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FIFTY YEARS AGO...

Readers of the *International Hydrographic Review* for July 1979 will be aware that the Foundation Stone of the International Hydrographic Bureau building was laid by H.S.H. Louis II, Sovereign Prince of Monaco, on 20th April 1929.

By December 1930 the building was complete. Part of an article in the May 1931 *Hydrographic Review* read as follows:

"The erection of the new offices entailed the removal, by blasting, of some 7 500 cubic metres of rock (about 18 000 tons) from the steep slope immediately below the Avenue de Monte-Carlo and above the Quai de Plaisance, on which the building was to stand. This work was commenced soon after the laying of the Foundation Stone and was continued throughout the summer of 1929. By the middle of September the foundations had been completed and during the middle of November the walls began to rise above ground level. At the end of the year the walls of the ground-floor were completed and the laying of the reinforced concrete first floor had been begun. In March 1930 the second floor was being laid and in August the roof. The work was pushed on with extraordinary rapidity, thanks to the energy of the architect, M. CHAUVET, Port Engineer, and the good will of the contractors, Messrs BONI Frères.

On the 18th December 1930, the work was all but completed and the Bureau was able to commence the transfer to the new building. This transfer, thanks to the good will of the whole Staff, was carried out very rapidly and with practically no interruption in the work of the Bureau.

H.S.H. the Prince of Monaco expressed his intention to inaugurate the new offices in person and this ceremony took place on 14th January 1931, the Directing Committee having invited the Secretary-General of the League of Nations to send a Representative to take part therein."

Photographs of the building in its various stages of construction and completion illustrate the article.

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At a time when the Bureau is involved with up-dating S.P. 46 'Correction of Echo Soundings' two extracts from a 'Note on Acoustic Sounding' by M. MARTI, Ingénieur Hydrographe Principal, are of interest:

VELOCITY WHICH SHOULD BE ADOPTED FOR SOUNDING

"In order to take accurate soundings by sound it is theoretically necessary to determine the temperatures and salinities of the different layers of the water at the very place and moment of the determination of the echo interval, after which a species of integration would give the depth; anyway this integration might be reduced to the finding of a mean velocity which, multiplied by the echo interval, would give the depth.

But, luckily, the physical conditions are generally such that the average velocity to be used for the purpose vary but little from a single value (1 500 metres per second), the temperature of the water usually decreasing with the depth, the increase in the velocity which is due to the increase of pressure is thus practically compensated by the decrease in velocity due to the lowering of the temperature. It is only in taking very deep soundings that the velocity of sound differs materially from the value 1 500 metres, as the temperature of the water is nearly constant (4 °C = 39 °F) in great depths and the increase of velocity due to the increase of pressure is, therefore, not compensated there.

The velocity of 1 500 metres, which is, therefore, usually fairly close to the velocity which must be employed, has been adopted as the only velocity for making the graduations used in the various instruments for measuring the echo interval. These instruments give an approximate value of the depth by direct reading. The corrections to be applied to their readings are always small and may be given with all requisite accuracy by tables or simple diagrams constructed with the arguments (*a*) mean temperature and salinity of the layers and (*b*) approximate depth of the sounding (*)."

DEPTH LIMITS FOR THE USE OF SONIC SOUNDING

"Generally speaking it is difficult to take soundings by acoustic methods in shallow water for, in these circumstances, the echo comes back very close on the emission of the wave and thus measurement of the echo interval by means of a single receiving apparatus, such as is used by most of the appliances of the present day, is not possible unless this receiving appliance can be brought to rest in the very short interval which separates the emission from the return of the echo.

Likewise it is difficult to sound by sonic methods in great depths, for the power of the acoustic appliance which can be used is obviously limited, and thus it happens frequently that but feeble echos have to be used.

Fortunately, in shallow water, the echoes are powerful, and thus the sensitiveness of the receiving appliance becomes of secondary consideration, and can be sacrificed in order to obtain the rapid damping which is necessary under these conditions; on the other hand, in great depths, the echo does not return to the ship until a relatively long while after the emission of the wave; it is the damping of the receiver which becomes a secondary consideration and thus can be sacrificed for the much greater sensitiveness required in this case. The desire to give suppleness to appliances in order to make them utilizable over a wide range of depths has induced those who make research on this subject to construct instruments which may be adjusted to suit the circumstances.

The appliances so far constructed have practically all got the same limit for sounding in shallow water; they sound without difficulty as soon as the depth under their emitters exceeds about 20 metres (65 feet), they even permit the echoes to be distinguished with about 10 metres below them, but sounding in five metres with sonic sounding machines, which necessitates a return to rest of the whole of the receiving appliance in less than one 150th of a second, must, at any rate for the present, be considered extremely difficult to attain.

In deep sea sounding the limits of the various instruments are far from being the same however. Those sounding by hammer blows will reach depths of 500 metres in fine weather, sounding by ultra sounds or by explosion produced by a rifle down to

(*) A diagram of this sort is at the end of 'Note sur le sondage aux grandes profondeurs par détonations' published in the *Annales Hydrographiques*, 1923-1924.

1 000 metres, sounding by oscillators down to 3 000 metres, but for regular sounding in very great depths (from 8 000 to 10 000 metres) sounding by detonation must be employed as this is the only means the power of which is not limited since, obviously, this can be increased by increasing the explosive charge used (*).

Thus, whatever efforts may have been made to extend as far as possible the limits of sounding with such instruments, no instrument has yet been constructed which will take soundings at all depths. This should not be astonishing for, as in all acoustic phenomena, the intensity of the echo decreases in proportion to the square of the distance (in this case the square of the depth); consequently, to obtain the same echo at the greatest depths (10 000 metres) as at the smaller depths (10 metres) a million times more energy must be used; acoustic emitters and receivers so far constructed are unable to deal with such a wide range of power."

M. MARTI had been the inventor of the 'Acoustic Sounding Apparatus by Successive Shocks of Detonations' in 1927, a system described in the *Hydrographic Review* for November 1928.

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Dr William BEEBE had recently been making his descents into the ocean off Bermuda in his bathysphere, reaching a depth of 435 metres. A description of his bathysphere by Otis BARTON appeared in the Review :

"The bathysphere is a spherical steel diving chamber, or tank, as we generally call it. It was designed by the writer, and Messrs. BUTLER and BARRET of Cox & Stevens. It consists of a single casting made by the Watson-Stillman Hydraulic Machinery Company. The first casting weighed five tons, which proved to be too heavy for any of the winches procurable in Bermuda. It was therefore junked. Our present tank weighs five thousand pounds, is four feet nine inches in diameter, and has walls at least an inch and a half thick.

It carries a four hundred pound door, fastened over the man-hole with ten large bolts. This door has a circular metal gasket which fits into a shallow groove. The joint, when packed with a little white lead, was entirely waterproof at twenty-four hundred feet. In the centre of the door is a win bolt plug, which can be screwed in or out quickly.

The windows are cylinders of fused quartz eight inches in diameter and three inches thick. They are a special produce of the General Electric Company, the use of fused quartz being suggested by Dr E.E. FREE. They are fitted into cannon-like projections in the front of the tank. The joint is secured with a paper gasket and white lead, and a light steel frame is bolted over each one in front. In all we have had five quartz windows. The first was chipped in an attempt to grind it into its seat. The second gave way under an internal pressure test of one thousand two hundred and fifty pounds to the square inch. It seems probable that the frame in front was bent out, and that the resulting sheering strains broke the glass. The third was broken when the frame bolts were rightened unevenly. The remaining two, however, have never leaked a drop, and have withstood the pressure at twenty-four hundred feet, and will, no doubt, hold much more.

The electric cable was specially made by the Okonite Company. It is one and one tenth inches in diameter, and has a heavy rubber insulation. Inside are two conductors for the lights and two for the telephone. The cable passes through a stuffing box in the top of the tank and is squeezed up by two glands, one on the outside of, and the other within, the sphere. It, too, proved entirely waterproof under all pressures we encountered.

The two big conductors passed to a two hundred and fifty watt spot-light (loaned by E.W. BEGGS of the Westinghouse Company) in the right forward projection. We were

(*) In any case but relatively minute quantities of explosive are necessary for sounding in the greatest depths, say 10 000 metres; at this depth a charge of 100 grams is sufficient under all circumstances.

obliged to seal the left projection with a steel plug, since only two quartz windows were left. At depths of over seven hundred feet the beam of light could be seen passing through the water. When more illumination was desired, it was simply necessary for the divers to direct the deck crew to speed up the generator. The light was turned out by the divers when they wished to observe the effects of the natural submarine illumination. To facilitate these observations the entire interior of the sphere was painted black.

The small conductors passed to the telephone lent by C.R. MOORE of the Bell Telephone Laboratory. The two sets were run by a twenty-two-and-a-half volt radio battery on deck. At times static occurred, especially when the free ends on the conductors were disturbed, but on the whole they were a success. All observations taken in the depths were recorded by the deck crew.

The breathing apparatus was designed by Dr Alvin BARACH of New York. On either side clamped to the wall an oxygen tank was carried, either of which would take Dr BARACH's special valve. We set this valve to allow two litres of oxygen per minute to escape for the two divers. One tank lasted about three hours at this rate. Above each tank was a wire mesh tray. One contained soda lime, which took up the CO^2, and the other calcium chloride which absorbs the moisture. Palm leaf fans kept air in circulation. During our deepest dive of fourteen hundred feet we were comfortable and cool, although we had been inside more than an hour and a half.

For lowering the bell, we used Dr William BEEBE's seven ton winch and special large reel. To operate these, we installed two boilers on the after part of the long deck of our lighter which had once been the H.M.S. *Ready*. The lighter was in turn towed by the tug *Gladisfen*, of the New York Zoological Society. This equipment was used on the Arcturus Expedition, as were also the three six-ton sheaves. One of these was bolted to the deck about 70 feet in front of the reel at midship. From this the cable returned to the second sheave close to the mainmast and then passed to the third at the end of the heavy boom.

The cable was a special seven-eighths inch, steel-centre, non-spinning one made by Roebling. It was thirty-five hundred feet long and would hold twenty-nine tons. It weighed about two tons under water. On our dive to fourteen hundred feet, therefore, the weight of the cable let out was nearly six-sevenths of a ton in the water. To this was added the weight of the bathysphere in water, about seven-eighths of a ton. The amount of cable out was tallied by the special meter wheel also from the *Arcturus*, as well as by a system of ribbons tied around the cable.

The comparatively light electric cable was let out by hand, and attached at intervals of not more than two hundred feet to the steel one. This we did at first with brass clamps, but later it was found better to tie them together with lengths of rope about a yard in length, since these took up much of the twisting. The winch could be stopped while the tie was made.

Several problems were naturally encountered in these operations. At first we found that the sphere swung badly when raised from the deck. To remedy this we lowered the boom, by means of a second winch, nearly down to the clevis, which connects the cable and sphere. The whole boom was then raised and pulled out over the side, with the top of the tank almost touching the third sheave. From this position the sphere could be lowered upon a single whip.

Perhaps the greatest trouble was caused by the twisting of the rubber hose about the steel cable. Most of this was apparently due to the failure to stretch the latter by letting it all out without the rest of the apparatus and then to rewind it under tension on the reel. When twisting was bad we would tie up the loops every two hundred feet in a loose coil, through the centre of which the steel cable continued to operate. Eventually, however, we succeeded in getting out as much as two thousand feet without twisting.

Besides taking observations at great depths in the open ocean, we tried towing the tank along under the vessel, endeavouring to keep the bottom in sight and not to run into any of the ledges which rise up quite suddenly in these waters. In this work we nailed a wooden rudder on each skid behind, by which the windows were kept always to the front in the direction of motion.

It is with this outfit that we hope next season to study the contours of the bottom down to five hundred feet and also to make dives in the open ocean of two thousand feet."

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To-day, when many types of marker or monitoring buoys are anchored in deep water, it is interesting to read of the vast use made of the Lucas Sounding Machine for such a purpose in a note contributed by a naval captain who was later to become President of the Directing Committee of the International Hydrographic Bureau.

A METHOD OF MOORING A FLOATING BEACON IN DEEP WATER

by Captain J.D. NARES, D.S.O., R.N.,
lately in command of His Britannic Majesty's Surveying Ship *Iroquois*

"It is occasionally necessary, such as when carrying out an examination of an Ocean Bank, to moor a Beacon in deep water. The following description of a method successfully adopted in a depth of 1 625 fathoms may therefore be of interest.

The ship having arrived in the desired position, a deep sea sounding was obtained using a LUCAS Pattern Sounding Machine, but without a Driver Rod, the weight (90 lbs) being secured to the 20 gauge sounding wire by means of a 1 1/2 inch tremp tail line, 20 fathoms in length. Bottom having been reached, another 40 fathoms of wire was allowed to run out and a wire stopper was then placed on it. The inboard end was then cut and secured to a thimble at the end of a 1/2 inch wire 8 fathoms long secured to the chain mooring sling of the beacon, which had previously been hoisted outboard ready for slipping. The stopper was then taken off the sounding wire, beacon slipped and bight of wire thrown overboard.

This beacon retained its position without dragging although a moderate swell was running but little wind, the nature of the bottom being mud.

NOTE. – (1) The thimble to which the inboard end of the sounding wire is secured should be well parcelled with either canvas or sheet lead to prevent chafe.

(2) The Beacon was subsequently recovered, but it was not found practicable to weigh the moorings which were therefore cut."