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Lighthouse

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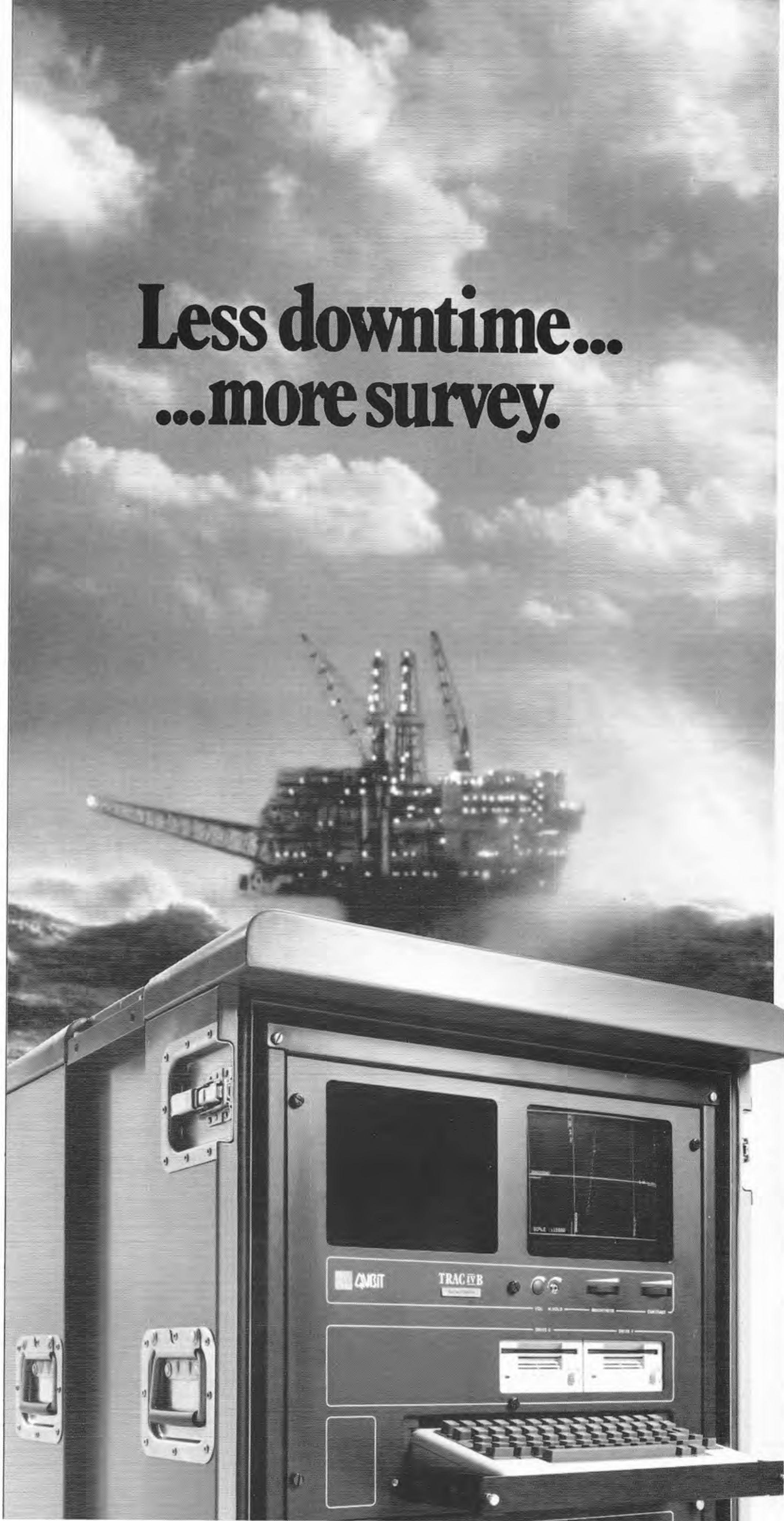

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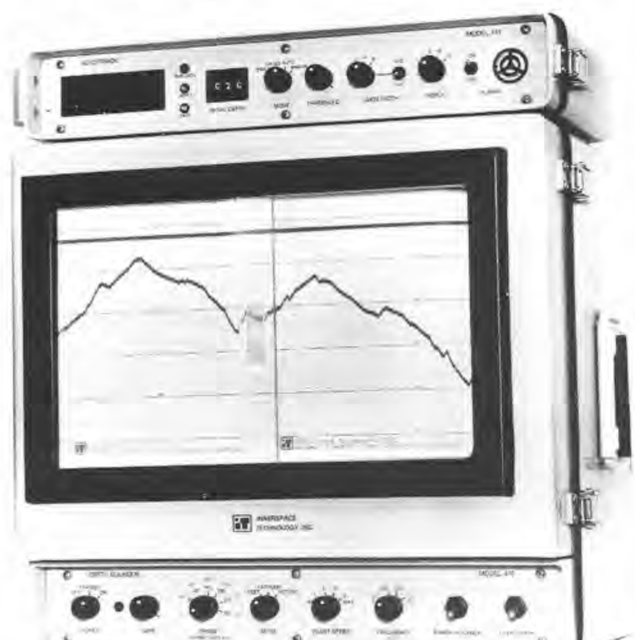

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'The Voyage of George Vancouver 1791-1795'

Edited for the Hakluyt Society by W. Kaye Lamb
(London 1984) Four Volumes
Review by Rear Admiral Steve Ritchie C.B., D.S.C.

The objects of the Hakluyt Society, founded in 1846, are to advance education by the publication of scholarly editions of records of voyages, travels and other geographical material of the past. These records are edited by historians, librarians and others who bring their skills to bear in order to establish the facts from all remaining contemporary documents relevant to the travels concerned. The four Volumes of Vancouver's voyage recently published by the Hakluyt Society have been edited by Kaye Lamb, a former Dominion Archivist and National Librarian of Canada, who has now done for Vancouver what Professor Beaglehole did for James Cook in the five Hakluyt Society Volumes published over twenty years from 1955.

George Vancouver served with Captain Cook in 'Resolution' and Beaglehole has remarked that 'It would be difficult, indeed, to imagine a better education for a young seaman than three years in 'Resolution'. Cook had also instructed the young gentleman in observing, surveying and drawing.

Vancouver was fortunate in being able to select the majority of his officers for 'Discovery', the vessel in which he made the great voyage to the Pacific. Some had served with him before, including Lieutenant Zachary Mudge, Peter Puget, Joseph Baker and the master, Joseph Whidby, an older man in whom Vancouver had the utmost confidence. In 'Chatham', the small armed brig which accompanied 'Discovery', there were officers not previously associated with Vancouver, but who proved equally successful during the four long years. Lieutenant William Broughton was 'Chatham's' commanding officer, whilst in James Johnstone he had a competent master. Under Vancouver's guidance all became proficient hydrographic surveyors.

Many of the officers, midshipmen and some of the men kept logs or journals during all or parts of the voyage, a number of which Kaye Lamb has located and used to flush out the journal which Vancouver edited for publication during the three short years he had to live after his return to England in 1795.

Sir Joseph Banks sent a medical man as supernumerary to report to him on the voyage, Archibald Menzies. His journals, written by an outsider so to speak, are both forthright and fair and have clearly been of major assistance to Kaye Lamb.

The objects of the expedition were largely two-fold. Firstly, Vancouver was to meet Quadra, the Spanish Naval Commander at Nootka Sound, who had expelled former shipmates of Captain Cook and others who had come to the Northwest Coast to exploit a sea-otter fur trade, the possibilities of which had been revealed during Cook's third voyage. One of these traders, John Meares, had complained to the British Government that Quadra had appropriated land and buildings belonging to him at Nootka. This led to a major confrontation between the British and Spanish governments which stopped short of war only when Spain promised to return the requisitioned property. It was then Vancouver's task to meet Quadra, recover the land and ensure that British seamen be permitted to continue gathering sea-otter skins from the natives of the N.W. Coast.

Vancouver's tactful approach to Quadra when he reached Nootka and the friendship which developed between the two men was perhaps one of the main reasons that the British colonised British Columbia rather than the Spanish.

The second object of the voyage was to search further for a sea passage from the North Pacific to the Atlantic. Captain Cook had arrived at Nootka in 1779 and had probed northwards in the Bering Sea as far as Icy Cape in a vain search for the N.W. Passage. Vancouver's search, which was also unsuccessful in the main objective, resulted, however, in a detailed coastal survey all the way from Monterey in Mexico to Turnagain Arm at the base of the Alaskan Pennisula, including the first circumnavigation by a European of Vancouver Island and the exploration of Puget Sound.

Nor was Vancouver idle during the winter months which separated the three summer surveying seasons; he took his ships to the Sandwich Islands, not only to refit but also to complete a survey of the whole island group.

Despite the fact that Lieutenant Hergest, the captain of the expedition's supporting storeship was murdered, together with William Gooch, an astronomer on his way to join 'Discovery', by natives of Oahu and for which Vancouver obtained retribution in the execution of three of the alleged murderers, nevertheless, Vancouver established excellent relations with the Hawaiian chiefs. His association with King Kamehameha was particularly close and led the King to cede his island of Hawaii to Britain at a ceremony on board 'Discovery'. Had Britain not been embroiled in the Napoleonic wars by the time Vancouver returned to England with the news of this cession, Hawaii might have become a British colony.

For the hydrographer, the main interest in the 'Voyage' must be the many detailed descriptions, supported by midshipmen's sketches, which reveal the survey methods employed and the hardships involved. The ships sought secure anchorages where instruments were landed to obtain accurate geographic positions, whilst detached parties in boats were sent ahead along the coast or into the numerous arms of the Sea.

These boat crews would be absent from the ships for weeks at a time during which they rowed hundreds of miles. Archibald Menzies wrote in his journal of these men enduring at times the tormenting pangs of both hunger and thirst, yet on every occasion struggling who should be most forward in exercising the orders of their superiors to accomplish the general interest of the Voyage... And if we look back on the different winding Channels and Armlets which the Vessels and Boats traversed... it will readily be allowed that such an intricate and laborious examination could not have been accomplished in so short a time without the cooperating exertions of both Men & Officers whose greatest pleasure seemed to be in performing with alacrity & encountering the dangers and difficulties incidental to such service... persevering, intrepidity & manly steadiness.

Such loyalty may appear strange today when seen against the background of life in the Navy in those days, and under the command of Captain who was a severe, and sometimes harsh, disciplinarian. Floggings were commonplace, one member of the ship's company being flogged a dozen times during the Voyage.

Vancouver even had a midshipman flogged, the Hon. Thomas Pitt, for trading a ship's nail for the attentions of a Tahitian girl; and later discharged him home to England in 'Daedalus'. As Lord Camelford, Pitt reappeared on Vancouver's return to England and plagued him throughout his few remaining years, trying to discredit his immense achievements in every way he could.

A dozen charts of the Northwest Coast were published as a result of Vancouver's surveys. An original chart lives on however many up-dates are subsequently incorporated; modern Canadian charts reflect much of the work of Vancouver's officers whose names still denote the many features they first charted.

Vancouver's name and his contribution to Canada's history are, of course, immortalised in the name of the great city and of the island to which he and Quadra once jointly gave their names.

Kaye Lamb has now himself made a major contribution to the history of Canada in chronicling in such scholarly manner the Voyage of George Vancouver. The first 250 pages constitute a most readable essay on the objects, preparation, conduct and aftermath of the Voyage; the remaining 1500 pages comprise Vancouver's published journal fully supported by footnotes, appendices, including a complete list of the ship's companies, and an extensive index to guide the reader to areas of his personal interest.

UPGRADE OF THE CARTOGRAPHIC WORKSTATIONS

Timothy V. Evangelatos
Canadian Hydrographic Service
Ottawa, Ontario

1. INTRODUCTION:

This report attempts to describe the current efforts to upgrade the cartographic software used for the production of nautical charts and to put this work into perspective for the evolution of the workstations. During the early seventies when automation first started affecting chart production, cartographers' expectations were low. Today, microprocessor technology is fairly prevalent and expectations are much higher. Now there is a danger that the systems may not evolve as fast as the new technology permits and therefore fail to meet some expectations. To minimize the negative effects, and ensure that the priority of the tasks are optimized, the cartographers involved with the systems must be aware of what has to be done as well as what is being done.

In late 1984, several activities crystallized and led to the establishment of a contract with Universal Systems Ltd., in Fredericton, for upgrading portions of the cartographic software. Although the only formal communication with users regarding the contract, was the distribution of the specifications of the upgrade in January, 1985, all regional system managers were consulted regarding the design of the new system structure. This was not the best way of approaching such a major step, but with the potential loss of $300,000 in 1984/85 funds, time was not available for any lengthy formal discussions. As it was, the contract was let 2 weeks before the end of the fiscal year, but no money was lost!

The cartographic system upgrade has been described in an earlier technical report (Evangelatos, 1985) which was written for specialists with a good technical knowledge of the systems. This report endeavors to explain the upgrade in less technical terms and to consider its potential and its impact upon computer-assisted chart production. Familiarity with the cartographic systems used by the CHS is required to understand this report.

2. CARTOGRAPHIC SYSTEMS:

2.1 Current Status: PDP 11 computer-based systems were developed during the mid-1970's and implemented in all regions, except Quebec, during the late 1970s. Since then, numerous minor upgrades, fixes and extensions were done. Some of the more important ones are summarized below:

1. Move to a multiple-user system (1978)
2. Enhancements to GOMADS (1979)
3. Extended the attributes of soundings (Missing Link-1983)
4. STARS version II, the program used to symbolize the digital data (1978) STARS version III (1984)
5. Implementation of CARED, the interactive editor from Universal Systems (1984)
6. Improvements to the DIGNTX, the digitizing program for more efficient data input (1983)
7. Fixes, improvements and enhancements to the cartographic UTILITIES.

The CHS purchased its first PDP 11 computer in 1974 and although it was an excellent minicomputer, by 1980 some of the cartographic software had outgrown it. The size and complexity of the interactive editor (GOMADS — see Footnote 1) and the symbolization program (STARS) made it very difficult to add the new functions being demanded as computer-assisted cartography evolved. The growing interest and commitment of the CHS to the digital technology also created a demand for additional equipment.

To solve these problems, it was decided to move to a new computer (1982 System Managers Meeting), to transfer the existing PDP 11 software to it and then to gradually upgrade it. This effort began in early 1983 when Ottawa purchased a VAX 11 computer and started the conversion of the software. All regions now own VAX systems and as of July, 1985 all of the CHS cartographic software, with one important exception, has been transferred to the VAX and made operational.

The exception is CARED, the interactive editor. There are no plans to make a CHS version of CARED. The reasons for the latter are rather complicated but are due to several factors. The accurate pointer (i.e. digitizing table) interface in CARED is not compatible with CHS hardware. The CARED software could be modified as was done with the PDP 11 version of CARED, but as the CHS plans to buy the new interface there is little point in modifying the software. At this time Universal Systems does not plan to support the VAX version of CARED since they will have a new version called CARED II, available in 1986. This upgrade is described in more detail below.

2.2 Limitations of Current Systems: The limitations of the current computer-assisted cartographic workstations are of two forms:

i) Those caused by the architecture of the computer system (i.e. PDP 11 computer). Closely related to the computer is the operating system which gives the user the capabilities to carry out many of the chores related to data-processing. The restrictive hardware also prevents the manufacturer from making significant improvements to the operating system which in turn reduces the overall effectiveness of the system.

ii) Those caused by the design of the cartographic software. The design of the software was in part based on the architecture of the PDP 11 and is now too restrictive in comparison to that of other computers that have appeared over the past few years. Another important limitation is the underlying structure of the software itself, which is described by our NTX format. This format, or internal structure of the CHS software, has been in use for 10 years. Even though the format has been quite successful, it does not adequately address all of our requirements for interactive compilation and the proposed hydrographic data base, which were distant dreams in 1974 when the format was designed.

2.3 Current Requirements: A well defined specification of our current needs in computer-assisted cartography did not exist as such, but from user and system manager meetings, workshops, special projects, discussions with users and published papers, it was possible for the author to prepare specifications for the cartographic system upgrade. These specifications were based upon what the author perceived as "CHS requirements" and are summarized below.

Footnote 1: The initial interactive editing system developed in the CHS was called GOMADS and the enhanced version of the interactive editor from Universal Systems Ltd. is called CARED. They call their mapping system CARIS and the upgrade is been called CARIS II.

a) More powerful computer: Move all software to the VAX, reducing the number of programs where possible, and build a more effective cartographic package using the more powerful tools and enhanced capabilities that are provided with the VAX software. (1983 System Managers Meeting)

b) Colour graphics: For interactive work with digital files, cartographers have requested large colour screens and although it has taken many years, colour terminals with resolutions comparable to the monochrome terminals are finally available. Unfortunately, size has not increased significantly, nor is there an indication of larger screens in the near future. It is, nevertheless, felt of significant value to move to colour graphics. (1983 Users Meeting)

c) Symbolization of features in GOMADS: Most editing is done on the unsymbolized file. Roads, rocky ledges, etc. appear as a thin line whose width does not change as the magnification of the display is increased. The cartographers' task would be made much easier if data was shown close to its actual chart size and appearance, with allowance for the magnification factor. (Bellemare, 1984, Czartoryski, 1978)

d) Interactive compilation: More powerful commands for interactive compilation, colour graphics. (Cassidy, 1984, Bromfield, 1984)

e) Digital field data: Hydrographic development groups want to store an increasing amount of descriptive information with digitally collected soundings. Requires modification to the NTX format. (Forbes, 1984)

f) Chart notes: Request to allow notes to be added to the chart file. (Lemieux, 1983)

g) Composite files: Request to store insets with main chart in same file. (Cashen, 1982)

h) NTX format: Ability to include rotation angle and height with unsymbolized point data. (Czartoryski, 1983)

i) NTX format: Ability to include rotation angle with soundings. (Crowther, 1985)

j) NTX format: More adaptable format so future changes could be accommodated more easily. (Bellemare, 1984)

k) NTX format: Improve the method of storing names and text data. (Watkins, 1980)

l) Data base: Add source identifier (Bellemare, 1984) and scale indicator to all data types (Evangelatos, 1984).

m) French version: Provide a French version for Quebec (Bellemare, 1984). This would include French error messages and the translation of all user manuals.

n) Alignment line: Provide a better way of orienting a digital chart on paper. Standard charts are usually shown with north up, but small boat or strip charts may be rotated to any angle. Current system is inadequate. (Watkins, 1982)

o) Data base: Capability to edit and process digital survey data and to provide the tools for qualifying the data before entry into the digital hydrographic data base. (Bellemare, 1984)

p) System: Minimal use of magnetic tape, faster processing, friendlier and easier to use system. (Evangelatos, 1982)

q) Windows: Use of windows with the interactive editor. (Crowther, 1985)

r) Convert the mathematical graphics software to the new format. (Evangelatos, 1984)

s) New software: Generalization software and Edgematching software. (Crowther, 1985)

3. PLANNED UPGRADE AND ITS POTENTIAL:

3.1 The Upgrade: Besides eliminating deficiencies in the existing systems, a primary motivation for the upgrade is to provide a capability for the flexible use of colour and for better commands for interactive compilation. A CHS wide forum to discuss and debate the specifications would have been desirable and may have resulted in an even better plan. As mentioned earlier, the success in obtaining DSS Resource Development funding came late in 1984 and the funds being provided by Quebec Region for hardware and by the Planning and Development Branch for software development had to be spent by the of the 1984/85 fiscal year. The actual contract was let in the middle of March, 1985 and so it is apparent that time for formal debate was not available.

The regions were not ignored: all system managers were consulted about the extensions of the NTX format and some of the managers were able to attend the discussion meetings. Further, the proposed specifications were distributed to the regions in January, 1985 for comment.

The contract is described in detail elsewhere (Evangelatos, 1985). It should be noted that the specifications were provided as minimum requirements that the supplier had to meet, but were not meant to restrict them from using their talents to advance the system as far as possible. There are two other important aspects of the contract. One is to provide a (physical) cartographic system to Quebec and the other relates to the funding from DSS. One of the underlying principles of the Resource Development Funding, from DSS, which is providing 60% of the money for the software upgrade, is to make the systems suitable for more widespread application in other government departments. Most of the other applications will probably relate to topographic or land resource mapping and not all the extensions being added by the manufacturer will neccessarily be of interest to the hydrographic mapping community.

With reference to the current requirements itemized in the previous section, all should be satisfied through this specific upgrade, except for m), q), and s), inspite of the fact that funding for the contract was inadequate to pay for all requirements. Facilities for the French version (item m) will be negotiated outside of the contract. In this version, the use of windows (item q) is limited to one for the dialogue with the operator. USL is developing software for generalization and edgematching (item n) which will be evaluated and purchased separately if it is suitable for CHS applications. Other important programs which were not included in the final contract are being handled in one of three ways:

1. Some items will be funded this year (e.g. CARDIG)
2. Some items will be done by Ottawa (e.g. STARS, NTXKNG and other utility software).
3. USL will sell or licence some programs (e.g. Edgematch)

The report "Cartographic System Upgrade" by T. Evangelatos

(June, 1985) gives specific details on the overall plan.

The following describes in detail the technical aspects of the upgrade.

The internal structure of the system which we call the "NTX format" was modified to eliminate deficiencies that were found over the past ten years. These are described below. The format was also extended to include features which will facilitate interactive compilation and for working with digital source data such as survey data. We felt that it was impossible to foresee all future requirements and therefore the new structure was designed so that future changes can be made without modifying all of the software. The latter feature is essential if this system is to continue to evolve. The next significant change deals with the interactive editor which is to be called CARED II. An attempt is being made to provide the flexible use of colour graphics. We want to be able to use colour in different ways for different tasks. For example, when simply adding data to the file each feature could be shown in its specified colour; when contouring the sounding data, each range of depth values could have its own colour. The latter is a technique being used by some hydrographers when plotting their field sheets. We have also requested the facilities to use different colours to show data based on attributes such as source, accuracy ranges, and data flags (which will be explained below).

Improvements to the "NTX" format: The new structure currently being tagged "NEWNTX" eliminates several serious limitations. Changes that only concern computer programmers are not described here. However, to understand some of the important changes a slight knowledge of computer basics is required. As in the past, to master their trade, cartographers had to have a knowledge of their tools and their materials. This is still vitally important today.

a) The VAX computer which is replacing the PDP 11 systems has an internal word size which is double that of the PDP 11s. Coordinate data will now be stored with a greater precision. The lower resolution was causing difficulties for the system designers. Although an important change, it won't be too visible to cartographers. One benefit will be the increased resolution available for the generation of drawn symbols. The full resolution of the Kongsberg plotter (0.01 mm) can be utilized.

b) The digital chart data is registered geographically and normally the chart or field sheet is drawn with north up. Small boat charts are an exception and to make the processing easier and provide more flexibility for handling special cases, an "alignment line" has been added. The concept of this "line" is quite simple: the coordinates of two points on the chart are given in both geographic coordinates (latitude/longitude) and in the rectangular cartesian coordinates (X,Y plotting values). These two sets of values will make it easy to determine the orientation (i.e. rotation) of the plotted chart.

c) All digital chart files start with a header that provides important information on the chart such as its name, number, depth units, geographic coverage, projection, scale, etc. With the current system each chart file could have only one "MAINHEADER"; but in the new system multiple headers are allowed. This means that insets cán be stored as part of the main file and retain their own geographic registration data.

d) Recently there has been more effort applied to the development of the hydrographic data base. The construction of the latter will not be easy, but there appears to be little doubt that it is coming and the cartographic workstations will have to interface with it. It was apparent that additional fields in the NTX structure were desirable and necessary for this interface. A field has been added to all data which identifies the source of the data (source identifier). An optional field has been added which can be used to indicate the largest scale at which the data (scale indicator) should be used. These two concepts are important and, we think, fundamental to the digitally based charting systems. Having a source identifier on the data means that it will be possible to trace the origin of any sounding, or other data, that appears on the chart. The use of the scale indicator is not so clear. Consider a navigator using a computer-based display system such as the electronic chart where he (or she) might try to enlarge the scale of the display; assume a file for a chart at 1 to 100,000 was being used; if the operator were to carelessly zoom the data up to a large scale, say 1 to 25,000, a potentially dangerous situation could be created if that displayed chart were used for navigation. To prevent this, or at least warn the user, the scale indicator would be checked by the system before the data is displayed.

In the future if additional fields are needed then they can be added without much difficulty.

e) The structure used for sounding data has been greatly extended to follow the trend in the regional development groups where a lot of descriptive information is added to each sounding (Varma, 1984). An optional field is also available which provides a pointer to an external file where an unlimited amount of space can be used for descriptive information about the depths of the field survey itself. This option can also be used for other data types and could be used for navigational aids, if desired.

f) Cartographers have, in the past, requested a capability to add notes to the digital file. This capability has been added and at the same time data structures used for incorporating text with position and for names have been improved.

g) In the past wiggly lines (as opposed to straight lines) were stored as "Freeman vectors". This was a number from 0 to 7 which specified a direction as follows:

Freeman vector	Direction	
0	0	degrees
1	45	"
2	90	"
3	135	"
4	180	"
5	225	"
6	270	"
7	315	"

For shoreline, which has a fractal nature, "Freeman vectors" provide a very space efficient form of storage, but for contours or other smooth lines they are not so efficient. "Freeman vectors" are also awkward to program, time consuming to process and relatively slow to draw on crt displays and plotters. It was therefore decided to drop the "Freeman vectors" and to store wiggly lines as X and Y increments.

h) Data Flags: This topic will be discussed, even at the risk of getting into technical details, because it is being used to provide capabilities that we plan to use for interactive compilation. Techniques for good man-machine interaction, using these new capabilities, must still be developed.

It is fairly common knowledge that the basic element of a computer is a "bit" and that a bit can have two values, sometimes called "on" and "off" or "0" and "1". Eight of these bits constitute a "byte". Two bytes make a PDP 11 computer "word" and four bytes make up a VAX computer "word". (Very simple or very confusing depending upon your background.)

Now, in the "NTX" structure a few computer words (called "fields") are used as "flag words" and each bit of these words is called a "flag". These flags are similar to the ticks we might put on paper to indicate that certain items are special. The use of flags in the new format has increased. Every sounding has its own flag word, now assigned as follows:

Sounding Flag Word

Bit 0 — sounding deleted due to overplot
1 — drying height
2 — unassigned
3 — non-standard drawing size (could provide for 1/2 size digits as recommended in the Missing Link report (Evangelatos, 1981)
4 — unassigned
5 — Sounding is plotted out of position (True position is provided along with plotted position)
6 — unassigned
7 — check line sounding
8 — track sounding
9 — shoal examination
10 — unassigned
11 — known depth (over artificial feature)
12 — swept depth
13 — no bottom found
14 — bracketed sounding. The coordinates are not the position of the depth, but where the depth is to be drawn.
15 — approximate position
16 — sounding selected
17 — sounding suppressed
18 — shoal sounding
19 — deep sounding
20 — 31 — Unassigned

Many of these flags are mutually exclusive and cannot be set at the same time. A second flag word which is attached to all data has the following flags assigned:

Data Flag Word

Bit 0 — System function
1 — Used to link different features together; for example, a text string could be linked to a bridge feature.
2 — Selected feature
3 — Suppressed feature
4 — portion of the feature is masked; for example a portion of a contour would be masked, or not drawn ,where a label has been specified.
5 — Data marked for deletion; proposed by USL and would allow for the recovery of some data that might be inadvertently deleted.
6 — line is closed; i.e., island or loop.
7 — 14 — unassigned
15 — Data has been symbolized
16 — 31 — unassigned

Although the usage of most of these flags is self-explanatory some of them require additional description. The selected and suppressed flags are to be used for interactive compilation. Generally the source data would not have these flags set and all data would then be considered as background data. After studying the data (on the CRT) the cartographer would select and reject various soundings. Those soundings that are rejected would disappear from the screen and those that are selected would appear brighter or in a different colour from the background soundings. Eventually, when the compilation is completed, only the selected sounding would be drawn on the final chart, even though the file still contains all the original soundings. If a file needs updating, the initial data is available and a new selection can readily be made, if required. A perceptive reader would notice that both flag words have bits for selected and suppressed data. This does not cause any confusion but is an example of the flexibility of the format. Soundings can be stored individually or as part of a group. The first flag relates to the individual sounding and the second flag relates to the group and it is possible to have background, selected and suppressed soundings in one group, or to have homogeneous groups of any one type.

The mask bit is a useful addition; if a contour label is moved, the original segment of the contour that was under the the label can be retrieved.

3.2 The Potential: What will the new system do for the CHS? We hope that the upgrade will provide a system that will not only advance the state of computer-assisted cartography in the CHS, but also provide a system that will be able to continue to evolve with the proposed hydrographic data base, and with the anticipated electronic chart. The more powerful computer and operating system will let the programmers create a more friendly and easier to use system. The use of magnetic tape will be greatly reduced, thus allowing files to be updated and processed much faster, with less effort. It must be emphasized that unless the new system is properly phased in, a lot of unnecessary turmoil could be generated in our mapping offices. Ottawa will be participating in the testing of the system and hopefully any bugs or other serious problems will be caught before the software is released. During this activity, Ottawa will also be experimenting with as many of the new features as possible and will therefore be in a position to guide others. In some of the new areas, such as interactive compilation, there may be a delay as one or two chart projects should be carried out before the procedures are established.

Plans for the introduction of the system have not been made yet and the success of the system will depend, in part, upon how it is introduced into the CHS. This fall, detail plans for implementing the system will be formulated. The proposed plan should be ready for discussion at the system users' meeting to be held later this year. Funding for the contract was adequate to cover only a portion of the upgrade and final plans will be contingent upon having a complete compatible system to work with.

3.3 The Impact: Section 3.1 went into a lot of detail on the upgrade and it may be difficult to see the impact that this upgrade will have on digital charting in the CHS. New solutions usually introduce new problems and this upgrade probably won't be excluded from this axiom. Since the work consists of many small changes that have been relatively well thought out, new problems should be minimal or else be eliminated in a relatively short time.

All existing chart files will have to be converted to the new format. Although not difficult, this will be a nuisance. Some older chart files will also require a slight bit of editing to be compatible with the new version of STARS, where symbolization for some features was not previously available.

This upgrade is another evolutionary step for computer-assisted cartography in the CHS. It should eliminate many of the deficiencies found in the PDP 11 based systems and provide additional capabilities for interactive compilation. Some basic links for the proposed hydrographic data base and for the inevitable electronic chart have been added to the "NTX" format. The overall format has been improved, strengthened, and reorganized in such a way that it will be possible to add new fields (i.e., computer words for new attributes, flags or other items) without affecting all the cartographic software and having to modify all of it. The volume of software is large, growing and, without the more flexible format, future upgrades might not be feasible. The move to the more powerful computer system is important. Besides making this upgrade possible, it provides the power for additional advances in the future, as well as providing a system that is easier to use.

This upgrade continues the policy set many years ago of trying to "mimic" the established traditional manual techniques. To some this exercise was a waste of time and resources but I believe it was a necessary phase in our evolution. Indications are that the mid-eighties may be a watershed in that breaks with past traditions will start and in the future, research and development (and eventually chart production) will be directed much more towards creating a product based upon the digital technology, rather than trying to force the technology to produce an imitation of the manually produced paper chart.

Several of the major components of the system are being supplied by Universal Systems Ltd. who will also be providing future software support for these products. Other components dealing with symbolization, Kongsberg plotting, and the mathematical generated graphics, are not supported by USL and will continue to be maintained by Cartographic Development in Ottawa. This splitting of the development and support of the software may cause future difficulties, but it is felt that the risk is warranted, in order to enhance and speed up the development cycle of the cartographic systems.

4. THE FUTURE:

Interest in the electronic chart is growing very quickly but many major obstacles will have to be overcome before widespread use of the electronic chart is realized. The electronic chart is only one of several ways that new technology could affect chart production.

Raster plotters for outputting the final chart data will supplement, if not eventually replace, the vector based systems, such as the Kongsberg which is being now used in the CHS. The Kongsberg produces good quality plots but it does not have the flexibility and reliability of the raster plotter. With the latter it should be possible to produce negatives for printings without any manual intervention (other than developing the film). All colour-filled areas would be done on the raster plotter.

Colour electrostatic plotters with resolutions of 200 points/inch are available and units with higher resolutions are expected. With these colour plotters, it may be possible to produce up-to-date charts of acceptable quality, on demand, from a digital chart data base. Such a system would eliminate the lithographic printing process with its large press runs that result, for some charts, in costly manual updating and the need for warehouses to store the charts. The same digital chart data base might also satisfy the electronic chart user and the justification for a CHS-wide commitment to digital systems might be created.

The resolution of the Tektronix colour graphic display is 1280 pixels by 1020 pixels (see Footnote 2) and although CRTs with 2000 pixels have been made, new high resolution systems probably won't be generally available for a few years. The high cost of the CRTs coupled with the larger volume of data that needs to be processed (4 million pixels) and the limited demand for such high resolution means we will have to wait. The cartographers' wish to have large, high resolution graphic displays remains unfulfilled.

Lately the press has been writing about "Artificial Intelligence" and "Expert Systems". These are developments that will affect chartmaking. In the 1960s, visionaries talked about charts being produced automatically without manual intervention; in the 1970s these ideas were pushed aside when computers showed how inferior they were in many decision-making areas. Now it appears that technology can provide the framework needed to automate more of the manual functions that once appeared impossible to program. Progress (as this type of change is usually called) will probably continue at a relatively slow pace, but the elements for a revolution in chartmaking are gradually falling into place.

Footnote 2: PIXEL, short for PICture ELement with C replaced with X, refers to the minimal resolvable area of the screen.

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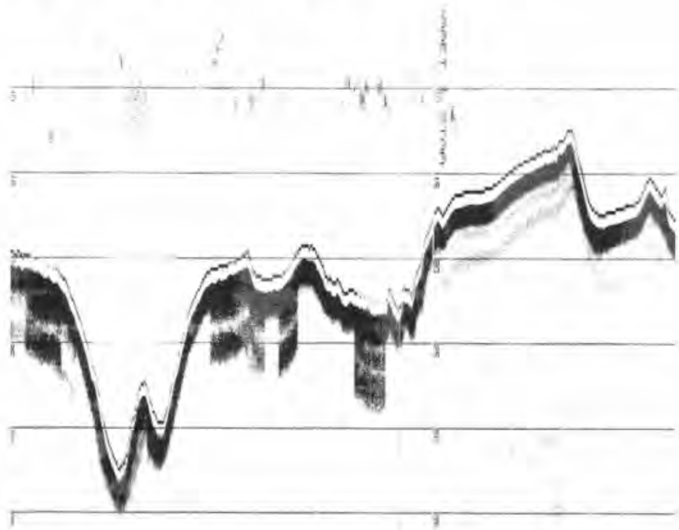

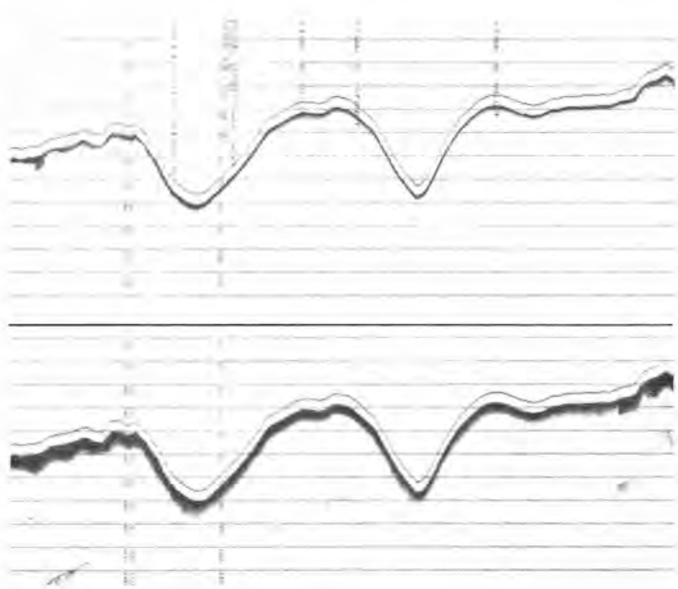

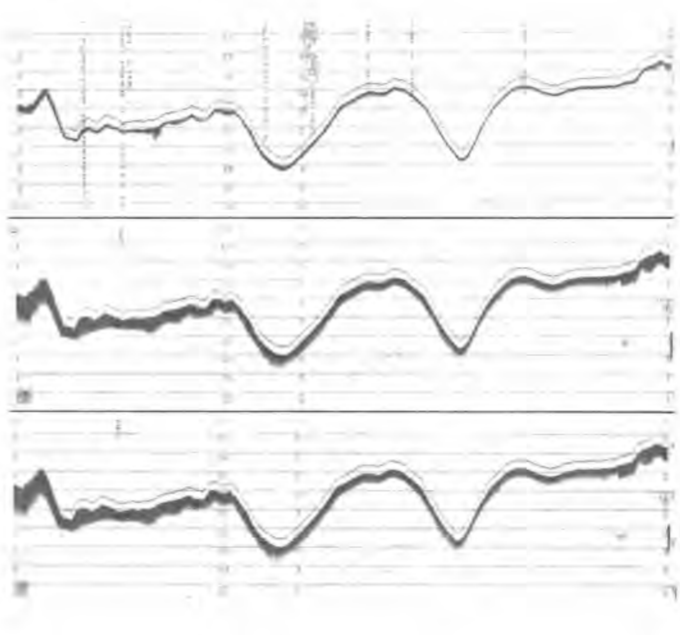

VERIFYING THE GULF OF MAINE COMPUTATIONS

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Abstract

A Chamber of the International Court of Justice recently handed down its decision on the delimitation of a single maritime boundary between Canada and the United States of America in the Gulf of Maine and Georges Bank areas. To most people, the turning points of the line are accepted without question. The author has investigated how the line was computed, recomputed it using his own methods, and reports no significant differences.

On Nov. 25, 1981, Canada and the United States of America applied to the International Court of Justice in The Hague, Netherlands, for the Court to define a single maritime boundary between the two countries in the Gulf of Maine and Georges Bank areas that both countries would accept as binding. On October 12, 1984, the Chamber of the International Court of Justice brought down its decision after receiving written pleadings, rebuttals, and oral arguments by both countries. The arguments put forward and the reasoning behind the decision are not part of this paper and those readers wishing such information will have to look at the documents filed with the Court, the judgment, or other authors' analyses (e.g., Cooper, 1985).

The Chamber appointed a technical expert to carry out the computations of the boundary line according to its instructions. Commander Peter Bryan Beazley, O.B.E., F.R.I.C.S., R.N. (Ret'd), a well-recognized authority on maritime boundaries, was selected. The author will be citing from Beazley's appendix to the Judgment separately from the Judgment itself; references to the Judgment are by numbered paragraphs.

An unusual procedure in Cdr. Beazley's computation is the use of Transverse Mercator grid bearings in conjunction with geodetic distances. Although he used the standard six-degree Universal Transverse Mercator (UTM) constants in his computations, he chose a non-standard central meridian (68° W longitude), in part, it is supposed, to balance the errors on either side of the boundary. His forethought is commended even if it added extra diligence in following his work.

The real proof in verification was to compute the positions of the turning points as independently as possible and to compare the results. Here, the author chose to use the GALS — an acronym for Geographic Adjustment by Least Squares — (McLellan, 1971) program written by the Geodetic Survey of Canada and used by the Canadian Hydrographic Service for the past 15 years and to follow the original instructions given to Cdr Beazley. The GALS program does all its computations on a specified ellipsoid, in this case, the Clarke 1866 ellipsoid that is the basis of the 1927 North American Datum.

The Chamber of the International Court of Justice in its Judgment went to great pains to find what was the nature of the Continental Shelf and the fisheries in the area (para. 28-59), and what legal obligations it was bound to (para. 60-125). It reviewed and commented on the behavior of the two countries during the dispute (para. 126-163), analyzed and rejected the boundary lines proposed by the two countries (para. 164-189) and then proceeded to prepare its own, independent, version of the boundary line (para. 190-229).

The first segment of the line (from 'A' to 'B') was specified to be the angular bisector of the angle formed by a line through 'A' perpendicular to the line from Cape Elizabeth to the Boundary Terminus and by a line also through 'A' perpendicular to the line from the Boundary Terminus to Cape Sable. The Chamber's philosophy was that this part of the coast was akin to the 'adjacent states' situation where it would be equitable to bisect the angle formed by the general directions of the respective coast (para. 206). Although the author set up the computer program to do this computation, he also did a second computation using the bisector of the angle formed by lines through 'A' that were parallel to the two baselines.

How does one construct a line on an ellipsoid that is parallel to another line? Suppose one is at the equator and desires a line parallel to one's meridian. That line cannot also be a meridian since all meridians converge at the Poles; so, it is a small circle at a set distance from the meridian. Similarly, a line parallel to the equator is a parallel of latitude (small circle) and not a geodesic (great circle). (On a perfect sphere, all meridians and the equator are great circles, since the radius of the circle is the radius of the sphere, whereas all other parallels of latitude are small circles, since their radii are less than the radius of the sphere.) The solution the author chose was to compute an auxiliary point equidistant from the line on the perpendicular to the line at the end of the line. Strictly speaking, this is not quite correct either, since the GALS program only considers normal sections (great circles) and cannot consider small circles. If this is unclear; then, an example is in order:

Purpose: To construct a line parallel to the line Cape Elizabeth to Boundary Terminus that passes through 'A'.

Step 1: Compute the length of the perpendicular from 'A' to the line.

Step 2: Construct the perpendicular at Cape Elizabeth.

Step 3: Lay off the length of the perpendicular from Step 1 along this perpendicular.

This point is then the 'target' for constructing the bisector of the angle at 'A' (see Figure 1). The author considers that this equal length of perpendicular principle follows the basic concept of

Figure 1 - Showing construction of boundary line between points A and B.

parallel lines better than the plane geometry theorems that are developed from parallel lines (e.g., interior angles formed by an intersecting line sum to 180), which the Chamber had in fact specified by bisecting the perpendiculars. The comparison in positions of point 'B', as will be noted in the section on computational results, amounts to 2.2 metres.

The second segment of the line ('B' to 'C') was to be a line parallel to the mean bearing of the lines Cape Cod Elbow to Cape Ann and Cape Sable to Whipple Point and to divide the line from Chebogue Point to its nearest point on Cape Cod, known as the 'location line', by the ratio 1.38:1 (a ratio of coastline lengths derived by Cdr. Beazley on instructions from the Chamber) while giving a half effect to Seal Island. This is certainly a complicated statement and is no less so when trying to spell it out mathematically. It took eight auxiliary points to do so. (See Figure 2.) This sort of principle is sometimes followed when constructing the median line between two states that are opposite one another where minor protrusions of the coast and small islands are disregarded or given reduced effect. In this case, the Chamber was attempting to give due weight to the length of coastlines and to lessen the effect of Seal Island (para. 206, 217-218). The mean bearing was determined by constructing the intersection of the two lines and hence constructing its angular bisector. The length of the 'location line' (as determined by Cdr. Beazley) was easy but a line through Seal Island parallel to the line Cape Sable to Whipple Point had to be constructed and its intersection with the 'location line' determined. The distance from that intersection point to Chebogue Point had to be bisected and the 'location line' from the bisected point to Cape Cod had to be divided by the ratio 1.38:1 in favour of the United States. Through that point, the line parallel (by the method described previously) to the angular bisector had to be constructed and then two points determined: one, the intersection with the angular bisector from 'A' to be known as 'B'; and the other, the intersection with the closing line (Nantucket Island to Cape Sable) to be known as 'C'.

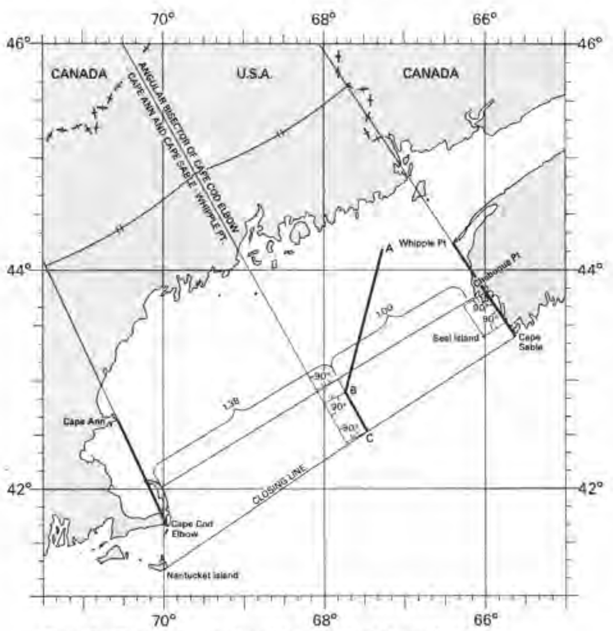

Figure 2 - Showing construction of boundary line between B and C.

It is very interesting to note that points 'B' and 'C' are computed in such a manner that they are on the same small circle that is parallel to the angular bisector. In the application to the Court, the two countries requested that the line between turning points be a geodesic line (great circle); therefore, the computation is done using one line and the boundary line is defined on a different line. The separation of the two lines midway between 'B' and 'C' is approximately 16 cm. — a distance of little significance to the practical user but only to the purist.

The last line segment ('C' to 'D') was to be a perpendicular at 'C' to the closing line of the Gulf (Nantucket Island to Cape Sable) and to extend to seaward a distance of 200 nautical miles from the nearest point on the American shoreline. (See Figure 3.) The principle of erecting a perpendicular to a closing line is consistent with the principle of a median line between adjacent states seaward from the closing line (para. 224). Cdr. Beazley had identified the point on Nantucket Island that was the controlling point for the 200 mile limit and so the determination of the intersection of the perpendicular from 'C' and the 200 mile radius arc was simple to obtain. This point is now identified as 'D' or the terminal point of the boundary delimitation as ruled by the Chamber.

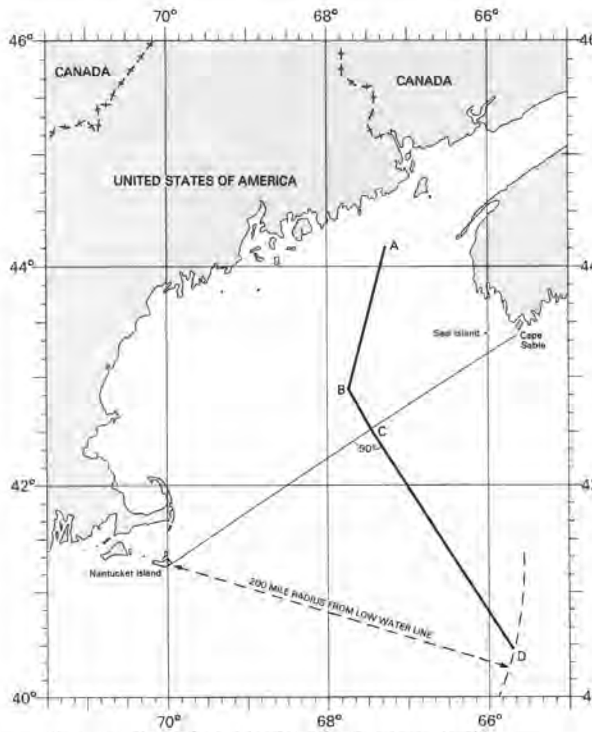

Figure 3 - Showing construction of boundary line between C and D.

Computational Results

A listing of geographic positions follows giving the data used by Cdr. Beazley and the results obtained by the author with comparisons with Cdr. Beazley's results in parenthesis where available.

Given:	Ø °	'	"	λ °	'	"
SE tip of Nantucket Island	41	15	04.	69	58	01.
LWL position for determining 200 mile limit	41	15	56.	69	57	37.
Cape Cod elbow	41	38	35.	69	57	15.
Position on Cape Cod nearest to Chebogue Point	42	00	31.	70	01	36.
Cape Ann	42	38	12.	70	34	27.
Cape Elizabeth	43	33	41.	70	12	02.
International Boundary Terminus (TP 15)	44	46	35.3	66	54	11.3
Whipple Point	44	14	11.	66	23	50.
Chebogue Point	44	43	57.	66	07	18.
Cape Sable	43	23	22.	65	37	23.
Seal Island (SW point)	43	23	33.	66	01	21.
Boundary Point 'A'	44	11	12.	67	16	46.

Computed Points:	∅	λ
	° ′ ″	° ′ ″
Base of the perpendicular to 'A' on the line Cape Elizabeth to Boundary Terminus	44 33 19.1919	67 32 00.7587
Length of perpendicular =	4569.64 m.	
Target point off Cape Elizabeth	43 11 55.4811	69 56 03.9235
Base of the perpendicular to 'A' on the line Cape Sable to Boundary Terminus	44 29 51.6343	66 38 23.5589
Length of perpendicular =	61608.21 m.	
Target point off Cape Sable	43 05 02.7721	66 15 22.2769
Angle between the coastal parallel lines through 'A'	98 06 37.7	
Base of the perpendicular to Seal Island on the line Cape Sable to Whipple Point	43 31 31.9625	65 44 44.4083
Length of perpendicular =	26841.56 m.	
Point on the 'location line', 26841.56 m. off the line Cape Sable-Whipple Point (the same distance as Seal Island)	43 40 08.6784	66 16 30.0872
Distance to Chebogue Point =	14229.51 m. (14234. m.)	
Point on the line Cape Sable to Whipple Point and at the base of the perpendicular from the point listed immediately above	43 48 09.8271	65 59 50.9329
Point on the 'location line', 7114.755 m. from Chebogue Point	43 42 02.9321	66 11 54.1891
Distance from there to nearest point on Cape Cod =	364973.005 m.	
Division of that length into 1.38:1 parts	211623.003 :	153350.002 m. (153349. m.)
Point on the 'location line' that divides line by ratio 1.38:1 with half effect of Seal Island	43 00 19.8229 (19.8)	67 49 56.6680 (56.7)
Point of intersection of the Cape Cod Elbow to Cape Ann and Cape Sable to Whipple Point lines	57 03 12.7801	83 23 32.5893
Point on bisector of Cape Cod Elbow to Cape Ann and Cape Sable to Whipple Point lines and at base of the perpendicular from the point listed two entries above	42 53 55.0950	68 05 37.6371

	$\varnothing$	λ
	° ' "	° ' "
Length of perpendicular =	24411.69 m.	
Point 'B', 24411.69 m. off angular bisector and on angular bisector from 'A'	42 53 14.1545 (14.)	67 44 35.7581 (35.)
(Point 'B', using the bisector of the perpendiculars through 'A', as specified by the Chamber)	42 53 14.2173	67 44 35.8054
Distance between the two positions of 'B'	2.22 m.	
Point 'C', 24411.69 m. off angular bisector and on line from Nantucket Island to Cape Sable (closing line)	42 31 08.3899 (08.35)	67 28 05.2462 (05.33)
Point 'D', on perpendicular at 'C' to the closing line and 200 n.m. from LWL position on Nantucket I.	40 27 04.7029 (05.)	65 41 58.9699 (59.)

Supplemental Information:

Cdr. Beazley did some extra computations that were not used by the author to compute the turning points but were computed for comparison purposes only.

	$\varnothing$	λ
Point on the angular bisector of the Cape Cod Elbow to Cape Ann and Cape Sable to Whipple Point lines and at the base of the perpendicular to Whipple Point	° ' " 43 24 28.0491 (27.0)	° ' " 68 29 03.7662 (03.0)
Length of perpendicular =	191481.49 m.	
Point of intersection of the perpendicular and the line Cape Cod Elbow to Cape Ann	42 32 31.2540 (29.6)	70 30 50.9971 (49.8)
Length of perpendicular =	191481.09 m.	
Point on the angular bisector of the Cape Cod Elbow to Cape Ann and Cape Sable to Whipple Point lines and at the base of the perpendicular to Cape Cod Elbow	42 32 49.3624 (50.1)	67 49 42.2470 (42.9)
Length of perpendicular =	202500.10 m.	
Point of intersection of the perpendicular and the Cape Sable to Whipple Point line	43 24 37.1749 (38.4)	65 38 30.5685 (31.7)
Length of perpendicular =	202500.56 m.	

The Judgment then continued with twelve paragraphs (para. 230-241) of examination and verification that the line rendered was equitable to both countries. Once satisfied with its line and accepted by four of the five judges hearing the case it was then brought down. One of the four (Judge Schwebel), although he concurred with the ruling, wrote his own separate opinion and the fifth judge (Judge Gros) filled his dissenting opinion.

Conclusions

Was the reporting of this analysis necessary?

This delimitation is important to both countries, and the knowledge that the computations duly reflect the desires of the Court is necessary to give both countries peace of mind. This paper has proved that the computations were done in accordance with the Court's wishes.

The technical expert championed the subtle pitfalls involved in such a computation. If any fault were to be found with the boundary delimitation, the onus should not be put on his shoulders.

The delimitation is noteworthy in the geodetic problems that must be addressed in this type of computation. Some eleboration of these problems are in this paper. Therefore, this boundary delimitation will probably become a case-study for future students of international boundary computations.

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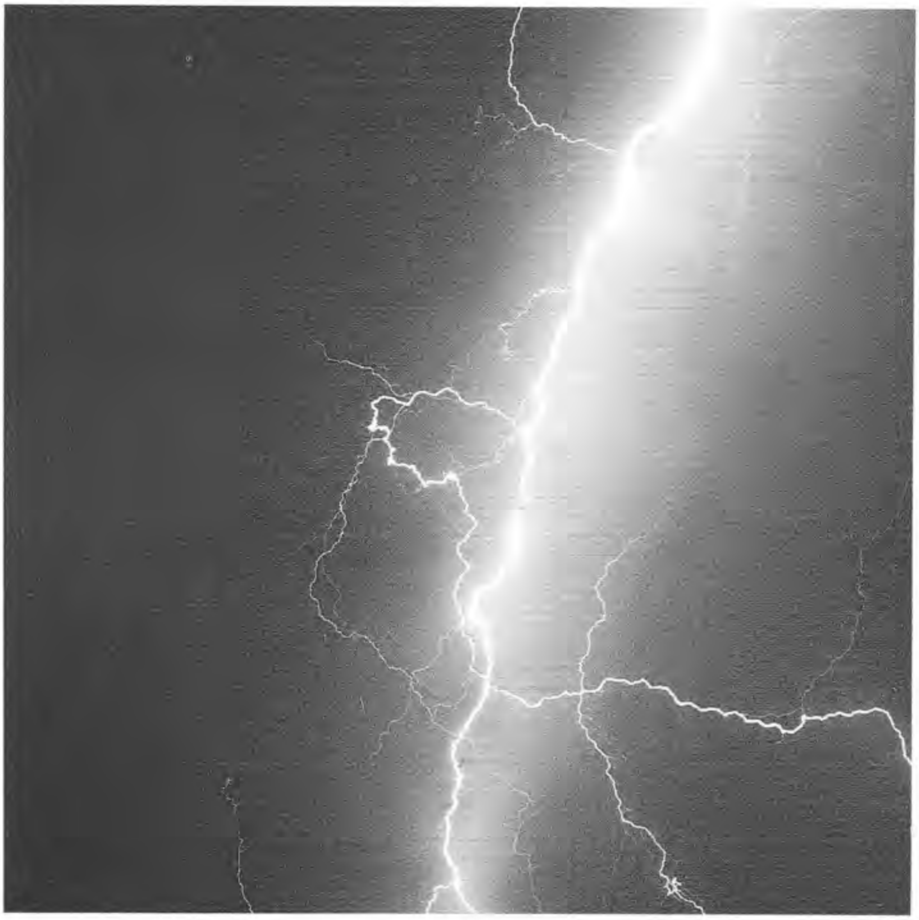

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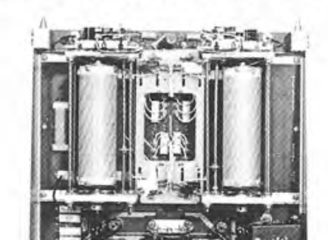

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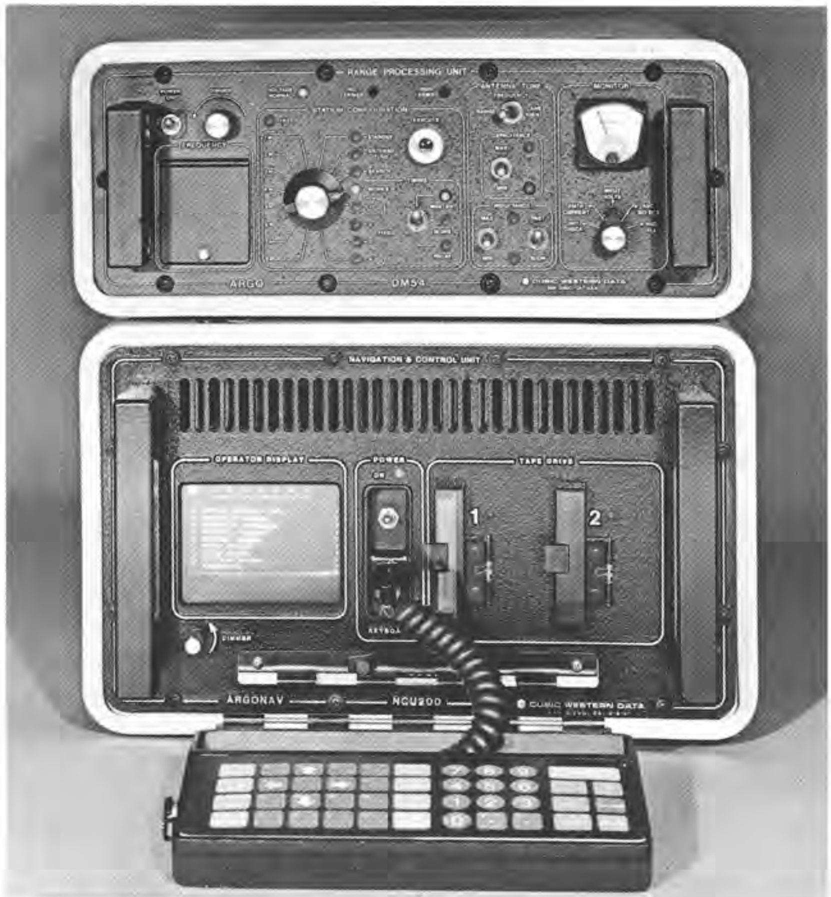

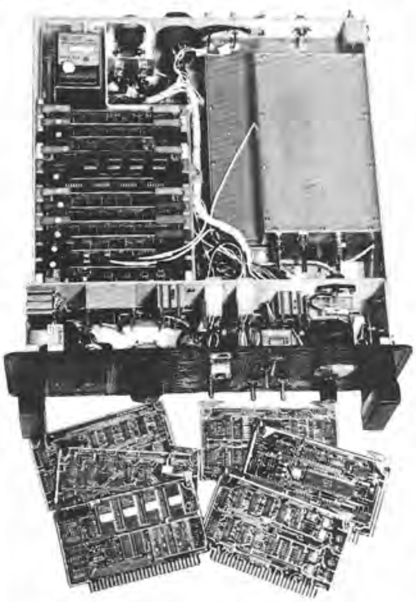

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SOME COMMENTS ON CANADIAN FISHERMAN'S CHART 43058 A 85 OF SABLE ISLAND BANK

by
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July 31, 1985
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This map series at 1:250,000 was initiated in 1983 by NORDCO Ltd. of St. John's "in Collaboration with [the] Environmental Protection Service and [the] Canadian Hydrographic Service." The map series is: "compiled under the direction of NORDCO Ltd., these charts are published to record only the dangers, obstacles and area of foul ground which may cause loss and damage to fishing gear and loss of fishing time. They are not intended for the purpose of general navigation."

"Information for these charts has been provided by experienced skippers. With a view to increase [sic] the usefulness of these charts to the benefit of all fishermen, NORDCO especially requests reports on, or further information for, this area..."

"Apart from known wrecks, most of the obstructions have been reported by skippers using bottom towed gears [sic].They have been plotted by Loran C reading as listed" (quotes taken from marginal notes of map 43058 A 85).

It is with NORDCO's request above in mind that I've prepared the following comments.

Geomarine Associates Ltd. recently ordered the Sable Island Bank map (First Edition, March 1985) produced by NORDCO Ltd. and H.A. Simons (International) Ltd. (of Vancouver) along with map 46047 A 85 of the Hibernia area. The cost is significantly more than a navigation chart and runs $14.50 for each map. I find myself either uncertain how to interpret the map or rather disappointed in the information. The Sable Island Bank map purports to display a large number of reported seafloor obstructions when in fact, the number is significantly inflated without cause.

On Map 43058 A 85 of Sable Island Bank, NORDCO shows 56 obstructions, of which 26 are "abandoned wells" and 8 are "wellheads", for a total of 34 oil industry related obstructions. (Incidently, the symbols NORDCO uses for the wells are the symbols for a "plugged and abandoned" **oil** well or for a "suspended" **oil** well instead of the industry convention for a "plugged and abandoned" well ("p and a") and for a "plugged and suspended" well ("p and s"). One could designate the full status of the wells on the maps if one wished; most are dry holes and a number have gas —alas, few have oil.

NORDCO lists 26 plugged and abandoned wells as obstructions. Were all of these recorded "by experienced skippers" as "obstructions"? I suspect not, or else some skippers went aground. It appears that NORDCO simply plotted the co-ordinates given out by the Canadian Oil and Gas Lands Administration (indeed, GOGLA is credited on the map) of the various "offshore" exploratory wells drilled since 1967 and assumed that they all are "obstructions" and assumed that they all are offshore underwater. One of the listed plugged and abandoned wells is Obstruction No. 33 shown dead center and just north of Sable Island. There is no exploratory well in this location offshore. NORDCO appears to have taken the co-ordinates of the first Sable Island C-67 well, not realized its nature, and perhaps misplotted it too far north? C-67 was the first well drilled off Nova Scotia in 1967 and it is an onshore well drilled right on Sable Island on the north side. Obstruction Nos. 30, 31 and 32 also appear to be the onshore Sable Island wells, H-58 (a group of four suspended and two abandoned wells), E-48 (suspended) and O-47 (suspended). These too appear to have been misplotted on Map 43058 A 85 to fall offshore just north of the Island.*

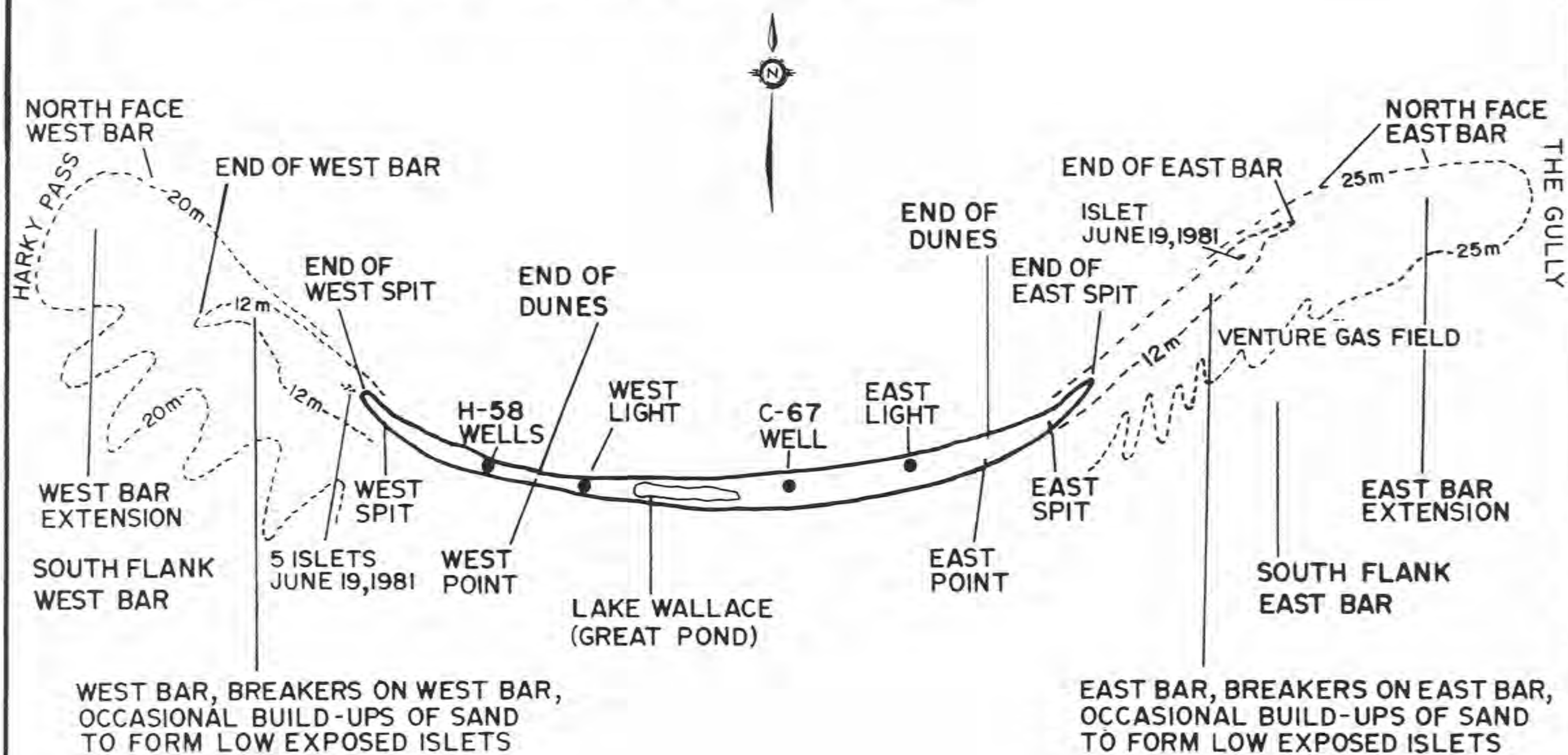
Obstructions Nos. 42 and 38 appear to be the plugged and abandoned Shell wells, Marmora P-35 and C-34 and, similarly, the group of obstructions 37, 39, 40 and 41 appear to be the four plugged and abandoned Shell Onondaga B-96, O-95, F-75 and E-84 wells, etc, etc. all around the map. I believe it is inappropriate to plot or to list a "plugged and abandoned" well on this map as an "obstruction observed by more than one skipper" **unless** an obstruction has been **actually** observed.

When an oil company plugs and abandons an exploratory well, they are required to "shoot off" the uppermost casing and baseplate using a circular cutting charge lowered down the hole to about 3 to 6 m below the seafloor "mudline". They then must lift the whole junk of metal to the rig for recycling or disposal onshore. No obstructions are to be left on the seafloor and, indeed, the companies generally strive to leave the site free of debris. The firms are also supposed to report to GOGLA all losses of equipment or debris over the side.

I am sure GOGLA would be appalled to have all plugged and abandoned wells declared to be obstructions. There have been some exceptions known to GOGLA such as the Petro Canada *et al.* West Esperanto B-78 well* where the baseplate could not

* The fact that the four onshore well positions consistently misplot offshore to the north after conversion from geographic to Loran C co-ordinates, may indicate a slight skewing of the Loran C net because of land path or other factors not yet calibrated. It may also indicate that NORDCO has mislocated the Island. The best current position of Sable Island's shoreline for mapping purposes is that seen on the June 19, 1981 colour air photos taken by the Canadian Hydrographic Service to support their detailed launch and zodiac surveys on and around East and West Bars in August, 1981. This shoreline is shown on CHS Field Sheets 4946, 4947, and 4948 at 1:20,000 (CHS, 1981a; b; c). This shoreline replaces that shown on the currently issued 1:50,000 topographic sheet (Surveys and Mapping Branch, 1964), which is based on 1963 air photos.

SABLE BARRIER ISLAND – SHOAL COMPLEX*



DIAGRAMMATIC INDEX MAP TO MAIN GEOMORPHIC FEATURES OF SABLE ISLAND AND RELATED IMMEDIATE OFFSHORE AREAS

* known as Sable BISC

FIGURE 1

come free and eventually an ROV was required by GOGLA to go down to cut off the protruding guide posts. Hopefully, that site is no longer a serious obstruction to bottom fishing gear. Similarly, a large piece of gear was dropped by Shell at the Alma E-58 well and has subsequently been salvaged.

Even the site of the OCEAN RANGER (Mobil *et al.* Hibernia J-34) had to be cleaned up by the insurers so that no debris larger than one metre in a dimension was left. There was considerable debate within GOGLA as to whether the job was done properly. In the end they passed it. It would, however, be a site to be avoided by skippers doing ground fishing.*

The only wells which should pose obstructions to fishermen are the "plugged and suspended" offshore wells where the wellhead and top 3 to 6 m of subseafloor casing have not yet been removed. Wells are left suspended with Canada Oil and Gas Lands Administration's (GOGLA's) approval on occasions where reuse is contemplated for further drilling, for testing or perhaps even for production. Such offshore suspended wells do represent an obstruction to ground fishing activities.

The NORDCO map shows the eight obstructions, 13, 29, 32, 34, 46, 48, 49 and 50, as "wellheads" which I interpret to be "plugged and suspended" wells. These eight obstructions appear to be the exploratory wells Chohasset D-42, Migrant N-20 (or the abandoned first attempt Migrant O-20), the Sable Island (West Spit) onshore well E-48, Thebaud P-84, Uniacke G-72(?), Venture D-23, Venture B-13 and Venture B-43 respectively. All of these sites, with the exception of the abandoned wells Uniacke G-72 and Migrant N-20, are "suspended" wells. Where the suspended wells are offshore they do represent obstructions to bottom fishing; the onshore suspended Sable Island E-48 well does not represent a hazard to a fisherman.

If what I estimated as Uniacke G-72 from the NORDCO map is in fact Citualta I-59 but slightly misplotted, then it too is an obstruction to fishermen since Citnalta is only a suspended gas discovery well. If the well plotted on the NORDCO map is Migrant O-20 not N-20 then it was a well which was plugged and abandoned and "junked" as the first attempt at the site by the jackup GULFTIDE. N-20 should be called a "debris site" and it is a probable hazard to bottom fishing. The well history report here records cement, chain link fencing, plastic sandbags, and such potentially hazardous material put down around the legs of the jackup in an attempt to prevent current scour and removal of sediment from under the legs. Finally, the rig was moved a short distance because of downhole problems and further potentially hazardous material was used to stabilize the current erosion around the legs again until the hole was done; these materials would only be hazardous to bottom fishing activities, however.

There are a further three plugged and suspended wells offshore around Sable Island that are not on the NORDCO map. These are South Venture O-59, Arcadia J-16 and Olympia A-12, all of which were plugged and suspended wells before the compilation of Map 43058 A 85 was completed. All suspended wells are recorded in GOGLA's publication "Offshore Schedule of Wells, 1966-1984" or the positions are available from GOGLA shortly after the well is begun. (A note of caution here; GOGLA seems unable or unwilling to give precise co-ordinates in its "Weekly Status of Oil and Gas Activities on Canadas Lands". Persons wishing precise final co-ordinates must wait for GOGLA's often-delayed updates to the "Offshore Schedule of Wells" or preferably turn to the Surveyor General of Canada, to Nova Scotia Department of Mines and Energy or to the Newfoundland Petroleum Directorate, (all of which generally exercise more care in reporting the co-ordinates.)

The NORDCO map of Sable Island Bank is also deficient in not recording the known and well-documented positions of the two halves of the 1942 loss of the liberty ship INDEPENDENCE HALL, a further eight known wrecks of probable steel vessels and ten known debris sites from other vessels (Ruffman, 1983a.). These positions are quite precisely known from the 1:20,000 Canadian Hydrographic Service field sheets 4946, 4947 and 4948 prepared in 1981 CHS (1981a; b; c). Most of these wrecks can be seen on the June 19, 1981 airphotos. There are two other wrecks known which are essentially on the beach of Sable Island as opposed to offshore. These were the SS ALFIOS which sank April 23, 1946 on the south side of Sable Island and the SS SKIDBY which stranded on January 31, 1905 on the north side.

My recommendations for the NORDCO series of "Canadian Fishermen's Charts" are in general that:

a) The legend be changed to conform to the conventional industry symbol for plugged and suspended wells.

b) **No** "abandoned" exploratory oil and gas wells be shown as obstructions **unless** there is experience to show that there actually is an obstruction. (If there is abandoned debris, it will be of great interest to GOGLA and they may require that it be removed to return the seafloor to its unimpeded state.) If an abandoned well is shown, the appropriate symbol should be used.

c) I would recommend that "in use" cables such as the Teleglobe Canada CANTAT 2 cable, shown on Map 43058 A 85 (as the easternmost cable), be shown as a solid unbroken cable symbol and that "out of use" (OOU) cables be shown as a broken symbol (as presently done on Map 43058 A 85 (i.e. the "HFX-SJN" cable laid by the Cable and Wireless Company in 1876 and which is seen to the very southwest on the NORDCO map sheet). This symbology would then conform to the CHS charts.

d) I would recommend that the series be called "Canadian Fishermen's Bottom Obstruction Maps" or preferably "Canadian Skipper's Bottom Obstruction Maps". I don't believe the series sould be referred to as "charts" since they are not intended to be used for navigation.*

I would specifically recommend that:

e) The Sable Island Bank sheet 43058 A 85 be withdrawn until the 25 or so non-obstructions are removed (i.e. the plugged and abandoned wells which have no reports of debris or hazards) and until the 1981 CHS obstruction data around Sable Island is added. (Geomarine will at that time be able to contribute one precisely-known wreck and possibly be able to combine a number of fishermen's observations into one position as a result of our own survey activities.)

f) I also believe that the map is deficient in not showing, at least approximately, the now well-known outline of the hazardous section of the Sable Barrier Island-Shoal Complex (Sable BISC). Any vessel that ventures onto West or East Bar (or the Spits) will surely run a great risk of running aground. We have defined in our work for Mobil Oil Canada Ltd. "East Bar Extension" and "West Bar Extension" as being the reasonable limits of the bathymetric hazard as defined in Appendix 1. On such a map, I would recommend that the limits of East Bar Extension and West Bar Extension be shown on Map 43058 A 85 when

* The West Esperanto B-78 official position is: 44° 47'03".41 N and 58° 26'11."22 W and the Hibernia J-34 position is: 46° 43'33."84 N, 48° 50'13".00 W (GOGLA, 1985).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revised per the definitions in Appendix 1 and shown on the accompanying diagrammatic index figure (Figure 1).

These definitions and the index figure (Ruffman, 1983c) first appeared in the August, 1983 Mobil Oil Canada Ltd. Supplement to the Venture Development Project Environmental Impact Statement (pp 78-83), then later appeared in Newsletter #2 of the Sable Island Bank-Banquereau Working Group (SIBBWG) of May 18, 1984.

g) Finally, I would recommend that the Hibernia sheet of NORDCO's map series, No. 46047 A 85, be re-examined for possible revision in the light of the above suggestion a) to e).

* There is a precedent for the use of the term "maps" as opposed to "charts". When CHS first published the coloured 1:1,000,000 maps of interpreted bottom contours, they were referred to as "Bathymetric Chart" 801 (CHS, 1969) and 802. When the Geoscience Mapping Section of CHS developed the coloured 1:250,000 series of maps of interpreted contours, the series became the "Natural Resource Series of Maps" (NRM) (e.g., Finlayson, 1973). NRM 801 and 802 are now being updated by whole new series of 1:1,000,000 sheets called National Earth Science Series (NESS) of "Maps" available through the Canada Map Office. The operative word is "maps" with none of the implications (or legal responsibilities) of a "chart".

None of the above critical comments are meant to in any way depreciate from the real value of the NORDCO series of maps showing wreck and other obstructions. My remarks are meant only to challenge NORDCO for improvement. Far too long we scientists have tended to downplay folk knowledge, folklore, old wives tales and other very real and valuable "non-scientific" data: the fact remains that men (and some women now) who work daily at sea interacting with the seafloor through bottom-towed gear come to know that seafloor very intimately. Hence, we find the picturesque names of seafloor features on the Scotian Shelf such as "The Stone Fence," the "Cow Pen" or the "Bull Pen", or even the sexist and suggestive name of Montresor on his 1768 chart; "My Lady's Hole". These active skippers come to know obstructions as hazards to avoid (or in some cases to exploit) and record their co-ordinates carefully. As scientists, we can but profit from their observations.

The Decca chains of the 50's to 70's allowed the skippers to have a reasonable degree of repeatability; now Loran C has further improved their accuracy.. We are indebted to NORDCO, to the Environmental Protection Service and to CHS for initiating the series. For the map under discussion on Sable Island Bank, we are most appreciative of the following skippers' contribution to the Sable Island Bank sheet: Peter Atwood, Alex Green, Ed Hanson, Hentry Marks, Morris Nowe, Pat Savoury and Donald Weagle.

It is to be hoped that the bottom obstruction series of maps will prove useful and will be continually improved by other skippers' input and by such impertinent remarks as mine. The Canadian Department of Defense could also contribute by declassifying their exact co-ordinates of those wrecks on their NSC Series of Charts (Non Sub Contract) which have already been defined by skippers as wreck hazards on the first editions of the Obstruction Maps. In this way DND would not be revealing the locations of any potential submarine hiding spots, but rather would be contributing to safer more economic fishing activities by Canadian skippers.

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APPENDIX I — Morphologic Terminology used on Sable Island Bank

Sable Island Bank	- as generally used for many years on Canadian Hydrographic Service Charts (e.g. CHX 1973; 1978);
Sable Barrier Island-Shoal Complex	- all the sedimentary complex (which can be referred to by the acronym Sable BISC) which is encompassed by Sable Island, West and East Bar, West and East Bar Extensions and by the North Face and South Flank of West and East Bar. The full extent of the Sable BISC is not completely known; its vertical extent is to the bottom of the Holocene advance;
Sable Island	- all that area of exposed sand, above the "lower low water large tide" or LLWLT chart datum of the Canadian Hydrographic Service, which is attached to the main Island (recognizing that portions of West or East Spit may be extended or retracted from time to time by sand build-up or loss);
West Point	- western limit of dunes on Sable Island;
East Point	- eastern limit of dunes on Sable Island;
West Spit	- low, nearly flat, western extension of the Island that is, at most, two or three metres above sealevel and eventually levels out to the west to virtually sealevel;
East Spit	- low, nearly flat, eastern extension of the Island that is, at most, two or three metres above sealevel and eventually levels out to the east to virtually sealevel;
West Bar	- submerged, westward extension of West Spit within 0 to 12 m water depths; areas of breakers on shoals may exist within this area on top of West Bar; shoal areas can be highly variable from season to season; shoals may build up to

small, exposed islets of flat, bare sand that are often and easily awash;

East Bar	- submerged, eastward extension of East Spit within 0 to 12 m water depths; areas of breakers on shoals may exist within this area on top of East Bar; shoal areas can be highly variable from season to season; shoals may build up to small, exposed islets of flat, bare sand that are often and easily awash;
Breakers	- areas that are so shallow (0 to about 2 m) that virtually all waves or swells break on them (see CHS Field Sheets 4946 and 4948; CHS, 1981a; c);
Islets	- exposed areas of flat, bare sand that have occasionally been built up on the Bars as small islands just above sealevel in the earlier areas of breakers. There were five islets directly off the west end of West Spit on June 19, 1981 (Canadian Hydrographic Service, 1981a) and one islet near the end of East Bar on the same date (CHS, 1981c; Kerr, 1983). The islets come and go regularly and are by no means constant features (see for example, Goldthwait (1924, p. 147) where he reports a 1913 flurry of newspaper comment on the creation of new islets at Sable Island);
West Bar Extension	- submerged westward extension of West Bar within 12 to 20 m water depths (and any areas beyond the end of West Bar that may build above 12 m or any lows within West Bar Extension that may be deeper than 20 m);
East Bar Extension	- submerged eastward extension of East Bar within 12 to 25 m water depths (and any areas beyond the end of East Bar that may build above 12 m or any lows within East Bar Extension that may be deeper than 25 m);
North Face of West Bar	- steep northern slope of West Bar which extends all along the northern edge of West Spit, West Bar and West Bar Extension from about the end of the dunes at West Point to beyond the western end of West Bar Extension; the North Face of West Bar drops from 5 to 20 m on the east near West Spit and drops from 15 to 30 m further west, near the western end of West Bar Extension;
North Face of East Bar	- steep northern slope of East Bar which extends all along the northern edge of East Spit, East Bar and East Bar Extension from about the end of the dunes at East Point to beyond the eastern end of East Bar Extension; the North Face of East Bar drops from 5 to 20 m on the west near East Spit and drops from 10 or 15 to 50 m on the east, near the eastern end of the East Bar Extension; the North Face of East Bar is almost twice as high as the North Face of West Bar;
South Flank of West Bar	- very gently sloping southern margin of West Bar and West Bar Extension which extends from 20 m water depth southward out onto the continental shelf;
South Flank of East Bar	- very gently sloping southern margin of East Bar and East Bar Extension which extends from 25 m water depth southward out onto the continental shelf;
Harky Pass	- geographic name applied by Geomarine Associates Ltd. (Ruffman, 1983b; d; d; Ruffman *et al.*, 1983) to the linear low of up to 32 m depth which separates West Bar Extension from the Northern Spur of Sable Island Bank;
Wreck	- submerged wreck of a vessel with a discernible outline that clearly can be identified as a ship's hull. These are probably only going to be the steel ships at Sable Island;
Exposed Wreck	- wreck which is at all times above the "lower low water large tide" or LLWLT chart datum of the Canadian Hydrographic Service, e.g., the SKIDBY and the ALFOIS, as seen on the June 19, 1981, aerial Hydrographic program;
Debris Site	- mapped site of submerged wreckage, cargo or ballast or other such debris of probably human origin that does not have a discernible hull shape. Debris sites probably mark old wreck sites that have been severely reworked by wave action. In at least one case a wellsite is classed as a debris site; at Migrant O-20, then N-20, considerable material was dumped to combat sediment scour around the legs of the jackup rig, GULFTIDE, in 1977 (Ruffman, 1983a).

NOTE: Because of the different slopes on the south sides of the Bars, West Bar Extension is defined as being from 12 to 20 m of water depth and East Bar Extension is defined as being from 12 to 25 m of water depth (see Figure 1). There is a natural break to the west, beyond about 20 m water depth along West Bar Extension, that serves as a natural morphological termination on the west, to the West Bar Extension. We have used the name Harky Pass for this feature (Ruffman, *et al.*, 1983), in recognition of Professor Harcourt (Harky) L. Cameron, who worked on Sable Island's morphology while associated with the Nova Scotia Research Foundation (NSRF) in 1965*. To the east, East Bar Extension is effectively terminated at about 25 m by the edge of the shelf-edge canyon, known for years as The Gully.

Thus, using the suggested terminology, the proposed Venture production platform sites are located near the southern margin of East Bar Extension, the ZAPATA SCOTIAN was drilling as Arcadia J-16, just to the north of the base of the North Face of East Bar; and the two halves of the wreck of the INDEPENDENCE HALL are located to the west-southwest of the end of West Spit on the southern margin of West Bar (Ruffman, 1983a).

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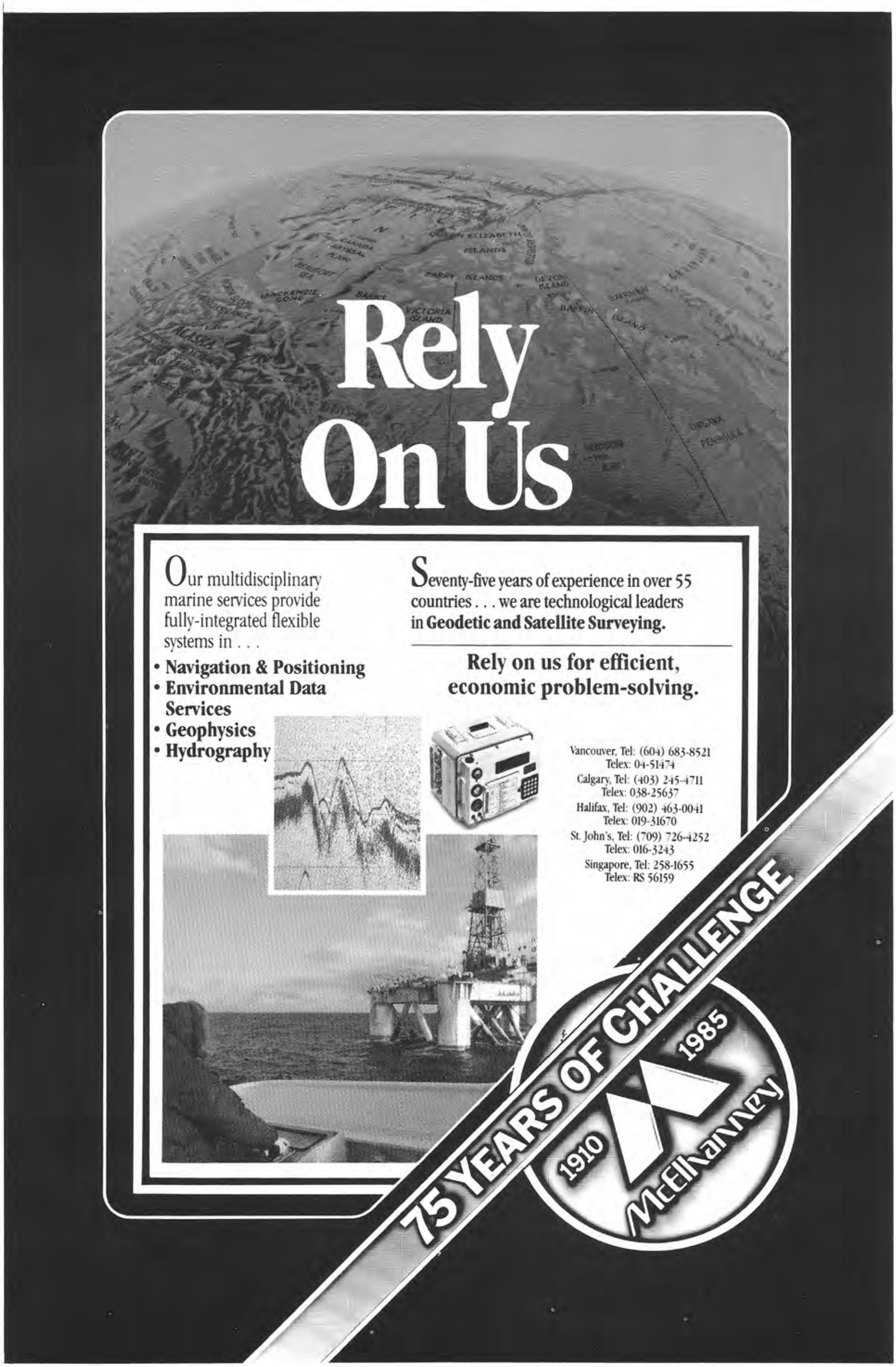
* Professor Harcourt L. Cameron died shortly after he wrote his paper on Sable Island (1965). All of Cameron's original materials including his Sable Island maps were deposited in The Public Archives of Nova Scotia by Dr. Don Bidgood of N.S.R.F. in mid-1983; contact Gary Shutlak at P.A.N.S. for access.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THE INFLUENCE OF INTERNATIONAL STANDARDS ON THE TRAINING AND EDUCATION OF HYDROGRAPHERS

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ABSTRACT

In 1972 two international organizations FIG (Fédération Internationale de Géomètres) and IHO (International Hydrographic Organization) decided that some form of international accreditation for hydrographic surveyors was desirable. The former was concerned with the need for commercial firms working in the offshore to have some recognized certification of the quality of staff which they might employ. The latter was driving towards providing developing nations with a capability in hydrographic surveying and this meant the training of personnel.

A jointly sponsored working group was set up which later led to the formation of an International Advisory Board. A standard Syllabus and recommended levels of experience were established. It was realized from the start that individual accreditation was impractical and a decision was reached to accredit individual teaching establishments. They in turn could provide individual certification if they wished.

The Board and the Standards have now been in place for eight years. The process is now well established and although amendments have been made each year to fit new and changing circumstances the result has been to increase the completeness and quality of hydrographic training throughout the world. Institutions which had apparent gaps or weaknesses in their Syllabi have been urged to improve them. Schools, such as the Indian Navy's Hydrographic School at Goa, funded partly by UNDP, now offer their courses to developing countries on an international standard that is followed by several advanced industrial nations, including France, the United States and the U.K.

Introduction

During the International Congress of Surveyors (FIG) at Wiesbaden in 1971 concern was voiced that there were no international standards of competence for hydrographic surveyors. This concern was particularly felt by companies working in the North Sea offshore oil industry that would have liked a set of Standards that would assist them in selecting personnel. A year later at the International Hydrographic Conference in Monaco, the position was put forward by Canada that there was a need for international training standards as an aid to developing countries in setting up their own hydrographic courses. (Kapoor, 1980)

As a result of the interests of FIG and IHO, a joint Working Group was established in 1974. The report of this group was presented to the two parent bodies in 1977, and resulted in the publication of Standards of Competence for Hydrographic Surveyors and the formation of an International Advisory Board to administer the Standards.

It had been realized earlier that it was impractical for an international board to administer standards for individuals in different countries and it was proposed that educational institutions be accredited as being capable of producing hydrographic surveyors. These surveyors were classified into Categories A, B and C. Only the first two categories were given direct attention, and these are defined as follows:

Hydrographic Surveyor, Category A. A comprehensive and broad-based ability in all aspects of the theory and practice of hydrography and allied disciplines. With appropriate experience, to be able to plan and direct any type of hydrographic operation and take responsibility for its accurate and thorough execution. To be able to develop new approaches to hydrographic operations and assess recorded data.

Hydrographic Surveyor, Category B. A practical comprehension of hydrographic surveying and skill in carrying out the various hydrographic tasks. He will normally work as an assistant, but, with appropriate experience, will be able to perform these tasks without direct supervision and be able to analyse the recorded data.

The Standards were defined primarily with two elements: a Syllabus that must be adhered to at a defined level dependent upon whether A or B category, and a requirement with respect to practical experience. The practical experience includes a part of the actual training and basic experience, defined as an aggregate period of at least two years in the field.

The method of administering the Standards is that by working through a National Focal Point in each country, educational institutions may submit programs on the education and training of hydrographic surveyors to the Advisory Board. The Board will then compare them against the Standard and either advise on amendments, reject or approve against one of the two categories. The Board does much of its work by correspondence but meets once a year to review courses and to amend the Standards in accordance with suggestions and evidenced needs. To date five Category A courses and two Category B courses have been awarded as reaching the Standards. Interest in the process appears to be increasing and at present the Board is reviewing approximately four courses each year.

The Standards

Hydrographic surveyors enter the profession from a wide variety of backgrounds, depending particularly on whether they are part of naval hydrographic offices or from private industry. In Canada we are somewhat anomalous in having a civilian government hydrographic office. Backgrounds vary from graduation at naval academies, to diplomas from technological institutes, university degree courses in surveying or other physical sciences. Unlike their oceanographic cousins, they do not normally pursue their academic studies to the doctoral level, but in industry, a number of hydrographic surveyors have practiced earlier careers as Masters and Mates of merchant vessels. To attempt to bring all these varied academic backgrounds to a reasonably common point the Standards establish a set of basic subjects in Mathematics, Mechanics and Statistics; Measurement Science (Theory); and Measurement Apparatus and Systems. The Standard permits exemption in these subjects provided that the National Focal Point can confirm that these are prerequisites for the entry to a course being submitted. (IHO-FIG 1983)

In the Syllabus, two subjects are required as support to the main core. These are Automated Data Gathering and Processing and Environmental Sciences. The former concerns the ubiquitous computer which has now entered every phase of a surveyor's work. The latter recognizes the fact that hydrographic surveying today is truly multidisciplinary and that the student must have a good understanding of subjects such as Oceanography, Geology and Geophysics. There are two core subjects required to be covered in detail. These are Terrestrial and Marine Surveys. Finally there are two subjects which may be considered peripheral to the main studies required for a hydrographic surveyor. These are Law of the Sea and Nautical Science. In retrospect, the Board now considers Law of the Sea a specialist subject that is more applicable to government offices than to Industry. The requirement for Nautical Science, which in essence means navigation, seamanship and meteorology, has been contentious. Some believe that a hydrographic surveyor must be a true navigator and sailor. Others, including the Board, believe this to be an impractical requirement for all to comply with. It is an essential requirement, however, for hydrographic surveyors to understand operations aboard ships when at sea. (Kapoor, 1980)

The Influence of the Standards on Professional Development

It is now eight years since the first edition of the Standards was issued. As noted earlier, seven courses have been approved. Four more are currently before the Board seeking approval. The majority of thoses courses that have been approved have required some form of amendment before final approval has been given. Sometimes these amendments have been minor and at times major. There has been, in some instances, a reluctance by the submitting institutions to incorporate subjects that they have felt not applicable to the work for which they were preparing their students. However the Board has generally been of the opinion that graduates will be recognized as having passed a program categorized and approved against the Standard, and that they may move to another employer with a credential valid for the entire hydrographic survey profession. The result has hopefully been to produce graduates with a broad base of knowledge, who can readily move from Government to Industry and vice versa. There have been some comments that the Standards are unduly demanding and unnecessarily broad and this will be discussed later.

The use of the Standards by developing countries as a basic Syllabus for developing courses is not completely known. Certainly the Hydrographic School at Goa, India is partly funded by UNDP as a measure to provide a centre for teaching hydrographic surveys for developing countries in Southeast Asia. (Naval Hydrographic Office, India, 1982) Its courses have been approved by the Board in meeting the Standards at the 'A' level. A course recently reviewed by the Board for the Australian Maritime College, in Tasmania, has plans to set itself up as a training centre in hydrography for persons from the western Pacific countries. In Brazil, there is a very active hydrographic school associated with the Naval Hydrographic Office which offers instruction to persons from other South American countries. Although that organization has not yet requested accreditation of its courses, it has participated very actively by providing a member of the Board. An important move recently has been the provision of a Syllabus in Port Surveying to the new U.N. Maritime Institute al Malmo, Sweden. This Syllabus has been provided by the International Hydrographic Organization and is essentially modelled along the lines of the Standard.

Rather an anomaly in the system has been brought about by a request to the Board to accredit the program of the U.K. Royal Institution of Chartered Surveyors which provides a program of examinations rather than of courses leading to examinations. This organization provides a hydrographic specialization and as it is widely considered, may indirectly result in a dissemination of the Standard throughout many developing countries of the Commonwealth

In establishing the Standards there were some who argued for lower levels of knowledge in order to be acceptable to developing countries. However, it was recognized that in a number of developing countries modern hydrographic equipment was already in use and it was therefore not reasonable to have too low a level. It was realised that nevertheless the hydrographic instruction between countries was quite variable and that it was sensible to use a minimum level as the Standard. Several of the courses submitted have been in several areas well above the minimum Standard but all are now similar in terms of the subject matter taught.

It is clear that during its rather brief tenure the Board has established itself as a rigorous and demanding group and this in turn is steadily resulting in a world-recognized standard of education and training for hydrographic surveyors. At the same time the Board has left itself open to consider amendments to the Standards as the profession itself changes with the adoption of new systems and methods. The fact that there is some concern in hydrographic circles that there may be some use of the accreditation in selecting graduates for work with Industry shows that the system is working according to its design. At the same time some care must be exercised in ensuring that the system does not develop elitists but rather that an improved Standard of hydrographic education and training becomes available to those who seek it.

Future Developments

Although the Standards were established to cater to both the needs of FIG and IHO, and thus to those of Industry and Government, it has become clear that to date the Standard has been more accessible to the latter than to the former. Part of the difficulty has been associated with the requirement for two years of practical experience. Government Hydrographic Offices with associated training establishments have not found this a difficulty. Young hydrographic surveyors entering the profession are simply programmed through several years of sandwiched theoretical and practical training. Typically, a recruit may spend three years at a naval academy studying navigation, seamanship and all aspects of naval warfare. This would be followed by three years of seagoing aboard a warship, then into a basic hydrographic school ashore followed by two or more year's practical hydrographic experience and finally to an advanced theoretical school ashore for six months or more. In most cases this type of program is not available to civilian non-governmental education institutes, as normally they only have students available for classroom instruction. While most such institutions do insist on some form of field camp, this is only for a limited period. Until recently the heavy requirement for field experience, which is nevertheless only a minimum requirement, has not been possible to meet except by those institutions with a "sandwich" plan. Since the civilian institutions, such as the North East London (Ingham, 1978) and Plymouth Polytechnics in the U.K., and the Humber Institute and University of New Brunswick in Canada, that are the main source of recruits for Industry, the Board has recently decided to take action. A new academic Standard covering categories A and B has been established that requires only compliance with the Syllabus. The concept proposed by the Board is that a national organization, such as the Canadian Hydrographers' Association in this country or perhaps the RICS or the Hydrographic Society in the U.K., Netherlands or U.S.A. could use this international accreditation of a course to insist that graduates complete two years of defined experience before being granted national individual accreditation by one of those bodies.

A second area of concern to the Board has been the demanding breadth of the Standard. It has been pointed out that the knowledge requirements for port surveyors are different from those surveying with the oil industry offshore and that the requirements of Industry are in some aspects different from those of Government hydrographic offices. "Why,", it may be asked, "does a government surveyor need to learn about geotechnical soil reconnaissance?" or "Why, does the Industry surveyor need to learn about chart compilation processes?" Certainly, all knowledge is of value, but to insist upon a student studying a subject that he will never meet in his professional life requires questioning, particularly if a course has a limited duration.

An earlier approach to the above matter was to partition the subject matter of the Standard in association with different subdisciplines of hydrographic surveying. It was felt for instance that a port surveyor might be more interested in photogrammetry than offshore positioning by satellite and that for an oil and gas industry surveyor the requirement would be reversed. However even this small example tends to question this idea with the satellite positioning system GPS threatening to provide a common basis for all positioning. An approach which is now being given some thought is based on the idea that all surveyors at sea require some common basic knowledge. On study it was found that there is a rather large core of basic knowledge. For instance, all hydrographic surveyors, and indeed all surveyors, must have a good knowledge of Mathematics and Physics. Moving then to one step of specialization, all must have a good knowledge of Geodesy, Acoustics, Computer Science and Marine and Terrestrial Surveying. All, as has been argued earlier, must by familiar with Nautical Science. It is only when we specialize still further is it possible that not all hydrographic surveyors need to know all the possible subjects. It has therefore been suggested that there could be a selection of peripheral subject modules from which the student could select a certain number but need not take all. Geology, Geophysics, Cartography, Law of the Sea, Oceanography might all be in the form of modules from which a selection could be made. Although this approach infers that a graduate may not be versed in every aspect of every subject, he/she will have at the very least a solid grounding in the essential subjects.

It should be stressed that these latest developments are still being considered. It must also be emphasized that the Standard is not static and that the Board is very much aware of its commitment to both Government and Industry, to produce an excellent world class of hydrographic surveyors to meet the needs of the future in both the developing and developed nations.

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FIG '86 - Preliminary Announcement

The Canadian Institute of Surveying is honoured to host the XVIII Congress of the International Federation of Surveyors in Toronto, Canada from June 1-11, 1986. The Congress will feature an informative technical program, excellent exhibits, interesting tours and excursions and an exciting social program. To have your name added to the mailing list for the preliminary announcement, write to:

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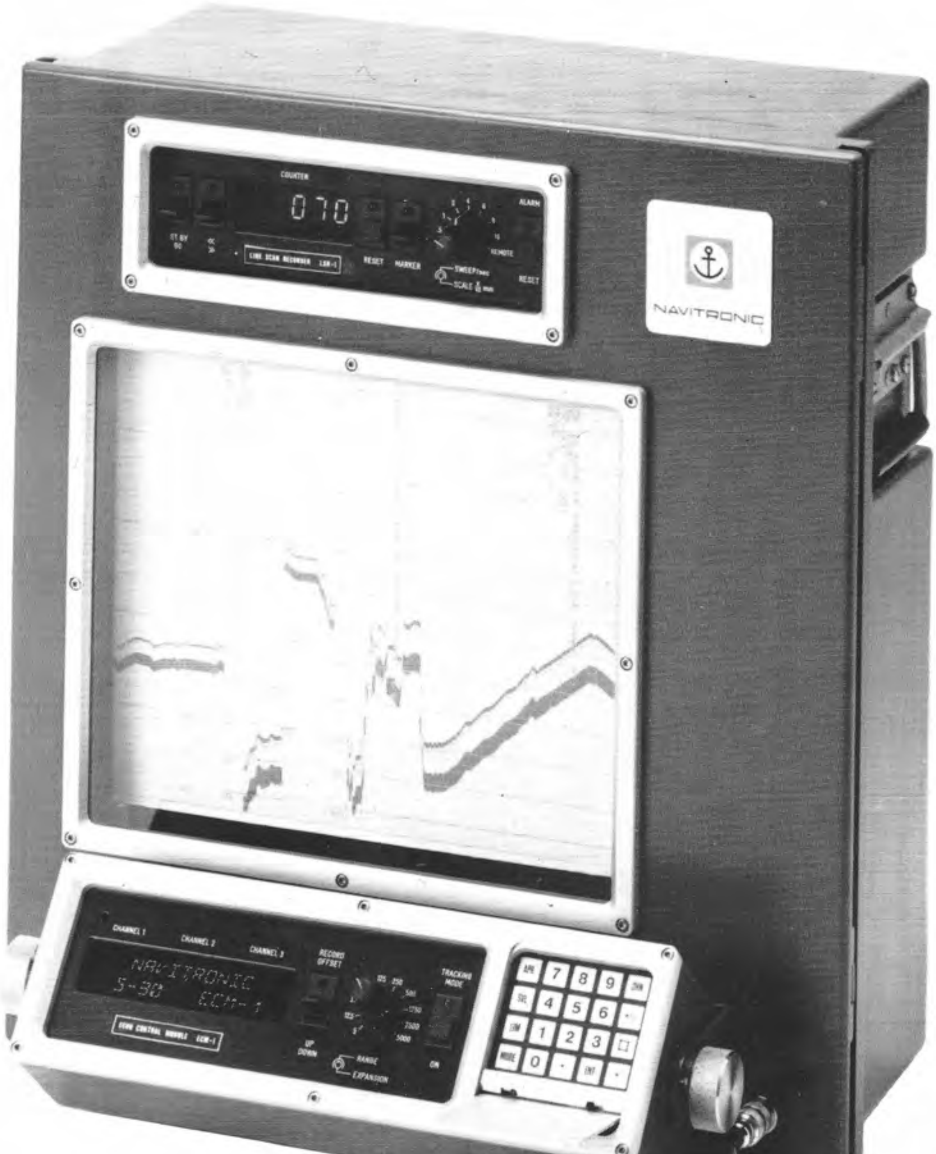

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