

## CONSTANT RADAR RANGE SOUNDING

Report of the H.M.S. *Seagull*.

Extract from "Hydrographic Department Professional Paper", No. 1, London, 1947.

### PREFACE

Developments in Radar have brought it to a pitch of accuracy suitable for Surveying, and the Constant Radar Range Sounding method, which forms the subject of this paper, shows how it may be used to excellent advantage for Hydrographic Surveys.

Future developments in radar will doubtless lead to other methods and applications for Surveying but it must be stressed that no electronic aids are to be accepted without providing for routine checks by old established methods.

1. A method of sounding using Radar, with an accurate ranging device, has been used in H.M.S. *Seagull*. It has a number of advantages over sextant fixing.

2. *Principle*.—The ship is steered along the arc of a circle, which is a constant range from a fixed mark. The fix along the arc is obtained from a range of a second mark.

3. *Procedure*.—(a) The marks selected must be good radar targets. In the case of H.M.S. *Seagull's* survey between Inishtrahull and Orsay, off the north coast of Ireland, the Master Station from which the arcs of the circles were drawn was the easternmost end of Inishtrahull Island, as this was the nearest echo, when ranging on the Island, and therefore more clearly defined than the lighthouse in the middle. The "cut-off" ranges were from beacons carrying radar reflectors.

(b) All sounding marks are fixed in the normal way with sextants or theodolites and radar ranges are taken to all radar-visible marks. This checks the radar and ensures that the correct point is being ranged on in the case of rocks, an island, or a lighthouse.

(c) The flood and ebb positions of floating survey beacons are obtained by the calculation of the scope of the moorings and by check fixes, and the three positions, flood, ebb, and slack water, are plotted on the board.

(d) Ranges of beacons, carrying reflectors about 20 feet above the sea, could be obtained comfortably up to 18,000 yards. Wave interference is experienced at short ranges.

(e) The distance at which a rock or point of land can be ranged on depends on its height. The most easterly point of Inishtrahull, about 120 feet high, was used at 34,600 yards.

(f) It can be seen that, when using radar fixing, the beacons can be further apart than normal. Their positioning depends on the Master Station, since it is desirable to "cut-off" nearly at right angles to the Master. This means that fewer beacons need be laid than when fixing by sextant. At the same time it must be noted that an adequate number of beacons must be laid to enable the radar ranges to be checked by angles, although not always by a fix.

(g) The fitting of the radar reflector reduces the height of the beacon and the size of the flag, so that it is not visible by eye at long distances. In H.M.S. *Seagull's* survey a shore fix was possible in reasonable visibility and the number of additional visible beacons required was cut down to a minimum.

(h) During the sounding, positions are checked by sextant angles, or a fix when possible, and by ranging on all the radar-visible marks, with the ship stopped.

4. *Gear*.—(a) No special instrument not already supplied to a surveying ship is required.

(b) The lines to be run, arcs of circles from the Master, are drawn on the board at the normal spacing of 0.2 inches apart, and against each is written the appropriate range of the Master. It is convenient to draw these in ink as they are to be seen under tracing cloth.

(c) Since the track of the ship is an arc of a circle and the course will alter along the line, it is convenient to draw a number of lines ten degrees apart to give an indication of the course normal to the circles.

(d) The only other special requirement is a cloth tracing on which range circles 200 yards apart (the scale of the survey was 1:75 000) are drawn.

5. *Sounding*.—(a) The cloth tracing is placed exactly on the flood, ebb, or slack water position of the beacon, selected as “cut-off”, and well weighted down.

(b) The radar is trained on the Master and the ranges called at frequent intervals of about 15 seconds. The slightest deviation of the ship off the line is seen at once, as ranges are given to 10 yards, and suitable alteration of course can be made. There is little difficulty in keeping the ship within 50 yards of the track in normal circumstances.

(c) Communication to and from the Radar Office is by inter-com.

(d) When 5 soundings, at timed intervals, have been obtained since the previous fix, “five gone” is passed to the Radar Office. A final range of the Master is given, and booked, followed by a range of the “cut-off” beacon preceded by the call “fix”; and then immediately a repeat range of the Master. The fix is plotted with the cut-off range against the mean of the two Master ranges.

(e) Usually it will be found that a sixth sounding has been booked before the fix is given by the Radar Office. The echo sounding operator marks the record in the usual way, when the call “fix” comes over the inter-com. After the range of the cut-off has been passed he calls out the soundings at the fix and then carries on at the prescribed intervals.

(f) To plot the fix, the range of the cut-off on the cloth tracing is pricked through against the mean range of the Master on the board. It is then circled and numbered in the usual way.

(g) The enclosures at the back include a “ship’s board”, a specimen cloth tracing, a page from the ship’s sounding book, and a diagram of a radar reflector beacon.

6. *Personnel*.—(a) The teams required are as follows :—

On the Bridge. Plotting Officer, Writer-down, Echo Sounder.

In the Radar Office. Trainer, Rangetaker. (Surveying Officer and Recorder).

(b) The training of the radar team presents no difficulties. The apparatus is easy to handle and the ranges simple to read off. Once the work gets going the switch round from Master to cut-off becomes almost automatic. The Officer on the Bridge passes down a rough bearing and range of a new cut-off when required. This is then easily picked up on the P.P.I., and can in fact be done between fixes without materially interfering with the passing of ranges of the Master, especially if the ship has been steady on the line for some time.

(c) The radar team is trained to switch back at once to the Master if for any reason the cut-off can not be obtained. Thus the ship is kept on the line until a new cut-off range is obtained.

7. *Notes*.—(a) If the Master is a shore station, and therefore not affected by tidal stream, the arcs of range can be drawn on the board before starting the days soundings. If the Master is a floating beacon a second circled tracing is placed over it and is moved as the stream conditions alter. In practice, this shifting with the stream, and the fact that the prick through is made through two tracings, instead of one, offers no inconvenience or difficulty.

(b) The advantages of radar sounding are many :—

1° Independence of visibility conditions once the beacons are laid. At a pinch, too, a beacon can be laid by radar ranges only, provided there are enough radar visible marks to afford check ranges ;

2° Fewer beacons need be laid. A check that the beacons have not moved is obtained by all-round ranges with the ship stopped ;

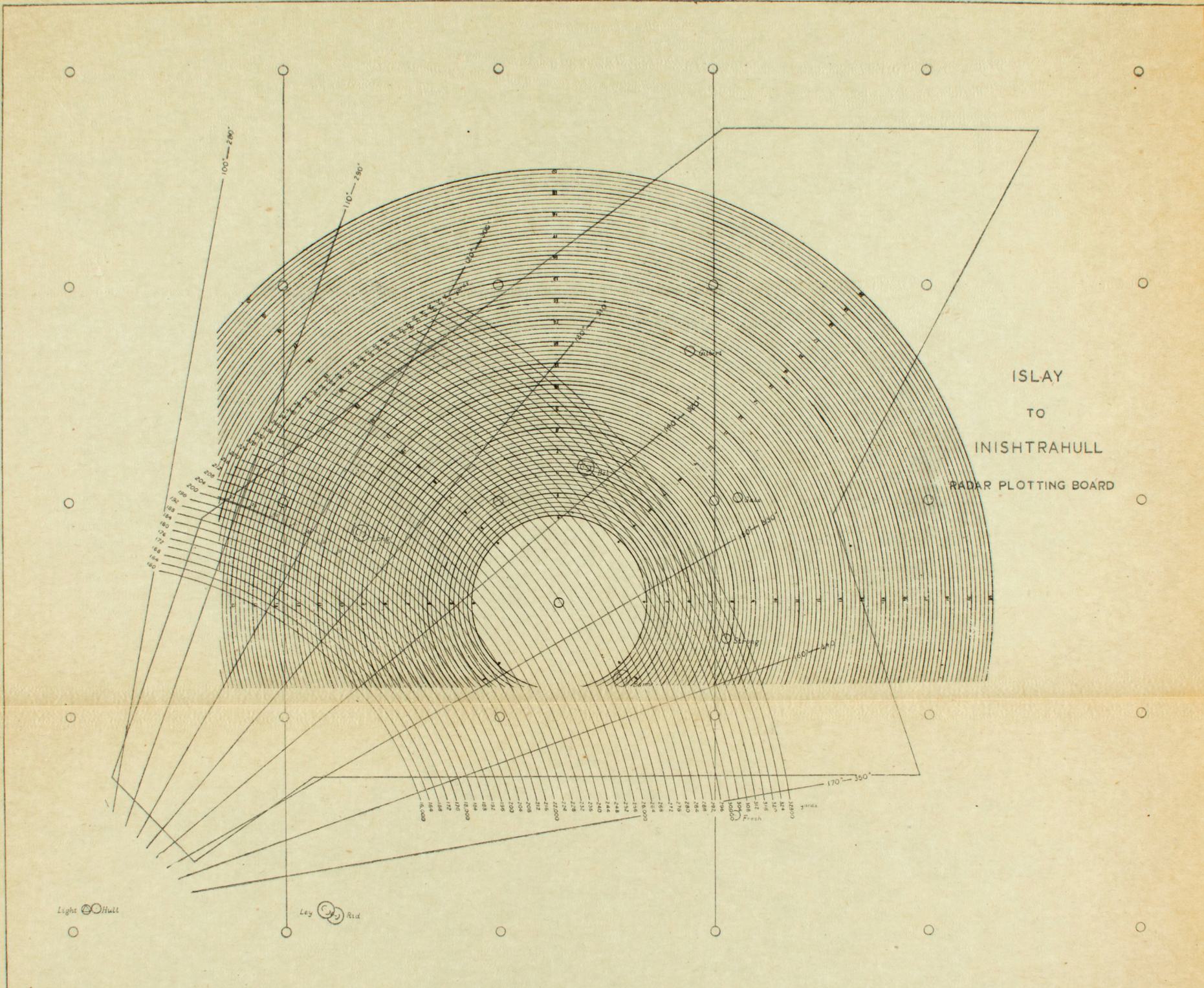
3° The control of the ship is simple, even when the stream is 3 1/2 knots and changing conditions are experienced along the line ;

4° The ship is kept on the line, despite a “Not Plot” fix, while a new cut-off is obtained, or a visual angle or fix taken ;

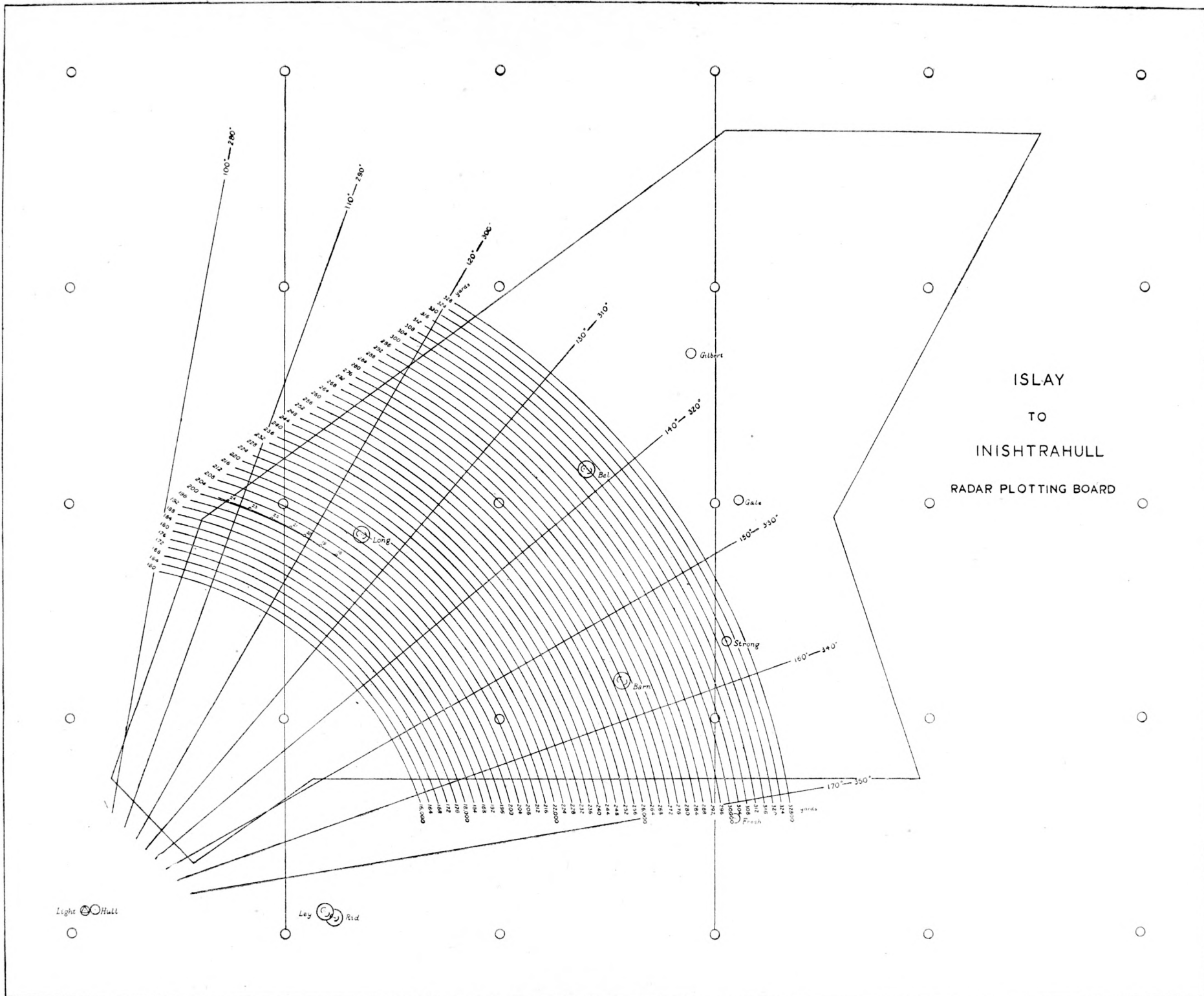
5° Interlines are facilitated, since the ship can be run at, say, 50 yards intervals of range ;

6° Fixing can be done under cover or in the wheelhouse when it rains ;

7° Turning from one line to another is simplified as ranges of the Master are obtained on the turn and helm can be eased or put hard over as necessary to end up on the new line.



Pl. 1.



PI. 1.

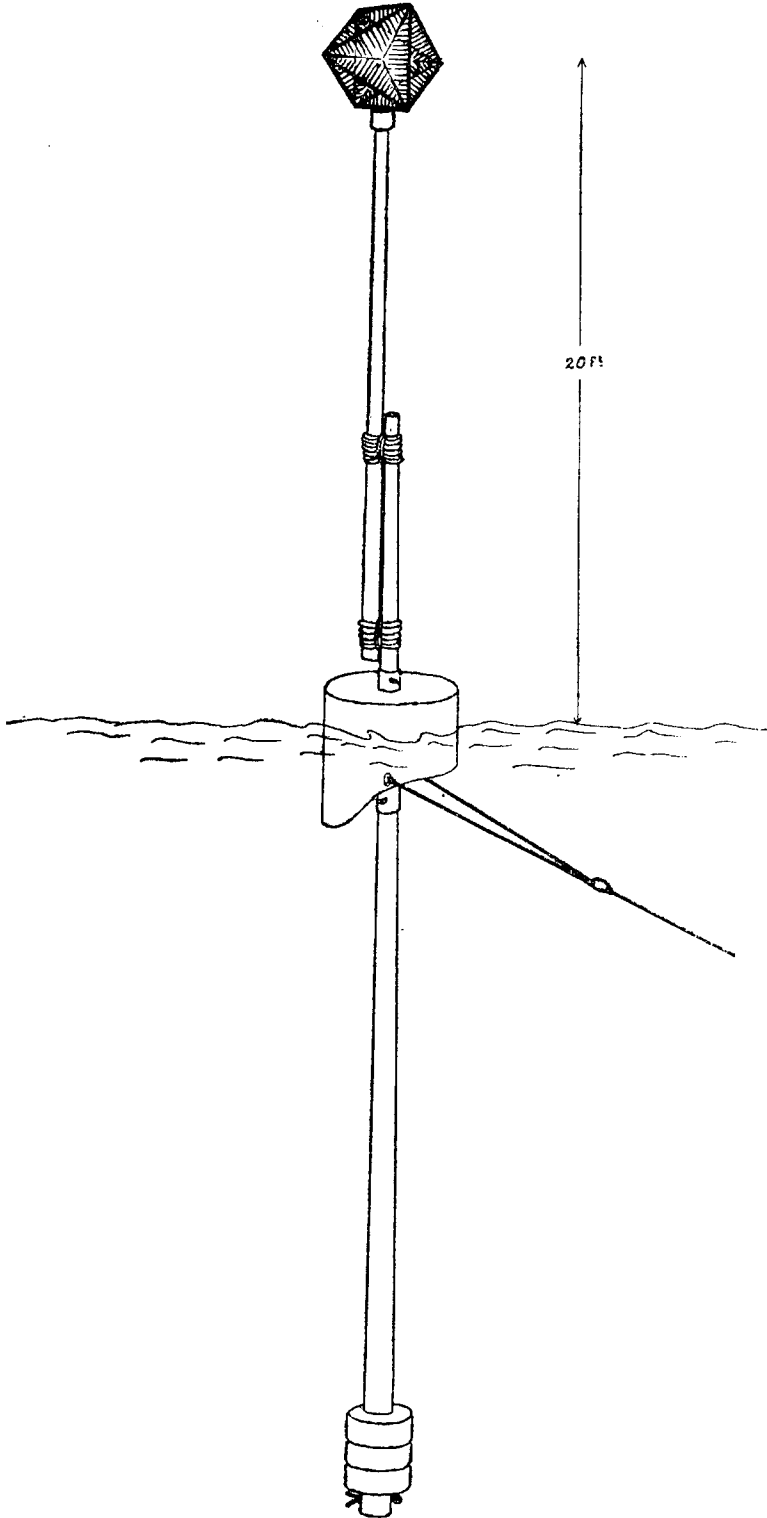


Fig. 2  
Surveying Beacon with wire mesh Radar Target.

## PAGE FROM A SHIP'S SOUNDING BOOK.

Inishtrahull - Orsay

Date 23-10-46

No. Fix	Range of Master	cut-off	Time	Log	Sounding at Fix	Sounding after	Remarks
	<b>HULL</b>	<b>RID</b>					
18	20000 20000	16870	0935	61.34	26/—	25 26 X X 27	East going stream
19	19960 19960	17330	0938	61.68	27/—	26p 25 26 X X X	p = peak 21/—
20	19970 20000	17920	0941	62.25	27/—	27 X X X X X 28	
	<b>BEL</b>						
21	20030 20020	14070	0944	62.62	28/—	28 X X X X X X	
22	20010 20010	14930	0947	63.12	28/—	28 X 27 X X X X	
23	19990 20000	15870	0951	63.59	27/—	27 X X X X X	
24	20010 20030	16850	0954	64.11	27/—	27 X X X X	Long. 95° 30' Hull

