

ASTRONOMY

Astronomic data are necessary for the adjustment of the horizontal control network, and in the determination of the size and shape of the earth. Astronomical work consists of the determination of latitude, longitude, and azimuth. The motion of the earth's rotation axis within the body of the earth is studied by means of a special international program of latitude measurements.

Special Publications:

80. **An Investigation of the Latitude of Ukiah, California and of the Motion of the Pole** (1922) by Walter D. Lambert—While quite old, the analysis and data of this publication are still of classic interest. Out of Print, may be found in scientific libraries.

237. **Manual of Geodetic Astronomy, Determination of Longitude, Latitude, and Azimuth** (1952) by Albert J. Hoskinson and J. A. Duerksen—A manual for field and office use, describing the methods used in the observation and computation of astronomical determinations connected with geodetic surveys. Deals especially with the use of the Bamberg broken-telescope transit instrument for determining latitude and longitude, and azimuth in high latitudes—NTIS (PB-267 465).

Numbered Publications:

64-1. **Second-Order Astronomical Position Determination Manual** (1965)—Covers the primary method used by the National Ocean Survey in the determination of astronomic positions with probable errors of about ±0.4". Observations are made with a first order theodolite ordinarily used in triangulation surveys. Out of Print.

HORIZONTAL CONTROL

The national horizontal control network provides a rigid basic framework for engineering, surveying, mapping, charting and research. Electro-optical and microwave distance measuring instruments, satellite triangulation and other developments have increased demands for control, and have supplemented the conventional triangulation, traverse and astronomical field methods.

Manuals of instructions and information publications for field observations and computations, and for office computations and adjustment, are listed below. Descriptions and lists of data will be found in the Geodetic Control Data section. Publications concerning plane coordinates are also listed separately.

Special Publications:

5. **Tables for a Polyconic Projection of Maps and Lengths of Terrestrial Arcs of Meridian and Parallels Based Upon Clarke's Reference Spheroid of 1866,** Sixth Edition (1935)—The primary purpose of this publication is to furnish data for the construction of the polyconic projection for maps. It is useful also in geodetic computations involving lengths along the meridians and parallels based on Clarke's spheroid—NTIS (PB-267 481). GPO (003-002-152-3) Price: $3.00.

8. **Formulas and Tables for the Computation of Geodetic Positions,** Seventh Edition (1952)—Explains the method of computing geodetic positions by the use of logarithms, and gives the tables used in the computations for the Clarke Spheroid of 1866, used by the National Ocean Survey as a basis for its triangulation computations since 1880. The dimensions of this spheroid with theory and formulae are given. (See SP 241 for tables in calculating machine computations.) NTIS (PB-267 459).

28. **Application of the Theory of Least Squares to the Adjustment of Triangulation** (1915) by Oscar S. Adams—Illustrates the application of the method of least squares to the problem arising in the adjustment of triangulation. It contains mostly samples of the different computations involved, but also includes theoretical discussions of some of the computations, particularly the adjustment method based on variations of geographic coordinates and the method of adjusting vertical observations. (See also SP 138, described below.)—NTIS (PB-267 535).

65. **Instructions to Lightkeepers on First-Order Triangulation,** Third Edition (1936) by Carl I. Aslakson—Describes the use and care of the instruments used by lightkeepers, gives instructions for signaling to the observer including the use of the Morse code, and tells how the various duties of a lightkeeper should be carried out to avoid any delays to the observing party. Out of Print.

137. **Manual of First-Order Traverse** (1927) by Casper M. Durgin and Walter D. Sutcliffe—Summarizes the methods used in executing first-order traverse. Contains detailed instructions for the various operations in the conduct of field work, describes the records and computations to be made in the field, explains in detail the office computations, including the least-squares adjustment, and contains a number of tables needed in making the computation—NTIS (PB-267 466).

138. **Manual of Triangulation Computation and Adjustment** (1934) by W. F. Reynolds—Explains the methods used in the National Ocean Survey in the computation and adjustment of triangulation. Illustrated is the computation of the triangulation from the time the field observations are received in the office until the final results are published. Examples of each part of the computation are given. A number of valuable suggestions, general rules, formulas, and tables which have been formulated over many years of experience in the adjustment of triangulation are given—NTIS (PB-267 458).

145. **Manual of Second and Third-Order Triangulation and Traverse** (1957) by C. V. Hodgson—Contains a description of the specifications and criteria for second-order and third-order triangulation, traverse, and base measurement, with detailed instructions for field and office operations and specimens of field records and office computations. The section on instrumental adjustments and errors, and the discussion of the sources of error in triangulation traverse are written in considerable detail. (See also SP 247) NTIS (PB-267 456).

200. **Formulas and Tables for the Computation of Geodetic Positions on the International Ellipsoid** (1935) by Walter D. Lambert and Clarence H. Swick—Contains tables and explains the method of computation of geodetic positions using logarithms on the International Spheroid as adopted by the International Association of Geodesy for special scientific purposes. (See Publication G-58 for calculating machine computations.) Out of Print.

225. **Manual of Reconnaissance for Triangulation** (1959) by William Mussetter—Includes the selection of sites for stations, the testing of lines for visibility, the determination of required signal heights and the collection of local information which will expedite the work of the building and observing parties. Instructions for this important operation in triangulation survey are included in this manual—NTIS (PB-267 457).

227. **Horizontal Control Data**—A general information leaflet describing horizontal control, history of developments, observing instruments, adjustments and data. Out of Print. (Superseded by NOAA Technical Report NOS 88 NGS 19).

231. **Natural Sines and Cosines to Eight Decimal Places**—Contains sines and cosines (no tangents) and in conjunction with Special Publication 241 is used primarily in computing geodetic positions by calculating machine. The interval is one second. GPO (003-002-00019-5) Price: $8.40. (Replaced by S.P. 246)

234. **Signal Building** (1943) by Jasper S. Bilby—Describes the construction of wooden towers and signals used in triangulation and hydrographic surveys. Out of Print.

241. **Natural Tables for the Computation of Geodetic Positions** (1949) by Lansing G. Simmons—Used to compute geodetic positions on the Clarke spheroid of 1866 with a calculating machine. (See SP 231). Out of Print.

242. **Definitions of Terms Used in Geodetic and Other Surveys** (1948) by Hugh C. Mitchell. Out of Print, being revised.

247. **Manual of Geodetic Triangulation** (1950) by F. R. Gossett—Covers the methods used by the National Ocean Survey in executing first-order triangulation, base measurements, and azimuth observations. Little or no attention is given in this volume to historical developments or to theoretical discussions of the subject. Provides a manual of approved practices. (Entirely supersedes SP 120, Manual of First-Order Triangulation, and portions of SP 145.)—NTIS (COM-71-50047).

Numbered Publications:

62-1. **Tellurometer Manual** (Revised 1961) by Austin C. Poling—A manual for the instrument based on the experience of the National Ocean Survey in traverse surveys. Out of Print.

62-2. **Geodimeter Manual** (1969)—Describes the setup, operation, alignment, calibration, trouble shooting, and computation of results of the Geodimeter Models 1, 2, and 2A which were used by the Coast and Geodetic Survey for measuring base lines in first-order triangulation. Out of Print.

62-3. **Bilby Steel Tower for Triangulation** (1965 Edition) by James K. Richards—Contains illustrations, drawings and specifications for the construction of these steel towers and comprehensive instructions for organizing a field building party, including personnel and outfit. Describes the method used for marking stations, and other operations required in cooperating with the observing party. (Supersedes SP 158.) Out of Print.

G-45. **The ABC of Triangulations Adjustment** (1942)—Simplified basic instructions with samples of mathematical computations and adjustments. Rockville.

G-56. **Elevations from Zenith Distances (Machine Computations) with 6-Place Natural Tangent Tables 0° to 45°** by Austin C. Poling—Instructions for computation and adjustment of elevations from vertical angles. Rockville.

G-58. **Natural Function Tables for Computing Geographic Positions on the International Ellipsoid** (1947)—(See SP 200 for logarithmic computations)—NTIS (PB-267 469).

Serials:

250. **Some Elementary Examples of Least Squares** (1924) by Oscar Adams. Rockville.

529. **Triangulation**—A general information leaflet, obsolete. (Available for reference only through library resources.)

632. **The Preservation of Triangulation Station Marks**—Instructions with samples and drawings for constructing monuments, placing markers and making measurements and observations for resetting and replacement of horizontal control marks. (Available for reference only through library resources.)

Technical Memorandum:

1. **Preliminary Measurements with a Laser Geodimeter** (1966) by S.E. Smathers, G.B. Lesley, R. Tomlinson and H.W. Boyne—NTIS (PB-174 649).

3. **Electronic Positioning Systems for Surveyors** (1967) by A.A. Ferrara—NTIS (PB-175 604).

4. **Specifications for Horizontal Control Marks** (1968) by L.S. Baker—NTIS (PB-179 343).

Technical Bulletins:

2. **Tellurometer Traverse Surveys** (1958) by Lt. Hal P. Demuth—Out of Print.

11. **Use of Near-Earth Satellite Orbits for Geodetic Information** (1960) by Paul D. Thomas—Out of Print.

13. **A Singular Geodetic Survey** (1960) by Lansing G. Simmons—Out of Print.

15. **Transformation of Rectangular Space Coordinates** (1960) by Erwin Schmidt—Out of Print.

HORIZONTAL CONTROL: State Plane Coordinate Systems

Systems of plane coordinates were developed for each state by the National Ocean Survey beginning in 1933 for the transformation of geographic coordinates of latitudes and longitudes to x and y coordinates, and to provide a simplified local system on the national network. Surveys between stations having state coordinates on the network datum can be computed on a plane, and will be mathematically on datum and coordinated just as if computed in the more difficult spherical geographic coordinates. The state plane coordinate projection tables for making computations, and the 2½-minute intersections of meridians and parallels for making maps for the various states are listed below, and are available from GPO unless otherwise indicated.

***Alabama:** Projection Tables (PT) - Special Publication (SP) 304 (003-002-00063-2)
Price: $1.40.
Intersection Tables (IT) - Numbered. Publication (NP) 65-1, Part 1
NTIS (COM-71-50382). GPO (003-002-00111-6) Price $1.40.

***Alaska:** Zone 1, IT 65-1, Part 49 Out of Print.
Zones 2-9, IT 65-1, Part 50 Out of Print.
Zone 10, IT 65-1, Part 51 Out of Print.
(Intersection Tables serve as Projection Tables.)

Arizona: PT - SP 257 Out of Print.
IT - 65-1, Part 2 Out of Print.

***Arkansas:** PT - SP 289 Out of Print.
IT - 65-1, Part 3 (003-002-00119-1)
Price: $1.25.

***California:** PT - SP 253 Out of Print.
IT - SP 327 NTIS (COM-75-10736).

***Colorado:** PT - SP 276 Out of Print.
IT - 65-1, Part 5 Out of Print.

***Connecticut:** PT - SP 266 NTIS (COM-71-50602).
GPO (003-002-00040-3) Price $ .40.
IT - SP 330 (003-002-00080-2)
Price: $ .55.

***Delaware:** PT - SP 305 (003-002-00064-1)
Price: $ .55.
IT - 65-1, Part 7 (003-002-00130-2)
Price: $ .55.

District of Columbia: Use Md. or Va. tables

Florida: PT - SP 255 Out of Print.
IT - SP 296 Out of Print.

***Georgia:** PT - SP 322 Out of Print.
IT - 65-1, Part 9 (003-002-00131-1)
Price: $1.50.

Hawaii: PT - SP 302 (003-002-00061-6)
Price: $ .55.

Idaho: PT - SP 306 NTIS (COM-72-50358).
IT - 65-1, Part 10 (003-002-00112-4)
Price: $2.40.

Illinois: PT - SP 303 Out of Print.
IT - 65-1, Part 11. Out of Print.

***Indiana:** PT - SP 259 Out of Print.
IT - SP 332 (003-002-00082-9)
Price: $1.25.

Iowa: PT - SP 284 (003-002-00048-9)
Price: $ .65.
IT - 65-1, Part 13 (003-002-00113-2)
Price: $1.30.

Kansas: PT - SP 285 NTIS (COM-71-50372).
GPO (003-002-00049-7) Price $ .65.
IT - 65-1, Part 14 Out of Print.

Kentucky: PT - SP 290 Out of Print.
IT - SP 341 Out of Print.

***Louisiana:** PT - SP 291 Out of Print.
IT - SP 329 Out of Print.

***Maine:** PT - SP 256 Out of Print.
IT - SP 339 Out of Print.

***Maryland:** PT - SP 292 (003-002-00056-0)
Price: $ .55.
IT - SP 331 (003-002-00081-1)
Price: $ .65.

***Massachusetts:** PT - SP 274 Out of Print.
IT - 65-1, Part 19 Out of Print.

‡Michigan: Traverse Mercator.
PT - SP 313 Out of Print.
IT - 65-1, Part 20 Out of Print.

‡Michigan: Lambert.
PT - 65-3 Out of Print.
IT - 65-1, Part 52 (003-002-00129-9)
Price: $2.55.

***Minnesota:** PT - SP 264 Out of Print.
IT - SP 299 (003-002-00060-8)
Price: $1.90.

Mississippi: PT - SP 321 Out of Print.
IT - 65-1, Part 22 Out of Print.

***Missouri:** PT - SP 319 NTIS (COM-71-50388).
IT - 65-1, Part 23 Out of Print.

***Montana:** PT - SP 261 Out of Print.
IT - SP 325 (003-002-00077-2)
Price: $3.20.

Nebraska PT - SP 286 Out of Print.
IT - SP 295 Out of Print.

***Nevada:** PT - SP 318 Out of Print.
IT - SP 337 Out of Print.

New Hampshire: PT - SP 317 (003-002-00073-0)
Price: $ .55.
IT - SP 340 (003-002-00089-6)
Price: $ .65.

***New Jersey:** PT - SP 316 Out of Print.
IT - SP 333 (003-002-00083-7)
Price: $ .65.

***New Mexico:** PT - SP 324 Out of Print.
IT - SP 344 (003-002-00092-6)
Price: $1.00.

***New York:** PT - SP 323 Out of Print.
IT - SP 328 Out of Print.

***North Carolina:** PT - SP 272 Out of Print.
IT - SP 310 Out of Print.

North Dakota: PT - SP 262 Out of Print.
IT - SP 309 (003-002-00066-7)
Price: $1.75.

***Ohio:** PT - SP 269 Out of Print.
IT - SP 336 Out of Print.

Oklahoma: PT - SP 287 Out of Print.
IT - 65-1, Part 34 (003-002-00120-5)
Price: $1.55.

***Oregon:** PT - SP 270 NTIS (COM-71-50370).
IT - 65-1, Part 35 NTIS (COM-71-50390).

***Pennsylvania:** PT - SP 267 Out of Print.
IT - SP 326 Out of Print.

Puerto Rico: PT - 65-2 (003-002-00132-9) Price: $ .40.

***Rhode Island:** PT - SP 315 (003-002-00071-3)
Price: $ .55.
IT - SP 342 Out of Print.

South Carolina: PT - SP 273 (003-002-00044-6)
Price: $ .60.
IT - 65-1, Part 38 Out of Print.

***South Dakota:** PT - SP 263 (003-002-00039-0)
Price: $ .65.
IT - SP 312 (003-002-00045-4)
Price: $ .60.

***Tennessee:** PT - SP 268 Out of Print.
IT - 65-1, Part 40 (003-002-00123-0)
Price: $1.00.

Texas: PT - SP 252 Out of Print.
IT - SP 335 NTIS (COM-71-50381).
GPO (003-002-00084-5) Price: $2.75.

Utah: PT - SP 277 Out of Print.
IT - SP 311 (003-002-00068-3)
Price: $2.10.

Vermont: PT - SP 314 Out of Print.
IT - SP 343 (003-002-00091-8)
Price: $ .80.

Virginia: PT - SP 293 Out of Print.
IT - 65-1, Part 44 Out of Print.

Washington: PT - SP 271 NTIS (COM-71-50371).
IT - SP 338 (003-002-00087-0)
Price: $1.65.

West Virginia: PT - SP 275 (003-002-00045-4)
Price: $ .60.
IT - 65-1, Part 46 Out of Print.

Wisconsin: PT - SP 288 NTIS (COM-72-50353).
IT - SP 308 Out of Print.

Wyoming: PT - SP 258 Out of Print.
IT - SP 297 Out of Print.

*State legislation enacted legalizing the use of the coordinate systems for property surveys and for the descriptions of property surveys and property boundaries.
‡Legislation enacted for Lambert projection.

HORIZONTAL CONTROL NETWORK

NOAA Professional Paper 12 - A Priori Prediction of Roundoff Error Accumulation in the Solution of a Super-Large Geodetic Normal Equation System (1980) by Peter Meissl - This is a documented study on roundoff error prediction. The adjustment of the North American Horizontal Datum required the solution of a system of about 500,000 simultaneous linear equations. Because the roundoff errors occur and accumulate during the solution, the question arose as to whether the final results - the coordinate shifts of some 200,000 stations - could retain significance. By using a linear and statistical roundoff error model, Meissl was able to predict the numerical feasibility of the adjustment. GPO (003-017-00493-7) Price $5.00.

The following manuals and tables concerning plane coordinates are available:

Special Publications:

193. **Manual of Plane Coordinate Computation**—Describes the two basic types of conformal projections used as bases for the state systems of plane coordinates, with formulas and examples of computations for various applications to geodetic measurements—NTIS (COM-71-50368).

194. **Manual of Traverse Computations on the Lambert Grid** (1935)—Explains methods of computation with examples on the Lambert projection which has been used as the state plane coordinate projection for many states. Out of Stock, may be available in scientific libraries. (Superseded by Classification, Standards of Accuracy, and General Specification of Geodetic Surveys and Specifications to Support Classifications, Standards of Accuracy, and General Specifications of Geodetic Control Surveys).

195. **Manual of Traverse Computations on the Transverse Mercator Grid** (1935)—Explains methods of computation with examples on the Transverse Mercator which has been used as the state plane coordinate projection for many states. Out of Stock, may be available in scientific libraries. (Superseded by Classification, Standards of Accuracy, and General Specification of Geodetic Surveys and Specifications to Support Classifications, Standards of Accuracy, and General Specifications of Geodetic Control Surveys).

235. **The State Coordinate System (A Manual for Surveyors)**—Contains simplified instructions for the use of the state plane coordinate systems—NTIS (COM-71-50367).

246. **Sines, Cosines, and Tangents, Ten Decimal Places with Ten-Second Interval, 0° to 6°**—Tables for use in the computation, by calculating machine, of state plane coordinates on the Lambert projection—NTIS (COM-71-50369).

Numbered Publications:

62-4. **State Plane Coordinates by Automatic Data Processing**—Equations and constants for programming the computations of state plane coordinates by electronic computers. GPO Price: $1.15.

Serials:

562. **Plane Coordinate Systems** (1948)—Information leaflet regarding state plane coordinates. Rockville.

584. **Azimuths from Plane Coordinates** (1936)—Discussion and sample computations of the relations of geodetic and state plane azimuths. Rockville.

624. **Computation of Traverse by Plane Coordinates** (1940)—Rockville.

Technical Reports:

36. **Geodetic and Grid Angles - State Coordinate Systems** (1968) by Lansing G. Simmons—Describes relation of observed angles to state plane coordinate angles and a simple method for making corrections. Out of Print.

Preprints:

Fundamentals of the State Plane Coordinate System (1974)—Simplified basic instructions with samples of mathematical computations of traverse. Rockville.

The Alaska Coordinate System (1975)—Provides several methods of computations and inverses for Zones 2 through 9. Includes a sample computation of a traverse using plane coordinates and geographic positions. Rockville.

Understanding the Plane Coordinate System (1978)—Simplified basic instructions. Rockville..

VERTICAL CONTROL

The national vertical control or leveling network provides a rigid vertical framework for engineering, surveying, mapping, charting, and research. Manuals of instruction and explanation published for field observations and computations, and office adjustments, are listed below. Descriptions and lists of data will be found in the Geodetic Control Data section.

Special Publications:

* 226. **Control Leveling**—Describes, briefly, leveling, history of developments, observing instruments, adjustments and data. NTIS (COM-71-50373). (Superseded by NOAA Technical Report NOS 73 NGS 8).

* 239. **Manual of Geodetic Leveling**—Contains the general instructions and procedure for geodetic leveling as practiced by the National Ocean Survey. Revision and expansion of Part I, SP 140 Manual of First-Order Leveling—NTIS (COM-72-50049).

240. **Manual of Leveling Computation and Adjustment**—An office manual, describes in detail the methods of computing and adjusting first-order and second-order leveling. Revision and expansion of Part II, SP 140 Manual of First-Order Leveling—NTIS (COM-72-50181).

GEODETIC CONTROL DATA—Availability and Prices

General Information—NGS issues horizontal and vertical control data for National network surveys. An automatic mailing service of up-to-date data and diagrams is available.

The National network publications of geodetic control data are primarily represented by standard quadrangles of 30′ of latitude by 30′ of longitude. However, in congested areas, standard quads are 15′ of latitude by 15′ of longitude. In Alaska, because of sparity of control, quadrangle units are 1° of latitude by 1° of longitude. Data are available in these formats for 85% of the United States. The remaining 15% are in the old formats, i.e., State level lines, plane coordinate sheets, geodetic position sheets, description booklets, etc. Until the Old format data are converted to the standard quadrangle formats, vertical and horizontal control data in some areas will be available only by complete county coverage. Unadjusted data or recently adjusted projects in manuscript form are available upon request.

National network data or supplemental control data, established by or in cooperation with NGS, that have been adjusted to the North American 1927 Datum or the National Vertical Datum of 1929 are printed on white paper. Preliminary, unadjusted, or field data are printed on yellow paper.

Data from Surveys Performed by Other Organizations—When field observations are performed to NGS standards, and data are evaluated and adjusted by NGS, the results are included in the NGS National network publications. NGS also publishes and distributes supplementary data for control surveys by other organizations that have not been evaluated or adjusted by NGS.

Horizontal Control Data—Data may be requested by areas of latitude and longitudes, by counties, or for an entire State. Graphic control diagrams depicting locations of control are published at various scales. Horizontal data not yet converted to the quad format are printed in three parts: (1) latitudes, longitudes, geodetic azimuths, and distances, assembled by arc of triangulation; (2) State plane coordinates, available by State plane coordinate zones; and (3) descriptions of stations, assembled by triangulation arc or project areas, e.g., Defense Mapping Agency's domestic geodetic data.

Vertical Control Data—Data may be obtained by areas of latitudes and longitudes, by counties, or for an entire State. Graphic control diagrams depicting locations of control are published at various scales. Data not yet converted to the quad format, consisting of elevation lists and bench mark descriptions, are available and assembled by numbered level lines with the State.

Combined Horizontal and Vertical Data—Certain supplementary surveys by other Government agencies, listing both horizontal and vertical data, are combined on the same data sheets and are published and distributed by NGS. For simplicity, these data are listed and priced under Horizontal Data.

Unpublished Geodetic Data—Observations are adjusted and processed for publication in standard format as soon as practicable upon completion of a project. However, unavoidable delays may be caused in processing data for surveys that are incomplete. Information and available preliminary data for new projects, incomplete, or unadjusted projects are furnished upon request. Information regarding re-established triangulation stations (i.e., no. 2 marks, new azimuth) or resetting vertical stations is available.

Additional Data—As an additional service, NGS furnishes other related geodetic data, i.e., gravity values, astronomic positions, preliminary adjusted horizontal positions, horizontal and vertical control crustal movement data, UTM coordinate data, etc. Usually these data are available on magnetic tape and/or paper. New micropublishing techniques are being introduced in the form of computer generated microform.

Control Diagrams—Status maps on 1:5,000,000 scale of horizontal and vertical control networks are published annually. Separate triangulation and leveling diagrams by States show the National network control surveys and supplementary surveys.

A series of control diagrams for the 48 conterminous States is available on 1:250,000 scale topographic map bases covering primarily 1° of latitude by 2° of longitude. NOS and the U.S. Geological Survey with some participation by other Federal agencies compiled this information. These diagrams show the order of survey accuracy, locations and names of triangulation stations, and routes of traverse and level lines. When necessary, supplemental diagrams on large-scale maps and coastal charts are issued for clarity. An index map identifies the 1:250,000 geodetic control diagrams available for the 48 conterminous States and the triangulation diagrams available for Alaska, Hawaii, and Puerto Rico.

Contract and Fee Schedule—The automatic mailing service for geodetic control data enables users who maintain active files to automatically receive newly published data for a specific area. To facilitate an order, the desired area must be requested by complete quadrangle units.

A subscription may be obtained by completing NOAA Form 29-3, "Geodetic Control Data Automatic Mailing List Agreement."

Director, National Geodetic Information Center, OA/C18
National Ocean Survey, NOAA
Rockville, MD. 20852

Telephone orders are accepted: 301-443-8631.

GEODETIC CONTROL DATA—Availibility and Prices

The prices for initial data furnished through the automatic mailing service are the same as for individual orders. Revised or additional published data for the requested area will be automatically furnished thereafter for an annual subscriber charge based on the number of sheets mailed during the year (not to exceed $8.00). Handling and postage costs involved for each supplemental data shipment will be charged to the subscriber. It is necessary that a copy of each charge statement accompany payment to insure proper credit. In the event no data is mailed to the user, there will be no service charge.

Except as specified under the automatic mailing service contract a minimum charge of $2.00 will be made for all orders. Prepayment is required for all orders which exceed $50.00. The standard charges for geodetic control information are as follows:

1. Published quadrangle booklets-horizontal *or* vertical control
   - 1 to 20 sheets, per booklet ..... $2.00 each
   - 21 to 50 sheets, per booklet ..... $5.00 each
   - 51 or more sheets, per booklet ..... $8.00 each
2. Complete county coverage-horizontal *or* vertical control
   - Old format data not presently available in published quadrangle booklets ..... $4.00 each
3. Manuscript form-horizontal *or* vertical control
   - Unadjusted field project data or recently adjusted projects in process of being incorporated into quadrangle booklets.
   - 1 to 20 sheets, per project ..... $2.00 each
   - 21 to 50 sheets, per project ..... $5.00 each
   - 51 or more sheets, per project ..... $8.00 each
4. Geodetic diagrams (regardless of size or area covered) ..... $3.00 each

The above prices include postage. Any special handling or mailing request will require additional expense and will be so noted on your bill.

MISCELLANEOUS PUBLICATIONS:

Special Publications:

68. **Elements of Map Projection with Applications to Map and Chart Construction** (revised 1944) by Charles N. Deetz and Oscar S. Adams—Presents the theory of map projections, part I, and the practical construction of some of the most important projections, part II. GPO (003-002-00095-1) Price: $7.80.

71. **Relation Between Plane Rectangular Coordinates and Geographic Positions** (1938)—Explains method of logarithmic computation and provides tables for local coordinates on an azimuthal projection on a tangent plane. This projection is suitable for purely local use in which distances are not more than 20 or 25 miles from the origin. Out of Print, may be available in scientific libraries.

238. **Air-Line Distances Between Cities in the United States** (1961) by C. A. Whitten—Contains geographic positions of the intersection of two principal streets or some other central point in 392 cities on certified domestic air routes, plus 100 additional large cities. Accurate air-line distances computed by geodetic methods between the cities are listed. NTIS (PB-267 497).

251. **Conformal Projections in Geodesy and Cartography** (1952, Revised 1968) by Paul D. Thomas—Presents in detail the mathematical development of the formulae of source references for the Lambert conic, stereographic, Mercator, transverse Mercator, and oblique Mercator for the convenience of geodetic computers and cartographers—NTIS (PB-267 467).

334. **Geodetic Leveling Instruments**—Furnishes a description of the design and method of construction of the Geodtic Level and Level Rod extant at the time of its publication. Out of Print.

Monographs:

10-3. **The Prince William Sound, Alaska, Earthquake of 1964 and Aftershocks, Volume I**, Fergus J. Wood, Ed.—Operational phases of the Coast and Geodetic Program in Alaska. Includes geodetic observations and measurements. Out of Print.

10-3. **The Prince William Sound, Alaska, Earthquake of 1964 and Aftershocks, Volume III**, Parts A and B Louis E. Leipold, Ed.: Fergus J. Wood, Scientific Coordinator—Research studies and interpretive results of geodesy and photogrammetry. Contains analysis of the data resulting from horizontal, vertical and gravity measurements before, during and after the earthquake and resulting earth shocks. Out of Print.

ESSA Monograph 2 - **Mathematical Geodesy** (1969) by Martin Hotine—Out of Print.

Numbered Publications:

60-4. **Geodetic Operations in the United States and Other Areas through International Cooperation** (1967)—Covering the period January 1, 1963 through December, 1966, this is one of a series of similar reports covering geodetic activities of U.S. agencies. Out of Print.

Technical Bulletins:

27. **Survey of the Boundary between Arizona and California** (1965) by Lansing G. Simmons—Historical information, description of boundary and the markers with geodetic positions and state plane coordinates, determined by geodetic observations and aerial photogrammetric methods. Out of Print.

Unnumbered Publications:

First Marine Geodesy Symposium, Columbus, Ohio, September 28-30, 1966—The opinions, views, and conclusions expressed in the papers and panel discussions as presented in the six sessions dealing with the problems, technologies, and motivations of Marine Geodesy. Out of Print.

Geodetic Operations in the United States and in Other Areas Through International Cooperation (1971)—Covering the period January 1, 1967 to December 31, 1970. One of a series of similar reports, each covering geodetic activities of U.S. agencies. Out of Print.

NOAA Professional Paper:

7. **Three-Dimensional Triangulation with Satellites** (1974)—In the World Net Project, passive satellites were photographed against the star background from 45 globally distributed stations, and the resulting directions were combined to determine three-dimensional Cartesian coordinates for each—NTIS (COM-75-11241).

North American Datum (1971)—A report of a National Academy of Sciences - National Academy of Engineering Committee on the present North American horizontal datum and the need for a longe-range program for a new general adjustment to a modern new datum. Rockville.

Relationship Between Local Plane Coordinates and Geographic Positions—Explains the method of computation by Natural Functions. Rockville.

Report on Geodetic Measurements of Crustal Movement, 1906-71 (1973)—Reprints of Special Publications, scientific papers and reports, as well as copies of correspondence, memoranda, and previously unpublished reports, all of which relate to the work of the National Ocean Survey in the use of geodetic techniques for monitoring movement of the earth's crust. Out of Print.

Tables of Folded-Sine x/x Interpolation Coefficients (1966) by Leslie F. Bailey. Out of Print.

Technical Bulletins:

14. **Film Distortion Compensation for Photogrammetric Use** (1960) by G.C. Tewinkel—Out of Print.

20. **The Earth as Viewed from a Satellite** (1962) by E. Schmid—Out of Print.

Technical Reports:

40. **A Comparison of Methods of Computing Gravitational Potential Derivatives** (1970) by L.J. Gulick—NTIS (COM-71-00185).

42. **Computational Procedures for the Determination of a Simple Layer Model of the Geopotential from Doppler Observations** (1971) by B.U. Witte—NTIS (COM-71-50400).

43. **Phase Correction for Sun-Reflecting Spherical Satellite** (1971) by E. Schmid—NTIS (COM-72-50080).

44. **The Determination of Focal Mechanisms Using P- and S-Wave Data** (1971) by W.H. Dillinger, A.J. Pope, S.T. Harding—GPO Price: $ .95.

56. **Cholesky Factorization and Matrix Inversion** (1973) by E. Schmid—NTIS (COM-73-50486).

59. **Gravity Gradients at Satellite Altitudes** (1973) by B. Chovitz, J. Lucas, F. Morrison—NTIS (COM-74-50231).

60. **The Reduction of Photographic Plate Measurements for Satellite Triangulation** (1973) A. Bush—NTIS (COM-73-50749).

61. **Radiation Pressure on a Spheroid Satellite** (1974) by J.R. Lucas—NTIS (COM-74-51195).

62. **Earth's Gravity Field and Station Coordinates from Doppler Data, Satellite Triangulation and Gravity Anomalies** (1974) by K. Koch—NTIS (COM-74-50490).

63. **World Maps on the August Epicycloidal Conformal Projection** (1974) by E. Schmid—NTIS (COM-75-50052).

Technical Memorandum:

7. **Error Study for the Determination of the Center of Mass of the Earth from Pageos Observations** (1970) by K.R. Koch, H.H. Schmid—NTIS (PB-190 982).

9. **The Earth's Gravity Field Represented by a Simple Layer Potential From Doppler Tracking of Satellites** (1971) K. Koch, B.U. Witte—NTIS (COM-71-00668).

11. **Errors of Quadrature Connected with the Single Layer Model of the Geopotential** (1971) by K. Koch—NTIS (COM-72-10135).

NOAA GEODETIC PUBLICATIONS

Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. Federal Geodetic Control Committee, John O. Phillips (Chairman), Department of Commerce, NOAA, NOS, 1974, reprinted 1980. National specifications and tables show the closures required and tolerances permitted for first-, second-, and third-order geodetic control surveys. GPO (A single free copy may be obtained, upon request, from the National Geodetic Survey, OA/C18x2, NOS/NOAA, Rockville, Maryland 20852).

Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys. Federal Geodetic Control Committee, John O. Phillips (Chairman), Department of Commerce, NOAA, NOS, 1975, revised June 1980. This publication provides the rationale behind the original publication. **Classification, Standards of Accuracy . . .** cited above. GPO (A single free copy may be obtained upon request, from the National Geodetic Survey, OA/C18x2, NOS/NOAA, Rockville, Maryland 20852).

Proceedings of the Second International Symposium on Problems Related to the Redefinition of North American Geodetic Networks. Sponsored by U.S. Department of Commerce; Department of Energy, Mines, and Resources (Canada); and Danish Geodetic Institute; Arlington, Va., 1978. GPO (003-017-0426-1). Fifty-four papers present the progress of the new adjustment of the North American Datum at mid-point, including reports by participating nations, software descriptions, and theoretical considerations.

NOAA TECHNICAL MEMORANDUMS, NOS/NGS SUBSERIES

NOS NGS-1. **Use of Climatological and Meteorological Data in the Planning and Execution of National Geodetic Survey Field Operations.** Robert J. Leffler, December 1975—NTIS (PB-249 677). Availability, pertinence, uses, and procedures for using climatological and meteorological data are discussed as applicable to NGS field operations.

NOS NGS-2. **Final Report on Responses to Geodetic Data Questionnaire.** John F. Spencer, Jr., March 1976—NTIS (PB-254 641). Responses (20%) to a geodetic data questionnaire, mailed to 36,000 U.S. land surveyors, are analyzed for projecting future geodetic data needs.

NOS NGS-3. **Adjustment of Geodetic Field Data Using a Sequential Method.** Marvin C. Whiting and Allen J. Pope, March 1976—NTIS (PB-253 967). A sequential adjustment is adopted for use by NGS field parties.

NOS NGS-4. **Reducing the Profile of Sparse Symmetric Matrices.** Richard A. Snay, June 1976—NTIS (PB-258 476). An algorithm for improving the profile of a sparse symmetric matrix is introduced and tested against the widely used reverse Cuthill-McKee algorithm.

NOS NGS-5. **National Geodetic Survey Data: Availability, Explanation, and Application.** Joseph F. Dracup, Revised January 1979—NTIS (PB-80 118 615). The summary gives data and services available from NGS, accuracy of surveys, and uses of specific data.

NOS NGS-6. **Determination of North American Datum 1983 Coordinates of Map Corners.** T. Vincenty, October 1976—NTIS (PB-262 442). Predictions of changes in coordinates of map corners are detailed.

NOS NGS-7. **Recent Elevation Change in Southern California.** S. R. Holdahl, February 1977—NTIS (PB-265 940). Velocities of elevation change were determined from Southern Calif. leveling data for 1906-62 and 1959-76 epochs.

NOS NGS-8. **Establishment of Calibration Base Lines.** Joseph F. Dracup, Charles J. Fronczek, and Raymond W. Tomlinson, August 1977—NTIS (PB-277 130). Specifications are given for establishing calibration base lines.

NOS NGS-9. **National Geodetic Survey Publications on Surveying and Geodesy 1976.** September 1977—NTIS (PB-275 181). Compilation lists publications authored by NGS staff in 1976, source availability for out-of-print Coast and Geodetic Survey publications, and subscription information on Geodetic Control Data Automatic Mailing List.

NOS NGS-10. **Use of Calibration Base Lines.** Charles J. Fronczek, December 1977—NTIS (PB-279 574). Detailed explanation allows the user to evaluate electromagnetic distance measuring instruments.

NOS NGS-11. **Applicability of Array Algebra.** Richard A. Snay, February 1978—NTIS (PB-281 196). Conditions required for the transformation from matrix equations into computationally more efficient array equations are considered.

NOS NGS-12. **The TRAV-10 Horizontal Network Adjustment Program.** Charles R. Schwarz, April 1978—NTIS (PB-283 087). The design, objectives, and specifications of the horizontal control adjustment program are presented.

NOS NGS-13. **Application of Three-dimensional Geodesy to Adjustments of Horizontal Networks.** T. Vincenty and B. R. Bowring, June 1978—NTIS (PB-286 672). A method is given for adjusting measurements in three-dimensional space without reducing them to any computational surface.

NOS NGS-14. **Solvability Analysis of Geodetic Networks Using Logical Geometry.** Richard A. Snay, October 1978—NTIS (PB-291 286). No algorithm based solely on logical geometry has been found that can unerringly distinguish between solvable and unsolvable horizontal networks. For leveling networks such an algorithm is well known.

NOS NGS-15. **Goldstone Validation Survey-Phase 1.** William E. Carter and James E. Pettey, November 1978—NTIS (PB-292 310). Results are given for a space system validation study conducted at the Goldstone, Calif., Deep Space Communication Complex.

NOS NGS-16. **Determination of North American Datum 1983 Coordinates of Map Corners (Second Prediction).** T. Vincenty, April 1979—NTIS (PB-297 245). New predictions of changes in coordinates of map corners are given.

NOS NGS-17. **The HAVAGO Three-dimensional Adjustment Program.** T. Vincenty, May 1979—NTIS (PB-297 069). The HAVAGO computer program adjusts numerous kinds of geodetic observations for high precision special surveys and ordinary surveys.

NOS NGS-18. **Determination of Astronomic Positions for California-Nevada Boundary Monuments Near Lake Tahoe.** James E. Pettey, March 1979—NTIS (PB-301 264). Astronomic observations of the 120th meridian were made at the request of the Calif. State Lands Commission.

NOS NGS-19. **HOACOS: A Program for Adjusting Horizontal Networks in Three Dimensions.** T. Vincenty, July 1979—NTIS (PB-301 351). Horizontal networks are adjusted simply and efficiently in the height-controlled spatial system without reducing observations to the ellipsoid.

NOS NGS-20. **Geodetic Leveling and the Sea Level Slope Along the California Coast.** Emery I. Balazs and Bruce C. Douglas, September 1979—NTIS (PB80-120 611). Heights of four local mean sea levels for the 1941-59 epoch in California are determined and compared from five geodetic level lines observed (leveled) between 1968-78.

NOS NGS-21. **Haystack-Westford Survey.** W. E. Carter, C. J. Fronczek, and J. E. Pettey, September 1979—NTIS. A special purpose survey was conducted for VLBI test comparison.

NOS NGS-22. **Gravimetric Tidal Loading Computed from Integrated Green's Functions.** C. C. Goad, October 1979—NTIS (PB80-128 903). Tidal loading is computed using integrated Green's functions.

NOS NGS-23. **Use of Auxiliary Ellipsoids in Height-controlled Spactial Adjustments.** B. R. Bowring and T. Vincenty, November 1979—NTIS (PB80-155 104). Auxiliary ellipsoids are used in adjustments of networks in the height-controlled three-dimensional system for controlling heights and simplifying transformation of coordinates.

NOS NGS-24. **Determination of the Geopotential from Satellite-to-Satellite Tracking Data.** B. C. Douglas, C. C. Goad, and F. F. Morrison, January 1980—NTIS (PB80-161 086). The capability of determining the geopotential from satellite-to-satellite tracking is analyzed.

NOS NGS-25. **Revisions of the HOACOS Height-controlled Network Adjustment Program.** T. Vincenty, May 1980—NTIS (PB80-223 324).

NOS NGS-26. **Motorized Leveling at the National Geodetic Survey.** Heinz Poetzschke, October 1980—NTIS (PB81-127 995).

NOS NGS-27. **The Houston-Galveston and Texas Gulf Coast Vertical Control Surveys,** 1980—NTIS.

NOS NGS-28. **Storage of Satellite Altimeter Data,** 1980—NTIS.

NOS NGS-29. **Subroutine Package for Processing Large, Sparse, Least-Squares Problems,** 1981—NTIS.

NOAA TECHNICAL REPORTS, NOS/NGS SUBSERIES

NOS 65 NGS-1. **The Statistics of Residuals and the Detection of Outliers.** Allen J. Pope, May 1976—NTIS (PB-258 428). A criterion for rejection of bad geodetic data is derived on the basis of residuals from a simultaneous least-squares adjustment. Subroutine TAURE is included.

NOS 66 NGS-2. **Effect of Geoceiver Observations Upon the Classical Triangulation Network.** R. E. Moose and S. W. Henriksen, June 1976—NTIS (PB-260 921). The use of Geoceiver observations is investigated as a means of improving triangulation network adjustment results.

NOS 67 NGS-3. **Algorithms for Computing the Geopotential Using a Simple-layer Density Model.** Foster Morrison, March 1977—NTIS (PB-266 967). Several Algorithms are developed for computing with high accuracy the gravitational attraction of a simple-density layer at arbitrary altitudes. Computer program is included.

NOS 68 NGS-4. **Test Results of First-Order Class III Leveling.** Charles T. Whalen and Emery Balazs, November 1976—GPO (003-017-00393-1), NTIS (PB-265 421). Specifications for releveling the National vertical control net were tested and the results published.

NOS 70 NGS-5. **Selenocentric Geodetic Reference System.** Frederick J. Doyle, Atef A. Elassal, and James R. Lucas, February 1977—NTIS (PB-266 046). Reference system was established by simultaneous adjustment of 1,233 metric-camera photographs of the lunar surface from which 2,662 terrain points were positioned.

NOS 71 NGS-6. **Application of Digital Filtering to Satellite Geodesy.** C. C. Goad, May 1977—NTIS (PB-270 192). Variations in the orbit of GEOS-3 were analyzed for M_2 tidal harmonic coefficient values that perturb the orbits of artificial satellites and the Moon.

NOS 72 NGS-7. **Systems for the Determination of Polar Motion.** Soren W. Henriksen, May 1977—NTIS (PB-274 698). Methods for determining polar motion are described and their advantages and disadvantages compared.

NOS 73 NGS-8. **Control Leveling.** Charles T. Whalen, May 1978—GPO (003-017-00422-8), NTIS (PB-286 838). The history of the National network of geodetic control, from its origin in 1878, is presented in addition to the latest observational and computational procedures.

NOS 74 NGS-9. **Survey of the McDonald Observatory Radial Line Scheme by Relative Lateration Techniques.** William E. Carter and T. Vincenty, June 1978—NTIS (PB-287 427). Results of experimental application of the "ratio method" of electromagnetic distance measurements are given for high resolution crustal deformation studies in the vicinity of the McDonald Lunar Laser Ranging and Havard Radio Astronomy Stations.

NOS 75 NGS-10. **An Algorithm to Compute the Eigenvectors of a Symmetric Matrix.** E. Schmid, August 1978—NTIS (PB-287 923). Method describes computations for eigenvalues and eigenvectors of a symmetric matrix.

NOS 76 NGS-11. **The Application of Multiquadric Equations and Point Mass Anomaly Models to Crustal Movement Studies.** Rolland L. Hardy, November 1978—NTIS (PB-293 544). Multiquadric equations, both harmonic and nonharmonic, are suitable as geometric prediction functions for surface deformation and have potentiality for usage in analysis of subsurface mass redistribution associated with crustal movements.

NOS 79 NGS-12. **Optimization of Horizontal Control Networks by Nonlinear Programing.** Dennis G. Milbert, August 1979—NTIS (PB80-117 948). Several horizontal geodetic control networks are optimized at minimum cost while maintaining desired accuracy standards.

NOS 82 NGS-13. **Feasibility Study of the Conjugate Gradient Method for Solving Large Sparse Equation Sets.** Lothar Grundig, February 1980—NTIS (PB80-180 235). Method is suitable for constrained adjustments of triangulation networks but not for free adjustments.

NOS 83 NGS-14. **Tidal Corrections to Geodetic Quantities.** Peter Vanicek, February 1980—NTIS (PB-189 376). Corrections for tidal force are formulated and tidal aspects relating to geodesy are discussed.

NOS 84 NGS-15. **Application of Special Variance Estimators to Geodesy.** John D. Bossler and Robert H. Hanson, February 1980—NTIS (PB80-223 332). Special variance estimators, one involving the use of noninteger degrees of freedom, are analyzed and applied to least-square adjustments of geodetic control networks to determine their effectiveness.

NOS 85 NGS-16. **The Bruns Transformation and a Dual Setup of Geodetic Observational Equations.** Erik W. Grafarend, April 1980—NTIS (PB80-202 302). Geometric and physical observations are combined within a unified theoretical framework.

NOS 86 NGS-17. **On the Weight Estimation in Leveling.** Peter Vanicek and Erik W. Grafarend, May 1980—NTIS.

NOS 87 NGS-18. **Crustal Movement Investigation Tejon Ranch, California.** Richard Snay and Michael Cline, June 1980—NTIS.

NOS 88 NGS-19. **Horizontal Control.** Joseph Dracup—NTIS.

NOAA MANUALS, NOS/NGS SUBSERIES

NOS NGS-1. **Geodetic Bench Marks.** Lt. Richard P. Floyd, September 1978—GPO (003-017-00442-2), NTIS (PB-296 427). Reference guide provides specifications for highly stable bench marks, including chapters on installation procedures, vertical instability, and site selection considerations.

MARINE SURVEYS AND MAPS

The marine services of NOS are primarily available through the Office of Marine Surveys and Maps. The Office determines requirements for a national program of nautical charting; constructs and maintains nautical charts, coast pilots, and related marine products for the Nation; directs field programs for shore-based hydrographic survey units; conducts photogrammetric surveys for coastal mapping, seaward boundaries, and coastal evacuation maps; and conducts technological development and application programs to maintain efficiency in survey data acquisition and chart production.

The Strategic Role of Perigean Spring Tides in Nautical History and North American Coastal Flooding, 1635–1976 (1978) by Fergus J. Wood—Deals with the origin, nature, and impact of severe tidal flooding of lowland coastal regions resulting from the coincidence of astronomical and meteorological forces. GPO Price $10.75.

Color Aerial Stereograms of Selected Coastal Areas of the United States (1971) by Harland R. Cravat and Raymond Glaser—A general description of the NOS color aerial photography program, along with selected examples of color aerial stereograms of United States coastal regions. 93 pages, 13 illustrations, 36 index diagrams, 45 color aerial stereogram plates. Out of Print.

UNITED STATES COAST PILOTS

The NOS Coast Pilots are a series of nine nautical books covering a wide variety of information important to navigators of United States coastal and intercoastal waters. Most of this information cannot be shown graphically on the standard nautical charts, and is not readily available elsewhere. Information includes navigation regulations, outstanding landmarks, channel and anchorage peculiarities, dangers, weather, ice, freshets, routes, pilotage and port facilities. All Coast Pilots are revised annually except 8 and 9 which are revised every two years.

U.S. Coast Pilot 1—Atlantic Coast, Eastport to Cape Cod—Riverdale Price: $6.50.

U.S. Coast Pilot 2—Atlantic Coast, Cape Cod to Sandy Hook—Riverdale Price: $6.50.

U.S. Coast Pilot 3—Atlantic Coast, Sandy Hook to Cape Henry—Riverdale Price: $6.50.

U.S. Coast Pilot 4—Atlantic Coast, Cape Henry to Key West—Riverdale Price: $6.50.

U.S. Coast Pilot 5—Atlantic Coast, Gulf of Mexico, Puerto Rico, and Virgin Islands—Riverdale Price: $6.50.

U.S. Coast Pilot 6—Great Lakes: Lakes Ontario, Erie, Huron, Michigan, and Superior, and the St. Lawrence River (formerly Great Lakes Pilot)—Riverdale Price: $8.50

U.S. Coast Pilot 7—Pacific Coast and Hawaii—Riverdale Price: $6.50.

U.S. Coast Pilot 8—Alaska, Dixon Entrance to Cape Spencer—Riverdale Price: $6.50.

U.S. Coast Pilot 9—Pacific and Arctic Coasts, Alaska, Cape Spencer to Beaufort Sea (1964)—Riverdale Price: $6.50.

Distances Between United States Ports, Sixth Edition (1978)—Riverdale Price: $2.00.

BATHYMETRIC MAPS

In comparison to other NOS charting and mapping programs, bathymetric mapping is a fairly new program. During its 16-year existence, the program has produced nearly 200 bathymetric maps (various scales) covering both the coastal and offshore areas of the United States, including portions of Alaskan waters. No bathymetric maps of Hawaii, Great Lakes, or Puerto Rico areas have been produced as of the date of this publication.

Bathymetric maps (topographic maps of the sea floor) are produced through the use of detailed depth contours and full use of the survey data to vividly portray the size, shape, and distribution of underwater features. No other map or chart gives this descriptive picture of the ocean bottom terrain. The bathymetric map serves as the basic tool for performing scientific, engineering, marine geophysical and marine environment studies that are required in developing energy and marine resources, determining efforts of sediment flow of waste disposal, constructing drilling platforms, and preparing environmental impact statements prior to leasing offshore areas for oil and gas exploration. To identify the lease areas the 1:250,000 scale maps are overprinted with the Bureau of Land Management's Outer Continental Shelf (OCS) protection diagram data (lease block grids), except for Alaska and several maps along the west coast.

Included in the 200 maps is a new but unique series of maps entitled topographic/bathymetric maps or topo/bathy maps. These detailed multipurpose maps show both the NOS bathymetry and shoreline and the U.S. Geological Survey (USGS) land topographic

information. The topo/bathy maps are produced jointly by NOS and USGS to support the activities of land-use planners, conservationists, oceanographers, marine geologists, and others having an interest in the physical environment of the coastal zone, including the OCS. Three series of topo/bathy maps are being produced: 1:24,000 scale for in-depth studies of specific areas, 1:100,000 scale for areas studies, and 1:250,000 scale for large geographical studies. The 1:100,000 and 1:250,000 scale maps are overprinted with the Bureau of Land Management's lease block areas.

Geophysical maps are also a part of the bathymetric map series. Each consists of three sheets (a base bathymetric map, a magnetic map, and a gravity map), and where practical a sediment overprint (NOS 1308N-175). The bathymetric map, when combined with the other three maps, serves as a composite base for making geological-geophysical studies of the ocean's bottom crustal structure and its composition. There are two series of these maps: (1) 1:250,000 scale containing geophysical data for the Continental Shelf and slope, and (2) the SEAMAP series (1:1,000,000 scale) that cover geophysical data gathered in deep ocean areas and portions of the adjacent Continental Shelf and slope.

For more detailed information on the above bathymetric products, users should consult NOS **Map and Chart Catalog 5 – Bathymetric Maps and Special Purpose Charts** and the pamphlet **Date of Latest Editions**. Both of these publications can be obtained free of charge from the Distribution Division, OA/C44, National Ocean Survey, Riverdale, Maryland 20840. The bathymetric series should be purchased from the Distribution Division, because it is unlikely that your local chart agent will have them in stock.

FLORIDA COASTAL ZONE MAPS

This series of orthophoto maps at 1:10,000 scale provides data for the selection of baseline points to establish coastal boundaries including seaward boundaries, and boundaries between sovereign land and the uplands subject to private ownership for the State of Florida. These maps show tidal datum lines delineated from the tide-coordinated infrared photography, nonfloating aids to navigation, landmarks, and other significant features. These maps are produced by NOS in cooperation with the State of Florida, Department of Natural Resources.

MARINE BOUNDARY CHARTS

These nautical charts portray the territorial sea (3-mile limit) and contiguous zone (12-mile limit) and/or fishery conservation zone (200-mile limit) boundaries in the U.S. waters.

OFFSHORE MINERAL LEASING AREA MAPS

This series of nautical charts shows the offshore mineral leasing areas and blocks overprinted in red from data furnished by the Bureau of Land Management. These charts are not to be used for navigation or for official lease block information, but can be used as a reference when navigating in the offshore lease areas.

STORM EVACUATION MAPS

This series of maps is designed to show areas that would be inundated by various levels of hurricane-generated storm surges, and the best routes for evacuation inland. The maps are used by Federal, state, and local officials for hurricane-preparedness planning and are available to the general public.

MISCELLANEOUS PUBLICATIONS

Unnumbered Publications:

Hydrographic Manual, Fourth Edition (1976)—GPO Price: $14.00.

TECHNICAL BULLETINS—May be consulted in larger libraries:

1. **Aerotriangulation Adjustment of Instrument Data by Computational Methods** (1958) (Superseded by No. 23) by W.D. Harris —Out of Print.
4. **Radio Telemetry Applied to Survey Problems** (1959) by R.R Ross—Out of Print.
5. **Raydist on Georges Bank** (1959) by G.R. Fish—Out of Print.
7. **Pantograph Adjustments** (1959) by G.C. Tewinkel—Out of Print.
8. **Mathematical Basis of Analytical Aerotriangulation** (1959) (Superseded by No. 21) by G.C. Tewinkel—Out Of Print.
10. **Vertical Adjustment of Instrument Aerotriangulation by Computational Methods** (1959) (Superseded by No. 23) by W.B. Harris—Out of Print.
12. **Use of Artificial Satellites for Navigation for Oceanographic Surveys** (1960) by P.D. Thomas—Out of Print.
19. **Analytic Absolute Orientation in Photogrammetry** (1962) by G.C. Tewinkel—Out of Print.
21. **Analytic Aerotriangulation** (1962) (Corrected July 1963) by W.D. Harris, G.C. Tewinkel, C.A. Whitten—Out of Print.
23. **Aerotriangulation Strip Adjustment** (1964) by M. Keller, G.C. Tewinkel—Out of Print.

24. **Satellite Triangulation in the Coast and Geodetic Survey** (1965)—Out of Print.

25. **Aerotriangulation: Image Coordinate Refinement** (1965) by M. Keller, G.C. Tewinkel—Out of Print.

29. **Three-Photo Aerotriangulation** (1966) by M. Keller, G.C. Tewinkel—Out of Print.

TECHNICAL REPORTS:

32. **Space Resection in Photogrammetry** (1966) by M. Keller, G.C. Tewinkel—NTIS (PB-174 512).

34. **Aerotriangulation: Transformation of Surveying and Mapping Coordinates Systems** (1967) by M.J. Umbach—Out of Print.

35. **Block Analytic Aerotriangulation** (1967) by M. Keller, G.C. Tewinkel—Out of Print.

39. **An Advantageous, Alternative Parameterization of Rotations for Analytical Photogrammetry** (1970) by A. Pope—NTIS (COM-71-00077).

45. **Pacific SEAMAP 1961-70 Data for Area 15524-10** (1972) by J.J. Dowling, E.E. Chiburis, P. Dehlinger, M.J. Yellin—NTIS (COM-72-51029).

46. **Pacific SEAMAP 1961-70 Data for Area 15530-10** (1972) by JJ. Dowling, E.F. Chiburis, P. Dehlinger, J.J. Yellin—NTIS (COM-73-50145).

47. **Pacific SEAMAP 1961-70 Data for Area 15248-14** (1972) by J.J. Dowling, E.F. Chiburis, P. Dehlinger,M.J. Yellin—NTIS (COM-73-51030).

48. **Pacific SEAMAP 1961-70 Data for Area 16648-14** (1972) by J.J. Dowling, E.F. Chiburis, P. Dehlinger, M.J. Yellin—NTIS (COM-72-51028).

49. **Pacific SEAMAP 1961-70 Data for Areas 16530-10 and 17530-10** (1972)) by J.J. Dowling, E.F. Chiburis, P. Dehlinger, M.J. Yellin—NTIS (COM-73-50173).

50. **Pacific SEAMAP 1961-70 Data for Areas 16524-10 and 17524-10** (1972)) by J.J. Dowling, E.F. Chiburis, P. Dehlinger, M.J. Yellin—NTIS (COM-73-50172).

51. **Pacific SEAMAP 1961-70 Data for Areas 15636-12, 15642-12, 16836-12, and 16842-12** (1972) by J.J. Dowling, E.F. Chiburis, P. Dehlinger, M.J. Yellin—NTIS (COM-73-50280).

52. **Pacific SEAMAP 1961-70 Data Evaluation Summary** (1972) by P. Dehlinger, E.F. Chiburis, J.J. Dowling—NTIS (COM-73-50110).

53. **Grid Calibration by Coordinate Transfer** (1972) by L. Fritz—NTIS (COM-73-50240).

55. **A Mathematical Model for the Simulation of a Photogrammetric Camera Using Stellar Control** (1972) by C.C. Slama—NTIS (COM-73-50171).

57. **Complete Comparative Calibration** (1973) by L.W. Fritz—NTIS (COM-74-50229).

81. **Formulas for Positioning at Sea by Circular, Hyperbolic, and Astronomic Methods** (1980) by James Collins—NTIS (PB80-184757).

TECHNICAL MEMORANDUM:

10. **Evaluation of the Space Optic Monocomparator** (1971) by L.W. Fritz—NTIS (COM-71-00768).

NAUTICAL CHARTS

Nautical charts are published to serve the specific requirements of marine navigation. They illustrate the nature and form of the coast, depths of the water and character of the bottom, aids to navigation, channels landmarks, hazards to navigation, marine limits, electronic positioning lines, magnetic variations, port and harbor facilities, cultural details, and must be constantly maintained to assure safe marine navigation. Nautical charts vary in scale with the importance of the area, purpose for which designed, and the necessity for clearly illustrating dangers within the area.

New editions of nautical charts contain up-to-date information essential to safe navigation. New editions cancel former editions, and mariners are cautioned not to use obsolete charts.

Charts and related publications may be purchased from NOS authorized Sales Agents in many cities of the United States, and from the Distribution Division, OA/C44, National Ocean Survey, Riverdale, Maryland 20840, and are listed in the following:

NAUTICAL CHART CATALOGS

No. 1. **Atlantic and Gulf Coasts, including Puerto Rico and the Virgin Islands**

No. 2. **Pacific Coast, including Hawaii, Guam, and Samoa Islands**

No. 3. **Alaska, including the Aleutian Islands**

No. 4. **Great Lakes and Adjacent Waterways**

No. 5. **Map and Chart Catalog–Bathymetric Maps and Special Purpose Charts.**

The Nautical Chart Catalogs are available free of charge from the Distribution Division, OA/C44, or the authorized sales agents listed in the catalogs.

CLASSIFICATION OF CONVENTIONAL CHARTS

Harbor Charts—published at scale 1:50,000 or larger, depending upon the size and importance of the harbor and the number and types of existing dangers. Intended for navigation and anchorage in harbors and smaller waterways.

Coast Charts—scales from 1:50,000 to 1:150,000. Intended for coastwise navigation inside offshore reefs and shoals, when entering bays and harbors of considerable size, and for navigating certain inland waterways.

General Charts—scales from 1:50,000 to 1:600,000. Intended for navigation of vessels whose positions can be fixed by landmarks, lights, buoys, and characteristic soundings, but whose courses are well offshore.

Sailing Charts—published at scales smaller than 1:600,000. They are plotting charts for offshore sailing between distant coastal ports, and for approaching coasts from the open ocean.

DATES OF CHARTS

A new edition of a chart is published when revisions of importance to navigation are made to the prior edition. New editions supercede prior editions and printings. The number and date of the edition appears in the lower left corner, as follows:
5th Ed., Apr 1/75.

The current edition may be extended if a new printing is required, but no changes of importance to navigation have been made known through charting information sources. The date of this revised print appears to the right of the edition date:
5th Ed., Apr 1/75; Revised Oct 5/75. A revised printing does not make prior printings obsolete.

CLASSIFICATION OF SMALL-CRAFT CHARTS

Published in three formats, folded into convenient panels, and contain information for the small craft user.

I. Small-craft chart folios consist of three or four folded sheets printed front and back and packaged in a suitable cover.

II. Small-craft route charts (rivers and narrow waterways and Intracoastal Waterways) consist of a folded single sheet printed front and back and issued in a suitable cover.

III. Small-craft area charts are generally Conventional Charts with additional information for small-craft. A folded single sheet printed front and back and issued in a suitable cover.

DATES ON SMALL-CRAFT CHARTS

New editions of Small-Craft Charts are generally issued annually. The number and date of the edition appears at the lower left hand corner of each chart page.

RECREATIONAL-CRAFT CHARTS

A series of large-scale charts published in book form and containing detailed nautical information of certain harbors and confined localities of the Great Lakes.

CANOE CHARTS

A series of charts of the Minnesota-Ontario Border Lakes designed to suit the needs of small shallow draft vessels. Except for four charts, they do not show hydrography.

DATES OF RECREATIONAL-CRAFT AND CANOE CHARTS

A new edition of these charts is generally printed on a three year schedule. The number and date of the edition for both charts is printed on the lower left corner of each page.

IMPORTANCE OF UP-TO-DATE CHARTS

The date of a chart is of vital importance to the navigator. When charted information becomes obsolete, further use of the chart for navigation may be dangerous. Natural and artificial changes, many of them critical, are occurring constantly, and it is important that navigators obtain up-to-date charts at regular intervals, and hand correct their copies for changes published in the "Notice to Mariners."

Charts are revised at regular intervals. Users should consult the pamphlet **Dates of Latest Editions** for the dates of current chart editions. The pamphlet, published quarterly, is available free of charge from the Distribution Division, C44, National Ocean Survey, Riverdale, Maryland 20840.

The printed date on each chart reflects the most current navigational information available. Chart users should acquaint themselves with information published in notices to mariners subsequent to the date of the chart.

Notices to mariners are published to advise operators of vessels of marine information affecting the safety of navigation. The notices include changes in aids to navigation chartlets, depths, bridge and overhead cable clearances, reported dangers, and other useful marine information. They should be used routinely for updating the latest editions of nautical charts and related publications.

Local Notice to Mariners—issued by each Coast Guard District Commander for the waters under his jurisdiction and a prime source for updating NOS charts. These notices are usually printed weekly and may be obtained without cost by making application to the appropriate District Commander.

Notice to Mariners—published weekly by the Defense Mapping Agency Hydrographic/Topographic Center is prepared jointly with the National Ocean Survey and the Coast Guard. These notices contain selected items from the Local Notices to Mariners, and other reported marine information required by oceangoing vessels operating in both foreign and domestic waters, including the Great Lakes. Special items covering a variety of subjects and generally not discussed in the Coast Pilot or shown on nautical charts are published annually in Notice to Mariners. These items are important to the mariner and should be perused for future reference. The weekly notices may be obtained by operators of oceangoing-vessels, without cost, by making application to the Director Defense Mapping Agency Hydrographic/Topographic Center, Washington, D.C. 20390.

FIELD SURVEYS

Maps and charts are compiled and updated using planimetric, topographic and hydrographic surveys as a basis. Charts are a smaller scale than field survey sheets, and reflect selected compilation survey data. Critical and extreme features are shown, but for clarity purposes all data obtained on the survey cannot be shown on the charts or maps.

Copies of surveys and related documents are processed on request. Requisitions for such materials should be addressed as follows: Director, National Ocean Survey, NOAA, Rockville, Maryland 20852, Attn: Data Control Branch, OA/C353.

Indexes of topographic and hydrographic survey coverage showing data of survey, scale, and limits are available free of charge from the NOS at the above address.

AERONAUTICAL CHARTS

CHARTS AND MAPS

The National Ocean Survey publishes and maintains aeronautical charts and related publications designed for use in air navigation. These charts, in several series, depict the communication facilities, navigational aids, airport landing patterns, safe operating procedures, and air traffic rules as determined by the Federal Aviation Administration, which comprise the National Airspace System for use by navigators and pilots for air navigation, air traffic controllers, airports and airlines.

The aeronautical charts are primarily divided into two major series; Visual Charts and Instrument Charts. Sub-series of each are designed to satisfy the varied types of air flights dictated by the availability of electronic navigation facilities, as well as by the pilot's requirements.

Catalog of Aeronautical Charts and Related Publications—This catalog, published quarterly, contains descriptions, prices, and ordering information on each series of aeronautical charts published by the National Ocean Survey. Information on related publications of the Federal Aviation Administration and the Defense Mapping Aerospace Center (DMAAC), which may be of interest to the civil aviation community, are also briefly described. The catalog is free on request from the Distribution Division, C44, National Ocean Survey, Riverdale, Maryland 20804. Over-the-counter salesrooms are located at:

6501 Lafayette Avenue
Riverdale, Maryland 20804

WSC #1, Room 101
6001 Executive Blvd.
Rockville, Maryland 20852

439 West York Street
Norfolk, Virginia 23510

1801 Fairview Avenue East
Seattle, Washington 98102

632 Sixth Avenue
Room 405
Anchorage, Alaska 99501

VISUAL CHARTS

The several series of Visual Charts are designed for contact flying, under Visual Flight Rules (VFR), wherein the pilot depends on visual landmarks for his locations and direction. The topographic and cultural base charts are overprinted with pertinent aeronautical information.

VFR/IFR (Visual Flight Rules/Instrument Flight Rules) Planning Chart; Scale 1:2,333,232 (One inch=32 nautical miles—This chart is designed to fulfill the requirements of pre-flight planning for VFR and IFR operations. The chart is printed in two parts in such a manner that when assembled, it forms a composite VFR Planning Chart on one side and IFR Planning Chart on the other. Each half is 41½ by 56 inches. When joined, the size is 82 by 56 inches. Information on the VFR chart includes selected populated places, large bodies of water, major drainage, shaded relief, navigational facilities, airports, reserved airspace, and related data. For convenience, an index of Sectional Chart coverage is identified. The chart may be purchased flat or folded. Riverdale. Price: $4.75.

Flight Case Planning Chart; Scale One inch=60 nautical miles—This chart is designed for pre-flight and enroute flight planning purposes. Its size, 30 by 50 inches, and convenient fold, 5 by 10 inches, provides for ease of storage in a flight case with other navigational charts. It covers the 48 conterminous United States and includes airport, Navaids, major towns and drainage features, shaded relief, airways with mileages, special use airspace, index of Sectional and Low and High Altitude Enroute Charts, with the reverse side including a mileage table and city/aerodrome locations index. Riverdale. Price: $2.50.

World Aeronautical Charts (WAC); Scale 1:1,000,000 (One inch=13.7 nautical miles)—These charts provide a standard series of aeronautical charts covering the land areas of the world at a size and scale factor convenient for navigation by moderate speed aircraft. The National Ocean Survey publishes that part of the series covering the conterminous United States, Alaska, Mexico, Central America, Caribbean Area and Puerto Rico/Virgin Islands. Topographic information depicted includes cities and towns, principal roads, railroads, distinctive landmarks, drainage and relief. The latter is shown by spot elevations, contours and gradient tints. Aeronautical information includes visual and radio aids to navigation, aerodromes, airways, restricted areas, obstructions, and other pertinent data. The charts are printed on both sides of the paper with the north half on one, the south half on the other. Riverdale. Price: $2.00.

Sectional Aeronautical Charts; Scale 1:500,000 (One inch=6.86 nautical miles)—This series of charts, designed for visual navigation of slow/medium speed aircraft, covers the conterminous United States and Alaska. The charts are printed on both sides of the paper with the north on one half and the south on the other. The charts show large scale, 1:250,000 coverage of highly congested metropolitan areas as insets on the applicable charts. Topographic information depicted includes a judicious selection of visual check points for VFR flight, such as populated places, drainage, roads, railroads, and other distinctive landmarks. The elevation features of the earth's surface are shown by contours, spot elevations, a system of gradient tints and shaded relief. The latter is intended to provide an illusion of third dimension, which aids in the rapid visual interpretation of the terrain characteristics. The aeronautical information overprint, which is superimposed on and adjusted to the topographic data, includes visual and radio aids to navigation, aerodromes, controlled airspace, restricted areas, obstructions, and related data. Riverdale. Price: $2.00.

VFR Terminal Area Charts; Scale 1:250,000 (One inch=3.43 nautical miles)—This series provides large-scale charts of highly congested metropolitan areas. These charts are designed for visual navigation and are similar to the sectional charts, but are at a larger scale and provide more detail. Riverdale. Price: $1.80.

Local Chart; Scale 1:250,000 (One inch=3.43 nautical miles)—This series consists of one chart, Puerto Rico-Virgin Islands. It contains the same information as shown in the VFR Terminal Area Charts, with the reverse side including a planning chart of the Caribbean and Gulf of Mexico area, airport tabulation, search and rescue information, emergency procedures and a special use airspace tabulation. Riverdale. Price: $2.00.

VFR Helicopter Chart; Scale 1:145,827—This series consists of one chart, Los Angeles and Vicinity. The chart contains selected topographical information, with specified routes and associated data to satisfy the needs of helicopter air operations under VFR conditions. Riverdale. Price: $1.85.

INSTRUMENT CHARTS

The several series of Instrument Charts are designed to support the more sophisticated flights, cleared for Instrument Flight Rules (IFR), that are usually under the direction of the air traffic controllers. The various series show information relative to radio navigation supplemented by textual information. They include planning, departure, enroute, arrival, and approach charts which together depict the National Aviation System.

Aircraft Position Charts; Scale Varies, 1:5,000,000 to 1:6,750,000—This series provides charts suitable for plotting lines of position from celestial observation and electronic aids. They are designed for long-range flights usually over extensive water or desert areas. All enroute aeronautical data necessary for over-water flight is provided. This information varies with the area requirements and includes oceanic control areas, flight information regions, weather zones, normal positions of air-sea rescue vessels, and loran and consol data. Riverdale. Price: $3.75.

Enroute Low Altitude Charts (Radio Facility Charts)—The charts cover the conterminous United States, Alaska, and Hawaii. They provide aeronautical information for enroute navigation (IFR) in the low altitude stratum, up to but not including 18,000' MSL. Information includes the portrayal of L/MF and VHF airways; limits of controlled airspace; position, identification and frequencies of radio aids; selected aerodromes; minimum enroute and obstruction clearance altitudes; airway distances; reporting points; restricted areas and related data. The Area Chart, which is part of this series, furnished terminal data at a larger scale in congested areas. Charts are printed back-to-back. They are published on a 56-day cycle and are distributed to the user prior to the effective date of the airspace changes. Riverdale. Price: $1.50 per copy.

Enroute High Altitude Charts—The charts cover the conterminous United States and Alaska. They provide aeronautical information for enroute instrument navigation in the high-altitude stratum at and above 18,000' MSL. Information includes the portrayal of jet routes, identification, and frequencies of radio aids; selected aerodromes; distances; time zones; special-use airspace; radar jet advisory areas, and related information. Published on a 56-day cycle. Riverdale. Price: $1.50.

RNAV Enroute High Altitude Charts—The charts cover the conterminous United States. They provide aeronautical information for enroute instrument navigation in the high altitude stratum at and above 18,000' MSL and portray Area Navigation (RNAV) routes, RNAV waypoints, selected aerodromes, distances, time zones, special use airspace and related information. Riverdale. Price: $1.50 per chart.

Alaska Supplement; United States Government Flight Information Publication—This Supplement, in a bound book 5 by 10 inches, is a joint Civil/Military Flight Information Publication (FLIP), designed for use with the Enroute Charts, Area Charts, USAF TACAN charts covering Alaska and portions of southwest and northwest Canada, WAC and Sectional Aeronautical charts. It contains an Aerodrome/Facility Directory of all aerodromes shown on Enroute Charts and those requested by appropriate agencies, communications data, navigational facilities, radar data, and special notices and procedures applicable to the area of the charts. The bound book is published every 56 days, on the same schedule as the Enroute Charts. Riverdale. Price: $2.75.

Alaska Terminal Publication—This 5 by 10 inch bound book is a joint Civil/Military Flight Information Publication (FLIP), published to provide all the information required by pilots landing and departing civil and military airports in the state of Alaska under Instrument Flight Rules. It contains Instrument Approach Procedure Charts, Airfield Diagrams, Standard Instrument Departure Charts and Standard Terminal Arrival Charts, and related tabular data. Riverdale. Price: $2.25.

Pacific Chart Supplement—This supplement, in a bound book 5¼ by 10 inches, is published to provide pilots with all required data necessary to supplement the navigational information contained on aeronautical charts. This supplement contains flight data, special procedures, and other operational information, in composite form, covering the state of Hawaii and that area of the Pacific served by U.S. facilities. In addition, terminal instrument procedures of the area; i.e., Instrument Approach Procedure Charts, Standard Instrument Departure Charts, Standard Terminal Arrival Charts authorized for civil use and related tabular data, formerly published and distributed in a looseleaf format, are now included in the Pacific Chart Supplement. Airport data are tabulated by geographic location; i.e., Island groupings, Islands, City, etc. NAVAID and enroute communications information shown on Enroute Charts is duplicated in this publication to insure the availability of this data to pilots utilizing current visual flight charts. The bound book is published every 56 days, on the same schedule as the Enroute Charts. Riverdale. Price: $6.00.

Standard Instrument Departure (SID) Charts—These charts cover the conterminous United States in two bound books, East and West. The books, 5½ by 8½ inches, furnish pilots departure routing clearance in graphic and textual form. The SID charts are designed to expedite clearance delivery and to facilitate transition between take-off and enroute operations. The bound volumes are issued every 56 days. Riverdale. Price: eastern volume $1.85; western volume $2.00.

Airport Facility Directory (AFD)—This publication is designed primarily as a pilot's operational manual containing information relative to airports, seaplane bases, and heliports open to the public and information as to their associated city and state, runway characteristics, lighting and radio navigational aids. The AFD is available in seven 5- by 10- inch bound volumes, each covering a specific geographic region of the United States, Puerto Rico and the U.S. Virgin Islands. These bound volumes also contain Special Notices and procedures, preferred IFR routes, VOR receiver check points, and an aeronautical chart bulletin providing a tabulation of the major changes that have occurred since the last publication date of Sectional and Terminal Area Charts. Each volume is re-issued every 56 days. Riverdale. Price: $2.50 per volume.

Standard Terminal Arrival Charts (STAR's)—These charts cover the conterminous United States in one bound volume. The 5½ by 8½-inch book contains arrival routings in graphic and textual form to expedite and facilitate transitions from the enroute structure to the initial approach fix and is issued every 56 days. Riverdale. Price: $1.75.

Instrument Approach Procedure Charts (IAPC)—These charts cover the conterminous United States, Puerto Rico, and the U.S. Virgin Islands in 15 bound volumes. The 5½ by 8¼ inch books portray the aeronautical data which are required to execute instrument approaches to airports. Each chart contained in the books depicts the Instrument Approach Procedure, all related data, communications information, and airport diagram. Each procedure is designated for use with a specific electronic navigational aid such as omnidirectional ranges (VOR), instrument landing systems (ILS), and Area Navigation (RNAV). Selected airport taxi charts for several major airports are included and provide pilots detailed information for ground maneuvering of their aircraft. The bound volumes are issued every 56 days. Changes to procedures between publication dates are reflected in a single Change Notice (CN) volume. Changes are in the form of complete new charts. Riverdale. Price: full set (including CN) $25.00 or $4.00 per book for the first book and $2.00 for each additional book.

AUXILIARY CHARTS

Airport Obstruction Charts-Piston (OC)—These large-scale (1:12,000) charts of airports show runways and flight paths for landing and take-off, together with the positions and elevations of the objects which are potential hazards to these operations. The charts are used in determining the mazimum safe take-off and landing gross weight of civil piston-driven aircraft, in determining airport instrument approach and landing procedures, and to provide data for engineering plans relative to clearing of obstructions and improvement of airport facilities. Riverdale. Price: Conventional Chart or photo background $3.85.

3042 - **Chart of the World on Azimuthal Equidistant Projection Centered on New York City (in four colors); Scale 1:47,423,730**—Size 36 by 42 inches. The projection on which this chart is constructed enables the user to determine true distances and azimuths from the point upon which it is centered to any other point within the area of the chart. A straight line drawn from the center to another point shows the shortest route, distance, and places traversed enroute. Riverdale. Price: $2.70.

3074 - **Great Circle Chart of the Conterminous United States on the Gnomonic Projection, Showing the Principal Cities: Scale 1:5,094,000**—Size 31 by 43 inches. Riverdale. Price: $2.15.

PROJECTIONS

3062 - **Equatorial Gnomonic; Scale 1:50,000,000**—Size 12 by 22 inches. Riverdale. Price: $2.15.

3063 - **Polar Equatorial Gnomonic; Scale 1:50,000,000**— Size 21 by 22 inches. Riverdale. Price: $2.15.

3065 - **Equatorial Azimuthal Equidistant; Scale 1:52,670,165**—Size 32 by 32 inches. Riverdale. Price: $2.15.

3099 - **Aitoff's Equal Area Projection of the Sphere**—Size 17 by 42 inches. Riverdale. Price: $2.15.

OUTLINE MAPS

3060 - **Conterminous United States on Lambert Conformal Conic Projection; Scale 1:5,000,000**—Size 29 by 42 inches. Riverdale. Price: $2.15.

3068 - **Conterminous United States on Lambert Zenithal Equal Area Projection; Scale 1:7,500,000**—Size 22 by 28 inches. Riverdale. Price: $2.15.

3078 - **Conterminous United States on Lambert Conformal Conic Projection (in two parts); Scale 1:3,000,000**—Riverdale. Size 48 by 70 inches. Price: $2.70.

3084 - **Conterminous United States; Scale 1:17,800,000**—Size 9 by 13 inches. Riverdale. Price: $1.00.

3085 - **Conterminous United States Murdoch's Projection on Intersecting Cone; Scale 1:7,000,000**—Size 20 by 20 inches. Riverdale. Price: $2.15.

3090 - **World on Mercator Projection; Scale 1:38,000,000**—Size 35 by 47 inches. Riverdale. Price: $2.50.

MISCELLANEOUS

3060c - **Base Map of the Conterminous United States with Gradient Tints (two parts); Scale 1:3,000,000**—Size 36 by 47 inches. Riverdale. Price: $3.20.

3069 - **Base Map of Alaska on Lambert Conformal Conic Projection; Scale 1:5,000,000**—Size 29 by 45 inches. Riverdale. Price: $2.70.

3093 - **Outline Maps for Construction of a Model of the World; Scale 1:55,800,000**—Produces a "Lambert Globe" 9 inches in diameter. Size 22 by 30 inches. Riverdale. Price: $1.00.

Radar Video Maps (RVM)—One-eighth inch thick plates of varying sizes made specifically for and at the request of the Federal Aviation Administration. Prepared with specific information for requesting airports. Not a sale item.

GREAT LAKES

The National Ocean Survey conducts field surveys for new editions of nautical charts of the Great Lakes and Coast Pilot 6; processes data obtained from surveys and other sources; and maintains a network of water level gages throughout the Great Lakes.

GREAT LAKES CHARTS AND RELATED DATA

Catalog No. 4—Free upon request from the Distribution Division, OA/C44, National Ocean Survey, Riverdale, Maryland 20840, and authorized sales agents. Gives prices, sizes, scales, etc., of navigation and recreational charts of the Great Lakes and instruction on how to order. Also contains lists of other pertinent publications and names and addresses of authorized sales agents.

Nautical Charts—Available from the Distribution Division OA/C44, and authorized sales agents. Navigational and recreational charts of the Great lakes, connecting channels, Lake Champlain, the New York State Barge Canal System, and Minnesota-Ontario border lakes are published by the National Ocean Survey. New editions of most charts are prepared every three years. Depict hydrography of water area, limited typography of the adjacent shores and islands in order to show docks, structures and landmarks visible from the lakes and channels. Various scales are used to show features in sufficient detail for the different classes of charts. Included are:

General Lake Charts—small scale, suitable for open-lake navigation.
Coast, River and Sectional Charts—medium scale, greater detail for closer navigation.
Harbor Charts—large scale, show detail for restricted navigation in harbors or confined localities.
Recreational Charts—books of large-scale charts primarily designed for use in small boats. Include names and localities of features, rules of the road, distress and fog signals.
Training Charts 39 TR—coast chart of the west end of Lake Erie, reverse side Upper Mississippi River. Includes information on weather forecasts, chart symbols, datum and projection for training purposes in connection with public educational courses.

U.S. Coast Pilot 6 —Available from the Distribution Division (OA/C44), and authorized sales agents. Great Lakes: Lakes Ontario, Erie, Huron, Michigan, and Superior and St. Lawrence River - This publication covers a wide variety of information important to navigators of the Great Lakes' waters. Most of this information cannot be shown graphically on the standard nautical charts, and is not readily available elsewhere. Information includes navigation regulations, outstanding landmarks, channel and anchorage peculiarities, dangers, weather, routes, pilotage, and port facilities. Published annually. Price: $8.50

The following publications are available free, in limited quantities (a chart is made for larger orders), upon request from the National Ocean Survey but are not available from authorized sales agents:

Bench Mark Descriptions—Gives the name, when established, physical description and elevation of each bench mark. The marks are located at selected sites on the United States waters of the Great Lakes and are located in various harbors or other specified locations. Rockville, Attn: OA/C23.

International Great Lakes Datum—Contains a brief description in layman's language of why IGLD (1955) - the reference point to which levels of the Great Lakes are referred - was needed and how the datum was determined. Rockville, Attn: OA/C23.

WATER LEVEL INFORMATION

Hydrograph of Lake Levels—In graph form showing the monthly mean levels of the Great Lakes from 1860 and of Lake St. Clair from 1889 to date. Riverdale.

Daily Mean Elevations—Individual yearly tables, one for each of the 50 permanent Lake Survey Center gaging stations located throughout the Great Lakes. Periods vary for each gage, the earliest beginning 1870. Rockville, Attn: OA/C23.

Maximum and Minimum Elevations—Individual tables, one for each of the 50 permanent Great Lakes gages throughout the Great Lakes area. Illustrate the highest and lowest monthly mean, daily mean, and instantaneous levels recorded and the time of occurrence. Rockville, Attn: OA/C23.

Monthly and Annual Mean Elevations—Individual tables, one for each of the 50 permanent Great Lakes gages throughout the Great Lakes area. Riverdale.

Annual Summary of Water Temperatures—Individual tabulation by station, listing daily and monthly mean water temperature by year with current year updated on a monthly basis. Tabulation also shows station number, location and depth of sensor. GLERL.

RIVER DISCHARGES AND DIVERSIONS

Mean Daily Discharge in Cubic Feet per Second—Individual tables, one for the Niagara River from 1935 to date, and one for the St. Lawrence River from 1917 to date. Detroit District, Corps of Engineers, 477 Michigan Avenue, Detroit, Michigan 48226.

Monthly and Annual Flow for Outflow Rivers in Thousands of Cubic Feet per Second—Individual tables, one each for Niagara River from 1860 to data, St. Lawrence River from 1860 to date, Detroit River from 1936 to date, St. Clair River from 1957 to date, St. Marys River from 1860 to date, and a table showing the combined discharge of the St. Clair and Detroit Rivers from 1860 to 1956. Corps of Engineers, 477 Michigan Avenue, Detroit, Michigan 48226.

Monthly Mean Diversions in the Great Lakes System above Cornwall, Ontario—Individual tables, illustrating the monthly amounts of all diversions in the Great Lakes System above Cornwall, Ontario from 1952 to date; the Ogoki Diversion from 1943 to date; Long Lake Diversion from 1939 to date, the Chicago Drainage Canal from 1900 to date; the Welland Canal from 1860 to date. Rockville, Attn: OA/C23.

PRECIPITATION

Average Monthly and Annual Precipitation in Inches on the Basins of the Great Lakes—A table, illustrates long-term average, previous year and current year precipitation of each of the five lake basins and the entire Great Lakes Basin. Rockville, Attn: OA/C23.

Average Monthly and Annual Precipitation, Entire Great Lakes Basin (inches of precipitation)—Comprehensive table. Shows the precipitation for individual years from 1900 to date for the entire Great Lakes Basin. Rockville, Attn: OA/C23.

Average Precipitation in Inches on Lake Surface—Individual tables for each of the Great Lakes. Shows the monthly and annual precipitation covering the period 1882 to date. Rockville, Attn: OA/C23.

Average Precipitation in Inches on Land Surface of Drainage Basin—Individual tables for each of the Great Lakes. Shows the monthly and annual precipitation covering the period 1882 to date. Rockville, Attn: OA/C23.

Monthly and Annual Precipitation on Basins in the Great Lakes Systems—Individual tables for each of the Great Lakes. Shows the values in inches of the precipitation on the basins (combination of land and water) for a period 1900 to date. Rockville, Attn: OA/C23.

GENERAL INFORMATION ON THE GREAT LAKES

Data Sheet—Lists statistics on the land and water areas of the Great Lakes, volume of water in each lake, the lengths of shorelines (including islands), length of outflow rivers, significant lake stages, general hydrologic data, and comparative volumes. Rockville, Attn: OA/C5131.

Research Reports—Research was formerly carried out in several fields to better understand the natural environment and to forecast effects of man-made changes. Data and results of these studies are furnished by means of reports or on individual requests. The following publications are available from GLERL:

1. **Water motion**—covers waves, tides, surges, seiches, currents, and flows in the Great Lakes and associated channels. Studies are used to aid in lock and harbor designs, modification, and improvement; layout and maintenance of navigation channels; shoreline preservation and protection; and the maintenance and/or restoration of lake beaches.

2. **Water characteristics**—includes the systematic investigation of the physical and chemical characteristics of the Great Lakes water; short-term variations in both water quality and water properties, including factors causing variation; and the determining and monitoring of long-term trends. Results are used to forecast short-term changes and long-term trends in order to obtain optimum development and utilization of the lakes by industrial, municipal, and recreational interests; to adjust man-controlled outflow from upper lakes and inflow to lower lakes to improve the water characteristics of the lower lakes; to aid in improving forecasts of ice formation and decay in the lakes, and outline the ice-free stretches caused by warmer currents in the lakes; and to more efficiently locate, design, and maintain navigation channels and harbors.

3. **Water Quantity**—pertains to the factors which affect water supply to the lakes. The amount of precipitation lost by evaporation has a significant effect on available water in the lakes, on water quality, and on heat storage in the lakes. Studies are used to provide more accurate forecasts of water levels and outflows to benefit commercial and recreational navigation, hydro-power generation and shore protection.

4. **Ice and Snow**—related to ice and snow formation, accumulation, composition and decay; time and areal distribution; and structural features. Data are analyzed and corrected with physical and meteorological conditions. Results are used in improving forecasting and controlling the effects of ice and snow on lake and river navigation, water supplies, shorelines, shoreline structures and hydroelectric generation. Ice charts, the result of aerial observations, are furnished in limited quantity to the Coast Guard, the National Weather Service, and the Canadian Department of Transport (who reciprocally provide their charts). The charts are then incorporated into reports available to others.

MACHINE INTELLIGIBLE DATA DISSEMINATION

Water Level Data—Water level data are available for 57 water level gaging stations covering the Great Lakes and connecting channels in punched card form. Data consists of daily and monthly mean values, and the extreme elevations that occur each month and the time of their occurrence. Most records are available back to 1900, some as far back as 1860. Hourly instantaneous values are available on punched cards on a selective basis for major gage locations. Rockville, Attn: C3314.

Water Temperature Data—Water temperature data for fourteen permanent stations and four temporary stations on the Great Lakes are available in punch card, magnetic tape and disk pack form. Data consists of hourly or fifteen-minute water temperature readiness depending on station location. GLERL.

REPORTS AVAILABLE FROM GLERL (Free upon request)

RR Series

Field 1

RR 1-1. **Currents at Little Lake Harbor, Lake Superior** (January 1896) by James H. Saylor—Out of Print.

RR 1-2. **Winds, Wind Set-ups and Seiches on Lake Erie** (January 1959) by Ira A. Hund, Jr.—Reprinted without. change January 1968 Out of Print.

RR 1-3. **Currents at Harbor Beach, Michigan** (August 1968) by James H. Saylor—Out of Print.

RR 1-4. **Water Movement in Toledo Harbor, Ohio** (November 1969) by Gerald S. Miller—GLERL.

RR 1-5. **Correlating Subsurface Pressure Fluctuations with Surface Waves** (September 1970) by P.C. Liu—GLERL.

Field 2

RR 2-1. **Bottom Stability and Sedimentary Processes at Little Lake Harbor, Lake Superior** (August 1970) by J.H. Saylor and S.B. Upchurch—GLERL.

RR 2-2. **Sedimentation on the Bermuda Platform** (September 1970) by Sam B. Upchurch—Out of Print.

Field 5

RR 5-1. **Great Lakes Ice, Winter 1964-65** (December 1965) by R.E. Wilshaw and D.R. Rondy—Out of Print.

RR 5-2. **Great Lakes Snow Depth Probability Charts and Tables** (April 1967) by S.J. Bolsenga—Out of Print.

RR 5-3. **Total Atmospheric Water Vapor Aloft over the Great Lakes Basin** (April 1967) by S.J. Bolsenga—Out of Print.

RR 5-4. **Great Lakes Solar Altitude Charts and Tables** (September 1968) by S.J. Bolsenga—GLERL.

RR 5-5. **River Ice Jams, A Literature Survey** (June 1968) by S.J. Bolsenga—Out of Print.

RR 5-6. **Great Lakes Ice Atlas** (April 1969) by Donald R. Rondy—Out of Print.

RR 5-7. **A Literature Review of Dusting Technology in Deicing** (December 1969) by Bruce P. Cavan—GLERL.

RESEARCH AND ENGINEERING REPORTS AND MISCELLANEOUS REPORTS

MP Series

MP 65-1. **Compensation for Navigation Improvements in St. Clair-Detroit River System and Regulation of Lake Ontario and St. Lawrence River** (October 1965) by L.D. Kirshner and Frank A. Blust—Out of Print.

MP 66-1. **Modification of Nearshore Currents by Coastal Structures** (June 1966) by James H. Saylor—Out of Print.

MP 67-1. **Control of Great Lakes Water Levels** (September 1967) by B.G. DeCook and E. Megerian—Out of Print.

MP 67-.2 **Forecasting the Levels of the Great Lakes** (September 1967) by B.G. DeCook and E. Megerian—Out of Print.

MP 68-1. **Shifting Offshore Bars and Harbor Shoaling** (December 1967) by D.U. Duane and L. Bajorunas—GLERL.

MP 68-2. **Simulation of Great Lakes Basin Water Supplies** (February 1968) by E. Megerian and R.T. Pentland—GLERL.

MP 68-3. **Water Transparency in Lake Erie** (March 1968) by A.P. Pinsak—GLERL.

MP 68-4. **Lake Superior Ice Characteristics** (March 1968) by E.W. Marshall—GLERL.

MP 68-5. **Snow Depth Probability in the Great Lakes Basin** (March 1968) by S.J. Bolsenga—GLERL.

MP 68-6. **The Use of Geopotential Heights for Great Lakes Vertical Datum** (August 1968) by C.B Feldscher and R.M. Berry—Out of Print.

MP 68-7. **Effects of Diversions on the Great Lakes** (November 1968) by L.D. Kirshner—GLERL.

MP 68-8. **Regulation of Great Lakes Levels and Flows** (November 1968) by B.G. DeCooke—Out of Print.

MP 69-1. **Great Lakes Regulation** (March 1968) by B.G. DeCooke—Out of Print.

MP 69-2. **Spectral Analysis of Shallow Water Waves in Lake Michigan** (March 1968) by Paul C. Liu—GLERL.

MP 69-3. **Computer Program for Sediment Textural Analysis** (July 1969) by Sam B. Upchurch—GLERL.

MP 69-4. **Experimental Techniques for Levels of High Precision Using the Zeiss N12 Automatic Level** (July 1969) by R.M. Berry—Out of Print.

MP 69-5. **Currents at Toledo Harbor** (March 1968) by G.S. Miller—GLERL.

MP 69-6. **The Zeiss Apparatus for Crossing Water Spans in Precise Leveling** (October 1968) by R.M. Berry—Out of Print.

MP 70-1. **Color Velocity Method in Measuring Discharge** (June 1969) by I.M. Korkigian and T.E. Ottenbaker—GLERL.

MP 70-2. **Visual Wave Observations Along the Lake Michigan Shore** (June 1970) by P. Liu and J. Housley—Out of Print.

MP 70-3. **Some Features of Wind Waves in Lake Michigan** (September 1970) by P.V. Liu—GLERL.

MP 70-4. **Plane Coordinate Survey System for the Great Lakes Based on the Hotine Skew Orthomorphic Projection** (September 1970) by R.M. Berry and V. Bormanis—Out of Print.

RESEARCH REPORTS - BASIC DATA SERIES

BD 5-2. **Great Lakes Ice Cover, Winter 1965-66** (December 1966) by D.R. Rondy—Out of Print.

BD 5-3. **Great Lakes Ice Cover, Winter 1966-67** (November 1967) by D.R. Rondy—Out of Print.

BD 5-4. **Great Lakes Ice Cover, Winter 1967-68** (October 1968) by D.R. Rondy—Out of Print.

BD 5-5. **Great Lakes Ice Cover, Winter 1962-63, 1963-64** (June 1969) by D.R. Rondy—GLERL.

LAKE SURVEY BULLETINS

B 65-1. **Operation of Research Vessel SHENEHON,** by D.J. Leonard and R.N. Brown.
Hydrographic Survey of Lake Winnebago, by G.R. Ropes.
Construction and Use of the Arnhem Bed-Load Sampler, by D.J. Leonard and R.N. Brown—Out of Print.

B 66-1. **Determination of Flow Over Niagara Falls,** by L.T. Schutze.
Lake Survey Charts, by G.E. Ropes—Describes chart making procedures used by the Lake Survey Center in 1966.
Construction and Operation of South Manitou Island Research Station, by D.J. Leonard—Out of Print.

B 66-2. **Some Considerations on the Study of Gravity Waves in a Ripple Tank,** by Paul C. Liu.
Coordination of Basic Data for International Joint Commission Study of the Great Lakes, by G.T. Carlson.
Selected Progress Reports on Lake Survey Research and Engineering Studies, by G.T. Carlson—Out of Print.

B 68-1. **Corps of Engineers Great Lakes Research Continuous Since 1841,** by L.D. Kirshner.
Total Albedo of Great Lakes Ice, by S.J. Bolsenga.
Electronic Positioning in Hydrographic Surveys by Means of Decca Hi-Fix, by K.H. Fagg—Out of Print.

MISCELLANEOUS PUBLICATIONS

Great Lakes Water Levels, 1860-1975 (1977) Contains 180 pages of figures, a map and geographical index showing the over 50 permanent-gage network, and tabular records of monthly and annual average water surface elevations for each gage for the period of its existence, as well as tables showing summaries of average and extreme levels.—Riverdale Price: $2.50.

Great Lakes Water Levels-1970 (1972) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1971 (1973) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1972 (1973) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1973 (1974) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1974 (1975) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1975 (1976) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1976 (1977) Daily and monthly data—Riverdale Price: $2.50.

Great Lakes Water Levels-1977 (1978) Daily and monthly data—Riverdale Price: $2.50.

NOAA TECHNICAL MEMORANDA—NATIONAL OCEAN SURVEY—GREAT LAKES SUBSERIES

Memoranda listed below are available from the National Technical Information Service, Springfield, Virginia 22151. Order by accession number shown in parentheses at the end of each entry.

NOS LSCR-1. **Great Lakes Ice Atlas** (September 1971) by D.R. Rondy—COM 71-01052.

NOS LSCR-2. **Annotated Bibliography on Freshwater Ice** (September 1971)—COM 72-10151.

NOS LSCR-3. **Winter Climatology and Ice Characteristics: St. Marys River-Whitefish Bay Waterway** (September 1971) by A.J. Brasel—AD 733958.

NOS LSCR-4. **Lake Superior Beginning of Month Water Levels and Monthly Rates of Storage Changes** (February 1974) by F.H. Quinn and M.J. Todd—COM 74-11032AS.

NOS LSCD-1. **Great Lakes Ice Cover Winter 1968-69** (October 1971) by D.R. Rondy—COM-72-10197.

NOS LSCD-3. **Great Lakes Ice Cover Winter 1969-70** (March 1972) by D.R. Rondy—COM 72-10917.

NOS LSCD-4. **Great Lakes Ice Cover Winter 1970-71** (September 1972) by R.A. Assel—COM 73-11023.

NOS LSCD-5. **Directory and Project Forecasts the Great Lakes-1973** (April 1973) by Louis X. Barbalas COM-73-11637.

NOS LSCD-6. **Great Lakes Cover Winter 1971-72** (October 1972) by R.A. Assel—COM 73-11746/AS.

NOS LSCD-7. **Great Lakes Cover Winter 1972-73** (April 1974) by R.A. Assel—COM 74-11822/AS.

NON TECHNICAL PUBLICATIONS

Informational and educational brochures and pamphlets, offering a non technical understanding of some of the National Ocean Survey's services and products. All are available free of charge unless otherwise indicated, and can be obtained by writing the Director, National Ocean Survey, NOAA, 6001 Executive Boulevard, Rockville, Maryland 20852; Attn: Physical Science Services Branch, OA/C513.

HISTORICAL

History of Copperplate Engraving:-"Copperplate Engraving's Last Hurrah," by William A. Stanley (Reprinted from NOAA Magazine July 1974)—Describes the National Ocean Survey's reproduction program of 19th century nautical charts from the original copperplate engravings.

"A Capital Plan," by William A. Stanley (Reprinted from ESSA World, January 1969)—Describes the National Ocean Survey's restoration of the original map of Washington, D.C., designed by Pierre L'Enfant in 1791.

"The Wilkes Expedition," by Albert Stanley (Reprinted from NOAA Magazine, October 1971)—Describes the 19th century expedition to the Pacific Northwest, headed by Admiral Charles Wilkes, and the marine charts executed of its discoveries and explorations.

"Three Short Happy Months," by William A. Stanley (Reprinted from ESSA World, January 1968)—Describes the work produced by the American artist, James McNeill Whistler, while employed by the Coast and Geodetic Survey. Whistler produced two engravings available in lithographed form:

Plate 414A. Anacapa Island
Plate 414B. Sketches by Whistler
Price (set): $1.00.

"Lost Maps of the American Coast," by Fergus J. Wood (Reprinted from ESSA World, October 1969)—Describes the cartographic work and studies of Dr. Johann Georg Kohl in the mid 19th century, and the present effort to find and recompile his work.

"Hassler's Legacy," by Albert A. Stanley (Reprinted from NOAA Magazine, January 1976)—A brief description of the early history of the Survey.

"An American Philosopher," by William A. Stanley (Reprinted from NOAA Magazine, April 1978)—Discusses the life and work of Charles Sanders Peirce, noted American philosopher.

GENERAL

10-2. **The Coast and Geodetic Survey, Its Products and Services** (1966). Out of Print.

The Coast and Geodetic Survey 1807-1957, 150 Years of History, by A.J. Wraight and E.B. Roberts—A historical review of the works of the Coast and Geodetic Survey. Out of Print.

An Introduction to NOAA's National Ocean Survey—A booklet describing the organization, services and products of the National Ocean Survey.

Catalog of Early Nautical Charts—Originally prepared for the 1976 U.S. Bicentennial. A listing of lithographic reproductions of 19th century copperplate engravings.

America's Islands—Information on islands of the conterminous United States, Alaska, and Hawaii, including classification, location and size.

Possible Sources of Shipwreck Information—Indicates where information may be obtained on characteristics and locations of shipwrecks, also includes a publications reading list on various types of shipwreck information.

List of Frequently Used World, Historical, and U.S. Maps—Provides a complete list of projections, world, United States and historical maps available for purchase, as well as prices and ordering information.

List of Free and Inexpensive Educational Materials—Provides a list of free and inexpensive booklets, pamphlets, maps, charts and other educational items available from the National Ocean Survey.

Principal Rivers and Lakes of the World—Provides non-technical information on the rivers and lakes of the world, indicating location, size/length. Illustrated. Includes agency addresses for obtaining maps, charts and related publications.

First Technical Agency, NOS—A condensed history of the National Ocean Survey. Major events, significant achievements, and individual accomplishments are traced over 169 years of public service. Out of Print.

Magnetic Publications and Services—A list of NOAA Offices who furnish magnetic data.

National Ocean Survey Products and Information—A pamphlet which describes the various products available from the National Ocean Survey.

National Ocean Survey Abstracts—An annual compilation of abstracts of scientific and technical papers, reports, and oral presentations published and/or produced by NOS authors within the previous year.

National Ocean Survey Records for Litigation—Leaflet to assist persons seeking NOS records, publications, and supplementary information for court use when the Federal Government *does not* have a direct interest in the litigation.

National Ocean Survey Pacific Marine Center—Discusses organizational functions and services.

Great Lakes Data Sheet—Lists statistics on the land and water areas of the Great Lakes, volume of water in each lake, the lengths of shorelines (including islands), length of outflow rivers, significant lake stages, general hydrologic data, and comparative volumes.

The NOAA Story—Booklet describing the formation, organization and various components and services of the National Oceanic and Atmospheric Administration.

Monthly Report of Activities—A report, published monthly, covering the activities of the various components of the National Ocean Survey.

Annual Report to the Director of the National Ocean Survey—Describes the accomplishments and activities of the various components of the National Ocean Survey, published annually.

CARTOGRAPHY

A Guide to Books on Maps and Mapping—A list of sources of information on the art of map and chart compilation.

Map Projections for Modern Charting, by Albert Stanley—Describes the various types of map projections used in the production of aeronautical charts.

Example of a Nautical Chart—For classroom use. This example of a nautical chart illustrates the waterways of Flushing Bay, New York. Not intended for navigational use.

Publications for Safe Navigation—Provides a list of maps, charts and related publications, published by the National Ocean Survey, which help to insure navigational safety in U.S. coastal waters and the Great Lakes.

Aeronautical Charts as Base Maps—A list of sources and price information of selected aeronautical charts which may be used as base maps. (Information in these charts is compiled for air usage).

Obsolete Aeronautical Charts—Available for educational purposes. Not for navigational use.

Map of the United States Continental Shelf—Page size map illustrating the United States and adjacent continental shelf, including Alaska and Hawaii.

Coastline of the United States—Lists lengths of general coastline (in statute miles) and tidal shoreline (in statute miles) for each coastal state.

National Ocean Survey Cartobibliography—Civil War Collection—A cartobibliography of the Civil War maps in the historical map collection of the National Ocean Survey—GPO (003-017-00483-0) Price: $4.00.

GEODETIC DATA

Geographic Center of Washington, D.C.—Describes the layout of the Nation's Capitol, and its approximate geographic center.

Geographic Center of the United States—Indicates the geographic center of the conterminous United States, and of the United States after the admission of Alaska and Hawaii.

Geographic Center of Hawaii—Describes characteristics of the Hawaiian Islands, and indicates their approximate geographic center.

Meet Marvin Marker—An educational pamphlet describing the function and maintenance of geodetic station markers. Out of Print.

Geodetic Survey Mark Preservation—An informational leaflet describing survey operations in the United States, and the preservation of geodetic survey marks. This supersedes the Meet Marvin Marker pamphlet.

OCEANOGRAPHY

List of Institutions Offering Degrees in Oceanography—A list of Institutions, degrees offered, and courses of study leading to degrees in Oceanography.

Our Restless Tides (1974)—An educational booklet describing the origin, variations and prediction, and types of tides. Illustrated.

Tidal Currents—An educational pamphlet describing types of tidal currents. Illustrated, with table examples and list of references for additional information.

Principal Ocean Currents of the World—A page size map illustrating and naming the earth's principal ocean currents.

The Gulf Stream—An educational pamphlet giving the chronological history of the study of the Gulf Steam.

Oceanography in the National Ocean Survey—An educational pamphlet defining the study of Oceanography, and the work of the NOS in the field.

DISCOVERER OSS-02—an educational pamphlet offering a general description of facilities; characteristics and capabilities of the NOAA Ship DISCOVERER. Out of Print.

Mapping our New Sea Frontier—A dicussion of the NOS bathymetric mapping program.

PHOTOGRAMMETRY

Photogrammetry in the National Ocean Survey—An educational pamphlet describing the art, science and technique of obtaining reliable measurements from photographs, and the process as utilized by the National Ocean Survey.

Reproductions of Aerial Photographs—A brochure describing the types, prices, and ordering information for aerial photographs produced by the National Ocean Survey.

Requests for priced items must be addressed to the office indicated, accompanied by remittance made payable to the Department of Commerce, NOS.

MI 100. **Peirce's World Quincuncial** map, buff tint, water tint, boundaries, major cities. Size: 25 by 49½ inches Rockville (OA/C513) Price: $1.50.

MI 102. **Mercator Projection** map, buff tint. Size: 8 by 10½ inches. Rockville (OA/C513) Price: $ .50.

MI 103. **Miller's Modified Mercator Projection,** outline map, black and white, major cities. Size: 29 by 22½ inches. Rockville (OA/C513) Price: $1.50.

1210TR. **Training Chart (Narragansett Bay)** for use in classroom work; ideal in navigational symbolization. Riverdale Price: $1.00.

6151TR **Training Chart (Columbia River Entrance)** for use in classroom work; ideal in navigational symbolization. Riverdale Price: $1.00.

116-SC TR. **Small-Craft Training Chart** for use in classroom work; ideal in navigational symbolization. Riverdale Price: $1.00.

Chart No. 1. **Nautical Chart Symbols and Abbreviations** (revised July 1975)—Contains symbols and abbreviations which have been approved for use on nautical charts published by the United States of America. Riverdale Price: $1.65.

Chart No. 2. **So You Bought a Boat**—Practical Tips for the Mariner. Presents innovations and techniques to make the art of piloting and seamanship more enjoyable, more common, and safer. Not a substitute for standard texts. Riverdale Price: $1.10.

Visual Aeronautical Chart Symbols (July 1974)—Contains topographical and aeronautical symbols and abbreviations which have been approved for use on aeronautical charts. Riverdale Price: $1.60.

L'Enfant Plan of Washington, D.C. (1791)—L'Enfant Plan of the nation's capital, in color with descriptive text. Size: 30 by 48 inches. Riverdale Price: $2.15.

Ellicott Map of Washington, D.C. (1792)—Adopted by Congress as the final plan for the Federal City, black and white. Size: 23 by 30 inches. Riverdale Price: $2.15.

OCEANOGRAPHY

The Office of Oceanography collects and evaluates oceanographic, marine navigation, and water level data. The Office performs analyses of physical phenomena pertaining to the sea and Great Lakes, including tides, water levels, currents, the dynamic and physical properties of seawater, and shoreline and bottom configuration as they affect waves and current propagation and attenuation; and further conducts investigations in wave climatology, offshore water movement, marine environmental assessment and satellite oceanography. The Office has the responsibility for the establishment and operation of networks of tide stations and water level gages, and for the compilation of tide and current predictions for direct use in marine navigation, for the application in civil engineering, for the solution of environmental problems, and for the correlation and analysis in scientific research.

TIDE TABLES

Issued in advance, annually, include the predicted times and heights of high and low water for every day in the year for many of the more important harbors, and tidal differences and factors to obtain similar predictions elsewhere. Include other tables, including height of tide at any time, local civil time of sunrise and sunset, reduction of local civil time to standard time, moonrise and moonset, and astronomical data.

East Coast of North and South America, including Greenland.—Riverdale Price: $5.35.

West Coast of North and South America, including Hawaiian Islands.—Riverdale Price: $5.35.

Europe and West Coast of Africa, including Mediterranean Sea.—Riverdale Price: $5.35.

Central and Western Pacific Ocean and Indian Ocean.—Riverdale Price: $5.35.

TIDAL CURRENT TABLES

Issued in advance, annually, include the predicted times of slack water and the times and velocities of strength of current for each day of the year at a number of the more important waterways and factors to obtain similar predictions elsewhere. Includes other useful current information, including velocity of current at any time, duration of slack, coastal tidal currents, Gulf Stream, wind currents, combination of currents and current diagrams.

Atlantic Coast of North America—Riverdale Price: $5.35.

Pacific Coast of North America and Asia—Riverdale Price: $5.35.

TIDAL CURRENT CHARTS

Each publication consists of a set of 12 or 13 charts which depict, by means of arrows and figures, the direction and speed of the tidal current for each hour of the tidal cycle. The charts, which may be used for any year, present a comprehensive view of the tidal current movement in the respective waterways as a whole, and supply a means for readily determining the direction and velocity of the current at various localities, at any time, throughout the water areas covered. The New York Harbor and Narragansett Bay tidal current charts are to be used with the annual Tide Tables. The other charts require the annual Tidal Current Tables.

Boston Harbor, First Edition (1974)—Riverdale Price: $3.55.

Narragansett Bay, First Edition (reprint 1971)—Riverdale Price: $3.55.

Narragansett Bay to Nantucket Sound, Third Edition (1973)—Riverdale Price: $3.55.

Long Island Sound and Block Island Sound, Sixth Edition (1977)—Riverdale Price: $3.55.

New York Harbor, Seventh Edition (1956)—Riverdale Price: $3.55.

Delaware Bay and River, Second Edition (1960)—Riverdale Price: $3.55.

Upper Chesapeake Bay, Second Edition (1973)—Riverdale Price: $3.00.

Charleston Harbor, S.C., First Edition (1967)—Riverdale Price: $3.00.

San Francisco Bay, Sixth Edition (1973)—Riverdale Price: $3.00.

Puget Sound, Northern Part, Third Edition (1973)—Riverdale Price: $3.00.

Puget Sound, Southern Part, Third Edition (1973)—Riverdale Price: $3.00.

TIDAL BENCH MARKS

To provide permanent reference points for the observed heights of the tide and the tidal datum planes determined from them, a system of bench marks is established at each tide station. The description and elevations of these bench marks along our coast are compiled, published and available for distribution. Requests for such bench mark data should specify the coastal locality for which the information is desired.

TEMPERATURE AND DENSITY OF SEA WATER

Daily observations of sea water temperature and density are made at tide stations operated by the National Ocean Survey and at stations maintained cooperatively in this and other countries. This monthly and yearly means together with the yearly maximum and minimum of these observations are given in the following publications:

Numbered Publications:

31-1. **Surface Water Temperature and Density,** Atlantic Coast, North and South America, Third Edition (1968)—NTIS (COM-73-50757).

31-3. **Surface Water Temperature and Density,** Pacific Coast, North and South America and Pacific Ocean Islands, Third Edition (1970)—NTIS (COM-71-50027).

NOS Oceanographic Circulatory Survey Report No. 1, Tide and Current Observations From 1965 Through 1967 in Long Island Sound, Block Island Sound, and Tributaries (1978)—NTIS (PB-283 849).

NOS Oceanographic Circulatory Survey Report No. 2, Tampa Bay Circulatory Survey 1963 (1978)—NTIS (PB-299 163).

NOS Oceanographic Circulatory Survey Report No. 3, Puget Sound Approaches Circulatory Survey (1980)—NTIS (PB81-113 375).

MISCELLANEOUS PUBLICATIONS

Special Publications:

98. **Manual of Harmonic Analysis and Prediction of Tides** (1940)—NTIS (COM-72-50045).

298. **Sea Water Temperature and Density Reduction Tables** (1953)—GPO Price: $ .65.

Research Papers:

Deep Circulation, Central North Pacific Ocean: 1961, 1962, 1963 (1965)—GPO Price: $2.75.

Unnumbered Publications:

Tide and Current Glossary (1975)—revision of Special Publication 228—GPO Price: $ .75.

TECHNICAL BULLETINS:

3. **Recent Increases in Coastal Water Temperature and Sea Level - California to Alaska** (1958) by H.B. Stewart, Jr.; B.D. Zetler; C.B. Taylor—Out of Print.

6. **The Tsunami of March 9, 1957, as Recorded at Tide Stations** (1959) by G.G. Salsman—Out of Print.

16. **Erosion and Sedimentation - Eastern Chesapeake Bay at Choptank River** (1961) by G.F. Jordan—Out of Print.

18. **Submarine Physiography of the U.S. Continental Margins** (1962) by G.F. Jordan—Out of Print.

22. **Tidal Current Surveys by Photogrammetric Methods** (1963) by M. Keller—Out of Print.

26. **Instrumented Telemetering Deep Sea Buoys** (1965) by H.W. Straub, J.M. Arthaber, A.L. Copeland, D.T. Theodore—Out of Print.

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