

THE CONTRIBUTION THE HYDROGRAPHIC OFFICES CAN MAKE TO MARINE SCIENCES

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IIB Note. — This article and the two that follow it are replies to the article "Hydroceanography" by Captain ALBINI published in the last number of the Review.

Those interested in this discussion will find additional information in the last number of the Review.

Those interested in this discussion will find additional information in the *III Bulletin* No. 10, October 1966, in the form of two short articles, one written by Captain G. P. D. HALL, R.N., the other by Commander L. OUBET of the French Navy.

In a recent article in the *International Hydrographic Review* [1] (*), Captain C. F. ALBINI, technical assistant at the International Hydrographic Bureau, discusses a number of studies made by hydrographers from various countries on the relationship between hydrography and oceanography and concludes that, apart from the exchange of a few mutual services, these two disciplines must remain entirely independent of each other.

Having myself published an article on the subject in the same journal eighteen months ago, I feel authorised to respond to the wishes of the International Hydrographic Bureau, which were expressed in a preliminary note to Captain ALBINI's article, and make a further contribution to the discussion.

Summarising the ideas already put forward, Captain ALBINI manifests some apprehension at the idea of what he calls, without clearly defining it, the "union of hydrography and oceanography", fearing that it may strike a serious blow at the steady work being done by hydrographers.

I do not myself feel that a veteran hydrographer, i.e. a specialist who has devoted much of his professional life to hydrographical operations and has constantly endeavoured to improve their quality and increase their efficiency, can fail to realise to the full the responsibilities borne by hydrographers, who are universally considered as the guarantors of safety at sea. Nor can he wish that hydrographers should be asked to engage in additional activities to the detriment of their indispensable utilitarian task.

The problem of the relationship between hydrography and oceanography is a complex one for there is no pronounced permanent distinction

(*) The figures in brackets refer to the bibliography at the end of the present paper.

between these two disciplines. There is a field of marine sciences where they overlap to a certain extent and the personnel concerned are mainly differentiated by the ultimate objectives they pursue and the methods and procedures they adopt. At what distance from the coast, for example, does the study of tides, currents and depths cease to be hydrography and become oceanography ?

As long as these phenomena are of importance to navigation, hydrographers consider them as part of their domain, but owing to the development of navigational equipment and methods, this domain is steadily expanding towards the open sea. Hydrographers have also adopted precision as a criterion. Their work ends when the degree of precision they achieve in determining positions and executing measurements ceases to be adequate for the quality of the documents they are responsible for publishing. But here, too, the improvement in their instruments is broadening their field of activity to an increasing extent.

In the present paper I shall briefly consider two questions. First I shall deal with the systematic hydrographic and oceanographic surveys which I outlined in my previous article [2] and on which I shall make a few additional points. I shall then revert in greater detail to the question of the borderline between hydrography and oceanography showing how uncertain and fluctuating it is.

When I outlined the problem of systematic surveys in all branches of oceanography in which a knowledge of the geographical distribution of phenomena is necessary, I was mainly concerned about the future — a rather distant future — much more than the present or the near future. A long while ago, but only in connection with bathymetry and specifically for the VIth International Hydrographic Conference [4], [5], I drew attention to the importance of developing bathymetric soundings to compile the future detailed chart of the oceans of the world. I was admittedly referring to a distant future which might, however, be brought nearer if the work involved were resolutely put in hand as soon as possible.

I now refer to the future generations who will one day need specific charts of the oceans of the world. They will require these charts not only for navigation but also for the exploitation of the varied resources the oceans contain in their waters, on their beds and in their sub-soil. I leave aside entirely the question of the scientific value of the charts.

It is already possible at the present day to make systematic surveys, although on a very modest scale, which are likely to lead to the production of such charts and we shall not have done our duty by our descendants if we have not planned or even begun this task when we already have certain ways and means of carrying it out. Whether the usual nautical charts or other specific charts are involved, the work to be done is considerable and will take many decades, spreading slowly outwards from the nucleus of what can be done at the present day.

It is obvious that this essential task will be achieved under far better conditions if the foundations are laid here and now and thought is given

to the international cooperation required, the bodies to which the task can be assigned, the funds needed, the methods applicable, etc.

It so happens that the only bodies which are organised to conduct systematic cartographical surveys at sea and to prepare and publish the necessary charts are the Hydrographic Offices. They have a sense of international cooperation, and the gradual coordination that has taken place in their methods would easily enable them to work side by side on a hydrographic chart of the world oceans.

It therefore seems tempting to *supplement* their work by assigning them systematic surveys designed to produce other special charts e.g., for physics (hydrology, streams, tides), geophysics (gravity, geomagnetism, heat flow), geology and biology (*). This is particularly the case as existing oceanographical institutions which are geared to research in a wide range of fields do not and cannot have the efficient organisation which decades, and even centuries, of responsibility have forced on the Hydrographic Offices.

But there can of course be no question of asking these Offices to take up new work immediately and to more or less drop their traditional tasks, as Captain ALBINI seems to suppose. At the end of my article I made it quite clear that it was necessary at the outset to persuade governments of the importance, in both the near and the distant future, of compiling a large number of specific detailed charts and the consequent urgency of affording the Hydrographic Offices additional facilities in respect of the staff, equipment and vessels required for their participation in this new activity.

I do not see the need to make the hydrographers themselves competent in all the disciplines involved in the specific charts. As they are generally well versed in physics and mathematics, owing to their basic training, they are able, if they wish, to take over hydrological and geophysical operations, but they might just as well be assisted in those disciplines by qualified specialists. This will probably be indispensable in the case of geological and biological surveys.

The assignments in question naturally have little to do with the oceanographical investigations which hydrographers already conduct for hydrographical purposes. The omission of these investigations from my article [2], noted by Captain ALBINI, was intentional, as this question was outside the scope of my study. Just as hydrographers carry out their own geodetic operations when there is not enough geodetic cover on the coast along which they are operating, they have to obtain the experimental or theoretical data they require by themselves when it has not yet been collected or worked out by oceanographers.

(*) A few years ago the United States Coast and Geodetic Survey showed the way by carrying out a systematic survey of the depths, the gravitational intensity and the intensity of the earth's magnetic field on profiles at intervals of ten nautical miles, in the north-eastern part of the Pacific, between the Hawaiian islands, the Aleutians and the west coast of North America.

Let us now return to the problem of the limits of hydrography. They are habitually regarded as mainly functional. The hydrographical authorities are responsible for issuing nautical documentation, i.e., charts and sundry publications enabling ships to navigate with the maximum safety, and hydrographers may well be proud of the absolute confidence navigators have in their publications. But scientific and technical progress has been providing both parties with new means of investigation and new observation instruments and nautical documentation will have to turn the opportunities now available to account by extending its present field of action. In so doing research will be guided by new and as yet unsuspected applications of marine sciences in the coming years.

One now ancient example of an unexpected development in navigation is "mécrométrie", which was used by navigators crossing the Atlantic shortly after the discovery of America when unable to determine their longitude. They had noticed that the difference between the geographical north and the compass north varied considerably between the old and the new world, and they made use of this phenomenon. And so, without realising it, they navigated with the help of what we would to-day call a specific chart showing the geomagnetic isogonic lines.

Navigation by soundings which has now been discarded in coastal waters in favour of more convenient and reliable methods may be found useful again now that ships have echo-sounding equipment with a range of several thousand yards. Any reliable isobath on the map may be used by the navigator as a line of position. Hydrographers have therefore extended their bathymetrical surveys into the deepest waters, as far as their methods of precise radiolocation allow them to go. The day will come when there will be detailed topographical charts of vast areas of the world oceans and ships will then perhaps be able to feel their way continuously over the sea-bed by constant reference to the slightest changes in underwater relief.

Owing to the possibility of navigating in very deep waters by sounding techniques, I cannot agree with Captain ALBINI when he envisages correcting soundings for insertion in nautical charts by reference to the variations in the velocity of sound due to the physical conditions of the masses of water traversed; these variations necessitate corrections in echo-soundings which are incidentally, recorded in the British Admiralty table H.D. 282. In reality, if the soundings have been made by adopting a conventional velocity for the propagation of sound, they need no correction unless a bathymetrical chart is being compiled for scientific purposes. A nautical chart must be a record of uncorrected echo-soundings to enable the navigator sounding at the same point with similarly adjusted equipment to find the depth recorded on the chart.

I have already had occasion to mention this problem of nautical cartography in a paper read at a symposium on underwater topography [3] in which I also referred to a similar problem, i.e., the nature of the surface of the sea-bed in waters where ships can find an anchorage. The natures of sea-bottom recorded on charts have to be inferred from samples taken by

the same process as that used by navigators, i.e., a greased sounding lead rather than much more elaborate sample collectors, although the latter could make a valuable contribution to sea-bed lithology. In the same paper I briefly compared the respective problems of a hydrographer and a specialist in underwater morphology when faced with rocks dangerous to shipping, just as Captain ALBINI, in his article, compares the attitude of a hydrographer and an oceanographer in a similar position.

At the end of last century an attempt was made to make more use of natures of sea-bottom by preparing lithological charts for certain coastal areas to enable ships to make landfall in bad visibility. Perhaps such charts might be put to some use in circumstances where silent or scrambled radio-aids could not be utilised.

It is also a fact that gravity readings at sea usually follow the general configuration of the sea-bed, taking an average of the changes in relief. But in navigation by soundings in very deep waters, changes in relief though sometimes useful for guiding a vessel may often involve it in gross errors, according to the scale and quality of the bathymetric chart. This has led to the idea of using gravity readings which are easier to utilise with their evened-out relief, to obtain the ship's lines of position. But, for the time being, the application of marine gravimeters is still too delicate an operation and sea gravity charts are still too few in number to make it possible to consider using this method of navigation.

The future will show what utility it may offer, but if ever it materialises the relevant navigation charts will have to give uncorrected measurements.

Moreover, underwater navigation will perhaps not always be reserved for naval operations and will be used for peaceful purposes. One of its special advantages is to spare crews, vessels and cargoes the strains, damage and delays to which surface navigation is exposed in bad weather. Ship-builders who are anxious to be able to regulate the size of freights according to the seas in which the vessels concerned are likely to navigate are already showing an interest in surface water density. The peaceful use of submarines might lead the Hydrographic Offices to publish a range of charts for the requirements of these ships.

These few examples, and it would certainly be possible to find others, show that hydrography, even if limited to preparing and circulating nautical documents, may well have to encroach on many marine sciences in addition to its task of giving a geometrical description of the sea-bed. Hydrographers will also have to make the relevant surveys themselves, as they will themselves be responsible for published documents, and logically their responsibility makes it necessary to verify measurements at the time they are made. This is incidentally the origin of the meticulous accuracy which is the hallmark of hydrographers and automatically makes them consider all outside sources of information with considerable reserve. They already know by experience that the soundings provided by unspecialised vessels, even those engaged in oceanographical research, can only be used with caution for marine cartography. If they are called upon one day to prepare

documents relating to factors other than the depths of the oceans, they will rely only on the data collected under their direction and with the tried and tested methods they use. It is therefore very likely that oceanographers will not be able to make more than a limited contribution to hydrography. But by their very objectivity and strict accuracy the documents published by the Hydrographic Offices will not only furnish an exact description of the geographical distribution of phenomena but will also provide scientists engaged in marine research with a wealth of subjects as a result of the peculiar features revealed by systematic surveys.

Cooperation between hydrographers and oceanographers is most likely to be ultimately profitable to oceanography. But whatever the direction in which the benefits flow, cooperation is now indispensable and will become even more so with the increasing need to know and understand the sea in all its aspects. What is essential is that the protagonists of both disciplines should make an effort to understand one another while retaining their particular outlook which is an earnest of the qualities of their respective work.

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