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INTERNATIONAL COOPERATION IN HYDROGRAPHY

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HISTORICAL

International cooperation in the field of hydrography has been a matter of great importance, due primarily to reasons of practical necessity. It is only in comparatively recent times that international cooperation has emerged in the different fields of ocean sciences; but the mariner, by the very nature of his profession, has always needed to know the water routes to countries and ports with which he has traded. This required, for a period of centuries, the use of charts and navigational documents which had to be interpreted from foreign languages. Hence, there existed a pressing need to achieve international standardization in nautical charts and ancillary publications in the interest of peaceful trade and the development of better global communications.

The first practical steps taken towards establishing an international organization — which would pursue the objectives of standardization through coordinated international action — began with a Conference of Hydrographers held in Washington in 1899 and another in Saint Petersburg in 1912. A few years later, in 1919, twenty-four nations met in London for a hydrographic conference during which it was decided to establish a permanent organization — and thus the International Hydrographic Bureau was created. It started its activity in 1921 with headquarters in the Principality of Monaco.

In 1967 a formal intergovernmental convention was drawn up giving legal status to an International Hydrographic Organization. The Bureau, however, remains as the permanent headquarters of the Organization which now has a membership of 47 states.

Over the past fifty years, the IHO, through its regular conferences and continuous communication by correspondence, has achieved a remarkable

degree of standardization in the production of charts and allied publications particularly in such matters as the adoption of agreed symbols, abbreviations, formats and styles used for nautical charts. National practices have wisely been sacrificed in the interest of achieving an international goal which would permit mariners of all nationalities the maximum use of charts published in any part of the world. This concept has been particularly successful in the preparation and issue of Notices to Mariners and radio navigational warnings, where standardization, and hence the quick dissemination of vital information through a coordinated system, has made it possible for mariners of all nationalities to receive this information in a timely manner and in an easily understood format.

INTERNATIONAL CHARTS

The IHO's policy for the adoption of the metric system has found increasing acceptance with Member States, and this has opened the way to the production of an international series of charts. As a result of a study undertaken within the organization it was decided to establish a world series of international charts on small scales (1:3½ M & 1:10 M) to an agreed scheme and specifications. There are some 60 charts in the 3½ M series and seventeen member countries have, on a purely voluntary basis, assumed responsibility for their production. The first chart was published in early 1972 and today as many as 48 INT charts have already been published.

Within the general concept of this programme, one member country produces the particular international charts of an allocated geographic area, using bathymetric and other data which may be supplied by a number of Member States for the purposes of compilation. The reproduction material is then made available to any other member country who wishes to reprint these charts with suitable acknowledgement. The two salient features of the programme are the tremendous economy in effort that results from only one country undertaking the compiling work of a given ocean area, to the general benefit of all other members of the organization; and, secondly, the fact that all international charts, irrespective of which country produces them, conform to a standard set of specifications.

The extension of this concept of international charts to cover the the *medium* and *large* scales is presently being examined by a commission formed within the IHO.

The achievements outlined earlier are indeed significant and in keeping with the aims of the Organization which, among other objectives, include the fostering of the greatest possible uniformity in nautical charts and documents.

THE LIMITS OF HYDROGRAPHIC KNOWLEDGE

Having dealt with the progress achieved in the various aspects of standardization in the production of nautical charts let us now examine

the overall status and progress of hydrographic surveys and bathymetric knowledge in the context of present day requirements and future needs of nations. It is relevant to state here that any chart, whether national or part of an international series, is dependent entirely upon the adequacy of survey data upon which it is based.

As man's activity in the marine environment continues to develop, there is an increasing demand from a variety of users for bathymetric data acquired by means of modern surveys. These users include navigators, fishermen, engineers concerned with coastal and undersea works, sea-bed mining operators, recreational agencies, research workers as well as pollution control and regulatory agencies. Bearing in mind the need for bathymetric data we should now examine the status of hydrographic knowledge which is depicted in the diagram at fig. 1.

This diagram, which has been prepared in the IHB, has been compiled from the latest GEBCO plotting sheets augmented by information derived from published nautical charts and bathymetric maps. The classification of the bathymetry, for its adequacy for determining sea floor topography, is based on the density of the soundings only.

- The areas in dark grey indicate zones in which the density of data is sufficient to determine sea floor topography. This represents about 16% of the oceans.
- The areas in black show zones in which the density of data is adequate to determine only the major sea floor features; this represents approx. 22% of the oceans.
- The light grey areas indicate zones in which data is too sparse for determining sea floor topography. This is the remaining 62% of the ocean areas.

Generally speaking it would, indeed, be correct to say that the majority of charts available to the mariner today are adequate for the safe navigation of conventional ships navigating in areas where safe routes have been established. There are, however, numerous regions containing uncharted dangers which are best avoided by any prudent mariner; these include such areas as the South China Sea, the coastal areas eastward of the Gulf of Aden, the Gulf of Mexico, Banda Sea, Flores Sea, Strait of Macassar, North Coast of New Guinea, sections of the Red Sea and parts of the Caribbean Sea. These are just random examples where existing charts bear such cautions as :

"Because of old and imperfect surveys the area should be navigated with caution"

or

"Owing to the imperfect nature of the surveys mariners are warned that great care must be taken when navigating between .....".

Apart from the coastal regions bordering states with well developed hydrographic services, the major part of the surveys of the coastal margins of the world were conducted during the nineteenth and early twentieth centuries. Many of these were adequate only for establishing sea lanes or covering the immediate approaches to harbours. The sea-lanes, especially in the more remote regions, are not necessarily the most direct routes but

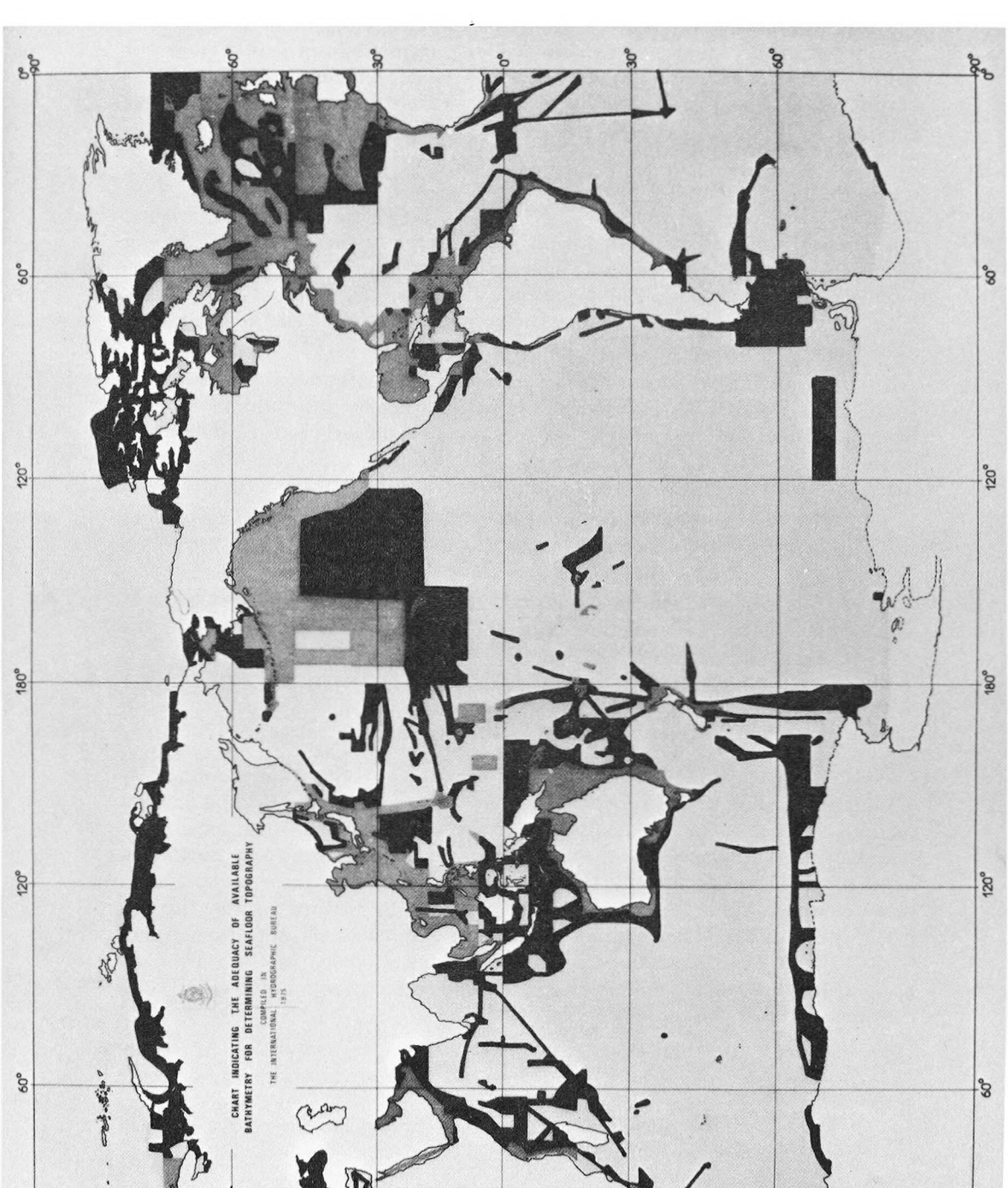
CHART INDICATING THE ADEQUACY OF AVAILABLE
BATHYMETRY FOR DETERMINING SEAFLOOR TOPOGRAPHY
COMPILED IN
THE INTERNATIONAL HYDROGRAPHIC BUREAU
1975
90°
60°
30°
0°
30°
60°
90°
120°
180°

FIG. 1

frequently those which have been established as a result of exploratory surveys as constituting safe routes. Hence, a vast majority of charts are based on knowledge gained through hand lead-line sounding made with visual fixing methods, and such soundings as are available out of sight of land are generally very sparse. Modern surveys, with close echo-sounding profiles and accurate positioning, constitute only a very small percentage of the existing data even in coastal and continental shelf areas of the world.

THE DEVELOPING NATIONS

A study made for the United Nations Economic and Social Council by an ad-hoc Group of Experts on the subject of hydrography and bathymetric charting shows that for countries who do not have a national capability in hydrographic surveying the coastal areas of at least 60% are covered by either low density or incomplete surveys, which in many cases date back to between the 1830s and about 1910.

By and large, the surveys covering the coasts of most newly independent countries were made by the larger charting nations, principally the United Kingdom, France, Netherlands, Italy, Spain, Portugal and U.S.A. However with the process of decolonization the responsibility for surveying has, inevitably, passed to the new nations who, in many cases, are not equipped to undertake the resurveys required to update the existing chart coverage. In fact, despite improvements in surveying vessels, instrumentation and positioning equipment, there has been a gradual scaling down of surveying activity.

A large majority of the developing countries have not yet established national hydrographic services due, in part, to the fact that the immediate need for such services has not been felt in the absence of any substantial national shipping fleets that would require modern charts. Furthermore, hydrographic surveying is a laborious, time consuming and expensive task which calls for considerable resources in vessels, equipment and trained personnel. In general, these resources are not presently available in the developing countries where, economically speaking, there are other pressing problems which stand higher in national priorities. Perhaps there is also some lack of appreciation of the limitations in reliability and usefulness of the existing charts; and just because certain charts are available it is assumed that these reflect up-to-date knowledge. I quote here a personal incident where, during an international conference, a prominent delegate approached me to enquire why the IHB had failed to issue a new and reliable chart covering the approaches to a particular harbour where a number of ships had been known to go aground !

Viewed against this background one must consider the growing likelihood in the near future of coastal states exercising jurisdiction over an extensive coastal zone, when it will become a matter of national importance carefully to survey these zones in order to prepare accurate charts and thus examine the economic potential of the seabed and its subsoil. In keeping with modern practice it will be necessary to obtain bathymetric, geo-

magnetic, gravity, and perhaps seismic, information simultaneously when conducting such surveys.

While reviewing the status of hydrographic surveys and bathymetric knowledge against the present and future requirements of nations, I hope I have succeeded in establishing the urgent need for the hydrographic community to take a closer look at the problems involved, with a view to instituting measures whereby the needs of the international community can be met in an adequate and expeditious manner.

COOPERATION

We, as members of the international hydrographic community, can best approach the problem through a cooperative effort with the active participation of the Member States of the IHO and, in particular, through the contribution that the smaller hydrographic services can make towards this joint effort.

The gradual improvement of hydrographic knowledge through a system of cooperative investigations can be achieved, and this would make it possible to compile international charts based on modern surveys. The first step towards initiating such a programme would be to define and set priorities for areas requiring urgent resurvey, particularly those areas that fall within, or adjacent to, international shipping routes. Due to the increase in maritime traffic, in both volume and draught of ships, certain areas used by international shipping are becoming more critical for safe navigation owing to lack of modern hydrographic knowledge.

Thereafter, the sponsoring agency should invite countries interested in such areas to participate in the joint survey programmes, which would be coordinated at an international level, utilizing the aid and resources made available by participating countries in keeping with the obligations that each state is willing to assume. It is, however, realized that such resources will be available for a very limited period in each phase of a given programme, due to over-riding national requirements and the severe economic constraints imposed on most hydrographic services.

This idea of joint expeditions may perhaps be a new concept within the hydrographic field; but, in fact, vessels and resources drawn from hydrographic services have in the past participated in various international oceanographic expeditions sponsored by the Intergovernmental Oceanographic Commission. Such expeditions include, for instance, the International Indian Ocean Expedition, and the GATE experiment under WMO/ICSU's Global Atmospheric Research Programme (GARP).

Within the IHO there has been some discussion in the past on the role of the world charting agencies *vis-à-vis* the smaller hydrographic offices who normally confine their chart coverage to national waters. In this context, it could be said that the main beneficiaries from the proposed cooperative survey expeditions would be the world charting countries. I believe that this, in fact, is not the case, as the benefit of this work is essentially to the user, i.e. international shipping, irrespective of which

country compiles the charts. Furthermore, within the concept of an international chart series, the repromat material for any compiled chart is available to all Member States of the IHO. Hence, perhaps in an indirect manner, all Member States stand to benefit from these cooperative programmes.

REGIONAL COMMISSIONS

A parallel course of action for achieving the goal of bettering our hydrographic knowledge is by strengthening the existing regional commissions and by the organization of new commissions for specific geographic regions. Here, perhaps, some re-orientation in the objectives of regional commissions would be necessary, in order to establish a structure suitable for joint hydrographic survey projects, through a pooling of existing resources and the coordination of plans.

Within the framework of the IHO there are at present three regional commissions :

a) *The North Sea Hydrographic Commission* — which has achieved very useful results through cooperative programmes in the conduct of deep-draught route surveys in the North Sea, and in the exchange of data and the publication of the North Sea International Charts.

b) *The Northern Hydrographic Group*
This was formed by the Hydrographers of Scandinavian countries; cooperation is extended in various hydrographic matters including joint surveys of Scandinavian waters.

c) *The East Asia Hydrographic Commission*
This was formed in 1971 and has built up cooperation in various matters of mutual interest within the region.

Although not part of the IHO, the *South China Sea Hydrographic Commission* deserves mention; it was instituted as a result of recommendations made by the 6th United Nations Regional Cartographic Conference for Asia and the Far East (1970) with the object of conducting joint surveys in parts of the South China Sea in order to chart the numerous dangers to navigation. It is most regrettable that this Commission has not yet been able to start its work.

JOINT SURVEYS

A very successful regional hydrographic venture has been the joint surveys made in the Straits of Malacca and Singapore by Japan, Indonesia, Malaysia and Singapore. The primary aim of these surveys was to provide modern charts for an area where there is extensive international shipping activity.

The joint surveys were conducted under the auspices of the Malacca Strait Council, which is an incorporated foundation established in Japan.

However, participation was at intergovernmental level, with ships and personnel drawn from the four nations. The surveys were made in four separate phases, each of 4 to 5 months' duration, from 1970 to 1974. The survey area was divided into sections, each placed under the charge of a hydrographic officer who was responsible for the efficient conduct of the work and the processing of results. The final data processing was done in Tokyo by officers deputed from the four countries. The processed data and the fair sheets of all the areas were sent to each hydrographic office, and copies supplied to other interested hydrographic and shipping agencies.

In addition to the vital data that these joint surveys have provided for modern charting, this was an excellent opportunity for hydrographers from the four countries to exchange ideas and make friends. This has naturally led to developing an excellent rapport within the region.

Such joint hydrographic surveys conducted through the participation of countries within regional commissions will in future, it is hoped, provide much of the data required for updating the world chart coverage. It will, however, be necessary for the international coordinating agency (the IHO) to be more directly involved in sponsoring such programmes for action by Member States. It will also be necessary for the IHO actively to encourage the formation of new regional commissions as and when deemed appropriate to the progressive growth of national hydrographic capabilities in particular geographic areas. Areas where such commissions could work with considerable mutual benefit are : the Caribbean, South China Sea, Red Sea, Eastern Mediterranean, South Asia and the North Coast of Africa.

THE FUTURE

In the present changed circumstances it appears no longer possible for two or three leading nations in the hydrographic field to undertake the enormous task of revising the old and frequently incomplete surveys of the world. Furthermore, in the rapidly changing international atmosphere it is becoming increasingly obvious that coastal states will, in the future, exercise far greater control over the waters adjacent to their coasts; this will inevitably mean certain restrictions being placed on research activity by foreign vessels. However, if such research or — in our case — the development of hydrographic knowledge, is carried out as an international or regional programme taking into account all interests and rights of coastal states, it seems much more likely to find acceptance with the concerned states, who will have the opportunity thereby to participate in the expeditions and to receive copies of the complete data collected.

As far as assistance to developing countries is concerned, I believe that the joint international and regional programmes will, to a great measure, provide important data to these countries and at the same time help to fill the vacuum that presently exists in hydrographic activity *vis-à-vis* those countries that do not yet have a national capability in this

field. This type of practical activity will also provide impetus to the development of hydrography in these countries. Added to this, of course, are the very important "Aid in kind" programmes which countries like the United Kingdom, United States and Canada continue to undertake, in surveying the continental margins and approaches to various harbours. An excellent example of this is Canada's recent aid agreement, under the Canadian International Development Agency, for bathymetric and geophysical surveys off the coasts of Senegal and Gambia.

WORK FOR THE IHO

A most important service that the IHO could perform at the present time in fostering the growth of world hydrography is in the field of training and education. Recognizing the fact that trained personnel are the very foundation upon which national hydrographic capabilities can be built, it appears logical that training and education programmes constitute an important activity within any specialized technical organization. In the IHO, progress in this field has in fact been very slow, although a fairly large number of hydrographic services of Member States have, by bi-lateral arrangements, been training personnel from other countries. However, the task of producing trained personnel in adequate numbers to meet future demands is of a magnitude where coordination at an international level is necessary. In the implementation of such a task it would be necessary to prepare suitable and generally agreed syllabi for training at various grades, to make an assessment of personnel to be trained in the short and long term periods, to prepare estimates of resource requirements, and to study the feasibility of conducting training on a regional basis taking into account the possibilities of strengthening existing national institutions to cater for personnel from the region. It would also be necessary to identify international sources for funding training programmes, as well as national agencies prepared to provide aid in kind.

If, indeed, we recognize the need for cooperative action in developing hydrographic surveying programmes, in strengthening regional cooperation and coordination of training programmes, it would be necessary to broaden the field of activity within the International Hydrographic Organization; this will necessitate the creation of a suitable infrastructure in support of such activity. However, the role of international organizations and the scope of their activities is a matter of progressive change as dictated by the needs of Member States.

The various proposals made in this paper are intended to generate discussion within the hydrographic community on various aspects of the future role of the IHO. Criticism or comments on the views expressed would be welcome.

THE CAREER OF A NAVIGATOR

Prince Albert I of Monaco, to whom the International Hydrographic Organization is ever indebted for his invitation in 1921 to set up the Bureau in the Principality, was introduced to the Sea, which became his great love, when serving as a junior officer in the Spanish Navy.

In his autobiography, 'La Carrière d'un Navigateur' first published in 1901, he wrote as follows concerning his early attraction towards the Sea : —

"Aujourd'hui que ma carrière de navigateur est avancée, je dois à mes anciens maîtres, à ces hommes rudes qui ont hérité de leurs ancêtres le courage, la noblesse et la générosité sans lesquels il n'y a pas de véritable marin, de leur dire combien je suis fier d'eux.

J'ai gagné mes galons d'enseigne dans une campagne aux Antilles; mais je dois avouer que déjà l'étude de la nature, l'observation des hommes et des choses m'intéressaient plus que l'exercice du canon et le branle-bas de combat".

"Puis, le contact étroit de cette mer qui palpite et gronde sous la quille du vaisseau pendant les jours d'orage, ou qui lui ouvre son sein dans le demi-sommeil des nuits calmes, fit croître ma passion en élevant sa nature et je m'abandonnai à des jouissances où la philosophie, la tendresse et la poésie réunissaient leurs forces. Ainsi j'ai commencé la culture de l'océanographie, de la science nouvelle qui pénètre le secret des abîmes. Et cette œuvre a rempli les plus belles années de ma vie en absorbant le meilleur de moi-même. Aujourd'hui, je ne regrette rien de ce que je lui ai donné, car son influence m'a garanti contre les assauts du mal de la sottise, et elle a mitigé les peines qui s'emparent peu à peu de la place d'abord occupée dans le cœur de l'homme par les rêves de bonheur".

"La Carrière d'un Navigateur", Albert I^{er}, Prince de Monaco. Editions des Archives du Palais Princier, Monaco, 1966.