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NAUTICAL CHART STANDARDIZATION

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1. INTRODUCTION

This paper deals with the work of the International Hydrographic Organization (IHO) during the last ten years towards the standardization of nautical charts. The work began with the devising of a regional scheme of medium- and large-scale sheets of the north-east Atlantic area, to be coproduced by member nations as contributions to an International (INT) set of charts. It subsequently became clear that, as well as the scheme, a detailed set of specifications would be necessary to secure uniformity of choice of symbols and abbreviations throughout the International series, and also in the various national chart series of which it would form a part.

The history of nautical chart standardization has recently been traced by RITCHIE [1] — gradual at first after the beginning of the International Hydrographic Bureau in 1921, and later speeding up when the International Hydrographic Conference of 1967 established a study which led to two series of INT charts on very small scales. After this, the process gathered further speed with the successful establishment of the two bodies with whose work this paper is primarily concerned : the North Sea International Chart Commission (NSICC) in 1972 and the Chart Specifications (later Standardization) Committee (CSC) in 1977. The ten-nation NSICC, in drawing up the network of INT sheet-lines for its area, established the principles on which such schemes would be extended worldwide and also did extensive groundwork for the Chart Specifications of the IHO [2]. These were completed for worldwide application by the seventeen-nation CSC. The thinking behind these two fundamental aspects of nautical chart standardization — the chart scheme and the chart content — will be explored.

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2. PUBLISHERS OF NAUTICAL CHARTS

The construction and publication of nautical charts is preponderantly in the hands of national hydrographic services, the majority of which are numbered among the 50 members of the International Hydrographic Organization. Most chart their own waters on a full range of scales — the index in Fig. 1 shows part of a national chart cover. Such series tend to make the fullest possible use of available hydrographic surveys, giving full coverage of the national waters and including the smallest ports used by the country's own coasting vessels, and by other local categories of users such as yachtsmen and fishermen.

A few hydrographic offices — France, U.K., U.S.A., U.S.S.R. — chart the whole world or, in the case of the Federal Republic of Germany and Japan, a major part of it. Outside their own waters, they limit their chart series — which are compiled partly from original surveys, partly from other countries' published charts — by omitting small ports and often using smaller scales (though they are adequate) than do the national authorities themselves. Such series are available from world-wide networks of chart agents and they tend to be geared to the needs of 'international' foreign-going shipping and to be preferred by the shipowners concerned.

New ground was broken after 1967 when fifteen IHO member countries decided to co-produce, to an agreed specification, the two world series of INT charts on 1:10 000 000 and 1:3 500 000 : 79 sheets altogether. They were to be available for any IHO member country to reprint in its own national series in modified facsimile form, thereby reducing wasteful duplication of compilation effort. These small-scale International series established an important new principle which clearly would lend itself to further development.

3. STANDARDIZATION TO DATE

A prime objective, from the foundation of the IHO, has been the standardization of its member countries' publications in their users' interests. During the first five decades of its existence, standardization mainly took the form of proposals by individual countries, at full quinquennial conferences or by circular letter in the interim, for a new symbol to accommodate a newly identified need. After discussion, agreement was reached and an addition made to the Organization's Repertory of Technical Resolutions (an example is given in Fig. 2). This rather cumbersome procedure had, after 50 years, produced only a limited degree of standardization — at the most, three out of every ten of detail types — and the technical resolutions gave limited guidance on the use of the symbols with which they were concerned. Another drawback of piecemeal standardization was the failure to introduce a fully logical set of differentiation criteria in allotting details to the black and magenta plates, which are the prime colours in nautical charting for line and point detail.

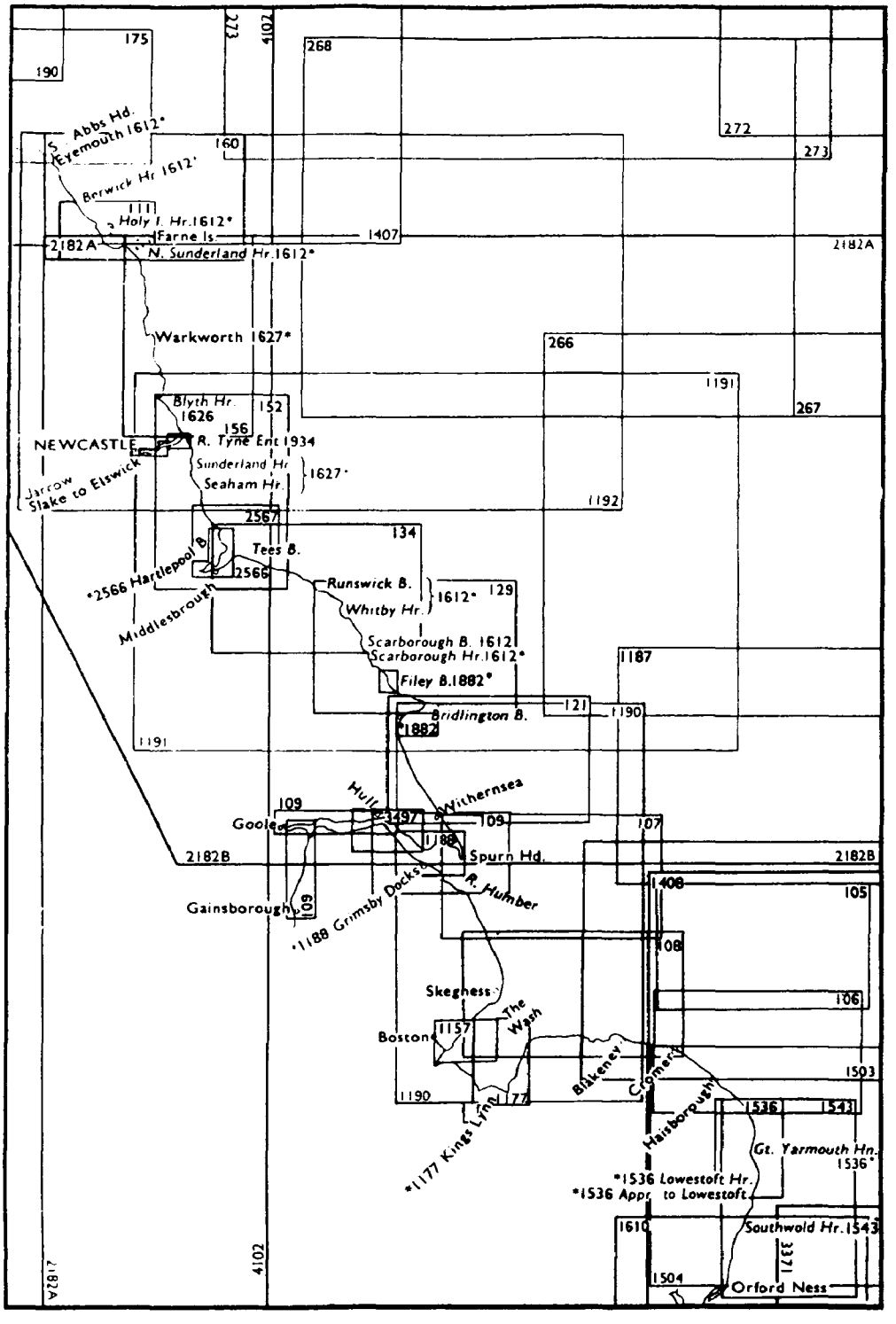

FIG. 1. — British chart cover of eastern England, 1982.

B4.L51 *Beacons; spar or pillar buoys*

1. It is resolved that these symbols shall be adopted for beacons and spar or pillar buoys respectively, but that hydrographic offices shall be allowed to modify them in detail as considered advisable.
2. If practicable, spar or pillar buoys should be distinguished from beacons by being sloped instead of vertical.

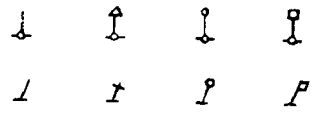

FIG. 2. — IHO Technical Resolution B4. L51, 1976.

It may be worth mentioning some of the more obvious results of the limited scope of early standardization. Different countries use markedly different paper sizes and have printing machines to suit. Language differences appear in the all-important descriptions of the characteristics of navigational lights and in the quasi-legal textual notes which are very significant on nautical charts. Different series place a different emphasis on pictorialism in the symbols used and in the symbol size, and for non-standardized items widely different symbols sometimes exist. Perhaps the most glaring discrepancy has been in the unit for vertical measurements, the metre having been the IHO's choice since its inception, but countries wedded to imperial units have been undeviating in their use of fathoms and feet until comparatively recently.

4. NORTH-EAST ATLANTIC STUDY

The task of conducting a pilot study towards extending the INT chart concept to medium- and large-scale charts was entrusted in 1972 to the regional hydrographic group of North Sea countries, which set up for the purpose the North Sea International Chart Commission. Its ten members included Canada and U.S.A. at their request. The North Sea area was chosen, among other reasons, because of its intensive level of use and because it is well surveyed and charted, though the natural study area was eventually seen to be the whole of the north-east Atlantic between Greenland and North Cape and Ushant. Nautical charts on all scales of 1:1 500 000 and larger were to be included in the investigation.

The aim of the study was the co-production of a set of charts suitable for the needs of international shipping, enabling selected modern charts to be printed in facsimile with minimum modifications. Twenty countries, distributed world wide, later identified themselves as potential printer nations of such a compact international set of medium- and large-scale charts, adequate for coastal navigation and access to trading ports. For this, a consistent scheme of sheetlines from the whole study area and a single comprehensive set of specifications were seen to be required.

5. INTERNATIONAL CHART SCHEME

The choice of ports to be catered for by the chart scheme was an early requirement. NSICC member countries identified national ports most used by visiting foreign ships and foreign ports in the area most used by their own ships. Their choices were set to scale by a statistical analysis of the total net registered tonnage of ships arriving in any port during a year, and the proportion of these under foreign flags. The busiest of those chosen was Rotterdam, 125 000 000 n.r.t. in 1971 including 117 000 000 n.r.t. foreign ships, and at the other extreme Groningen, 41 000 and 11 000 respectively. Naturally, the choice of ports has to be up-dated as traffic patterns change.

Size

The choice of size was a problem. Some NSICC countries preferred to gear themselves to the use of a large size of paper (international AO size) thereby permitting a 750 × 1 100 mm inner border, but others wished to retain the more traditional smaller frame size of 650 × 980 mm, with the long side exceptionally increased to 1 100 mm. Replies received to an IHO-wide questionnaire showed that all potential printer nations of charts of the study area could handle the larger size on their printing machines. It was therefore decided to allow the optional use of either set of dimensions.

Scale

At one end of the scale range continuous cover of the oceanic part of the area is provided by the earlier 1:3 500 000 International chart series, though the true scale is actually more than twice as large in these high latitudes. It was therefore decided, in effect, to extend this cover across the British Isles and North Sea by means of two sheets on 1:1 500 000. For the most part, however, the appropriate choice of medium and large scales for the INT charts of the area was determined by an intensive study of the various national chart catalogues. To span the North Sea with three sheets and to encompass in one sheet the coastal waters of Iceland, 1:750 000 was most appropriate, while for the western shores of Great Britain and for the coasts of Ireland 1:500 000 suggested itself.

For larger scales than these the national catalogues indicated that several broad scale bands were suitable, determined by variations from area to area in coastal configuration, depth of water, density of traffic, and so on. In the INT chart scheme continuous cover in the coastal belt accordingly varies from 1:350 000 along the Norwegian coast to 1:150 000 in the English Channel. (Each national series, but not the International scheme, usually also has — and will continue to have — another, larger-scale, continuous coastal series.) The most complex coastal areas with the densest traffic call locally for larger scales — e.g. 1:50 000 for the

entrances to the major rivers of the eastern North Sea and 1:75 000 for Dover Strait. The largest scales are required for ports and for the rivers themselves — Yarmouth, Isle of Wight, on 1:3 000 being on the largest of all.

Scheme

Using the port choice and scale criteria outlined, a draft International chart scheme of the region was devised [3]. The intention was that the INT sheets should have a double existence with both international and national numbers, as part of each respective national series — limited resource availability would preclude otherwise. A fair proportion of the sheet limits were those of corresponding sheets in member countries' own chart series. Following decisions by some countries to amend their national series, the final version of the International scheme showed close correspondence with them, and in implementing it some minor changes to the scheme itself have already proved necessary. (Figure 3 shows the original scheme of INT Charts along the east coast of England, and may be compared with Figure 1.) One altogether new factor which had to be taken into consideration when the sheetlines were schemed was the need to accommodate the limits of national economic exploitation zones.

6. SPECIFICATIONS FOR MEDIUM- AND LARGE-SCALE CHARTS

Having established the need to produce a comprehensive set of specifications for medium- and large-scale charts, the NSICC decided that they should be produced in six separate volumes covering : generalities; format, positions, compasses; topography; hydrography and navigational aids; names, lettering, numerals; and latticed versions, for use with electronic position-fixing systems. Following guidelines suggested by the U.K., responsibility for the first draft was shared between France, the Federal Republic of Germany, the Netherlands, the U.K. and U.S.A. Their work was coordinated by the U.K. and rewritten as necessary to secure uniformity and eliminate duplication. A further draft was circulated block by block to all members for voting and comments and a final version prepared in the light of these. Altogether, it was a time-consuming procedure, but very worthwhile in that each item was eventually agreed unanimously or by a large majority of countries.

Principles

In the approach to the specifications, a number of basic principles emerged, as follows.

(*a*) An important pre-requisite was agreement on the place of nautical charts in the repertory of navigational documents — their relation to books of sailing directions, lists of lights and radio signals, and tide tables, and the extent to which

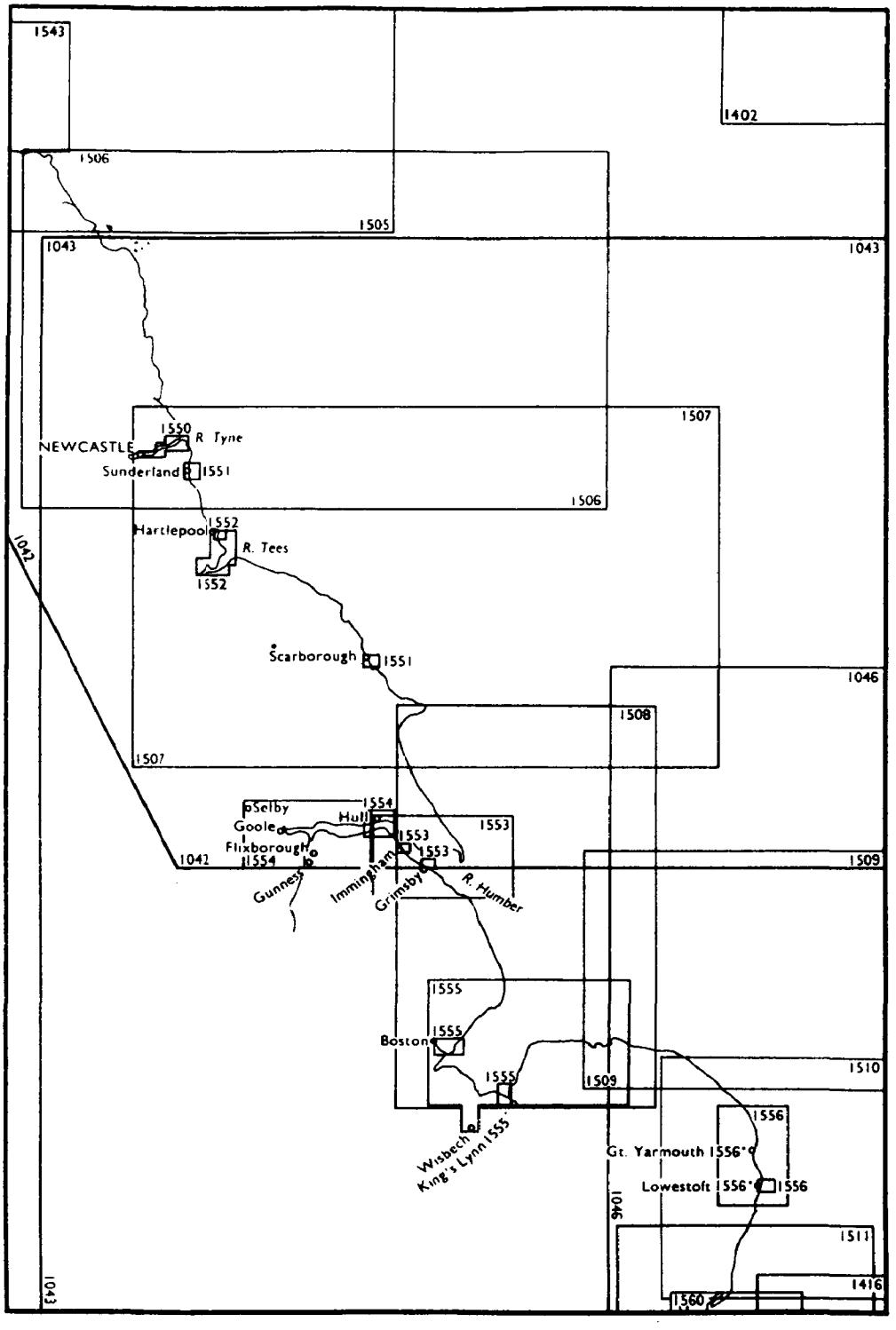

FIG. 3. — INT chart scheme for eastern England, 1977.

a nautical chart is the appropriate medium for different categories of information, such as tidal data. Some flexibility was clearly going to be necessary : for instance, the U.K. shows tidal levels and streams on its national charts, but the Federal Republic of Germany only in special publications. But it was agreed with the IHO group concerned with the standardization of nautical books that charts, being the basic documents, should show as much detail as can be clearly represented in graphical form.

(*b*) Another essential was to secure agreement within the NSICC on the definition and real significance to chart users of any feature shown — for example, what information should a chart convey about a fog detector light, or an offshore oil platform, or a buried gas pipeline, or a deep-water route ? Accordingly, many specification paragraphs begin with definitions. (Examples of paragraphs are given in Fig. 4, which is to be compared with Fig. 2.)

(*c*) The starting point in arriving at a standard representation of any feature was a comparison of the existing IHO technical resolution, if any, on the subject with the current practices of NSICC countries. Their various symbols and abbreviations booklets and examples of their latest charts were examined, special attention being given to the preferences of hydrographic offices with most experience in their waters of a particular feature, and the best symbol was selected. But variations between existing national charting practices were accepted, if they were not misleading — usually the case with topographic relief. Nevertheless, complete uniformity was aimed at for essentials, such as the definition and use of submerged rock symbols. An important but fully justified variation allowed is the multi-coloured light sectors in the complex waters on some Scandinavian charts, compared with the more normal use of black, considered adequate for such detail by most hydrographic offices. One effect of such variations will be the persistence of a degree of national charting individuality.

462,5 PILLAR 'Pillar buoy' is not defined in the IALA Dictionary but is defined by the British buoyage authority as 'having a tall central structure on a broad base'.

Buoys (other than spars) which are relatively tall in relation to their diameter, but otherwise have no distinctive shape, shall be charted by the symbol shown. This symbol should be used for both 'High Focal Plane' and smaller pillar buoys. In the cardinal system most such buoys will be fitted with topmarks and many with lights.

462,6 SPAR France : Espar. Germany : Spierentonne. Sweden : Prick. IALA Dictionary : 'A buoy in the shape of a spar floating nearly vertically'. Many such buoys carry topmarks; a few carry lights; the representation of these is shown in 466.

If thought necessary, the spar symbol may be broadened slightly to show a distinction between an open (or partly open) symbol, and a black 'filled in' (or partly black) symbol.

It is recommended that the phrase 'floating beacon' should not be used.

Spindle buoys (France : Fuseau. Germany : Spindeltonne) are fairly similar in shape to spar buoys and should be charted by the same symbol.

FIG. 4. — Chart specifications of the IHO, 462,5 and 462,6, 1979.

(*d*) In general, symbols were preferred to legends requiring translation, though the need to avoid making mariners learn too wide a range was kept in mind. Non-self-explanatory symbols were avoided as far as possible. Some international abbreviations were introduced, if common to several languages or very frequent in use, in particular for the composition of the sea-bed and for navigational light descriptions. Sometimes, if no common abbreviation already existed, an English-language abbreviation was recommended, in keeping with the recommendations of the IHO and the International Maritime Organization to give preference to that language.

(*e*) A last general point observed was that national requirements to introduce minor variations into standard chart specifications are always likely. The needs of defence, just one of the several uses to which nautical charts are put, are one example. In the final analysis, every hydrographic office, whether compiling a product itself or using reproduction material supplied by another nation, must as publisher satisfy the users of its own products. Therefore, the ultimate decision as to chart content must be its own.

Symbolization

A few examples of symbolization, reflecting the character of nautical charts, will be mentioned. The recommended standard sequence of depth contours — 2, 5, 10, 20, 30, 50, 100, 200, 300, 400, 500, 1 000, 2 000 ... metres — is at irregular intervals and represents the different physical facts and user needs on and off the continental shelf. Several different ways of indicating inadequate basic surveys are covered, being particularly important to users. On land, the existing preference of some countries for pictorial symbols — chimneys, flare stacks, towers, radio masts among others — was followed for general use [4]. New, larger and more informative symbols for floating buoys were devised, and the world-wide re-buoyage programme of the International Association of Lighthouse Authorities provides an appropriate time for their introduction. But the most notable standardization achievement was almost certainly the new code of abbreviations for the characteristics of navigational lights, a problem which the IHO has been trying to solve since its inception. The system, devised at the instigation of France, is brief without being confusing, and uses a maximum of three letters derived from the English language for each separate characteristic.

Other items of standardization include the introduction of estimated safe clearance depth over unsurveyed wrecks; the correlation of the different types of sea-bed consistent with specific ranges of particle size; the agreed symbolization of controlled zones of many kinds — dumping, military, submarine cables and so on — of different categories of routeing symbols, and of tidal level and stream tables; the tentative standardization, deriving from United Nations Law of the Sea discussions, of various seabed limits; encouragement to show more detail on light sectors so that they convey their message more rapidly; and a new emphasis in view of recent developments on the depiction of detail associated with offshore oil exploitation.

Colour

In respect of colour there was no reason to depart from the normal practice of most hydrographic offices to limit their nautical charts to four basic colours — usually black, magenta, blue, and buff or grey, the last two often being combined to produce a fifth colour (green or murky blue). Alternatives to magenta, such as red, are also permissible, and the optional use of red, green and yellow to clarify light sector colours in difficult waters is beneficial, as already mentioned. In determining the choice of colour for nautical charts the need for them to be legible under subdued, red or amber, bridge lighting has always to be borne in mind.

A particular effort was made to systematize the use of magenta, which has tended to be introduced on nautical charts on a piecemeal basis. Use to date was examined and found to be not altogether consistent, and consideration was given to the likely extended use of the colour in the future in the light of the rate of growth of traffic management schemes. Two main categories of detail requiring the use of magenta were distinguished. First, features with a significance extending beyond their immediate location, such as light flares and radio circles. Secondly, information superimposed on the physical features : transitory hazards such as submarine exercise areas; restrictions such as prohibitions on anchoring and fishing; the regulation of vessel movement, such as traffic separation schemes; maritime boundaries, such as territorial waters limits; and marginal information and cautionary notes. The distinction was firmly drawn with line symbols which have a definite physical basis, an example being the edges of dredged channels. Such symbols are more appropriately shown in black.

Generalization

A recurrent theme throughout the specifications is advice on the generalization of detail, on the inclusion or otherwise of any feature, and on the degree of detail in which an item should be shown. As the specifications cover all scales of 1:1 500 000 and larger, such guidance is important. The fundamental principle followed is full depiction of detail within the limitation imposed by scale — over most of a chart nothing should be omitted if it is essential for safe navigation. On the largest scales, full detail is to be shown throughout. On second and third scales, full detail is needed in the offshore coastwise shipping belt, but the inshore zone may be generalized partly by smoothing depth contours, partly by simplifying navigational aid descriptions and omitting altogether the shorter-range aids. On such charts, semi-enclosed harbours covered by larger scales can be left blank or minimum depiction used. By these means the continuous updating task, requiring the incorporation of Notices to Mariners both on users' copies and on chart plates, is lessened. But in deciding on the omission of detail, the need to present an adequate overall picture for route planning must also be remembered, as must the need to show in full detail minor harbours of refuge which, in normal circumstances, will be of no interest to foreign-going shipping.

7. CHART SPECIFICATIONS OF THE IHO

By 1977, the NSICC's work on the chart specifications was well advanced. The International Hydrographic Conference of that year realized that the detailed specifications, drawn up originally for application to a selective international set of medium- and large-scale charts, must logically also be applied throughout the national series within which the International sheets would also exist — to all charts, not just those with additional INT numbers. The NSICC was therefore replaced by the Chart Specifications (later to become Standardization) Committee, a seventeen-nation standing committee with members drawn from all continents. Its task was to expand the specifications to make them apply world-wide — only small extensions were found to be necessary in the event. Another, more permanent, function of the CSC was, and remains, keeping itself informed of changing user requirements, and thereby keeping the master standardization document up to date. In recent years, updating needs have proved to arise most often as a result of changes in ships' routeing arrangements.

At the 1982 International Hydrographic Conference, the Chart Specifications of the IHO, as they are now officially styled, were formally adopted for use in all nautical chart compilation, as far as national requirements and practices permit. At the suggestion of the International Chamber of Shipping, it was recommended that priority be given to the production of INT charts of ports, and it is therefore likely that the new specifications will, in the first instance, be applied to these. The first few large- and medium-scale INT sheets have already been published by Denmark, France, the Netherlands and the U.K. on scales between 1:15 000 and 1:150 000.

8. THE FUTURE

The 1982 Conference also gave encouragement to the establishment of further regional charting groups, to extend schemes of medium- and large-scale INT charts across the world. Such groups already exist, apart from the North Sea area, for the Mediterranean Sea, the Straits of Malacca and Singapore, and the Great Lakes. Others may well be fathered by the regional hydrographic commissions of the Baltic Sea, Eastern Asia and, when it comes into being, the South-West Pacific. Others may have to be formed in advance of full regional hydrographic bodies. But not every coastal country is a member of the IHO, and not all IHO members have chart production capacity. In such areas, the world agencies will continue to provide requisite charting cover. Another 1982 decision of the IHO was to establish a sub-committee of the CSC to investigate the future design of nautical charts, considering modern cartographic practice and theory and the relation of charts to new techniques, both in data-gathering and user equipment. Coming automated navigational systems are likely to be of particular importance to the study.

The progress of nautical chart standardization which has been described provides, in the author's view, an excellent example of international cooperation. It is essentially in keeping with the traditions of the intergovernmental International Hydrographic Organization, which has always had a good record of practical achievement. Looking ahead, the conversion of all the national chart series to the Chart Specifications of the IHO will be accompanied by the earmarking of selected charts for inclusion in the International series of medium- and large-scale charts. Thereby, the whole world will ultimately be covered by an internationally conceived homogeneous series of 3 000-4 000 sheets, of manageable size and on adequate scales, to suit the needs of international shipping and to be accepted without question in all parts of the globe.

9. ACKNOWLEDGMENTS

In my capacity as Chairman over the last ten years of, initially, the North Sea International Chart Commission and, latterly, the IHO Chart Standardization Committee, I would like to make clear that the work described in this paper would not have been possible without the many contributions of the members of these two bodies. I am very grateful to them. I would like to express my particular thanks to Richard HALLIWELL, U.K. member of the two bodies during most of that time, for his unique contribution to their work, and also to Ann SALUSBURY and David MCPHERSON, the successive secretaries of the NSICC and the CSC.

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