THE LOWESTOFT CROSSBOW FLOAT

A Self-anchoring, Self-signalling and Self-timing Drifting Buoy, for Use in Tidal Stream Surveys and Investigations on Currents in Shallow Waters.

by

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Preliminary experiments have recently been carried out from the research vessel *Onaway* belonging to the Ministry of Agriculture and Fisheries, with a cheap and easily-made buoy which promises to be very useful. The following article has been written primarily for the information of people interested in the study of tidal streams. The possible uses to which the float to be described could be put will so readily occur to them that only a brief article is necessary.

There is much that one would like to learn about water movements in parts of the North Sea that cannot well come from the employment of existing apparatus. Current-meters of various kinds and drift-bottles of different types have, of course, been long used with conspicuous success, but it will be obvious that for certain purposes very good use indeed could be made of a simple float which :

(1) Could be set adrift to float with little enough freeboard to ensure that it was not seriously affected by wind.

(2) Would, after a time known with reasonable certainty in advance, anchor itself.

(3) Would, on so doing, besides rising somewhat in the water as a whole, shoot up a staff carrying a topmark enabling it to be seen at a good distance.

(4) Would, by so doing, announce to an observer armed with a telescope and posted at a position of vantage, that it had ceased its travels.

(5) Would, on anchoring, provide in a simple, sure and cheap manner, a record of the time at which it ceased drifting and which :

(6) Would, on anchoring itself in a tideway, bring into use a drag of sorts serving to keep it as upright as possible — so that it could be seen from a good way off.

It was decided to try to produce such an apparatus. The most frequent use envisaged for it requires that a number of the floats (perhaps a dozen) should be available at a time. For this reason it was decided to use no component parts which could not be obtained more or less anywhere at little cost. The nature of the apparatus can best be seen by examining the accompanying diagrams very kindly and skilfully drawn for me by Professor A.C. Hardy — from a series of rough sketches and descriptions supplied to him by post.

As to components, here is a list :

(a) A 10 to 15 ft. length of builders' planking.

(b) A mop-pole.

(c) A bicycle inner tube costing a shilling.

(d) Two 4-inch lengths of common brass gas-piping, screwed into a knee joint — the latter having a hole bored through it near the angle to permit the passage of a stout nail.

(e) Several ring brackets such as are used for tumbler holders in bathrooms, and which are obtainable at sixpence each.

(f) A strong bucket.

(g) A dhan anchor.

(h) A length of line suitable for use with the latter.

(j) A few glass trawl headline floats with their little netholders (or 2 aluminium water bottles as in sketch).

(k) A half-crown alarm clock.

(l) A large shed-door hinge.

(m) A common sixpenny rubber sponge.

(n) A drift-bottle to contain questionnaire papers. This can with advantage be a bottle of the waisted type so that is can be easily and securely lashed on to a post.

Also, sundry rubber rings, lengths of cord, bits of wire, wood screws, staples, large nails, an the unthreaded half of a large vine hook to serve as a draw bolt. The latter is just like an extra large steel meat skewer, and the rubber rings are gauge glass rings costing a penny each.

A specially-made fitment (which, too, could be improvised if necessary) is a ring bracket (s) which is nothing more than a very substantial version of one of the tumbler holders referred to above.

It remains to mention that one needs also a sort of stocking made of hessian (sugar sacking) by sewing together two flats (cut 6 inches by 2 feet) along both sides and one end. Into the toe of this stocking (o) is to go a fabric bag full of crystals soluble in water. The fabric bag is made for ease of reproduction, by sewing together two flats cut round an ordinary table-tennis bat — leaving the end open as a tube which can be tied up very easily. On reading further it will be seen that it is convenient to use such a bag inside the stocking because a number of them already filled with crystals can be kept handy.

It should be stated that the use of a length of builders' planking to serve as the main part of the float was decided upon because it can be bought as a standard article. The use of round poles would mean that one would have to contend with different buoyancies as between different poles. Moreover, the use of square timber means the production of a buoy which does not resemble a fisherman's dhan; several advantages of this are fairly obvious. Also, the essential attachments can be made without any difficulty to a square post.

The Assembled Float. — The accompanying diagrams show quite clearly how the float is constructed and how it works. Actually, the experimental model was a much less presentable affair. There is a good deal of choice as to how the various fitments should be made, and no importance attaches either to detail or beauty of workmanship. A few tumbler holders (e) are screwed on to one face of the plank near what is to be the top. They are fitted above each other at suitable distances in the centre line. To one end of the mop-pole (b) a wire stirrup is fitted, and to the other end a little rod bearing a pennant is attached. The pennant can carry an identity number or, instead of it, any small daymark of recognisable nature can be used. If a small flag be employed it might be well to hang it like a banner after the method described by Vice-Admiral Nares in the *Hydrographic Review* of November 1932. That would enable it to be seen furthest. A small wooden bar is nailed accross the main post as shown, and a bobbin (p) is screwed to each end of it. Their function is to serve as pegs from which to hang the bicycle inner-tube.

In a way which calls for no particular description, it is arranged that the mop-pole acts as the quarrel of a sort of crossbow which can be shot off when the stretched tube is released from a "trigger". The latter is component (d) mentioned above. It is screwed (or more simply nailed) on to the face of the main post at a position chosen to give enough stretch of the rubber tube. When the latter (which passes through the wire stirrup at the foot of the mop-pole) is in the stretched position, it is held extended by one of the arms of the "trigger". The said arm is held at right-angles to the length of the post, because a simple slip bolt (q) contrived from a sort of large skewer and a few

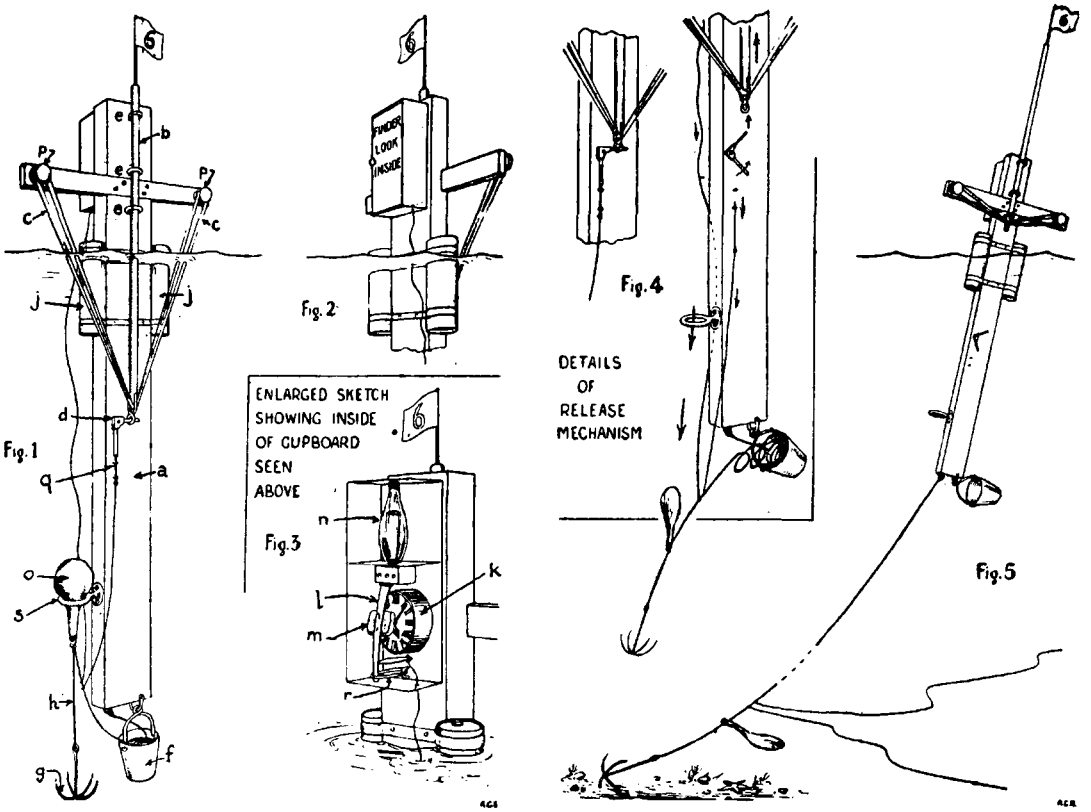

Fig. 1. — Showing the float as set adrift. The cylindrical objects on the water-line are buoyancy cans. Their weight can easily be adjusted by putting shot or water inside.

Fig. 2. — Showing the clock cabinet with door closed

Fig. 3. — Showing the simple timing mechanism and the questionnaire bottle.

Fig. 4. — Showing (on left) the release mechanism before the crossbow has "fired", and (on right) the same at the moment of firing. The anchor is seen descending, the line running out, and the pennant staff shooting upwards.

Fig. 5. — Showing the float after anchoring itself in a tideway. The pennant is high and the bucket is functioning as a drag to counteract cant of the float.

staples, locks the other arm in the up-and-down position. To the lower end of this slip bolt a cord is attached by means of which the bolt can be snatched down to "fire" the crossbbow. The result is that the mop-pole bearing the pennant shoots upwards.

To what is to be the foot of the main post, an anchor line is attached — of length suited to the depth of water in which the apparatus is to be used. It is bent on to a dhan anchor (g) and is coiled into (and, if necessary around) a bucket (f), the handle of which is shackled into a hole in the heel of the post. The strong iron ring (e) referred to above is then screwed on to the side of the post a little way from the bottom. The fabric bag (o) is filled with crystals, its neck tied up, and then placed in the toe of the hessian "stocking". The leg of the latter is then passed down through the iron ring, and round it the anchor is clove-hitched at a point perhaps half a fathom from the anchor. The hessian stocking cannot pass through the iron ring because of the bulge due to the crystal bag, but it could do so if the size of the latter were decreased enough. It is destined to be so as the result of solution of its contents in the water. It will be seen quite clearly that once the crystal bag has decreased enough in size the anchor will be dropped. To the anchor is secured one end of a "not quite-tight" cord whose other end is attached to the slip bolt (q) mentioned above.

The crystal bag anchor release is a copy of a device due to my colleague, Mr. H.H. Goodchild. He used it very successfully in a role much more difficult than that here assigned to it. It was employed by him to bring about the throttling of a small-meshed cover fitted over a trawl net. The throttling had to take place during a tow. The idea was to prove that fish of certain small sizes could get through the meshes of the commercial trawl whilst it was being towed. Mr. Goodchild used common "hypo" crystals.

Somewhere on the main post of the buoy (above water-level) a cheap alarm clock (k) with no glass in it is fastened. It is mounted in such a manner that its face lies underneath a rubber sponge (m) which, but for a small wooden peg, could press down strongly upon its hands. The rubber sponge is bound on to the underside of the long arm of a gate hinge (b) — the oblong end plate of which is screwed down on to the plank on top of a wooden block of about the same thickness as the clock. The hinge lies across the clock face and the end of it is lifted against the tension of a stout rubber ring (r) stapled to the post. It is held up by a wooden peg so that the sponge is lifted well clear of the clock face. If the peg be snatched away, the sponge presses down on the latter and locks the hands. A cord leading from this peg to the anchor serves to effect the snatching when, the anchor having been released, the buoy has stopped drifting.

When such a float as that illustrated is made up, it can be given sufficient buoyancy to take a good-sized anchor in a very easy way. All that is necessary is to have available a supply of trawl headline glass floats each in its little net bag. Then it is simplicity itself to staple as many on to the post as may be needed. Alternatively (and with more resemblance to the diagram) a couple of ordinary shilling aluminium hot-water bottles (j) can be lashed on to serve as buoyancy tanks. They can be easily ballasted with water, and, using them, the risk of fouling the snatch cords will perhaps be less than with the glass floats.

The bucket, besides serving as a convenient stowage place for the anchor line, comes into use as a drag serving to minimise cant when the buoy anchors itself in a tideway.

It is not to be assumed that the writer would necessarily attach the anchor line to the very foot of the post. It is most conveniently drawn so, but it is left to users of the float to make whatever choice they think would keep the anchored float most upright in the water.

If a drift-bottle (n) containing questionnaire papers be lashed to the post or placed in the clock box (as in the diagram), one has a means of ensuring that a buoy lost for a time to the survey does not necessarily mean the loss of a record nor the permanent loss of apparatus. The finder could learn from the papers in the bottle that he was requested to deliver the buoy to the most

convenient harbour authorities, and that he could claim such and such a reward on saying where he found it.

Uses. — It is not intended to go into any detail here concerning the degree of certainty with which one can predetermine the drifting times of the buoys. Nor shall we look ahead to the time when they will be used for long enough drifts to reveal the speed and direction of the overall "make" of water after the to-and-fro streamings due to the tides have balanced themselves out. That would involve the provision of something more than a cheap alarm clock with a 12-hour face to give the time record. Those who may be occupied in studying currents in the interests of fishery research problems will not be able to use these crossbow floats until enough experience with them has justified the provision of a special clock — that is, if an exact time record be desired.

It seems that in their early days the buoys will be most useful for investigating the streams of complicated estuaries. They need not be retrieved immediately after they have anchored themselves, and need not be pursued in a launch whilst they are drifting. They could be used to throw light on the nature of the streams at times of heavy weather — a matter of concern in certain connections.

An obvious enough investigation would call for the release of a dozen circa one-hour floats at intervals of an hour from a fixed position. Short-drift buoys could be kept in view by telescope, and their anchoring times noted by looking for the appearance of the raised pennants or other marks. That would present little difficulty in the case of a coastal stretch always under the eye of a Coastguard.

Miscellaneous Remarks. — The experimental model, used in the preliminary tests, was of much rougher construction than that shown in the diagrams. It was, too, considerably simpler than that described in the above article. The guides for the mop-pole were made in very few minutes by dint of driving a couple of 6-inch nails into the plank about 2 inches apart, and mousing the heads with whipping twine. Four such guides were made at vertical intervals of about 8 inches. Also, instead of the short cross bar to the ends of which the inner tube was to be attached (as suggested above), a 6-inch nail was driven into each side of the plank at a suitable point, and the ends of the tube merely hung down from them after passing it through the wire stirrup at the bottom of the mop-stick. These arrangements were very effective indeed and took up little time. The clock was not enclosed in a box, but was merely lashed to the plank and covered over with a piece of waterproof material which shrouded both it and the hinge quite satisfactorily. As to the arrangements employed for the anchor release, the fabric bag was of the shape mentioned above and was made of the very fine-meshed material used for pocket linings. Several such bags were made by the local tailor both in fine brown linen canvas and in closely woven grey pocketting. The crystals used were most often the small dominoes of hard white sugar purchasable under the style of "Coffee Crystals". They are obtainable in very convenient pound packets costing fourpence each. Using the contents of one such package as the loading for the brown bag, a timing of 30 minutes was secured when a ring 2 1/3 inches in aperture and a 23 lbs. anchor were employed. Recourse to different crystals, different sizes of ring, and different sizes of ring, and different kinds of fabric would provide a range of timings.

For instance, using 3/4 lb. of boiled sweets (acid drops) a timing of 2 1/2 hours was obtained with the fine-meshed grey bag. With the same bag, ring and anchor, a timing of nearly 24 hours was obtained when the hard sugar dominoes were employed, and with another combination a drifting time of one hour was arrived at. It is of course quite easy to alter the ring aperture as may be desirable by binding it round with twine. It would of course be very simple to make the descent of the anchor fire a shot or let off a smoke candle, a Very light, or a ship's lifebuoy canister. Extra height of the pennant could be obtained by flying it from a bowed cane which straightened out at the time of anchoring.

There is a likelihood that these crossbow floats may be made by a firm of instrument makers. Anyone interested in them could learn whether they are procurable ready-made, on writing to the author of this article.

Acknowledgements. — I wish to express my sincere thanks to Professor A.C. Hardy for his great kindness in drawing the diagrams, and to Mr. H.H. Goodchild of the Lowestoft Fisheries Laboratory for allowing me to use his crystal bag releasing device.

ADDENDUM.

It will have been realised that the float constructed as described would ride at anchor as shown in Fig. 5 in a weak stream only, even using an anchor line three times as long as the water was deep.

To ensure that it was not pulled under when it had anchored itself in a stream running at 2 1/2 knots and more, would require the attachment of cans having considerable buoyancy. This in turn would require the use of a fairly weighty anchor to make the float sit deep enough in the water when drifting.

The experimental model which met these needs is rather more cumbersome than was desired and is convenient — but experiments are being continued to get over this. It is of course possible to economize with weight by adding lift to the anchored float — by making it sheer upwards after the manner of the head-line otter-board of certain herring trawls. In other words, it could be made to ride a bridle or crow's-foot something like a kite. It remains a matter for further test to decide upon the most convenient arrangement.

A very convenient and cheap way of attaching the alarm clock has been found. All that is necessary is to slip it into a length cut from a discarded inner-tube of motor-car size. The length of tube used needs to allow for the rolling up of a few inches at both ends. Then it becomes an easy matter to hold the rolled ends down on to the plank by means of screwed-on battens. It is very simply arranged that one screw only has to be drawn in order to get at the clock.

With this arrangement, it has been found more convenient to let the peg concerned be snatched upwards by the ascending mop pole.

ELECTROMAGNETIC HYDROPHONES, OR "MAGNETOPHONES"

by

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U.S. COAST AND GEODETIC SURVEY.

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"Necessity is the mother of invention" and one of the difficulties of radio acoustic ranging was the noise which developed in the cable from the hydrophone to the shore station, due to leakage, since a small current was necessary in the cable to operate the carbon button of the hydrophone. The carbon button itself, also produced some electrical noises, called drying or burning, especially if the applied voltage was too high. It was desirable, therefore, to have some method whereby an electromotive force would be generated in the hydrophone itself, by the bomb sound, without the use of auxiliary voltages.

Back in the days when minds were working on these ideas there were several kinds of loud speaker units on the market. One type was meant to be used with a horn, in which the currents from the radio receiver caused a diaphragm to vibrate and set air in motion; another type was built to be fastened