THE DORSEY FATHOMETER.
SONO-RADIO-BUOY.
RADIO ACOUSTIC RANGING.

(Lecture delivered by Captain G.T. RUDE, U.S. Coast and Geodetic Survey, before the Fourth International Hydrographic Conference, Monaco, 20th April, 1937).

I. *THE DORSEY FATHOMETER.*

The past ten years have marked the beginning in the United States of a new era in hydrographic surveying methods. This has been due mainly to the development and modification of echo sounding equipment and, too, to more accurate methods of offshore horizontal control. The adoption of echo sounding equipment by commercial and naval vessels has brought about a real need for detailed surveys of coastal areas which otherwise might never have developed. In the progress of these surveys many submarine features have been found off the coasts of the United States of America which make navigation by means of these features one of the most reliable and desirable of all methods.

In the absence of a suitable commercial instrument in the U. S. for shoal water, it was found necessary to develop the Dorsey Fathometer, described in a recent issue of the *Hydrographic Review*. *

This instrument was developed by the U. S. Coast and Geodetic Survey strictly as a precision depth-measuring device and its performance has more than met all expectations.

To insure that the speed of the indicator is absolutely correct at all times, it is driven by a synchronous motor, the source of current for which is derived from a tuning fork. The fork obviates the use of a governor and therefore there is no possibility of the speed being just an average of upper and lower limits. To start the instrument the motor is brought up to speed by a small auxiliary motor and thereafter the speed is correct for the day's work with no anxiety about variation in friction or burning of contacts or changes in ship's voltage.

The fork itself is made of special steel so that its frequency is little affected by temperature. The frequency of the fork is adjusted in the laboratory of the U.S. Coast and Geodetic Survey by comparing with signals sent from the National Bureau of Standards. Furthermore, during the working season, the speed of the indicators is occasionally checked by radio signals sent to the ships from Washington so that the speed of the indicator is never in error by so much as one part in ten thousand. Since this would be an error of only about one-eighth inch in a depth of 104 feet, the speed

(*) See : *Hydrographic Review,* Vol. XII N° 2, Nov. 1935, p. 50.

may be considered constant and correct. The frequency of the fork is 1,025 cycles per second and the dial and motor speeds are arranged for a velocity of 820 fathoms, or approximately 1,500 metres per second.

It would be useless of course to maintain the indicator at a constant speed if there were variations in the time the signal is emitted, due to changes in any mechanical means of sending the signal. The signal is therefore sent by a beam of light acting upon a photoelectric tube, the impulse of which is amplified to operate the transmitting tubes to send the signal. When the echoes return, they generate a small voltage in this same transceiver so that no error is introduced by sending on one instrument and receiving on another. The echo is amplified sufficiently to produce a flash of light in a Neon tube which is bent in a circle and installed back of a thin disc rotated by the synchronous motor. In front of the rotating disc is a glass scale through which shines the light of the Neon tube through a narrow radial slot in the disc. The duration of the flash in the Neon tube is not over two-millionths of a second so that the scale is illuminated by a red line at the depth indicated. Over a flat bottom the flashes of light are so frequent and steady that the slot can be examined by a magnifying glass even under this test it appears sharp-edged and stationary. When the ship anchors over a flat bottom, the indicated depth will change, due to the change of tide or motion of the vessel.

For shoal depths, the indicator is graduated to 20 fathoms and 20 soundings per second are given. As an example of a recent accomplishment of this instrument, 552 square miles of hydrography was executed off the Gulf coast of Louisiana on a sheet which had 550 crossings in the system of sounding lines. There were no crossings differing by more than one foot. The maximum depth sounded was 75 feet and the minimum was 23 feet.

II. *SONO - RADIO - BUOY.* *

These excellent crossings of sounding lines were due also to the strength of horizontal control which was available. In this particular case, a combination of taut wire traverse and radio acoustic ranging was used.

Because of the shallow coastal plains on the Atlantic and Gulf coasts, the sound from the bomb explosions will not reach shore hydrophones as on the Pacific Coast, making necessary the use of station ships for radio and acoustic stations. This constitutes a hazard for the personnel at sea at great distances from a harbour of refuge because, for economic reasons, it is necessary to keep these units small in size. In an effort to remedy this menace the U.S. Coast and Geodetic Survey has recently developed a buoy to replace these small station vessels. It is automatic in operation. During the summer of 1936, these buoys were used for the first time in actual R.A.R. work. Although their performance is not yet quite up to that which has been experienced in the use of station vessels, they have given every promise of completely eliminating station vessels possibly this present season.

(*) See details further on.