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FIFTY YEARS AGO...

With much thought and research being devoted by the Bureau and Member States to the costly and tedious subject of the elimination of doubtful data, it is interesting to note the wonder expressed by hydrographic surveyors fifty years ago about the phenomenon of false echoes from shoals of fish. The following extract, which appeared in the May 1935 issue [Vol. XII(1)] of the *Hydrographic Review*, from a letter from the British Hydrographer, with an extract of a report from HMS *Challenger*, refers to the "Deep Sea Echo Gear" being used to obtain a record in 40 fathoms of water. Today, an enormous amount of hydrographic effort will be needed to verify reported shoals, which may well be based upon nebulous reflections such as those described, and which gave rise to the charting of PA, PD, ED and SD features. Not every user of an echo-sounder, even today, can believe that they have not discovered a shoal of their own. When the mariner cries "Wolf", no hydrographic office can afford to ignore it — thus their plea is for such reports to be supported by as much additional information as possible, including positioning, with an estimate of its accuracy, and the echo-trace.

FALSE ECHOES IN DEEP WATER

(Extract from a letter received from REAR-ADMIRAL J.A. EDGELL, OBE, RN, HYDROGRAPHER OF THE BRITISH NAVY)

Occasional instances of false echoes are found with both sonic and supersonic type of gear, especially in deep water. An interesting case occurred some time ago and it so happened that the records could be preserved; the same are reproduced herewith in the thought that they might be of interest to readers of *The Hydrographic Review*.

The following is an extract from the Report of HMS *Challenger*.

"In April 1933, whilst steaming down the Channel in the vicinity of Start Point, soundings were being obtained of about 40 fathoms with the Deep Sea Echo Gear; the bottom was of an even depth when a report was received that the soundings were shoaling rapidly and almost at once 5 fathoms were recorded. The engines were put astern and when the wash subsided soundings of about 40 fathoms were obtained; these were checked by lead.

"A buoy was dropped and the ship steamed slowly round in the vicinity; on going ahead again the same thing occurred, soundings shoaling suddenly from 40 to 5 fathoms when, on the engines being put astern, 40 fathoms was again recorded and instantly tested by lead. This continued for some time, the phenomenon being observed whenever the ship went slowly ahead and then astern, until finally, although covering precisely the same ground near the buoy, continuous soundings of about 40 fathoms were obtained over an even bottom.

"The conclusion arrived at was that echoes were being obtained off a dense shoal of fish swimming at a depth of about 30 feet, these collecting under her bottom when the ship was going slowly ahead, but scattering whenever the engines were put astern".

Challenger then altered course, only very faint repetitions being received, and dropped a buoy. A continuous and level bottom of approximately 40 fathoms is still shown, until arriving at a spot where this phenomenon is again repeated, although immediately on going astern 40 fathoms is again picked up. During the course of her manœuvring, the "shoal" is again noticed at two spots, from which time on, the same level bottom is shown until the "shoal" is again found swimming, apparently, at much the same depth, but in a different place. On going astern it is dispersed.

There appears no doubt at all that this phenomenon was produced, as suggested by *Challenger*, by a dense shoal of fish swimming underneath the ship's bottom and dispersing when the action of the propeller going astern was felt.

Incidentally, it is worthy of note that the echo still showed a depth of 40 fathoms *through* the layer of fish ! This can be seen in several instances on the records.

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Early acoustic trilateration is described in the following extract from the May 1935 issue of the *Hydrographic Review*. The ingenious use of sound transmitted through the water, reception at hydrophones, and radio transmission of the received signals back to the point of origin, is the precursor of today's sophisticated acoustic navigation systems. One wonders what the effect of all the depth charging was on the fish population of Georges Bank.

One also wonders at the computing of reduced data : two ranges from time of travel in water and by radio, allowance for eccentricity, a solution of three known sides of a triangle — all done with log tables, no doubt — or was it entirely a graphical solution with the range circles expressed as time scaled from the chronograph record ? Indeed, the world was awaiting the microchip.

RECENT PROGRESS IN HYDROGRAPHIC SURVEYING

by GILBERT T. RUDE, U.S. COAST & GEODETIC SURVEY

(Extract from the *Report to the Fifth Pacific Science Congress*, Vancouver, 1933)

The narrow continental shelf on the Pacific coast and the absence in general of off-lying shoals, which tend to absorb or to reflect the sound waves from the explosion of the depth-bombs, have been favorable factors in the progress under modern methods of the hydrographic surveys along that coast. The comparatively low water temperatures in addition furnish a medium quite conducive to successful underwater sound transmission. Experiments have demonstrated that the sound wave travels faster in warm water than in cold, but does not go so far; the water of high temperature apparently absorbs the wave energy.

The favorable features presented by the physical conditions on the coast have permitted the installation of hydrophone stations along the actual coast-line, and the obtaining of accurate positions of the surveying vessel at considerable distances off shore. A bomb explosion in one instance carried through a distance of 206 miles.

The Atlantic coast, on the other hand, presents difficulties which have not yet been entirely overcome. The wide continental shelf and off-lying shoal water on the north Atlantic coast constitute adverse conditions for the sound waves generated by distant off-shore explosions to reach hydrophones located on shore, and along the south Atlantic coast the comparatively high water temperatures are unfavorable to successful sound transmission.

Radio Acoustic Triangulation

The unfavorable conditions on the north Atlantic coast, however, have been partly overcome by a variation in technique; a system of marine triangulation is extended from a buoy anchored off shore on the continental shelf and located by a long series of star observations made from the surveying vessel anchored nearby. This method was used for the first time, and successfully, on the recent survey of Georges Bank.

Georges Bank extends to the eastward about 200 miles off the New England coast and contains an area of about 15 000 square miles within the 100-fathom contour. The depth over a large part of this area is less than 50 fathoms, and generally from 20 to 30 fathoms along the backbone or ridge of the bank.

The origin buoy is anchored in about 30 fathoms near the outer end of the bank and is located by the series of astronomical observations within a probable error of about 400 metres. This position has ample accuracy for the scale of an off-shore chart and is held fixed for the purposes of the survey. A second buoy, forming a base line approximately at right angles to the axis of the proposed triangulation system, is anchored about ten miles distant.

A station ship, with a hydrophone suspended under the keel and connected with the radio transmitter, is anchored near the origin buoy and the mobile survey ship is steamed past the second buoy close aboard, a depth charge being dropped in passing. The sound wave from this explosion travels via the sea water to the hydrophone of the station ship; thence electrically to the radio set, and its receipt is automatically and instantly flashed back by radio to the survey ship's chronograph in a manner similar to that used on regular surveying operations on the Pacific coast. A determination of the length of the base line is thus furnished; at least three determinations of this length are made.

The mobile survey vessel is now anchored near the second buoy for the determination of the azimuth of this base line. If it is during the day time, a sextant angle is observed between the sun and the station ship anchored at the origin buoy; if at night, the angle is observed between a suitably located star and the searchlight of the station ship. The azimuth of the line is readily computed by means of this inclined angle.

An azimuth and a base line with a survey buoy at each end having been determined, a system of quadrilaterals is now extended shoreward along the ridge of the bank; this system is composed of triangles with sides 10 to 12 miles long, with a survey buoy at the vertex of each triangle. The lengths of the triangle sides are determined in a manner similar to that for the base line, and an occasional azimuth is observed over some line of the system as a check on the data.

Two station ships, with suspended hydrophones, are now anchored at any two of the buoys and the mobile survey vessel is steamed along on a system of sounding lines; positions are obtained as on the Pacific coast except that the station ships replace the shore hydrophone stations.

Obviously the physical conditions obtaining on the Atlantic coast, necessitating the use of two station ships in place of two comparatively inexpensive shore hydrophone stations, render this variation in procedure considerably more costly than the method employed on the Pacific coast and, in addition, slow up the work somewhat by withholding the two station ships from active, productive surveying operations. Later experiments may point the way to a more economical solution of the problem, but in the meantime quite accurate and interesting surveys are being accomplished in the manner briefly described above, and much more rapidly than was formerly possible by the older methods.