THE CUBAN SURVEY

Rear-Admiral W. R. GHERARDI, Hydrographer of the United States Navy, has very kindly sent to the International Hydrographic Bureau the following information in regard to the Cuban survey:

The publication of the new chart of Cuba by the Hydrographic Office of the U. S. Navy marks the completion of a survey project on which the Navy has been engaged for twenty-five years, with the result that accurate information of the Cuban waters is now available.

To obtain the data for this work, a total of 2,300 miles (3,700 kms.) of shore line have been surveyed and 23,429 square nautical miles of soundings have been made. During this field work, one general chart, 21 coastal charts, and 56 harbor or plan charts have been evolved, all of them hydrographically and geodetically accurate. While the work progressed, 634 editions of the various charts have been produced incorporating changes and additions as the data became available from the field parties.

With the exception of the years 1917 to 1921, the Navy has had one and, part of the time, two naval survey vessels engaged in this work during the season when it could be expeditiously employed.

The Cuban Survey parties were augmented in 1923 by a plane and aerial photographic equipment. By the use of aerial photography much more topographical detail was obtained. Mangrove covered shores and cays which were almost inaccessible by boat were accurately charted. The aerial surveys served two main purposes: first, the mosaic of the coast not yet under control by triangulation, when reduced to the scale of the field sheet, made an excellent reconnaissance sheet by means of which the triangulation system for the next season was planned with more certainty as to intervisibility of stations and as to adequacy for subsequent surveying operations, as well as saving considerable time heretofore taken in making land reconnaissances; and secondly, after the survey was made, the detail and the shore line between salient points located by the ground parties were drawn from the photographs. Another advantage of the aerial survey was that the shoals and reefs below water and not observed from the boats were frequently distinguishable from the air. With such knowledge of their location obtained from the plane, they were readily located and sounded by the boat survey parties. Indications of deep holes and channels could also be observed from the air, all of which was of great assistance to the surface surveyor. More than 1265 miles (2,040 kms.) of the main coast line of Cuba and the Isla de Pinos have been flown, photographed and charted by these methods.

In 1924, another addition was made by science to the instrumentalities available to the hydrographer, in the form of the sonic depth finder. This device was installed in the survey ships and later in the subchasers which accompany them and assist in the work. The installation was of material assistance in developing the one hundred fathom curve, as this could now be done by running in and out across the curve without stopping, taking soun-

dings at shorter intervals than was feasible under the old hand method in a limited time. As a result of the increased speed with which deep sea soundings could thus be taken, it became feasible to survey much of the water included within the limits of the chart and outside the one hundred fathom curve, and this was done.

The Spanish-American war proved the necessity and provided the opportunity for immediate and accurate surveys of the more important harbors and sections of Cuba. In 1898, the Hydrographic Office published and had on issue 26 charts of Cuban waters, consisting of two general charts and twenty-four harbor or plan charts. However, they were crude affairs, as they had been constructed from old and incomplete Spanish and British charts of the region, supplemented by five minor surveys of the United States Navy. In 1899, the Navy started the work of making an accurate survey and detailed the U. S. S. *Eagle* and U. S. S. *Yankton*, gunboats, for the duty.

The survey work was continued so that in 1904 a sufficient nucleus was considered to have been acquired to issue the original publication of a general chart of Cuba. The data used in compiling the first publication of Hydrographic Office General Chart N° 2145, "The Island of Cuba", was obtained from British Admiralty charts for those portions of the Bahamas included within the limits of the chart, from U. S. Coast and Geodetic Survey charts of the southern tip of Florida, and from Spanish charts, from the prior surveys by the U. S. Navy and from the work of the U. S. S. *Eagle* and *Yankton* from 1899 to 1904, supplemented from 1901 by the U. S. S. *Vixen*, for Cuba and the surrounding waters. By this time, twenty new charts of the harbors and coasts surveyed had been constructed and put on issue by the Hydrographic Office as a result of the work of the above vessels.

The survey of Cuban waters has progressed steadily up to the present, not as rapidly as might have been desired at times due to shortage of facilities, but nevertheless it succeeded in keeping up with the necessities of our fleet and the demands of an ever increasing commerce which grew apace as the natural resources of the new Republic were developed. The World War caused the only cessation of the work of any moment. The U. S. S. *Yankton* was withdrawn from this duty in the fall of 1903; the *Eagle* continued until 1912; the *Vixen* operated in 1901-1902; the *Nashville* in 1903; the *Hist* surveyed from 1908 to 1917; the *Paducah* from 1911 to 1917 and again in 1921; the *Des Moines* in 1911-1912; the *Hannibal* took up the work in 1918 and with occasional temporary diversions caused by other survey necessities, remained until 1930; and the *Nokomis*, which entered the field in 1924, continued with the work through its completion this year.

All of the above operations were in the form of a hydrographic survey with geodetic control, which gave results of a high degree of accuracy. In 1911, the astronomical positions of twenty-one points about the entire coast of Cuba were established by means of astronomical transit and telegraphic time signals. A complete report of this most interesting, as well as extremely necessary, undertaking is given in H. O. Publication N° 131 (1911-1912), "The Cuban Longitude Report". After the survey had been run from Batabano along the south coast around the western end of Cuba at Cape San

Antonio and along the north coast to Habana, the Batabano coordinates were extended overland to Habana, some twenty-five miles almost due north, as a check on the triangulation work. The difference between the two positions, one carried overland for twenty-five miles and the other carried along the irregular coast line for about three hundred and seventy miles, was only three-quarters of a second in latitude and one second in longitude, or about seventy-five feet (23 m.) and ninety-four feet (28 m. 5) respectively, of error. This result provided immense satisfaction to those performing and to those in charge of the work and ample proof of the high degree of accuracy of the data on which the charts were being constructed.