FIFTY YEARS AGO...

A second dip into the past — following the inauguration of this feature in the *Review* of July 1974 — reveals much that remains of consuming interest today.

Volume II, No. 1 of the *Hydrographic Review* dated November 1924 in effect contains a number of contributions treating subjects on which the last word has not yet been said, including "Rapid distribution of important Notices to Mariners" and "Harmonic analysis of tides".

The President of the Directing Committee, Sir John F. PARRY, contributed an account of his visit to the Netherlands Hydrographic Office, at that time 50 years old and recently established in its new building at 147 Badhuisweg, The Hague. Praising the organization as "an excellent example of what a modern Hydrographic Office should be" he points out the value for the IHB of keeping in touch with the Hydrographic Offices of Member States by personal visits, and remarks "the association of two Naval Officers, although of different nationalities, in my opinion invariably facilitates that intimacy which it is so important should be established between the principals concerned".

J. GARCIA BELLIDO (Cartographer of the Spanish Deposito Hidrografico) contributed a well thought out article on the Representation of Relief on Charts, starting:

"The writer (of an article published by the Royal Geographical Society of Madrid) proposes that differences of level, both of the land and of the sea-bottom, should be represented on charts by curves only. It is certain, however, in the case of submarine levels, that he must compromise in shallow waters by showing a few soundings; but his ideal appears to be a chart on which land would be shown by bands or zones of shades of sepia increasing in density with increase of altitude and bounded by lines of equal altitude (hypsometric lines). The seas would be in shades of blue, increasing in density with the depth, each shade being bounded by isobathic curves, or depth-lines. In other words, a chart somewhat similar to the Prince of Monaco's Bathymetric Chart of the Oceans.

"It must be noted that every chart or map is a conventional representation of terrestrial reality and that this convention, this craft which suppresses, ignores or exaggerates one or other of the details or aspects of

reality varies with the object for which the chart or map is intended and is the guide or standard of which the cartographer should never lose sight, for it is in accordance therewith that he must construct the chart or map.

"Oceanographers naturally desire to have a graphic representation of the medium in which the phenomena take place and which form the objects of their research, and as till now (in Spain at any rate), there have not been any other but navigational charts, they require that these be modified to serve the purposes of oceanography and fishery".

In a section headed Representation of Submarine Relief he states the cartographer's problem most succinctly:

"All who know anything of topographic work are aware that the isohypsometric curves, or contours of dry land, are determined by joining the points of equal altitude in the various levelling lines which are run over the ground and by interpolating equidistant contours between the points of differing altitudes, the numerical data obtained by levelling being always completed by the notations made on the field-sketch and by the recollection of the land formation as seen by the topographer.

"That is to say that even in the representation of land formation seen there is always some inexactitude or imagination.

"What then may not happen when we are dealing with submarine relief where we know nothing beyond the depth at the points of sounding ? (*).

"We cannot, therefore, refrain from showing the soundings for they are the only precise data known. The depth lines, which are most useful in conjunction with soundings, serve to guide the eye in reading the latter and to indicate the limits of the zones of defined depth. The selection of the soundings, sparse in those parts where the bottom is flat and both numerous and precise in order to show up shoals and danger-spots, as also the tracing of the depth-lines, is the work in which the ability of the cartographer is brought out in the highest degree.

"It is only in very detailed hydrographic surveys that the depth-lines can be drawn with any confidence and, as we must publish many charts even when the data which we possess are few, to adopt the system of depth-lines only would entail withholding from publication the charts of those zones which have not been minutely explored, or else to have different systems of representation according to the degree of this minuteness.

"The representation of the sea-bottom by the exclusive use of depth-lines can be adopted only on charts on small scales, i.e. on those which embrace large areas in which the general formation or the major features of the relief are to be shown and not the detail required by the navigator.

"One of the points which must not be lost sight of, with reference to navigational charts, is the confidence with which they must inspire the user. If depth-lines only are shown all charts will inspire the same

(*) The author added as a footnote "Photographic exploration of the sea-bottom from aircraft is still in the experimental stage" — a state of affairs that has not changed greatly in the last 50 years.

confidence. On the other hand, numerous and uniformly spaced soundings give the impression of a conscientious survey whereas rare soundings or lines thereof in but few directions give the impression of areas explored in no very great detail and in which the navigator should move with greater caution than in others.

"To sum up in a few words — the essentials on a navigational chart are the soundings. As I said above, depth-lines are most useful to divide the soundings into zones, to show up shoals and to guide the eye of the user of the chart.

"N.B. — No country uses either the systems of depth-lines only for its navigational charts, or that of depth-lines and soundings in the zone of shallow water, but always soundings, soundings and soundings, without however omitting to show a few depth-lines.

"The English, whose charts embrace the seas and coasts of the whole world are very prodigal with soundings, as also are the Germans, the Dutch and the Danes, whose charts are perfect examples of what charts should be. The North Americans and the Chileans who, in the New World, pay the greatest attention to this type of work, follow the same custom".

It is of interest to note that the Bureau accepted to translate GARCIA BELLIDO's article from his mother tongue into the Bureau's working languages (English and French) and is now again prepared to do this, by special arrangement (see Foreword) so as not to lose valuable contributions from experts writing in other languages to whom no translator may be readily available.

The issue included two important papers on Echo Sounding: the first was reproduced from a lecture delivered in Paris by Professor LANGEVIN on 10 May 1924 on "Super-sonic waves and their employment" describing the adoption for this purpose of the piezo-electric properties of quartz, which were discovered in 1880 by Pierre and Jacques CURIE.

The second was by Dr. Harvey C. HAYES on "Measuring ocean depths by acoustical methods". To quote HAYES:

"Three methods have been developed for determining ocean depths by means of sound waves, two of which serve for measuring depths less than about one hundred fathoms and one of which serves for measuring any depth greater than about forty fathoms. All three methods make use of the time required for a sound signal to travel from a transmitter to a receiver by way of reflection from the sea-bottom. It will be seen that this time interval, which is too short to be measured directly with sufficient accuracy, can be determined indirectly as a function of a much shorter time interval that can be very accurately measured. Of the two methods that serve for determining shoal depths, one has been termed the 'Angle of Reflection Method' and the other the 'Standing Wave Method'. The method that serves for greater depths has been called the 'Echo Method' ".

After describing these methods and apparatus developed in the United States Navy to exploit them he continues:

"During the months of October and November 1922 the U.S.S. destroyers *Hull* and *Corry*, using the echo method, made a survey of the ocean floor along the California coast from San Francisco to Pt. Descanso

from the hundred-fathom curve out to a depth of 2000 fathoms. The area covered was approximately 35 000 square miles and the work was accomplished in thirty-eight days. Over 5000 soundings were taken while the ships steamed steadily at twelve knots. There is no doubt but that these soundings, as assembled in chart form by the Hydrographic Bureau of the U.S. Navy, represent the contour of the sea-bottom with considerable accuracy even though the survey was made at the rate of about 1000 square miles per day. This survey has demonstrated beyond a doubt that the ocean beds can now be charted with a high degree of accuracy and that the survey work can be done with a speed and an economy of expense and effort that has heretofore been believed impossible.

. . . . . .

"The application of the methods and apparatus for taking depth soundings that have been described are more numerous and valuable than one might at first suppose, as has become evident to the author through the many letters of inquiry that he has received.

"Their value as an aid and safeguard to navigation has been repeatedly proved on various vessels of the U.S. Navy. And their value does not cease when a vessel steams into ocean depths for such survey work as has already been done shows that the deep-sea mountains and valleys will furnish numerous "landmarks" for determining the progress of a vessel, as soon as the main trade routes have been carefully charted.

"Moreover, the M V - Hydrophone receiver, besides determining the direction of sound signals used for sounding purposes, will equally well determine the direction of such signals transmitted from other moving vessels or from light-vessels placed at harbor entrances or at dangerous points along shore. In this way it serves to prevent collisions during conditions of low visibility and to direct vessels safely into harbor or away from dangerous rocks and shoals. If all ships were equipped with the sound apparatus that has been described and would sound their submarine sound transmitter during fog, the navigator could then know the bearing of every vessel within a radius of at least ten miles, in addition to knowing the depth of water underneath his own vessel. With such information at his disposal, the grounding of, or collision between, vessels could be absolutely avoided.

"These sound devices will serve to make a cheap, quick and accurate survey of rivers and harbor entrances through which a channel is to be dredged, thereby furnishing accurate data for computing the amount of material that must be moved. They will also serve to determine the capacity of reservoirs with a minimum of effort and expense.

"A study during the flood period of the beds of such rivers as the Yangtse, the Mississippi and others that are wont to overflow and cause great loss of both lives and property would doubtless furnish much valuable information for controlling such streams. The velocity of the water is usually so great that soundings cannot be made with the hand-lead, but by means of the 'standing wave method' the beds of such rivers can be surveyed with great accuracy. Such surveys made at numerous sections of the stream should show over what portion erosion takes place and,

what is more important, should show where the sediment is being deposited. If erosion at the bottom of the stream becomes active then the velocity of flow exceeds a certain minimum value (as is believed by some engineers), and if it can be determined what this minimum velocity is, then it is quite possible that the proper method of controlling the stream will be to narrow its confines rather than to widen them or raise the dykes, for by so doing the required cross-section to carry the flow will be gained by deepening the stream through the process of erosion. The possibilities of the depth sounding devices for use in this way are perhaps far greater than we can now appreciate.

"The 'echo method' of determining depths is not confined to determining submarine depths. It should serve equally well for determining the depth below the earth's surface of abrupt changes or discontinuities in the earth's crust such as are offered by coal and oil deposits or subterranean caverns. These surfaces of discontinuity will reflect to the surface a part of any sound disturbance that may be transmitted to them. And though it may seem far-fetched there is a possibility that the methods outlined may also be utilized for locating cracks and blow-holes in large castings.

"The apparatus employed with the 'echo method', which has been described as a means for determining the distance between two points in a uniform medium when the velocity of sound is known, serves equally well for determining the velocity of sound between two points in any medium when the distance they are separated is known. In this connection this apparatus may serve to determine the velocity of sound through the rock formation of a mountain or between borings or workings in mining operations. And since the velocity so determined is equal to the square root of the elasticity of the formation divided by its density, this information may lead to the identification of valuable ore.

"Of the above-named applications of the acoustical depth-finding devices that have been described, only two have been put to practical test. Their ability to aid and safeguard navigation during conditions of low visibility has been repeatedly demonstrated on ships of the Navy, and the survey of the sea floor off the California coast together with a more recent survey of a region off the entrance to the Panama Canal has proved that the sea floors can now be accurately and easily mapped".

In a foreword to these articles contributed by Admiral PARRY, the IHB President recounts a visit in May 1924 to LANGEVIN, the acknowledged 'father' of echo sounding, in the University of Paris and comments : "In these days of the extraordinary application of scientific methods to obtain practical results it will never even be suggested that the last word has been said on this important subject, so vital to hydrography and oceanography, but the invention now in question is most certainly another definite step in the direction of that perfection which we all earnestly hope to attain".

To assist Admiral PARRY on this visit, the French Hydrographic Service detailed Lieutenant BENCKER as interpreter; BENCKER subsequently served the IHB from 1 August 1924 to 31 August 1957, being Secretary-General from 1947.

The two articles in question were published additionally as the IHB's Special Publication 3, a testimony to the importance the Bureau was already attaching to new developments.

This issue of the Review contained an innovation, an invaluable bibliography running to some 200 titles concerning hydrography and related subjects. A duplicate list on one side of the paper only was included for cutting up for use on card index systems in subcribers' own libraries. Books reviewed included "Founders of oceanography and their work" by Sir William HERDMAN, and "Ocean passages for the world", compiled by Rear Admiral B.T. SOMERVILLE.

The work of bringing recent articles and publications to the notice of hydrographers continues today although the medium has been changed, and this feature is now contained in the Documentation Section of the *I.H. Bulletin* where it has the advantage of reaching readers at monthly instead of six-monthly intervals.