CURRENT MEASUREMENTS IN THE GEORGES BANK CANYONS

by

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Among the many speculations concerning the origin of submarine canyons, bottom-currents of various types have been appealed to frequently. This is one theory to which it is possible to apply some quantitative data, and to form an estimate as to the importance which may be attached to this means of producing submarine canyons, both now and in past ages. I refer of course, to normal currents due to differences in densities caused by temperature and salinity, and to those which have a tidal origin, and not to the type recently proposed by DALY. Consequently during the summer of 1936 measurements of the bottom-currents were made in three of the submarine canyons of Georges Bank from the research vessel *Atlantis* of the Woods Hole Oceanographic Institution. Because of the physical difficulties of obtaining readings on the bottom in deep water, in a region where tidal currents at the surface are strong, the results are far from giving a complete picture. Nevertheless, some idea may be obtained of the magnitude of the velocities which might be expected.

The instrument used was an EKMAN meter which is too well known to warrant detailed description here. For an account of its construction, one should refer to V.W. EKMAN's publication : *An improved type of Current Meter,* Conseil Perm. Internat., J. Conseil, v. 7, pp. 3-10, 1932. Velocities are measured by recording the turns of a delicately balanced propeller, and a device controlled by a compass needle gives the direction of the current. The instrument is designed to be suspended from a wire, and when it has been lowered to the desired depth the propeller is released by means of a messenger which is slid down the wire. It is stopped in the same manner by another. Consequently, only the current at a given level is recorded and the machine does not register during lowering or raising. Due to the motion of the ship and the inevitable wire-angle, it is impossible to get readings close to the bottom in deep water by the usual procedure of lowering the meter on a wire. The instrument, therefore, was suspended in a framework of brass pipe fitted with a device for releasing one messenger when the frame touched the bottom, and another when it was hoisted up again. While on the bottom the frame was buoyed because at the depth at which the work was carried on it is practically impossible on an anchored station to keep the ship from swinging excessively. Using a frame set on the bottom has an additional advantage, in that it eliminates the necessity of making a correction for the surge of the ship.

The frame was constructed of 3/4 inch brass pipe with standard fittings. All the other parts were also of brass. There is nothing significant in the dimension of parts or materials used. The bows are fastened at the top by U-bolts to a plate which has a hole in the centre to admit the tripping ring. The device for releasing the first messenger was adapted from one constructed by Fridtjof NANSEN : *Methods for measuring direction and velocity of currents in the sea,* Conseil Perm. Internat., Pub. de circonstance, N° 40, 1906, Pl. II, Fig. 3. The apparatus is operated in the following manner. The line from the surface ends with a ball-bearing swivel to which is shackled a two-part wire-bridle. The longer part is permanently made fast to a U-bolt set in the head-plate, and the shorter part ends in an oval iron ring. This ring is passed through the hole in the centre of the head-plate and engages the top hook of the trigger, which is then held in a horizontal position by the weight of the frame, which is now taken by this part of the bridle. The second messenger is controlled by a push rod which is free to move up and down in guides made of short sections of one-inch pipe, fastened to the under side of one of the legs of the frame. The push rod is just long enough to pass through the topmost guide, which is partly cut away on the under side in order to allow the end of the rod to engage the loop of the wire holding the second messenger. While the frame is being lowered, the push rod is held in place by a wire, which is made fast to the short part of the bridle just above the ring. As this part takes all the weight of the frame during the lowering, the push rod is thus held up and its end kept from slipping past the first guide, thus releasing the second messenger.

When the frame touches the bottom, the short part of the bridle goes slack, and the trigger — no longer held horizontal by the strain on the ring — falls, dropping the first messenger from the lower hook. Releasing the short part of the bridle also slacks the line holding the push rod, which is now kept in place by its foot pressing against the bottom. The frame is hoisted by the long part of the bridle, and as it leaves the

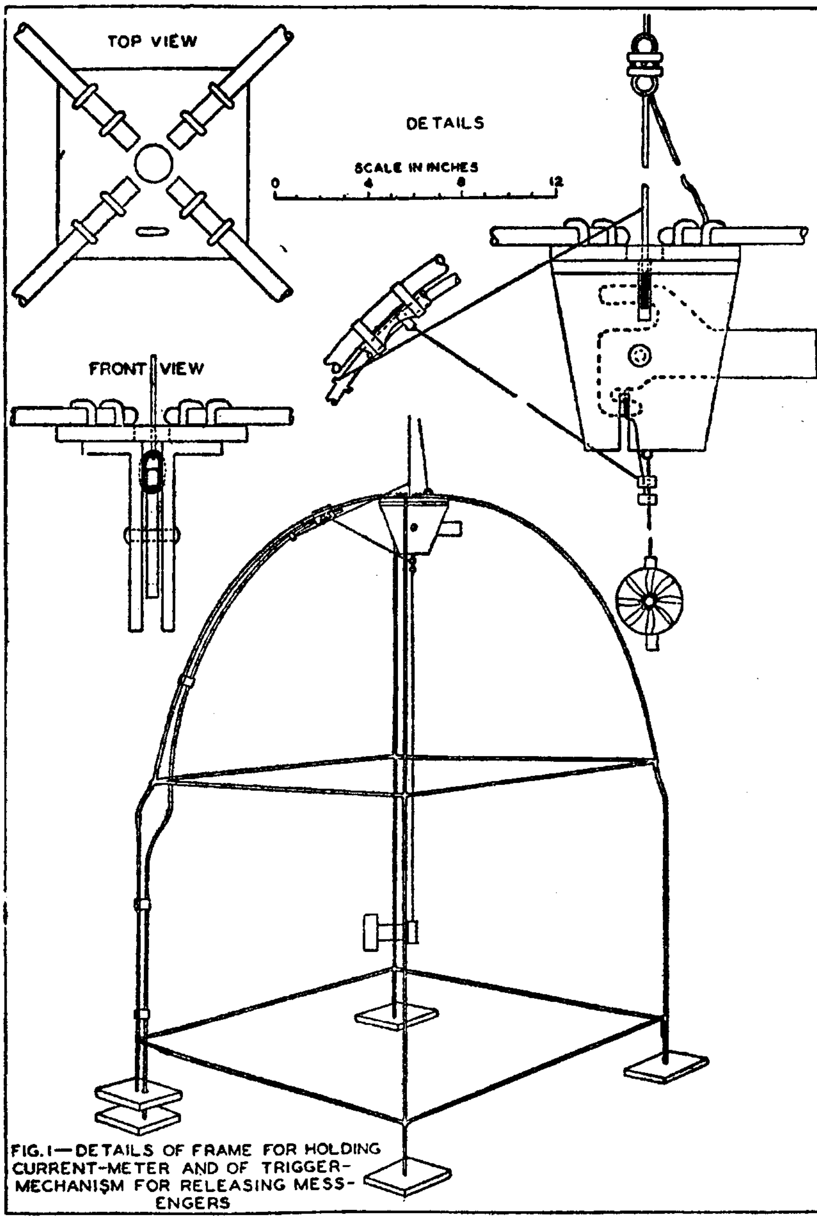

FIG. I—DETAILS OF FRAME FOR HOLDING CURRENT-METER AND OF TRIGGER-MECHANISM FOR RELEASING MESSENGERS

Fig. 1

bottom the push rod drops down until its end, around which has been passed the loop in the wire holding the second messenger, clears the slot in the under side of the topmost guide — thereby allowing the second messenger to drop. Since it was possible by the feel of the line to tell when the frame touched bottom and when it was completely

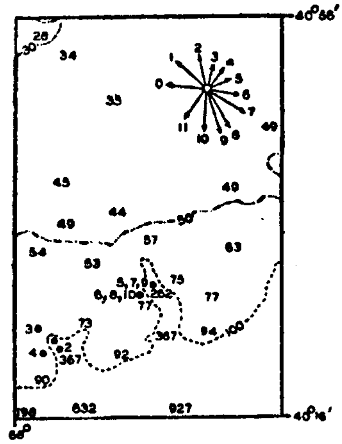

FIG. 2

clear, the time-interval during which the meter was recording could be measured with reasonable accuracy. What slight errors there may have been in timing the arrival and departure were compensated for by allowing the machine to operate for at least 30 minutes.

When used on Georges Bank the frame was five feet high and about five feet on a side. Later, as in Figure 1, four more feet were added so that readings could be taken at two different levels. The frame had square lead blocks for feet weighing about 10 pounds each. These gave added weight and stability, and at the same time prevented the frame from sinking in on soft bottoms. The centre of the propeller was 11 inches off the bottom when the frame was standing on a hard surface. A check on the amount of sinking was made on oozy bottom in Woods Hole Harbor by chalking the sides of the leads. It was found that the feet sank about three-fourths to one inch, and therefore the current in the canyons was measured approximately 10 inches above the bottom. On a bottom of sand or silt, there was no appreciable settling and the current was measured at the full 11 inches.