

CORRECTIONS APPLIED TO ECHO SOUNDINGS.

(Extract from *Bulletin N^o 19*, U. S. Coast Guard — *The "Marion" Expedition to Davis Strait & Baffin Bay, 1928* — Scientific Results - Part I, Washington, 1932, P. 57).

It is well known that echo soundings are not accurate as taken. They have to be corrected for *instrumental* and *personal* errors; also for errors arising from the varying speed of sound in the water column under the ship. The fathometer of the *Marion* was constructed on the assumption that the speed of sound in the water column is always 820 fathoms a second. This, as a matter of fact, never was the truth throughout the entire expedition, it being less than this value in every case. Therefore, every fathometer sounding recorded was, theoretically at least, somewhat too great.

The speed of sound in sea water varies principally according to the salinity, temperature and pressure. The soundings themselves, by giving at least the approximate depth, furnished a clue regarding the latter factor, and the first two could be determined with considerable precision from the salinity and temperature values observed at the 191 oceanographic stations which the *Marion* occupied. For complete information regarding this station data, the reader is referred to United States Coast Guard *Bulletin 19*, part 2 : *The Oceanography of Baffin Bay and Davis Strait*.

The first step in correcting the fathometer soundings was to determine the speed of sound at each station. This speed was obtained, after averaging the salinities and temperatures for each 200-fathom water layer at each station, from the tables on pages 160 and 161 of *Hydrographic Manual*, J. H. HAWLEY, Special Publication N^o 143 of the United States Coast and Geodetic Survey, 1928. The stations were occupied to various meter levels, but it was possible to plot the salinities and temperatures to a meter scale, graphically convert to fathoms, and average conditions by 200-fathom layers in every case by inspection without any important error.

The United States Hydrographic Office, the Carnegie Institution of Washington, and the United States Coast and Geodetic Survey, all assisted the writer with information and with advice on how to attack the problem of determining the speed of sound in the water columns of Davis Strait. The United States Coast and Geodetic Survey went over the preliminary soundings correction work in several of its stages, independently checking a large number of the speed of sound values. Because of this checking, the writer feels much more confident regarding the accuracy and value of this chart than otherwise would be the case.

After the first speed of sound chart was constructed, all the *Marion's* offshore soundings and all the speed of sound values were plotted on the MERCATOR projection on two large rolls of tracing paper, ruled up on a scale of 4 inches to the degree of longitude. The various soundings were grouped on the new chart with different speeds of sound varying by 2 fathoms per second. Corrections were then made in accordance with the table given below :

SPEED OF SOUND IN WATER COLUMN AT SOUNDING SPOT IN FATHOMS PER SECOND
AND PERCENTAGE CORRECTION TO BE APPLIED TO FATHOMETER READINGS.

<i>Fathoms per second.</i>	<i>Per cent.</i>	<i>Fathoms per second.</i>	<i>Per cent.</i>
790	— 3.64	808	— 1.46
792	— 3.40	810	— 1.22
794	— 3.16	812	— .98
796	— 2.92	814	— .74
798	— 2.68	816	— .48
800	— 2.48	818	— .24
802	— 2.20	820	No correction.
804	— 1.96	822	+ .24
806	— 1.72		

The correction for each fathometer sounding as calculated was applied right on the large chart rolls to the observed depth values. In addition, 2 fathoms were taken from each fathometer value to allow for the fathometer constant, a number which was obtained

by comparing corrected red-light fathometer and simultaneously taken wire soundings with each other. The fathometer constant is a sort of index error of the apparatus. It does not vary with the depth or character of water column, but with the location of the particular fathometer oscillator and hydrophone being used below the water line of the sounding ship. After the above two corrections were applied, the shallow water or red-light soundings were *corrected so far as possible*.

All the soundings in fact were now better than they were when first taken, but there still remained *personal* errors in the white-light soundings which it was possible, in large part, to eliminate. Fifty-three wire soundings, over 100 fathoms deep, had been taken at stations during the course of the expedition, and these were now analysed in comparison with the partly corrected white-light echo soundings which had been taken simultaneously in the same places. Some 35 of these wire soundings had been fair to good up-and-down casts taken during moderate weather. It was seen that these reliable checks had rather consistent differences from the partly corrected echo soundings when the latter were grouped according to the watches of the *different officers* who had had the deck and taken and recorded the fathometer readings. It was found that one officer, on the average, had recorded all of his white-light soundings 32 fathoms too great, while the three others had recorded them, on the average, only 11 fathoms too great; 32 or 11 fathoms, therefore, were taken from all the partly-corrected white-light soundings plotted on the chart, depending upon who had had the watch during which they were taken. This completed the corrections to all of the offshore soundings, and brought them, on the average, as close as possible to the good wire soundings and the true depth.

When all offshore soundings had been corrected, the values obtained in the harbors and inland waters were corrected in the same general manner. These were plotted on special large-scale charts of the areas concerned, the soundings being much too close together in these regions to permit their being plotted and corrected on the chart rolls containing the offshore soundings on the scale of 4 inches to the degree of longitude.

It is hard to say how much the fully corrected fathometer values may vary from the true depth, just as it is to say how far wrong the different wire soundings may be. It is thought that the completely adjusted fathometer values are correct in at least half of the cases to within plus or minus 25 fathoms for all depths. There are probably a few over plus or minus 50 fathoms in error, but this number is undoubtedly very small.

