HOW HYDROGRAPHIC CHARTS ARE MADE.

BY FELIX REISENBURG, LATE OF UNITED STATES COAST AND GEODETIC SURVEY.

THE casual observer looking at a coast sheet chart as published by the United States Coast and Geodetic Survey, or, for that matter, any ocean chart, is often puzzled to know the meaning of the various numbers that dot the water surface of the chart. The amateur sailor, of course, knows that they are soundings, which means the depth of water, but he, as well as many of his professional brethren, is often more or less in the dark as to how the depths and their exact locations are obtained. The soundings that appear on the finished chart are only the characteristic soundings and show the least depth of water to be expected. They represent but a small percentage of those actually taken to obtain a correct development of the bottom. An idea of this phase of chart construction, known as hydrography, is best obtained by following the method of making a simple hydrographic survey as practised by the parties of the United States Coast and Geodetic Survey. Most of the hydrographic work is carried on from small vessels of from 500 tons displacement to a steam launch, and the party will usually comprise from eight to ten officers and forty men on the larger vessels.

When a survey or a re-survey of a certain locality is ordered, the assistant in charge of the party receives such data from the bureau at Washington as will usually enable him, after an inspection of the ground to be covered, to determine upon the system of sounding lines which will cover the work to the best advantage.

A projection of the work is then prepared. This is a sheet showing the meridian and parallels, and is made of heavy drawing paper backed by cotton cloth of a variety not easily distorted by moisture. The projection used in the Coast Survey is that known as the polyconic and is the most accurate representation of the surface of our spheroid on a plane. It is constructed strictly to scale in accordance with the computed values of the projection for the different latitudes. Upon this sheet, bare of all but the meridians and parallels, the triangulation stations of the locality are plotted, as well as any remarkable features of the topography that might serve as signals. The shore line is drawn, and the hydrographic signals, which usually consist of whitewashed tripods from 30 to 40 feet high surmounted by white and black flags, are accurately plotted on the sheet. The sheet is now a chart of the locality showing the shore line and signals, with the water space left blank. It is larger than the finished chart, ranging from 1-5,000 to 1-1,200,000 of the actual size of the earth's surface shown, according to the magnitude or importance of the work.

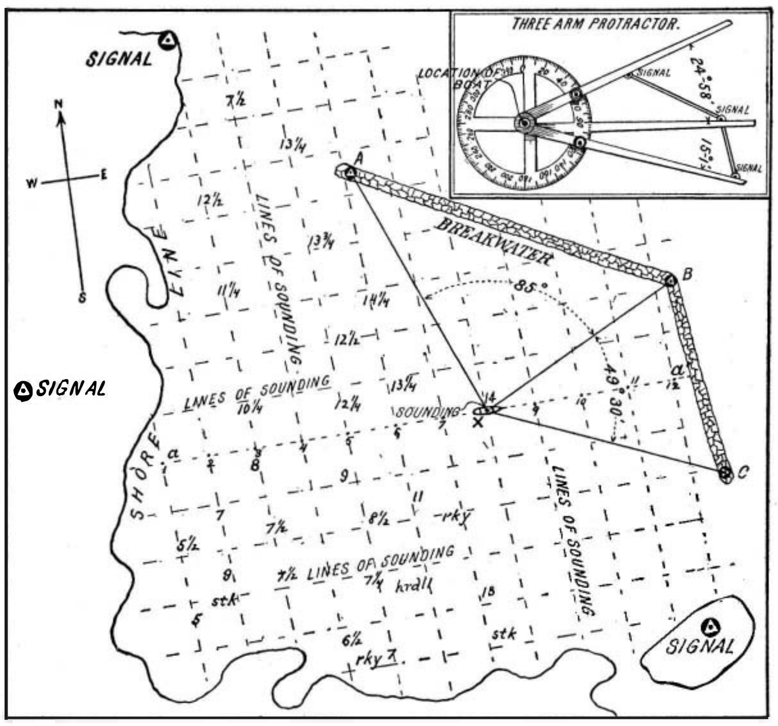
The next step in the survey is to cover the water space of the chart with a system of lines of soundings. A sounding line is run either by a steam launch or the steamer, and in shallow water whale boats are sometimes used. In a launch or small boat the sounding party consists of the two observers, the recorder, the leadsman, and the coxswain. The method of procedure is as follows: The launch is located at the end of the line by the two observers, who simultaneously measure with sextants the two horizontal angles between three signals ashore; these angles, set on a three-armed protractor, and transferred to the chart, give the exact location of the sounding boat at that instant. The principle of this operation is based on the geometrical fact that a circle can be drawn through any three points, and the intersection of the two circles, one drawn through the right and center signals and the launch and the other through the left and center signals and the launch, gives the exact location of the boat. The three-armed protractor furnishes an easy and expeditious mechanical solution of this, the three-point problem. After each fix, the observer who takes the right angle sets the angles on the protractor and plots the position of the boat. The boat sheet or projection is stretched on a board in front of the observer who plots, and by means of the positions, which are taken at intervals of from a minute to four minutes in ordinary work, the officer in charge of the boat is enabled to direct the movements and keep the lines properly spaced.

The leadsman stands in the bow and sounds with the hand lead, or blue pigeon, getting a cast at each position and at equal time intervals between positions. The recorder, who is by far the busiest man in the boat, watches the clock, gives the time of angling to the observers, and tells the leadsman when to sound. He keeps a record of the time of each sounding and the depth of water obtained, also the time of each position, the angles, and the signals observed upon. He also fills in the column of remarks on the character of the bottom as given by the leadsman, such as hard, sticky, soft, etc., obtained by the feel of the lead as it touches bottom, and makes notes of tide rips and all changes of course or ending of lines, etc. The recorder exceeds the proverbial busy bee by improving each shining second—eyes, ears, voice, and fingers work together; and as the boat speeds along over the surface a record of the time position, and depth, as well as such other data as will assist the draftsman, is entered in the sounding book. The time, aside from its usefulness in spacing the soundings between positions, is a most important factor in the reduction of soundings to the datum plane of mean low water.

To obtain this datum plane and also the state of the tide at each cast of the lead, a tide gage is set up in some sheltered place adjacent to the work. An observer, supplied with a clock frequently compared with those used in the sounding boats, is stationed at the gage and records its readings at regular intervals during the progress of the work. With the tidal data so obtained a reduction is applied to each cast of the lead, reducing it to mean low water.

Soundings on a survey are recorded in feet and quarters of a foot, while the mariner has his lead line marked to fathoms. In accordance with this custom the depths on a finished chart are always marked in fathoms, except on the shaded portions close inshore, where the numbers indicate depths in feet.

A, *B*, and *C* are temporary signals set up for convenience in locating soundings inside of the head water. *X* represents the position of the sounding boat at the eighth set of angles on the line *a a'*. *C*, *X*, *B* is observed by the right-hand observer and is termed the right angle. *B*, *X*, *A* is observed by the left-hand observer and is termed the left angle. A three-armed protractor set to these angles and the edges of arms made to pass through the signals *A*, *B*, *C*, will locate the boat at the center of the instrument. The figures in outline show the three-armed protractor as applied to position 8.



HOW THE CHARTS OF THE COAST AND GEODETIC SURVEY ARE MADE.

On the survey steamers "Bache" and "Blake" employed in the survey of the Atlantic and Gulf coasts, two steam launches and the ship will usually carry on the work of sounding at the same time. The parallel lines of soundings run by one boat crossed at right angles by those of another boat, furnish a valuable check on the work, the steamer being employed in the offshore hydrography. The final plotting of all the reduced soundings on the smooth sheet is the basis of the new or corrected chart.

Thirty miles of sounding lines is considered a good day's work for a steam launch, but the average is less. Currents, tide rip, and rough water often confuse the lines by setting the boat off her course, thus delaying the work.

The charts of the coast are the most important to the navigator, as they mark the danger point of his voyage, namely, the landfall. When this happens in thick or foggy weather, the mariner must in a great measure depend upon the soundings shown on the chart for the necessary information to take him safely into port.

Antwerp, at the end of 1903, still retained the position of being the third largest port in the world, the tonnage of vessels which entered the port being 9,039,-313. This figure was only exceeded by London, Hongkong, and New York.

Prizes in France.

The Académie des Sciences has established a number of prizes which are to be awarded during the period from 1905 to 1909. Among the number we may mention the following:

Fourneyron Prize ($200). The Academy establishes the concourse for this prize in 1905 the following question: Theoretical or experimental study of steam turbines.

Hébert Prize ($200). Annual prize designed to reward the author of the best treatise or the most useful discovery for the popularizing and practical use of electricity.

Hughes Prize ($500). Biennial prize founded by the physicist Hughes, designed to be awarded to the author of a discovery or researches which contribute the most to the progress of physics.

Gaston Planté Prize ($600). Biennial prize to be given to the author (French) of an important discovery, an invention or research in the electrical field. The Academy will award this prize in 1905 should there be occasion for doing so.

La Caze Prize ($2,000). This biennial prize will be awarded in 1905 to the author (of any nation) of works or memoirs which shall have contributed the most to the progress of physics. It cannot be divided.

Kastner-Boursault Prize ($400). A three-yearly prize which will be given (if need be) in 1907 to the author of the best work upon the different applications of electricity in the arts, industry, and commerce.

Wilde Prize (one prize of $8,000 or two of $4,000). An annual prize given to the person whose discovery or treatise upon astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics shall have been judged by the Academy as the most worthy of recompense. This work may have been done in the same year, or at another period.

Jean Reynaud Prize ($2,000). An annual prize which will be awarded in 1906 by the Academy to the most meritorious work which is produced during a period of five years. This work is to be original, of a high order, and to have the character of invention or novelty.

Leconte Prize ($10,000). This triennial prize will be given (if need be) in 1907 to the author of a new and capital discovery in mathematics, physics, chemistry, natural history, medical sciences, or to the author of new applications of these sciences which give much superior results over the present.

The close of the concourse for 1905 will take place on June 1 of this year.

Salt Marshes of Congo.

The salt marshes of the Congo region are to be found in considerable number in the district of Sambalt, and there are also many of these marshes on the left bank of the river Lufubu. In general they resemble a kind of pocket or rift in the soil. The walls of the rift show first a layer of blackish clay mixed with sand and containing numerous quartz and silex pebbles, or more exceptionally black and white shells, fragments of oyster and mussel. Then comes a layer of stratified and gray-blue schist. The soil of the depression also contains schist as the greater constituent, and is covered by a layer of sandy clay. In order to collect the salt, the natives dig a funnel-shaped hole from 6 to 10 feet in diameter and about 3 feet deep. The cavity soon fills up with a warm and clear water which is strongly charged with salt. It comes up with considerable pressure and the liquid seems to boil. The salt is partly precipitated at the bottom of the cavity and mixes with the soil to form a blackish mud. The latter is washed out with hot water to extract the salt which is then crystallized from the solution. The product which is thus obtained is of a salty gray color. Its taste is more alkaline than that of European salt.

The density of population in the Philippines is 67 per square mile. In continental United States it is 26 per square mile. The inhabitants are usually found on or near the coast, except in the island of Luzon, where about half the people live in the two rich valleys in the interior. Only one-seventh of the civilized population live inland, but the wild peoples are confined almost entirely to the interior. In the archipelago there are 13,400 barrios or villages, with an average population of 500 inhabitants. The average size of the barrio varies widely in different provinces. A number of adjacent barrios form a pueblo or municipal unit, and thus there is practically no rural population. Three-fifths of the population live in villages of less than 1,000 inhabitants and 4 per cent in towns of over 5,000. There are four towns with a population exceeding 10,000 each, and thirty-five with a population exceeding 5,000. Manila is the only incorporated city in the islands, and its inhabitants number 219,928.