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THE PLASTIC SEABED "OYSTER" FOR MEASURING BOTTOM CURRENTS

By

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Many of his friends will recall that Gunnar Rollefsen had a genius with simple materials—as witness his achievement in taking a cine-film of cod spawning with simple gear at a time when others possessing expensive apparatus had had but scant success.

The recollection has emboldened the present writer to submit for publication in the volume now honouring Rollefsen's seventieth birthday, a small paper which deals with the first employment of a device for measuring bottom currents whose very keynote is simplicity. It is not unreasonable to maintain that there are various problems in oceanographical research where a simple and cheap apparatus can have real merit on grounds other than those of economy and simplicity. Sometimes the use of such a device may be the only way of tackling a problem hopefully, and although that to be described does not produce a continuous record but makes only easily-repeatable single observations, these latter can be just what is wanted for certain purposes.

In what follows we shall give an account of a modest tool for investigating seabed currents, without depth limitation. The broad nature of the device can be conveyed at the outset by merely quoting the legend carried on a large diagram from which our present figures have been cut out. The legend in question reads:

> "This device is meant to be thrown out anywhere from any kind of ship over any ocean depths. It is designed to sink to bottom to make a single record of bed current speed and direction. Some time later it will rise to surface to travel as does a drift bottle until cast ashore. It carries a multi-language questionnaire paper, the perusal of which should result in the investigator receiving back by post the directional pendulum bearing permanent interpretable grooves."

Contribution given in honour of Gunnar Rollefsen at his 70th birthday.

Any serious paper dealing with current measuring would of course be expected to make many citations from the nigh-staggering literature which now exists, and any writer on bottom currents would equally be expected to quote from the many papers which give the results of effort spent to measure them. Because there is (not surprisingly!) a real paucity of data on currents right down on the deep ocean bed, and because much of what is known about them has come from photographic studies of their effects of various kinds, we can here justifiably abstain from citations on the grounds that we have attempted a novel approach. We were concerned to produce a device which would not require the possession and operation of deep sea cameras, would involve only very modest expenditure of money, would not call for the availability of a specialist ship, could be used more or less anywhere without any concern at all for weather, and would require no line attachments at all to an attendant ship or to a mooring. Because our aim was to measure actual bed currents there would be no similarity with the well-known seabed drifter.

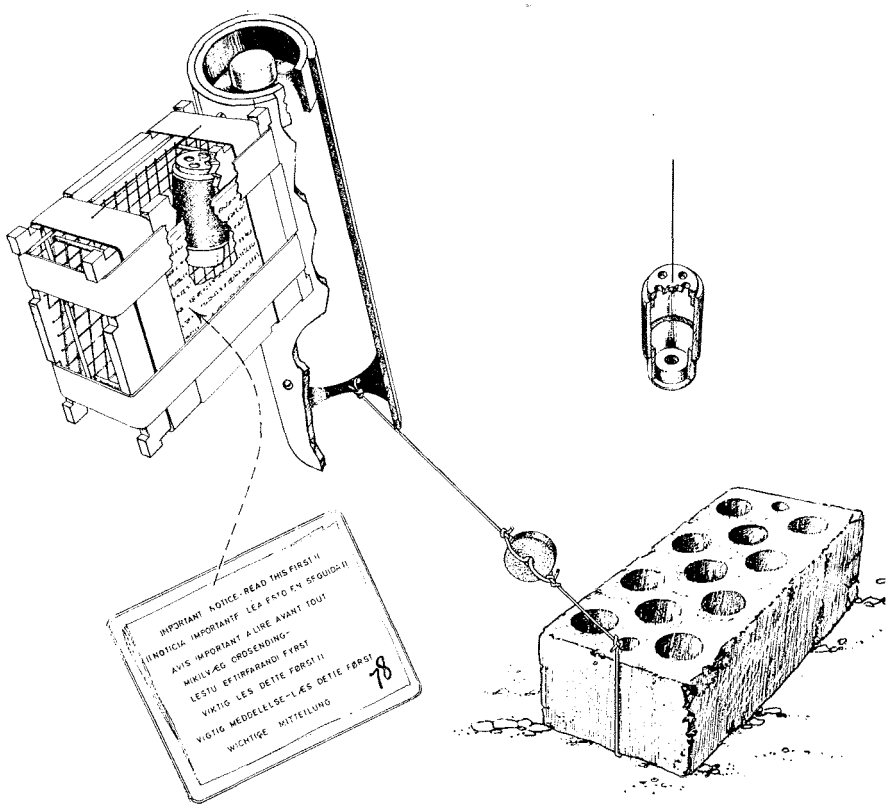
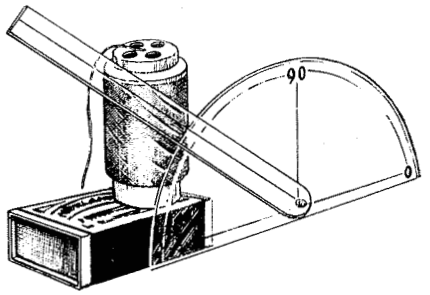
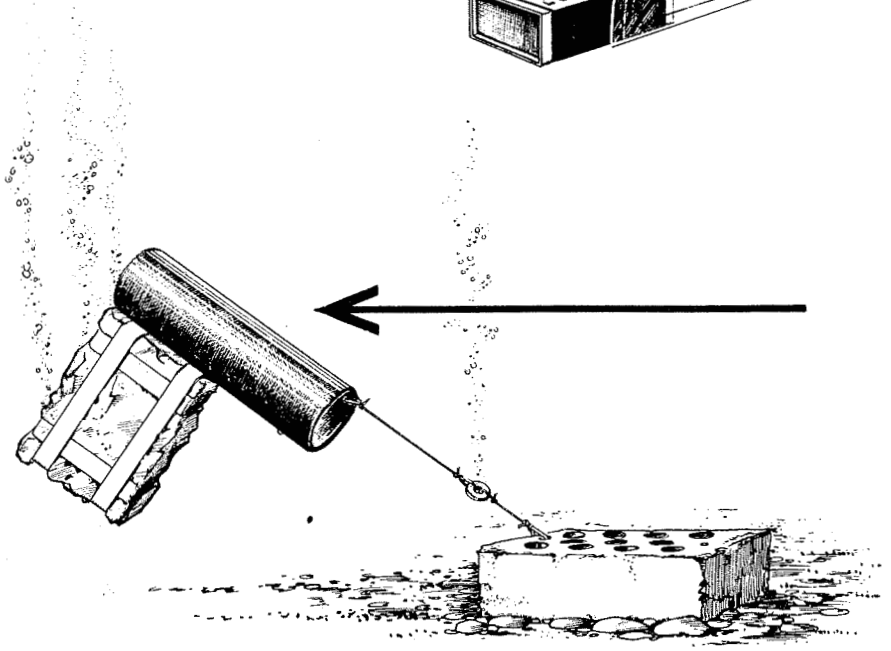


Fig. 1. The construction of the device as described in the text. The suspended directional pendulum is shown (in section) — as also is the come-loose tether to the brick.

Fig. 2. The device in operating situation on the seabed (below), and the way in which the grooves-slope is easily determined (above).





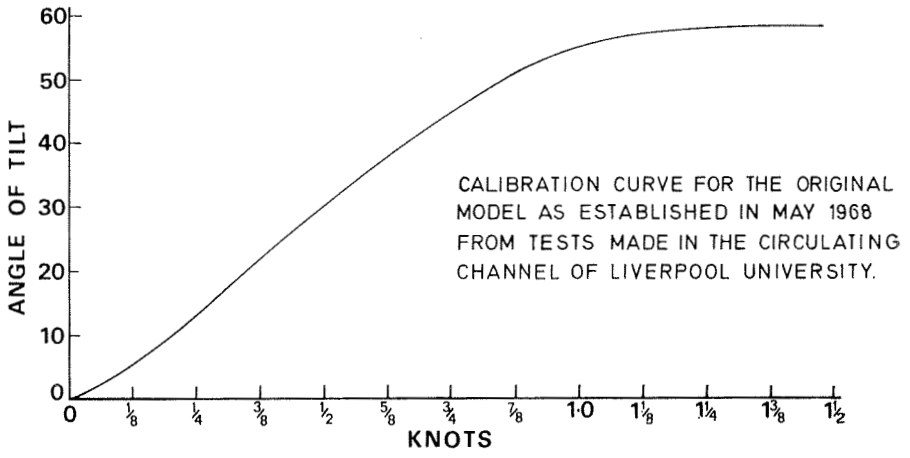


Fig. 3. Tilt/speed eurve.

This paper can be kept brief and realistic if we do little more than reproduce (1) the memorandum which we sent to finders of the stranded "oysters" and (2) the diagram which we also posted to them. For publication purposes however, we have cut the large diagram into three illustrations, Figs. 1, 2, and 3.

We particularly wished to avoid the trouble of paying rewards, and we therefore relied upon the desire of finders to receive promised information about their finds proving sufficient to bring in returns. In the event it certainly did so, and some finders even asked that we should not bother to refund their postage costs.

A sufficient description of the "oysters" is afforded by reproducing the memorandum sent to finders—and we here give it as posted to the latest of these:

> *MEMORANDUM FOR THE INFORMATION OF PERSONS WHO HAVE FOUND ONE OF OUR "STRANGE OBJECTS" STRANDED AND HAVE KINDLY SENT BACK TO US THE PART ASKED FOR BY THE MULTI-LANGUAGE YELLOW PAPER WHICH THEY FOUND BOUND INTO IT.*

At the outset it is to be said that the object which you found relates to a new method of sea research which could be called: "Seabed Currents by Post" to use rather picturesque language. You will be best able to appreciate what is involved if you read what follows whilst looking at the artist's diagram now sent to you. It is convenient for workshop and stock purposes to have a nickname for various sorts of device when many exist—and the thing you found goes conveniently under the name: "Plastic Seabed Oyster". The use of the word "Oyster" will become obvious we think. The object which you found and which we shall call a "P.S.B.O." from now on, was originally tossed overboard from the survey launch *Waterwitch* (Lieut.-Cdr. J. Paisley, R.N. (retd.)) at a spot near Alderney in the Channel Islands on 23rd September, 1968. It was sent to the bottom in the depth of about 172 metres in a long deep trough in the sea-floor called the Hurd Deep. This deep is of interest for a number of reasons, and in the old days masters of home-bound sailing ships liked to find it with their leadlines to assist their positioning. A number of the devices were thrown out each hour round the clock so that we could hope to learn what changes in speed and direction the bottom tidal streams might display in this area where they are strong (and known) on the surface. There would have been real difficulty in measuring the bottom currents in the wild weather which prevailed at the time, and the occasion was therefore very suitable for trying a new way of working which does not require a ship to keep an instrument captive on a suspension line. The following is a description of the P.S.B.O. as it was when

thrown out to sink to bottom. Two small rectangles of buoyant stiff polythene held about two inches apart by four strong perishable stiff rods (3.9 mm in diameter) set into little pits drilled in their corners on their inwards sides, were bound round with powerful stretched "garters" made of non-perishable butyl rubber. Extra strong bands of ordinary rubber were added to increase the squeeze force. These bands were disposed both across the length (14.5 cm) and the width (11.0 cm) of the polythene rectangles. The hold-apart rods were made of a corrodible alloy which fizzes away in sea water. On the inwards face of one of the polythene plates was fixed an equal-sized rectangle of green square-meshed plastic material such as is used for making meat safes etc. This material has stiff and pronounced raised ribs and the sheet of it used in the P.S.B.O. has these prominent hard ribs running parallel to the 14.5 cm edges of the plastic rectangle.

Hung midway between the polythene rectangles (at one end) is a cylindrical pendulum suspended on a terylene thread set into the centre of its top. This pendulum is about the size of a wine bottle cork. It is made from a polythene tube such as pharmacists use for keeping capsules in. The tube has holes in it to allow it to fill with water. Over the tube is a sleeve of soft rubber tubing and, over this latter, a strip of thin pure copper foil (0.7 mm thick) is wound to encompass the whole circumference of the tube. The copper foil is held secure from twisting movements by means of a thread tied suitably through it and the cylinder. The circular base of the pendulum contains a tight-fitting disc compass made from ceramic steel. This compass is very powerfully magnetized across its diameter which means that one point on the circumference seeks north, and the opposite one south. As so far described, if you held the cylindrical pendulum by the suspension thread, it would always rotate to come to rest in the same position. The suspension of the pendulum between the polythene rectangles is so arranged that it stays always midway between them so long as the hold-apart rods are intact. As so far described, if you tilted the plates the pendulum would remain vertical, but, if whilst you held them tilted the rods could suddenly crumble, the "oyster" would close with a powerful grip. The result would be that the plastic mesh would press its ribs into the copper and would make deep grooves in that soft covering of the directional pendulum. If you now forced the plates apart again and removed the pendulum, you would of course find that the grooves were on the slope—that is, not parallel to the top and bottom of the pendulum. These remarks explain how the grooves which you may have noticed on the pendulum which you returned to us were made.

Let us return to the device as so far described. The next step in its manufacture was to fasten the box affair comprising the two plates, the

hold-apart rods, the rubber binders and the pendulum—at right angles to the top of a short length of plastic tubing (6 cm wide and 26 cm long) containing a thin-skinned plastic detergent bottle filled with junk oil. This addition is made to give the gadget more buoyancy—more flotation power. From a point on the circumference of this tube (at its bottom) a string leads away which has to act as a limp tether. We next tie the free end of this string to a brick—using for convenience one of the holed kind of brick known to builders as "airbricks". We allow about 20 cm for the length of the limp tether. We next sink the whole affair in a glass tank of sea water. It "floats" of course but at first the box part rides up somewhat above the horizontal. We then wind some thick solder wire round the box at the end away from the tube until it (the box) is horizontal. If we could now set the sea water in motion (thereby imitating a current), the tube would incline from the vertical and the box would dip below the horizontal—but the directional pendulum would always hang vertical. Clearly, the faster the current the greater would be the angle of tilt. Thanks to suitable laboratory tests made in water moving at various known speeds, we know the connection between angle of tilt and speed of current. Obviously we want the current to tilt the whole device without "blowing" directly on the pendulum. We therefore enclose the box part within a close-fitting cellophane bag such as is used for packing sandwiches—but we put some holes in the top of the bag to allow the escape of air and of the gas which will be produced when the rods fizz away.

The way of using the devices is as follows: we take them in our ship to a place where the bottom currents are of interest to us. Then we toss them overboard separately with the tether of each tied to a brick—but, in the tether, we incorporate a washer of the same corrodible alloy as the rods are made of. This washer takes much longer to fizz away and crumble than the rods do. When the P.S.B.O. reaches the bottom, if there is a current it tilts of course. When the hold-apart rods crumble the oyster snaps to and squeezes the pendulum very tightly to produce grooves whose slope is in proportion with current speed, and whose position on the pendulum (when referred to the known north-seeking vertical of the latter) reveals the direction of the current. Some time after the answer has become securely squeezed within the P.S.B.O., the tether washer crumbles and lets the device rise to the sea surface. Thereafter it floats on and on much under wind influence until such time as it fetches up on a beach. This makes one think of drift bottles and of the thousands of records of their travels which we hold—but, with the P.S.B.O., we want the winds to blow them along so that we shall not have to wait so long for returns as we might in the case of drift bottles carefully ballasted to escape wind influence.

We do not of course care where the P.S.B.O.'s go ashore; it is all the same to us so long as we get returns from them—their message having been securely locked within them ever since they closed on the seabed.

One thing remains to be explained. Clearly we had to have a way of hearing from persons who might find P.S.B.O.'s stranded on beaches. Obviously we could not accept the expense of much printing on plastic even if space sufficed. We therefore had recourse to multi-language questionnaire sheets enclosed in heat-sealed wallets of clear thin polythene. We tested these latter in water pressurized to more than 1,400 kilograms per square metre which is a much greater pressure than exists anywhere in the deepest parts of the oceans.

After the P.S.B.O. which you found stranded had risen to the surface, it travelled up the whole length of the English Channel under the influence of currents and winds. It rounded Kent and travelled on along the coasts of Essex and Suffolk to reach Norfolk after accomplishing a journey of about 280 miles. At the time of writing this twenty-one of the forty P.S.B.O.s put out near Alderney have been found stranded on the Norfolk coast. It may well be that some not urged ashore there by the north-easterly winds then prevailing, may travel on to go ashore very much further afield.

The recipient of this memorandum is warmly thanked for his help, and is informed that he is completely free to make any use of the story he may wish.

Your number was:—

Your finding date was:—

Your bottom current was:—

Addendum.

Since the above was written, two further P.S.B.O.s have been returned —of which yours is one. That returned from near Saltburn on the northernmost part of the Yorkshire coast and also that from Whitley Bay in Northumberland have travelled on about 130 miles further than those returned from the Norfolk coast. In other words they have covered a track of about 410 miles from the place where they were put on the sea bed.

[Memorandum ends here]

The multi-language yellow questionnaire paper referred to in the foregoing memorandum brought very pleasing success indeed, and we became accustomed to the postman bringing neat little parcels with the two supplied adhesive labels affixed to them.

The wording of the questionnaire paper (folded to the size 11.5 cm by 9.0 cm) was as follows:

(*a*) The portion visible through the polythene envelope on recovery read thus:

IMPORTANT NOTICE – READ THIS FIRST !!

!! NOTICIA IMPORTANTE – LEA ESTO EN SEGUIDA !!

AVIS IMPORTANT – A LIRE AVANT TOUT

MIKILVÆG ORDSENDING –
LESTU EFTIRFARANDI FYRST

VIKTIG – LES DETTE FØRST !!

VIGTIG MEDDELELSE – LÆS DETTE FØRST

WICHTIGE MITTEILUNG !

(*b*) the subsequent wording was the following printed successively in English, Spanish, French, Icelandic, Norwegian, Danish, and German:

The strange object which you have found stranded, should contain within itself information relating to the speed and direction of the water movements on the deep ocean bed at a spot very far away and on an occasion perhaps very many months ago.

If you will very kindly help us by acting as requested in what follows, the whole story will be told to you by letter as soon as we hear from you.

We particularly need to receive from you the little polythene tube coated with thin copper foil which you should have found squeezed within the object which you discovered stranded. This should have marks upon it which we can interpret for our purposes, and we accordingly beg you to send it back to us wrapped in a way which will preserve those marks. You will find enclosed with this two small printed labels which become strongly adhesive when their brown paper covers have been removed. Please affix them both to the little parcel which we strongly hope you will send to us. One of them will save you the trouble of writing our address, and the other will let the British Customs know what is contained. Please tear out from this sheet this portion which is in your own language, and please post it back to us with the undisturbed tube after having filled in the little questionnaire beneath. If you have difficulties, please solicit the help of a local official—and please tell us whether you require the postage expenses to be refunded.

As time goes on we shall hope to give finders more information than that obtained from the single object found by them. Please tell us very clearly your own name and address, and please state where and when you found the stranded object.

Our address is:

The National Institute of Oceanography,
WORMLEY, GODALMING, SURREY, ENGLAND.

Your name: .....

Your address: .....

.....

Date of finding: .....

Place of finding: .....

Our identity number marked on the paper: .....

It is pleasing to be able to state that all the directional pendulums returned to us were in excellent condition and had been carefully packed. The "grooves in copper" method of recording had been chosen after much pondering how best to achieve a record which would be virtually indestructible by the handling the pendulum would get from finders, and which would stand up to much rough usage due to wave motions on beaches. The reader might wonder how the method would work miles deep when the rubber sleeve under the copper would be "bone hard" before the oyster closed. This was checked by tests in a pressure tank. It was expected and proved that once the oyster had closed tight upon hard rubber whilst down below, it would maintain its powerful grip and make the grooves as the rubber softened again on ascent to surface. When the oysters were put out in the Hurd Deep a violent storm was raging and the tides were top equinoctial springs. As already remarked, all the returned pendulums were easily interpretable and there is no reason at all to doubt any of the speed values which, "round the clock", ranged from slack to one-knot on bottom below the 172 metres of water. It is however unfortunate that the directions are not so credible from this first experiment. It is clear that the hung pendulums must have spun somewhat from touching the side plates during surgings of the oysters. This is a fault which has now been rectified in preparation for another experiment. The pendulums are now pivotted on a swinging bracket in such a way that they cannot touch the sides of the oysters before closure.

Oysters furnished with the new pivotted pendulum have had their behaviour effectively checked in the following way. Some of them adapted to close in ten minutes were put on bottom from a lightship moored in the estuary at Harwich. They were used both on the seagoing and land-going stream along with infallible current-measuring jelly bottles of the same timing. In all cases a complete direction check was obtained. It is now intended to use the oysters in the greatest depths of the Bay of Biscay. When this is done they will probably have been modified a little to increase their sensitivity still further at lowest speeds. It is easy enough to cater for very slow speeds and equally easy to cater for speeds up to and beyond three knots—but there are of course real problems in making an oyster which will be satisfactory for both. Ideas are not lacking but they are a matter for the future. We may conclude by expressing the hope that publicity given by the B.B.C. might help towards future success.

ACKNOWLEDGEMENTS

I am indebted to my colleague Mr. D. Bookham for all the constructional work involved, an to our artists Mr. N. R. Satchel and Miss P. E. Williamson for all the drawings.

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