THE NEW GOLDEN AGE OF HYDROGRAPHY

by Commander L. OUDET
of the French Navy Hydrographic Office

I. — *CHARTS*

A history of British hydrography appeared some years ago in the English publication, « The Journal of the Institute of Navigation », in the form of articles signed by Admiral Day, who was then the British Hydrographer, and Mr. Robinson. These articles contained a large number of comments of general interest on the development of hydrography. Having recalled the fact that hydrography, from its etymological point of view, covers everything which concerns the maritime areas of the world, the authors observed that it should actually be confined to meeting the needs of navigation. They emphasized the close association which exists between the methods used by the hydrographer and those of the navigator for establishing, in particular, position and depth, and quoted the following example: The improvements in sextants and chronometers achieved in the second half of the Eighteenth Century resulted in the need for more accurate charts and, at the same time, in the means for obtaining them. Which is why this period became known as « the golden age of nautical charting ».

This approach is understandable from the English point of view as it relates more especially to the work of Cook, of whom Admiral Day has said: « Cook might indeed be held up as the ideal of the hydographic surveyor, for he was both a fine seaman and navigator as well as a gifted surveyor ».

The French however would more readily place the golden age of cartography at the turn of the Nineteenth Century, which was the period of the more well-known works of Beautemps-Beaupré. In fact, according to Rollet de l'Isle, one-time Director of the French Hydrographic Service, it was at the end of the Eighteenth Century, during d'Entrecasteaux's voyage in search of Laperouse, that Beautemps-Beaupré « invented and put into operation entirely new methods which were destined to make of hydrography an accurate science and which still constitute the basis of the systems in use to-day ».

These methods, which have been gradually improved, have served for more than a century, and continue to serve, in carrying out regular surveys and drawing up nautical charts. By them, whenever it has been possible to use them, hydrographers of all nations have plotted and continue to plot with accuracy the coastline (with their adjoining landmarks and relief), soundings, dangers and depth contours close to the coast. These methods, however, are slow and their use is limited to the areas immediately adjoining the seaboard. But even if these areas are restricted to strictly territorial waters, they are still sufficiently extensive in themselves to occupy the activity of the various national hydrographic services. In these circumstances, it is not surprising that after a century and half of hydrography and of the application of the Beautemps-Beaupré methods, there are still numerous regions of the world that are virtually unexplored, even though considerably used

for navigation. In these areas, the shoreline on nautical charts is still very far from accurate and the submarine relief even more so, since it can only be properly determined in relation to the coast. Such is the case with regard to the track-charts of the Red Sea, the South-West and South-East coasts of Africa, the coast of South-East Arabia, etc. They are used by navigators merely for noting their astronomic observations and for plotting safe routes where it is certain that no dangers exist. The bearings and distances obtained by radar on the coasts do not enable the accuracy of their astronomic observations to be improved, and neither do the depths shown continuously on their sounding apparatus enable greater determination of position. The most that the latter can do is to give them a general warning if they are drawing dangerously close to the coast.

The navigator of the present day is aware of the deficiencies in the old track-charts because he now has at his disposal quick and accurate means of sounding and of determining his position — means which were unknown when these charts were drawn up fifty or a hundred years ago. Time signals, which enable the exact time to be known anywhere on the face of the earth, did not then exist; for a sounding to be carried out, it was necessary to stop the vessel and explore the bottom with a hand line which was rarely longer than about 300 ft; and radar was of course out of the question.

But if the instruments used in modern navigation enable the navigator to-day to determine the deficiencies in his charts, they also enable him to rectify them. This was recently proved by a French navigator, Captain André of the Merchant Navy, a Lieutenant in the Naval Reserve. Captain André, who is the author of numerous surveys of roadsteads, anchorages and rivers, and who was put in command of the banana-ship « CAP DES PALMES » some years after the last war, had already noticed, in the course of previous voyages as Master, the inadequacy of the nautical charts of the west coast of Africa, particularly off the coasts of the Sahara and of Guinea.

During four years on the « CAP DES PALMES », he used each of his voyages between Marseille and Guinea, the Ivory Coast or the Cameroons to correct the charts of Guinea and, even better, to draw up the one that was lacking completely — i.e. the chart of the area from Cape Juby to Cape Blanc. On the basis of very frequent astronomic observations which gave him relatively accurate positions, he first fixed the main coastal capes by latitude and longitude. Then, determining his position by these capes, be plotted the whole coast of the Sahara by compass bearings. Finally, in relation to the land, he traced a series of soundings extending out in places as much as sixty miles offshore. Chart No. 6083, published in 1953 by the French Hydrographic Service on a scale of 1 : 845.000, is the outcome of his labours and is probably a unique example of a chart in which 500 miles of coast and its neighbouring depths have been entirely surveyed by a Merchant Navy captain in the course of routine trading journeys.

It would be out of the question to request navigators to carry out a task of such gigantic proportions — a task which was the result of four years continuous effort based on twenty-five years of general hydrographic experience and a complete familiarity with the coast surveyed. But it is important to study this remarkable contribution to hydrography by a navigator, and to devise therefrom a method of work which would make it possible to fill the numerous gaps of a similar nature which are the daily cause of insecurity, dangers and delays for hundreds of vessels.

It will first be noted that Captain André immediately attacked the problem which most concerns present-day navigators, that is the cartographic representation,

at scales of between 1 : 500 000 and 1 : 1 000 000, of a coast which, though unsheltered, is skirted by heavy maritime traffic. To carry out this work, the only instruments he had were a sextant, a chronometer and a simple recording-sounder which did not record depths greater than 500 metres; he did not even have radar, which would have been of the greatest service for plotting the coast.

As has been seen above, his whole work was based on the fixing of objects on land through astronomic observations taken from a moving ship along a coast where the refraction is particularly subject to variations. It was only by the accumulation of numerous observations that it was possible to obtain a half-mile accuracy, which was sufficient for the scale; greater accuracy under these conditions would appear to be almost impossible. In this particular case, incidentally, this accuracy was sufficient for the precise plotting of the depth contours, as the submarine relief was very even in the coastal strip studied.

On the other hand, this would not apply in the case of a region with a more irregular submarine relief, even if a really effective (4,000 metres) sounding apparatus were used, as the half-mile accuracy of position would not be sufficient to allow the various sounding contours to be connected smoothly. Consequently, Captain André was unable — and even with such a sounder would still probably have been unable — to fix beyond sight of land the edge of the continental shelf which, as we now know, is nearly everywhere broken up by deep cuts which are particularly suitable for intermediate soundings.

Hydrographic missions to-day possess the means of doing this. From 1934 to 1937, a mission which was operating off the south coast of France discovered a whole network of submarine valleys the contours of which will soon be appearing on the track charts of the Mediterranean; the mission used the sonic-ranging method which enabled it to fix soundings at distances from shore which were unusual for that period. But what was unusual twenty years ago is a commonplace to-day thanks to radio-navigating methods. The Hydrographic Survey of the French and North African Coasts, which has been operating for some years off the coast of Morocco, can extend its surveys to more than 50 miles off shore and can take soundings up to 4,000 metres; it also has discovered that the edge of the continental shelf fringing this almost straight coastline is very irregular. When the chart is published, those vessels which use it and which are equipped with sounding apparatus capable of easily sounding these depths will be able to fix their position with accuracy, even under foggy conditions.

Without counting the time required to set up the radio-navigation ground installations and to carry out the resulting calculations, the offshore soundings themselves may speedily be carried out and only account for about ten days of navigation (about 2,500 miles) out of a hydrographic cruise of 6 months covering 60 miles of coast. In addition, their plotting is facilitated by the fact that corrections for tide are unnecessary in the case of greater depths.

But the development of large-scale coastal hydrography, on the other hand, is a slow and costly business. It might well be asked what, under such conditions, would be the cost in time and money of introducing on these track-charts the depths which accord with the possibilities of modern sounding apparatus. Who, for example, could devote 20 years to the survey of the 1,200 miles of the coast of Arabia from the Straits of Bab-el-Mandeb to Ras-al-Hadd?

For the last twenty years, thousands of tankers yearly have run this coast, which is only drawn on their charts to an accuracy of within one or two miles.

To avoid the risks attendant upon this lack of accuracy, they have frequently been obliged to give the coast a wide berth for some hours of each trip. A total of how many thousands of hours have been lost in this way ?

With considerable patience, the captain of one of these tankers could probably have fixed the coastline to an accuracy of half a mile with his radar and by astronomical observations. But this would not have been sufficient for a proper drawing of the submarine relief. The few soundings appearing on present-day charts indicate sufficiently clearly that the relief is irregular, and that its adequate plotting requires accurate control points.

To obtain the latter, and to carry out the necessary work successfully within a reasonable time-limit and at minimum expense, the solution, in the opinion of the writer, would be to install radio navigational aids in the areas to be charted and to entrust the vessels which frequent these areas with the task of making the offshore soundings. The role of the hydrographic missions would be restricted to the work which they only are capable of undertaking — i.e. the installation of the ground transmitters, the determination of their positions by means of astronomic observations, and the fixing of the general limits of the coastal belt within which vessels should not penetrate. A detailed and large-scale survey of this safety zone would, in fact, serve no useful purpose, as vessels do not attempt to follow too closely a deserted coastline except perhaps in the case of certain conspicuous points or in narrow channels between offshore islands. It would seem that, in these circumstances, a hydrographic mission could survey several hundred miles of coast a year, the outline of the coast itself being obtained either by aerial photographs or by merchant vessel radar, the soundings being taken by their sounding apparatus over a fifty-mile-wide strip covering their commercial routes.

No attempt will be made here to go into the details of the apparatus and working methods to be used, but a study of recent surveys undertaken by hydographic missions shows that such apparatus — SHORAN, DECCA, RANA, etc. — are available. Furthermore, the use of helicopters unquestionably eliminates in practice the difficulties of setting up and provisioning stations on a deserted and unsheltered coast.

As to the use of merchant marine navigators as voluntary hydrographers, this would certainly not be any more difficult to arrange than the organizing of selected vessels for meteorological observations. Captain André, furthermore, was not alone in his masterly demonstration of the capabilities of merchant vessels and the willingness of their officers. When we were discussing this problem some years ago with the captain of a French tanker, he remarked spontaneously : « But why put off calling on us any longer ? ».

It is to be hoped that the large maritime nations will come to some agreement to organize the goodwill which is at their disposal and achieve in ten years what would otherwise take more than a century to accomplish.

II. — *SAILING DIRECTIONS*

« Sailing Directions » hold a special place in the general scheme of nautical documents, although not the first place, as nautical charts showing submarine relief are unquestionably the most important documents for the navigator. The latter, however, do not contain all the information he requires, which is for the most part gathered together in a certain number of special publications, such as « Lists of Lights », « Tide Tables », etc. The information which does not appear in these various works is collected in « Sailing Directions ». This is the purely

negative definition given in the important notices inserted at the beginning of French « Sailing Directions ». The various International Hydrographic Conferences, incidentally, have not found a better description, as they confine themselves to stating (see Part C, « Sailing Directions », Item 2, page 55 of the « Repertory of Technical Resolutions ») :

« The general arrangement and division of material in each volume, as typified in the Sailing Directions of most countries, should be adhered to. The actual amount of detail to be given is a matter for the decision of the country concerned. »

The information required by the navigator, and which is not to be found in the other works, is actually very varied and can only increase with advances in human knowledge — advances which are partly concerned with the safety of vessels that are becoming ever larger, faster and more costly. Hydrographic Offices cannot confine themselves to their own surveys for obtaining this information, but must call on organizations which specialize in the administration of corresponding national interests. But the needs of the navigator only account for a small part of those which are met by these organizations. It is therefore the job of the Hydrographic Offices to pick out information concerning navigation from a mass of documents, and to present it in a practical form.

Up to now, organization of the data has consisted essentially in grouping the information, first by geographic region, then, within each region, in an order prescribed by the nature of the area — i.e. descriptions of coasts, currents, buoyage, anchorages, etc. « Sailing Directions » have thus become nautical encyclopedias. When observing this fact, Captain Bastard, who for some years has devoted his time and experience to the drawing up of « Sailing Directions », stated (see « Revue Maritime », Christmas Number, 1949) : « It must however be admitted that even if these new « Directions » are clearer and better presented than the earlier ones, their perusal, as they allow for very little of an unusual nature, has become very much less attractive ». And he concluded : « It should be possible to depart at any moment from the role of compiler and project oneself in spirit on the bridge of a vessel. We should try to make each publication an accurate, complete, clear and interesting book which will be both easy to use and pleasant to read ».

This desire is not unattainable, and in view of the fact that it was achieved in the older publications, we need only study them in order to discover what is missing in the present works. Examining the publications of a century ago from this angle, it will be observed that the basis of the « Sailing Directions » for the North and West coasts of France was the « Pilote Français » (French Pilot), which is a collection of informative charts completed in 1838 under the direction of Beautemps-Beaupré. It soon became evident, however, that the nautical information appearing on these charts was insufficient, and towards 1840 the drawing up of separate « Sailing Directions » was undertaken by Givry, who described as follows his method of work : « First of all, I took from the notebooks of the hydrographic engineers who had cooperated under the orders of Monsieur Beautemps-Beaupré on the study of the coast... the nautical documents found therein. Then, in order to complete them, I covered this stretch of coast with the « French Pilot » charts in hand, gathering in each locality, from the most experienced pilots and mariners, all information which could be of interest to navigation ».

Thus a century ago, hydrographer realized that the outcome of his work was not sufficient for the navigator and that information supplied by « the most experienced pilots and mariners » was needed to complete it. This approach was

normal at that period because the young science of hydrography had not forgotten that its roots and its aims lay in navigation and that, for many countries of the world, accounts of voyages still constituted the navigator's principal documents. Since then, however, the establishment, in nearly all of these countries, of competent organizations has systematically supplied a mass of more accurate information under which the experience of mariners has become buried. Furthermore, this experience was generally concerned with navigation under sail, and as a result, it seemed out-worn and uninteresting when steam took over.

It is true that Hydrographic Offices have never ceased to recognize the necessity of maintaining contact with the navigator; whatever the method of propulsion, the navigator remains their only customer. But this contact has also taken on an administrative character. Requests for information are presented in the form of detailed questionnaires on buoyage, lights, depths, port equipment, etc., and consequently navigators, in their turn, have developed the habit of confining their information within this rigid framework.

And yet, even if the art of navigation has developed a scientific character, it has not lost, as is claimed by the lovers of sail, the interest which resulted from risk. (The continuity of maritime law, which is justified by the particular hazards of transport by sea, may be mentioned as a single instance). Neither can it state its problems in the form of equations, as is claimed by the scientists when they assert that the mariner has become an engineer. Whatever the scientific knowledge required for navigating, a good mariner — to-day as much as yesterday — is the man with nautical sense. He only differs from his predecessors by the factors upon which this nautical sense relies.

As far as « Sailing Directions » are concerned, this means that they should not be confined to a dry enumeration of the exact data on which the navigator will base his decisions, but should also — precisely because of the number and complexity of these data — accentuate the most important, connect them up, and explain the advantages derived from them by « the most experienced pilots and mariners ».

A few illustrations would seem to be necessary in order to clarify the above statements.

In the description of the entrance to Brest, the « Sailing Directions » describe the marks, lighthouses and Iroise buoyage separately. As a result, they list a large number of marks which only local pilots can recognize close up, but omit to draw attention to the « Pierres Noires » and the « Parquette » which bear, respectively, a lighthouse and a beacon mark — and yet these are the first marks to be seen from offshore and are easy to identify. A good description of the coast should point them out.

In the description of the channels between the Isle of Wight and the mainland, the « Sailing Directions » describe the banks and their buoyage, but omit to point out that the latter is placed for vessels heading for Portsmouth. Consequently, a ship coming from the East and sailing for Southampton via Spithead first sees the black buoys to starboard and the red to port, then the opposite. It would be better to omit the account of the buoyage, which shows up better on the chart, and point out in the « Sailing Directions » the particular character of the buoyage.

The currents of the Channel are widely described in the « Sailing Directions », and the chapters concerning the Channel Isles and Raz Blanchard stress

the strength of those which occur there. But this information is not developed for the special use of the numerous vessels which, coming from the West, make landfall on the Casquets and then head for Cherbourg, Le Havre or the North Sea. As a result, two ships which were unfamiliar with this area ran aground recently in foggy weather in the vicinity of Cap Hague, on which they were thrown by the Raz Blanchard current whereas they thought they were heading well to the North. Brief information on the frequency and causes of accidents at sea would probably be very useful in preventing their repetition.

And finally, let us consider navigation in the Gironde. The « Sailing Directions » are at present limited to information regarding pilotage, tides, currents and regulations. They barely outline conditions of navigation, assuming doubtless that as this is a pilotage area, the pilot will be there to protect the vessel from unexpected eventualities. However, the present-day navigator is always in a hurry and on the look-out for anything which can enable him to « save a tide ». Consequently, he should be given the means of calculating, at least approximately, the limited time in which he should contact the pilot boat in order not to miss the tide. Furthermore, the presence of the pilot does not relieve the Master of his responsibilities. Consequently, the difficulties which may be met with in navigating the river should be clearly explained to him so that he can exercise these responsibilities advisedly.

These examples suffice to demonstrate that « Sailing Directions » should try to live up to their title, which is so descriptive — « Instructions » (directions) in French, « Pilot » in English. They should constitute a digest of the experience of those mariners who know a given region for the use of those who don't. Incidentally, this is where the difficulty lies because, when a navigator knows the area in which he is operating, he no longer opens his « Sailing Directions ». It is true that under the opposite conditions, he studies them with care, but how can be expect to find the sum total of the experience he is looking for in them if he does not make his own contribution whenever he is able ?

On this point, there is an unjustified belief that each Master carefully guards his experience like a secret capable of giving him an advantage over his competitors. The truth of the matter, quite on the contrary, is that mariners are generally not aware of the value of their experience. Their very lonely existence prevents them from assessing it, and they imagine that everyone knows as much as they do. Even when they are directly approached and asked what they know, they are unable to pick out of the web of their daily lives the kind of details that could be of interest to the community.

This situation will perhaps improve later on when the fruit of their experience is once again published in « Sailing Drections », but for the present, it is up to the Hydrographic Offices to contact the navigators, to get them to talk, and to study their ways of navigating. The officers responsible for keeping the volumes of « Sailing Directions » up to date are in a better position than the navigators themselves to ascertain what they need to know ; it is on the bridge of the experienced mariner that they can find it. Furthermore, as Commander Massé — who has participated for nearly 30 years in this work of keeping « Sailing Directions » up to date — humourously wrote : « It is up to us to turn out good publications, and, regrettable though it may be, we can only depend on ourselves for success ».

III. — *NAUTICAL INFORMATION*

The documents dealt with up to this point — charts and « Sailing Directions » — represent a synthesis of the knowledge accumulated by generations of scholars and mariners. Each new generation makes its contribution to it, but the basis remains the same, because at the period which concerns us here, the appearance of the globe is stable. However, man's activities are directed towards modifying it when he finds it advantageous to do so, and modern techniques are constantly offering him new means of doing this. In the field of hydrography, these modifications are essentially in the form of aids to navigation and of port installations, the characteristics of which must be brought to the attention of navigators.

There was no question of this a century and a half ago. The first French periodical designed to keep navigators informed of news which was likely to interest them seems to have been the « Annales Maritimes et Coloniales » (1814) (Colonial and Maritime Annual). In addition to the official documents, this private publication chiefly contained accounts of voyages which, in the case of distant countries, constitute the basis of the « Sailing Directions ». Twenty years later, under the title « Annales Hydrographiques » (Hydrographic Annuals), the publication was produced by the French Hydrographic Office (called « Naval Charts and Plans Depot » at that period), and began to include information regarding rocks, shoals, beaconage and lights, the detection of dangers being much more frequent than the putting into operation of lights. The news came rather haphazardly from a still very undeveloped information system and was sometimes a year out of date when published. It was, incidentally, reproduced exactly as received, it was often of a doubtful nature, and there was no question of its appearing in existing nautical documents.

It was only towards 1865 that the numbers of the charts and the titles of the works affected began to appear opposite each item of information. From this time onwards, and particularly during the close of the 19th Century, this system improved progressively and led to the « Notices to Mariners » as we know them to-day. The chief improvement, however, does not lie in the regular keeping up to date of nautical documents, for which purpose these « Notices » are designed, but in the fact that, thanks to the International Hydrographic Conferences, all the States-Members of the International Hydrographic Bureau pool their information. But as regards the speed of exchange and circulation of this information, which the Conferences have certainly attempted to improve, the result has been limited to the establishment of Centralization Offices for « Notices to Mariners ». Thus navigators passing through any of the large ports of the world in which these Offices function can obtain information despatched with a speed which is unaffected by the delays attendant upon mail sent to ships.

Over and above this written documentation, navigators can tune in to urgent radio notices concerning navigation — known in France as « AVURNAVS ». But there is no international coordination of Avurnavs, which are generally transmitted by short-range stations, the greater part of the broadcast information concerning solely the immediate neighbourhood and the unusual features of the aids to navigation to be found there. With a few exceptions, there is still no sure method of warning a navigator coming from afar of an important occurrence which may have taken place a month earlier in the area in which he is due to pass.

The danger which results from such a situation has, however, been pointed up by the accident which occured to the liner « Champollion » in December 1952.

Misled by unusual atmospheric conditions, it ran aground and was wrecked through mistaking a light, the existence of which it did not know, with another light five miles away, which it did know about but had not seen. The light it was not aware of had been in operation for more than a month, but news of its installation had not been transmitted with sufficient speed to enable the ship to be informed in time. In a statement regarding this accident, the Government of the country on whose coast it had occurred refused to accept any responsibility declaring that the publication of this information was a formality to which it was not bound by any national or international regulation.

In France, the obligation to make known such information was still not officially required in 1952, but the accident to the « Champollion » contributed to show the necessity for such action, and in 1954 it was recognized by an Inter-ministerial Order. From now on, all agencies which participate in the country's maritime activity, or which put anything into operation which is likely to be of interest to navigation, are obliged to inform the French Hydrographic Office.

But the drawing up of an official order does not solve all the difficulties. They were already solved, and without official action, in the case of lights and beaconage. The « Service des Phares et Balises » (Lighthouse and Beacon Service) exists for the sole purpose of contributing by these means to the security of navigation, and it learned long ago the necessity of close liaison with the French Hydrographic Office. On the other hand, as has been noted in connection with « Sailing Directions », certain information which is necessary for navigation falls within the province of agencies for which the point of view of the navigator counts little. In such cases, the French Hydrographic Office cannot be content with waiting for the information: it must look for it, train those who supply it, and attempt to ensure that nothing escapes the Office. But as it will certainly never achieve perfection, particularly in so vaguely defined a field, it needs the help of the navigator to bridge the gaps.

At the same time as efforts were made to ensure that the information would be complete, an attempt was also made to make it rapid. The first step consisted in setting up a French Avurnav system of world-wide coverage. At the present time, in whatever part of the world he may be, the French navigator, by listening in to the appropriate broadcast, can receive French nautical information of a permanent nature. This is already a step forward, but is still most inadequate. Regular watches only occur at sea; in ports, the aerials are lowered in order to enable operation of the derricks; radio equipment has to be inspected; there are broadcasts which are not received. Furthemore, and above all, the French navigator — (the case or foreign navigators will be examined later) — needs foreign information; the French radio cannot undertake this for the whole world.

At the present time, there is no happy medium between radio and « Notices to Mariners », and experience has shown that the weekly groups of « Notices » reach the navigator several months after the occurrences they announce. The main reason for this is that as these weekly groups are heavy and their despatch by air would be very costly, they are forwarded by sea and consequently only reach the Centralization Offices after considerable delay.

This is one of the reasons why navigators do not often use these Offices — they have little to gain by doing so.

Another reason is that, in order to locate the information likely to be of interest to them, they are obliged to study a large number of weekly groups of

« Notices » issued by several nations. But these groups are not classified according to the order of importance of the « Notice ». The system of « Notices to Mariners », side by side with the improvements it has made, has also become unwieldy. As the « Notices » have now developed into correction documents, they are published as the information is received, without regard to degree of importance, and give in detail the corrections to be made to each chart or document concerned. Of course, the drawing up of these « Notices » is a meticulous and time-consuming occupation in which the text becomes lengthy in relation to the actual information being transmitted, and the printing, in turn, is delayed accordingly.

In order to rectify this situation, the French Hydrographic Office has been driven to evolve a new information system. This consists in choosing important information from all over the world, and printing it promptly in concise form on light-weight paper so that it can be forwarded by air at reasonable cost to all subscribers, and in particular to the more remote Centralization Offices. Thanks to this rapid system of despatch — called « DIFRAP » for short — which will probably be in operation by the time this article appears, the weekly groups of important items of information will be at the disposal of navigators in the large ports throughout the world less than eight days after their despatch to the printers. In this way, the gap which existed between the transmission of information by Avurnavs — quick but incomplete — and the circulation of information by « Notices to Mariners » — complete but slow — will be largely bridged.

This innovation is an important advance in the field of information for navigators. The French Hydrographic Office does not claim all the credit for it. Its initiative in this matter was preceded by the British and American transmissions known under the name of NAVEAMS, W-Messages, Hydrolants, etc... These consist of long-range radio transmissions reproduced on sheets for rapid distribution and incorporated in the groups of « Notices to Mariners » of those two countries. Their chief disadvantage is that the information they contain does not cover the entire world. They are profuse on a national scale, but only occasionally extend to other countries. This is the gap which the French Hydrographic Office has bridged by making a selection from foreign « Notices » in general. This selection, admittedly, is still far from satisfactory, as the foreign information given is sometimes already out of date when the French Hydrographic Office receives it; in addition, anything up to a fortnight can pass between its receipt in Paris and its distribution in the most distant Centralization Offices: one week due to the printing schedule, and one week covering printing and despatch by air.

The safety of navigation will never be really assured in the field of information until every important item of news, of whatever origin, is immediately broadcast by radio with world coverage, and is followed up by a printed publication despatched by air with the least possible delay. Such an arrangement requires the cooperation of all maritime nations and consequently an international agreement, of which the following points could form the basis:

The surface of the globe would be divided into a certain number of zones, and all maritime nations would undertake to transmit rapidly their important items of information from a point in their zone which would be chosen for its advantages as regards telephone, radio and air communications. From that point, they would be transmitted, as already said, throughout the world. The number of zones should be fairly restricted so that navigators would not have to follow too many broadcasts. Centralization in a single place — a solution which would be consistent with the speed and range of the networks of communication — would risk

overloading these networks. Even if the number of important items of information were only in the region of twenty per week, consideration would have to be given to the fact that the organization charged with making the selection would actually receive many more than it would transmit, and crowding the network through which it is supplied would have to be avoided. Furthermore, selection is a delicate matter which must be based on a perfect knowledge of the region concerned and of the information already published. For these various reasons, it would seem preferable to envisage between five and ten information zones. It should be noted that, as the radio transmissions would necessarily have world coverage, it would be an advantage if radio were also used for communication between zones. In this way, each centralization organization would ensure world radio transmission of the information regarding its zone, and written transmission within its zone of world information. This procedure would multiply the number of printings, but as it would reduce proportionally the air transmission required for each, it would be both rapid and economical.

This description of the organization of the rapid world distribution of information makes no pretence at solving all the problems posed — particularly the most delicate of them all, which is international agreement on the principle involved. This principle, in fact, is the principle of international « Notices to Mariners » — an innovation which the International Hydrographic Conferences have not yet ventured to advance. Up to now, they have been satisfied with coordinating exchange of information and the method of presenting nautical documents. An important step forward is now proposed. It is felt, however, that the most important decision was made the day international exchange of information was established, and that the only question now is to adapt the methods of exchange to the requirements of navigational security, which can now be met by present-day techniques.

CONCLUSIONS

Particularly qualified authorities who, by showing us the simultaneous progress formerly made possible in navigation and hydrography by improvements in sextant and chronometer, have prompted us to undertake this study. These instruments, which require special handling, brought to light some intelligent and enterprising men who knew how to uncover all the advantages which were to be derived from them. Similarly, radio and rapid transportation are ways of pooling effort. Without coordination, such effort bears little fruit. We have therefore endeavoured to show all the benefits that may be achieved with an international organization, particularly in the field of cartography and information.

« Sailing Directions » appear at first glance to fall outside the requirements of international cooperation and therefore to be alien to the general theme of this study. It is true that the original « Sailing Directions » were the outcome of national effort. But cooperation is equally difficult to achieve on a national level, and this difficulty increases with technical advances which lead to specialization. It was not superfluous, we believe, to point out that international accord with no national basis would be like putting the cart before the horse. We have also stressed the necessity of including in « Sailing Directions » the experience of navigators who are familiar with a given region for the benefit of those who are not. The fact that it is not, is why French « Sailing Directions » are of little interest to French navigators, who know at least as much as they contain. They only acquire value, when translated, for the use of foreign navigators who frequent our coasts.

Navigation has always been a means of communication between men. These contacts have all too frequently consisted in friction and violent clashes. Fortunately hydrography offers a means of bringing men closer together. The three subjects that have been touched on have shown, in fact, the benefits that can be derived from this rapprochement. It is noteworthy that technical advances have in each case been at the source of difficulties, but have, at the same time, provided the means of solving them. The process that was described at the beginning of this article, and which made the end of the 18th Century the golden age of hydrography is occurring again to-day. The progress achieved during the 18th Century makes a very modest showing in comparison with developments during the 20th Century, and it would be indeed surprising if the latter does not prove to be a new golden age of hydrography.