CHAPTER 6

Interpretation and Use of Nautical Charts

Every maritime nation recognizes the need for surveying and charting its coastal regions in the interest of waterborne commerce. Without adequate charts, free and unrestricted intercourse by water would be impossible and the harbors would be as effectively closed to the commerce of the world as though blockaded by an enemy fleet. Charting the coastal areas of a nation, therefore, stands high on the list of obligations for the promotion of the comity of nations. In the commerce clause of the Constitution of the United States (Art. I, sec. 8, cl. 3) that obligation is fully recognized in the provision that Congress shall have the power "To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes." As an incident of that power, there is the concomitant power to control and protect navigation, which necessarily includes the preparation and publication of nautical charts.

This national obligation and constitutional power was given force and effect in the early history of our country. The young Nation was concentrated along the Atlantic coastal plain; fisheries and shipbuilding were important industries, and waterborne commerce between the harbor cities was the medium for the movement and exchange of fish, shipbuilding materials, and other products. To promote that commerce and to develop trade with foreign nations, a survey of the coast, on which the nautical charts would be based, was authorized in 1807 (*see* Part 1, 121).[1]

61. EVOLUTION OF THE NAUTICAL CHART

The first hydrographic information available for the use of mariners was in the form of written descriptions of the coasts along which they sailed. They were crude beginnings and probably consisted of the merest details of headlands. As navigators ventured farther from home, this was supplemented by informa-

1. The act was approved on Feb. 10, 1807.

tion concerning harbors and channels and the dangers to be avoided along such routes.

As was pointed out in 127, the modern nautical chart may be described as 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 navigator whose responsibility is the safety of lives and cargo. To effectively discharge that trust, the navigator must have at all times a full and complete knowledge of the coast; the depths of the water and the character of the sea bottom; the locations of reefs, shoals, and other dangers to navigation; the rise and fall of the tides; the direction and strength of currents; and the behavior of the earth's magnetism in areas that must be navigated. Modern nautical charts provide this information.

An important distinction thus exists between the nautical chart and maps in general; whereas the latter may serve as reference mediums, the nautical chart in its special and accurate delineation is an instrument to be worked upon in the solution of all problems relating to the navigation of a vessel, be they problems of position, direction, or distance.

611. The Work of Claudius Ptolemy

Although the modern chart is of comparatively recent origin, the period from Ptolemy to Mercator, covering the first 16 centuries of the present era, saw three great developments in cartography that have profoundly influenced contemporary chart making.[2] Claudius Ptolemy—Egyptian mathematician, astronomer, and geographer—who lived in the second century, stands without doubt in the front rank of early geographic thought. His *Geographia* represented the sum of all geographic learning and served as a groundwork for future cartographers. In it was embodied a catalog of places arranged according to their geographic positions, including the mathematical principles for the scientific construction of maps.[3] Ptolemy gave details for the construction of 26 maps and a general world map, and is credited with being the originator of the conic projection—at least his map of the world was constructed on a modification of this projection with meridians and parallels both curved. Ptolemy's other contributions to cartography were his insistence on the sphericity of the earth, and his invention of dividing it by means of meridians and parallels.[4]

2. The first marine charts of which there is actual record are those constructed by Marinus of Tyre during the second century. Adams, Hydrographic Manual 1, Special Publication No. 143, U.S. Coast and Geodetic Survey (1942).

3. Deetz, Cartography 4, Special Publication No. 205, U.S. Coast and Geodetic Survey (1943).

4. Brown, The Story of Maps 59, 68, 71, 73, 79 (1949).

Ptolemy's scientific teachings were lost to the medieval world, which was generally marked by stagnation and retrogression. There was a reversion to the theory of a flat earth, and the concept of latitude and longitude was entirely neglected. The superstition that Paradise was situated in the East caused the mapmakers of that period to give it a position in accord with its importance by placing it at the top of the map. The East remained conventionally at the top until the introduction of the compass in navigation around the 13th century.

612. Portolano Charts

The compass paved the way for a new type of chart which flourished towards the close of the middle ages and forms a notable exception to the prevailing darkness of the period. This was the second great influence on contemporary chart making. The Italian and Catalan mapmakers introduced the *Portolanos* or "handy plans." No projection was included, but in its place were networks of straight lines, each network radiating from a common center like the spokes of a wheel and corresponded to the points of the compass. These lines enabled the navigator to set his course at and to any point by aid of the magnetic needle. For limited areas, these charts gave nearly correct azimuths so that those of the Mediterranean in the 14th century closely approximated a modern chart based on the Mercator projection (*see* 613).[5]

The Portolanos marked the return of north to the top of the chart and were the first to carry a linear scale of miles. They were almost always drawn on parchment and with bright colors. The Portolanos achieved only an approach to mathematical accuracy, but it was enough to give the seamen of that period the confidence which they needed to sail the open sea. It remained for Mercator, 150 years later, to *solve* the problem of cartography for the navigator.

The influence of the Portolanos on chart making was felt for several centuries after their introduction, and Juan de la Cosa in 1500 still covered his chart with the spider-web lines (*see* fig. 66).[6] The Cosa chart is of great interest historically, being the earliest map now extant which shows the American coast. The chart was drawn on oxhide in bright colors and purports to cover the entire world; it joins Asia and America as one continent, the Pacific Ocean being then unknown.

5. The oldest Portolano of which the date can be accurately fixed covers the eastern Mediterranean and was drawn by Petrus Vesconte in 1311. Adams, *op. cit. supra* note 2, at 2.

6. Cosa accompanied Columbus on his first voyage as master of his flagship and as cartographer on his second voyage.

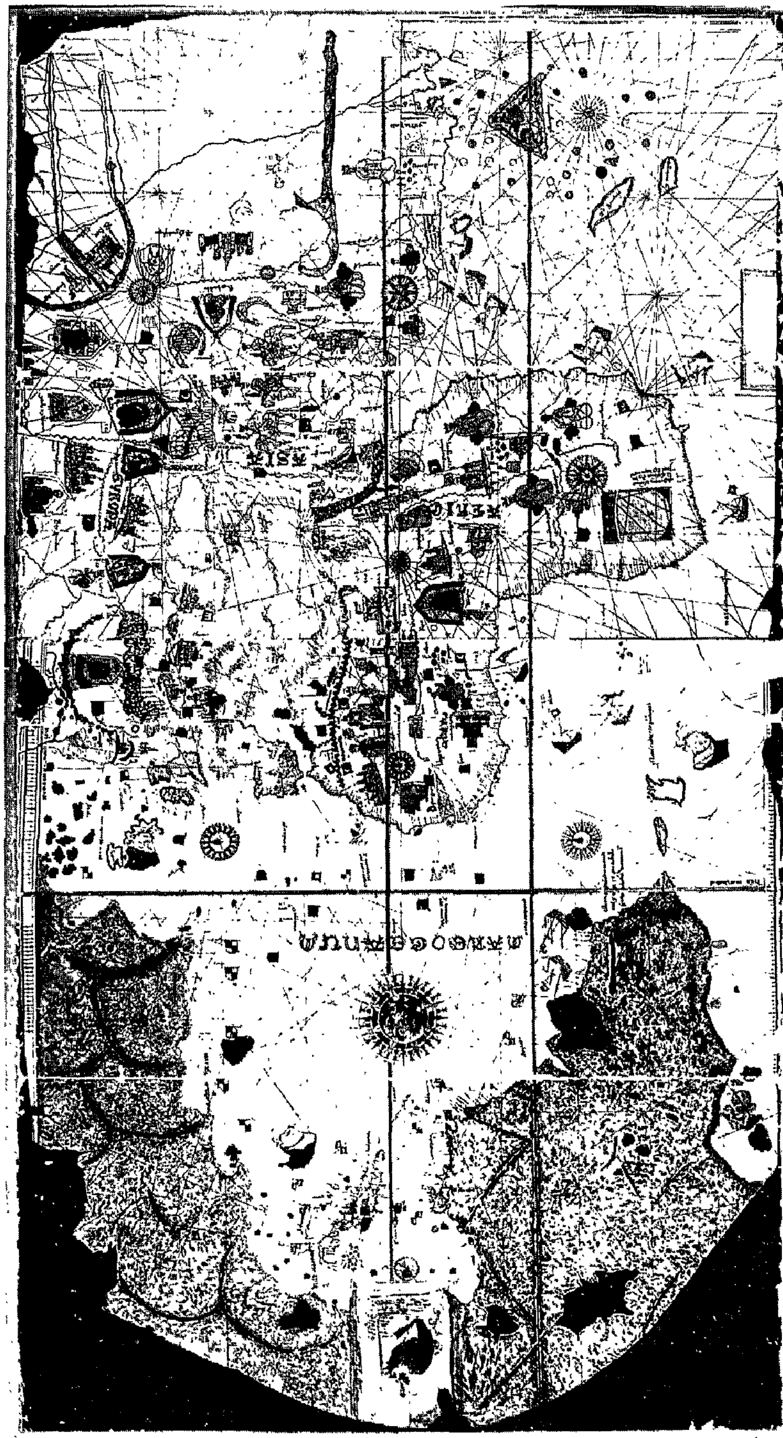

FIGURE 66.—The Cosa chart of 1500 was drawn on oxhide and in bright colors. The radiating lines, which characterized the Portolanos, enabled the navigator to set his course at any point by aid of the magnetic needle. The Cosa chart is the earliest map now extant which shows the American coast.

613. Mercator's Great Contribution

The third great influence on the modern nautical chart was the contribution of Gerhard Krämer (better known by his Latin surname Mercator, meaning merchant), the Flemish mathematician and cartographer who lived in the 16th century. Ptolemy, as we saw, introduced the latitude and longitude idea in maps. The Portolano chart makers of the 14th century neglected this concept and used the points of the compass as their "grid system." Mercator combined the scientific theories of the one with the practical advantages of the other and devised the well-known projection which bears his name. In his famous World Map of 1569 (*see* fig. 67), the latitude and longitude lines are straight, parallel lines intersecting each other at right angles. The meridians of longitude Mercator spaced equally throughout the map based on their distance apart at the equator. This caused a spreading of the meridians everywhere except at the equator, since meridians on the earth converge toward the poles. To compensate for this, Mercator conceived the idea of also spreading the parallels in exactly the same proportion as the meridians were spread.[7]

What Mercator sought to accomplish by this arrangement of meridians and parallels was to provide the navigator with a chart on which a straight line—the simplest of all lines—joining any two points would determine the constant course he must steer in sailing between those points. Such a line is known as a *rhumb line* (loxodromic curve). On the earth it cuts all the meridians at the same angle and is a continually curving line, always approaching the pole but theoretically never reaching it. A ship sailing a "rhumb" is therefore on one course continuously. The uniqueness of the Mercator projection lies in the fact that on it and it alone the rhumb line is a straight line (*see* fig. 87). This is the essential property which Mercator wished to preserve, and he subordinated other properties to this one.

Although it took nearly a century for navigators to appreciate this property of the Mercator projection, today the projection is looked upon as one of the most useful ever to be devised for marine navigation; it will likely be so considered as long as ships "sail the rhumb."

7. This means that if at any place on the map a minute of longitude is spread to twice its value on the earth, then the minute of latitude at that place is also spread to twice *its* value on the earth. In order to differentiate between the chart measurements along a meridian and the geographic distances in nautical miles which they actually represent, the chart measurements are conventionally referred to as *meridional parts*. For any latitude, the meridional parts are the number of nautical miles by which that latitude would be distant from the equator, if every degree and minute between them had been lengthened proportionately to the lengthening of the longitude. Thus, the meridional parts for latitude 60° (on a sphere) are 4527.37 minutes, but the actual number of nautical miles between the equator and latitude 60° is 3600. The difference of 927.37 miles is the amount by which the distance from 0° to 60° must be increased on a Mercator chart of the world in order that a mile of latitude at 60° may be in true proportion to a mile of longitude at that latitude.

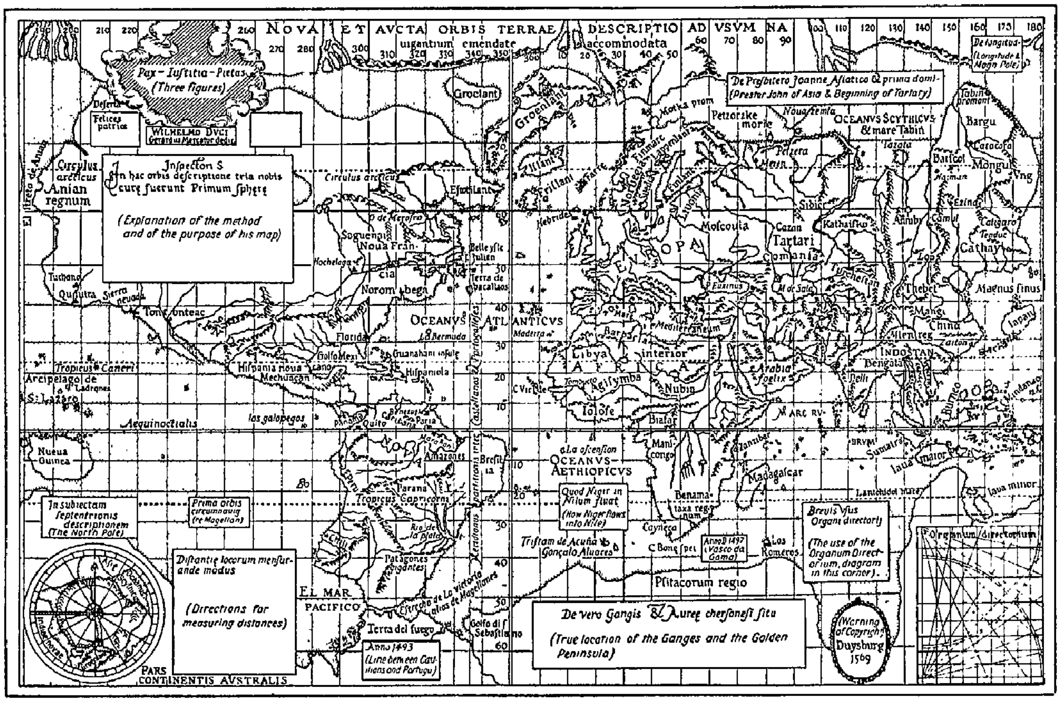

FIGURE 67.—Mercator's world chart of 1569 was characterized by two systems of straight parallel lines intersecting each other at right angles. The spacing between the parallels of latitude increase in a mathematical progression from the equator to the poles, making the *rhumb* line on the chart a straight line. (*Courtesy, Encyclopedia Britannica.*)

The Mercator projection belongs to that class of map projections known as "conformal," in which the property of correct shape is preserved for geographical features, rather than correct size. In contrast, there is the "equal-area" type of map projection, in which correct size is preserved rather than correct shape.[8] Another limitation of the Mercator projection is that a great circle (orthodromic curve)—the shortest distance between two points on the surface of the earth—would be projected as a curved line (*see* fig. 87). This means that radio bearings, which follow the paths of great circles over the earth, cannot be plotted as straight lines on a Mercator chart without correction.[9] Also, as one recedes from the equator, both north and south, the scale of the projection

8. For mapping extensive portions of the world, it is mathematically impossible to preserve both properties in the same projection. This follows naturally from the obvious fact that the surface of a sphere cannot be flattened without distortion. This is the underlying principle of all map projections. Any projection is at best a compromise and the choice usually depends upon the purpose which the map or chart is to serve.

9. Only true north and south bearings, and true east and west bearings along the equator do not require a correction. This problem is discussed further in connection with using nautical charts (*see* 691).

continually increases, reaching infinity at the north and south poles. This expanding scale makes the projection unsuitable for charting the polar regions and limits its use for ordinary geographic purposes where equal-area representation is desirable.[10]

But notwithstanding its limitations, Mercator's contribution will always remain one of the great landmarks in the development of nautical cartography. His projection plays a definite part in giving a continuous conformal mapping of the world. The restrictions of relative size may be more or less disturbing, but so are the tripartite or quadripartite arrangements, with discontinuities in oceans and continents, seen in other projections when extended to world proportions.[11]

62. THE MODERN NAUTICAL CHART

In evaluating and interpreting the modern nautical chart, particularly the charts of the Coast Survey, cognizance must be taken of the fact that what had previously been called a chart was largely the result of exploration or of limited surveys and was generally the work of individual effort and private undertaking. The Portolanos of the 14th century, the Cosa chart of 1500 (*see* 612), and the Atlantic Neptune charts of the late 18th century are all examples of the work of this exploratory period.[12] These, like all the early charts, suffered from two great defects—the want of detailed surveys and the lack of a rigid system of connection between the various ports.

10. Mercator recognized this shortcoming, and on his World Map of 1569 the north polar region is shown as an inset on a projection centered at the pole (*see* fig. 67). Mercator's original chart of 1569 contains numerous Latin inscriptions of both historical and technical interest. They give a résumé of the geographic knowledge of the time, and show how the chart should be used and the reasons which led Mercator to develop his system of map projection. The International Hydrographic Bureau has issued a full-size reproduction of this chart in 18 sheets, including a pamphlet giving the Latin text and English translations of the legends. TEXT AND TRANSLATION OF THE LEGENDS OF THE ORIGINAL CHART OF THE WORLD BY GERHARD MERCATOR, ISSUED IN 1569, INTERNATIONAL HYDROGRAPHIC BUREAU (1932).

11. Historically, it is known that Mercator derived his results by approximation, and that 30 years later Edward Wright developed a more accurate method of computation and tables for the construction of the projection which were made known in a publication entitled, "Certaine Errors in Navigation." Accurate values of *meridional parts,* however, did not become available until the calculus was invented more than a century later. DEETZ AND ADAMS, ELEMENTS OF MAP PROJECTIONS 104, SPECIAL PUBLICATION No. 68, U.S. COAST AND GEODETIC SURVEY (Revised 1944). This publication contains a comprehensive treatment of the Mercator projection, including a general table of meridional distances for the spheroid, and a method of construction.

12. The Atlantic Neptune collection is an atlas of charts compiled between 1775 and 1781 by Des Barres, the Royal Surveyor General for the colonies, from surveys by British naval vessels, from private surveys, and from records kept by the Lords of Trade.

It was not until the early part of the 19th century that governments began to recognize the wisdom of systematically surveying and charting their coastal regions as a necessary prelude to their commercial intercourse with other nations. This marked a new era in chart making and was the beginning of the accurate chart of today. In this country, as has been noted, the Coast Survey was created in 1807 to survey and chart the coasts of the United States, although actual work was not begun until a much later date.[13]

The modern nautical chart is the end product of many field operations—triangulation, topography, hydrography, tides and currents, and geomagnetism—and the office operations of compilation, reproduction, and maintenance.[14] Progressive improvement in the chart has therefore, in the main, been coextensive with the development of systematic surveying and of surveying techniques, including instrumentation and equipment.

621. A Geodetic Base for Charting

Triangulation provides the framework for the chart—it gives it rigidity and knits together all portions into a harmonious whole. Today, the whole of North America to the Bering Strait is coordinated on a single geodetic datum—the North American 1927 Datum—resulting in full coordination between the nautical charts of the Atlantic and Gulf coasts with those of the Pacific coast and Alaska. Even the distant, offshore islands in the Bering Sea are now connected with the triangulation network on the mainland of Alaska by a system of trilateration (a measurement of the sides of a triangle, as distinguished from triangulation in which the angles are measured), using electronic methods, the longest distance measured being 501 statute miles (*see* fig. 31). The successful completion of this project furnished a control net for hydrographic surveys from which accurate charting of this vast, strategic area can proceed with minimum danger to men and ships.[15]

13. The first chart published under the new governmental setup was of Bridgeport Harbor, Conn., in 1835.

14. Besides these Coast Survey sources, the best available data from other sources are also utilized. 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 of the Department of Commerce); controlling depths in dredged channels and depths in other areas where improvements are projected, and bridge and overhead cable clearances are obtained from the U.S. Corps of Engineers. In addition, charts frequently contain reported information, such as a shoal, a bank, an obstruction, etc., which, though perhaps of doubtful accuracy, must be charted as a matter of policy until such time as it can be verified or disproved.

15. For an account of the field work on this project and the accuracies obtained, *see* Pierce, *Datum Connection to the Bering Sea Islands,* and Meade, *Preliminary Adjustment of Shoran and EPI Observations in the Bering Sea,* 5 Journal, Coast and Geodetic Survey 3, 10 (1953).

622. Advent of Photogrammetry

The years preceding and following World War II saw the emergence and flowering of the science of aerial photogrammetry—the greatest advance in topographic mapping since the prototype of the modern planetable was developed by Johann Praetorius in the latter part of the 16th century (*see* fig. 68). Ground topographic methods are rapidly giving way to this more economical and more expeditious method of mapping from the air. The wealth of information and fullness of detail provided by an aerial photographic survey cannot be matched by any other practicable method of surveying. The development of multilens aerial cameras—together with stereoscopic plotting equipment for reducing the photographs to map form—gave considerable impetus to the mapping of difficult and inaccessible terrain, which could now be mapped with a minimum of ground control (*see* fig. 69).

The application of infrared photography to mapping of the high- and low-water lines will result in greater charting accuracy of these tide lines, particularly in areas that are difficult of access for identification of shoreline (*see* Part 1, 2232). Techniques have been developed for the use of this type of photography, in conjunction with tide observations, for charting riparian boundary lines based on tidal definition.[16]

The advent of photogrammetry in the Coast Survey has had two salutary effects on the nautical chart: (1) It has further increased the accuracy of the chart, particularly in inaccessible areas; and (2) it has brought within practicable scope the immediate revision of areas where natural or man-made changes have occurred—an important factor in safeguarding the sealanes.

623. Hydrographic Advances

From the standpoint of the nautical chart, the greatest advances made since the early days of charting have been in the field of hydrographic surveying. The correct charting of the water area is of supreme importance to the navigator because, unlike the land area, it involves features hidden from his view. Modern hydrographic methods permit the accurate delineation of the ocean floor with its intricate patterns of submerged valleys, shoals, ridges, and plateaus. These characteristic features serve the navigator as permanent submarine "land-

16. The low-water line survey of the Louisiana coast is an example of the application of these techniques to a difficult coastline where a high degree of accuracy was required. Full coordination between the photography and the height of the tide was essential to the execution of this project, and infrared photography provided a good contrast between land and water. For a full discussion of the technical problems encountered, *see* Volume One, Part 2, 17.

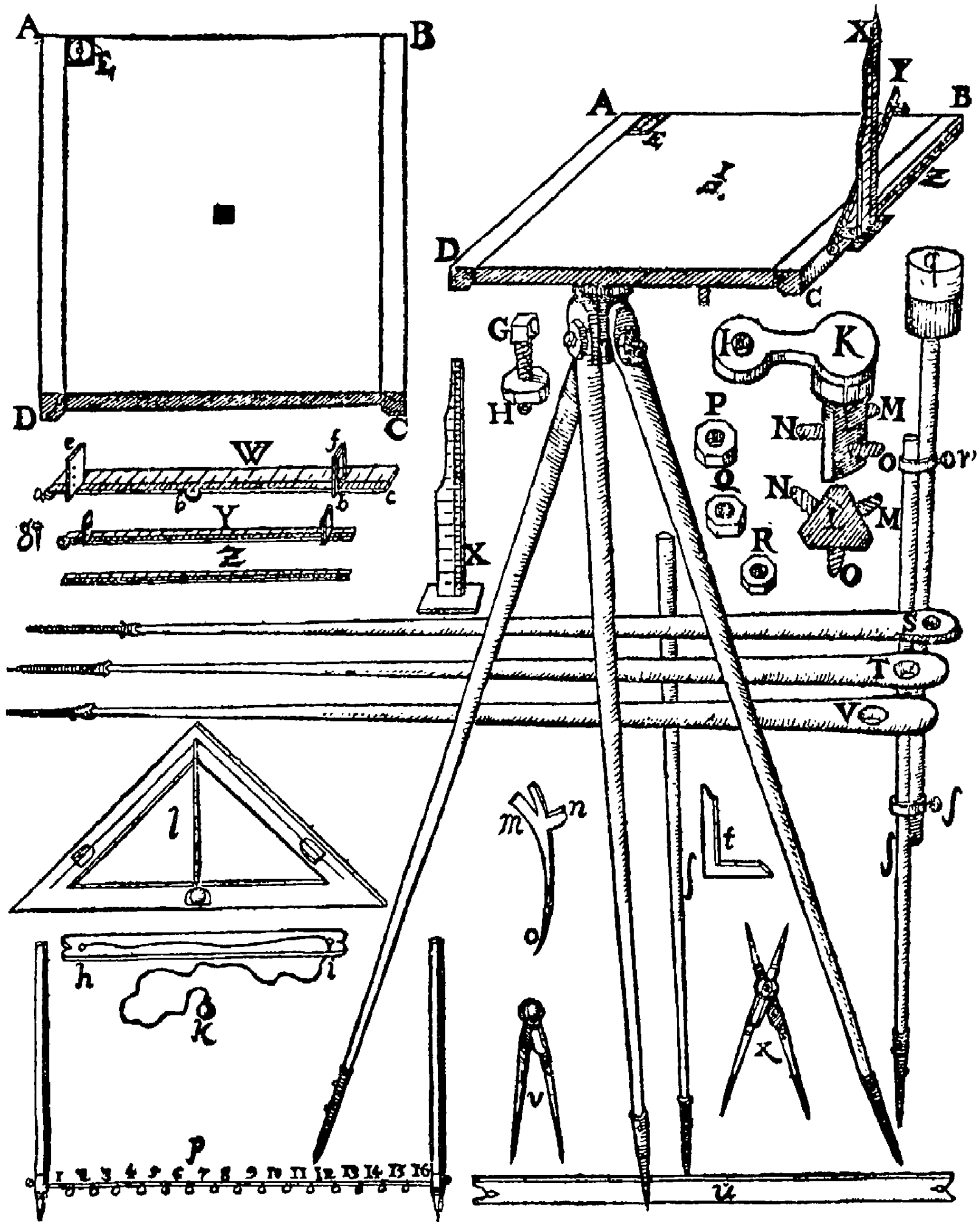

FIGURE 68.—The planetable of Johann Praetorius developed during the 16th century was the prototype of the modern planetable.

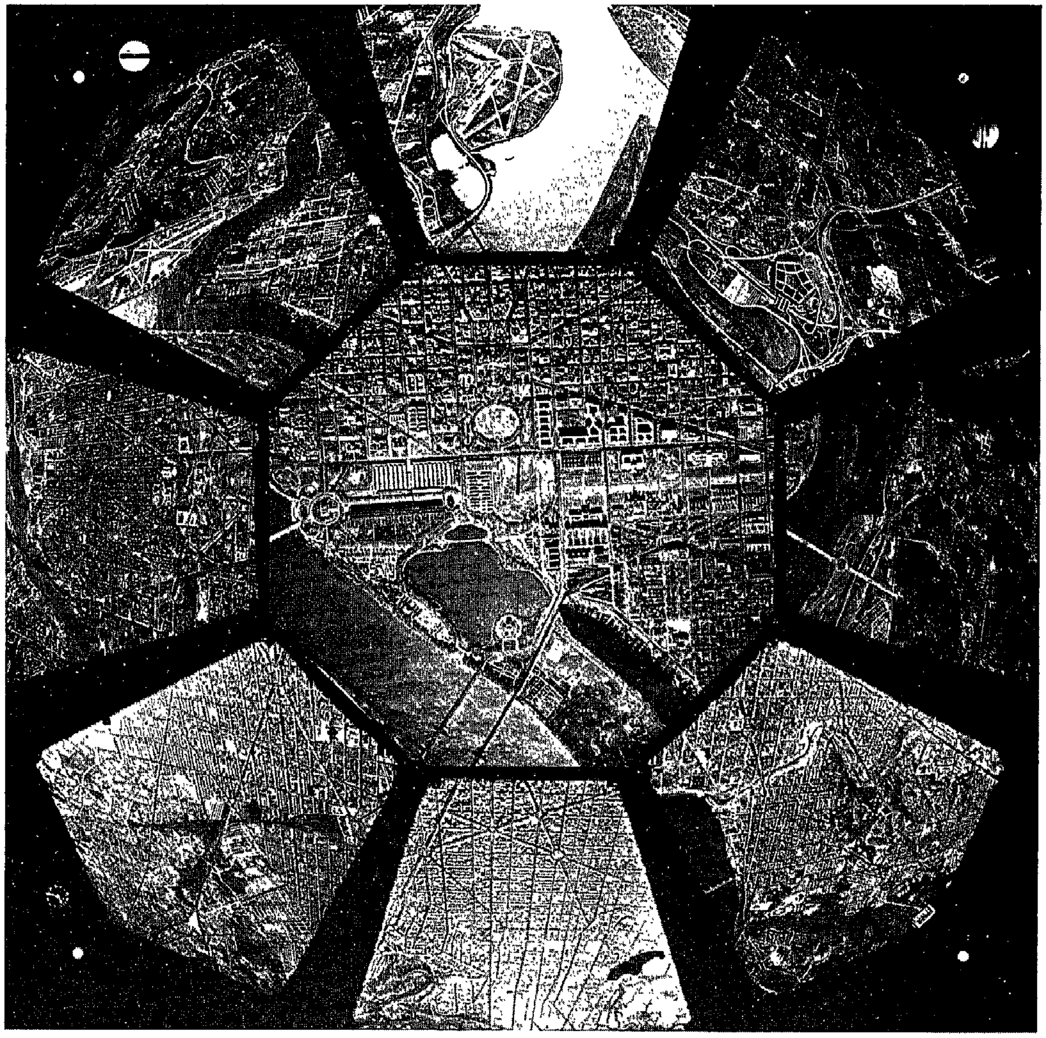

FIGURE 69.—Contact print from a nine-lens aerial camera negative, consisting of one vertical and eight oblique exposures. When transformed and rectified, each wing negative will be reversed and on opposite side of the film so as to form a single, composite print with geometrical characteristics of a single-lens photograph but with much greater angular coverage.

marks" for identifying his position at all times, irrespective of adverse weather conditions (*see* 6931(*b*)).

Developments in the science of hydrographic surveying, during the past three decades, have had a greater effect on the accuracy and usefulness of the nautical chart than the combined developments during the preceding hundred years. The old and well-known methods of sounding—the handlead and line

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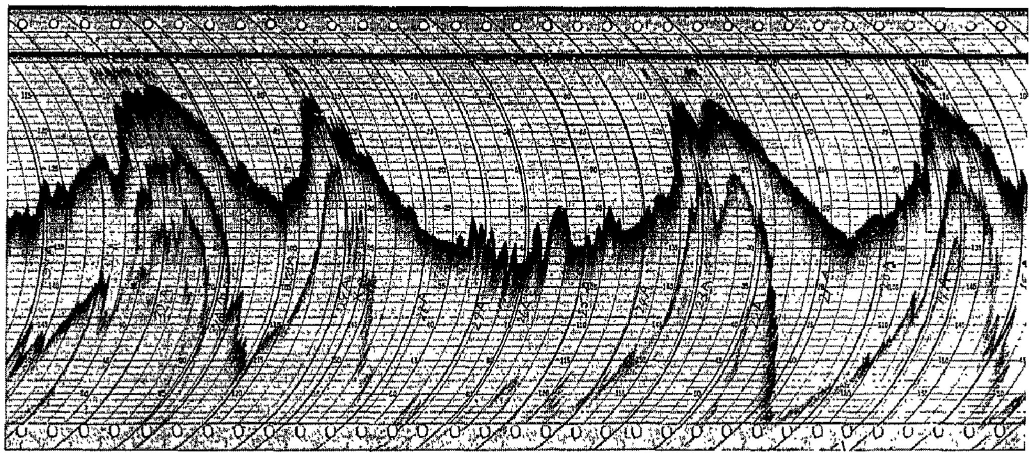

FIGURE 70.—Profile of the sea bottom obtained with a graphic-recording type of echo sounder. Graphic recorders trace electronically a continuous profile of the sea bottom over which the survey vessel is traversing and provide a permanent record (called a fathogram) on specially treated paper for later study. The shoalest depth shown in the figure is slightly over 7 fathoms near the left-hand edge.

for shoal water, and the wire-sounding machine for deep water—have given way to echo sounding (*see* fig. 70),[17] and electronic methods have superseded all previous less accurate methods of positioning the sounding vessel. The latter has undergone more radical changes during the span of the modern nautical chart than perhaps any other technique.[18]

The electronic era in hydrographic surveying began with World War II when Shoran, a form of radar, was developed for strategic aerial bombing. This technique was adapted by the Bureau to the accurate location of a survey ship's position. Being a line-of-sight system, it is limited, under practical operating conditions, to distances of 50 to 75 miles. To extend these limits, a new

17. Echo sounding is an outgrowth of the experimental work begun in 1912 for detecting the presence and nearness of icebergs, and of the submarine-detection devices developed during World War I. A sound impulse emanating from the survey vessel is reflected from the ocean bottom as an echo. The time elapsed for its receipt on the vessel affords a measure of the depth, if the velocity of sound in sea water is known. The latter is dependent upon the existing physical properties of the water—temperature, salinity, and pressure—and is determined during the progress of the survey. SHALOWITZ, SLOPE CORRECTIONS FOR ECHO SOUNDINGS, SPECIAL PUBLICATION NO. 165, U.S. COAST AND GEODETIC SURVEY (1930).

18. From the beginning of hydrographic surveying in this country, the position of the sounding vessel has been determined by sextant angles on signals ashore or afloat. This system is still used for inshore surveys (*see* 542). For offshore surveys, precise dead reckoning was developed together with refinements in celestial observations. Prior to development of modern electronic systems, a method was developed in the Coast Survey, known as Radio Acoustic Ranging (R.A.R.), which utilized underwater sound transmission and radio to determine the distance of the survey vessel from two or more known stations (*see* fig. 7). This method is no longer used. For a discussion of the principles underlying R.A.R. and some of the problems encountered in its use, *see* Shalowitz, *The Physical Basis of Modern Hydrographic Surveying*, 17 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 445 (1931).

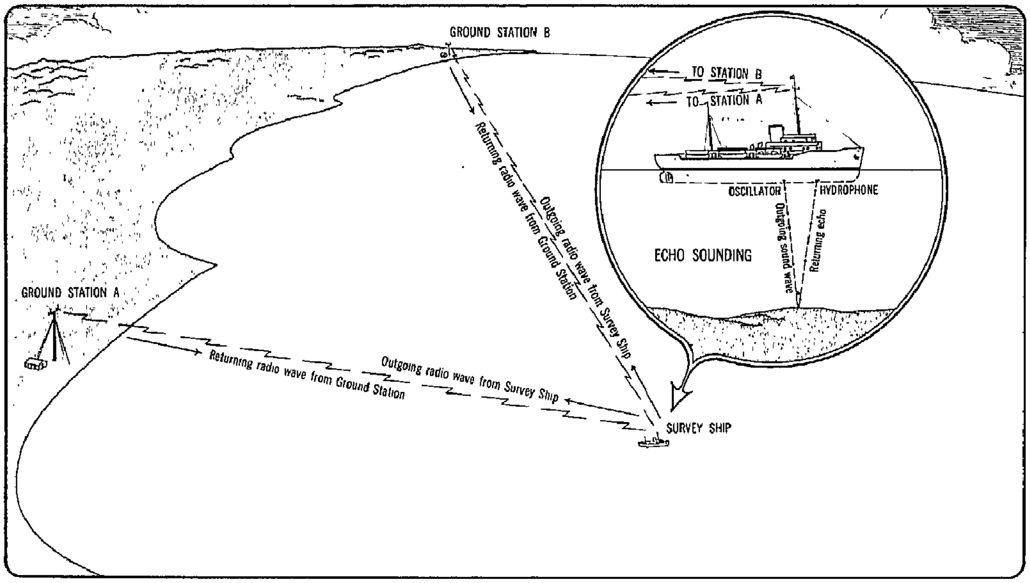

FIGURE 71.—Echo sounding and electronic position determination. While the ship's echo sounder measures the depths by sound, the position of the survey vessel is determined by electronic methods.

electronic device was developed—the Electronic Position Indicator (E.P.I.)—which made possible the precise measurement of distances in excess of 300 miles.[19] More recently, another electronic system—Raydist—using different principles has been utilized by the Coast Survey for determining a survey vessel's position.[20]

The acoustic and electronic methods have steadily pushed seaward the frontiers of accurate hydrographic surveys (*see* fig. 71). They have made feasible the survey of the intricate patterns of our continental shelves and slopes with an accuracy and completeness undreamed of by former methods. The rapidity with which ocean depths can be measured by echo sounding (a matter of seconds compared to the hour or more required by the older methods) has made it possible to take thousands of soundings in areas where formerly only a few scattered ones were economically feasible. Our sum total of geographic knowledge has thus been increased and many heretofore unknown submarine features, of major physiographic proportions, have been brought to light.

19. E.P.I. combined the long-range characteristics of Loran with the distance-measuring features of Shoran. Both Shoran and E.P.I. yield results within the limits of precision required in hydrographic surveying. For references to descriptions and use of these systems, *see* 542 note 30.

20. For references to description and use of this system, *see* 542 note 30.

624. Scientific Chart Making

With each accession of new data, resulting from surveying developments, the nautical chart improved in accuracy standards and in coverage. But the chart also developed in its own right, cartographically. Since publication of the early charts by the Coast Survey there has been a progression of improvements both in the character of the chart and in the methods of reproduction—all designed to enhance its value to the navigator and thus add to the safety of life and property at sea.

Chart making is a combination of the work of the cartographer, who compiles the engineering drawing, and of the engraver or lithographic artist, who translates the drawing into a finished product for quantity reproduction. Chart compilation is a process of selection. The usefulness and accuracy of the chart depend not only upon the material entering into its construction, but also upon the critical appraisal of such material and upon the intelligence with which the essentials are portrayed (*see* fig. 72). "Easy reading is hard writing" may well apply to the modern nautical chart. The skilled cartographer must sift from the mass of data before him the important from the unimportant, the strong from the weak, the stable from the changeable. Some data he rejects entirely, some in part, and from the rest he coordinates and selects the information that is to appear on the finished chart.[21]

In addition to these engineering elements, the compiler is ever conscious of the importance of artistry in the chart. Overcrowding of material is avoided lest it confuse the navigator, and the arrangement is orderly so the chart will not appear off balance. It is just as important to make proper and effective use of various forms of graphic presentation in the chart as it is to study the values of different methods of verbal or written presentation.

6241. *A New Type of Nautical Chart*

The most significant advance in nautical chart design, since the introduction of colors (*see* 6242), was made in March 1939 when the Coast Survey published the first chart in which special emphasis was given to depth contours.[22] The installation of echo-sounding apparatus on naval and merchant vessels signaled the need for a new type of chart—one that would enable the

21. An amazing amount of material is required to produce a single nautical chart. Figure 73 shows the field survey sheets, sounding and tidal records, volumes of triangulation and magnetic data, and miscellaneous reports used in the making of a single nautical chart of the Coast Survey.

22. This was chart 5101A, San Diego to Santa Rosa Island, Calif. *See* Adams, "*On Soundings*," 65 United States Naval Institute Proceedings 1121 (1939).

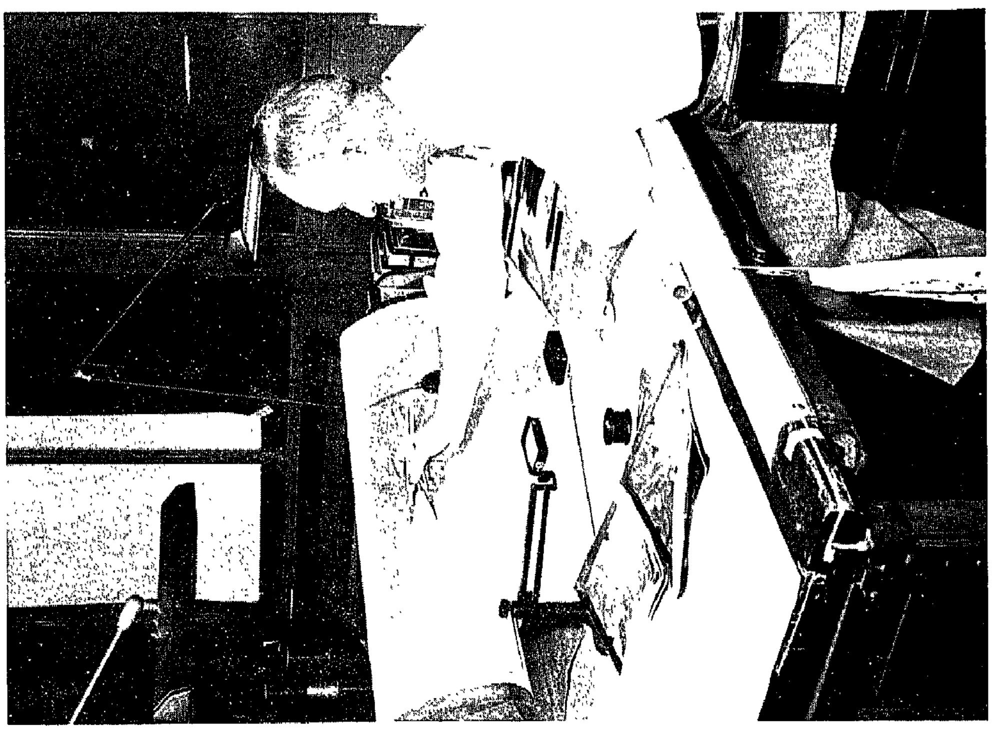

FIGURE 72.—Chart compilation is a process of selection.

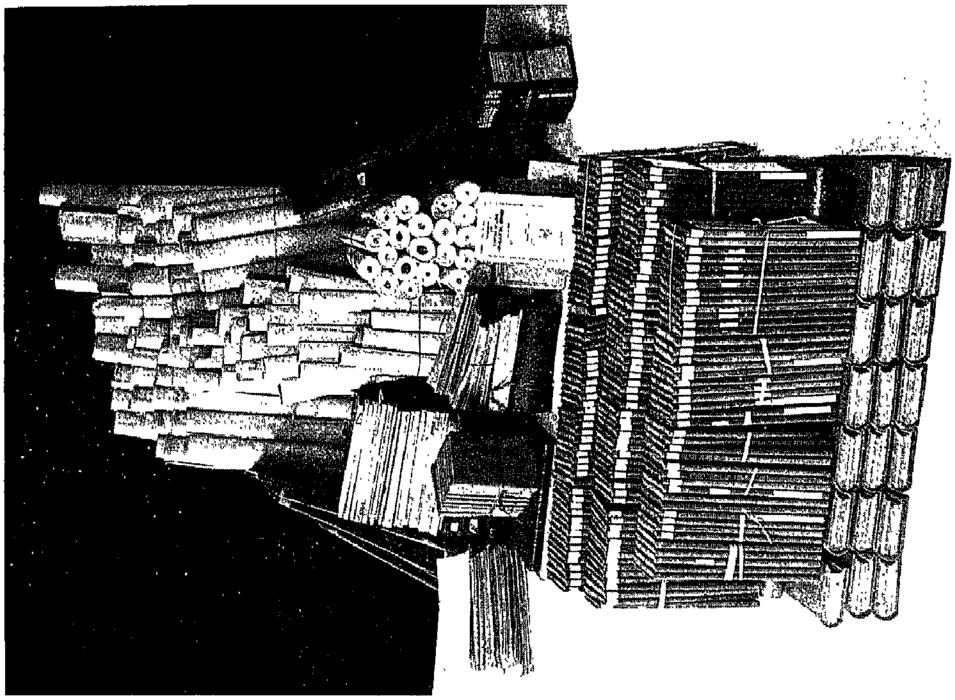

FIGURE 73.—Source material for a single nautical chart.

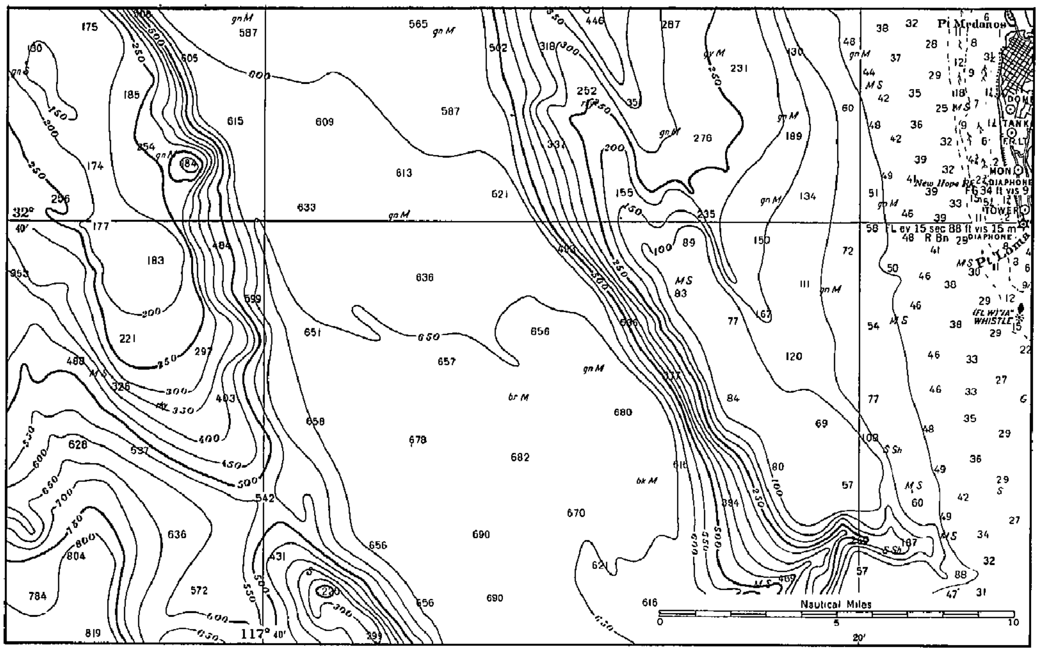

FIGURE 74.—A new type of nautical chart was designed in 1939 which utilized depth contours to emphasize submarine configurations useful to the navigator in locating the position of his vessel. Formerly, charts were characterized by many soundings but few depth contours.

navigator to utilize fully the new sounding technique for fixing his position at sea. It is axiomatic that the more faithfully the chart portrays the submarine relief, the greater will be its usefulness to the navigator. The answer was not found in an increase in the number of soundings charted; this was already a characteristic of the conventional chart. What was called for was a method that portrayed in a simple and usable manner, the wealth of submarine information provided by modern hydrographic surveys. The new chart was the result (*see* fig. 74).

In this chart, depth contours, which are equivalent to land contours on a topographic map, are given special emphasis. In the drawing of the contours, full use is made of all the soundings obtained on the hydrographic survey. Each depth contour, when properly controlled, is the equivalent of an infinite number of soundings of equal depth. Characteristic features of the ocean bottom are brought into prominence. These features are comparable to permanent landmarks and provide the navigator with a simple method for identifying his position by comparing a line of echo soundings with the charted depth contours (*see* 6931(*b*)). Because of the large number of soundings obtained on a modern, echo-sounding survey, the term "depth contour" is appropriate (*see* 563 note 58).[23]

6242. *The Reproduction Process*

On the reproduction side, we have indeed traveled far from the early days of copper engraving and plate printing. Charts of this period were entirely engraved by hand—every line, every figure, and every letter. Many were artistic masterpieces. The fineness of detail that was possible by this method of reproduction afforded the chart engraver an opportunity for artistic expression seldom equalled in any other method. These early charts were all black and white reproductions. Many were embellished with elaborate views of harbor entrances and headlands for the guidance of mariners, one of the finest of these being of Anacapa Island, off the southern California coast (*see* fig. 75), engraved by James McNeill Whistler while employed in the Coast Survey.[24]

The introduction of photolithography in chart reproduction has made it possible to use colors for emphasizing important navigational features—for example, the coloring of buoys to correspond to their colors on the ground; the accentuation of lighted aids to navigation by using a color overprint; and the use of tints for the land and the shoal-water areas. The nautical chart of today is a synthesis of the utilitarian and the artistic, and is suitable for meeting present-day demands for quality and quantity production. Today each rotary lithographic press in the Coast Survey is capable of printing 3 to 5 thousand impressions an hour, as compared with the 100-a-day maximum that was possible with the older method of printing directly from engraved copper plates.

The greatest single contribution the Survey has made to the reproduction process has been the development of negative engraving (now commonly referred to as "scribing") around the turn of the century. This technique was first used as a more economical means of revising nautical charts. Revisions were applied directly to the wet-plate glass negatives using the conventional engraving needles then in use. Later, entire nautical charts were reproduced by this method. The compilation manuscript was photographed on glass

23. This type of chart was not possible before the advent of modern hydrographic methods because the contours could not be delineated with sufficient accuracy. As a matter of historical interest, it should be noted that contours were actually used for delineating the floor of the ocean even before their use on land (*see* 563).

24. Whistler's stay in the Survey was brief but hectic. The rules of the Office he soon found too exacting for his artistic temperament, and he became a habitual late-comer. When chided about it in later years, his biographer tells us, he invariably replied: "It was not that I arrived too late in the morning, but the office opened up too early."

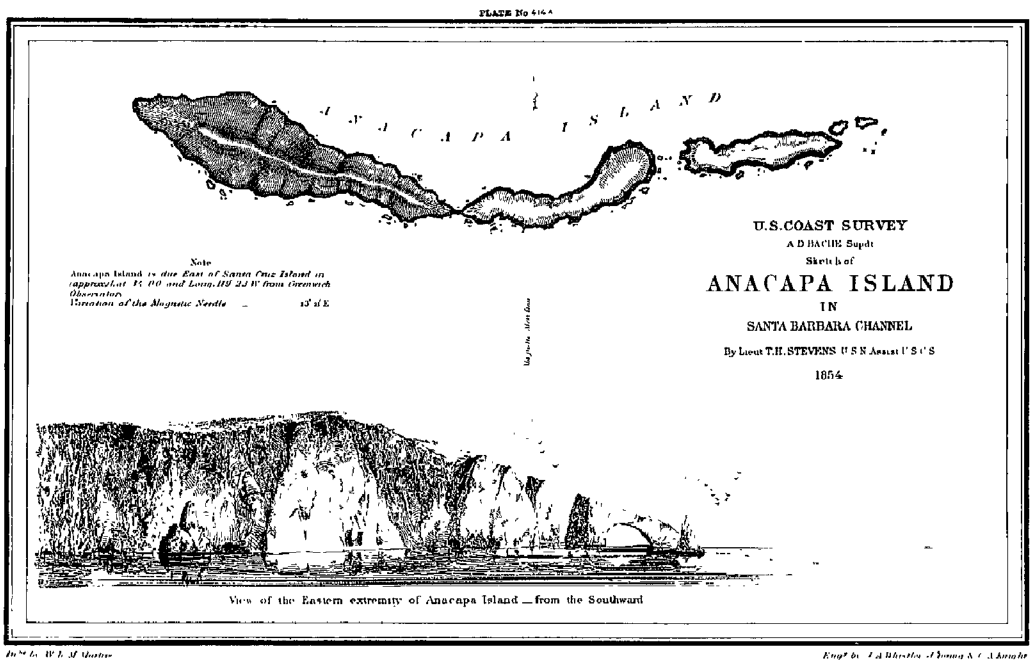

FIGURE 75.—The early charts of the Coast Survey sometimes included sketches of the prominent headlands for the guidance of the mariner. In this sketch of Anacapa Island, Calif., the artistic work of James McNeil Whistler is illustrated.

negatives. These were then coated with an emulsion that was pervious to light and so afforded the engraver with a facsimile of the manuscript. In 1935, the first engraving tool for specific use on glass negatives was designed. A special assignment of reproducing maps for the Tennessee Valley Authority gave impetus to the design of additional tools, and by 1940 all the basic instruments and techniques in universal use today had been perfected in the Bureau. Both glass and plastic are now used for negative engraving. In the Coast Survey, the direction is toward complete conversion from drafting to scribing of final copy, in both the chart production and reproduction stages, so as to realize all of the inherent quality and economy of the technique.[25]

625. Classification of Charts

The design of a nautical chart depends upon the needs of navigation in a particular area. A transoceanic liner, sailing between distant ports and re-

25. For a detailed description of the various steps involved in the production and reproduction of nautical charts, *see* Bruder, *Modern Nautical Charts,* MARINE NEWS 16 (Feb. 1957).

stricted to the main channels in entering a port, does not need the same information on a chart that a small pleasure boat needs while cruising in protected waterways, and which may be required to venture into unfamiliar places. The amount of detail, physiographic and geographic, that can be adequately shown on a chart is dependent on its scale (*see* 131). To meet these different needs, a variety of scales is used, ranging from 1:2,500 to about 1:5,000,000. Large-scale charts cover relatively small areas and are used by the mariner for inshore or harbor navigation; small-scale charts covering large areas are used for offshore navigation. For convenience of reference, Coast and Geodetic Survey charts are classified according to scale as follows:

(*a*) *Sailing Charts,* scale 1:600,000 and smaller, are used for planning and for fixing the mariner's position as he approaches the coast from the open ocean, or for sailing between distant coastwise ports. On such charts the shoreline and topography are generalized and only offshore soundings, the principal navigational aids, outer buoys, and landmarks visible at considerable distances are shown. The 1000 series along the Atlantic and Gulf coasts and the 5000 series along the Pacific coast exemplify this type of chart.

(*b*) *General Charts,* scale 1:100,000 to 1:600,000, are for coastwise navigation outside of outlying reefs and shoals. On this type of chart, features are still generalized to a certain degree but not to the extent of the sailing chart. The 1100 series along the Atlantic and Gulf coasts and chart 5202 along the Pacific coast are examples of General charts.

(*c*) *Coast Charts,* scale 1:50,000 to 1:100,000, are for inshore navigation where the course may lie inside outlying reefs and shoals, for entering or leaving bays and harbors of considerable width, and for navigating large inland waterways. The 1200 series along the Atlantic and Gulf coasts, at a scale of 1:80,000, belongs to this class. This is the largest-scale continuous series of charts along these coasts, and although constructed on the Mercator projection (*see* 613), the latitude extent of each chart is sufficiently limited to allow a uniform scale to be used throughout the chart, thus making it useful for a variety of purposes other than navigation. Along the Pacific coast, a continuous series of Coast charts is available for Puget Sound and surrounding area. Chart 5142 of San Pedro Channel is the only chart of this series along the outside coast.

(*d*) *Harbor Charts,* scales larger than 1:50,000, are for navigation in harbors, anchorage areas, and the smaller waterways. The greatest amount of detail consistent with the scale used is shown on these charts. They show channels, soundings, bottom characteristics, shoreline, depth curves, aids to navigation, cable areas, anchorage areas, and other information. There is no continuous series in this classification.

(*e*) *Intracoastal Waterway Charts,* scale 1:40,000, embrace the inside route of New Jersey; the route from Norfolk, Va., to Key West, Fla.; across Florida from St. Lucie Inlet to Fort Myers, Charlotte Harbor, Tampa Bay, and Tarpon Springs; and from Carabelle, Fla., to Port of Brownsville, Tex. They are special-type charts in both format and content, designed especially for small-boat operators and yachtsmen. In February 1962, a new format was adopted for this series. The charts are accordion folded in a handy folio jacket and are especially suited for plotting in close quarters. As these charts are converted to the new format, they will be included in the Small-Craft series with the letters "SC" added to the numbers (*see* (*f*), below).

(*f*) *Small-Craft Charts,* generally at scales 1:40,000 and 1:80,000, are another of the special series, designed for maximum usefulness to the yachtsman and the small-boat operator. They are issued in folio form or as a single sheet printed on both sides in a suitable folder and contain information in tabular and pictorial form not included on the standard charts of the Bureau. This class of charts was begun in 1959 and thus far (Aug. 1963) is available for Long Island Sound, the Potomac River, the Florida Keys, San Francisco Bay, and Puget Sound. Eventually, such charts will be published covering most of the active coastal boating areas. In some areas, the conventional charts are also being published in folded format with an overprint of small-craft information. These are then designated as Small-Craft charts and the letters "SC" added to the number. (*See* 1271 B.)

63. CHART ACCURACY AND RELIABILITY

The most important criteria by which the value of a nautical chart may be measured are its accuracy, adequacy, and clarity. The accuracy of a chart depends on the quality of the field surveys; its adequacy is a combined responsibility of the hydrographic and the cartographic engineers; and its clarity results entirely from the good taste and judgment which the cartographic engineer injects into the compilation.

Inasmuch as a chart is a compilation of one or more surveys, it is axiomatic that its accuracy must be dependent upon the accuracy and thoroughness of the surveys on which it is based; it cannot be more accurate, no matter how painstaking the process of compiling has been or how artistic the final product is. And, in turn, the date of a survey is, in general, a good indication of its thoroughness, and possible accuracy. A century ago there were such vast unsurveyed areas that the hydrographer was sometimes obliged to subordinate completeness to speed, for even an inadequate chart was better than no chart. Since that time, decade by decade, standards have become stricter, new methods and instrumental equipment have been devised, and new concepts of adequacy have been adopted—all of which have added immensely to the accuracy and reliability of the chart.

The scales of most hydrographic surveys are at least twice, and often several times, as large as the scales of the charts on which the information appears. The effect of this reduction in scale is to reduce the errors of plotting to an amount which, for all practical purposes, is not measurable at the chart scale. On the other hand, a line or dot of 0.01 inch thickness on a 1:80,000 scale chart would represent a distance on the ground of 66 feet, whereas on the scale of the original survey (1:10,000 or 1:20,000) the same line or dot would represent a distance of 8 feet or 16 feet, respectively. It is obvious, therefore, that, if it can be avoided, the chart should not be used for a quantitative determination of shoreline changes, or for the establishment of an early tidal shoreline on the ground, where the original surveys would afford a better criterion.

In evaluating the adequacy or reliability of a chart, one criterion that may be used is the fullness or scantiness of the soundings. Each sounding represents an actual measure of depth and location, but it represents that depth over only a small area. And each line of soundings represents only a narrow width. Consequently, in coral regions, or where rocks and boulders exist, it is always possible that soundings, however detailed, may have failed to find every small obstruction unless the survey has been supplemented by the wire drag and it is so indicated on the chart (*see* 666(*c*)). Large or irregular blank areas among soundings, or absence of depth curves, generally mean that no soundings were obtained in these areas. When the nearby soundings are deep, it may generally be assumed that the water in the blank areas is also deep; when the surrounding water is shallow, or if the chart shows that reefs or banks are present in the vicinity, the possibility is strong that similar conditions exist in the blank areas.

Cognizance must also be taken of the fact that where the bottom is composed principally of mud and sand and strong currents or heavy surf exist, changes in the shore or in the bottom may be relatively rapid and may have taken place since the last survey was made. This is especially true around the entrances to some bar harbors, bays, and rivers. In localities where the bottom is known to change rapidly, notes are usually printed on the chart calling attention to this fact.

The publication of a chart, therefore, by no means completes the problem of the chart maker. Change, not stability, is the order of nature. This finds significant expression along the seacoast and the littoral. Breakwaters and jetties are built, channels and harbors are dredged, and new paths of commerce are opened. Rivers empty vast quantities of sediment near their mouths and thus build out the coastline and change the underwater configurations. Charts must be kept alive if they are to serve their purpose properly. They must be revised frequently to give an accurate and up-to-date picture of existing conditions.

This responsibility for maintaining high accuracy standards and for keeping the navigator fully informed of vital changes in the chart has always been recognized by the Bureau. In recent years, an added element has appeared that has made the Bureau even more conscious of the need for maintaining the highest accuracy standards in its nautical charts. This has resulted from passage by Congress of the Federal Tort Claims Act and the liberality (in favor of claimants) with which the Supreme Court has interpreted it. Because of its implications for federal charting agencies, and because of its importance to administrative officers of the Bureau upon whom rests the responsibility for disseminating navigational information to the seafaring public, the essentials of the act will be discussed together with the interpretations placed on it by the courts in various maritime situations.[26]

631. The Federal Tort Claims Act

The general principle of law involved in suits against the Government is that they cannot be instituted without the Government's consent. This stems from the English common-law doctrine that the King can do no wrong. This doctrine was repudiated in America at quite an early date, but in its place there grew up a legal doctrine that the Crown was immune from suits to which it had not consented. After the American Revolution, the doctrine of consent was invoked on behalf of the Republic and was vigorously applied by the courts. As the activities of the central government broadened, the number of remediless wrongs multiplied—wrongs which would have been actionable if inflicted by an individual or a corporation, but remediless because committed by an agency of Government.

The Federal Tort Claims Act is essentially a waiver-of-immunity statute and marks the culmination of nearly 30 years of effort to mitigate unjust consequences of sovereign immunity from suit.[27] The act waives sovereign immunity of the United States from suits in tort and permits claims for injury "caused by the negligent or wrongful act or omission of any employee of the Government while acting within the scope of his office or employment, under circumstances where the United States, if a private person, would be liable to the claimant for such damage, loss, injury, or death in accordance with the law of the place where the act or omission occurred." [28]

6311. *Limitation of Liability*

The act does not apply to all cases of negligence. The waiver of immunity is circumscribed by 13 exceptions, the most important being the so-called "discretionary function exception," which provides that the act shall not apply to "any claim based upon . . . the exercise or performance or the failure to

26. For a fuller treatment of the act in relation to a particular maritime situation, *see* Shalowitz, *Federal Liability for Failure of Navigational Aids*, 7 Journal, Coast and Geodetic Survey 98 (1957).

27. The act was passed in 1946 as Title IV of the omnibus Legislative Reorganization Act (60 Stat. 842).

28. 60 Stat. 844 (1946). Prior to the passage of the act, the only remedy that an aggrieved claimant had for damages resulting from the negligent act of a federal employee was to have a private bill passed compensating him for the loss sustained. The alleviation of this costly and burdensome procedure of private relief bills was the other facet of the purpose of the Tort Claims Act.

exercise or perform a discretionary function or duty on the part of a Federal agency or an employee of the Government, whether or not the discretion involved be abused." 60 Stat. 845 (1946). It is around this exception that many of the cases revolve.

The act furnishes no yardstick for ascertaining what a discretionary function is, and courts have struggled with this exception ever since the first case arose. In the early cases, the lower Federal courts, lacking Supreme Court interpretation, had applied the exception in the light of the circumstances involved and in an effort to balance the general purpose of the act against the practical necessity of leaving the Government free from crippling interferences. It was natural that such judicial construction would not be uniform, and no satisfactory answer was produced for determining exactly where the delicate line of immunity from liability was to be drawn in the complex scale of governmental operations.[29]

6312. *The Discretionary Function Exception in the Supreme Court*

In the first case to come before the Supreme Court involving an application of the discretionary function exception, the Court sharply divided on the interpretation of the exception with respect to a particular factual situation. The case was one of imposing magnitude resulting from the Texas City disaster in 1947, in which 560 persons died and 3,000 were injured. Out of the holocaust arose 273 claims for wrongful death, personal injuries, and property damage, aggregating some $200,000,000.[30] Faced with a complex factual situation, reflected by an enormous record, the Court—resting on the legislative history of the act, which assured protection for the Government against liability for errors in administration or in the exercise of discretionary functions—held in a 4 to 3 decision that the acts or omissions complained of fell within the discretionary function exception on the basis that the exception includes not only determinations by executives and administrators in establishing plans, specifica-

29. In a number of cases, the rule was adopted that even if the decision is discretionary, once made the Government must thereafter proceed with due care. In other cases, the courts have examined the statute, regulation, or order under which the agency or the employee was operating at the time, and if words expressly providing for the use of discretion, such as "may," were present they were made the basis for the decision. And *contra,* where the statutory language leaves the agency or employee with no choice but to perform an act, courts have held the act to be non-discretionary and must be performed with due care.

30. *Dalehite* v. *United States,* 346 U.S. 15 (1953). The disaster resulted from the spontaneous combustion of ammonium nitrate fertilizer which was being loaded onto ships, under Government auspices, as part of a foreign aid program. The negligence alleged was in the manufacture, packaging, and transportation of the explosive material without warning of the possibility of explosion, and the negligence of the Coast Guard in failing to supervise its storage and in fighting the fire after it started.

tions, or schedules of operations, but also *the acts of subordinates in accordance with official directions.* "Where there is room for policy judgment and decision," the Court said, "there is discretion." (The Court also noted the traditional immunity of public bodies for injuries due to firefighting.)

While the Court made no attempt to define the scope of the exception, but rather chose to apply it in an *ad hoc* manner to the facts in hand, the effect of the decision was to extend the area of discretionary function further down the scale toward the operational level. Nevertheless, it did not close the door to recovery for all subsequent actions arising from a discretionary function.[31]

Two years later, in *Indian Towing Co.* v. *United States, infra,* the Supreme Court came to closer grips, albeit obliquely, with the application of the discretionary function clause, in one of the first maritime tort cases to come before it under the Tort Claims Act. The case concerned the grounding of the tug *Navajo* on Chandeleur Island, La., and the severe damage sustained by its cargo, it being alleged that the grounding was due solely to the failure of the light on the island, which in turn was caused by negligence of the Coast Guard in not keeping the light in repair or give warning that the light was not operating.

The case was dismissed by the District Court for Louisiana on the ground that the Government had not consented to be sued, and this was affirmed by the Court of Appeals for the Fifth Circuit. On appeal to the Supreme Court a hearing was granted because the case presented an important aspect of the still undetermined extent of the Government's liability under the Tort Claims Act. On rehearing, the judgment of the lower court was reversed and the case remanded to the district court for further proceedings.[32]

It was contended by the Government that the section of the act which imposes liability in the same manner and to the same extent as a private individual under like circumstances must be read as excluding liability in the performance of activities which private persons do not perform.[33] But the Court denied that immunity attached to uniquely governmental activities, since all governmental activity is inescapably "uniquely governmental" in that it is

31. Without defining precisely where discretion ends, there is clear implication in the majority opinion that a distinction exists between injuries flowing from decisions made at a planning level and those arising on the operational level.

32. *Indian Towing Co.* v. *United States,* 350 U.S. 61 (1955). At the first hearing before the Supreme Court, the judgment of the Court of Appeals was affirmed by an equally divided Court (4 to 4). On petition for rehearing, the earlier judgment was vacated and the case reargued before the full bench. The Court then voted for reversal by a 5 to 4 decision.

33. This contention followed the holding in *Feres* v. *United States,* 340 U.S. 135 (1950), which denied liability for injury sustained by a member of the Armed Forces, *while on active duty,* through the negligence of others in the Armed Forces, on the ground that no private individual has power to conscript or mobilize a private army, and that the purpose of the act "was not to visit the Government with novel and unprecedented liabilities." The *Dalehite* case, *supra* note 30, followed the same reasoning with respect to firefighting.

performed by the Government. It said that the statute imposing liability on the United States "as a private individual under like circumstances" does not depend upon the presence or absence of identical private activity, and that "it is hornbook tort law that one who undertakes to warn the public of danger and thereby induces reliance must perform his 'good Samaritan' task in a careful manner."

On the matter of the discretionary function exception, the crux of the opinion is contained in the following significant passage:

> The Coast Guard need not undertake the lighthouse service. But once it exercised its discretion to operate a light on Chandeleur island and engendered reliance on the guidance afforded by the light, it was obligated to use due care to make certain that the light was kept in good working order; and, if the light did become extinguished, then the Coast Guard was further obligated to use due care to discover this fact and to repair the light *or give warning that it was not functioning.* (Emphasis added.) [34]

The Court's interpretation of "like circumstances" in the statute as not meaning "identical circumstances" broadens its scope and opens the door to many situations that would otherwise be barred under previous rulings of the Court.[35]

6313. *Maritime Tort Cases in the Lower Federal Courts*

Several cases in the "maritime tort" class have been decided in the lower Federal courts, but all were prior to the Supreme Court decision in *Indian Towing,* and therefore exhibit conflicting interpretations of the act. For example, in *Somerset Seafood Co.* v. *United States,* 193 F. 2d 631 (1951), the Government was held liable for the negligent marking of a wreck on the basis that under the Wreck Acts (30 Stat. 1152 (1899)), the duty to mark and remove the wreck was mandatory. But the court went even further and stated, by way of dictum, that even if the decision to mark or remove the wreck be regarded

34. *Indian Towing Co.* v. *United States, supra* note 32, at 69. On remand (*see* text at note 32 *supra*), the district court found in favor of the United States (on the basis of the evidence) and dismissed the suit on the ground that the "casualty complained of was not caused or contributed to by any act or neglect of governmental personnel but was occasioned solely by negligence, fault, carelessness and incompetence in the maintenance and operation of the *Navajo* and her tow." Of particular interest was the court's finding, as a matter of law, that the *Navajo* was unseaworthy because, among other things, "she did not have tide and current tables, which were necessary navigational information." *Indian Towing Co.* v. *United States,* 182 F. Supp. 264, 270 (1959). This was affirmed by the United States Court of Appeals for the Fifth Circuit in 276 F. 2d 300 (1960), and *certiorari* denied by the Supreme Court in 364 U.S. 821 (1960).

35. *See,* for example, the *Feres* and *Dalehite* cases, *supra* note 33. *See also Sigmon* v. *United States,* 110 F. Supp. 906 (1953), which barred recovery for injuries to federal prisoners, and *National Mfg. Co.* v. *United States,* 210 F. 2d 263 (1954), which barred recovery for injuries arising from an erroneous flood forecast, on the ground that private persons do not operate prisons or disseminate flood information. *But see* text following note 39 *infra* for recent Supreme Court holding with respect to suits by federal prisoners.

as discretionary, there is liability for negligence in marking after the discretion has been exercised and the decision to mark has been made. "There is certainly no discretion," the court said, "to mark a wreck in such way as to constitute a trap for the ignorant or unwary rather than a warning of danger." *Id.* at 635. (This dictum is in keeping with the Supreme Court's holding in *Indian Towing.*)

In *Kline* v. *United States,* 113 F. Supp. 298 (1953), the court refused to go along with the dictum in the *Somerset Seafood* case, and held the Government not liable for failure to rebuild a range light because the Coast Guard had discretion under the statute as to whether, when, and how lights should be restored.[36] The court also held that considering the difficulties and delays that Government departments sometimes experience in getting appropriations even for emergencies, and in drawing specifications, advertising for bids, letting contracts, and getting a job done, even after appropriations have been made, a delay of 3 months in restoring the range light would not constitute negligence.

In *Bray* v. *United States,* 1954 A.M.C. 308 (1953), the complaint charged that the failure of a lighted buoy, maintained by the Coast Guard, to be lighted, or properly lighted, was the cause of damage. In denying recovery, the district court did not rely on the permissive wording of the statute under which the Coast Guard was authorized to establish and maintain aids to navigation, but rather on the ground that it is a provision for fostering shipping and does not declare a duty actionable at law, in equity, or in admiralty. Under the doctrine of the *Dalehite* case, the court held that the discretionary function exception of the Tort Claims Act precluded jurisdiction of the case because the Coast Guard was performing a governmental function.

The case of *Thompson* v. *United States,* 111 F. Supp. 719 (1953), involved damage to a yacht as a result of the mast striking an overhead cable. The cable and height were properly shown on the Coast Survey charts, but no information was given that it was a high-voltage cable. The court found for the United States on the ground that the plaintiff had knowledge of its high-voltage character, and hence the omission of such information from the chart would have no causal connection to the accident. Although the court intimated that the proper place for a warning as to the high-voltage nature of the cable would have been on the nautical chart, it did not pass on the question whether failure to include such information would or would not fall within the purview of the discretionary function exception of the Tort Claims Act.

36. This case appears to be in direct conflict with *Indian Towing,* except for the court's finding that the record failed to show that the Coast Guard did not take adequate steps to warn the seafaring public that the range light was not in operation. The court also distinguished the *Somerset Seafood* case on the basis of the mandatory provision of the Wreck Acts.

Everitt v. *United States,* 204 F. Supp. 20 (1962), is one of the more recent cases involving a maritime tort. This arose as a result of damage to a boat in Aransas Bay, Tex., allegedly caused by the negligence of the Corps of Engineers in not removing broken-off piling which had been submerged for over 6 months. The piling was part of a reference line, consisting of a series of creosote logs, 6 inches in diameter and 20 feet high, placed at intervals of 1,000 feet, which the engineers used for surveying the channel once a year. The Government had contended that the decision to make annual surveys and replacements of reference-line pilings was the exercise of a discretionary function and fell within the exceptions in the act and for which the Government could not be held liable, even if abused. But under authority of the *Indian Towing* case, *supra* note 32, the court held that once the Corps of Engineers exercised its discretion to place reference-line pilings, it was obligated to use due care to make certain that the pilings, when not visible, were not so submerged as to come in collision with the boats using the bay.

6314. *The Recent Supreme Court Decisions*

While the decisions in the lower and higher Federal courts point up the great difficulty of drawing the line where federal immunity ends and liability begins under the Tort Claims Act—witness the closely divided Supreme Court in the *Dalehite* and *Indian Towing* cases—*Indian Towing* marked a definite trend toward a liberal construction (in favor of claimants) of the act generally and the discretionary function exception specifically.[37] This has now been buttressed by three other cases, each of which broadened the base of recovery under the act.

In *United States* v. *Union Trust Co.,* 350 U.S. 907 (1955), the Supreme Court, upon authority of *Indian Towing*, affirmed, in a *per curiam* opinion, the holding of the two lower courts that the United States was liable for the negligence of its control tower operators in regulating air traffic at a public airport, thus clarifying the meaning of the word "discretion" in the act (*see* 6311) as not applying to discretion exercised on the operational level. This narrows federal immunity from suit to those claims for negligence that arise from decisions made on a policymaking or planning level. But it still leaves open the question as to where the operational level begins at which Government liability attaches.

In *Rayonier Inc.* v. *United States,* 352 U.S. 315 (1957), which involved the question of federal immunity from liability for the negligence of the Forest Service in fighting a

37. This was the view taken by the Court of Appeals for the Fifth Circuit in *Fair* v. *United States,* 234 F. 2d 288 (1956), which involved the death of three persons shot by an Air Force officer who had been released from a government hospital following a discretionary decision by the medical staff. The court held that "the Government is liable for the actions of its employees dealing directly with the public in the application of established policies even if such employees are vested with a measure of discretion." *Id.* at 294. To the same effect is *Jemison* v. *The Duplex,* 163 F. Supp. 947 (1958).

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forest fire, the Court, by a decided majority (7 to 2), vacated the judgments of both lower courts and held the intent of Congress to be that losses caused by the negligence of such employees be "charged against the public treasury." *Id.* at 320.[38] In holding that fire-fighting is not immune and that liability can attach to "uniquely governmental" activities, the Supreme Court to this extent overruled the *Dalehite* case. A significant facet of the *Rayonier* case was the Court's holding that "the very purpose of the Tort Claims Act was to waive the Government's traditional all-encompassing immunity from tort actions and to establish *novel and unprecedented* governmental liability." (Emphasis added.) *Id.* at 319.[39] The liberal trend in favor of claimants, evidenced in *Indian Towing* by a narrow margin (*see* note 32 *supra*), was given positive and unmistakable direction in *Rayonier.*

United States v. *Muniz and Winston,* 374 U.S. 150 (1963), is the most recent pronouncement by the Supreme Court on the scope and construction of the act. By a unanimous decion (one justice did not participate) the Court refused to read into the act an implied exception which would have barred federal prisoners from recovery for the negligent conduct of prison employees. It cited and endorsed the *Rayonier* case, by stating: "There is no justification for this Court to read exceptions into the Act beyond those provided by Congress. If the Act is to be altered, that is a function for the same body that adopted it." *Id.* at 166. The Court thus affirmed the finding of the Court of Appeals. It emphasized, however, that the Government is not without defenses since the act relieves it from liability if the claim is based upon *"the exercise or performance* or the failure to exercise or perform *a discretionary function or duty* on the part of a federal agency or an employee of the Government, whether or not the discretion involved be abused." *Id.* at 163. (The question involved was on the right to sue and not on the merits of the case.)

6315. *Implications for Federal Charting Agencies*

The recent Supreme Court cases hold important implications for all service agencies of Government, particularly those that deal with the safeguard and control of marine and air commerce. The present temper of the Court appears to be to hold these agencies to a stricter accountability for acts of negligence that result in injury to the public, and therefore pose new responsibilities for them, both in the matter of an exercise of greater care on the operational level and in the matter of duly warning the public of potential dangers. But neither is the navigator absolved from taking all necessary precautions to avoid disaster, for, in the final analysis, monetary recovery will depend upon the causal connection between the alleged negligence of the Government and the accident, and such matters as the claimant's failure to use the latest nautical charts, *Coast Pilots,* and *Notices to Mariners,* or to have *Tide Tables* and *Tidal Current Tables* aboard, or his failure to listen to daily broadcasts concerning aids and dangers to navigation, will directly affect the outcome. (*See,* for example, the *Indian*

38. The lower courts had dismissed the complaint on authority of the *Dalehite* case (*see* text at note 31 *supra*). This was prior to the *Indian Towing* case.

39. This statement is in conflict with the Court's statement in *Feres* v. *United States* (*see* note 33 *supra*). Since *Rayonier* did not overrule *Feres,* the latter must now be taken as limited exclusively to members of the Armed Forces on active duty.

Towing case on remand (note 34 *supra*) and the *Kline* case (text at note 36 *supra*), where, in denying Government liability, these criteria of prudent care were raised by the trial court.)

For the federal charting agencies, the decisions raise some interesting questions. In the gamut of operations involved in the publication of nautical charts and related data—from the inception of the field survey to the final printing—there are many levels of responsibility, below the overall policy or planning level, where matters of judgment and discretion arise. It is doubtful whether the doctrine of the *Indian Towing* case, limiting federal immunity to the exercise of the initial discretion, would be applicable in such situations. Since this case has not overruled the *Dalehite* case with respect to the level at which liability attaches, perhaps the true interpretation of the Tort Claims Act lies in the direction of both doctrines, and in considering each case on an *ad hoc* basis—in the light of the particular facts involved—keeping in mind the overall purpose of the act as expressed by Justice Frankfurter, namely: "The broad and just purpose which the statute was designed to effect was to compensate the victims of negligence in the conduct of governmental activities in circumstances like unto those in which a private person would be liable and not to leave just treatment to the caprice and legislative burden of individual private laws." [40]

As a result of actions brought under the Tort Claims Act involving Coast and Geodetic Survey charts, two practices have been adopted by the Bureau for safeguarding navigation—the addition of a "power" cable note on the charts (*see* chart 572 at Bush River), which grew out of *Thompson* v. *United States* (*see* 6313); and the addition of a warning note ("Danger Unexploded Bombs and Shells") and a special warning symbol marking the *San Marcos* wreck in Chesapeake Bay (*see* chart 1223).[41]

The Coast and Geodetic Survey has been responsive to the implications of the Federal Tort Claims Act in another area. In the early part of March 1962, the Bureau was faced with a critical charting situation growing out of one of the most turbulent, wind-driven tidal storms ever to strike the Atlantic coast from North Carolina to Long Island. The storm was equally devastating to the nautical charts of the Bureau which were made obsolete by the radical

40. *Indian Towing Co.* v. *United States, supra* note 32, at 68. For a recent treatment of various aspects of the Tort Claims Act, *see* Hunt, *The Federal Tort Claims Act: Sovereign Liability Today,* MILITARY LAW REVIEW 1 (Department of the Army Pamphlet No. 27–100–8, Apr. 1960).

41. This resulted from *Thomson* v. *United States,* 266 F. 2d 852 (1959), in which the court found the *San Marcos* wreck (the wreck of the old U.S.S. *Texas*) to be improperly marked but found the captain of the *Moby Dick* also negligent and therefore applied the admiralty rule of divided damages. On recommendation of the Justice Department to the Coast Survey, following the decision, the danger note and symbol were added to the chart.

changes in the shoreline and the underwater features. Recognizing the need for immediate action to safeguard the navigation of sealanes along the coast, the Survey mobilized a special land, sea, and air task force of about 300 men to resurvey the coastline. Photography was begun on March 13, less than a week after the storm had subsided, and on the following day emergency charting was begun. On March 28, the first 9 chartlets were issued and covered areas of significant change and importance to the mariner, commercial fisherman, and pleasure boatman. By April 13, or one month after the first aerial photographic film was available, 27 such chartlets were distributed for use as overlays on the existing nautical charts (*see* text following note 36 *supra*).[42]

Under Department Order No. 70 (Amended Oct. 26, 1959), the Director of the Survey, subject to approval of the Secretary of Commerce, may settle any claims against it arising out of the Federal Tort Claims Act, where the total amount of the claim does not exceed $2,500. *Regulations,* Coast and Geodetic Survey, at 02502D(1). Department Order No. 70 (Revised May 24, 1963) continues this limitation of amount of claim and sets out the procedures for making such claims.

64. PROJECTIONS FOR NAUTICAL CHARTS

The base or framework for any chart is the projection, that is, the systems of lines that represent the parallels of latitude and the meridians of longitude on the surface of the earth. Without this framework, the chart would lack the property that enables the navigator to plot his position readily and to lay down the ship's course with accuracy and ease. Since it is physically impossible to flatten the surface of a sphere without tearing, it is obvious that a strictly accurate representation of a portion of the earth's surface is not possible on a flat sheet of paper. Some distortion is inevitable, but the smaller the area embraced, the less appreciable will be the errors of representation. The underlying problem in map or chart projection is how to represent a portion of the spherical or spheroidal earth on a flat surface with the least amount of distortion (*see* 31, 32). This is resolved by preserving certain properties inherent in a spherical surface, but at the expense of others. The question of which properties to retain and which to sacrifice depends upon the purpose the map or chart is to serve.

42. For a fuller account of this emergency charting project and some results of the storm, *see Emergency Charting of Storm-damaged Atlantic Coast,* and *New Atlantic Seaboard Chartlets,* 54 THE MILITARY ENGINEER 276, 372 (1962).

641. THE MERCATOR PROJECTION

It was previously noted that the Mercator projection belongs to the conformal class where correct shape is preserved rather than correct size (*see* 613). Some of its characteristics and limitations were there noted. Although often referred to as a cylindrical projection with the cylinder tangent at the equator, it is best to consider it as derived by mathematical analysis, the spacing of the parallels bearing an exact relationship to the spreading of the meridians along a corresponding parallel. This expansion of the latitude and longitude scales approximates the secant of the latitude. The contrast between a perspective projection upon a tangent cylinder and a Mercator projection is shown in figures 76 and 77.[43]

From the standpoint of the user, the Mercator projection has a number of advantages, among which are simplicity of construction, the existence of a general table applicable to any part of the globe, convenience in plotting and scaling positions by latitudes and longitudes from the border divisions of the chart, and the fact that on it a course can be laid off from any meridian or compass rose within its borders. Its principal advantage (*see* 613), however, and the one responsible for its worldwide use for nautical charts, is that a straight line drawn on it in any direction is a rhumb line, or loxodromic curve. The track of a ship on a constant course is a straight line on the projection and will, at least theoretically, pass all features along that line exactly as charted. This is of great value in coastal navigation because the straight line representing a constant course to be made good will indicate at once the distance abeam that dangers will be passed.

Disadvantages of the Mercator projection are that it exaggerates areas appreciably—seriously when large differences of latitude are involved—and that the scale is constantly changing with latitude, so that a graphic scale cannot be used on the smaller-scale charts, and for measuring distances recourse must be had to the border scale for the latitude in which the distance lies (*see* 692). These disadvantages are in addition to that discussed previously regarding the plotting of radio bearings (*see* note 9 *supra* and accompanying text).

43. The only similarity that a Mercator projection has to a cylindrical projection is that meridians may be conceived as formed by passing planes through the earth's meridians, the intersections of the planes and the cylinder tangent at the equator forming straight, vertical lines. If the cylinder is now cut vertically and spread out, the projected lines will form the meridians on the Mercator projection. The dissimilarity between the two types of projections is emphasized in Special Publication No. 68 as follows: "It is thus misleading to speak of the tangent cylinder in connection with the Mercator projection, and it is better to discard all mention of its relation to a cylinder and to view it entirely as a conformal projection upon a plane . . . . The distances of the various parallels depend upon an integral, and the required values are not obtained by any simple formula." DEETZ AND ADAMS (1944), *op. cit. supra* note 11, at 111.

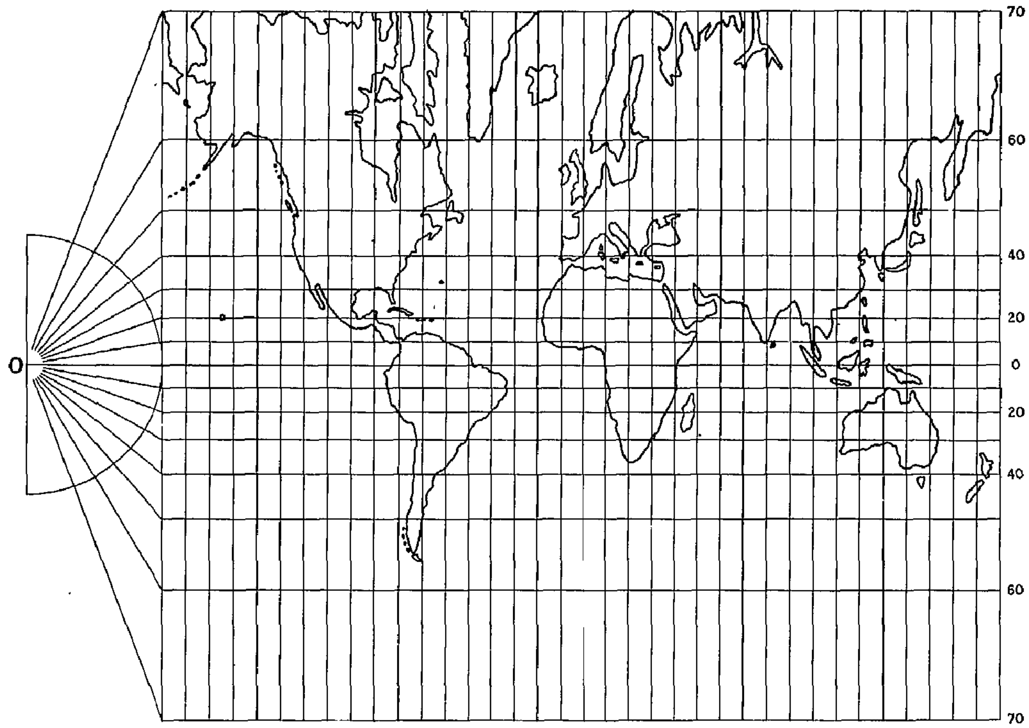

FIGURE 76.—Perspective projection upon a tangent cylinder. The contrast with a Mercator projection is shown in figure 77.

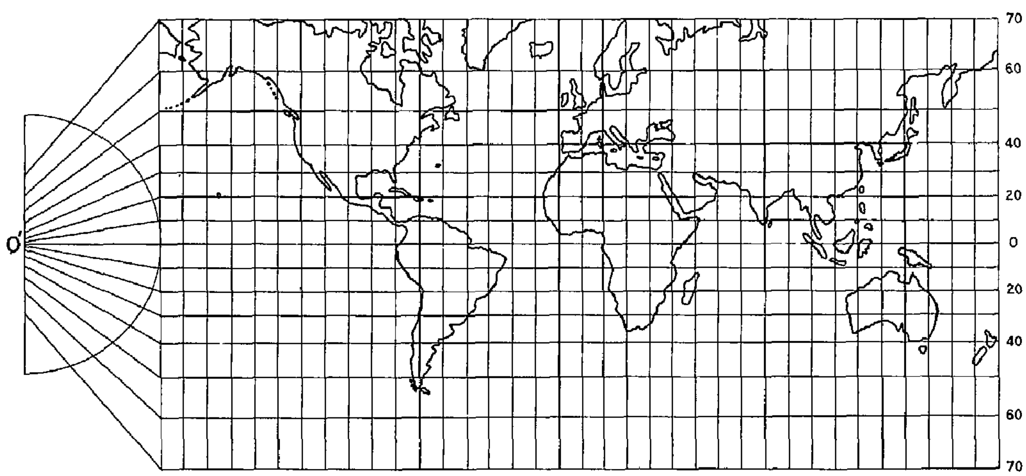

FIGURE 77.—Mercator projection—a comparison.

6411. *Adoption by the Coast Survey*

All nautical charts now published by the Coast and Geodetic Survey are constructed on the Mercator projection. But this was not always the case. The early charts were based on the polyconic projection and some perhaps on the Bonne (*see* 342). The exact identification of a projection on the larger-scale charts is not a simple matter. It was not the practice in the early days to indicate the type of projection on the chart proper. This was a later development and was at first shown only when the projection was other than the Mercator.[44] On small-scale charts, it was relatively simple to identify a polyconic projection by the fact that the parallels are curved and the meridians converge, both characteristics being sensible on charts of scale 1:100,000 and smaller.

As near as can be determined at the present time, chart 52, Montauk Point to New York and Long Island Sound (scale 1:200,000), issued October 1889, was the first to be constructed on the Mercator projection.[45] This was evidently an experimental chart and did not at this time represent a definite conversion to the Mercator projection. Charts continued to be published on the polyconic projection. By 1899, only a few charts had been published on the new projection.[46]

The real impetus to general conversion to the Mercator projection was provided by Superintendent Tittmann on March 10, 1910, when he named a chart board to study "in the most comprehensive manner the subject of the Coast Survey Charts" and to submit, among other things, a general scheme for

44. The placement of the name on the chart, when given, varied between the upper right-hand corner and the title. On chart 188, Mobile Bay and Entrance (1894 ed.), the name of the projection (polyconic) was given in the title. The definite change to the title was approved Oct. 5, 1954, and this is the present practice. *New Format for Nautical Charts*, 6 JOURNAL, COAST AND GEODETIC SURVEY 151 (1955).

45. This is based on the following research: Apparently, beginning with about 1880, and perhaps a few years prior thereto, a study was undertaken relative to adopting the Mercator projection. In a report by Charles A. Schott (dated Sept. 15, 1875), in the Annual Report for 1880 (page 290), it is stated: "Mercator's projection is generally employed for the purposes of navigation." And at page 296, the report states: "In conclusion, it is believed that, with respect to projection, the above investigation tends to commend the harbor, coast and sailing charts of the Coast Survey to the fullest confidence of the geographer as well as of the mariner." This would seem to indicate that as of this date no change was contemplated. The Annual Reports for 1888 and 1889 are silent on the matter of using a new projection, as is the Annual Report for 1890 which lists chart 52 as a new chart issued, but without further comment. However, *Notice to Mariners* 121, of Oct. 31, 1889, lists this chart as being on the Mercator projection.

46. There is some evidence that in 1900, the sailing charts were published on both projections. The basis for this is the statement promulgated in 1900 that "The sailing charts are on a small scale, their limits generally extending to a distance over 400 miles from the coast line and covering an area where the position of the ship would be fixed by astronomical sights. For these limits the navigator is given his choice of either the Mercator or polyconic projection, the Survey publishing both." NOTES RELATIVE TO THE USE OF CHARTS 20, SPECIAL PUBLICATION NO. 6, U.S. COAST AND GEODETIC SURVEY (1900). It is doubtful whether charts of the same area and the same scale were published on both projections. The chart catalog of 1900 states at page 13 that "some of the first two classes of charts [sailing and general] are on the polyconic projection and others on the Mercator projection." This seems more likely what was done.

"the kind of projection to be used on the respective scales."[47] The board submitted two reports pertaining to the projection to be used. The first (dated Apr. 27, 1910) dealt with charts on a scale smaller than 1:100,000. It recommended that all such charts constructed in the future should be on the Mercator projection, and all existing charts in that category should be converted to this projection. The second report (dated June 13, 1910) dealt with charts of scale 1:100,000 and larger. New charts in this category were to be based on Mercator and existing charts were in general to be converted only when new drawings or engravings were made or when a large part of the chart was revised.[48] This program has been implemented over the years and today (Aug. 1963) very few unconverted charts remain.

6412. *The Scale of a Mercator Chart*

The scale of a chart is the ratio of a given distance on the chart to the actual distance which it represents on the earth (*see* 131). On a Mercator chart, the scale, by construction, varies with the latitude, increasing progressively from the lower to the higher latitudes. This basic principle of the Mercator projection is fundamental in the measurement of distances on the smaller-scale charts (*see* 692). The standard scale of a Mercator chart generally applies to the scale at its middle latitude because that would be the mean scale of the chart, the scale becoming larger north of this latitude and correspondingly smaller south of this latitude.

There are two methods of designing a Mercator chart or series of charts with respect to scale: (1) to maintain a uniform construction scale at a selected latitude for each chart, and (2) to hold the adopted scale correct for a selected latitude of a series of charts. In the first, the mean scale will be the same for all the charts of the series, but the charts will not join accurately, the scale at the northern limit of each chart being greater than the scale at the southern limit of the adjoining chart. In the second method, the charts will all join accurately and the scale of adjacent charts will be the same in the overlapping

47. Letter of Mar. 10, 1910, from Superintendent Tittmann to G. R. Putnam, Chief of D. & E. Division. In this letter, it is stated: "In about 1899 it was decided that all charts on a smaller scale than 1:200,000 should be published on the Mercator projection." Prior to the naming of the board, the Secretary of the Navy had urged the adoption by the Coast Survey of the Mercator projection without regard to scale, as is indicated by his Letter of Feb. 26, 1910, in which it is stated that the 13 navigators of the battleships of the Atlantic fleet urge that "a strong appeal should be made . . . to have all Coast and Geodetic charts that are intended for the use of mariners plotted by Mercator projection." In his reply of Mar. 4, 1910, the Acting Secretary of Commerce and Labor stated that "the Coast and Geodetic Survey has for some time past published the general sailing charts and some others on the Mercator projection, and is extending it to others of larger scale as rapidly as facilities permit."

48. The recommendations of the chart board were approved by Superintendent Tittmann on July 15, 1910.

area. This results in greater convenience in navigating on adjacent charts. But the actual scale of each chart will vary from the standard scale adopted for the series. In the Coast Survey both methods are used in the following arrangement:

The 1200-series charts of the Atlantic and Gulf coasts, scales 1:80,000, are constructed at the scale of the middle latitude of each chart. The use of these charts in series is less important than their individual local use, and the slight break in scale between adjoining charts causes less inconvenience than would the variation in scale of the series, if constructed to the scale of the middle latitude of the series.[49]

The 1100-series General charts of the Atlantic and Gulf coasts are based on the scale of 1:400,000 at latitude 40° (charts 1107 and 1108). The different charts of the series therefore vary in scale but the charts join exactly. This also applies to the following three groups:

General charts of the Pacific coast, San Diego to Strait of Juan de Fuca, are constructed to the scale of 1:200,000 at latitude 41° (chart 5602).

General charts of the Alaska coast, Dixon Entrance to Unalaska Island, are constructed to the scale of 1:200,000 at latitude 60° (charts 8551 and 8552).

Sailing charts of the Pacific coast, San Diego to the western limit of the Aleutian Islands, are constructed to the scale of 1:1,200,000 at latitude 49° (chart 5052).

The 1000-series Sailing charts of the Atlantic coast are constructed to the scale of 1:1,200,000 at a selected latitude of each chart. This gives a nearly uniform scale for the series with no marked discontinuity at the junctions.[50]

The scale shown on the chart and in the nautical chart catalog is generally not a construction scale but a computed scale that approximates the mean scale of the chart. It is the natural scale at about the middle latitude of the chart. For example, the scale given on chart 1110 and in the catalog is 1:432,720, but the construction scale is 1:400,000 at latitude 40°.

The general subject of the scale of a survey or chart, including the method of determining scale, has been previously considered (*see* 131) and need not be repeated here. On a Mercator chart, the scale may be expressed by giving the natural or fractional scale, by a numerical scale, or by means of a graphic or linear scale. In addition, the east and west border subdivisions of the chart form

49. The Atlantic and Gulf coasts of the United States cover a latitude range of 20 degrees, extending from latitude 25° to latitude 45°. If the coast charts were constructed on a scale of 1:80,000 in latitude 35°, the actual scale would be 1:69,000 at the north end of the series and 1:88,000 at the south end. The chart board of 1910 (*see* text at note 47 *supra*) therefore recommended that the 1:80,000 series of Coast charts, and "in general for other series of charts of scale 1:100,000 and larger," be constructed with the scale true on its own middle latitude. This is the practice today.

50. Where a chart covers so large an expanse that for general navigational use a vessel would be within the limits of the chart on a single cruise and the need for junctions with other charts to be on the same scale is not so important, the charts are based on a uniform construction scale at a selected latitude for each chart. Thus, charts 1000, 1001, and 1002 are at scales 1:1,200,000 at latitudes 40°, 31°34′, and 25°11′, respectively. Chart 1007, which covers the entire Gulf of Mexico, is not constructed in series with overlapping charts 1001 and 1002, but is based on a scale of 1:2,000,000 at latitude 33°46′.

a scale for measuring distances on small-scale charts and these are termed latitude scales.

(*a*) *Natural Scale.*—The natural scale of a chart may be expressed as a simple ratio (1:80,000) or as a fraction $\left(\frac{1}{80{,}000}\right)$, which means that one unit of distance on the chart—for example, an inch—represents an actual distance of 80,000 of the same unit on the surface of the earth. This is also referred to as a "fractional scale" and the fraction is termed the "representative fraction" or the "R.F." of the chart (*see* 1311).[51]

(*b*) *Numerical Scale.*—This form of scale is in reality merely a statement of the distance on the earth represented by one unit on the chart—for example, "1 inch equals 20 miles," "3 inches to the mile," etc. On Mercator charts, a numerical scale can also take the form of "1° of longitude equals 2.50 inches." From the nature of the Mercator projection, irrespective of scale, the distance between meridians is the one constant value on this type of chart.[52]

(*c*) *Graphic Scale.*—In this type of scale, a line or bar is subdivided into nautical miles, yards, etc. A graphic scale is used on Mercator charts only when the chart is of such scale, or limited north-south extent, that there is practically a uniform scale throughout the chart. In the Coast Survey, a graphic scale is used on nearly all nautical charts of scale 1: 80,000 or larger (*see* fig. 26), in addition to the natural or fractional scale.[53]

(*d*) *Latitude Scale.*—On Mercator charts of scales 1: 100,000 or smaller, the east and west borders are subdivided in degrees and minutes to indicate a latitude scale. It is in a sense a variant of the graphic scale, since a minute of latitude is very nearly equal to a nautical mile. Inasmuch as the scale of a

51. On the nautical charts of the Bureau, the ratio form is used. This is also the form used throughout this publication.

52. The numerical scale of a chart may be readily converted to a natural scale and vice versa. Thus, if the numerical scale is 1 inch=20 nautical miles, and a nautical mile (international) equals 6,076.115 feet, or 72,913.38 inches (*see* note 148 *infra*), then the natural scale would be 1: (20 x 72,913.38), or 1: 1,458,268. Similarly, if the natural scale of a chart is 1: 80,000, one inch of the chart represents 80,000 inches on the earth. The numerical scale would then be $\frac{80{,}000}{72{,}913.38}$, or 1.097 nautical miles (international) to an inch. Stated differently, the scale would be $\frac{72{,}913.38}{80{,}000}$, or 0.911 inch to a nautical mile (international).

53. Graphic scales have been shown on the nautical charts of the Bureau from the earliest time. When the polyconic projection was used there was no limitation on the use of such scale, since one of the properties of this projection is that one scale may be used for any part of the chart. Graphic scales showing nautical miles, statute miles, yards, and kilometers have been used at different times. The nautical mile scale was always shown. The kilometer scale was shown on charts from about 1877 to 1917. The present practice is to show at least two graphic scales—one in nautical miles and one in yards. Other graphic scales, in statute miles and in feet are sometimes shown. EDMONSTON, NAUTICAL CHART MANUAL 9, U.S. COAST AND GEODETIC SURVEY (1956). On Intracoastal Waterway charts, a scale of statute miles is also used.

Mercator chart varies with the latitude, it is important to keep this in mind when using the latitude scale for measuring distances on the chart (*see* 692).

642. State Plane Coordinate Grids

In areas where the Corps of Engineers use the State Coordinate Systems (*see* Part 1, 2113 B) for control, dashed tick marks at 5,000- or 10,000-foot intervals are added in the borders of large-scale charts (*see* chart 6151). Intermediate tick marks are used in the center of the chart in the land areas where the chart has a considerable extent in an east-west direction, in order to take into account curvature. A note on the chart indicates the name of the grid and the interval of the tick marks.[54]

65. SIGNIFICANT FEATURES ON NAUTICAL CHARTS

A nautical chart consists of many features, both topographic and hydrographic. Over the years, certain practices have been developed for their representation, but some of the early ones are still in use; others have been modified; and still others have been discontinued, or superseded by new practices. A proper interpretation of these features is essential for an understanding of their significance and use by the navigator or by the investigator.

651. The Soundings

The soundings, or depths, are without doubt the most significant single feature that appears on a chart, for it is these depths that determine where a vessel can and cannot safely navigate. Vertical numerals have always been used, designed in size to permit a representative selection being made.

There are two important aspects of a depth that must be kept in mind when reading a chart—(*a*) the unit in which the depths are expressed, and (*b*) the sounding datum or plane to which they are referred. Associated with the depth is another aspect (*c*) the character of the bottom.

(*a*) *Depth Unit.*—Coast Survey charts have always carried a note giving the depth unit or units used. But the units used have differed during different periods and on the different coasts. There were of course exceptions even after a change in policy was adopted. These were due in some cases to the par-

54. *Id.* at 67. By connecting the tick marks with straight lines, they can be used for control of Corps of Engineers surveys. If the chart were on the same projection as the State Coordinate System in use for the area, then the plane coordinate grid would be truly rectangular.

ticular needs of an area, and in other cases it was a matter of a chart being reissued after a change in policy, but not reconstructed.

The early practice—prior to about 1852—was to chart the depths in feet. The practice of using "feet" to depths of 18 feet, and "fathoms" beyond was then inaugurated.[55] The use of the double unit continued into the 1900's. In 1911, the sailing charts on the Pacific coast changed to using fathoms only. The policy of using only feet on some charts was established in 1915, and the use of two depth units on one chart eliminated.[56]

Before 1920, the depths to which fractions were used were not uniform. Some charts used ¼ fathoms to 20 fathoms, while others used it to 10, and ½ fathoms to 20. In 1920, the general policy was to use ¼ fathoms to 7 fathoms, ½ fathoms to 8, and whole fathoms beyond, except adjacent to the 10-fathom curve where, in flat bottom, ½ fathoms were used to avoid displacement of the curve. No fractions were used on charts expressed in feet.[57]

The present practice is to use one depth unit only—feet or fathoms, or the combined form of fathoms and feet to 11 fathoms—throughout a single chart. General and Sailing charts along all coasts, and Coast charts along the Pacific coast use fathoms as the depth unit. On all other charts on the Atlantic and Gulf coasts the depth unit is feet, as is the case with most of the harbor charts on the Pacific coast. Charts of Alaska and the Hawaiian Islands are generally in fathoms. When the combined form of fathoms and feet is used, the foot part of the sounding is shown as a subscript. Thus, 6 fathoms 1 foot would be charted as 6_1.

(*b*) *Sounding Datum.*—The sounding datum, or the chart datum as it is sometimes called, is the plane of reference for the charted soundings and is based on tidal definition. It follows the plane of reference used on the hydrographic surveys on which the chart is based (*see* 564). The planes differ on the different coasts because the characteristics of the tide differ.[58]

Along the Atlantic and Gulf coasts, the early practice was to use a sounding datum referenced to low water spring tides. It was designated as "lowest spring tides observed" (New York Harbor chart of 1845) or as "mean low water, spring tides" (Long Island Sound chart of 1855). When such a plane

55. The New York Bay and Harbor chart of 1866 used the double unit except in some rivers, where only feet were used. The Potomac River charts used only feet in 1864.

56. Annual Report, U.S. Coast and Geodetic Survey 141 (1915).

57. Flower, Rules and Practices Relating to the Construction of Nautical Charts 22, Special Publication No. 66, U.S. Coast and Geodetic Survey (1920).

58. Along the Atlantic coast there is the semidiurnal type of tide with two tides a day of approximately equal range; in the Gulf of Mexico, the diurnal type is the predominant tide with but one high and one low water in a tidal day; and along the Pacific coast, the mixed type of tide prevails, with two high waters and two low waters each tidal day and an inequality in successive high-water heights, in successive low-water heights, or in both.

was used, the tide note on the chart gave information for determining the plane of mean low water. Other early charts used mean low water as the sounding datum. The present practice is to use the plane of mean low water. This also applies to Puerto Rico.[59]

Along the Pacific coast, the early practice was to use a sounding datum of mean low water. Beginning in about 1853, the datum of mean lower low water, or something equivalent thereto, was used (*see* 5642). The exception was the Puget Sound area where sounding datums varied from mean low water, to mean of selected lowest low waters, to harmonic or Indian tide plane, to 2 feet below mean lower low water, to mean lower low water in 1921 (*see* 5643).

In Alaska, the early practice (1867–1897) was to use mean lower low water and the mean of a few selected lowest lows, depending on the locality. Then the harmonic tide plane was used, with some exceptions. This was later replaced by a plane 2 feet below the mean of the lower low waters. Finally, in 1908, the datum was changed back to mean lower low water except in Wrangell Narrows where it was 3 feet below mean lower low water. This exception was eliminated in 1929. (*See* 5644.)

The present practice for charts along the Pacific coast, Alaska, and the Hawaiian Islands is to use the datum of mean lower low water throughout.[60]

Both the depth unit and the sounding datum on all present-day charts are prominently displayed in the title.

(*c*) *Bottom Characteristics.*—A feature associated with the soundings on a chart is the character of the bottom. The reasons for obtaining and charting bottom characteristics have been discussed in 567. Their value to the navigator under certain conditions has been recognized from the beginning of the Coast Survey. A feature of the early charts was the large number of detailed bottom characteristics included. Abbreviations were generally used for color but the type of bottom was often written out. The early charts also contained tables of abbreviations for bottoms.[61]

The present practice is to show a reasonable number of characteristics over the chart. Generally, two words, or their abbreviations, are used. In harbors, inland waters, and along the coast, where the navigator might be interested

59. This is derived by averaging all the low waters during the required cyclical period, but where tides are predominantly diurnal, with days when two low waters are recorded, as in the Gulf of Mexico and along the south coast of Puerto Rico, the plane of mean low water is derived by using only the lower of the two low waters on those days when the tide becomes semidiurnal (*see* Volume One, Part 2, 1613).

60. This is derived by averaging all the lower low waters during the required cyclical period. For the Columbia River this datum is determined during lowest river stages and is known as the Columbia River Datum (*see* 5645).

61. The value of bottom characteristics to the navigator in the early days is indicated by the complete descriptions of their use with characteristic soundings given in the *Coast Pilots* of 1878 and 1880 for navigating Nantucket Shoals during foggy weather.

in the holding quality of the bottom, the type or character is given, while in deep water the type and color are given as a possible aid in position determination.

652. Depth Contours

Depth contours, or curves of equal depth, are an important feature on a nautical chart. They bring order out of what may otherwise appear to be chaos. If clearly shown, they represent a great aid in interpreting the soundings and in emphasizing the submerged dangers and the safe channels (*see* 563). Depth curves have been used on nautical charts from a very early period, but in recent years they have come into greater prominence and wider use with the advent of echo sounding. This has also resulted in a changed symbolization.

(*a*) *Early Symbolization.*—Depth curves on sketches and preliminary charts (*see* 123) were shown by dotted lines. The dots were arranged in groups to indicate the depths in fathoms—single dots for the 1-fathom curve, two dots for 2 fathoms, and three dots for 3 fathoms. On finished charts, sanding was used to show depths of 3 fathoms or less (*see* 663). Additional curves were sometimes shown and in such cases were labeled on the chart. As surveys were extended farther offshore more depth curves were added, symbolized by a combination of dots and short dashes to indicate multiples of 10 fathoms. Under 10 fathoms, dashed lines were used but they did not always represent the same depth on contemporary charts and had to be either labeled on the curve or shown in a note on the chart.

(*b*) *Present Practice.*—The year 1939 marked a definite change in charting procedure insofar as depth curves were concerned. In that year, an experimental chart was published which was designed to utilize to the fullest extent the wealth of submarine information furnished by echo-sounding surveys (*see* 6241). The *many soundings and few depth curves* design of the then conventional chart was replaced by the *many depth curves and fewer soundings* design of the new chart.[62] The first such chart showed the 3-, 10-, and 20-fathom curves in black using the conventional dot and dot-dashed lines, and each 50-fathom contour thereafter in a solid blue line, with a blue tint from the shoreline to the 50-fathom depth contour. As echo-sounding surveys became available in various areas and the charts were revised, more depth contours were added but with this modification: continuous, black contours were used

62. Since each depth contour represents an infinite number of equal depths along that contour, there are in reality more "soundings" on the new chart than on the old. The term "depth contour" is appropriate where the depth curves are based on modern echo-sounding surveys (*see* 563 note 58).

in the tinted area and for contours of greater depth when not extensive; when extensive, blue was used.[63] Regardless of color, the depth contours are continuous when based on modern, adequate surveys, and dashed in areas of inadequate surveys.[64]

The practice in 1963 is to use continuous, solid contours in black, where formerly they would have been charted in blue. However, there is no present program for any systematic conversion from blue to black, and there will be charts with blue depth contours for many years to come.

Depth contours are labeled in the same unit as the soundings, and include within their limits all soundings of the same depth as the contour.

653. Aids to Navigation

Aids to navigation, as the name implies, are shown on charts to assist the mariner in navigating his vessel from one place to another. Charted aids fall into two general classes—fixed aids, and floating aids. Among the first are lights, daybeacons, and radiobeacons; among the second are lightships and buoys. Brief notes usually accompany the various aids regarding their characteristics, such as shape of buoys, period of flashing of lights, and the elevation and visibility of the larger lights. The number of aids shown and the amount of information concerning them varies with the scale of the chart. This discussion will be limited to buoys only.

6531. *Buoyage System in the United States*

Of the various types of aids to navigation shown on nautical charts, buoys occupy a most important place because they provide an economical and flexible system in which modifications can be readily made to accommodate the system to changes in underwater configurations. They can be moored close to the track of vessels to mark shortest routes and by their use constricted natural channels are sometimes made available to navigation that otherwise would

63. Edmonston (1956), *op. cit. supra* note 53, at 48. The term "extensive" was used to denote the closeness of the selected contours for a given area. If the contours were so close as to detract from the soundings, blue was used; otherwise they were shown in black. For example, chart 322 (1958 ed.) of the approaches to Penobscot Bay has 4 black contours within the tinted area and 4 blue contours outside; chart 1114 (1952 ed.) of the Gulf of Mexico has 12 black contours; and chart 1107 (1945 ed.) of the Cape Cod area has 15 blue contours.

64. *See* chart 322 (1950 ed.). When charts contain areas covered by modern surveys and areas with only reconnaissance or very early surveys, the depth contours are drawn only to the limits of the former (*see* chart 1106 (1955 ed.)).

be unusable. The present system of marking and numbering United States buoys dates back to September 28, 1850, when Congress passed "An Act making Appropriations for Lighthouses, Light Boats, Buoys, etc." [65] Conformity as to shape resulted from the recommendations of the International Marine Conference of 1889.[66]

The waters of the United States are marked by the *lateral system* of buoyage. The positions of marks in this system are determined by the general direction taken by the mariner when approaching a harbor, river, estuary, or other waterway from seaward. The principal buoyage in United States waters consists of *red* buoys and *black* buoys, and follow a simple rule as to color, shape, and numbering:

> On entering a harbor from seaward, the right or starboard side of the channel is marked by conical shaped buoys (termed nun buoys) painted red with even numbers, while the left or portside is marked by cylindrical shaped buoys (termed can buoys) painted black with odd numbers, the numbers for each side increasing from seaward. *Red-Right-In* is an easily remembered aid.[67]

Other types of buoys used for special markings are: *Red and black horizontally banded* buoys to mark junctions or bifurcations of channels, or an obstruction that can be passed on either side; *black and white vertically striped* buoys to mark the center of a channel that can be passed close aboard; and special purpose buoys which may be white, yellow, orange, green, or a combination of colors.

6532. *Symbolization of Aids on Charts*

It was noted previously that the early charts of the Survey were engraved on copper and printed directly from the copper plates (*see* 6242). These charts

65. 9 Stat. 500. Section 6 of the act provided: *"And be it further enacted,* That hereafter all buoys along the coast, or in bays, harbors, sounds, or channels, shall be colored and numbered, so that passing up the coast or sound, or entering the bay, harbor, or channel, red buoys with even numbers shall be passed on the starboard hand, black buoys with uneven numbers on the port hand, and buoys with red and black stripes on either hand. Buoys in channel ways to be colored with alternate white and black perpendicular stripes." *Id.* at 504. The use of distinctive colors for buoys was first proposed in 1838, but was not adopted until 1847 and then only in a portion of Long Island Sound. Annual Report, U.S. Coast Survey 64, 67 (1847).

66. Bowditch, American Practical Navigator 29, H.O. Pub. No. 9, U.S. Navy Hydrographic Office (1958).

67. As all channels do not lead from seaward, arbitrary assumptions are at times made in order that the system may be consistently applied. Buoys along the coast and used in coastwise navigation have characteristics based on the assumption that proceeding "from seaward" constitutes a southerly direction along the Atlantic coast, a northerly and westerly direction along the Gulf coast, and a northerly direction along the Pacific coast. On the Intracoastal Waterway, proceeding in a generally southerly direction along the Atlantic coast and in a generally westerly direction along the Gulf coast is considered as proceeding "from seaward." *Id.* at 977.

were all black and white reproductions. It was therefore not practical to have the buoys correspond in color to their actual colors in the water. The practice was to chart a black buoy or the black part of a buoy in black and merely show the outline for any other color, a note near the buoy giving the color.

The advent of lithography in chart reproduction just after the turn of the century brought with it a significant change in the symbolization of buoys and lighted aids to navigation. Buoys were now colored to correspond to their actual colors in the water, and lighted aids were accentuated by using a color overprint.

Except for the very early period, buoys, other than mooring, were shown by a diamond-shaped symbol and a small dot at the base of the symbol, the dot marking its position. This is the practice today. All buoys other than black ones carry abbreviations indicating their colors, regardless of the color shown on the chart. Modern charts use a magenta overprint for unlighted red buoys, and a small magenta disc centered on the dot at the base of the buoy symbol for lighted buoys.

In charting aids to navigation, it is the practice to omit them on small-scale charts when they are completely shown on overlapping large-scale charts.

654. PLANES OF REFERENCE

Besides the sounding datum (*see* 651(*b*)) two other planes of reference are used on nautical charts—(*a*) for elevations, and (*b*) for the shoreline.

(*a*) *Elevations.*—The plane of reference for elevations is mean high water. This applies to the elevations of rocks, bridges, landmarks, and lights. Contour and summit elevation values are given in feet and refer to mean sea level, if the source for such information is referenced to this plane.[68]

Associated with the elevations of alongshore rocks is their symbolization on the nautical chart. This follows the criteria used for the hydrographic surveys (*see* 5655) and is discussed in 666.

(*b*) *Shoreline.*—The plane of reference for the shoreline on nautical charts is mean high water and corresponds to the plane used on the topographic surveys of the Bureau. The shoreline is the mean high-water line as nearly as it can be determined by the topographer without actually running a line of levels (*see* 441). The basis for the use of mean high water is that it is the dividing line between the land and the sea (*see* 4411).

68. The former practice was to underline the elevations of inland mountain peaks referred to mean sea level. ADAMS (1942), *op. cit. supra* note 2, at 69.

655. Geographic Datum

The geographic datum of a nautical chart is the adopted position in latitude and longitude of a single point to which the charted features of a vast region are referred. The development of geographic datums in the United States and Alaska, from independent datums to the present North American 1927 Datum, is fully discussed in 22 and 23.

The early charts along the Atlantic and Gulf coasts occasionally used a local origin for longitudes. The projection on the chart was referred to the local origin with the Greenwich longitudes shown by tick marks in the borders. In all cases, however, the positions of lighthouses were given in tabular form with their longitudes referred to Greenwich.[69] Pacific coast charts were always referred to the Greenwich meridian.

As new values for longitude became available (*see* 352 and 37), changes were made in the charts. The change was first shown on Atlantic and Gulf coast charts by unlabeled tick marks to the east of the meridians. A standard note describing the change was later added which read as follows: "The lines marked in the border on the right of the Meridians indicate the latest or corrected Longitudes; and are so placed for reference on the charts on which the Meridians are not in accordance with the new Longitudes." The tick marks and note were removed from the charts in the 1890's, and the values of the meridians and parallels corrected and shown to seconds of arc to take into account the new values.

After the adoption of the United States Standard Datum (same as North American Datum) in 1901 (*see* 223), charts were based on that datum. This continued until the adoption of the North American 1927 Datum when charts were based on that datum (*see* 225). The early charts of the Bureau did not indicate by note or otherwise the datum of the chart. Beginning in the late 1930's, after the geodetic network in the eastern half of the country was adjusted to the 1927 datum, the geographic datum was inserted on the chart in the upper right-hand corner of the border, the form of note used being "N.A. 1927."[70] This continued until 1956 when the datum note was no longer used inasmuch as, with few exceptions, all charts of conterminous United States and Alaska were on this datum.[71]

69. The Boston charts used the State House (*see* chart 337, Boston Harbor, 1857 ed.), the New York charts used the City Hall (*see* chart 120, New York Bay and Harbor, 1845 ed.), and the charts of Mobile Bay used Fort Morgan (*see* chart 188, Mobile Bay, 1851 ed.).

70. Prior to this, the note "N.A. Datum" was used. This was so even after the adoption of the N.A. 1927 Datum, since the change was not made until a particular chart was reconstructed.

71. Edmonston (1956), *op. cit. supra* note 53, at 7. The Hawaiian charts are based on the Old Hawaiian Datum (*see* 242), and in the Caribbean area, charts are on the Puerto Rico Datum (*see* 243). *Ibid.*

The geographic datum of a chart becomes important when comparisons are made of charts widely separated in point of time. Such charts must first be brought to the same datum before accurate comparisons can be made, in the same manner as hydrographic or topographic surveys of different dates are compared (*see* 37).

656. GEOGRAPHIC NAMES

It has been well said that "A geographic name is a term in common use for a feature of the earth's surface whose identity it serves to establish. It is one of the essentials of map expression and incites an interest beyond the importance of the name itself, its suitability, and distinctiveness." [72] The importance of geographic names, insofar as they related to our surveys and charts, was recognized at a very early period in the history of the Survey. In the Annual Report for 1855, Superintendent Bache stated: "It was of the first importance, then, to trace the history of discovery on that coast [the western coast]; to ascertain the original names and the successive ones; to restore those which were corrupted, and to fix those uncorrupted beyond the power of change; to go back to the earlier names, when the later had not become so permanently attached to the localities as to make it too difficult; and, in short, to make the Coast Survey maps and charts the standard for names and their spelling, as for the geography of the country." [73]

Apart from their general geographic value, geographic names are essential for the intelligent use of nautical charts and *Coast Pilots.* It is distinctly annoying and conducive to error to have to use latitudes and longitudes, or long descriptive phrases, to refer to geographic features. And it is important that names be accurate since carelessness in this respect may cast doubt on the vital portions of the chart relating to navigation.

6561. *Early Studies*

Under the impetus of Superintendent Bache and the superintendents who followed him, considerable emphasis was placed by the Bureau on geographic names. A number of special studies were undertaken, among which were the

72. Deetz, *The Genesis of Geographic Names,* 23 THE MILITARY ENGINEER 371 (July–Aug. 1931).

73. Annual Report, U.S. Coast Survey 10 (1855). To this end, Bache engaged the noted ethnographer, Dr. J. G. Kohl. Bache's instructions to Kohl were "To trace the succession of discoveries and explorations from Cortez to those of Wilkes and De Mofras, giving their dates and localities . . . . To give the best authorities for the names of localities, showing how the names have been given, and thus to establish their orthography as a basis for the geography and hydrography of the western coast of the United States. To furnish a catalogue of the names of headlands, capes, sounds, bays, and harbors, with the authorities." *Id.* at 11. For a statement on Kohl's study, *see* 6561A.

work on names of the Pacific coast by George Davidson and embodied in his monumental Coast Pilot of 1889; [74] "Notes on the Coast of the United States," in 1861; [75] a memoir on "Geographical Names on the Coast of Maine"; [76] "Hawaiian Geographic Names"; [77] and a "Geographic Dictionary of Alaska," this still being the "bible" of Alaskan names existing prior to 1905.[78]

A. THE KOHL COLLECTION OF MAPS AND NAMES

It was noted above that the Kohl study of the western coast of the United States was the earliest of its kind made under the auspices of the Coast Survey. Over the years, many inquiries have been received regarding this study, particularly the geographic names which Kohl collected. Because of its historical interest and to avoid future research into this subject a résumé is included here of what Kohl prepared and, as near as it is now possible to determine, the disposition that was made of the material he assembled.

(*a*) *Historic Description of Western Coast.*—On March 1, 1855, Dr. Kohl, in a letter to Superintendent Bache, announced the completion of the historical portion of the work, the collection of historical maps, and the catalog of printed and manuscript books and maps relating to the western coast.[79] The historical portion consists of 284 sheets and describes each recorded voyage and exploration

74. DAVIDSON, PACIFIC COAST PILOT, U.S. COAST AND GEODETIC SURVEY (1889). This was the most complete record of the coast ever to be published for the use of the mariner. While the publication was issued more as a coast pilot than as a gazetteer, it contains many references to the authorities who named the features.

75. A series of manuscript books in eight volumes, piepared by Superintendent Bache, for the coast from Delaware Entrance to Mississippi Sound. Features such as shoals, inlets, sounds, bays, islands, harbors, and roadsteads are named and identified. Many of these features are shown and named on accompanying charts, but others are not.

76. Prepared under the direction of Superintendent Peirce by E. Ballard of the Maine Historical Society and published in the annual report of the Bureau. Annual Report (Appendix 14), U.S. Coast Survey (1868).

77. Annual Report (Appendix 7), U.S. Coast and Geodetic Survey (1902). This is a 54-page memoir compiled by W. D. Alexander, an assistant in the Survey, and formerly surveyor-general of the Hawaiian Islands. In 1943, a "Gazetteer [of the] Hawaiian Islands" was published by the Navy Hydrographic Office, based on the work of the Coast and Geodetic Survey. The gazetteer contains a glossary of words frequently found in Hawaiian geographic names, and an alphabetical list of names with their designations and latitudes and longitudes.

78. BAKER, GEOGRAPHIC DICTIONARY OF ALASKA (2d ed.), BULLETIN No. 299, U.S. GEOLOGICAL SURVEY (1906). This work was begun by Wm. H. Dall and Marcus Baker of the Coast Survey around 1873, and, after some interruption, was completed by Baker in 1901 while associated with the U.S. Geological Survey. It was adopted by the Board on Geographic Names and reissued as a second edition in 1906. The first edition contained about 6,300 names and 2,800 cross references; the second edition contains about 9,300 names and 3,300 cross references.

79. Annual Report (Appendix 64), U.S. Coast Survey 374 (1855). There is indication that the maps and other data were sent to the Library of Congress on Mar. 8, 1912 (*see* Memorandum of May 22, 1885, for the Assistant in Charge of the Office, under library classification G83/K79).

party on the west coast from Balboa in 1513 to and including Coast Survey operations in 1854. It is titled "History of the Discovery and Exploration of the Western Coast of the United States."[80] This part of Dr. Kohl's work, exclusive of the Coast Survey operations, was later edited and published in the Annual Report for 1884.[81]

In his letter of March 1, 1855 (*see* text at note 79 *supra*), Kohl also referred to a list of nearly 300 geographical names of bays, capes, harbors, etc., "with critical and historical remarks, settling the orthography of the names." This list could not be traced.[82]

(*b*) *Historic Description of Gulf Coast.*—On April 17, 1856, Dr. Kohl submitted his material on the history of the Gulf coast of the United States.[83] This included a historic portion containing an account of the coast from 1492, a hydrographic portion containing a list or review of all the principal points and names, and a bibliographic portion comprising chronological and critical lists of maps and books relating to the Mexican Gulf coast.[84]

(*c*) *Historic Description of Atlantic Coast.*—On November 1, 1856, Dr. Kohl completed his study of the history of the Atlantic coast, following the same

80. The work is divided into eight major subdivisions, as follows: (I) From the beginning of the discovery of America to Cortes, 1492–1532; (II) From Cortes to Drake, 1532–1579; (III) From Drake to the Jesuits, 1579–1697; (IV) From the Jesuits to the Franciscan missionaries; (V) From the expeditions of the Franciscans to Vancouver, 1769–1792; (VI) Vancouver, his associates and contemporary navigators, 1792–1796; (VII) From Vancouver's time to the beginning of the U.S. Coast Survey's operations, or from the end of the 18th century to 1849; and (VIII) The operations of the U.S. Coast Survey on the west coast of the Union, 1849–1854. Two manuscript copies of this work are filed in the Coast Survey library under the classification G83/K79/:94/1855. One copy is heavily corrected in colored inks and appears to be the original; the other incorporates the first corrections but is further corrected in pencil. The latter copy comprises 534 pages.

81. Annual Report (Appendix 19), U.S. Coast and Geodetic Survey 546 (1884). An abstract of the contents and a list of the charts used were added for this printing.

82. In 1958, an exhaustive search was made in connection with an inquiry relative to the origin of the name "Earthquake Bay" along the southern California coast (*see* note 89 *infra*). Various works on geographic names and other sources in the Coast Survey library were examined, and consultation had with the Library of Congress and other possible source centers. All yielded negative results. *See* Letter of of Mar. 14, 1958, from the Director, Coast and Geodetic Survey, to Walter W. Jenkins. The library records show that the maps used by Kohl and referred to in his letter were available in the Bureau in 1908 and that some of the material of the collection was transferred to the Library of Congress in 1912 (*see* note 79 *supra*).

83. Annual Report (Appendix 66), U.S. Coast Survey 322 (1856).

84. The historical portion is available in the Coast Survey library under the classification G83/K79/871/(1856). This was later edited and, with an abstract of the contents and a list of charts added to it, was published in the Annual Report of 1884 (Appendix 19) at page 513. A separate cahier entitled "Calendar Kohl Mss. (G83/K79)" indicates that the historic and hydrographic portions, except for the description of the south coast of Florida, were available in the Coast Survey on Mar. 17, 1908. The calendar also indicates that the notes on the charts used and a portfolio of charts were transferred to the Library of Congress in 1912 (*see* note 79 *supra*).

general procedure as for his other studies.[85] This included a historic portion, a list of names, copies of maps and notes, and a catalog of maps.[86]

(*d*) *Hydrographic Description of Western Coast.*—On November 10, 1857, Dr. Kohl, in a letter to Superintendent Bache, announced the completion of a comprehensive hydrographic description of the western coast.[87] The original manuscript is in 283 sheets. The coast is described as the early explorers saw it with special reference to the names they applied to the different features.[88] There are 695 names in this work, among which is the name "Bahia de los Temblores" (Earthquake Bay) on sheets 21 and 22.[89]

(*e*) *Collection of Early Maps.*—Besides the maps referred to in previous paragraphs which Dr. Kohl used in the various studies undertaken for the Coast Survey, mention should be made of another collection of maps which he brought with him to this country in 1854. This was contained in a series of portfolios and consisted of hand-copies which he had made of maps relating to the progress of discovery in America.[90] When Kohl returned to Europe about 1858, the State Department became the custodian of the collection. Because of the

85. Annual Report (Appendix 65), U.S. Coast Survey 319 (1856).

86. The original manuscript of the historic portion was available in the Bureau on Mar. 17, 1908, but could not be found in Feb. 1963. However, it was published (in probably edited form) in the Annual Report of 1884 (Appendix 19) at page 495. The list of names is available except for the section covering the coast of New Jersey which was lost in 1903 (*see* library classification G83/K79/:815). The maps and notes and the catalog were transferred to the Library of Congress in 1912 (*see* note 79 *supra*).

87. Annual Report (Appendix 52), U.S. Coast Survey 414 (1857).

88. The description of San Francisco Bay from this work was published in the *National Intelligencer* on Sept. 22 and 24, 1857; and the introductory remarks on the physical features of the western coast was published in the same newspaper on Oct. 8 and 20, 1857 (*see* library classification G83/K79/:94).

89. Because of the interest exhibited in recent years as to the origin of this name (*see* note 82 *supra*), the following extracts from Kohl's manuscript are given: "Between Point Loma in the South and Point Fermin in the North the coast of California trends in the following manner: At first East of Point Fermin, which projects very far into the Sea and towards the West, the coast runs for some time directly East, then it runs for a long distance Southeast, and in about 33°10′ N.L. it changes directly to the South to Point Loma, which projects again more to the West and into the Ocean, than any of the other headlands between it and Point Fermin. In this manner the coast describes here *a kind of semicircle* of however a very large radius, and forms a kind of bay of not a great depth . . . . The long-stretched bay on the coast is still more marked as a particular division or section of the Ocean by the two great islands Santa Catalina and San Clemente to the West of it, which shut it up to a certain degree, and separate it still more from the rest. This division of the Ocean has however no particular name on our maps. The Spaniards called it *'la Bahia de los Temblores'* (the Bay of the Earthquakes). We find this name on the greater part of the old Spanish maps, and the bay is still to-day called so on many Spanish, French and other charts. The name appears only to have disappeared on the English and American charts. The name was at first introduced on the land expedition of Portala and the Franciscan friars from S. Diego to Monterey, as the name of a river which they called *'Rio de los Temblores'* because they experienced there an earthquake . . . . The name is very characteristic because this whole coast is subject to frequent earthquake shocks . . . . The name *'Bay of Los Temblores'* is very appropriate, because it alludes to one of the most characteristic geographical features of the region, and it seems worth the while to revive and restore it again."

90. These were taken from old geographical and other printed treatises and from manuscripts in European archives and libraries. WINSOR, THE KOHL COLLECTION OF MAPS RELATING TO AMERICA, LIBRARY OF HARVARD UNIVERSITY (1886). This publication also included references to maps not mentioned by Kohl. There are 998 items listed, of which 474 are from Kohl. This was reprinted, with the addition of an author list and a dictionary index of all subjects and authors mentioned, as a Library of Congress publication in 1904.

importance of the maps to scholars and the desirability of having a key to them, the collection was transferred to the Harvard University library and the catalog prepared by the librarian (*see* note 90 *supra*). On July 17, 1903, the collection was transferred from the State Department to the Library of Congress.[91]

6562. *Later Studies*

Among the later studies of geographic names by the Coast Survey may be mentioned those of the Virgin Islands;[92] a publication on "Geographic Names in the Coastal Areas of Alaska," in 1943;[93] a publication on "Geographic Names in the Coastal Areas of California, Oregon, and Washington" (undated, but subsequent to 1940);[94] and a "Gazeteer of the Philippine Islands," in 1945.[95]

6563. *Procedure for Names Study*

Intensified names work in the Coast Survey began in the early 1930's when all investigations of names were concentrated in one office in the then Division of Charts, thus providing a centralized and specialized control that was available to all in the Survey who made use of names.[96]

Investigation of geographic names in the Bureau follows a systematic and inclusive procedure. It provides that a written record be kept of the sources consulted, conflicting usage, and decisions adopted. In this way, the history of a name is always available for future consultation. There are two aspects of the

91. Dr. Kohl also wrote a memoir on the early cartography of the northwest coast of North America which was deposited with the American Antiquarian Society at Worcester, Mass. (*Proceedings*, Oct. 1867, Apr. 1869, and Apr. 1872). Another significant contribution of Dr. Kohl was his "A History of the Discovery of Maine," prepared at the invitation of the Historical Society of Maine and published in 1869. This treatise on the region known as the Gulf of Maine was referred to by Winsor (*see* note 90 *supra*) as "the most important single contribution to the history of the discovery and cartography of our Eastern Coast."

92. McGuire, Geographic Dictionary of the Virgin Islands of the United States, Special Publication No. 103, U.S. Coast and Geodetic Survey (1925). This was prepared following the first survey of the islands by the Coast Survey. The publication is based upon the field reports and other literature. All conflicts in names were submitted to the United States Geographic Board for decision. The features are described and the origins of the names are given when available.

93. This publication of 9,847 names includes the names of all the features in the coastal areas which were shown on the Coast Survey nautical charts of 1940 and those named on other federal and private maps.

94. The publication follows the procedure used in the Alaska publication (*see* note 93 *supra*). A total of 6,807 names is included.

95. This contains 47,355 original entries and cross references. Fourteen sources were used in the compilation. All variant names were included, no attempt being made to determine the most likely name of any feature.

96. This was established by Memorandum of Sept. 5, 1934, from the Assistant Chief, Division of Charts. The present organizational set-up for this function (in 1963) is the Geographic Names Section in the Administrative and Technical Services Division.

investigation—the field and the office. The field examination is made in connection with the topographic and hydrographic surveys which form the principal sources of the charted geographic names. The field investigator has the duty of checking with residents of an area, or by consulting local libraries and archives, every name for its correctness and form, and to resolve, as far as local authority is concerned, all cases of conflict. In addition, he obtains all previously unpublished names which he finds to be well established in local usage. The investigator submits a special report on his findings with recommendations for cases where local usage differs from that shown on the published charts of the Bureau.

The office investigation of geographic names is sometimes made preliminary to the field investigation, and such information is furnished the field investigator; at other times it is made after the field report has been received. In either case, all available sources in the Washington Office are consulted and these may include the various charts, maps, and *Coast Pilots* published by the Bureau, and all other maps and publications by other federal agencies, such as topographic quadrangles, soil maps, post route maps, forest and reservation maps, postal guides, light lists, state and county highway maps, railway guides, state guides, atlases, etc.

From this combined investigation a decision is made as to the name to adopt or to be submitted to the Board on Geographic Names for disposition (*see* 6564). It is not necessary that all names be submitted to the board for a decision. Names known not to be in conflict with the principles adopted by the board need not be submitted—for example, names in undisputed local usage; names provisionally approved by the board; and official names of post offices appearing in the United States Postal Guide.[97]

6564. *United States Board on Geographic Names*

The United States Board on Geographic Names was constituted by President Benjamin Harrison on September 4, 1890, as the Board on Geographic Names. Its purpose was to decide "unsettled questions concerning geographic names," and to obtain "uniform usage in regard to geographic nomenclature and orthography . . . throughout the Executive Departments of the Government, and particularly upon the maps and charts issued by the various departments and bureaus."[98] Through several Executive orders the duties and

97. Such use does not mean that the board approves them, and they may be called up for formal decision at any future time, if it is found that they are causing confusion.

98. Sixth Report of the United States Geographic Board, 1890–1932, V (1933).

authority of the board have been changed (including its name), and for a period of time was actually abolished as a formal board, but essentially its duties today are as originally defined.[99]

The board exercises jurisdiction over geographic names jointly with the Secretary of the Interior. It is interdepartmental in composition and is made up of members from the Departments of State, Army, Navy, Air Force, Interior, Commerce, Post Office, Agriculture, and from the Library of Congress, the Central Intelligence Agency, and the Government Printing Office. The Coast and Geodetic Survey represents the Department of Commerce on the board.

The jurisdiction of the board extends to all unsettled questions concerning geographic names which arise in the departments; all cases of disputed nomenclature; and to the approval before publication of all names hereafter suggested for any place by any officer or employee of the Government. It also includes the duty of determining, changing, and fixing place names within the United States and the insular possessions. The decisions of the board relative to geographic names are final so far as the Federal Government is concerned and are accepted as the standard authority.

The board follows certain guiding principles, local usage carrying the greatest weight. Some of the other principles adhered to are the following:

Euphonious and suitable names of foreign or Indian origin are retained.

Excessive duplication of extremely common names, especially within one state, are avoided.

Newly assigned names in honor of living persons are not approved.

Long and clumsily constructed names and names composed of two or more words are avoided. If a two-word name is essential, consideration is given to combining the two words into one.

Only one name should be applied to a stream throughout its entire length, and the name should generally follow up its longest branch.

Where practicable, independent names are given to the branches of a river, unless there is thoroughly established usage to the contrary.

The spelling which is in undisputed local usage is generally adopted.

The possessive form is avoided when it can be done without destroying the euphony of the name or changing its meaning. When the possessive "s" is retained the apostrophe is almost always omitted.

99. The first change occurred on Jan. 23, 1906, when President Theodore Roosevelt, by Executive order, vested the board with the additional duty of "determining, changing, and fixing place names within the United States and insular possessions." *Ibid.* On Aug. 10, 1906, the President again enlarged the duties of the board to include advisory powers concerning the unification of the symbols and conventions used on maps. *Id.* at VI. As a result the name of the board was changed to United States Geographic Board. This was abolished on Apr. 17, 1934, by President Franklin D. Roosevelt, and its functions transferred to the Department of the Interior, where it was constituted as a Division of Geographic Names with representation from other departments. *See* Memorandum of Sept. 5, 1934, *supra* note 96. Subsequent thereto, but prior to May 16, 1936, it was re-established as the United States Board on Geographical Names. Its present designation is United States Board on Geographic Names.

Where two or more names for the same feature appear to be equally established in local use, that which is most appropriate, euphonious, and older is adopted.[100]

The following classes of names are required to be submitted to the board for a decision: all new names recommended for previously unnamed features; new names for previously named features and old names that are to be applied to features differing from the original ones; names for which there is an existing decision of the board which appears to be incorrect or inadequate from latest information; names whose usages differ in federal or other publications, or whose local usage differs from published usage; and names of places (cities, towns, villages, and settlements) which are duplicated within the same state.[101]

A. DECISIONS OF THE BOARD

Although all names are subject to review by the board at its option, and to approval or disapproval by the Secretary of the Interior, in practice the board's Domestic Names Committee takes final action on most names within its purview. Decisions are printed quarterly, and at long intervals all of the decisions of the board since its establishment are published complete in one consecutive alphabetical list. The Sixth Report published in 1933 is the latest complete report (*see* note 98 *supra*).[102]

The earlier decisions of the board usually indicated only the spelling of the name on which a decision was made, followed by information sufficient for identification of the place or feature to which the name applied. Because the range of problems presented to the board has increased in recent years, the published decisions have been amplified to include the following: spelling, thing named, location, pronunciation and hyphenation (when not self-evident), rejected names and forms of names, and history and derivation of the name.[103]

100. ADAMS (1942), *op. cit. supra* note 2, at 52. It should be noted that the restriction against naming features in honor of living persons is applicable only to *newly assigned* names to previously unnamed features, and even where names of living persons have become established as geographic names the board does not view with favor their perpetuation. A notable exception has, however, been made in the case of names in Antarctica

101. *Id.* at 53. Although not obligatory, the following types of cases are generally also submitted: names of natural features which are likely to cause confusion through duplication; names for which there are existing decisions of the board concerning which important new evidence is available or which it is believed might be revised if reconsidered; and names for which there are existing decisions, or names in undisputed use that are not spelled in accordance with their derivation or that are objectionable because they are awkward, misleading, or difficult to spell or pronounce. *Ibid.*

102. In the Geographic Names Section in the Coast Survey, a complete card file of the board's decisions is maintained.

103. Formerly, only the proper names were considered by the board, but current decisions include generic terms as well. For a more detailed treatment of the subject of geographic names—particularly in relation to the Board on Geographic Names—including terminology used for submarine relief, *see* ADAMS (1942), *op. cit. supra* note 2, at 46–56. *See also* JEFFERS, HYDROGRAPHIC MANUAL 245–249, PUBLICATION 20–2, U.S. COAST AND GEODETIC SURVEY (1960).

6565. *Charting Geographic Names*

The principal sources of charted geographic names are the topographic and hydrographic surveys of the Bureau. The topographic surveys—both planetable and photogrammetric—are the authority for most geographic names of all land features inshore from the high-water line; and in addition the names of lakes, small streams, rivers, and sloughs which are not sounded during the hydrographic survey. The hydrographic surveys are the authority for names seaward from the high-water line, including the names of all water features such as rivers, channels, sloughs, and inlets; the reefs, rocks, banks, and shoals therein; and all small islands and the names of geographic features thereon.

On the very early charts, lettering of names of features followed a system in which capitals, lower case, and italics (in the order noted) indicated the importance of the respective features to navigation (*see* New York Bay and Harbor chart of 1845). Beginning in 1860, a system was inaugurated of using vertical lettering for the names of land features which extended above the plane of mean high water, and slanting lettering for all names relating to water areas and features below the plane of mean high water (*see* same chart of 1861).[104] This is also the present practice with the addition that the former also applies to fixed aids above high water and the latter to floating aids.[105]

The placement of geographic names on nautical charts (this also applies to the topographic and hydrographic surveys) follows well-established cartographic principles. Thus, in the case of a point of land, the name is placed as near to the feature as practicable. But the name of a feature which covers a considerable area, such as an island or bay, is placed in the approximate center of the area, where possible, and is curved to follow the general configuration of the feature.[106]

A geographic name is applied to a particular feature which has identity. If the feature ceases to exist, the name becomes meaningless and is removed from the charts. Thus, where an inlet through a barrier beach has been closed permanently and another similar inlet breaks through, the practice is to remove the name and not to apply it to the new inlet. But where a named inlet or point of land has migrated from its original position, the name is retained but in the new position.

104. This practice originated with the "Rules for Representing Certain Topographical and Hydrographical Features on the Maps and Charts of the United States Coast Survey," promulgated in 1860 (*see* 462).

105. EDMONSTON (1956), *op. cit. supra* note 53, at 70.

106. *Id.* at 71. Names of rivers and features of unusual length are not spread out, but are spaced for easy reading and repeated if necessary. *Ibid.*

6566. *Some Legal Aspects of Charted Geographic Names*

There are various legal aspects of charted geographic names that may arise in connection with the interpretation of a historical or legal document, or with a statute in which a particular name appears. If the name can be identified on a survey or chart made around the date of the document, it would be strong indication of what was understood at the time by the parties to the document.

A case in point is the use of the name "bay of New York," or New York Bay, in the Compact of 1834, between New York and New Jersey, which invested the State of New York with an extraterritorial jurisdiction over all the waters of such bay. The specific question was the geographic extent of New York Bay, that is, whether it was confined to the area above The Narrows or whether it continued south of The Narrows to the New Jersey shoreline (*see* chart 369). It was stated by the Supreme Court of New Jersey that what started as a "routine enforcement of the gambling laws develops into one of major importance," the question for decision being "whether New Jersey ceded any portion of its otherwise exclusive jurisdiction to New York under the Compact of 1834 over the waters lying off Monmouth County and westerly of Sandy Hook, all of which lie within the New Jersey territorial boundary as established by that Compact." [107]

The State of New Jersey requested assistance from the Survey in ascertaining the geographic extent of "New York Bay" based, if possible, on maps dated around 1834.

Based on a comprehensive research and analysis of available maps, charts, and other material in the Coast Survey and in the Library of Congress (21 sources were consulted), we were able to state in summary that "none of the published charts of the Coast Survey have ever designated the area of 'Lower Bay' as 'New York Bay' or 'Bay of New York,' although there are references in the Annual Report of the Coast Survey for the year 1857 that New York Bay could have been thought of as also encompassing the lower bay; that in the early charts, the name is confined to the area north of The Narrows, and in the later charts the terminology 'Upper Bay' and 'Lower Bay' is used without the appendage 'New York'; and that there is no uniformity of treatment on non-

107. *New Jersey* v. *Carlajtes et al.*, 132 A. 2d 515, 516 (1957). The case arose under an indictment for violation of a New Jersey gambling statute on board a ship moving in the waters of Sandy Hook Bay south of the territorial boundary between New York and New Jersey about one-half mile off the New Jersey shoreline, seaward of low-water mark. The lower court dismissed the indictment for want of jurisdiction on the ground that the Compact of 1834 gave New York exclusive jurisdiction over the waters where the arrests took place. The State of New Jersey appealed the decision.

Coast Survey maps and publications, the majority indicating the name 'New York Bay' to be applied to the area north of The Narrows." [108]

The court said that if the intent of the parties is to be interpreted in the historical setting of 1834, attention must be directed to maps and writing of that period. The court then concluded that "these earlier writers and cartographers . . . confined New York Bay to the area above The Narrows and described The Narrows as the connecting link between the Bay and the Atlantic Ocean, although later works spoke in terms of an 'Upper Bay' and a 'Lower Bay.' " [109]

657. Dates on Charts

This subject has been dealt with at length in a former chapter (*see* 1272) and will not be repeated here other than to emphasize again that dates on charts represent the dates of publication and bear no relationship necessarily to the date when a particular area was surveyed or when certain information was obtained. Two adjacent soundings on a chart may sometimes be from surveys years apart. If the precise date of origin is required, recourse must be had to the original data from which the chart was compiled (*see* 1275).

658. Tide Notes

Tide notes are included on nautical charts in order that the navigator may have readily available information on the mean range or the diurnal range of the tide at key places on the chart. Since the early charts published by the Bureau, these notes have undergone considerable change in both form and content. Prior to 1853—the date of publication of the first tide tables in the annual reports of the Bureau (*see* Part 1, 2322)—the purpose of the tide note was also to furnish information for prediction purposes so that the time and height of the tide could be determined when used in conjunction with the Nautical Almanac.[110] The key to this was the information on the "Corrected

108. The Supreme Court of New Jersey quoted this Coast Survey summary, as well as many of the sources furnished the State of New Jersey which it in turn embodied in its brief to the court. *Id.* at 520–521.

109. *Id.* at 521–522. The judgment of the lower court was therefore reversed and the indictment reinstated. For other facets of the legal implications of charted geographic names, *see* Volume One, Part 1, 4541.

110. Finnegan, *Historical Note on Tide Predictions,* 5 Journal, Coast and Geodetic Survey 100 (1953).

Establishment of the Port" or the time interval between the moon's meridian passage (upper or lower) and the following high water. This is known as the "high-water lunitidal interval." The interval between the moon's passage and the following low water is the "low-water lunitidal interval." The early notes also gave values for the spring and neap tides, as well as other tidal information (*see* chart of Hell Gate, N.Y., 1851 ed.).

Tide notes for prediction purposes, in varied forms, were continued on charts for many years after the advent of the *Tide Tables,* and as late as 1898 they contained 11 elements for each place (*see* chart 109, Boston Bay and Approaches, 1898 ed.). Gradually they fell into disuse.[111]

The present practice (since 1955) for the Atlantic and Gulf coasts is to give the following four values, all referred to the datum of soundings (MLW): mean high water, mean tide level, mean low water, and extreme low water (*see* fig. 78). For Pacific coast charts, the values are given for mean higher high water, mean tide level, mean lower low water, and extreme low water, all referred to the datum of soundings (MLLW) (*see* fig. 79).[112] The values given are based on actual observations at the station named, and may vary from a few days to many years. However, short-series observations are reduced to mean values before publication, except the entry for "extreme low water" (*see* 6581).

The date of the tide note is the month and year which the latest information was applied, and is shown by a numeral in the lower left corner of the note, thus: "(463)"—meaning April 1963. The note is reviewed about every 3 years for new values.

111. The early charts of the Gulf coast stated that the range of the tide was small, irregular, and much influenced by the wind. Average values for the rise and fall were given for all tides, for tides when the moon's declination was greatest, and when it was least. The prevailing wind for each month was also given (*see* chart 188, Mobile Bay, 1858 ed.). The term "grand tides" was introduced on the charts in the 1890's and was defined as those tides occurring when the moon was at its farthest declination (*see* chart 188, Mobile Bay and Entrance, 1894 ed.). This was later changed to "tropic tides," in contradistinction to "equatorial tides" when the moon is on the equator.

112. Between 1940 and 1955, the standard tide note for charts of scale larger than 1:200,000 gave the values for mean high water, mean sea level, and lowest tide to be expected (*see* chart 246, Boston Harbor, 1946 ed.). In 1955, for uniformity, the Coast and Geodetic Survey and the Navy Hydrographic Office changed their tide notes to the form shown in figures 78 and 79. *Nautical Chart Tide Note,* 7 JOURNAL, COAST AND GEODETIC SURVEY 119 (1957). The value for "mean tide level" (half-tide level), was substituted for "mean sea level" because mean tide level is a plane that is exactly halfway between the planes of mean high water and mean low water and therefore can be readily determined from the high- and low-water tabulations. To derive the plane of mean sea level, all the hourly heights must be averaged. Since the two planes usually lie close to each other, it is sufficient to use mean tide level for most purposes. MARMER, TIDAL DATUM PLANES 69, SPECIAL PUBLICATION NO. 135, U.S. COAST AND GEODETIC SURVEY (1951).

TIDAL INFORMATION

Place	Height referred to datum of soundings (MLW)			
	Mean High Water	Mean Tide Level	Mean Low Water	Extreme Low Water
	feet	feet	feet	feet
Egmont Key	1.3	0.6	0.0	−3.0
Bradenton	1.5	0.7	0.0	−3.0
St. Petersburg	1.4	0.7	0.0	−3.0
Gulfport	1.5	0.8	0.0	−3.0

(858)

FIGURE 78.—Tide note for Atlantic and Gulf coasts charts.

TIDAL INFORMATION

Place	Height referred to datum of soundings (MLLW)			
	Mean Higher High Water	Mean Tide Level	Mean Lower Low Water	Extreme Low Water
	feet	feet	feet	feet
Alcatraz Island	5.8	3.1	0.0	−2.5
Rincon Point	6.1	3.3	0.0	−2.5
Oakland Pier	6.0	3.2	0.0	−2.5
Point Avisadero	6.6	3.5	0.0	−2.5

(1061)

FIGURE 79.—Tide note for Pacific coast charts.

6581. *Extreme Low Water*

Predictions for the height of tide as given in the *Tide Tables* reflect the normal astronomic tide to be expected. They do not take into account the effect that unusual meteorological conditions might have on the rise or fall of the tide at any particular time. Since the most dangerous situation for the navigator would arise if meteorological effects caused the water level to be lower than predicted—especially near the time of low water—the Bureau, as a precautionary measure, publishes in its tide note the value of the lowest water level observed or estimated for the limits of the chart. This is now designated as "extreme low water." Its value may be based on the lowest water level observed at a tide station over a short period or a long period, or it may be an estimated value based on the best available reports and information.[113] The important point to keep

113. On chart 346, Edgartown Harbor, Mass. (1943 ed.), where no long series of observations was available, the value for "extreme low water" was derived by examining the lowest water levels observed at Newport, R.I., and Woods Hole, Mass., where observations were available for about 30 years. From these the most probable value for the lowest water level at Edgartown was inferred as 2.5 feet below the plane of mean low water.

in mind is that the term "extreme low water" as used in the tide note is not a recognized tidal plane, as is the term mean low water or mean high water, and should not be confused with the lowest tide resulting primarily from astronomic causes which would reflect spring, perigean, and tropic tide effects.[114] Unless the term "extreme low water" is defined in relation to the astronomic tide by a fixed decrement, such as 2 feet or 3 feet below mean low water (a plane of definite ascertainment), it would be too uncertain a value to be used in the determination of tidal boundaries.

The term has been used (without definition) in some state decisions. Thus, in a case involving an application of an early Massachusetts ordinance, the court said: "The petitioner owned the fee to the flats adjacent to her land and her ownership, by virtue of the colony ordinance of 1641–47, extended to extreme low water or to one hundred rods from the ordinary high water mark, if the low water mark lies beyond that distance."[115]

(*a*) *Monthly Lowest Low Water.*—The datum of monthly lowest low water has been used when it was desired to have the datum so low that most low waters would be above it. As its name implies, it is the plane determined by the average height of the lowest low waters of each month over a considerable period of time. Although sometimes referred to as extreme low water or storm low water, it would be best not to confuse it with either of these designations. Extreme low water could exceed the monthly lowest low and the latter is frequently not due to storms. The term monthly lowest low water is self-explanatory and definitely refers to the low water which, during the month in question, falls to the lowest level.[116]

114. For Edgartown Harbor, Mass., the spring, perigean, and tropic tide effect is about one-half foot below mean low water as compared with the value of 2.5 feet derived for extreme low water (*see* note 113 *supra*).

115. *Iris* v. *Town of Hingham,* 22 N.E. 2d 13, 15 (1939). The actual wording of the ordinance was that "in all creeks, coves and other places, about and upon salt water, where the sea ebbs and flows, the proprietor of the land adjoining, shall have propriety to the low water mark, where the sea doth not ebb above a hundred rods, and not more wheresoever it ebbs further." As authority for its statement, the court cited the early case of *Commonwealth* v. *Alger,* 61 Mass. 53, 67 (1853), where the colony ordinance was comprehensively considered. But nowhere in the decision is the term "extreme low water" mentioned. All the references are either to "the land between high and low water mark," to "low water mark," or to "the shore between the high and low water mark," the last reference being to the property of the sovereign at common law. In *East Boston Co.* v. *Commonwealth,* 89 N.E. 236 (1909), the court held the word "ordinary," when applied to a high- or low-water mark in a grant made in 1640, to be used in the sense of average, by the courts of this country and of England, rather than "extreme low water." But the court distinguished a grant under the ordinance of 1641–1647, which "for reasons stated in decisions," the court said, "means the line of extreme low water shown at an ebb of the tide, resulting from usual causes and conditions" (citing *Wonson* v. *Wonson,* 96 Mass. 71, 82 (1867)). *Id.* at 237. This statement also leaves in doubt the line to be used for demarcating the boundary. However, it can be stated definitely that, whatever line the court had in mind, it could not be the line referred to in the tide note on the charts as "extreme low water," for the reason that the latter may result from storms and would not fall within the description "resulting from usual causes and conditions," as used by the court.

116. Marmer (1951), *op. cit. supra* note 112, at 127. For a discussion of other tidal datum planes sometimes used besides the principal datum planes, *see id.* at 128–130.

659. Loran Lines of Position

Loran is an electronic system, developed during World War II, for fixing a vessel's position regardless of the weather or the state of the sea. To make the system practicable for the navigator, it was necessary to chart the lines of position for the different Loran transmitters. These lines consist of two or more families of hyperbolic curves, each family being shown in a distinctive color.

The first Coast Survey chart to show such lines was published in 1946. The method of presentation was to print the Loran lines in register on the back of a standard navigational chart. When the navigator located his position by Loran, he transferred the position to the face of the chart by a prick point. This method, after some modification, gave way to the present method—adopted late in 1950—of showing the Loran data on the face of the chart. The lines of position are reduced in weight so as not to detract from the hydrographic information. Loran was first shown on the Sailing charts, but the system has gradually expanded to take in many of the General and Coast charts. For further discussion of the Loran principle and the method of determining position, *see* 6931(*c*).

66. SYMBOLIZATION

The complete symbolization used on nautical charts is given in Appendix F. In this section, emphasis will be placed on those features that have been the subject of inquiry from time to time or that may have a legal connotation. Where of importance, references will also be made to former practices. It should be noted, in this respect, that the earliest reference to symbolization for charts is contained in the pamphlet designated as "Rules for Representing Certain Topographical and Hydrographical Features on the Maps and Charts of the United States Coast Survey," published in 1860 (*see* 462). Included in these rules were guides for the drawing of every detail of the finished chart, from the symbols and dimensions for the topographic and hydrographic features to the style and gage of the lettering.

661. High-Water Line

The high-water line, which is the dividing line between land and sea, was always prominently displayed on the nautical chart as the heaviest, continuous, black line inside the neat line. It is the mean high-water line as nearly as it can be determined by the topographer without running levels (*see* 442). The modern practice is to decrease the weight of the line up streams and rivers. In areas where the fast land is fringed by vegetation, such as marsh or mangrove, the outer edge of the vegetation is used as the dividing line and is symbolized by a continuous, black line about half the thickness of the normal high-water line. The inshore limits of vegetation, which is generally the edge of the fast land, is represented by a black, broken line slightly lighter than the outer edge of the vegetation. Where the high-water line is unsurveyed, a heavy, black dashed line is used.

662. Low-Water Line

The low-water line on a chart represents the line of zero soundings, or the sounding datum (*see* 651(*b*)). On the Atlantic and Gulf coasts it is mean low water, and on the Pacific coast it is mean lower low water. The charted low-water line is taken from the hydrographic survey when it is defined by soundings; when not so defined, it is an adjusted line between the hydrographic and topographic surveys in case of a conflict (*see* 4461). The low-water area (high-water line to low-water line) was formerly symbolized by the heaviest sanding on the chart, the outer edge of the sanding following in detail the low-water line. In the low-water area, the type of material was sometimes indicated by either symbols or bottom abbreviations (*see* chart 637, Koos Bay, 1865 ed.). The modern practice is to eliminate sanding from the chart (*see* 663), hence the low-water line is symbolized by a single row of black dots and the low-water area by a yellow-green tint, the same as is used for marsh areas (*see* 664(*b*)). When known, the character of the area—sand, mud, grass, etc.—is given in several places.

663. Sanded Areas

A common practice on finished charts in the early years was to sand the area from the high-water line to a particular depth curve by means of gradations in the sanding so as to form adjacent bands, the band farthest offshore being the most open, and the low-water area being the most dense. For the most part three bands, besides the low-water area, were used to indicate the 6-, 12-, and 18-foot depth curves (*see* chart 671, San Pablo Bay, 1863 ed.).[117] This practice continued as long as charts were printed in black and white and two depth units were used on the same chart (*see* 651(*a*)). With the adoption of

117. It is important to note that when sanding was used, whether for the low-water area or for the deeper depths, it did not necessarily indicate the nature of the bottom material. It could be sand or grass or any other material, unless indicated on the chart.

one depth unit for a chart, the sanding below the low-water line was replaced by dotted lines (*see* chart 560, Potomac River, 1906 ed.). When lithography was introduced in nautical charting after the turn of the century, a blue tint was used on an experimental basis to replace the sanding. A buff tint was then added to accentuate the land areas of the chart.

664. Tinted Areas

Since the early 1940's, the blue tint has to an increasing extent replaced sanding. In 1952, the Nautical Chart Manual provided for the use of the blue tint in water areas to the curve which is considered the danger curve for that particular chart. In general, this is the 6-foot curve for Intracoastal Waterway and Small-Craft charts, the 12- or 18-foot curve for Harbor charts, and the 30-foot curve for Coast and General charts.[118]

(*a*) *Wire-Dragged Areas.*—Areas in Alaska which have been covered to a safe depth with the wire drag, but which have not been adequately sounded, are shown on the charts with a bright green tint. This treatment has also been used on other charts of important areas covered by the wire drag.

(*b*) *Marsh Areas.*—Another significant chart feature to which tinting is now applied is marsh area. The former practice was to use the regular marsh symbol corresponding to salt marsh or fresh marsh (*see* fig. 52). These were quite extensive in the San Francisco Bay and Delaware Bay areas. To avoid the use of an additional color plate the tint used is a combination of the blue plate for the water area and the buff plate for the land area, the resultant being a yellow-green shade.

665. Improved Channels

The improvement of rivers and harbors and the Intracoastal Waterways for navigation is under the authority of the Corps of Engineers. Copies of their surveys are furnished the Bureau for application to the nautical charts. The manner of showing a dredged channel has always been by black, dashed lines to represent the side limits, with the controlling depth and date of ascertainment given adjacent to or inside the channel. In the middle 1930's an elaborate caution note was added regarding the possibility of shoaling at the sides. This

118. The 1956 edition of the manual carries an identical provision. Edmonston (1956), *op. cit. supra* note 53, at 50. Chart 5101A, San Diego to Santa Rosa Island, Calif., the new chart designed in 1939 for echo-sounding navigation (*see* 6241), showed a blue tinted area from the high-water line to the 50-fathom depth contour. This was later changed to two shades of blue—a deeper blue to the 10-fathom contour and a lighter shade to 50 fathoms. This is the treatment used on the present chart.

OAKLAND OUTER AND INNER HARBORS

Tabulated from surveys by the Corp of Engineers - surveys to Sept. 1961

Controlling depths in channels entering from seaward in feet at Mean Lower Low Water						Project Dimensions		
Name of Channel	Left outside quarter	Left inside quarter	Right inside quarter	Right outside quarter	Date of Survey	Width (feet)	Length (naut. miles)	Depth M.L.L.W. (feet)
Bar Channel	29.8	35.3	36.7	34.0	9-61	800	0.45	35
Outer Harbor Entrance Channel	b23.0	35.3	35.5	c22.0	9-61	650-600	0.87	35
Outer Harbor	30.0	35.4	35.0	d20.3	9-61	600-1350	1.40	35
Inner Harbor								
Entrance Channel	20.0	29.9	31.5	e14.6	2,9-61	800-500	1.00	30
Inner Harbor Reach	f20.0	30.3	30.0	g10.4	2-61	500-600	2.27	30
Grove St. Pier to Brooklyn Basin	h22.0	29.3	29.2	i19.4	2-61	600	1.30	30
Brooklyn Basin South Channel	j17.2	28.7	30.0	k12.0	2-61	600-500	0.90	30
Brooklyn Basin North Channel	18.0	12.0	12.0	9.0	8-50	300	0.93	25
Park St. Bridge Reach	l15.9	20.2	21.9	15.6	2-61	500-275	0.42	30
Tidal Canal								
Fruitvale Avenue Bridge Reach	17.1	17.8	17.0	12.0	9-57	275	0.35	a 25
Fruitvale Avenue to San Leandro Bay	12.0	16.2	16.0	9.0	8-50 4-57	275	0.73	a 25

a. Project depth is 25 feet but channel is dredged and maintained to 18 feet.
b. The channel has shoaled along the edge; a depth of 33 feet was available in the inside half of the quarter.
c. The channel has shoaled along the edge; a depth of 26.7 feet was available in the inside half of the quarter.
d. The channel has shoaled along the edge from Richmond Outer Harbor Buoy 4 to 850 yards easterly; a depth of 29 feet was available in the inside half of the quarter opposite the shoal.
e. The channel has shoaled along the edge from the junction with Inner Harbor Reach to about 335 yards northwest; a depth of 25.3 feet was available in the remainder of the quarter.
f. The channel has shoaled along the edge; a depth of 28.8 feet was available in the inside half of the quarter.
g. The depth was 27.6 feet except for shoaling to 10.4 feet in the outside 50 feet of the quarter.
h. The channel has shoaled along the edge; a depth of 26.0 feet was available in the inside half of the quarter.
i. The channel has shoaled along the edge; a depth of 29.3 feet was available in the inside half of the quarter.
j. Shoal depth is located on the channel edge; a depth of 25 feet was available in the inside half of the quarter.
k. The depth was 20.1 feet except for shoaling to 12.0 feet in the outside 50 feet of the quarter.
l. The depth was 19.2 feet except for shoaling along the channel edge from the Park Street Bridge to 250 yards northwest.
Note.-The Corps of Engineers should be consulted for changing conditions subsequent to the above.

FIGURE 80.—Form of tabulation used on nautical charts for showing controlling depths and other information in important dredged channels.

note was simplified in February 1946 to read: "Improved channels shown by broken lines are subject to shoaling, particularly at the edges."

In the late 1940's it became apparent that more detailed information was required regarding depths in the important dredged channels for adequately safeguarding navigation. The result was the incorporation on the chart of a tabulation giving the project width of the channel, the minimum depth in each quarter width of channel, and the date of the survey on which the depths are based (*see* fig. 80). This applies to channels 400 feet wide and greater. There are variants of this treatment depending on the width of channel and the information available.[119]

666. Dangers to Navigation

The principal dangers to navigation shown on nautical charts are rocks (bare, awash, and sunken), reefs, and wrecks.

(*a*) *Rocks.*—The symbolization of rocks on the nautical chart follows the criteria used for the hydrographic surveys (*see* 565) and may be summarized as follows: Along the Atlantic and Gulf coasts, rocks whose elevations are 2 feet or more above mean high water are shown with the bare rock symbol and the height above the plane shown adjacent thereto in slanting numerals enclosed in parentheses; rocks whose peaks are in the zone between 1 foot above mean high water and 1 foot above mean low water are shown by the rock awash symbol (3 lines crossing) with the height above mean low water shown adjacent to the symbol in vertical numerals underlined and in parentheses;[120] and rocks whose peaks are covered more than 1 foot at mean low water are shown with the sunken rock symbol (a simple cross) if depth is unknown, or as a sounding with notation "Rk" adjacent, if the depth is known. For rocks along the Pacific coast, the same principles are followed for elevations and symbolization except that in each case the dividing line is increased by 1 foot and the sounding datum is mean lower low water instead of mean low water.[121]

(*b*) *Reefs and Ledges.*—The nature of reefs and ledges and their progressive symbolization have been described in connection with hydrographic surveys

119. Edmonston (1956), *op. cit. supra* note 53, at 50–51. Channels 100 feet to 400 feet wide are treated similarly except that the controlling depth is given for the middle half and for each outside quarter. This is the practice in 1963.

120. Where a rock is actually awash at the sounding datum, that is, where the summit is between 1 foot below and less than 1 foot above mean low water on the Atlantic and Gulf coasts and between 2 feet below and less than 2 feet above mean lower low water on the Pacific coast, a special symbol is used on the nautical charts—a simple cross with a dot in each quadrant, but no elevation given. This symbol is not used on hydrographic surveys. *Id.* at 53–55.

121. *Ibid.* These rules are not inflexible and in their application consideration is given to the character of the area, whether exposed or protected; the proximity to shore; the range of the tide; and the probable visibility of the rock at some stage of the tide. Special care is used in charting isolated and dangerous rocks by encircling the symbol with a black, dotted line. *Ibid.* Questions have occasionally arisen as to the interpretation of the notations "awash ¼ tide," "awash ⅔ tide," etc., appended to the rock awash symbol on hydrographic surveys and on nautical charts (*see* Register No. H–4865 (1928), and chart 5895, St. George Reef and Crescent City Harbor, 1949 ed.). Are they reckoned from the low stage of the tide or from the high stage? A study of the sounding records revealed unmistakably that such notations refer to the low stage of the tide. Because of the possible ambiguity, such notations are not used in charting and preference is given to the actual height of the rock at the chart datum. Edmonston (1956), *op. cit. supra* note 53, at 54.

(*see* 566). A rocky reef is always detached from shore, whereas a ledge is a rocky formation connected with and fringing the shore. On the nautical charts, coral and rocky reefs and ledges are indicated by the same symbol (a jagged formation simulating bedrock). The area between the high-water line and the outer edge of the reef or ledge is tinted yellow-green, the same as the low-water area (*see* 662), and the type of reef or ledge—rock or coral—is named when known.[122]

(*c*) *Wrecks.*—Charted wrecks are of two kinds—stranded or sunken. A stranded wreck is one where any portion of the hull is above the chart datum; a sunken wreck is one below the chart datum or where the masts only are visible. Figure 81 shows the treatment of various types of wrecks. When wrecks, rocks, or obstructions have been cleared by the wire drag, the maximum clearance depth is charted with a basket or bracket under it.

67. RULES OF THE ROAD BOUNDARY LINES

The "Rules of the Road" were adopted for preventing collisions at sea. This they attempt to do by providing standards of notice such that the master of a vessel can immediately determine what course of action to take in order to prevent his vessel from being placed in a collision situation. They cover requirements for lights, sound signals, steering, and sailing. The rules are set out in a pamphlet published by the U.S. Coast Guard and titled "Rules of the Road, International-Inland" (CG–169).

The rules of the road are in no sense optional, but are for the most part absolutely mandatory and apply with equal force to all vessels—naval, public, and private. Departure from them, other than to avoid immediate danger, must be justified on the ground that it could not possibly have contributed to the collision.[123]

671. History of the Rules

The first general set of rules regarding the avoidance of collisions at sea was published by Trinity House, London, in 1840, and was recognized as enforceable by the British Admiralty Court. Many of these rules were made statutory in 1846, but The Merchant Shipping Amendment Act of 1862 was the

122. *Id.* at 52. There is no distinctive symbol for a submerged reef or ledge, and where the limits have been determined they are indicated on the chart by a dashed line enclosing sunken rock symbols or an appropriate legend. *Ibid.*

123. Farwell, The Rules of the Nautical Road 197, 198 (1954).

Visible wreck	 	*Stranded wreck, showing any portion of the hull or superstructure above datum of soundings (not masts and funnels only).* *Note that the bottom line of the symbol, which represents the water surface, must always be parallel to the bottom of the chart.* *Do not apply this symbol in crowded areas, especially when it interferes with topography. (Use dangerous sunken wreck symbol instead.)* *When marked by a fixed red light (on charts with magenta overprint).*
Dangerous sunken wreck		*Wreck over which the exact depth is unknown but is considered dangerous to surface navigation and might have less than 10 fathoms over it.*
Nondangerous sunken wreck		*Wreck over which the depth is unknown but not considered dangerous to surface navigation or has more than 10 fathoms over it.*
Sunken wreck with only masts visible	 *Masts*	*All of hull or superstructure submerged. Masts showing above datum of soundings.*
Wreck, depth known	5 *Wreck*	*Least depth found over wreck.*
Wreck, cleared by wire drag	21 *Wreck or Wk*	*Wreck cleared by wire drag to 21 feet. (See instructions listed under wire drag.)*
Wreckage	*(Wreckage)*	*Outline of the area of a number of wrecks.*
Wreck, large-scale chart	 *Wreck*	*On large-scale charts, wrecks should be delineated in outline when all or most of the hull or superstructure shows above the sounding datum.*
Wreck, submerged, large-scale chart	 *Wreck*	*On large-scale charts, submerged wrecks should be outlined by a dashed line.*

FIGURE 81.—Symbolization for various types of wrecks shown on nautical charts.

real impetus to the adoption of rules of the road on an international basis. The Act of 1862 contained a set of "Regulations for preventing collisions at sea" which became the forerunner of the international rules later adopted.[124]

In the United States, the Act of April 29, 1864 (13 Stat. 58) adopted Rules and Regulations for Preventing Collisions on the Water. These were the first rules of the road to be adopted and became effective September 1, 1864. The international rules have been revised several times, the last amendment being in 1948 as a result of the proposal of the International Conference on Safety of Life at Sea held at London. Congress approved this revision on October 11, 1951 (65 Stat. 406) and it became effective on January 1, 1954.[125]

672. The Act of February 19, 1895

Prior to 1895, the laws pertaining to collisions at sea provided that certain rules should be followed by vessels on the high seas and in coastwise waters, while within harbors, rivers, and inland waters certain local modifications peculiar to the United States were to be observed. But nowhere was the line of demarcation between coastwise waters and inland waters drawn. This was an obvious defect and resulted in admiralty courts being left in doubt as to whether the international or the local rules should have been followed in a given collision situation in the channels leading from the harbors into the high seas.[126]

To remedy this, Congress passed the Act of February 19, 1895 (28 Stat. 672), entitled: "An Act To adopt special rules for the navigation of harbors, rivers and inland waters of the United States . . . supplementary to the Act of August nineteenth, eighteen hundred and ninety, entitled 'An Act to adopt regulations for preventing collisions at sea.'" Section 2 of the act provided that "The Secretary of the Treasury is hereby authorized, empowered and directed from time to time to designate and define by suitable bearings or ranges with light houses, light vessels, buoys or coast objects, the lines dividing the high seas from rivers, harbors and inland waters," thus determining the scope of application of the two sets of rules.[127]

124. Colombos, The International Law of the Sea (4th ed.) 292 (1959). In less than 10 years after passage of the act, the rules were accepted as obligatory by more than 30 of the maritime States of the world including the United States. *Ibid.*

125. Farwell (1954), *op. cit. supra* note 123, at 200.

126. Report of Commissioner of Navigation to Secretary of the Treasury 77 (1895).

127. The act became effective Mar. 1, 1895. Sec. 4 excludes from the term "inland waters" the Great Lakes and their connecting and tributary waters as far east as Montreal, these being regulated by the Act of Feb. 8, 1895 (28 Stat. 645). The authority which the act conferred upon the Secretary of the Treasury was successively transferred to the Secretary of Commerce and Labor by the Act of Feb. 14, 1903 (32 Stat. 829), later redesignated "Secretary of Commerce" by the Act of Mar. 4, 1913 (37 Stat. 736); to the Com-

Following passage of the act, the Secretary of the Treasury named an advisory board to recommend for his approval what lines should be established.[128]

6721. *Application to Coasts of United States*

The first lines to be designated were announced on May 10, 1895, and covered the areas of New York Harbor, Baltimore Harbor and Chesapeake Bay, Galveston Harbor, Boston Harbor, and San Francisco Harbor.[129] Over the years, other lines have been designated or existing lines modified when deemed in the public interest.

Figures 82 to 85 inclusive, show the present lines established by the Coast Guard for the coasts of conterminous United States, and reflect modifications made as of January 18, 1963.[130]

Recent lines established include the Gulf coast area from Pass a Loutre westward to the Rio Grande (*see* fig. 83),[131] and the entrances to a number of harbors along the California coast (*see* fig. 85).[132]

673. Designation of Boundary Lines on Charts

When the first rules of the road boundary lines were established (*see* note 129 *supra* and accompanying text), they were indicated by descriptive notes on the large-scale nautical charts (*see* chart 109, Boston Bay and Approaches, 1896 ed.). The title of the note did not always follow a standard form. Thus, the following titles have been used at different times: "Line Dividing the High Seas from Inland Waters" (1896); "Lines Dividing the High Seas from

mandant of the Coast Guard in 1946 (60 Stat. 1097–1098); to the Secretary of the Treasury in 1950, or to the Secretary of the Navy when the Coast Guard is operating in that department (64 Stat. 1280), and delegated by the Secretary of the Treasury to the Commandant of the Coast Guard (15 Fed. Reg. 6521 1950)).

128. The board was composed of the Superintendent of the Coast and Geodetic Survey, as chairman; the Commissioner of Navigation, as secretary; and the naval secretary of the Light-House Board, the Supervising Inspector-General of Steam Vessels, the chief of the Revenue-Cutter Service, as members. Report of Commissioner of Navigation, *supra* note 126, at 77.

129. *Id.* at 240. Later that year, the lines for additional areas along the Atlantic, Gulf, and Pacific coasts were announced.

130. 28 Fed. Reg. 490 (1963). Formerly, such sketches were included in the Coast Guard publication CG–169 (*see* 67). They were discontinued with the issue of Sept. 1953, after the Coast Survey adopted the policy of incorporating such lines on the nautical charts (*see* 673).

131. These became effective on Jan. 1, 1954. 18 Fed. Reg. 7893–7894 (1953). The purpose of establishing them was to remove confusion that had arisen regarding where the lines should be when specific lines are not described. *Ibid.*

132. These lines became effective Apr. 25, 1961. 26 Fed. Reg. 3527 (1961). The harbors not shown are Arcata Bay-Humboldt Bay, Port Hueneme, Marina del Rey, Redondo Harbor, and Newport Bay. In each case, the dividing line is the line connecting the outer ends of the breakwaters.

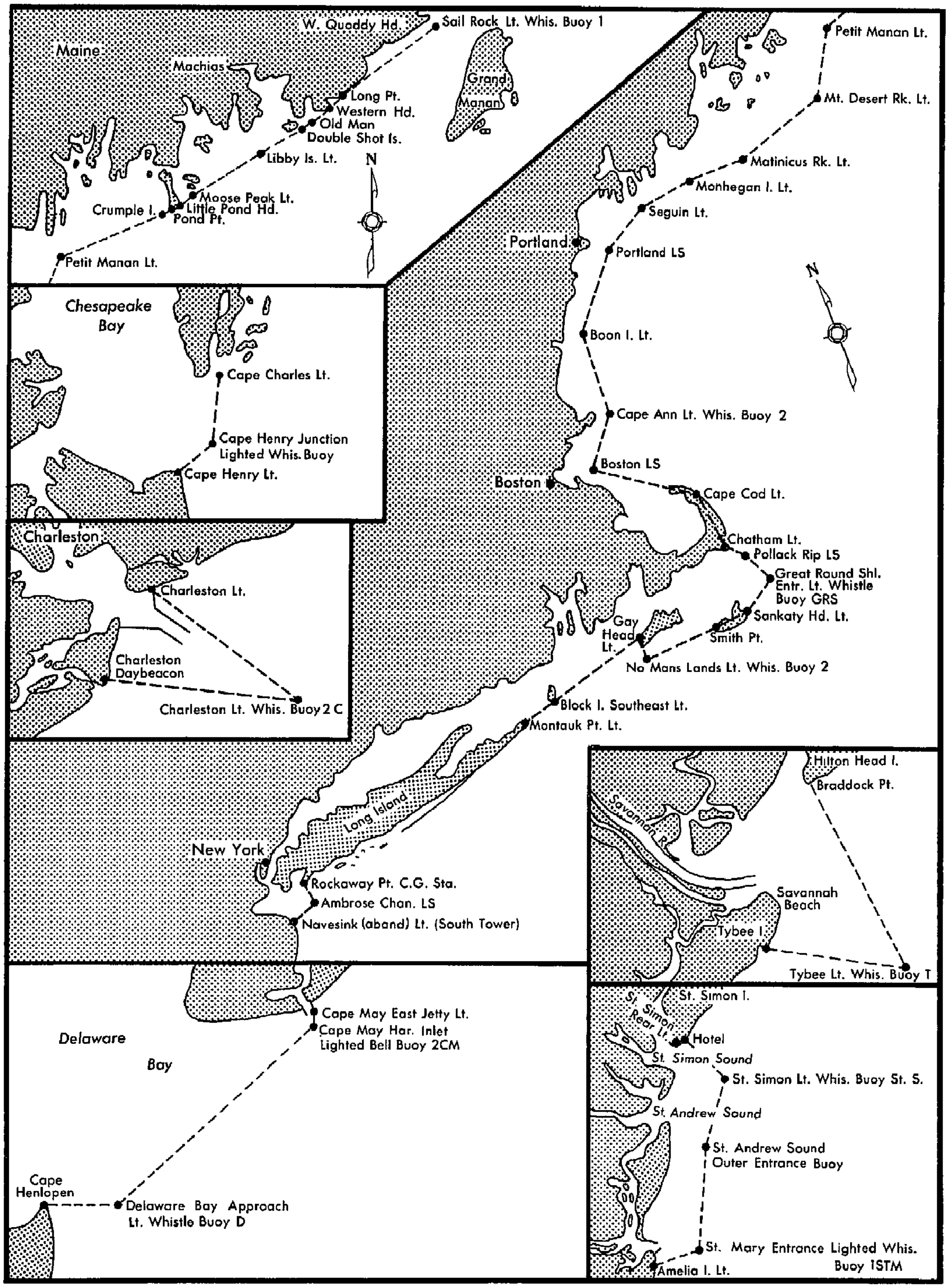

FIGURE 82.—Rules of the Road boundary lines—Atlantic coast.

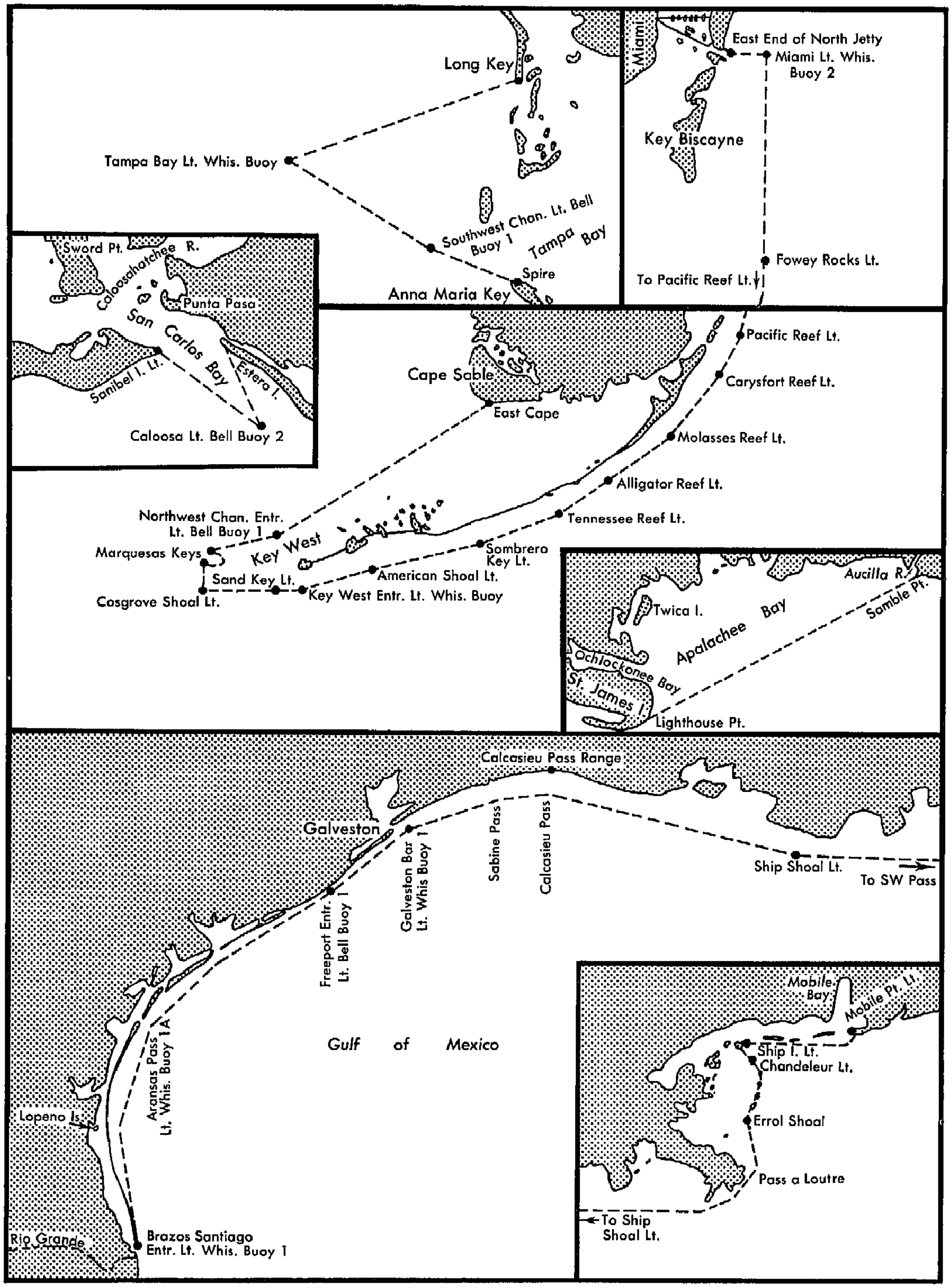

Figure 83.—Rules of the Road boundary lines—Gulf coast.

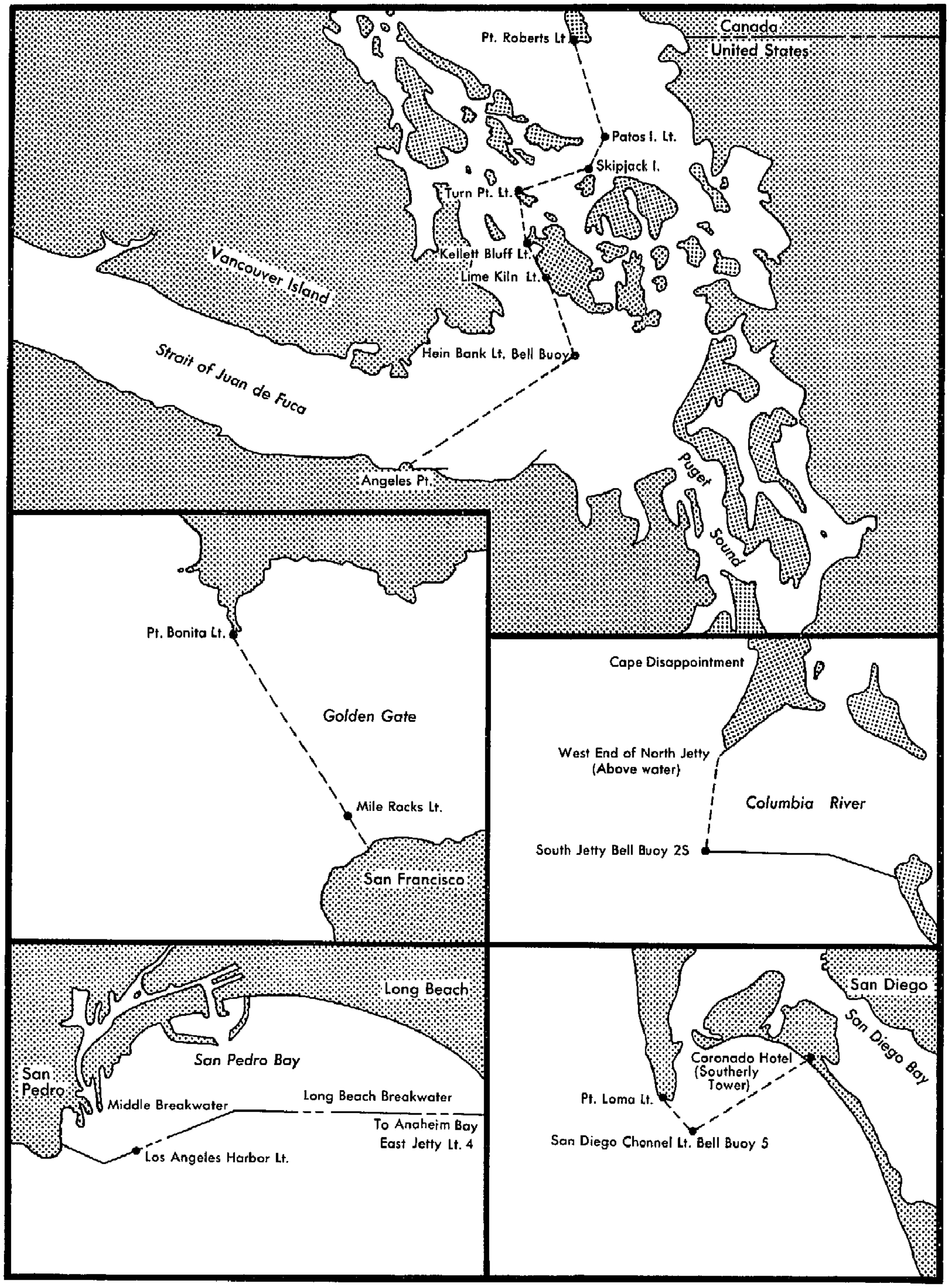

FIGURE 84.—Rules of the Road boundary lines—Pacific coast.

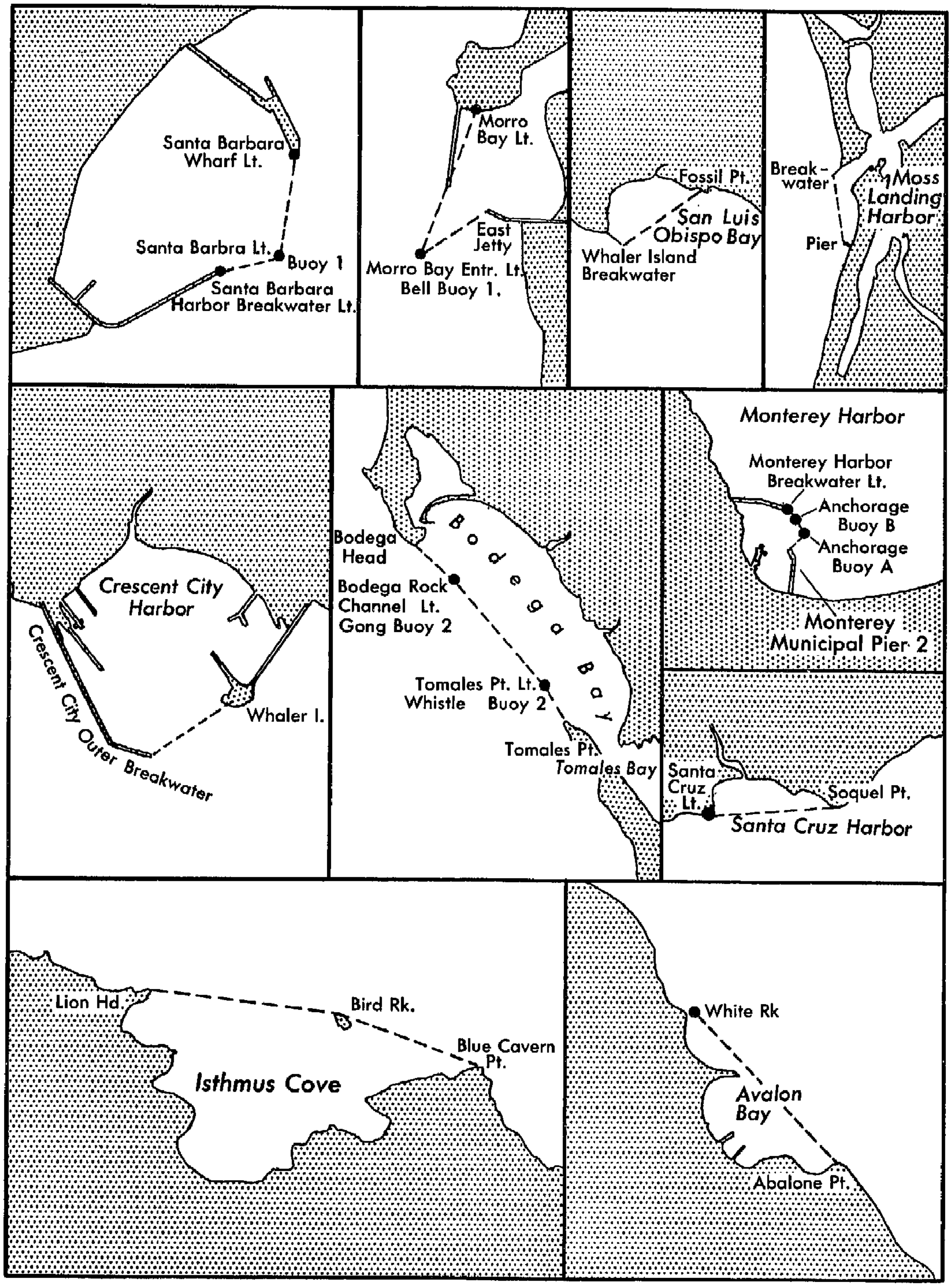

FIGURE 85.—Rules of the Road boundary lines—Pacific coast.

Inland Waters, relating to Rules of the Road" (1898–1916); and "RULES OF THE ROAD for inland waters must be followed for harbors inshore of a line . . . ." (*see* chart 1215, Approaches to New York, 1914–1947 eds.).

Beginning with 1948, the note described above was removed from the charts and the actual demarcation lines substituted with the label "Use Inland Rules of the Road" placed on the inshore side of the line. This is the practice in 1963. The general policy is to show these lines on charts of 1:80,000 scale and larger. But if it is found impracticable to use the line in any place, a note is added giving the limits within which the Inland Rules of the Road apply.[133]

674. INTERPRETATION OF BOUNDARY LINES

Questions frequently arise regarding the exact import of the rules of the road boundary lines under certain factual situations, particularly the question of the status of the water areas inshore of such lines. The few interpretations that have been made of these lines—judicially and administratively—are therefore of significance in the delimitation of sea boundaries.

6741. *Judicial Interpretation*

One of the first cases to come before the Federal courts following passage of the Act of February 19, 1895 (*see* 672), was *United States* v. *Newark Meadows Improvement Co.,* 173 Fed. 426, 428 (1909). This involved an indictment brought in the District Court of New York charging illegal dumping of refuse in the "tidal waters of the lower bay of the New York Harbor and its adjacent waters," at a place 2¼ miles from Sandy Hook, N.J. The court dismissed the indictment on the ground that it should have been brought in the District Court of New Jersey inasmuch as the offense occured within the 3-mile belt along the New Jersey coast. Although the offense occurred within the "harbor of New York," as prescribed by the Secretary of the Treasury under the Act of February 19, 1895, the court said: "This legislation, however, was for the purpose of delimiting the inland waters of the United States, in order to inform navigators where the inland rules of navigation, as distinguished from the inter-

133. EDMONSTON (1956), *op. cit. supra* note 53, at 18. Exceptions have been made in the case of charts 1115, 1116, and 1117 along the Gulf coast and some of the charts in Alaska (*see* chart 8102, for example) which are smaller than 1:80,000 scale but on which the lines are shown.

national rules, become applicable. It does not purport to change the boundaries of any federal district, nor enlarge the jurisdiction of any federal court; and it is obviously beyond the power of Congress directly or indirectly to enlarge or narrow the territorial limits of New Jersey."

This case would seem to be authority for the proposition that the rules of the road boundary lines serve navigational purposes and do not determine territorial boundaries.[134]

6742. *Administrative Interpretation*

Administratively, the Department of State, in the conduct of foreign relations, has also had occasion to express the position of the United States as to the effect of the Coast Guard lines on territorial boundaries. In a reply to an inquiry from the Norwegian Minister as to whether the United States had determined the geographic points for drawing up the basic lines for the territorial waters and the fishery boundary,[135] the Assistant Secretary of State replied, in a letter dated July 13, 1929, in part, as follows:

> The geographic points for drawing up the basic lines for the territorial waters and the fishery boundary, with the exception of certain limited areas covered by special treaty or agreement, have not been determined by the United States. Agencies of the Federal Government have made their own determinations for administrative purposes; for example, the Steamboat Inspection Service has made certain decisions regarding lines separating inland waters from the high seas. However, no final determination has been made which would be binding alike upon all agencies of the Federal Government.
>
> No general statute defines the territorial waters of the United States.

The Norwegian Minister was furnished with a copy of "Pilot Rules for Certain Inland Waters of the Atlantic and Pacific Coasts, and of the Coast of the Gulf of Mexico," and his attention called to page 11 where, under the heading "Boundary Lines of the High Seas," the designation is given of the lines dividing

134. The New York harbor lines were also involved in a different context in *Carlson* v. *United New York Sandy Hook Pilots' Assn.*, 93 Fed. 468 (1899). This was an admiralty action brought in the District Court of New York by the administrator for a seaman killed while being transferred from the pilot ship to a steamer. The court found no negligence and the case was decided on that ground. By way of dictum, the court considered the contention that the accident having occurred more than 3 miles from shore was on the high seas and not within any state limits where a state wrongful-death statute would apply. But the court held that the accident was within state boundaries because the lines designated under the 1895 Act seemed to coincide with a line drawn through points 3 miles from Sandy Hook and Rockaway.

135. The Minister also requested copies of "any regulations which might exist regarding the delineation of the political coastline or the drawing up of the limit between internal and territorial waters."

the high seas from rivers, harbors, and inland waters. With regard to these lines (now established by the U.S. Coast Guard), the letter stated:

> It should be understood that the foregoing lines do not represent territorial boundaries, but are for navigational purposes, to indicate where inland rules begin and international rules cease to apply.[136]

Perhaps the most potent administrative interpretation of the rules of the road boundary lines is to be found in the Coast Guard's order of December 1, 1953, designating the line between inland waters and the high seas along the Gulf coast from Mobile Bay to the Rio Grande, the greater portion of it for the first time (*see* 6721). In promulgating the lines, the Commandant stated:

> The establishment of descriptive lines of demarcation is solely for purposes connected with navigation and shipping. Section 2 of the Act of February 19, 1895, as amended (33 U.S.C. 151), authorizes the establishment of these descriptive lines primarily to indicate where different statutory and regulatory rules for preventing collisions of vessels shall apply and must be followed by public and private vessels. These lines are not for the purpose of defining Federal or State boundaries, nor do they define or describe Federal or State jurisdiction over navigable waters. Upon the waters inshore of the lines described, the Inland Rules and Pilot Rules apply. Upon the waters outside of the lines described, the International Rules apply.[137]

68. DEFINITIONS RELATING TO NAUTICAL CHARTS

Certain definitions relating to features on nautical charts have been standardized for international use and for more restricted local use.

681. Ocean Bottom Features

The International Committee on the Nomenclature of Ocean Bottom Features, meeting in Monaco on September 22, 1952, adopted the following nomenclature:[138]

Continental Shelf, Shelf Edge, and *Borderland.*—The zone around the continent, extending from the low-water line to the depth at which there is a marked increase of slope to greater depth. Where this increase occurs the term *shelf edge* is appropriate. Conventionally its edge is taken at 100 fathoms (or 200 metres) but instances are known where the

136. Excerpts from this letter are given in Hackworth, I Digest of International Law 644–645 (1940).

137. 18 Fed. Reg. 7893 (1953). Prior to issuing the regulation, a public hearing was held and comments invited. "Where practicable," the Commandant stated, "the comments, views, and data relating to safe navigation were accepted and parts of the described lines as proposed were revised accordingly. The comments, data, and views submitted which were based on reasons not directly connected with promoting safe navigation were rejected." *Ibid.*

138. Bulletin, International Union Geodesy and Geophysics 555 (July 1953).

increase of slope occurs at more than 200 or less than 65 fathoms. When the zone below the low-water line is highly irregular, and includes depths well in excess of those typical of continental shelves, the term *continental borderland* is appropriate.

Continental Slope.—The declivity from the outer edge of the continental shelf or continental borderland into great depths.

Borderland Slope.—The declivity which marks the inner margin of the continental borderland.

Continental Terrace.—The zone around the continents, extending from low-water line, to the base of the continental slope.

Island Shelf.—The zone around an island or island group, extending from the low-water line to the depths at which there is a marked increase of slope to greater depths. Conventionally its edge is taken at 100 fathoms (or 200 metres).

Island Slope.—The declivity from the outer edge of an island shelf into great depths.

Basin.—A depression of the deep-sea floor more or less equidimensional in form, but not necessarily large and pronounced.

Trench.—A long but narrow depression of the deep-sea floor having relatively steep sides.

Submarine Canyon and *Valley.*—An elongated steep-walled cleft running across or partially across the continental shelf, the continental borderland and/or slope, the bottom of which grades continually downwards. When the sides have a more gentle slope the term *submarine valley* is more appropriate.

Depth.—A term which may be used for a few of the deepest soundings.

Deep.—The well-defined deepest area of a depression of the deep-sea floor conventionally applied where soundings exceed 3,000 fathoms.

Rise.—A long and broad elevation of the deep-sea floor which rises gently and smoothly.

Ridge.—A long elevation of the deep-sea floor having steeper sides and less regular topography than a rise.

Seascarp.—An elevated and comparatively steep slope of the sea floor.

Gap.—A steep-sided furrow which cuts transversely across a ridge or rise.

Sill and *Sill Depth.*—A submarine ridge or rise separating partially closed basins from one another or from the adjacent ocean. The greatest depth over the sill is commonly known as the *sill depth.*

Plateau.—A very extensive but ill-defined elevation of the deep-sea floor, the top of which may be diversified by lesser features of elevation and depression.

Seahigh.—An elevation of the deep-sea floor of more than 3,000 feet, the morphology of which is insufficiently well known to be covered by a more precise definition.

Seamount.—An isolated or comparatively isolated elevation of the deep-sea floor of more than 3,000 feet.

Tablemount (or *Guyot*) and *Oceanic Bank.*—A *seamount* (roughly circular or elliptical in plan) generally deeper than 100 fathoms, the top of which has a comparatively smooth platform. When the platform has a depth less than 100 fathoms the term *oceanic bank* is appropriate.

Seapeak.—A *seamount* (roughly circular or ellipitical in plan) with a pointed top.

Seaknoll.—A submarine hill or elevation of the deep-sea floor less prominent than a *seamount.* (This term should only be used if the feature has been adequately surveyed, and the terms *seamount, tablemount* or *guyot,* and *seapeak* should be used if the elevation exceeds 3,000 feet above the surrounding floor.)

Deep-Sea Terrace.—A benchlike feature bordering an elevation of the deep-sea floor at depths greater than 300 fathoms.

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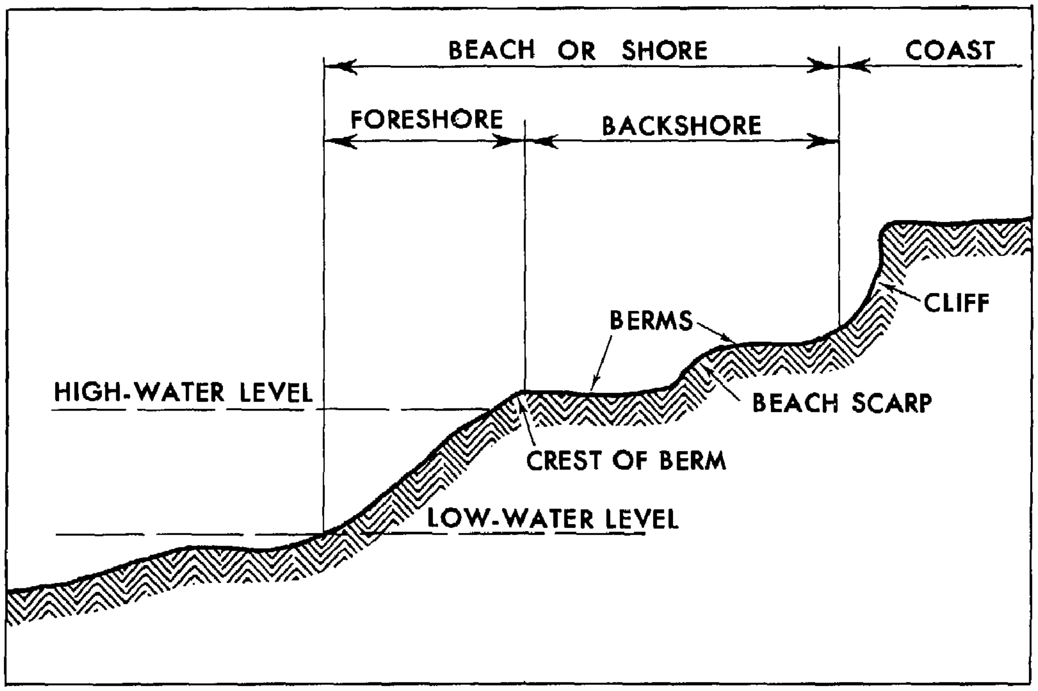

FIGURE 86.—Shore terminology and related terms.

682. Shore Terminology

At the margin of the sea there are several recognized shore features, or zones, characterized by the relationship of land to sea during the rise and fall of the tides. These have acquired a terminology which, while subject to some variation depending upon the purpose for which the classification is made, is fairly uniform.

In the field of shore processes and development, four distinct zones are recognized in the area between the low-water line and the coast, namely, *shore, coast, foreshore,* and *backshore* (*see* fig. 86).[139]

Shore.—This is the most important of the four zones, and extends from the low-water mark inshore to the base of the cliff (large or small), which usually marks the landward limit of effective wave action. It is the zone over which the line of contact between land and sea migrates.

Coast.—The zone of land of indefinite width (perhaps 1 to 3 miles) that extends inland from the shore to the first major change in terrain features.

139. These follow the definitions adopted by the U.S. Beach Erosion Board in Technical Report No. 4 (1954). Comparsion will be made with JOHNSON, SHORE PROCESSES AND SHORELINE DEVELOPMENT (1919); wherever differences exist.

Foreshore.—That part of the shore lying between the crest of the seaward berm (or the upper limit of wave wash at high tide) and the ordinary low-water mark.[140]

Backshore.—The zone of the shore that lies between the foreshore and the coast and is covered by water during exceptional storms only.[141]

In the field of riparian land ownership and where the common law prevails, the Supreme Court has held the term *shore* to be the "land between ordinary high and low-water mark, the land over which the daily tides ebb and flow." [142] Used in this sense, shore is synonymous with foreshore. The backshore, under this interpretation, would be the zone extending from the high-water line to the coast.

From the standpoint of shore and sea boundaries, the term *shore* has a special significance. Its inshore limit—the high-water line—marks the boundary of private property in most of the states, and its offshore limit—the low-water line—forms the baseline for the measurement of seaward boundaries (*see* Volume One, Part 1, 33).

Additionally, the following terms are associated with the zones defined above:

Mean High-Water Line.—The intersection of the tidal plane of mean high water with the shore.

Mean Low-Water Line.—The intersection of the tidal plane of mean low water with the shore.

Coastline.—The line of contact between land and sea. In the Coast and Geodetic Survey, the term is considered synonymous with shoreline.[143]

Shoreline.—The line of contact between the land and a body of water. On Coast and Geodetic Survey nautical charts and surveys the shoreline approximates the mean high-water line. In Coast Survey usage the term is considered synonymous with coastline.[144]

140. In *id.* at 161, *foreshore* is defined as that part of the shore that lies between the ordinary high- and low-water marks and is daily traversed by the oscillating water line as the tides rise and fall. This corresponds to the legal definition of the term *shore* (*see* text at note 142 *infra*).

141. The foreshore and the backshore are the two components into which the shore is divided. This is true according to both authorities (*see* note 139 *supra*), but the dividing line is different (*see* note 140 *supra*).

142. *Borax Consolidated, Ltd.* v. *Los Angeles,* 296 U.S. 10, 22–23 (1935). The civil law concept of shore has been interpreted by the Supreme Court of Texas as extending to the line of mean higher high tide. *Luttes* v. *State,* 324 S.W. 2d 167, 191 (1958).

143. In the field of shore processes and development, coastline has been defined technically as the line that forms the boundary between the coast and the shore and marks the seaward limit of the permanently exposed coast.

144. Designations sometimes used in studies of shore processes are *high-tide shoreline* to indicate the position of the water line at high tide, and *low-tide shoreline* for the position of the water line at low tide. The latter would mark the seaward limit of the intermittently exposed shore. JOHNSON (1919), *op. cit. supra* note 139, at 161.

69. USING NAUTICAL CHARTS

In using Mercator charts, the fundamental principles of the projection must constantly be kept in mind. These affect primarily the determination of direction, the measurement of distance, and the plotting of positions. For certain purposes, it may also be necessary to make allowance for any distortion that may have crept into the chart, especially if quantitative measurements are to be made for studying the rates of shore recession or advance (*see* 132).

691. The Problem of Direction

From the nature of the Mercator projection (*see* 613), the rhumb line (loxodromic curve), or line which cuts all the meridians at a constant angle, is a straight line (*see* fig. 87). It follows, then, that since the meridians on a Mercator chart are parallel, the direction or bearing of a rhumb line between any two points on the chart can be measured with a protractor from the nearest meridian or from the compass rose at any convenient place on the chart. The projection being conformal, directions and angles are correctly represented.

A great circle (orthodromic curve), which represents the shortest distance between two points on the surface of the earth, appears as a curved line on a Mercator chart concave toward the equator (*see* fig. 87). Exceptions to this are the great circles represented by the meridians and the equator which are straight lines on the projection.

This difference between rhumb lines and great circles is of importance in the determination of position by radio bearings. Such bearings follow the arcs of great circles, and, if plotted on a Mercator chart, would appear as a curved line. To facilitate the plotting, it is the practice to apply a correction to the radio bearing to convert it to a mercatorial bearing which can then be plotted as a straight line. The amount of the correction depends upon the convergency of the meridians, and the sign of the correction is dependent upon whether the bearing is taken from the ship or from the radiobeacon, whether the ship is east or west of the beacon, and whether north or south latitude is involved.[145] A radio bearing is always plotted *from* the position of the radiobeacon or fixed station since its position is known and charted. Hence, if bearings are observed from the ship, 180° must be added after the other correction. For distances less

145. When bearings are taken from the ship and read clockwise, the sign of the correction is *minus* in north latitude where the ship is *east* of the radiobeacon, and *plus* where it is *west*. In south latitude the signs are reversed. The signs are also reversed for bearings observed at the radiobeacon and radioed to the ship.

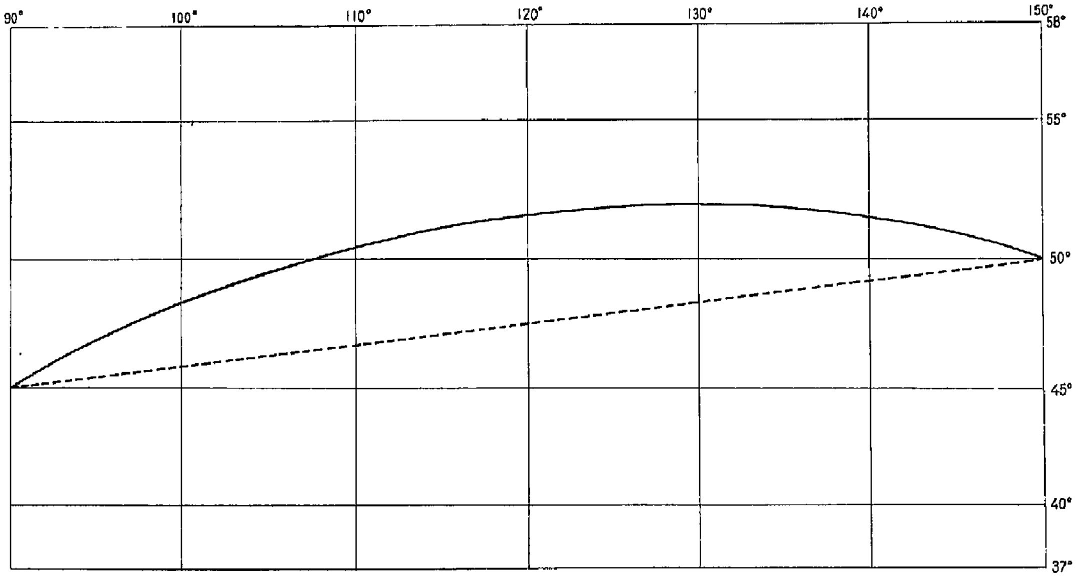

FIGURE 87.—Rhumb line and great circle on a Mercator projection. The dotted line is the rhumb line, which is a straight line on this projection, and the curved line is a great circle which lies on the polar side of the rhumb line.

than 50 miles, the corrections are negligible. A table of corrections is published in all the *Coast Pilots* of the Coast and Geodetic Survey.[146]

692. DISTANCE MEASUREMENT

The measurement of distances on a Mercator chart is closely associated with the principles of the projection. It will be recalled that the latitude intervals increase progressively with the distance from the equator, and it is these latitude intervals along the east and west borders of the chart, subdivided with sufficient closeness, that provide distance units for any latitude on the chart. The latitude midway up the border will have a mean value for the whole extent of the chart because there will be as many units longer above the mid-latitude as there are units shorter below the mid-latitude. It is this principle of the mean value that is used in measuring distances on a Mercator chart, no matter what the direction of measurement is.[147] The use of the latitude scale for distance

146. *See also* Table 1 of BOWDITCH (1958), *op. cit. supra* note 66, which contains similar data. For a full discussion of the problem and the derivation of formulas, *see* Shalowitz, *Conversion of Radio Bearings to Mercatorial Bearings,* 5 FIELD ENGINEERS BULLETIN 101, U.S. COAST AND GEODETIC SURVEY (1932).

147. Charts covering a limited range of latitude show no perceptible change in scale (for example, charts 1:40,000 scale and larger, and most charts of 1:80,000 scale (the exceptions being those in the northern latitudes)), and such charts carry a graphic scale, based on the middle latitude, for measuring distances.

measurement is based on the assumption that a minute of latitude is equal to a nautical mile. For practical navigation this is considered sufficiently accurate. Due to the spheroidal shape of the earth, the length of a minute of latitude actually increases from 1,842.8 meters at the equator to 1,861.7 meters at the pole. Strictly speaking, then, a minute of latitude is equal to a nautical mile in latitude 48°15′ only.[148]

If the distance between two points directly north and south of each other is to be measured, the difference between their latitudes expressed in minutes will give the distance in nautical miles. On the other hand, if the points are east and west of each other, the distance can be found by using as a unit of measure a small number of latitude subdivisions to the north and south of the latitude of the line and stepping that off between the two points with a pair of dividers.[149] Distances represented by rhumb lines at an angle to the meridians may be measured by taking between the dividers a small number of subdivisions on the border scale to the north and south of the middle latitude of the line to be measured, and stepping this off on the line. Thus, if it be required to obtain the length of a line running at an angle to the meridians between the parallels of 40° and 45°, a number of subdivisions on the border scale to the north and south of the middle latitude (42°30′) of the line is taken (the number of subdivisions used is a matter of judgment and will depend upon the scale of the chart used and the length of the line) and with the dividers this distance is stepped off on the line, the total number of minutes in the measurement being the length in nautical miles. In thus taking for a unit a mean value at the middle latitude of the line, there will be approximately as many miles shorter than the mean as there are miles longer than the mean. If the line is of

148. This follows from the definition of the U.S. nautical mile (prior to July 1, 1954) as being equal to one-sixtieth of a degree or 1/21,600 of a great circle on a sphere whose surface is equal to the surface of the earth. This value, calculated for the Clarke spheroid of 1866, is 1,853.248 meters (6080.20 feet), which is the length of a minute of arc at latitude 48°15′. MITCHELL, DEFINITIONS OF TERMS USED IN GEODETIC AND OTHER SURVEYS 59, SPECIAL PUBLICATION NO. 242, U.S. COAST AND GEODETIC SURVEY (1948). On July 1, 1954, the international nautical mile of 6,076.10333 U.S. feet, or 1,852.0 meters, was adopted in the United States, following the proposal of the International Hydrographic Bureau in 1929. This value was revised July 1, 1959, to reflect a refinement of the value of the yard, following an agreement among directors of National Standards Laboratories of English-speaking nations to obtain uniformity in precise measurements involving the yard. The new value for the international nautical mile is 1,852.0 meters=6,076.11549 international feet (approximately) and is based upon the new relationship of 1 yard=0.9144 meter, in place of the old relationship of 1 yard=0.91440183 meter. This, however, does not apply to any data expressed in feet derived from and published as a result of geodetic surveys within the United States. These will continue to bear the old relationship until such time as it becomes desirable and expedient to readjust the basic geodetic survey networks, after which the new ratio will apply. 24 Fed. Reg. 5348 (1959). For conversion tables based on the new relationship, *see* UNITS OF WEIGHT AND MEASURE, MISCELLANEOUS PUBLICATION 233, NATIONAL BUREAU OF STANDARDS (1960).

149. The measurement can also be made by taking one-half the line and laying it off along the latitude scale to the north and south of the latitude of the line. The difference between the latitudes expressed in minutes will give the distance in nautical miles.

considerable length it can best be measured by dividing it into parts and measuring each part with a unit of measurement referred to its middle latitude, as in the above example.

On small-scale charts covering a considerable extent of the earth's surface, it may be desirable, in the measurement of very long lines, to first plot the great circle through the end points of the line on a gnomonic chart and then transfer the great circle to the Mercator chart by latitudes and longitudes.[150] The great circle is then divided into segments and each segment measured by means of the latitude scale, as described above. Although the shortest measured distance is derived from the apparently longer of the two lines (the great circle being a curve and the rhumb line a straight line on the Mercator chart), this anomaly is explained by the fact that the distance unit of measurement as obtained from the middle latitude of a great circle is in a higher latitude and therefore longer than the middle latitude unit of the rhumb line (*see* fig. 87). Therefore, the distance along a great circle on a Mercator chart measures the shortest distance between two points.

693. Position Determination

Since meridians and parallels on a Mercator chart are straight lines at right angles to each other, it is a comparatively simple matter to plot a position of known latitude and longitude or to determine the latitude and longitude of a plotted position. The only instruments required are a straightedge and a pair of dividers. A position can be plotted by marking on the east and west latitude scales of the chart the latitude of the point and joining these two marks by a straightedge, drawing a short line in the vicinity of the longitude of the point. The longitude of the point is plotted in a similar manner by using the top and bottom longitude subdivisions of the chart. The intersection of the two lines is the position required.

To find the latitude and longitude of a plotted position, one point of the dividers is fixed on the position and the other point spread until it reaches the nearest charted parallel (if none is charted, a handy one is ruled). One point of the dividers is then fixed at the end of the same parallel on the latitude scale, and with the other point the latitude of the position is read. A similar procedure is used to determine the longitude of the position, this value being read off from the longitude scale at the top or bottom of the chart.

150. One of the properties of a gnomonic projection is that a great circle on it is a straight line. The gnomonic chart contains a specialized procedure for measuring distances.

6931. *Methods of Position Determination*

The modern nautical chart contains a variety of information by which the navigator may determine his position by any one of a number of methods or combination of methods. Three of these—visual bearings, depth contours, and Loran lines of position—are in common use and will be described. (Position determination by radio bearings is described in 691.) These methods are dependent upon the charted information, in contrast to methods where the nautical chart is merely used as a medium for plotting, for example, when navigating by celestial observations.

(*a*) *By Visual Bearings.*—In position determination by visual bearings on fixed objects the same precautionary measures must be taken as with radio bearings observed at the vessel. A line of sight follows the shortest path on the earth's surface, that is, a great circle. If the distances under consideration are

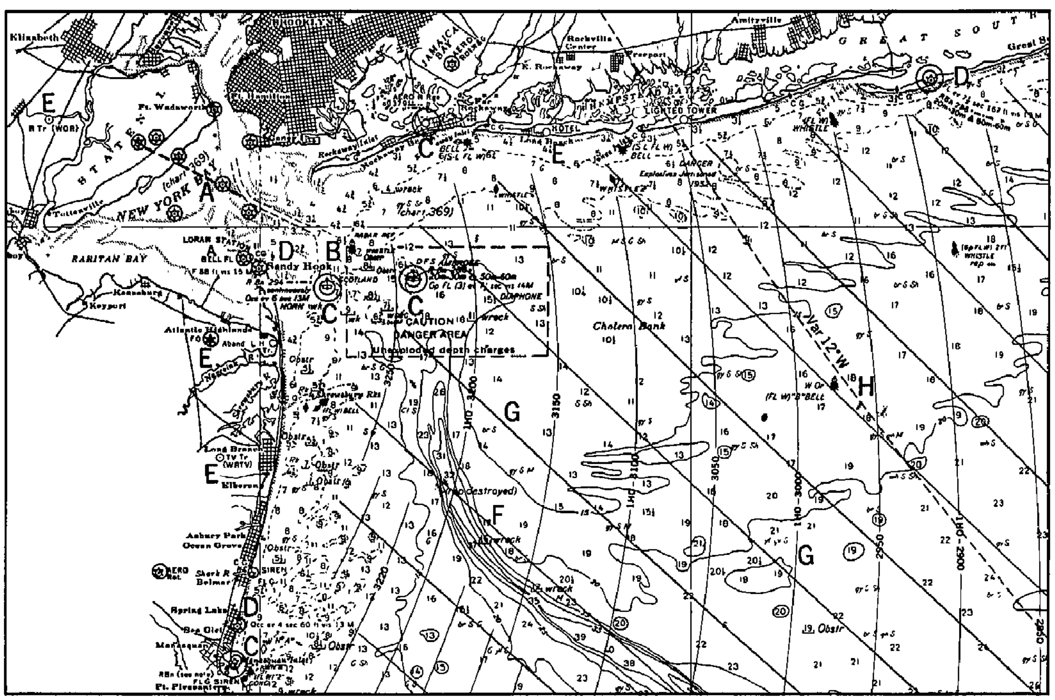

FIGURE 88.—Section of chart 1108 (reduced) showing aids to navigation available to the navigator in approaching or leaving New York Harbor. Tints are used to accentuate the land area and the shoal-water areas.

great enough visual bearings must first be converted to mercatorial bearings before they can be correctly plotted on the chart (*see* 691).[151]

(*b*) *By Depth Contours.*—Many nautical charts now contain sufficient depth contours to adequately delineate characteristic features of the ocean bottom. This provides a vessel, equipped for echo sounding, with a practical method of position determination. Simply stated, this consists merely in fitting a series of observed echo soundings to the depth contours on the chart. This is accomplished by recording with care a number of soundings and simultaneous log distances, and plotting these accurately on a strip of transparent paper at the scale of the chart. The line of soundings on the paper is then fitted to the depth contours on the chart by moving it so that it remains approximately parallel to the true course steered.

Charted submarine valleys are extremely useful in position determination. They usually are narrow, V-shaped in cross section, and have a continuous downward slope along the axis of the trough. The maximum depth obtained when crossing the axis gives a strong position because it occurs in only one place in the valley bed.

Depth contours may also be used as lines of position and may be combined with other information—radio bearings, visual bearings, or lines of position from celestial bodies—to obtain the position of a vessel.

(*c*) *By Loran Lines of Position.*—Loran is a hyperbolic navigation system in which the time difference between the arrival times of a pair of radio pulses transmitted from two widely spaced stations is measured with a high degree of accuracy by the vessel's Loran receiver. Since radio waves travel with the speed of light, the measured time difference represents the actual difference in distance of the position of the receiver from the two transmitters. This time difference establishes a Loran line of position. When time differences are obtained from two pairs of transmitters, the resulting lines of position intersect to form the Loran fix.[152] These hyperbolic lines of position are all precomputed when a chart is constructed and all necessary factors taken into account. The navigator does not have to concern himself with the calculation of the lines. When he measures his time differences he goes directly to the chart and interpo-

151. This precaution must also be followed in determining a vessel's position by the 3-point fix method where the angles are observed on distant mountain peaks.

152. The geometrical principle on which this is based is that the locus of points with a constant difference in distance from two reference points is a hyperbola having the transmitters as focal points.

lates between charted lines of position to determine the exact line corresponding to the measured time difference.[153]

6932. *Approaches to New York Harbor*

Figure 88 is a section of Coast and Geodetic Survey chart 1108, Approaches to New York Harbor, on which has been indicated by letters the various aids that can be used by the navigator on approaching or leaving the harbor. The extent of the aids available are indicated in the following summation (tints and colors, to accentuate the land topography, shoal-water areas, lights, etc., provide additional cartographic aids):

At *A*, he has a range for a line of position through Ambrose Channel; at *B*, he has a danger warning and channel marker—buoy with radar reflector by day, and light of fixed characteristics by night; at *C*, he has radio beacons on the lightships and on shore for obtaining bearings by radio compass from the vessel; at *D*, he has the height and visibility of lights for determining position; at *E*, he has landmarks for taking angles and bearings—structures and natural objects by day and lights by night; at *F*, he has depth contours for use with an echo sounder; at *G*, he has Loran lines of position for use with his Loran receiver by day or night; and at *H*, he has isogonic lines (lines of equal magnetic declination) to be applied to his magnetic compass.

694. Principal Chart Adjuncts

While the nautical charts themselves contain the essential data for the navigation of the waters covered by them, there is certain collateral information that the navigator must have but which it is not feasible to show on the chart because of its scale or because of the nature of the information involved. To provide for this, separate publications are issued by the Government which may be considered principal chart adjuncts. The more pertinent of these are the following (*see* fig. 89):

(*a*) *Catalog of Nautical Charts.*—The catalog lists nautical charts, auxiliary maps, and related publications of the Coast and Geodetic Survey, and includes references to similar publications of other federal agencies. The format is loose-leaf, and separate pages are available showing diagrams of charts for a designated area. The preliminary pages of the catalog contain certain general information pertaining to chart construction and to the classification and use of nautical charts. Each page of the catalog proper contains the layout of charts

153. Loran lines of position are now shown on certain selected nautical charts of the Coast and Geodetic Survey. They are indicated in the chart catalog by a dagger symbol (†) and an appropriate note. For detailed information on the Loran system of navigation, including certain limitations in its use, *see* Catalog of Loran Charts and Publications, U.S. Navy Hydrographic Office (1955).

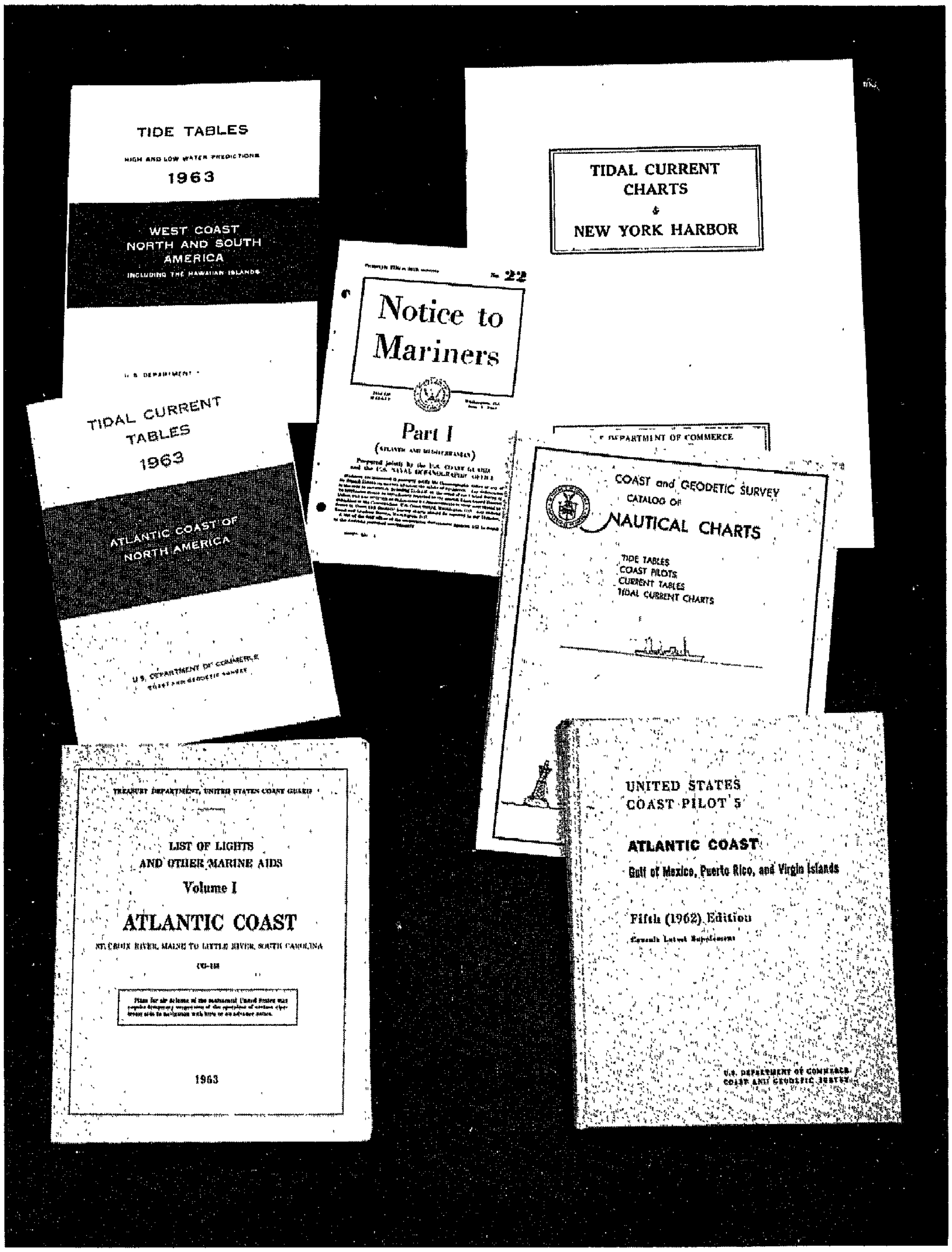

Figure 89.—Principal nautical chart adjuncts. Some of the publications issued by the Government for the navigator's use.

for that area. This is backed up by tabular information which gives the chart number, price, title, scale, and paper size, grouped into the various chart classifications (*see* 625). Also included is a list of sales agents for the charts and related publications of the Bureau, and a numerical list of nautical charts giving the price and catalog page.

To help insure that only the latest nautical charts are used, the publication of a revised list of charts titled "Dates of Latest Editions" was begun in March 1963 and will be published each month. By means of symbols, the user's attention is drawn to new charts, new editions, and discontinued charts.

(*b*) *Coast Pilots.*—These are published in eight volumes or parts and cover the coasts of the United States together with Puerto Rico and the Virgin Islands. Each volume furnishes information required by the navigator that cannot be shown conveniently on the nautical chart, such as detailed data relative to the coastline, port information, sailing directions for coasting and entering harbors, and general information as to weather conditions, radio service, etc. New editions are published about every 7 years, but supplements, giving changes and new information, are published annually.[154]

(*c*) *Tide Tables.*—Since all depths on a chart are reduced to the sounding or chart datum, the navigator must know the actual depth of the water during any part of the tidal cycle in order to make the most effective use of the charted information. This is furnished by the *Tide Tables* which give the predicted times and heights of high and low water for every day in the year for a number of reference stations, and differences for obtaining similar predictions for numerous other places. From these values it is possible to interpolate by a simple procedure the height of the tide at any hour of the day (*see* Part I, 2322 A).[155]

(*d*) *Tidal Current Tables.*—Such tables are issued annually in advance of the year for which they are prepared. They include daily predictions of the times of slack water and the times and velocities of the strength of flood and ebb currents for a number of waterways, together with differences for obtaining predictions at numerous other places. Also included is a method for obtaining the velocity of current at any time.[156]

154. *Coast Pilots* are divided in the following order: *Atlantic Coast*—Pilot 1, Eastport to Cape Cod; Pilot 2, Cape Cod to Sandy Hook; Pilot 3, Sandy Hook to Cape Henry; Pilot 4, Cape Henry to Key West; Pilot 5, Gulf of Mexico, Puerto Rico, and Virgin Islands. *Pacific Coast*—Pilot 7, California, Oregon, Washington, and Hawaii. *Pacific Coast, Alaska*—Pilot 8, Dixon Entrance to Cape Spencer; Pilot 9, Cape Spencer to Arctic Ocean. This form of classification was adopted in May 1953, and superseded the old *sections* and *parts* form. *Title Changes of Coast Pilots,* 6 JOURNAL, COAST AND GEODETIC SURVEY 151 (1955).

155. The coasts of the United States are covered in two volumes: East Coast, North and South America; and West Coast, North and South America.

156. Two volumes cover the coasts of the United States, as follows: Atlantic Coast of North America, and Pacific Coast of North America and Asia.

(*e*) *Tidal Current Charts.*—These publications consist of a set of 12 charts which depict the direction and velocity of the current for each hour of the tidal cycle. The charts present a comprehensive view of the tidal current movement in the respective waterways as a whole and also furnish a means for readily determining for any time the direction and velocity of the current at various localities throughout the water areas covered.[157]

(*f*) *Notices to Mariners.*—A weekly pamphlet prepared jointly by the U.S. Coast Guard and the U.S. Naval Oceanographic Office. These are issued as a safety aid to keep mariners constantly advised of changes so they may keep their nautical charts and *Coast Pilots* up to date. For additional information pertaining to this item, *see* 1272.

(*g*) *List of Lights.*—Lights and other marine aids to navigation, maintained by or under authority of the U.S. Coast Guard, are described in the List of Lights. The lists give fuller information on aids to navigation than can conveniently be shown on the charts, such as the characteristics, candlepower, visibility, and date of establishment of lights, as well as descriptions of light structures and daybeacons, buoys, radiobeacons, and fog signals.[158]

(*h*) *Nautical Chart Manual.*—Although this publication is intended primarily to give practical guidance to the cartographic engineer engaged in the construction and revision of nautical charts, it is classed here as a *chart adjunct* for the user because situations may arise where a specific charting practice may be of considerable importance. This manual should be consulted in such cases as the best authority for the practice. The first such manual was published in 1948 and was an updating and elaboration of a Bureau pamphlet entitled "Rules and Practices Relating to the Construction of Nautical Charts" (*see* note 57 *supra*) and other accumulated instructions. This was followed by a 1952 edition. The latest published revision is the 1956 edition (*see* note 53 *supra*).[159]

157. Tidal current charts are available for Boston Harbor, Narragansett Bay to Nantucket Sound, Long Island Sound and Block Island Sound, New York Harbor, Delaware Bay and River, San Francisco Bay, and Puget Sound.

158. In 1963, the following volumes covered the coasts of the United States: *Atlantic Coast*—Volume I, St. Croix River, Maine to Little River, South Carolina. *Atlantic and Gulf Coast*—Volume II, Little River, South Carolina to Rio Grande, Texas and the Antilles. *Pacific Coast and Pacific Islands*—Volume III.

159. A new edition of this manual was published in Mar. 1964 and is identified as BRUDER, NAUTICAL CHART MANUAL, PUBLICATION 83-1, U.S. COAST AND GEODETIC SURVEY (1963). An integral part of the latest revision will be a reprint of Chart No. 1 showing the symbols and abbreviations used on the nautical charts of the Bureau (*see* Appendix F).