CHAPTER 1

Introductory

Although much of the material in this part of the publication deals primarily with the surveys that were made during the formative period of the Coast Survey, it also covers the years to and including World War I and the years immediately following. It does not, except very generally, cover the echo-sounding surveys nor any of the hydrographic surveys executed by electronic methods. This also applies to topographic surveys utilizing photogrammetric methods. These modern surveys can be adequately interpreted for legal and engineering use by reference to existing manuals and other published material.

11. GENERAL ACCURACY OF THE EARLY SURVEYS

In evaluating the early surveys of the Bureau, certain factors regarding their specific accuracy should be given consideration. These will be described in subsequent chapters. In this chapter, some observations will be made relative to their general accuracy.

There is probably little doubt but that the earliest records of changes in our coastline that are on a large enough scale and in sufficient detail to justify their use for quantitative study are those made by the Coast Survey. These surveys were executed by competent and careful engineers and were practically all based on a geodetic network which minimized the possibility of large errors being introduced. They therefore represent the best evidence available of the condition of our coastline a hundred or more years ago, and the courts have repeatedly recognized their competency in this respect (*see* Part 3, 412).[1]

But this is not to impute infallibility to them, especially as to minute details. While remarkably few errors have crept into its work during the long history of the Survey, so much so that the work of the Bureau is known and respected

1. In *City of Oakland* v. *Wheeler*, 168 Pac. 23, 28 (1917), the competency of a hydrographic survey of the Coast Survey made in 1855 was objected to, but the Supreme Court of California said: "This map is a record of the United States Coast and Geodetic Survey, made in the performance of their duties by federal officers . . . . Whatever the rule may be elsewhere than in California, in this state these sections of the code cited [sections 1920 and 1926 of the Code of Civil Procedure] settle the competency of these maps and their character as prima facie evidence of the facts sought to be established by them."

throughout the world for its integrity and reliability, it must nevertheless be recognized that in any process involving human equations there is always present an element of possible error. However, the only consideration which would justify weight being given to such a possibility would be the production of concrete evidence, of approximately the same date, that showed a contrary condition.[2]

In appraising the surveys of the Bureau, particularly the early ones, and their general accuracy, several circumstances should be given consideration.

The first is the purpose for which the survey was made. In the Coast Survey, the primary purpose of making topographic and hydrographic surveys is to provide data for the construction of nautical charts. This purpose is reflected in the method and scale used. They are not the methods that the Bureau would use in the demarcation on the ground of waterfront boundaries based on tidal definition, but they are adequate for the purpose intended. In applying such surveys to other needs, such as the location of the high- or low-water line as of a given date, the limitations inherent in them should be properly appreciated.[3]

Other circumstances of a general nature that should be considered in evaluating surveys are the nature of the area surveyed and the date of the survey. In the early days of the Coast Survey, when so much surveying was to be done and there was pressure to get out charts of the country's uncharted shores, it was only natural that some of the relatively unimportant areas would be surveyed with what today would be considered no more than reconnaissance accuracy (*see* 121). To have surveyed every then unimportant creek or slough with the same degree of detail as was included in surveys of an important river or harbor area could not have been justified administratively or otherwise.[4] The date of a survey has a bearing on its general accuracy and may be

2. In the above case, the court also held that if "any inaccuracies existed in the maps themselves these experts [for the defendants who attacked the introduction of the Coast Survey maps], if qualified to do so, could have been permitted to point them out, and they were permitted to do exactly this; but they could not be permitted to give their general opinions as to the value of these maps for the purpose of defining boundaries, nor as to the weight to be given them as evidence." *Ibid.*

3. The Bureau has made occasional special-purpose surveys in which special methods were used and the surveys were made on scales large enough to serve the purposes intended. An example of this is the planimetric survey of the District of Columbia-Virginia boundary line in 1946–1948, made pursuant to an act of Congress, in which the mean high-water mark on the Virginia shore was tied horizontally to triangulation markers on shore and vertically to tidal bench marks. A more extensive special-purpose survey was made in 1957–1961, under a cooperative arrangement with the State of Louisiana and the U.S. Bureau of Land Management, to establish an accurate map location of the entire Louisiana low-water line for delineating the "coast line" under the Submerged Lands Act, from which the seaward boundary of the state could be determined. The mapping was accomplished by photogrammetric procedures in which the aerial photography was closely coordinated with an accurate tidal datum (*see* Volume One, Part 2, 17).

4. A case in point is the 1852 topographic survey (Register No. T–360) and the 1853 hydrographic survey (Register No. H–464) of San Antonio Creek, Calif. (the Oakland Estuary). These surveys were made shortly after the first officers of the Coast Survey went to the West Coast. Oakland in those days had not acquired the importance that it did later. The 1852 survey showed only one dock and about two

considered an offshoot of the nature of the area surveyed. In the early days of the Survey, land was in abundance and was cheap when measured by present values. The standard of survey work then, while high for its period, was not as high as it is today with practices and procedures fully standardized.[5] This latter fact accounted for the difference sometimes encountered in early surveys in the representation of detail on adjoining surveys executed by different topographers (*see* 43).

In summary, the degree of accuracy of the early surveys depends on many factors, among which are the purpose of the survey, the scale and date of the survey, the standards for survey work then in use, the relative importance of the area surveyed, and the ability and care which the individual surveyor brought to his task. The surveys and charts of the Bureau are highly technical documents. In their proper interpretation, particularly for purposes other than navigation, recourse must frequently be had to information that does not appear on the face of the survey or chart. Such interpretation can best be made by those familiar with the Bureau's historical development and with its field and office methods and procedures, and who have had an opportunity of comparing surveys executed at different periods along various sections of our coasts.

12. SURVEYS, MAPS, AND CHARTS

Many features and types of information are shown on the surveys, maps, and charts of the Bureau, the significance and import of which are not always apparent. In order that they may be of maximum value in the many specialized contexts that may arise, both legal and technical, they will be interpreted in the light of the various inquiries that have been received and dealt with over the years.

dozen buildings in the hinterland. The area was therefore relatively unimportant in the light of the need for surveys along the entire coast. This is reflected in the generality of the shoreline on the topographic survey and the absence of fixes for the sounding lines on the hydrographic survey. That these were considered in the nature of preliminary or reconnaissance surveys is evidenced also by the fact that 4 years later, with the growth of Oakland, new topographic (Register No. T–592) and hydrographic (Register No. H–573) surveys were made of the creek.

5. In more recent years, especially the years following the experimental period in aerial photogrammetry, the value of topographic surveys for engineering and other uses has been given greater recognition, and the instructions regarding the delineation of the high- and low-water lines have reflected this broader use. SWANSON, TOPOGRAPHIC MANUAL (Part II) 397–399, SPECIAL PUBLICATION No. 249, U.S. COAST AND GEODETIC SURVEY (1949). In modern hydrographic surveys, stricter attention is paid to the accurate location of inshore soundings by the requirement for recording a position fix at the beginning and ending of every line, when the sounding boat has attained sounding speed at the beginning of a line or is slowed down near the end of a line, and when the speed is changed appreciably. ADAMS, HYDROGRAPHIC MANUAL 213, SPECIAL PUBLICATION No. 143, U.S. COAST AND GEODETIC SURVEY (1942). *See also* JEFFERS, HYDROGRAPHIC MANUAL 10, PUBLICATION 20–2, U.S. COAST AND GEODETIC SURVEY (1960, 3d ed.).

References to surveys, maps, and charts are frequently made as though they are the same or similar types of documents. Technically they are distinctly different, and it is important to those having occasion to use them to understand these technical differences. Even in legal decisions a confusion in terminology is sometimes noted and reference is made to a "chart" when clearly a "survey" is meant, and vice versa. In this section, these terms will be defined and significant features emphasized. They will be more fully considered in subsequent chapters on interpretation.

A *survey,* as used in this publication, can be of two kinds—topographic or hydrographic. A topographic survey is the actual, original, field survey made with the planetable (*see* 124); a hydrographic survey is an original office plotting of the recorded sounding data taken during the field survey using the boat sheet as a guide (*see* 125). In either case, it is the result of the field operation. Original surveys are sometimes also referred to as topographic sheets and hydrographic sheets.

A *map* is a printed reproduction of a compilation resulting from one or more topographic surveys drawn to the scale of the original survey or smaller and on a definite projection. While a map may include some water area, basically it furnishes information relative to the land area.

A *chart* (nautical) is a printed reproduction of a compilation resulting from topographic and hydrographic surveys of the Bureau and from other sources (*see* 127).[6] In the early history of the Survey, the term "chart" was used where the water formed a considerable part of the whole, whereas if the land formed the dominant part it was classed as a "map."[7] Today the distinction between charts and maps is based on use rather than on the relation of land to water area, the major difference being that a chart is constructed for use in navigation.

121. Reconnaissance and Preliminary Surveys

A reconnaissance survey is a hasty, preliminary survey of a region made to provide advance information regarding the area, which may be useful pending the execution of more complete surveys. Such a survey is made in a rapid manner, usually covers an extensive area on a comparatively small scale, and may or may not be controlled by triangulation. The resulting survey is fre-

6. Aeronautical charts are not dealt with in this publication because the smallness of scale precludes their use for shoreline studies, or for the determination of shore boundaries except in a very general way.

7. Based on letter of Mar. 17, 1856, from Superintendent A. D. Bache to W. R. Palmer, Assistant in Charge of Coast Survey Office, relative to the classification of surveys, maps, and charts. The 1845 edition of New-York Bay and Harbor and the Environs (corresponding approximately to present chart 1215) was labeled "Map."

quently no more than a sketch of the area, and if soundings are made they sparsely cover the area and give only the most general idea of hydrographic conditions.[8] Such surveys are usually appropriately identified on the face of the survey. Hydrographic survey Register No. H–289 (1851) is a "Reconnaissance of West Coast" and covers the area from San Francisco to San Diego at a scale of 1:380,000.

A topographic reconnaissance was defined by the Bureau in 1865 as one where "there is any deviation from the closest attainable accuracy in a finished plane-table sheet" or where "the rudest sketch of a country in which the features are delineated in rough approximation, which for certain temporary purposes is all that is needed." [9]

A reconnaissance survey was the lowest order of surveys and could only furnish a "reconnaissance chart" (*see* 122) or a "sketch" (*see* 123). A preliminary survey was of higher order than reconnaissance, but did not have the detail of a complete survey. It could be the basis for a "sketch" or a "preliminary chart" (*see* 123), but not for a complete map or chart.[10]

122. Reconnaissance Charts

Reconnaissance charts are charts based upon reconnaissance surveys (*see* 121). Such charts were published in the early years for exploratory purposes and as a preliminary to the making of detailed surveys. A noteworthy example is the 1853 chart entitled, "Reconnaissance of the Western Coast of the United States," and covers the coastline from San Diego to San Francisco at a scale of 1: 1,200,000.

123. Sketches and Preliminary Charts

The publication of "sketches" and "preliminary charts" was inaugurated in 1845 in order to make available to the navigator the results of the surveys as soon as possible after they were made.[11] They were marked "sketches" when only a very limited area was included; otherwise they were labeled "charts."

8. Adams (1942), *op. cit. supra* note 5, at 309.

9. Annual Report, U.S. Coast Survey 229 (1865). The Topographical Conference of 1892 defined it as "a determination of the topographical features of a region or locality that, if plotted, would represent on a map only a partial development of the salient features of the region." Annual Report, U.S. Coast and Geodetic Survey 577 (1891).

10. Letter (1856), *supra* note 7. Reconnaissance and preliminary surveys usually contained topography and hydrography and were registered as hydrographic surveys. *See* Registers Nos. H–289 (1851) and H–502 (1855).

11. Annual Report, U.S. Coast Survey 3 (1845).

This practice, however, was not consistent and the terms sketches and charts appear to have been used interchangeably.[12]

Sketches were based upon reconnaissance or upon regular surveys, and presented the details of the hydrography with generally a true outline of the shore. For the most part, they were engraved by the apprentices in the Survey and served as subjects for practice.[13]

"Preliminary charts" were drawn and engraved as each season's work was submitted by the hydrographic parties. A clue to the distinction between the "preliminary" chart and the "finished" chart is contained in the chart catalog of 1863 where it is stated: "The preliminary charts are those which are issued as soon after the several surveys as is consistent with accuracy of general delineation; and are designed to supply the immediate and pressing demands of navigation. The finished charts embody *all* the information furnished by the survey, including the minutest details; and embrace not only the hydrography, but the topography likewise. The two classes of charts differ in regard to the *amount* of the information which they furnish; but not in regard to the correctness of that which is given." The shoreline and soundings only were usually engraved on preliminary charts.[14]

During World War II, the classification "preliminary" was again introduced but the designation applied to those charts constructed from unverified hydrographic surveys.[15] This was made necessary by the large backlog of unverified surveys. This is still the practice in 1963.

124. Topographic Surveys

A topographic survey is a graphic representation by means of conventional symbols of the land features (natural and artificial), *as they existed on a given date,* of a portion of the earth's surface on a reduced scale. It may and may not show the ground relief. As used in this publication it is the *original field survey sheet* on which the topographic features are delineated. The topo-

12. *See* sketches included in Annual Report for 1851.

13. Originally, sketches of newly discovered dangers, small detached surveys, and reconnaissance surveys were gratuitously distributed to navigators, underwriters, and other interested parties. Annual Report, U.S. Coast Survey 16 (1849). By 1863, this distinction was not so finely drawn, and some sketches were listed in the chart catalog for that year on a sales basis. The catalog of 1880 was the last to use the classification "sketches."

14. Letter (1856), *supra* note 7. The classification "preliminary" was used in the chart catalog through 1900.

15. Edmonston, Nautical Chart Manual 12, U.S. Coast and Geodetic Survey (1956). Another classification occasionally used is "provisional." This applies to charts for which there is an urgent need and which are smooth-drafted for direct reproduction. Chart 6159 (1961 ed.) of the Columbia River is an example of such a chart. It is so labeled because the depths shown will change when a dam is built in the area. *Ibid.*

graphic survey is the authority for the high-water line and for all information inshore of that line, including the names of topographic features, as well as all alongshore features that the topographer was able to see, such as bare rocks and rocks awash.

Since this publication deals primarily with the early surveys of the Bureau, the topographic surveys here defined are those surveyed with the planetable (*see* 41). In this method, the topographer constructed his map as he surveyed. Delineating the high-water line, sketching the contours, locating the roads and other culture were accomplished in the field with the terrain in full view. All measurements were immediately applied to the survey sheet, thus *eliminating the necessity of retaining field notes* for later plotting in the office. This is an important characteristic of planetable surveying which is frequently overlooked.

1241. *Registry Numbers*

Topographic surveys and hydrographic surveys (*see* 125) are identified by *registry numbers* which are assigned to them when received in the Washington Office. "Register No. 52" would mean that 51 surveys were registered before it. It is customary in referring to surveys to annex the letter "T" to the registry number of a topographic survey and the letter "H" to a hydrographic survey, although these do not appear on the survey sheets. It is also customary in written matter to give the date of the survey in parentheses. Thus, "Register No. T–52 (1838)" would be a complete identification of the survey.[16] Separate but parallel systems of numbering are used for both classes of surveys. Generally, but not always, the chronology of execution of surveys would be indicated by the registry numbers. They have no geographic significance.

The more recent surveys carry the identification "Topographic Survey No. ——" or "Hydrographic Survey No. ——" in the title.

1242. *Descriptive Reports*

A *Descriptive Report,* as the name implies, is a written report to accompany each topographic and hydrographic survey and becomes part of the official record of the survey. It is prepared by the field engineer for the purpose of supplementing the survey with information that cannot be shown graphically thereon and to direct attention to important results. It outlines the conditions

16. The 1942 Hydrographic Manual required only the designation H–6381 (1939) as the complete identification of that survey. ADAMS (1942), *op. cit. supra* note 5, at 40. But that was for intra-Bureau use. For outside use in all correspondence with the Bureau it is better to give the complete identification of the survey. This is the form followed throughout this publication.

under which the survey was made and sometimes throws important light on the interpretation of a particular stretch of shoreline (*see* 4433).

Descriptive Reports were not a standard requirement in the Coast Survey until April 11, 1887, when instructions for their submission were first published,[17] but some reports are available for topographic surveys beginning with 1863 (Register No. T–979). Descriptive Reports carry the same identification numbers as the survey sheets.

1243. *"Bis" Sheets and Revision Surveys*

A number of the early topographic surveys that have become dilapidated through continued use have been redrawn in the Washington Office. These are identified by the word "bis" placed after the registry number. They are in every respect identical with the original. Inadvertently, the term has sometimes been used to designate a revision survey (*see,* for example, Registers Nos. T–441 (1851–53) and T–441*bis* (1873)), but strictly the designation should have been T–441*a*, the usual designation for such a survey (*see* Registers Nos. T–795 (1859) and T–795*a* (1909) and T–795*b* (1909)).[18]

1244. *"a" and "b" Sheets*

On some of the early topographic surveys, an "a" and "b" designation was used for adjoining contemporary surveys where one was in the nature of an extension of the other (*see* Registers Nos. T–1482*a* and T–1482*b* (1878)). This practice was later followed on aluminum-mounted sheets where both sides of the sheet were used (*see* Registers Nos. T–6532*a* and T–6532*b* (1936)).

1245. *Tracings of Surveys*

A number of the early topographic surveys have tracings filed with the original planetable sheets which show the topography in considerable detail. The reason for this is that in the instructions for hydrographic work the following requirement was included: "The shore-line should be obtained from the Office, or from the topographical party acting in the vicinity, and entered upon

17. INSTRUCTIONS AND MEMORANDA FOR DESCRIPTIVE REPORTS TO ACCOMPANY ORIGINAL SHEETS 3, U.S. COAST AND GEODETIC SURVEY (1887). The instructions state that "those points which come under the notice and observation of the officer charged with a particular survey and which are characteristic of the locality surveyed are to be reported on. On all such distinguishing features, especially all such as are likely to be useful and valuable in future years, *the fullest information should be sought for and given.*"

18. For present practice in the handling of revision surveys, *see* SWANSON (1949), *op. cit. supra* note 5, at 517–518.

the sounding-sheets. In some cases, the shore-parties furnish tracings; in others, lend their maps to be copied." [19] This also accounts for the fact that tracings do not always accompany the sheets. In some cases, a tracing was made to cover several adjoining topographic surveys, but the tracing was assigned the register number of only one of the surveys (*see,* for example, the tracing accompanying Register No. T–1552 (1884) which includes Registers Nos. T–1681 (1884–85), and T–1682 (1885)).[20]

During the early surveys on the West Coast, it was also the practice, as a safety measure (although not rigidly so), to make tracings of all the original survey sheets before they were forwarded to the Washington Office, in the event of possible loss in transit. Many of these tracings were retained in the San Francisco office of the Survey.

125. Hydrographic Surveys

As used in the Coast and Geodetic Survey, a hydrographic survey is a representation of the water area of a portion of the earth's surface by means of soundings (depths) taken at various locations throughout the area, and in sufficient numbers to enable the hydrographer to delineate on the survey sheet all underwater features of special significance to the navigator, such as channels, reefs, banks, shoals, rocks, and characteristic submarine features, *as they existed on a given date.* Where practical, the low-water line is also delineated. The hydrographic survey is the authority for all data below the plane of high water, including the names of hydrographic features.

A hydrographic survey differs from a topographic survey (planetable) in one essential respect. The topographer makes his map as he surveys, whereas the hydrographer records the information he obtains in a "sounding volume" and is later plotted in the office as a "smooth sheet" which becomes the official record of the survey (*see* 552).[21] The original sounding volumes are filed in the Bureau's archives or in the National Archives and Records Service and are available for nearly all of the early surveys.

The numbering of hydrographic surveys is discussed in 1241. It need only be added that all records pertaining to a particular survey—sounding

19. General Instructions for Hydrographic Work 48, U.S. Coast and Geodetic Survey (1883).

20. Blueprints of such tracings have often been interpreted by users of our surveys as representing a new survey, particularly if the date when the tracing was made differed from the date of the survey (*see,* for example, tracing accompanying Register No. T–591 (1856)).

21. A complete smooth sheet is a record of the soundings taken during the field survey together with other data necessary for a proper interpretation of the survey, such as depth curves, bottom characteristics, names of geographic features, and control stations. Adams (1942), *op. cit. supra* note 5, at 657.

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volumes, Descriptive Report, fathograms (on more recent surveys)—are identified by the same number.

1251. *"A" and "a" Sheets*

On some of the early hydrographic surveys, an "A" sheet was used to designate an extension of the original survey but made at a later date (*see* Registers Nos. H–790 (1861) and H–790*A* (1871)). Other treatments were to designate as an "a" sheet an extension of the original survey but which could not include everything because of the size of the sheet (*see* 1244). These were contemporary surveys (*see* Registers Nos. H–3297 (1911) and H–3297*a* (1911)). The modern practice is to avoid the use of "a" sheets and to assign a new number to each survey sheet.[22]

1252. *Field Examinations*

In 1934, a new file was begun in the Chart Division, titled "Field Examinations." This consists of reports furnished by the field parties of the Bureau of examinations of small details (hydrographic or topographic) for which control is available and which can be correlated with the charts. Such examinations were formerly filed as "Chart Letters." Each field examination is submitted on either a section of a chart or a section of a planimetric map of the area, and is assigned a consecutive number in the Washington Office, each calendar year beginning a new series. They are identified thus: F.E. No. 5 (1959), indicating the fifth field examination in 1959, and are indexed on the hydrographic and topographic indexes but are not registered as original survey sheets.[23]

126. Combination Hydrographic and Topographic Surveys

In addition to the combined reconnaissance and preliminary surveys noted in 121, surveys sometimes included both topography and hydrography (Registers Nos. H–1737 (1886) and H–1930 (1889)). These were relatively infrequent, and were made only pursuant to special instructions, or to serve some special purpose. Thus, Register No. T–2196 (1895), which is a large-scale (1:1,000) combination survey of Port Orchard, Wash., was made for the

22. *Id.* at 749.

23. Letter of Sept. 21, 1934, from Chief, Division of Charts to Chief, Section of Field Records, and Adams (1942), *op. cit. supra* note 5, at 57. The 1960 Hydrographic Manual provides that where the boat sheet (*see* 551) is clearly legible and soundings have been corrected to show true depths, the sheet may be cut or folded and filed, after verification and review, with the report of the examination in the "Field Examinations" file. Jeffers (1960), *op. cit. supra* note 5, at 228.

Navy Department to serve as a guide for laying out the grounds, locating residences and other buildings, and estimating the amount of dredging necessary for access to the dry dock.

127. Nautical Charts

A nautical chart is a printed reproduction, on a reduced scale, of some portion of the navigable part of the earth's surface. It is constructed primarily to serve the needs of the mariner, and shows the nature and form of the coast; the depths of the water and character of the sea bottom near it; the locations of reefs, shoals, and other dangers to navigation; the rise and fall of the tides; the locations of artificial aids to navigation; the direction and strength of sea currents; and the behavior of the earth's magnetism in areas which must be navigated.

Coast and Geodetic Survey charts are compiled primarily from the topographic and hydrographic surveys of the Bureau and from the best available data from various other sources. For example, information on aids to navigation is obtained from the U.S. Coast Guard (formerly such information was furnished by the Bureau of Lighthouses); controlling depths in dredged channels and depths in other areas where improvements are projected, and bridge and overhead cable clearances are obtained from the Corps of Engineers. In addition, charts frequently contain reported information, such as a shoal, a bank, an obstruction, etc., which, though possibly of doubtful accuracy, must be charted as a precautionary measure until such time as it can be disproved or verified. It is important to keep this in mind when using nautical charts for engineering and legal purposes. Compilation is a process of evaluation and selection from the material available to the cartographic engineer. Those features that are of little interest to the mariner are generalized or omitted if they interfere with, or obscure data of navigational value. By contrast, those features of greatest navigational importance are accentuated so as not to be overlooked.

The first published chart of the Coast Survey of which there is a present record is that of Bridgeport Harbor, Conn., and is dated 1835.[24] This chart was probably engraved commercially on contract, since no engravers had been employed at this time. Neither the plate nor a copy of the chart is available in the Bureau at the present time.[25]

24. Catalogues of Charts 1, U.S. Coast Survey (1843–53).

25. Adams, *Engraved Charts*, 10 Field Engineers Bulletin 93, U.S. Coast and Geodetic Survey (1936).

1271. *Numbering of Charts*

The nautical charts of the Coast Survey are identifiable by number or by title. This practice was established in late 1866 or early 1867,[26] but the present system of numbering charts according to geographic location and classification dates back to 1898.

A. PAST PRACTICE

When charts were first published they were not given individual exclusive numbers. When used as inserts in reports, *Coast Pilots,* or other publications they were numbered as illustrations or by reference numbers used in the text. These numbers were usually engraved on the copper plates. Charts were designated, listed, and sold by title.

In 1856, the first project for a complete series of contiguous charts was adopted. It was to cover the Atlantic and Gulf coasts on a scale of 1: 80,000.[27] This was known and referred to as Coast Charts Nos. 1 to 113. The plan was rearranged in 1866 so the numbers before and after that date do not agree. In 1867, when chart numbers were assigned, 100 was added to the Coast chart number to form the chart catalog number.[28]

The 1867 assignment of chart numbers was as follows:

Atlantic and Gulf Coasts. Sailing, General, and Preliminary coast charts—1 to 31; Coast charts—101 to 213; Harbor charts—300 to 528.

Pacific Coast. All classes of charts—601 to 657.

Gaps were left in the numbering to take care of future charts in the different groups. The new numbers were placed on the existing stock by hand stamp and later engraved on the plates as new printings were made, in many cases without other change. This could lead to the erroneous conclusion that the numbers were assigned at an earlier date than 1867.[29] As far as is known, a new chart was never assigned a number that was previously used.

26. Unpublished ledger entitled "Compilation of Nautical Charts and Miscellaneous Maps Assigned Permanent Identifying Numbers Published by United States Coast and Geodetic Survey Subsequent to 1866." This ledger is on file in the Nautical Chart Division of the Survey, and is referred to in the Nautical Chart Manual as "Catalog of Chart Numbers." EDMONSTON (1956), *op. cit. supra* note 15, at 15.

27. This series superseded the "Preliminary Coast Charts" series, some of which were begun and never finished. They were listed and often entitled "Seacoast Charts of the United States." *See* unpublished 1936 compilation in Nautical Chart Division of the Survey entitled "Catalog of All Charts Published Prior to 1867." This compilation gives the 1867 chart number and the comparable 1936 number.

28. *Ibid.* In the chart catalog of 1866, the charts were arranged in geographical order and then numbered consecutively as item numbers. These were often taken to be chart numbers and caused confusion. As a result, the present practice of assigning each chart a permanent identifying number was established and first published in the chart catalog of 1867.

29. The first Alaska charts were dated 1868 and were assigned numbers beginning with 700.

The first major change in the 1867 assignment of numbers was made in 1891 when the Pacific coast charts were numbered from 5000 and the Alaska charts from 8000. This is reflected in the chart catalog of 1892.

B. PRESENT PRACTICE

The present assignment of chart numbers, based on the Catalog of Nautical Charts (corrected to May 1963) and subsequent information, is as follows:

Atlantic and Gulf Coasts. Sailing charts—1000 series (begun in 1900) and chart 70; General charts—1100 series (begun in 1912) and charts 71, 77, 78, 1350, and 1351; Coast charts—1200 series (begun in 1911); Intracoastal Waterway charts—800 series (begun in 1936) (*see* 625(*e*));[30] Harbor charts—200 to 700 series; Small-Craft charts—100 to 199 series (begun in 1959), 600–SC to 699–SC series and any conventional chart adapted to small-craft use (begun in 1961); Special charts—3000 series.

Puerto Rico and Virgin Islands. All charts—900 series (begun in 1898).[31]

Pacific Coast. Sailing charts—5000 series (begun in 1892); General charts—Series ending in "02" beginning with 5202 (begun in 1912) and including charts 5101, 6300, and 6401; Coast charts—6300 and 6400 series; Harbor charts—generally in 5100 to 6400 series inclusive; Small-Craft charts—100–SC to 199–SC series (begun in 1959 along Atlantic coast), 600–SC to 699–SC series and any conventional chart adapted to small-craft use (begun in 1963).

Hawaiian Islands. Sailing charts—4000 and 4100 series (begun in 1898); all other charts—4100 series.

Alaska. No uniform pattern prevails. Generally, the charts eastward of Unimak Pass are in the 8000 series and those to the northward and westward in the 9000 series, except the General charts of the Aleutian and the Pribilof Islands which are in the 8000 series.

Whenever possible, consecutive numbers for adjacent charts of the same scale are used, such as the 1100 and 1200 series of the Atlantic and Gulf coasts. This is not, however, generally possible in the case of large-scale harbor charts where an established sequence of numbers is frequently interrupted by the

30. These superseded the 3200 series charts of the Atlantic Intracoastal Waterway which were first published in 1924.

31. This series was also used for the charts of the Canal Zone until September 1949 when their publication was transferred to the jurisdiction of the Hydrographic Office of the Navy Department. "Catalog of Chart Numbers," *supra* note 26.

cancellation or rearrangement of charts, or by the changing of scales necessitated by the development of ports and the consequent change in the mariner's needs.[32]

As to the use of previously assigned numbers for new charts, the present practice is to use such numbers if the charts have been canceled for 20 years or more.[33]

The use of the suffix "SC" with the chart number in all cases except the 100 series will designate a folded conventional chart with additional information for the use of small craft (*see* chart 246–SC of Boston Harbor). These charts do not replace the conventional charts. The 600 series includes charts in the small-craft category not published as conventional charts (*see* chart 690–SC of Lake Washington), and conventional charts not in the small-craft category. The 800 series with the designation "SC" replaces the corresponding conventional charts in that series.

1272. *Dates on Charts*

Users of nautical charts should not be misled by the several dates appearing on them. Since a chart is a compilation, the information on it may have been obtained at different times. One portion, comprising an unchangeable area, may be based on surveys made many years ago, while another portion, subject to natural or artificial changes, may reflect the results of recent surveys. Therefore, from the dates alone, no indication can be had as to when any particular information was applied to a chart. For this, recourse must be had to the "History Sheets" in the Bureau files (*see* 1275). Nevertheless, the user of charts should be familiar with the meaning and significance of chart dates. On the most recent charts, three such dates appear—The *correction date,* the *edition date,* and the *new print date.* At one time, dates were included in the Publication Note of the chart (*see* 1273) and in the Authority Note (*see* 1274).

(*a*) *Correction Date.*—The most important date on a chart, from the standpoint of the navigator, is the date as printed in the lower left-hand margin on

32. In numerical order, the plan of assignment of chart numbers in 1963 (including aeronautical charts and miscellaneous maps and charts) is as follows: 1 to 9—Symbols and Abbreviations, etc.; 10 to 99—Sailing and General charts, Atlantic and Gulf coasts; 100–SC to 199–SC—Small-Craft folios consisting of 3 or 4 folded sheets, for all coasts; 200 to 799—Harbor charts, Atlantic and Gulf coasts; 600–SC to 699–SC—Small-craft route charts for rivers and narrow waterways consisting of a single folded sheet, for all coasts; 800 to 899—Intracoastal Waterway charts; 900 to 999—Puerto Rico and Virgin Islands charts; 1000 to 1999—Sailing, General, and Coast charts; 2000 to 3999—Aeronautical charts and Miscellaneous Maps and Charts; 4000 to 4199—Hawaiian, Samoa, and Guam Islands charts; 4200 to 4999—Open (formerly for Philippine Islands charts); 5000 to 6999—Pacific coast charts; 7000 to 7999—Open; 8000 to 9999—Alaska charts.

33. EDMONSTON (1956), *op. cit. supra* note 15, at 15. This does not apply to the Intracoastal Waterway charts in the new folded format with limits changed and suffix letters added. Although they cancel one or more of the previous charts in the flat format, they retain the old numbers.

Intracoastal Waterway and Small-Craft charts, thus: Corr. thru NM 3—1/21/61; or as hand-stamped in the lower right-hand margin on standard charts, thus:

CORRECTED THROUGH
NOTICE TO MARINERS
NO. 28 JULY 12 '58
U.S.C. & G.S.
WASHINGTON, D.C.

This is referred to as *correction date* or *hand-correction date.* It gives the number and date of the *Notice to Mariners* through which the chart has been corrected by hand for changes in aids to navigation, newly discovered dangers, and important changes in channel depths.[34] For changes subsequent to the stamped date, the mariner must consult the *Notice to Mariners* in order to ensure that his chart reflects the latest condition in the area to be navigated. This tie-in of the correction date of the chart with the *Notice to Mariners* is the current form used and was adopted October 5, 1954.[35]

(*b*) *Edition Date.*—When a new chart is published, the month and year of first publication is printed in the center of the upper margin of the chart as the first edition date, thus: 1st Ed., June 1957. This note never changes and is carried in this location for the life of the chart. The note also appears in the lower left-hand margin of the chart with the day of the month, but only the last two digits

34. *Notice to Mariners* is a pamphlet issued weekly by the U.S. Naval Oceanographic Office (formerly Navy Hydrographic Office) and contains material affecting the safety of navigation, such as changes in aids to navigation and channel depths, newly discovered dangers, and the like, with which the mariner can bring his charts up to date. It is published jointly by the U.S. Coast Guard and the Oceanographic Office. The Coast Survey and the Corps of Engineers contribute material to this publication. In addition to keeping mariners advised of changes, it also announces new charts, new editions of charts, and new publications. Prior to 1869, the Bureau issued notices in the form of a press release. The first serially numbered notice was published on Jan. 14, 1875. Notices were issued on a monthly basis from that time to Jan. 1, 1908, when it was discontinued as a publication of the Survey and was, by direction of the Secretary of Commerce and Labor, consolidated with and made a part of the weekly *Notice to Mariners* issued by the Light-House Board. BURCHARD, LIST AND CATALOGUE OF THE PUBLICATIONS ISSUED BY THE U.S. COAST AND GEODETIC SURVEY 95 (1902), 21 (1908 Supplement). Under the Reorganization Plan, effective July 1, 1939, the Bureau of Lighthouses was transferred from the Department of Commerce and consolidated with and administered as part of the Coast Guard. The latter then assumed the responsibility, together with the Oceanographic Office, for preparing the *Notice to Mariners.* This is the arrangement in 1963. Changes and deficiencies in aids to navigation, and other information of navigational importance, are published in Local Notice to Mariners. These are issued at frequent intervals by the commander of the Coast Guard for the district in which the aids are located. All such information of a continuing nature is inserted in the weekly *Notice to Mariners.*

35. *New Format for Nautical Charts,* 6 JOURNAL, COAST AND GEODETIC SURVEY 151 (1955). Prior to this date, the correction note was printed in the lower right-hand margin and read as follows: "Lights, beacons, buoys, and dangers corrected for information received to the following date." It was followed by a hand-stamp giving the date of issue of the chart. This note was used in substantially the same form from about 1915 (*see* chart 369). Prior to this no such detailed information was included on the chart. Conventional Intracoastal Waterway charts carry the following caution note regarding hand corrections: "This chart has been corrected only to the print date shown in the lower left-hand corner. Corrections subsequent to this date should be made from the Weekly Notice to Mariners."

of the year are given, thus: 1st Ed., June 24/57.[36] In the case of folded charts, the date is shown thus: 1st Ed., corr. thru NM 45-Nov. 10, 1962.

A *new edition* of an existing chart is printed when corrections are so extensive or of such importance to navigation as to render all previous printings obsolete. It includes all chart corrections published in the *Notice to Mariners,* and all other corrections too extensive to be applied by hand and which are not ordinarily published in the *Notice to Mariners.* New editions are also issued when there is an accumulation of hand corrections of the order of 80 or more. A new edition does not necessarily indicate that the chart has been reconstructed, nor does the date necessarily have any reference to the dates of the surveys. The frequency of new editions varies with the chart.

When a new edition is printed, all dates in the lower left-hand margin of the chart are removed and the new edition note substituted, thus: 2nd Ed., June 3/58.

(*c*) *New Print Date.*—When changes or corrections of a relatively minor character are made to a chart, the new issue is known as a *new print.* Such prints do not render the previous printings of the current edition obsolete for use in navigation. The corrections are applied to the negatives and a new printing plate is made and the date (month, day, and year) of the new print is added to the right of the edition date in the lower left-hand corner of the chart, thus: 1st Ed., June 24/57; Revised 1/7/58. Additional revisions of the chart in the form of new prints cancel the previous revision dates and the latest new print date is substituted, thus: 1st Ed., June 24/57; Revised 12/10/58.[37]

Charts are sometimes reprinted for the sole purpose of replenishing stock, without any corrections being made. Such issue is an exact duplicate of the current issue and no changes in printing or publication dates are made. But if one letter or one sounding is changed, the issue is classed as a *new print* and a revision date is added in the lower left-hand corner.

In summary, the essential point to bear in mind with regard to dates on charts is that they represent the dates of publication and bear no relationship necessarily to the date when a particular area was surveyed or when certain

36. This practice of indicating the 1st edition of a chart became operative on Oct. 5, 1954. *Ibid.* Formerly, beginning with Apr. 10, 1945, the 1st edition note was located in the Publication Note (*see* 1273). Prior to this, the date of first publication, if shown at all, was usually placed in the title. (*See* Coast Chart No. 120, New York Bay and Harbor, Dec. 1885 ed., which gives the date of first publication as 1866.)

37. Prior to 1915, the only dates, other than dates in the Authority Note (*see* 1274), that appeared on the chart were the date of publication and the date of first publication, both of which appeared in the title. After this date, the practice of showing new print dates on the chart in the lower left-hand corner was begun (*see* chart 369). (This may not be a firm date as far as other charts are concerned.) All the print dates after a new edition was issued were left on the chart and were removed only when the next edition was issued. This practice continued generally until 1954 (*see* note 36 *supra*).

information was obtained. The fact that a new edition was issued does not mean that the entire area of the chart was revised. The necessity for the new edition may be due to revision surveys far removed from the area of interest. It is obviously impossible to cover the entire area of most charts in one progressive field survey. The data used in the original compilation are therefore of different dates, even before any amendments have been applied. In fact, two adjacent soundings may sometimes be from surveys years apart. If the precise date of origin of a particular section of a chart is required, the original data from which the chart was compiled must be consulted (*see* 1275).

1273. *Publication Note*

When a new chart is published, a *publication note* is added in the lower center margin, thus:

Compiled and printed at Washington, D.C. by
U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, Secretary
COAST AND GEODETIC SURVEY
H. Arnold Karo, Director

When space is insufficient for the five-line note, the names of the Secretary and the Director are omitted.

Formerly, the publication note included the month and year of publication,[38] and between 1945 and 1954 the date of the 1st edition of the chart was also included (*see* note 36 *supra*). The present form of publication note shown above dates from February 1959. Before that only the Bureau name and the name of the Director were included.

1274. *Authority Note*

Every chart now published contains an *authority note,* similar to the following, which gives the federal agencies that have contributed to the information used in the compilation:

AUTHORITIES

Hydrography and topography by the Coast and Geodetic Survey with additions and revisions from the Geological Survey, Naval Oceanographic Office, and Corps of Engineers.

38. This practice was followed since about 1915. Prior to that time the date of publication was given in the title of the chart.

When most of the information is from sources other than the Coast and Geodetic Survey, a note similar to the following is used:

AUTHORITIES

Surveys by the Coast and Geodetic Survey and Corps of Engineers.[39]

The present form of generalized note, excluding all reference to dates of surveys, is of comparatively recent origin, dating back to 1947.

A. EARLY PRACTICE

Authority notes have undergone many changes in both form and content. The Map of New York Bay and Harbor, published in 1845, gave detailed information relative to the dates of surveys of the shoreline and soundings in various parts of the map. For example, with regard to Sandy Hook the note states: "The shore line of Sandy Hook as established in 1844, is distinguished from that of 1836, by an exterior line, and the Soundings of the same date are marked thus 2, 4, 5, 40." For elaborateness, a high point was reached in 1883 in the note on chart 369, Bay and Harbor of New York (*see* fig. 24). It gave the dates and locations of the basic surveys and resurveys, including the names of the surveyors. The surveys were confined to triangulation, topography, and hydrography. (Later, the dates of magnetic and astronomical observations were added but without specifically limiting the applicable areas.)

B. INTERMEDIATE PRACTICE

Since 1883 there has been a gradual tendency toward simplification and generalization, climaxed in the form of note used in the 1924 edition of the same chart, thus:

AUTHORITIES

Surveys to 1920
Surveys by U.S. Engineers to 1924 and other sources

C. LATER PRACTICE

There was an obvious deficiency in the latter type of note because it gave the user of the chart no indication of the obsolescence or recency of the material

39. Edmonston (1956), *op. cit. supra* note 15, at 25.

AUTHORITIES

This chart is reduced from a survey made in 1855,'56 & '57 under the direction of A.D.BACHE Superintendent of the Coast Survey for the New York Harbor Commissioners, and refers to that period, but the channels and aids to navigation, the water fronts and railroad lines have been generally brought up to 1873

The **Triangulation**, *based upon the primary triangulation of the coast executed by F.R.Hassler Superintendent in 1837 & '38, was made partly by J.Ferguson Assistant in 1836, but mainly by E.Blunt Assistant between 1833 & '35 and subsequently between 1852 & '57.*

The **Topography** *of both shores of the Hudson and East Rivers except the cities of New York and Brooklyn was surveyed by H.L.Whiting Assist. aided by F.W.Dorr, C.Rockwell and J.Mechan in 1857 & '58; Staten Island by H.L.Whiting aided by F.W.Dorr in 1856 & '57; South-shore of Raritan Bay by A.M.Harrison Assist. in 1855 & '56; from Perth Amboy to Newark by F.W.Dorr Sub-Assist. in 1858; Long Island south and east of Brooklyn by S.A.Gilbert Assist. in 1855 & '56; the interior between Brooklyn, Flushing and Jamaica by F.W.Dorr Sub-Asst. in 1859 and H.L.Whiting Assist. in 1862. The Wharf front of the cities of New York and Brooklyn was surveyed by A.Boschke Assist. in 1857. The compilation of the interior of the cities of New York and Brooklyn, the resurvey of the shores of Newark Bay and Passaic River and of new wharves and docks are by F.H.Gerdes Asst.*

The **Hydrography** *of the approaches of the Lower and Upper Bays and of East River was surveyed by Lieut.Comdg. T.A.Craven U.S.N. Assistant in 1855; that of Hudson River and Staten Island passages by Lieut.Comdg. R.Wainwright U.S.N. Assistant in 1855; changes in the Sandy Hook and Swash Channels and on the Jersey Flats by H.Mitchell and F.F.Nes Assistants up to 1872; Newark Bay and Passaic River by F.H.Gerdes Assistant in 1872.*

Edition of 1883

This edition shows the resurvey of Coney Island, Rockaway Beach and the shores and Islands of Jamaica Bay by J.W.Donn, Assistant, in 1877 and '78. The Hydrography of Jamaica Bay by Lieut. W.Maynard U.S.N. Assistant, in 1877, and the resurvey of Rockaway Inlet and the channels between Sandy Hook and Coney Island by Lieut. Comdr. E.B.Thomas U.S.N. Assistant, in 1881 and 1882. Resurvey of Gedney's and the Swash Channel by Ensign J.M.Orchard, U.S.N. Assistant, in 1884. And important corrections from resurveys in 1885 and 1888, by Engineers U.S.A.

FIGURE 24.—Facsimile of *Authority Note* used on the nautical charts in 1883.

used. Nor was any distinction made between hydrography and topography. To remedy these defects, a note was designed in 1938 that combined terseness with utility of purpose. Its general form was as follows:

AUTHORITIES

Topography by the U.S.C. & G.S. in 1933 and 1934
Supplemented by topography by the U.S. Geological Survey in 1892

Hydrography by the U.S.C. & G.S. in 1934
Supplemented by surveys in dredged channels by the U.S. Engineers to 1937

This form of note was used on charts on which almost the entire area was surveyed recently and within a short period. This applied to almost all new charts of scale larger than 1:80,000 and to some of the latter scale.[40]

Inextensive corrections to the chart, however recent, were not reflected in the authority note, but changes in the latter were made dependent upon the extent to which the chart had been amended. If new surveys covered the main portion of the chart, their dates were included, otherwise they were given only under special circumstances, as where they completely covered the changeable area of the chart. Another change effected in this form of note was the specific inclusion of the name U.S.C. & G.S. In all previous forms this was omitted, but Coast Survey sources were assumed unless otherwise stated.

But even this form of note was inadequate because it gave only a general idea with regard to the dates of surveys on which the chart was based. To avoid possible misinterpretations, it was decided to eliminate all dates from the authority note and adopt the form shown at the beginning of this section. A contributing factor to adoption of the present form was the fact that very complete history records are now kept of each chart and it is a relatively simple matter to trace the authority for all the information found on a modern chart (*see* 1275).

1275. *History Sheets*

An important innovation in the preservation of chart records was the establishment in 1900 of a "history sheet" file.[41] On these sheets are preserved, in compact form, every detail and authority used on the charts together with the date when a correction was applied. Through this file the history of every chart can be traced should this become of consequence. This file is still maintained. The present form of record is known as a "History of Cartographic Work" and is more elaborate in scope than the early records, one reason being that there are now many more sources of information used in the compilation of a chart than was the case formerly.[42] Also the Bureau has become more

40. On charts of very small scale, it was almost impossible to adopt an all-inclusive authority note. The extent of the area covered by a single such chart necessitated the use of data extending over a considerable period of time and to attempt to classify such information on the chart would have resulted in a note so cumbersome as to be of little practical value. It was therefore customary in such cases to omit the note altogether, or to insert a generalized statement regarding sources.

41. Annual Report, U.S. Coast and Geodetic Survey 90 (1900).

42. EDMONSTON (1956), *op. cit. supra* note 15, at 28–30. Prior to 1900 and dating back to 1851, there was maintained a series of "Chart Correction Books" in which corrections to the various charts were entered.

C&GS 925
Rev. 2 62

HISTORY OF CARTOGRAPHIC WORK – NAUTICAL CHART DIVISION FILES

CHART 566
DRAWING #18
SHEET 1
PROJECT 50150

NC REC CORR FUTURE
DATE

TO REPRODUCTION
NC (NE) NP RP TO
DATE

XLITH Rec'd
LITH Ver
PRINT DATE

REMARKS (over)
Changed to NE-95 hand corr. - 12-12-62

APPLIED Part	APPLIED Full	Item	SOURCE OF INFORMATION File No	Date	Authority	Type of Information	LOCALITY	INFORMATION APPLIED
	✓	1	H-8522	1961	C&GS	Hydro	W. of Kent I.	Applied entire basic survey
	✓	2	H-8523WD	1961	C&GS	Hydro	W. of Kent I.	150 and 121 sndgs. carried forward
	✓	3	L-964	1962	C of E	Topo	Cedar Pt.	Added piers
	✓	4	L-362	1962	C of E	Clearance	Ches. Bay Bridge	Lowered vert. clear. (for construction gondola)
	✓	5	L-89	1962	C&GS	Landmark	Entire chart	No corr.
	✓	6	L-340	1962	C&GS	Landmark	Entire chart	Added "0 standpipe" at Round Bay and deleted "0 CLOCK" at Crystal Beach
	✓	7	L-1285	1961	C&GS	Misc.	Entire chart	3 ft. sounding added at chan. into Lake Ogleton. Added shoaling note on chan. into Spa Creek. Deleted cupola at Annapolis. Added foot bridge at Annapolis.
	✓	8	L-1217 BP-60369	1961 4-61	USN	Hydro	Annapolis	Revised soundings and depth curves (thru cht 385)
	✓	9	BP-61203-05	12-61 4-62	C of E	Hydro	Craighill Chan.	Revised soundings (2) along edge of channel
	✓	10	Aid Proof #23					Corrections made thru 10-1-62
	✓	11	New print cht 566					Applied to drawings

Items	Compiled by	Started	Completed	Time (hrs)	Items	Verified by	Started	Completed	Time (hrs)
1-2	John Jones	9-24-62	9-26-62	11	1-2	John Doe		10-1-62	2
3-11	W. Smith	9-27-62	9-28-62	16	3-11	John Doe		10-2-62	4½

FIGURE 25.—Sample of history record of a nautical chart compiled in 1962.

conscious of the collateral uses of charts and the importance of being able to trace sources of information and dates of application. The history sheet represents a complete and detailed record of all available information used or consulted in the compilation. This may come from various types of surveys and records (*see* 127). A sample of the history record of a chart compiled in 1962 is shown in figure 25.

1276. *Special Files of Charts*

There are several special files of charts maintained in the Bureau for keeping track of chartable material received between successive editions or prints of charts, and for other purposes in connection with furnishing information on the navigational conditions existing at a given date. The more important of these will be described in succeeding paragraphs.

A. STANDARDS FILE

This file is one of the most important in the Bureau pertaining to nautical charts. It is the means by which a record is kept of incoming charting information, be it a survey of the Bureau, a Corps of Engineers blueprint, or a survey from a miscellaneous source. It was begun about February 1908. Prior to that time a record was kept in book form of all information as received and the charts affected. This was transcribed into a set of 12 volumes arranged according to charts. It is possible that in conjunction with these volumes some charts were also kept on which the information received was entered, but which were probably destroyed as soon as the information was applied to the chart. This system was abandoned with the beginning of the "Standards File" in 1908.[43]

The Standards File consists of a complete set of the published charts. When chartable information is received, the area affected is circled in color on the chart and a leader run to a stamp in the margin giving the authority for the information, the date when applied to the drawing, and the date when applied to the printing plate. Ordinarily, standards are only changed when a new edition is issued; however, if a standard becomes overcrowded with material that has been applied to new prints, a new standard may be made before a new edition is called for. As will be seen, this procedure differs from the aid proofs (*see* B, below). Information shown on the current standard is incorporated in the new edition and the latter becomes the new standard. The former becomes the "Preceding Standard." A stamp at the bottom of the chart gives the chronological sequence of the standards, thus:

STANDARD	July 1961
Preceding Standard	May 1960
Following Standard	Aug. 1962

In addition to the chronological stamp, each standard has a consecutive number to assist in keeping track of the successive standards.

When a current standard is replaced by a new standard, the date of the latter is entered opposite "Following Standard" in the stamp, and at the same time the date of the earlier standard is entered on the new standard. All standards from their beginning in 1908 to the present time are available, and it is the intention (in 1963) to retain them as a permanent file.

43. A standard is usually a copy of a new edition (*see* 1272) or a new chart on which is indicated in outline form all new information, except aids to navigation, to be applied to the chart before printing. *Id.* at 2.

B. AID PROOF FILE

The "Aid Proof File" consists of a complete set of the published charts on which a record is kept of all changes in aids to navigation and all hand corrections applied to the chart since the last new print (*see* 1272) was issued.[44] Just when such file was begun is somewhat uncertain, since it was never kept as a permanent file. Some form must have existed even at a very early time, but due to the relatively few corrections required in those days, the complete file in use today (in 1963) was not needed. However, the more important corrections were entered in a set of 12 volumes (*see* A, above).

Originally, hand corrections to the charts (dangers and changes in aids) were accurately shown on the aid proof and on the standard, but beginning with February 1931 such corrections were plotted only on the aid proofs and these formed the bases for the corrections applied.

Aid proofs are changed with every new print of a chart, thus differing from standards in this respect which are changed generally only with every new edition (*see* A, above). Information shown on the current aid proof is incorporated in the new print of the chart and the latter becomes the new aid proof. The former then becomes the "Preceding Aid Proof." A stamp at the bottom of the chart gives the chronological sequence of the aid proofs, thus:

AID PROOF	Mar. 1962
Preceding Aid Proof	Dec. 1961
Following Aid Proof	July 1962

In addition to the chronological stamp, each aid proof has a consecutive number to assist in keeping track of successive aid proofs.

When a current aid proof is replaced by a new aid proof, the date of the latter is entered opposite "Following Aid Proof" in the stamp, and at the same time the date of the earlier aid proof is entered on the new aid proof.

Aid proofs do not constitute a permanent file. As filing space becomes scarce, the aid proofs are microfilmed and then destroyed. It is the present plan (in 1963) to retain this file from 5 to 10 years which should satisfy the needs of the legal profession insofar as litigations arising from wrecks and collisions are concerned (*see also* E, below). However, even though the aid proofs are eventually destroyed the microfilms will always be available and the

44. An aid proof is a copy of the latest new print of a chart on which are indicated all changes in aids to navigation and important corrections that must be applied to the printing plate before the next printing of the chart. The majority of these changes are applied, by hand, to the existing stock of charts before issue to the public. Information regarding changes in aids is derived principally from the *Notice to Mariners* (*see* 1272). *Id.* at 3.

information will also be available in the daily entry book (on cards since 1942) kept in the Bureau.

C. RECORD FILE

A file of each edition of all nautical charts is maintained in the National Archives Building and is known as "Record File." It was established in 1956 and was formed from what was then known as the "Permanent File." It is as complete as it was possible to make it at that time. Since then, one copy of each new edition has been added to it. The remaining old charts in the Bureau, after the Record File was established, was set up as a "Reference File." This file was only about 75 percent complete and is not being expanded. Distribution is not made from these files.

D. DISTRIBUTION FILE

The "Distribution File" consists of copies of new editions of all nautical charts. Five copies of each new edition are placed in this file for sale or issue, after the regular sales stock is exhausted. Should the need arise for a chart of a certain date after the Distribution File is exhausted a photographic copy of the chart in the Record File (*see* c, above) could be furnished.

E. MARINE ACCIDENT FILE

In 1954, a special file of nautical charts was established for use in connection with the marine accident cases or wreck investigations, identified as the "Marine Accident File." Upon receipt of information of an accident, three copies of the appropriate charts in force at the time are placed in this file. These are retained for a period of 5 years.

13. ENGINEERING USE OF SURVEYS AND CHARTS

Those who use surveys and charts for engineering or legal purposes must understand certain of the basic elements associated with them in order to guard against the introduction of errors resulting from the medium on which surveys and charts are prepared, and from other sources. If these limitations are properly recognized, it is usually possible to make a comparison of two or more successive surveys with an accuracy equal to that inherent in the original surveys themselves.

131. The Scale of a Survey or Chart

Scale is the relation that a measured distance on a "survey, map, or chart" (referred to hereinafter for convenience by the generalized expression "map") bears to the corresponding actual distance on the earth. It is a system of proportion by which definite selected magnitudes on the map represent definite given magnitudes on the earth, and can be expressed by the fundamental relationship

$$\text{Scale} = \frac{\text{Distance on map}}{\text{Distance on earth}}.$$

Thus, a scale of 1 inch = 1,000 feet means that a distance of 1 inch on the map represents a distance of 1,000 feet on the earth. Scale determines the amount of detail that it is possible to show in a given area. Its selection therefore depends upon two factors—the character of the area to be mapped, and the use which the map is to serve. The larger the scale the more detail can be shown, and, conversely, the smaller the scale the more generalization will be required (*see* 1313).

The matter of scale is important to the user of maps. We are all familiar with the map of the world on which Greenland appears larger than the whole of South America. It is only when account is taken of the projection base of the map and its properties (*see* 613) that we realize that actually South America is nine times larger than Greenland. The same is true with surveys of different scales. A visual comparison of two surveys, without regard to scale, may often result in erroneous impressions of the amount of change having taken place in a given locality. Small differences may become overly magnified unless we are conscious of the difference in scale.

1311. *Fractional Scale*

On Coast Survey charts and surveys, the scale is indicated by a fraction in which the numerator is unity and the denominator is the number that the unit distance must be multiplied by in order to obtain its distance on the ground in the same units. Thus, the scale of 1 inch = 1,000 feet would be designated as $\frac{1}{12{,}000}$ (read "one to twelve thousand"), there being 12,000 inches in 1,000 feet. In other words, the unit distance of 1 inch in this case must be multiplied by 12,000 in order to obtain its distance on the ground, which is 12,000 inches. Similarly, any other unit—1 foot, 1 yard, 1 centimeter, etc.—represents 12,000 of the same unit on the ground. Such a scale is termed a "fractional scale," and

the fraction is commonly called the "representative fraction" or "R.F." of the map. It is sometimes also referred to as the natural scale (*see* 6412(*a*)) and appears variously as 1: 12,000, 1/12,000, or 1–12,000. On the more recent topographic and hydrographic surveys, and on the nautical charts, the form 1: 12,000 is used, and this is the form followed in this publication.[45]

Most of the topographic surveys of the Coast Survey are on scales of 1 : 10,000 and 1 : 20,000. This is also true of the hydrographic surveys adjacent to the coast, the scales being smaller for surveys of offshore areas.

The scales of nautical charts vary from large scales for harbor charts to small scales for charts used in offshore navigation (*see* 1313).

1312. *Graphic or Linear Scale*

On nautical charts of scales 1 : 80,000 or larger, graphic or linear scales are usually shown in addition to the fractional scale (*see* fig. 26). These consist of lines subdivided into units representing nautical miles, statute miles, and yards. Such scales have the great advantage of remaining true after the chart has been enlarged or reduced photographically, or has undergone changes in scale due to the printing process or to changes in the hygrometric conditions of the atmosphere, because any variation from true scale in the body of the chart is also reflected in the graphic scale and distances may still be measured with accuracy.[46]

When reproduction copies of original surveys are requested from the Washington Office, a graphic scale is attached to the survey prior to photographing.

1313. *Large and Small Scales*

Confusion often exists regarding the true meaning of the terms "large" and "small" as applied to the scale of a map or chart—so much so that they are frequently used in exactly the reverse sense. There is no absolute definition for

45. Where the metric system of measure is used (as in the Coast Survey), the denominator of the fractional scale is usually a round number because units in the metric system are related decimally, e.g., kilometer, meter, decimeter, centimeter, millimeter (meaning 1,000 meters, 1 meter, 0.1 meter, 0.01 meter, 0.001 meter, respectively). A survey on a scale of 1 centimeter to 500 meters is represented by the fraction $\frac{1}{50,000}$, since there are 50,000 centimeters in 500 meters. If the English system of measure is used, awkward fractions result because of the absence of a decimal relationship. Thus, a scale of 1 inch to the mile is indicated as $\frac{1}{63,360}$ and ½ inch to the mile as $\frac{1}{126,720}$.

46. In northern latitudes, such as Alaska, the 1 : 80,000 scale charts do not carry the graphic scale because of the rapid change in scale of Mercator charts (*see* charts 8302, 8520). For information regarding scales on nautical charts smaller than 1 : 80,000, *see* 6412.

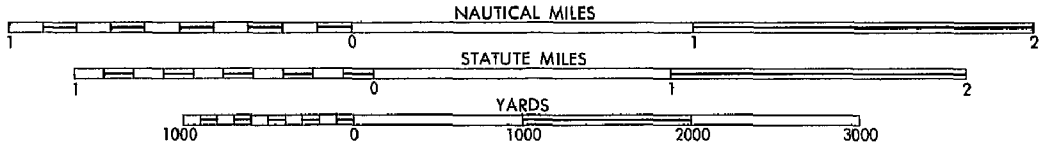

FIGURE 26.—Graphic scales used on Coast and Geodetic Survey charts.

these terms; they are necessarily relative. We cannot say that a 1: 40,000 scale chart is of small-scale, because in relation to a 1: 120,000 scale it is a large scale. On the other hand, it is a small scale in relation to a 1: 5,000 scale. Whether one chart is larger or smaller in scale than another is determined by the relative length that a distance on the ground has on the two charts, and not by the ground area covered, as is sometimes thought. The chart on which the ground distance spans a greater length is the larger scale. Thus, a ground distance of 10,000 inches would span a distance of 1 inch on a 1:10,000 scale chart, but would only span ½ inch on a 1:20,000 scale. Therefore 1:10,000 is a larger scale than 1:20,000, although for the same size chart the latter would cover four times the area of the former. A simple rule with fractional scales is that the larger the denominator the smaller the scale, or, stating it differently, the smaller the value of the R.F. of the map or chart, the smaller is the scale. Thus, $\frac{1}{20,000}$ is a smaller scale than $\frac{1}{10,000}$.

Insofar as Coast Survey usage is concerned, scales up to and including 1:20,000 would be considered *large* scales, those between 1:20,000 and 1:80,000 would be classed as *intermediate* scales, and scales smaller than 1:80,000 would fall into the category of *small* scales.

1314. *Determining the Scale of a Survey*

It sometimes becomes desirable to determine the actual scale of a survey, as where distortion has crept in or where the scale has for some reason not been indicated. Problems of this kind are readily solved in the following manner by application of the fundamental relationship for scale (*see* 131):

Assume a survey, with a fractional scale of 1:10,000, extending from latitude 45°05′ to latitude 45°15′, the projection intervals being given for each minute of arc. Take 1 minute of latitude near the center of the survey (say between 45°10′ and 45°11′) and find its value in meters on a metric scale. (By using a 1:10,000 metric scale, the distance in meters can be read directly since each subdivision on the scale equals 1 centimeter or 0.01 meter.) Suppose this value is found to be 0.1865 meter. The corresponding distance on

the earth's surface for 1′ of latitude at latitude 45° 10′ is then found from the published tables to be 1,852.24 meters.[47] The fractional scale of the survey is therefore $\frac{0.1865}{1{,}852.24}$ or $\frac{1}{9{,}932}$ (*see* 1311).[48]

If a metric scale is not available, the distance on the survey can be measured in inches and the tabular value of 1,852.24 meters converted to inches from the relationship 1 meter = 39.36990 inches.[49] The same fractional value for the scale will result.[50]

The scale of the survey can also be determined by measurement between meridians of longitude and comparing these measurements with the corresponding tabular values as taken from the left-hand pages of Special Publication No. 5 (*see* note 47 *supra*) marked "Arcs of the parallel in meters" for the particular latitude used. The mean of the determinations in the east-west and north-south directions should be taken as the scale of the survey.

Even where no projection is shown on the survey, the scale can be determined provided the work is based on a triangulation system. In such cases, the problem becomes one of measuring the distance on the survey between triangulation stations and comparing these values with the values given in the computational data.

Once the true scale of a survey has been determined, measurements made on the survey sheet, using a scale corresponding to the fractional scale of the survey, can be converted to true distances by the following simple proportion:

Measured distance times fractional scale = X times true scale.

Thus, if the measured distance is 50 meters on the $\frac{1}{10{,}000}$ fractional scale, and the true scale of the survey is found to be $\frac{1}{9{,}932}$, then the true distance would be

$$50 \times \frac{1}{10{,}000} = X \times \frac{1}{9{,}932}, \text{ or } X = 49.66 \text{ meters.}$$

132. Errors Due to Distortion of Medium

In using successive surveys or charts for studying the rates of shore recession or advance, or for other purposes, the first consideration is that the surveys or charts must be brought to the same scale before any quantitative measurements can be made. Even though the scale may have been correct at the time the

47. *See* Tables for a Polyconic Projection of Maps and Lengths of Terrestrial Arcs of Meridian and Parallels 101, Special Publication No. 5, U.S. Coast and Geodetic Survey (1946).

48. One minute of latitude is used in the example for simplification. In practice, several minutes should be used in order to minimize the effect of an error in the original plotting of one of the projection lines.

49. *Id.* at 3. The legal value for the meter in the United States is 39.3700 inches. *Ibid.*

50. If it is desired to express the relationship in miles to the inch, the distance on the survey is measured in inches and the tabular value converted to miles. The computation of the scale is obvious.

survey or chart was drawn, it cannot be assumed that it has remained so, as the paper used is subject to changes in dimensions due to varying atmospheric conditions and in the case of charts due also to the printing process employed. These changes are usually unequal in the two directions (with and across the grain of the paper), with intermediate values in other directions. These changes are referred to as distortions.

1321. *Correction Factor to be Applied*

To measure distances accurately on a survey where no graphic scale is shown and the fractional scale no longer represents the true scale, a correction factor must be determined and applied to every measured distance. This factor can be computed from the following relationship:

$$\frac{\text{Tabular value} - \text{Survey value}}{\text{Survey value}} = \pm \text{ Correction factor.}$$

A procedure similar to that described for the determination of the scale of a survey can be followed (*see* 1314), the survey value in this case being obtained by measuring on a scale corresponding to the fractional scale shown on the survey.[51]

For precise measurements, a correction factor should be obtained for both a north-south and an east-west direction. A mean value can then be used or a graduated factor applied to a measurement depending on its direction.

133. Errors Inherent in Original Surveys

Inherent in the distances scaled from the surveys are not only the errors due to paper distortion, but also those that might be considered inherent in the original surveys themselves. This arises from the fact that no survey is a precise copy, in miniature, of the original features on the earth. Even the best survey is but an abstract of a part of the earth's surface showing the major features with a greater or less degree of accuracy according to the nature and purpose of the survey.

The general accuracy of the early surveys of the Bureau has been heretofore discussed (*see* 11). The limitations inherent in the method of survey is discussed in the chapter on "Analysis and Interpretation of Topographic Surveys"

51. If no such scale is available, the survey value can be measured in inches and the tabular value converted to inches on the indicated fractional scale. Thus, if the fractional scale is 1: 10,000 and the tabular value for 1 minute of latitude is 1,824.24 meters, then this value multiplied by inches in a meter and divided by 10,000 will give the tabular value to be used in the above equation.

(*see* 442 and 443). Suffice it to say here that the degree of accuracy depends on a number of factors among which might be mentioned the purpose of the survey (*see* 4421) and the scale on which it is made.[52]

134. Transfer of Data

Under heading 1314 was discussed the matter of determining the true scale of a survey that was subject to distortion, in order that scaled distances may be in their correct values. In making comparative studies of successive surveys, some method of transfer must be utilized for either superimposing one survey on another if on the same scale, or for reducing one to the other if on different scales. There are several methods by which the shoreline or other detail can be transferred depending upon the respective scales of the two surveys, the degree of accuracy sought, and the instrumental equipment available. In this section will be considered the preparation of a composite drawing of several surveys on the same fractional scale (*see* 1311) but slightly different in actual scale (*see* 1341); and the transfer of detail from one scale to another (*see* 1342, 1343, and 1344).

1341. *Tracing-Paper Method*

Where the surveys to be studied are on the same scale, the simplest method of transfer is by means of tracing paper. The procedure is to first construct a projection in its true dimensions from the published tables (*see* note 47 *supra*) on the same fractional scale as the surveys being studied and with the same subdivisions. This tracing is then superimposed on the survey to be studied and the detail traced, frequently shifting the tracing minute distances so as to distribute the error (distortion) throughout each rectangle. By this method, the field within which distances must be considered is limited initially to the smallest rectangle formed by adjacent meridians and parallels. This may be further reduced by subdivision of corresponding rectangles into any number of equal parts. By such subdivision even those maps on which the distortion is appreciable can be mechanically allowed for in preparing the composite drawing. If the subdivisions are made small enough, the amount by which the tracing is shifted each time can be so reduced that no part of the feature traced need be

52. Douglas Johnson in his "New England-Acadian Shoreline," states: "In legal proceedings involving shore changes I have heard it sincerely maintained by counsel, and apparently accepted by the court, that the accuracy of a chart surveyed on a small scale is equal to that of one surveyed on a large scale, so that photographic enlargement of the small scale chart to the same size as the larger one, must give an accurate basis for comparison of shore changes; the argument being based on the erroneous assumption that surveys are precise copies of the original features, reduced in various degrees." Johnson, The New England-Acadian Shoreline 419 (1925).

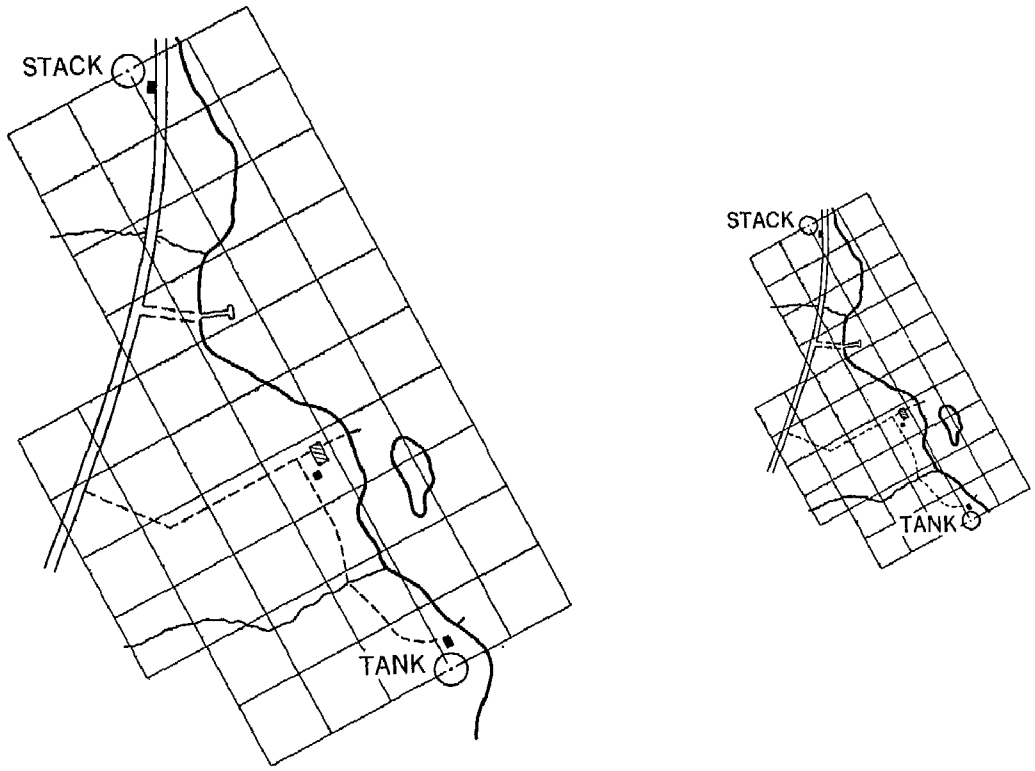

FIGURE 27.—Reduction of topography by method of squares.

in error by more than the width of the line drawn. The same procedure is followed with the other surveys.[53]

1342. *Method of Squares*

This method is useful for transferring detail from one survey to another where the scales are not the same. It was for many years one of the principal methods used in chart compilation for transferring hydrographic data from the survey sheet to the chart drawing (*see* 1344).

In this method (*see* fig. 27), common points on the two surveys are selected—usually intersections of meridians and parallels. Referred to these

53. If it is desired to transfer the detail from one survey to another, the same procedure is followed as outlined above with the exception that instead of constructing a new projection, a tracing is made of the projection on the survey *to which the transfer is to be made,* not of the survey to be transferred. All the adjustments are made on the survey being transferred and the detail traced. When this is completed it is merely necessary to fit the projection on the tracing paper to the projection on the survey and the transfer made by any of the methods ordinarily used.

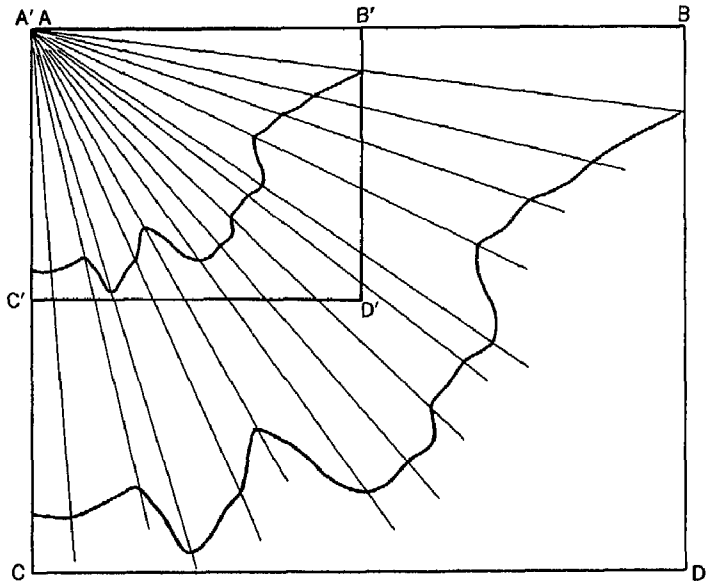

FIGURE 28.—Radial-line method of reducing topography.

common points, sets of corresponding squares or rectangles are constructed in pencil which are identical when referred to the actual ground detail, but differ in size on the two sheets.[54] To obtain reasonable accuracy, the squares on the smaller scale should be formed by lines not more than one-eighth inch apart. To facilitate identification, lines should be accentuated at intervals. The detail may then be transferred from one sheet to the other by reference to the positions within these small squares. The use of proportional dividers in the transfer of the detail will add to the accuracy of the results.

1343. *Radial-Line Method*

Another method of transferring detail from one survey to another, where the scales are not the same, is by means of "radial lines" (*see* fig. 28). A common point on the two surveys is selected from which radial lines can be drawn to intersect the general trend of the shoreline to be transferred at not too acute an angle. As in the method of squares, the radial lines are drawn on tracing paper which is placed over the source sheet. The lines are drawn to intersect the shoreline at all salient points and at enough intermediate points to permit fairly accurate sketching of the detail.

54. To avoid marking up the source sheet, the squares should be drawn on tracing paper and laid over the detail to be transferred.

In the simplest case, where it is desired to transfer to a scale half as large as the original, it is merely necessary to use dividers to halve the radial distances from the common point to the intersections with the shoreline and plot the new distances along the same lines. Subsequently, the intervening shoreline is sketched in pencil by eye through the new points so that it corresponds to the original. The shoreline at the new scale can then be transferred by any of the methods ordinarily used. The same method can be used to decrease the scale in any proportion by the use of proportional dividers.[55]

1344. *Photographic Method*

With the advent of stable-base photographic films and papers, the use of photography as a means of changing the scale of the material to be transferred was introduced. A stable-base film positive or a positive print on waterproof paper is used either with the tracing-paper method (*see* 1341) or with the transparent compilation drawing. This is the common method of transfer used in the Survey today.

55. Other methods of transferring detail from one survey to another include the use of a pantograph or a projector. For a description of these instruments and their use, *see* ADAMS, *op. cit. supra* note 5, at 434 and 435.