OCEANOGRAPHY JOINS HYDROGRAPHY

By Desmond P. D. SCOTT

Abstract

The 5th Edition of the GEBCO (and subsequent developments) has been the result of close and successful collaboration between the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) of Unesco. However, this paper shows that although there has been close working collaboration between the Hydrographic and Oceanographic communities over many years, and the International Hydrographic Bureau (IHB) clearly recognised this from its foundation in the early 1920s, the scientific input needed to develop a product that meets the needs of oceanographers did not become available until the IOC was established some 40 years later, and it was possible to set up a joint project with clear responsibilities identified for the two closely linked but disparate communities.

Foundation

Following the First International Hydrographic Conference held in London, 24 June-16 July 1919, the International Hydrographic Bureau (IHB) was founded and began its activities in 1921. Prince ALBERT 1er died in 1922 and responsibility for completion of the second edition of the GEBCO remained in the hands of Dr Jules RICHARD, Director of the Musée Océanographique, Monaco, in accordance with the wishes of Prince Albert as expressed in his will, together with a sum of money which appeared adequate at that time. It was not until the early 1930s that responsibility for the GEBCO series was transferred to the IHB and the first sheet of the third edition was published in 1935.

On the other hand, it was some 40 years after founding of the IHB that, following an Intergovernmental Conference on Oceanographic Research convened by Unesco in Copenhagen in July 1960 [1], the Intergovernmental Oceanographic Commission (IOC) was established (as an autonomous subsidiary of Unesco), and its first session was held in Paris in October 1961. The Summary Report of that session [2] (item 6) records:

> *'It was recognized that immediate exchange of oceanographic data in accordance with the Data Centre's Manual of the International Geophysical Year (IGY) should be started for such programmes commencing from 1 January 1960. Ways and means of exchange of bathymetric data were also discussed at length. The problem of publishing a new General Bathymetric Chart of the Oceans was raised several times and the opinion was expressed that Unesco might assist financially in this matter. However no specific recommendation was made in this connexion in view of the forthcoming International Hydrographic Conference in May 1962.'*

The 'new GEBCO' to which this refers was the 4th Edition, as the structure for this edition was then being developed by the International Hydrographic Bureau (IHB), the International

[1] A Preparatory Conference was convened by Unesco, in Paris, 21-26 March 1960 (doc. UNESCO/NS/163, Paris, 13 May 1960). This was followed by a full Conference, held in Copenhagen, 11-16 July 1960 (doc. UNESCO/NS/167, Paris, 7 October 1960)

[2] Report of the First Session of the Intergovernmental Oceanographic Commission, Unesco, Paris, 19-27 October 1961 (doc. UNESCO/NS/176, Paris, 1 February 1962)

Association of Physical Oceanography (IAPO) and the International Council of Scientific Unions (ICSU), following the strong scientific need which had been identified during the International Geophysical Year.

The History of Collaboration

There has been a long record of collaboration since the 19th Century between Hydrographers, and Scientists appointed by Academies of Science such as the British Royal Society - in those days these scientists were known as 'Naturalists'. The most famous is perhaps Charles DARWIN who served as a Naturalist aboard *H.M.S.Beagle*, under Captain Robert FITZROY, founder of the British Meteorological Office.

But these 'naturalists' were mainly concerned with land science in the various little known places visited by the exploration ships. Interest in marine science developed in the second half of the nineteenth century. The renowned voyage of *H.M.S.Challenger* (1872-1876) is generally accepted as the birth of the modern science of oceanography. She was classed as a screw corvette, of 2,306 tons (though Tony Rice has pointed out [3] that this figure varies with the system used to obtain the measurement). She was built in 1858 and had the advantage over pure sailing research and hydrographic surveying vessels in that her twin bladed screw and two cylinder engine allowed her to maintain position on station when sounding or dredging the sea floor.

The Captain of *H.M.S.Challenger* for the first part of the voyage was George Strong Nares (later Sir George Nares), an experienced Hydrographic Surveyor, who worked closely with the Chief Scientist, Professor Charles Wyville Thomson, to ensure the success of the expedition. It is worth recording here that although Professor Wyville Thomson has rightly been credited with the success of the expedition, this could not have been achieved without the strong support of the Hydrographer of the Navy, Sir George Richards, who is on record as announcing his great satisfaction, as the ship sailed [4] "that an expedition such as this, which has been the hope and dream of my life, is now on the eve of realisation", and also, as recorded by Jacqueline Carpine-Lancre [5], Sir John Murray's success in getting the Challenger Reports published, despite numerous difficulties, which was a key element in ensuring the enduring reputation of the expedition.

The Nares are an interesting family [6]. Sir George (1831-1915) [7] was the third son of Commander William Henry Nares R.N. (1786-1867). He was educated at the Royal Naval School at New Cross, London, and joined the Royal Navy in 1845. In 1852 he obtained a place under Sir Edward Belcher on the polar expedition in search of Sir John Franklin. Of particular interest is the fact that when serving with a training scheme for young officers, he wrote the *Naval Cadet's Guide*, later published in several editions under the title of '*Seamanship*', the forerunner to the *Admiralty Manual of Seamanship* which has also gone through numerous editions since. Sir John Murray named the 'Nares Deep', today known

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[3] Rice, Tony. *British Oceanographic Vessels 1800-1950*. The Ray Society, 1986, pp.8 and 30,31

[4] Ritchie, G.Stephen. *The Admiralty Chart. Brtish Naval Hydrography in the Nineteenth. Century.* Hollis and Carter Ltd., London, 1967, p.327

[5] Carpine-Lancre, Jacqueline. *The Origin and Early History of 'La Carte générale bathymétrique des océans'*, in Scott et al (eds), The History of GEBCO, GITC, Lemmer, The Netherlands, 2003, p.15

[6] Nares, Oliver. *The Nares Family Tree*. www.nares.net

[7] Deacon, Margaret and Ann Savours. *Sir George Strong Nares (1831-1915)*. Polar Record, Vol.18, No.113 (1976), pp.127-141

as the 'Nares Abyssal Plain', (23°30'N. 64°30'W.), after him and 'Nares Strait' lies between Greenland and Ellesmere Island, Canada. There are also many land features bearing his name.

Sir George and his wife, Mary (née Grant), had eight children. Both their two surviving sons, George EDWARD (1873-1905) who died as a young man when serving as a Senior Assistant in the surveying ship, *H.M.S.Egeria*, and John DODD (1877-1957) who ended his career as a Vice Admiral, and became one of the longest serving Directors of the IHB (the rules were different then !), from 1932 to 1952 as President of the Directing Committee, followed by over four years as Director 1 up to his death from cancer on 18th January 1957.

Although too young when Captain George NARES was in command of *Challenger*, John NARES had clearly learned a great deal from his father and was well aware of the needs of scientists. He and his fellow Directors, in particular Ingénieur Général Pierre de VANSSAY DE BLAVOUS, realised that at that time the IHB was the most appropriate international agency to meet these needs. As recorded by Adam Kerr [8], he presented a strong case for the GEBCO to the International Joint Commission on Oceanography in 1953 and spent a great deal of time and effort attempting to find extra funding, so as to speed up the production of the printed sheets. Furthermore Ingénieur Général VANSSAY DE BLAVOUS had earlier presented a report concerning Bathymetric Soundings of the Oceans to the Fourth General Assembly of IUGG.

In fact it was during his terms of office that a sound data collection and archiving system was developed and established, so that the IHB became *de facto* the World Data Centre for Bathymetry. However it was at the next stage, the actual contouring of the collected data, that problems arose and consequently the resulting bathymetric charts failed to meet the needs of their scientific customers, who voted with their purse strings and refrained from purchasing the products offered.

Up to this time the bathymetric image of submarine topography as shown on nautical, geographic and bathymetric charts was plotted by a method of linear interpolation between depths measured at discrete points by sounding machines: by length of reeled out wire soundings or by single echo-soundings. As David Monahan has pointed out [9], nautical chart cartographers were trained to exaggerate potential dangers and select the shallowest points of the profiles - this was a sensible technique for navigational charts, but this technique was also followed in deeper waters when, in fact, the shallowest points were of no danger to surface shipping. Unfortunately, what this did was to hide the true geomorphological form of the ocean floor, and, as a result, the GEBCO 3rd edition, and to an even greater extent the 4th edition, were found to be of little value by GEBCO's main customers.

Long-term and Expanded Programme of Oceanic exploration and Research

By 1968, the Intergovernmental Oceanographic Commission (IOC) was developing its Long-term and Expanded Programme of Oceanic exploration and Research (LEPOR) and the IOC was asked by the United Nations General Assembly to co-operate with the Secretary-General in the preparation of "the comprehensive outline of the scope of the long-term

[8] KERR, Adam J. *The International Hydrographic Bureau Period (3rd and 4th Editions)*, in Scott et al (eds), The History of GEBCO, GITC, Lemmer, The Netherlands, 2003, p.57

[9] Monahan, David. *The General Bathymetric Chart of the Oceans; Seventy-three Years of Cooperation in Small-Scale Thematic Mapping*, in the International Hydrographic Review, Vol.LIV, No.2, 1977, pp.9-17

programme of oceanographic research" [10]. The General Assembly resolution [11] requests UNESCO that its Intergovernmental Oceanographic Commission (IOC): '*intensify its activities in the scientific field, within its terms of reference and in co-operation with other interested agencies, in particular with regard to co-ordinating the scientific aspects of a long-term and expanded programme of world-wide exploration of the oceans and their resources, of which the International Decade of Ocean Exploration (IDOE)*[12] *will be an important element, including international agency programmes, and expanded international exchange of data from national programmes, and international efforts to strengthen the research capabilities of all interested nations, with particular regard to the needs of developing countries.'*

This comprehensive 'expanded programme' was divided into six parts:

1. Problems of Ocean-Atmosphere Interaction, Ocean Circulation, Variability and Tsunamis;
2. Living Resources and their relations with the Marine Environment;
3. Marine Pollution;
4. Geology, Geophysics and Mineral Resources beneath the Sea;
5. The Integrated Global Ocean Station System (IGOSS);
6. Specific International Regional Investigations.

It was clear from the start that only a very limited number of the proposed projects could be handled by the IOC with its existing staff and budget, and Unesco proved unwilling to increase its size and funding commensurate with the task foreseen as needed by the United Nations General Assembly. The 'expanded programme' became the basis for the Commission's programmes over many years, but these only covered a number of selected projects. In addition, many of the other projects were undertaken outside the aegis of the IOC.

One of the 'Research programmes proposed to solve the principal scientific problems' was:
Morphological charting of the sea floor

- *Scientific aspects: Geological investigations require bathymetric charts at appropriate scales as base maps. Other marine disciplines use reconnaissance or detailed charts of sea-floor morphology in aspects of their research.*
- *Practical aspects: Base maps for off-shore exploration for minerals and fuels; for bottom fisheries; or for engineering purposes. Bathymetric charts at appropriate scales are required for all aspects of mineral exploitation, fisheries, engineering construction, and other operations on or above the sea floor.*
- *Scales: 1:1,000,000 for reconnaissance purposes. Preliminary charts for many regions, both shelf and deep ocean, can be made from available data. More precise charts at this scale will be required for deep ocean areas with spacing of 5-15km between lines, depending on complexity of the bottom morphology and on the nature and detail of the geological programme in the area. Scales of 1:250,000 or larger will*

[10] Summary Report of the Sixth Session of the Intergovernmental Oceanographic Commission (Unesco doc. SC/MD/19, Paris, 1 June 1970), Annex X 'Comments on Development of the Expanded Programme, submitted by the Scientific Committee on Oceanic Research (SCOR) of ICSU, and the Advisory Committee on Marine Resources Research (ACMRR), of FAO.'

[11] United Nations General Assembly Resolution 2467 (XXIII), December 1968, as quoted in the Summary Report of the Sixth Session of the Intergovernmental Oceanographic Commission (Unesco doc. SC/MD/19, Paris, 1 June 1970), Annex IV 'Comprehensive Outline of the Scope pf the Long-term and Expanded Programme of Oceanic exploration and Research' (LEPOR).

[12] The International Decade of Ocean Exploration (1971-1980). IOC resolution VII/7 (Unesco doc. SC/MD/29, Paris, 30 October 1972), Annex VII

be required in critical areas (where land-sea geological and geophysical transects are to be made).

Advice from the Scientific Committee on Oceanic Research (SCOR)

From its foundation, IOC's main (non-governmental) Scientific Advisory body was the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU), so the Commission now turned to SCOR for advice on the scientific aspects of this programme. SCOR responded by forming a Working Group (41) on Morphological Mapping of the Ocean Floor to handle this request, the recommendations from which group became the basis for the new edition of the GEBCO. One of these recommendations which was immediately acted upon was the formation of a Joint IOC-IHO Guiding Committee for the GEBCO, with five members from the hydrographic community and five from the oceanographic community, including representatives from SCOR, the International Association for the Physical Sciences of the Ocean (IAPSO) and the Commission for Marine Geology (CMG) of the International Union of Geological Sciences (IUGS).

The method of linear interpolation of depths could now be replaced by a new method of geomorphological interpolation from profiles showing the natural structure of the morphology of the ocean floor, and the Intergovernmental Oceanographic Commission was tasked 'to provide advice and expertise, in consultation with SCOR, IAPSO and CMG, on the scientific input needed for the GEBCO, so as to ensure that it remains a respected product of high quality'. [13]

A number of new bathymetric charts had been published as a consequence of international co-operation during the International Geophysical Year (IGY) (1957-1960) and the International Indian Ocean Expedition (IIOE) (1960-1965). Bathymetric charts compiled for publication in the IIOE atlas: the Geological-Geophysical Atlas of the Indian Ocean (Chief Editor: Dr Gleb B. UDINTSEV; Assistant Editors: Dr Anthony S. LAUGHTON, Dr Robert L FISHER, Dr Viktor KANAEV, Dr Eric S W. Simpson and Dr Dina Zhiv) [14] were used for compilation of the first sheet of the GEBCO 5th Edition (Scientific Co-ordinator: Laughton, 1975)[15], and this became the basic format for the other sheets of the series.

Thus the way was clear for IOC to become fully involved, with the International Hydrographic Organization (IHO), in the production of a new edition (by now the 5th) of the General Bathymetric Chart of the Oceans (GEBCO).

Biography

After a 30-year career in the Hydrographic Surveying Service of the British Royal Navy, Desmond Scott joined UNESCO as Secretary of the Intergovernmental Oceanographic Commission (IOC), 1972-79. He served as Permanent Secretary GEBCO from the first session of the GEBCO Guiding Committee (April 1974) until the fifteenth session (May 1995).

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[13] *GEBCO Guidelines for the General Bathymetric Chart of the Oceans,* IHB publication B-7, 1.8.1 (1)

[14] Udintsev,G. (Chief Editor)(1975). *Geological-Geophysical Atlas of the Indian Ocean.* Academy of Sciences of the USSR, Main Administration of Geodesy and Cartography, Moscow, 151p

[15] Canadian Hydrographic Service, Ottawa, Canada, under the authority of the IHO and IOC (Unesco), *GEBCO Sheet 5.05,* April 1975