International Hydrographic Review, Monaco, LXII (1), January 1985

WHY A HYDROGRAPHIC OFFICE ?

by Rear Admiral David HASLAM, CB, OBE, FRICS(*)

This paper was presented to the Conference of Commonwealth Surveyors held in Cambridge in July 1983. It is also published in the Proceedings of this Conference and is reproduced here with the kind permission of the organizers.

The title of the paper may seem strange — if not superfluous. One would not dream of presenting a paper to an audience of surveyors with a title "Why a Land Survey Office ?" since almost every country represented has amongst its team a member of its Land Survey Office. But how many have a Hydrographic Office ?

The 51 Member States of the International Hydrographic Organization (IHO), at Monaco, include no less than thirteen of the original British Commonwealth countries — Australia, Canada, Fiji, India, Malaysia, New Zealand, Nigeria, Pakistan, Singapore, South Africa, Trinidad and Tobago, and the United Kingdom. The 1983 IHO Yearbook also gives details of the "organizations responsible for Hydrography in Non-Member States" — including Bangladesh, Barbados, Burma, Cook Islands, Cyprus, Ghana, Guyana, Ireland, Jamaica, Republic of the Maldives, Malta, Papua New Guinea, Sri Lanka, United Republic of Tanzania, Western Samoa and the People's Democratic Republic of Yemen of the original British Commonwealth. Of course, a number of these are no longer members of the Commonwealth; few of the listed Non-Member States would claim to have an active hydrographic office. Some other Commonwealth countries do indeed have at least an organization responsible (to some extent) for hydrography, but have not reported details to the IHO.

There are, of course, several Commonwealth countries which have no coastline (apart from large lakes) such as Botswana, Lesotho, Malawi, Swaziland, Uganda, Zambia and Zimbabwe. But even these, as will be explained later, have an indirect interest in hydrography. There are also the thirteen Dependent Territories — Anguilla, Bermuda, British Antarctic Territories, British Indian Ocean Territories, British Virgin Islands, Cayman Islands, Falklands, Gibraltar, Hong Kong, Montserrat, Pitcairn, St Helena and Dependencies, and the Turks and Caicos Islands.

(*) Hydrographer of the Navy, Ministry of Defence, Hydrographic Department, Taunton, Somerset TA1 2DN, U.K.

But what of the others ? — Antigua, Barbuda, Bahamas, Belize, Brunei, Dominica, Gambia-Senegal, Grenada, Kenya, Kiribati, Mauritius, Nauru, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Solomon Islands, Vanuata, West Indies Associated State of St Kitts/Nevis and Tuvalu ?

Many of the countries are represented at this Commonwealth Surveyor's Conference and their representatives could well ask : "Why should we have a hydrographic office ? The U.K. Hydrographer is responsible for the British Admiralty chart series. They produce charts of our waters in their world-wide series which are claimed to be fully up to date. British naval surveying ships have been carrying out surveys for over 175 years; surely they have completed all the surveying that is needed ? In any case, we have never (or very seldom) had any ships running aground in our waters due to the inadequacy of the charts, so why should we spend money, manpower and effort (which we cannot afford) on carrying out further surveys ?".

Some of such claims might well be true. British Admiralty (BA) charts do indeed cover the world's coastline and most ports and they are kept up to date right up to the day on which they are sold; the stock comprises almost 1 1/4 million copies of the 3,400 navigational charts which make up the Admiralty world series and all of these are hand-corrected up to the day of sale to its 220 chart agents located at most of the world's major ports. Many of these Chart Agents keep their copies amended by the Admiralty's weekly editions of Notices to Mariners so that customers buying these charts from them can have the latest possible information. Each week the Hydrographic Department sends off 26,000 copies of these Notices to Mariners to inform their customers of new dangers or changes of information reported to them.

Those last nine words are the crux though. Not all new dangers and changes are indeed reported to the Hydrographic Department, who are often unaware that new marinas, new jetties or other offshore works have been built or that sea areas have been reclaimed. Objects such as chimneys, churches or casuarina trees (which are shown as being so conspicuous as to be essential to mariners in establishing their position relevant to the coastline) may be demolished or obscured by new high-rise buildings. It is "inconvenient", perhaps, not to show these on land maps, but it could be "disastrous" for a mariner if other chimneys or churches are built close to the demolished originals, thus causing a mariner to fix himself in the wrong place at sea, where he cannot see the dangers below the surface.

And it is with such submerged dangers that the real problem arises. The Royal Navy has indeed been surveying many parts of the Commonwealth (and off other shores too) for well over 175 years. But, with over 71 % of the world's surface covered by water, and with only primitive techniques available with which to search below the opaque waters found in most parts of the world, hydrographic surveying has always been — and is likely always to be — a very slow process. The UK's available efforts have always been concentrated on those areas where shoals were thought most likely to be of danger to the size of vessel likely to need to navigate over or around them.

A very large proportion of the existing 3,400 BA charts are based on very old data indeed. The operations in the Falkland Islands perhaps demonstrated this rather well. Although the UK has had small teams detached ashore to the Falklands since the early 1950's — first from the Ice Protection Ship HMS *Protector* and then

from her sucessor HMS *Endurance* — these parties had concentrated on the approaches to the many small and scattered settlements; each year, the results were forwarded to the Hydrographic Department at Taunton and the various charts were updated from them. About three years ago, it was decided to modernize the complete cover of BA charts of the Falklands as part of a process of similarly modernizing the complete BA world cover. The series was re-schemed at standard scales and all the available data was looked at again in order to compile the modernized version, with the depths in metres instead of the old fathoms and feet. In many cases, modern maps gave a completely different shape to the coastline as depicted in the last century, and the early hydrography had to be adjusted to fit in areas where modern surveys were not available. By 1st April 1982, eight of the thirteen planned new, modernized charts were published and the other five had been compiled ready for fair-drawing. By an extraordinary coincidence, the chart of North Falkland Sound — with the approaches to San Carlos Water — had had a new edition prepared to reflect the work done by HMS *Endurance*'s team in 1980/81, and this was actually dated 2nd April 1983 — the date of the Argentine landing.

But — and this is the point to be stressed — many sea areas in the new 1982 charts were either blank or depended on very old data indeed. Berkeley Sound, the large inlet to the north of the capital, Stanley, was actually surveyed by Captain Robert FITZROY, in HMS *Beagle*, with Charles DARWIN on board in the southern summer of 1833-1834.

The same is true of the vast majority of BA charts. In order to help the mariner, or other users of their charts, the UK Hydrographic Office no longer puts in the main line of the title on its charts : "From the latest information available to the Hydrographic Office, 1983" or whatever the date of publication may be. For that "latest information" could well be 1833. Instead, they now put on a "Source Data Diagram" to indicate the date and scale of the data which they have been forced to use for want of anything better.

"So what ?" cynics might ask. "The old surveyors were extremely thorough, there are unlikely to have been as many changes at sea as there have been on land, so why should we try to get money to pay for new hydrographic surveys ?". In trying to answer this vital question, it may be advisable to start by trying to explain what "hydrography" means.

Perhaps the best explanation is given in the Report of the United Nations' Group of Experts in Hydrographic Surveying and Nautical Charting [1] presented to the 2nd UN Regional Cartographic Conference for the Americas in Mexico City, from 5 to 16 September 1979. It is an excellent document, and coming from such an independent expert group must carry more weight than any speaker ever can, and you are earnestly asked to insist that it is read carefully by your Governments. It not only explains the need for hydrographic expertise in every country, but also gives guidelines as to what action should be taken and how to obtain assistance.

What, however, is "Hydrography" ? The UN report defines it as "The science of measuring and depicting those parameters that are necessary to describe the precise nature and configuration of the sea-bed, its geographical relationship to the adjacent land masses and the characteristics and dynamics of the sea". The parameters include not only those of interest to land surveyors, such as bathymetry

(or vertical measurements of depths and heights), geodesy, geology and geophysics, but also the measurements of the horizontal and vertical movement of the water column (tidal streams, currents and tidal heights), studies of waves and swell and certain other physical properties of sea water as well as the composition of the sea and ocean floor.

Originally — i.e. until about 30 years ago — hydrographic surveyors were concerned almost entirely with measuring and depicting depths, tidal movement and the nature of the sea-bed only insofar as these aspects affected the safety of navigation. Even today, when the world's air networks have completely changed the pattern of the transport of passengers (and one may wonder how many of the overseas visitors to this Conference came by sea as they would have had to do about 50 years ago ?), over 90 % of the world's trade, by value, is still carried by water and an even greater percentage by volume. There is unlikely ever to be any major change in this proportional use of water to handle international trade.

But the pattern of maritime trade has changed significantly over the last 26 years and will continue to change. The closing of the Suez Canal in 1956 influenced the change to increasingly large (and deeper draughted) tankers; new ports and offshore terminals have been built to handle the new sources of minerals, hydrocarbons and manufactured goods; new trade routes have grown up in little-known (or hitherto little-used) areas of the world to which ships of any size had not previously ventured. To handle the increased volume of trade, the size of vessels used has increased dramatically as manpower and fuel costs have rendered the smaller ships uneconomic.

Whereas in 1965 there were only three vessels of over 130 000 dwt, by 1973 there were 514 such vessels. The traditional "charting" surveyor concentrated his available efforts on those areas likely to contain submerged dangers to ships likely to use the area. Until this dramatic increase in draught from the 12 metres of the *Queen Mary, Queen Elizabeth* and major warships of the 1930's to 1950's, the hydrographer was satisfied when he surveyed out from the shallow water to find general depths of about 20 metres. In 1963, the UK Hydrographer extended the area required to be thoroughly surveyed out to general depths of 31 metres.

But, increasingly, economic pressures have forced ship-owners to accept lesser "underkeel clearances" — that is, the depth between the keel of a vessel and the depth suggested by the chart after allowing for the height of tide above chart datum. Today, it is quite normal for VLCCs (each costing well over £ 100 M with their cargoes) to operate with about 10 % of their draught below their keels. This implies that, for a VLCC with a draught of 20 metres, it is assumed that the hydrographer will have accurately located and heighted every object standing 2 metres above the general sea-bed. Even in much greater depths, a wrecked vessel could have sunk vertically upright with its masts lying up to at least 50 metres above the general sea-bed; these could well be strong enough to puncture the comparatively thin hull of a tanker.

And, in British waters alone, it is known that there are at least some 19,000 wrecks of some sort or another; but the accurate location and height are known for less than a quarter of these. This is a very slow, methodical and tedious task. Indeed, until recently it was a virtually impossible task.

The techniques of hydrographic surveying changed little from Captain Cook's

day until the days of the 1949 HM Surveying Ship *Cook*. Depths were measured by casting a lead-weight over the side of the ship on a line marked in fathoms and feet and recording the depth when the line was vertical; but this was the depth at the spot hit by the lead; isolated peaks of rock or wrecks could well (and often did) lie undetected close to the spot depth recorded by the lead.

In the late 1930's, the introduction of the echo-sounder enabled surveyors to record the depth immediately below the track followed by their ship; but, again, isolated dangers could lie undetected close either side of the 17° cone of the echo sounder. During the 1940's, and until the mid 1970's, various types of hull-mounted sonars were used to send sound waves horizontally from the surveying vessel, or rather at varying horizontal angles, but sound is refracted by temperature layers in the water column just as light is bent when passing through glass; the sonar beams were thus liable not to cover the area the surveyor thought was being covered and, in any case, the sonars were designed for purposes other than surveying — such as looking for submarines or fish in the water column rather than on the sea-bed. Many tedious hours were spent in this way, usually giving a quite unfounded confidence of achievement.

But this could not be proved until the introduction, in the 1970's, of a towed sidescan sonar system. This is mounted in a metal or plastic "fish" and towed astern fairly close to the sea-bed to send sound waves out horizontally from below any thermoclines (or temperature layers); this produces a pictorial record in the ship of any objects to either side of the track. The range can be up to 300 metres either side but, to be certain of detecting small objects, the 150-metre scale must be used and the speed of the vessel must be about 5 knots over the ground. To ensure that the area is "looked at" thoroughly, lines must be spaced 150 metres apart.

With sidescan sonars, the surveyor is now, for the first time ever, almost sure that he has adequately surveyed an area. Even so, he still can only say that he has located all objects likely to endanger shipping. He still has to investigate all such objects to obtain the exact position of each one and subsequently to find the exact height over the top of each. Even then, he is not always sure of the identity of the wreck, and the reported position of sinking can be many miles away from the final resting place on the sea-bed.

So far, only the traditional hydrographer's task of producing surveys for the safety of navigation has been dealt with at length. It is relevant also to mention his need to be able to relate his findings to the adjacent land. Traditionally, the hydrographer has been content to use a positional accuracy slightly better than those who would use the charts. We have often been grateful to accept a geodetic network established by our brother land-surveyors. But often (far too often) such networks look away from the sea; trig points cannot always be seen from seaward and we hydrographers must usually ourselves extend the land network to the coast and to seaward. With the increasing use of satellites, national and continental networks are being brought into sympathy with each other which will ease the hydrographers' task when surveying between two such national networks. But many smaller island groups have not yet been linked to the various World Datum systems and, from the navigational aspect, we hydrographers are embarrassed (to say the least) to have to retain such notations on our charts as "Reported to lie 14 miles E.N.E. of its charted position". With more vessels now using Satnav

equipment we need the land surveyors' help in relating their network to WGS 72 (or 84).

This need for improved geodetic standardization is important also with the other new aspect of the hydrographer's task. Had this paper been presented before such a Conference 25 years ago, few would have believed it if it had been forecast that, by 1982, the British oil production from its own waters would be over 103 million tons which, together with 38.3 billion cubic metres of gas, would bring in a total revenue from sales of £ 15.3 billion; equal to about 5 % of the UK's Gross National Product.

Yet interest in the North Sea as a prospective area for hydrocarbon exploration did not begin until after the 1956 Suez Canal closure; it was intensified when the huge Groningen natural gas field was found in the Netherlands in 1962. Exploration could not begin in the North Sea until a legal framework existed under which the countries concerned could allocate exploration areas; this called for appropriate legislation in each of the littoral states and their agreement on the offshore boundaries between them. Most of the countries concerned accepted that the boundaries with their neighbours should be settled on the basis of median lines equidistant from their respective coasts. Unfortunately, the exact distance across the North Sea could not then be measured accurately and the differences between UK's Ordnance Survey Datum and European Datum were not known. As a result, the agreed boundaries are now known *not* to be exactly equidistant but — despite the huge sums involved — the original boundaries are still accepted, although West Germany disputed the median line with Denmark and the Netherlands and, after arbitration by the International Court of Justice in the Hague, a different boundary was agreed.

Various North Sea countries adopted different ways to allocate exploratory licences. UK, the Netherlands and Norway subdivided their offshore areas according to geographical grids and invited the oil industry to apply for blocks which the Government from time to time designated as being available. In the 10 years from 1973 to 1982, 531 exploratory drilling wells have been started in the UK Continental Shelf area; 286 appraisal wells and 787 development wells have been started. By the end of 1982, 20 offshore oilfields and 7 gasfields were in production in the British North Sea sector. The various oil production platforms include 23 steel structures, 7 concrete platforms and 2 converted drilling rigs. To bring the oil and gas ashore, over 2,000 miles of pipeline (varying from 16 to 36 inches in diameter) have been laid and buried in the sea-bed between adjacent platforms and to the shore terminals. Enormous sums of money are involved; in 1982, expenditure on exploration in the British sector was over £ 860 M plus a staggering £ 2,961 M on the construction and installation of platforms, pipelines and shore terminals and another £ 1,338 M on operating expenses. The total investment since 1965 has been some £ 29,000 M (at 1982 prices) plus £ 6,000 M on exploration expenditure.

All this in the inhospitable and unlikely North Sea area. There are many other parts of the world where similar fortunes may be lying undetected. Present estimates are that nearly half the world's proven resources of oil lie offshore but that only about a quarter are in less than 200 metres of water. Estimates of future potential and oil discoveries show that only about a third will be on land, one third from offshore within the 200-metre depth contour and one third offshore in deep water or polar regions. In future, therefore, for every barrel found on land, two will

be found offshore. Surely this prospect alone makes it essential that some degree of official hydrographic expertise is available to the Government in all countries ? Because the hydrographer must be very heavily involved at all stages of such offshore activity, much will be done by the private sector, but the State must exercise control of the work.

It is highly desirable that, before offshore exploration (which must be funded by the private sector in almost all cases) is allowed to begin, the country owning the rights of the Continental Shelf area should have agreed, where necessary, with its neighbours on the limits of its Continental Shelf. Where this does not impinge on a neighbour's Shelf, hydrographers will also be needed to advise on the complicated formulae defining the outer extremity, on the drawing of baselines, the delineation of high and low water lines and the location of offshore islands.

Once the limits of the Continental Shelf and Exclusive Economic Zone (EEZ) have been promulgated, it is again highly desirable that the State's government should have at least as good an idea of the potential value of its EEZ as do the private companies bidding for licences to explore and, hopefully, to exploit it. Otherwise, what value should be placed on the rights being disposed of ?

TABLE I

Theoretical areal allocations of sea-bed to coastal States within a 200-mile Exclusive Economic Zone (EEZ) (thousands of square kilometres)

Country	Total Land Area	E.E.Z.	Percentage of Areal Increase
Australia	7,687.0	7,006	90
Bahamas	13.9	759	5,450
Barbados	0.4	167	41,800
Canada	9,976.1	4,698	47
Cyprus	9.3	99	1,070
Fiji	18.3	1,135	6,210
Ghana	238.5	218	90
Guyana	215.0	130	60
India	3,280.5	2,015	60
Jamaica	11.0	298	2,710
Kenya	582.6	118	20
Malaysia	329.7	475	144
Mauritius	1.9	1,183	62,265
New Zealand	268.7	4,833	1,800
Nigeria	923.8	210	23
Seychelles	0.4	730	182,500
Sierra Leone	71.7	156	220
Singapore	0.6	0.3	50
Sri Lanka	65.6	517	790
Trinidad & Tobago	5.1	77	1,500
U.K. and Dependent Territories	286.7	2,336	1,230
U.S.A.	9,372.0	7,825	83

Some countries will gain sovereign rights to the resources of the sea and sea-bed in areas many times larger than their former land mass. Table I shows, for example, that Mauritius acquires rights over 1,183,000 sq km compared with its land mass of 1,900 sq km — an increase of over 62,000 %; the Seychelles an increase of over 182,000 % — from 400 sq km to 730,000 sq km; and Barbados an increase of some 42,000 % — from 400 sq km to 167,000 sq km. Put another way, Seychelles will acquire an EEZ roughly four times the size of New Zealand's land mass. When one thinks how many land surveyors have devoted their lives to mapping New Zealand, one realizes the problems involved in mapping Seychelles' EEZ.

If hydrocarbons are discovered within a country's EEZ, appraisal wells will need to be drilled and then, hopefully, production wells and pipelines will need to be placed. Whilst responsibility for the detailed sites surveys for these should be that of the oil company (as it would be if erecting a factory or refinery on shore), it is not unreasonable for them to expect to have sufficient basic data available — in the form of bathymetric, tidal and meteorological data to enable them to plan the best site and pipeline routes. Once the pipeline reaches the shore, national land survey offices will normally be able to provide a basic land map on which the pipeline route may be planned so as to avoid unsuitable terrain; the oil companies, with the enormous cost of exploration to support, surely have the right to expect the State to provide the same basic data within the State's new sea areas ?

But hydrocarbons — important as they are — are not the only potential new interests within the new, but huge, EEZs. Such mundane minerals as sand and gravel have for many years been extracted from suitable parts of the sea-bed and may be needed in larger quantities if hydrocarbon exploitation or other industrialization takes place in countries where shore supplies are limited or needed for ecological reasons. Fishermen, who often have such intimate knowledge of their local waters carried in their heads, may be forced to move to other areas — either by overfishing or hydrocarbon development; to avoid damage to their nets, all potential damaging sea-bed obstructions must be charted for them. Recreational users of the sea are also increasing and their needs, particularly in the in-shore waters previously not much used by shipping, must also be considered.

In some areas, the extent of hydrocarbon exploitation is such that the traditional freedom of navigation is threatened. The coastal State will need hydrographers to advise on locating appropriate navigational aids, establishing shipping clearways (in which no exploration licences will be issued), recommending Traffic Separation Schemes and issuing Radio and National Navigational Warnings.

Beyond the outer edges of the EEZs of the 130 or so maritime States, the 3rd UN Law of the Sea Convention proposes that the mineral and other rights should lie with an International Seabed Authority. The resources most likely at stake are polymetallic (or manganese) nodules containing nickel, cobalt, copper, manganese and other minerals. By means of modern technology (at present possessed by only a few developed nations) they could be sucked up from deep ocean depths, transported ashore and refined. This feature of UNCLOS discussions has been the most contentious but could lead to even the land-locked States referred to earlier having an interest in hydrographic activities.

This paper has tried to answer all the hypothetical questions it was suggested might be asked as to "Why a Hydrographic Office", except : "Why should the British Hydrographer of the Navy not continue to undertake the hydrographic responsibility for your country ?". Much as he would like to do so (if only to let his young surveyors have the same wonderful experiences that he himself had in his own earlier days), he just does not have the available effort even to cope with his own UK waters.

As long ago as 1903, when the Governor General of Australia asked a former UK Hydrographer, Rear Admiral Sir William WHARTON, to do some surveys of N.W. Australia, the then Secretary of State for the Colonies was asked to consider "whether it is not desirable to suggest to the Government of the Commonwealth of Australia that the institution of a marine survey department would be greatly to their own interests as it is impossible for the British Admiralty to satisfy all the requests for surveys throughout the Empire." In June 1904, Australia, Canada, New Zealand and the Cape Colony were asked to conduct their own surveys. I should note here that Canada has just celebrated the centenary of the Canadian Hydrographic Office established in 1883, but it was not until 11 March 1904 that Mr W.J. STEWART became the first Canadian to be the Chief Hydrographer of Canada. The Australian Hydrographic Office was not founded until December 1920. South Africa's present office was set up in April 1955 and New Zealand's in September 1949. These long delays were due to discussions over costs and time spent in training up the national surveyors; all four countries had Navies — although Canada chose to place hydrographic responsibility with her Department of Marine and Fisheries (apart from the period 1910 to 1922 when it was under the Department of Naval Service) until a reorganization in 1930 — and the Hydrographic Office fell naturally to the Navy Department in those Commonwealth countries already having a Naval Service.

But perhaps the real answer lies in the fact that with the rights to exploit an EEZ must go the responsibility to survey — not only for maritime safety but also for economic necessity. A hydrographic survey may not have the same immediate attraction as such tangible projects as new schools, roads, hospitals, power stations and factories but, without adequate charts, the much larger ships now in common use will not be able to enter and leave all waters. Even modern cruise liners may refuse to call at ports whose approaches are not properly surveyed. And offshore hydrocarbon exploration cannot start until there is a good knowledge of the bathymetry of the EEZ. If an accident takes place and pollution occurs, the costs could well exceed those of a reasonable hydrographic office for several decades.

This paper has only attempted to answer the question "Why a Hydrographic Office ?". To answer the further — and natural — question : "How do we go about setting up a Hydrographic Office ?" is more difficult. At the I.H. Conference in Monaco in April 1982, the Member States approved an increase in funds to enable the I.H. Bureau staff to visit countries, at their request, to advise on how this should be done, i.e. under which Government Department, using what resources, equipment and personnel, what training is needed, where this can be obtained, how assistance can be obtained in funding, etc. Once a country decides to go ahead and start a new hydrographic office or to build up its present arrangements for hydrography, the IHB will act as intermediary with a developed State willing and able to enter into a bilateral agreement for this purpose. The initial advice is free to both IHO's Member and Non-Member States.

Following a successful First International Hydrographic Technical Conference in Ottawa, in 1981, wonderfully sponsored by the Canadian Government, a Second International Hydrographic Technical Conference is taking place in Plymouth, UK, from 3 to 7 September 1984. The theme of this is the same as that covered by this paper, but it is hoped to attract representatives from all the Embassies and High Commissions based in UK so that — to quote the Abstract of the Report of the UN's Group of Experts — "those responsible at the highest level of government should recognize that, in the marine environment, there can be no exploitation of resources without exploration and there can be no exploration without hydrography".

It is hoped that, even if it fails to achieve anything else, this paper will persuade senior representatives of Government at least to attend the Plymouth conference and then to approach the IHO for its independent advice on "The Way Ahead" for each country with an unexplored EEZ. In turn, this could lead to joining the uniquely non-political IHO membership, and to the formation, in due course, of a hydrographic organization tailored to the needs of each country. This need not be large or expensive; sophisticated equipment is seldom justified or even needed; it is expensive to buy, difficult to maintain (especially when remote from the manufacturer) and useless when not operational. One does not try to drive a Formula 1 racing car before learning even to walk, or even to land a Harrier on a passing merchant ship before qualifying on a solid airfield.

Whilst a formal organization suitable to national needs is being evolved, the existing land surveyors can help considerably by forwarding details they consider of interest to mariners to the established hydrographic office at present responsible for maintaining their charts : i.e., details of objects conspicuous to seaward, of civil engineering works below the high water line, and items of interest to visiting or passing ships, be they VLCCs, tramps or yachtsmen. Details of new geodetic values related to World Datum are also needed.

The UK Hydrographer will continue to give all the advice and help that he can give and to try to maintain his worldwide series of charts in order to be able to maintain the adage earned by his predecessors : "Put your trust in God and the Admiralty Chart".

REFERENCES

[1] U.N. Economic and Social Council E. Conf. 71/L.1. 12 May 1978 : "Report of the Group of Experts on Hydrographic Surveying and Nautical Charting".

[2] D.W. HASLAM : "Hydrographic Services — Basic Charting Vital to all Sea Users". Marine Policy, January 1977.

[3] U.K. Department of Energy : "Development of the Oil and Gas Resources of the United Kingdom, 1982". HMSO, April 1983.

[4] D.W. HASLAM : "Marine Resource Management". RICS Conference, July 1983.