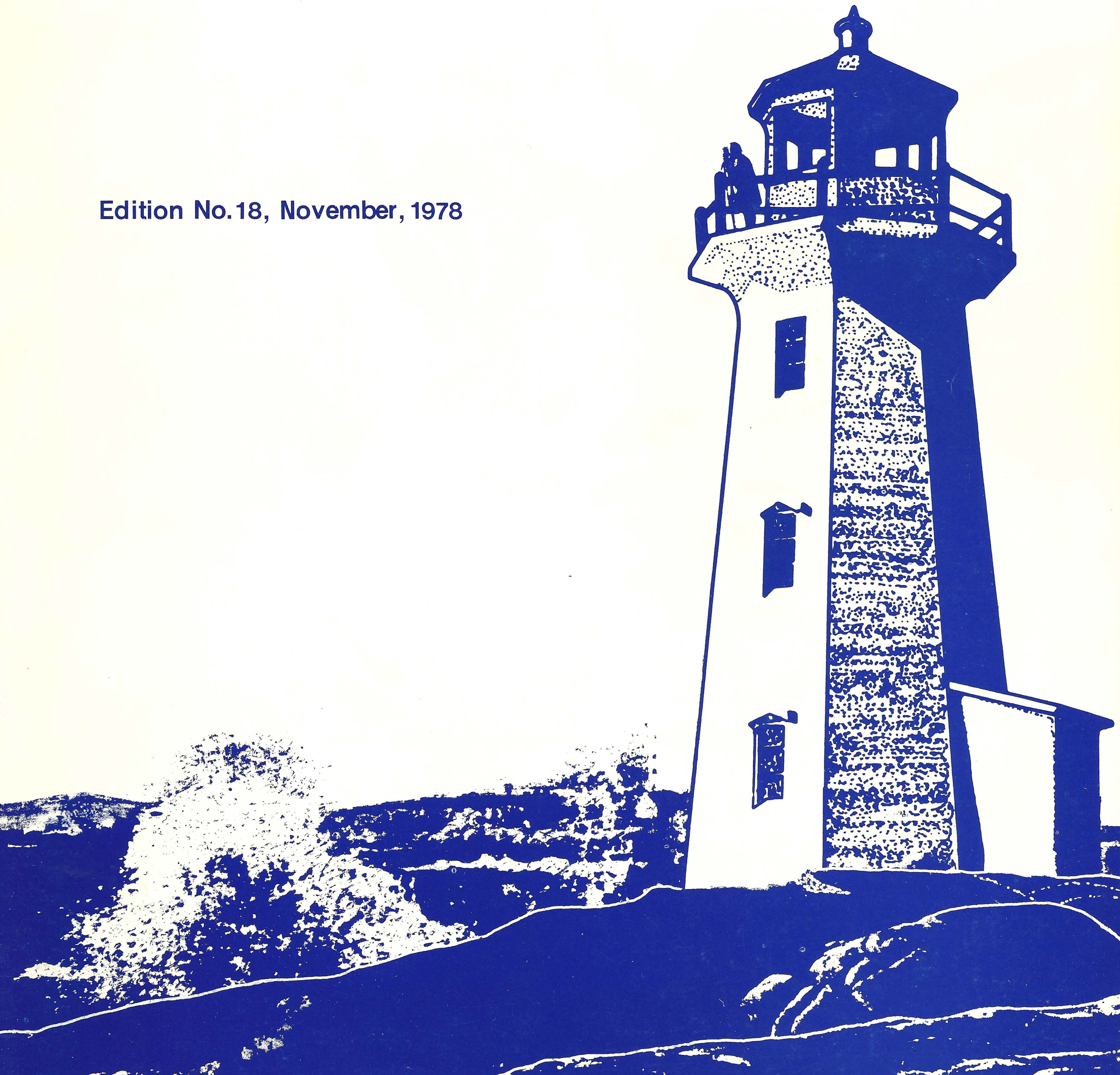
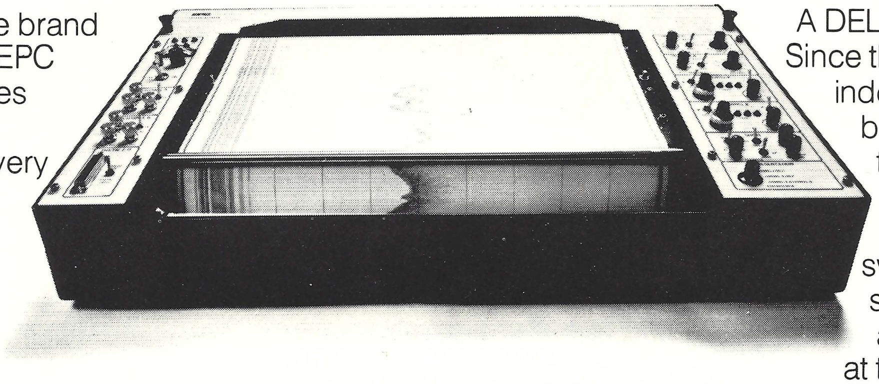
Lighthouse

JOURNAL OF THE CANADIAN HYDROGRAPHERS' ASSOCIATION

Edition No. 18, November, 1978



Announcing the one that does it all.



No baloney. The brand new dry paper EPC Model 3200 does everything.

It includes every worthwhile function on existing side scan, profiling and spectrum recorders.

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1/64TH SECOND DISPLAY.

The Model 3200 displays at ten rates between 8 seconds and 1/64th second. At the 1/64th second (15.4 millisecond) rate, it offers an unprecedented high resolution look at shallow water—8 times higher than ever offered before—displaying the first 35′ across a full 19.2″ record.

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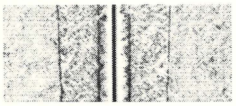
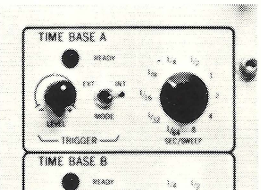
The 3200 can record a single channel across the entire printout—or record simultaneously on two channels, splitting the print-out in half. In the two channel mode, each channel is operated by a totally independent time base. It can therefore simultaneously record two different energy sources, sweep at two different speeds, and even sweep in two different directions.



Run on two channels as the ultimate 19.2″ dry paper center-out side scan. Or with two energy sources creating a high resolution shallow profile while simultaneously recording deep seismic penetration data.

A creative mind boggles at the possibilities.



A DELAYED BY B.

Since there are two independent time bases available, the 3200 can initiate a key pulse, delay the sweep by the time selected at B and then sweep at the time selected at A. Delay ⅛ second, sweep at 8 seconds; delay 8 seconds, sweep at ⅛ second.

Crucial data therefore can be located accurately, and compressed or expanded to suit your needs.

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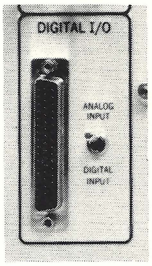

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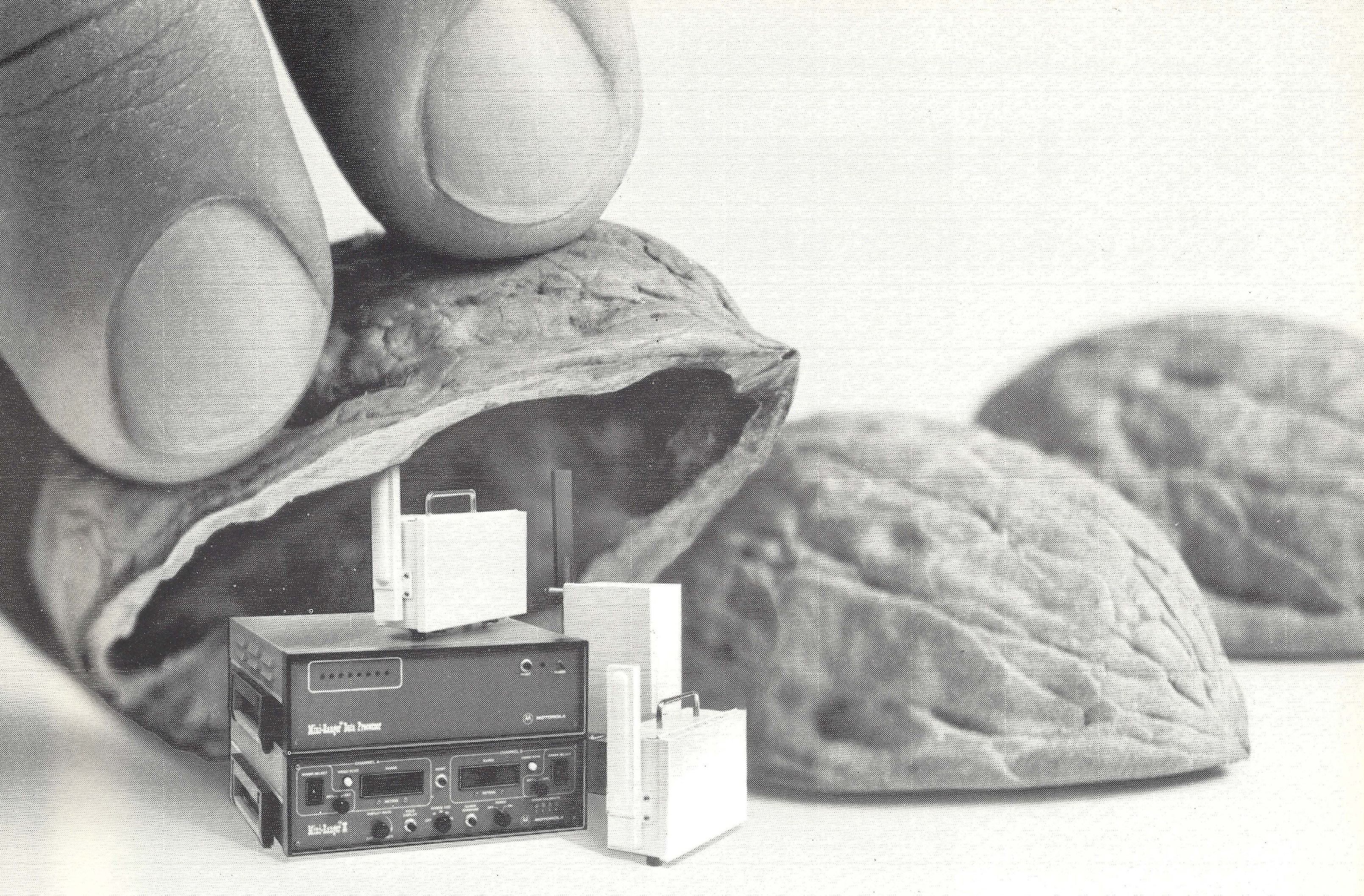

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But if, by accident or design, you happen to get a fair distance off the direct track to the next waypoint, the Internavigator will give you the true bearing to go straight to it.

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And finally, a unique plus. Thanks to velocity aiding through a built-in least squares recursive filter, Internavigator readouts are smoother than anything you've seen before. So smooth, in fact, that it's TD display is actually *more precise* than that of the receiver which is driving it. The CC2 operates from Internav 101, 104, 204, and 123 receivers, and costs $4,500. We'd call that a very competitive price — except that we don't seem to have too many competitors.

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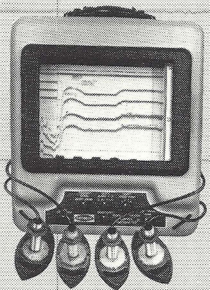
channel sweeping.



The Channel Sweep System, DE-719-CSS is significantly faster than the bar-sweep method of channel depth survey. This portable system operates in any type craft, with only one operator. It provides 100% bottom coverage and operates effectively with or against the current. Multiplexed 200 kHz transducers provide overlapping sonic beams to the recording fathometer making it possible to conduct sweeping and post-dredging soundings simultaneously.

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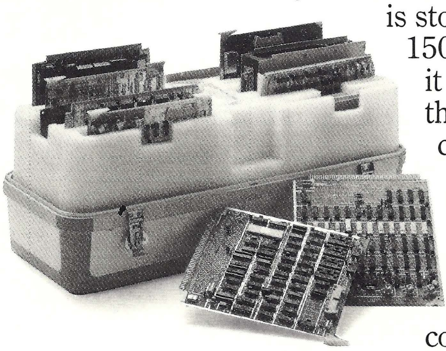
The MX 1502 Geoceiver makes sure you get valid data automatically. All satellite information is stored in the MX 1502's memory as it is received, then written on cassette tape for post-processing. Automatically, the tape is partially rewound and the entire contents checked against the memory. You end up with a bit-perfect final recording. If bit-perfect data isn't recorded, an alarm sounds—the beep that tells you to take corrective action in the field.



Accurate, Reliable Data.

The MX 1502 receives satellite signals on two channels to eliminate ionospheric refraction errors. Typical accuracy reaches 0.5 meters in Translocation.

Set up in minutes, the MX 1502 then operates completely automatically. It anticipates and tracks acceptable satellite passes, saving power and eliminating multiple satellite pass interference. It even tells you when you have sufficient data to meet the specified accuracy of your survey, saving time and needless expense. It self-tests and identifies any questionable circuit board or subassembly—field-repairable in less than 30 minutes.

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The MX 1502 Geoceiver gives you a reliable end result. Accurate geodetic positioning data, verified at the survey site. That's economy in itself. And since the MX 1502 costs less than you might expect, you'll realize cash economies too.

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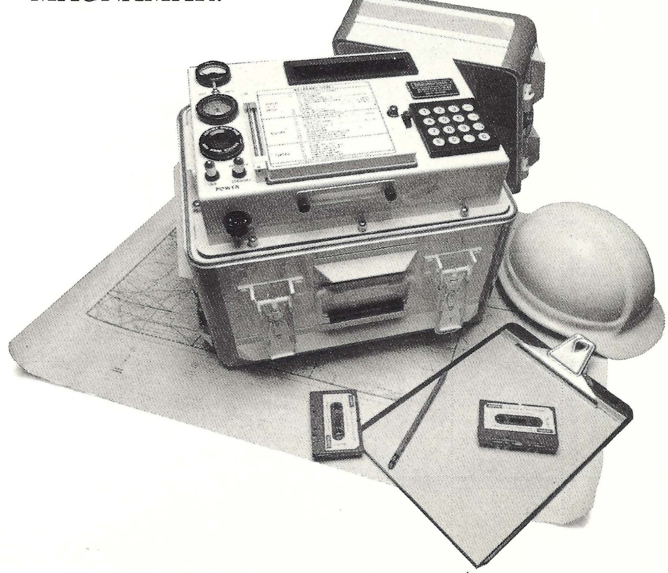

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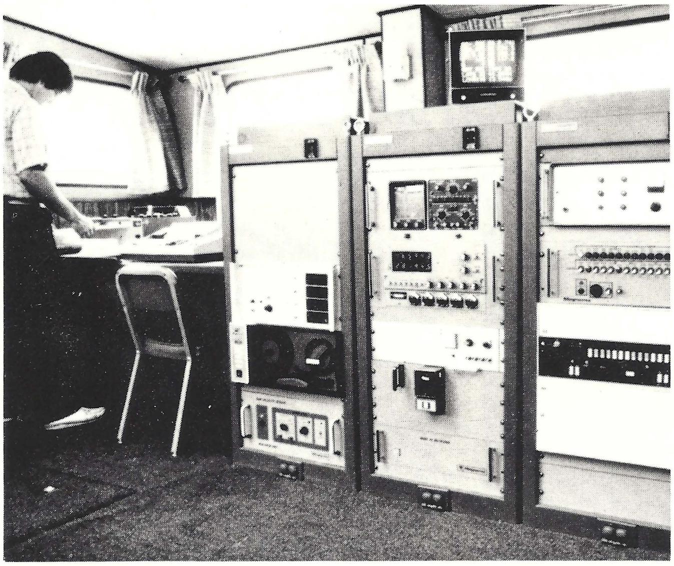

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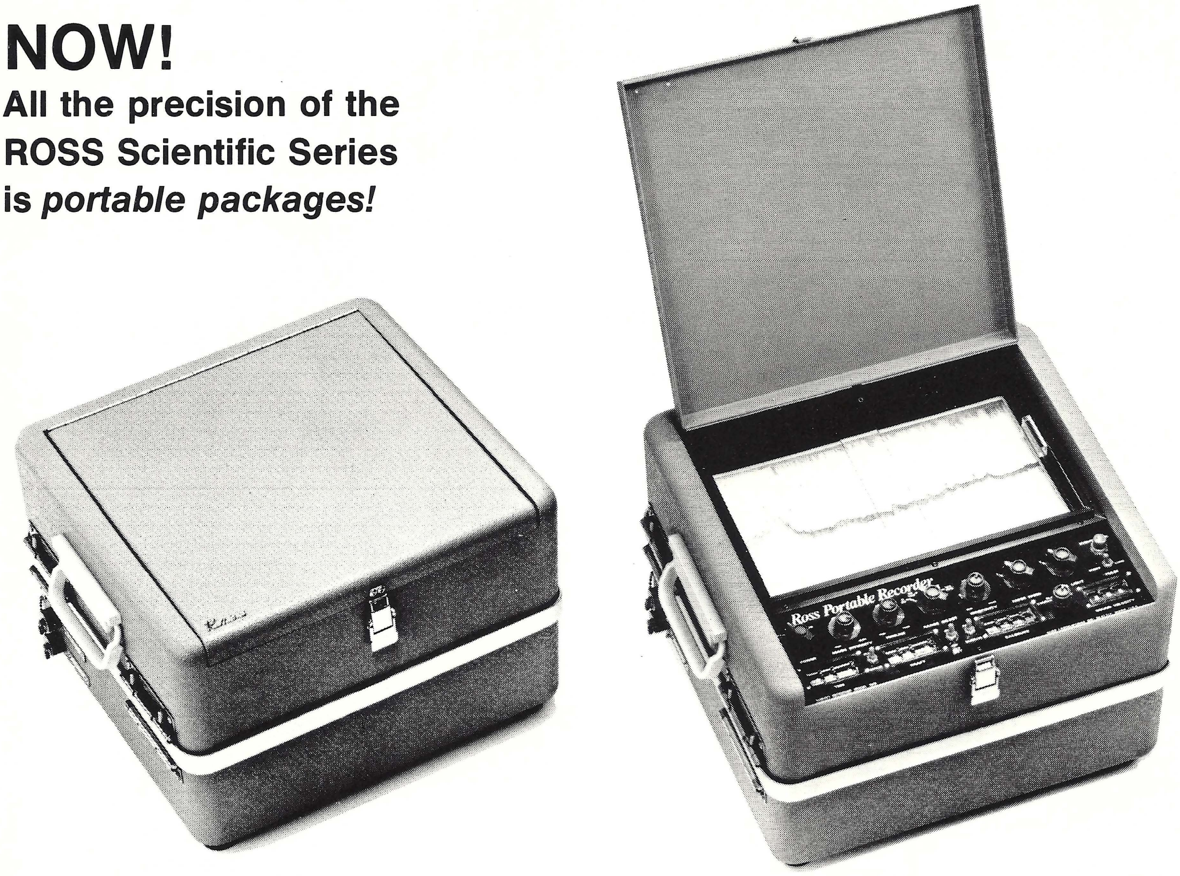

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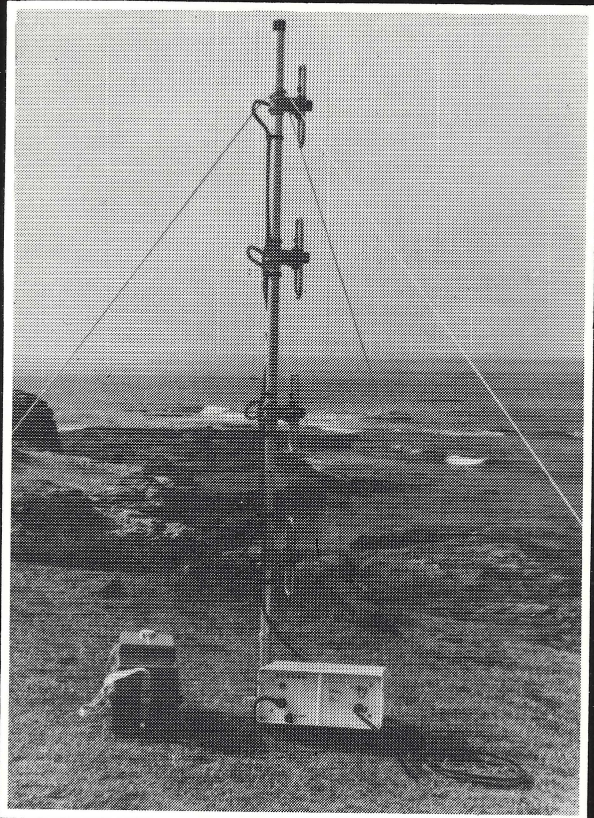

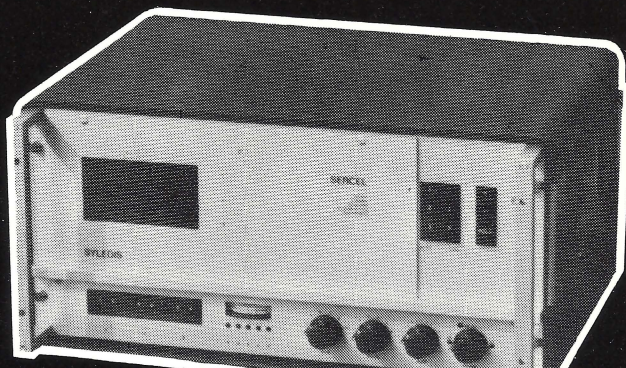

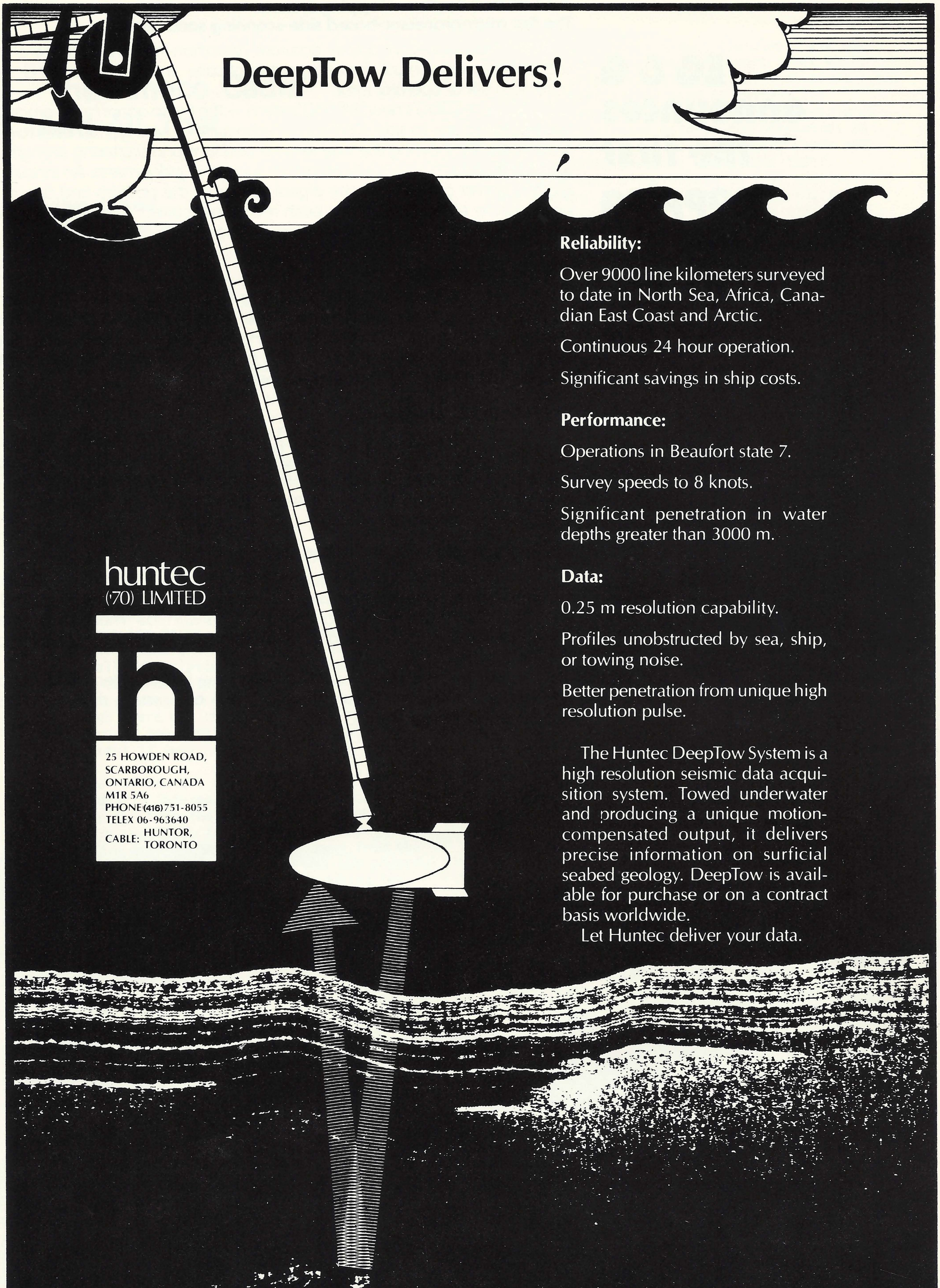

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JOURNAL OF THE CANADIAN HYDROGRAPHERS ASSOCIATION

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All correspondence should be sent to the Editor, **LIGHTHOUSE**, c/o Canadian Hydrographers Association, 867 Lakeshore Rd., P.O. Box 5050, Burlington, Ontario L7R 4A6.

Contents

Message from the President

The editor has asked me to write an inspiring message, waving the flag and promoting optimism and the C.H.A.

This is not the first time I have been asked to say something inspiring. Tony O'Connor (one of our Pacific Branch members) used the same line on me at the 1973 National Executive Meeting in Victoria.

Five years later, I can see the C.H.A. has made great strides, not because of anything that I said at that meeting, but because a lot of people have worked hard to make the C.H.A. what it is today.

What is it?

The C.H.A. is an association of over 200 national members and 20 international members. The four branches sponsor a number or branch activities too numerous to mention here.

The C.H.A. is the organization that was instrumental in the design and implementation of an advanced course in hydrography which is now a standard part of a hydrographer's training within the Canadian Hydrographic Service.

The C.H.A. is the publisher of *LIGHTHOUSE*, a journal that has world-wide recognition and is distributed to over 500 members and non-members.

The C.H.A. is a co-sponsor (along with C.H.S.) of a major annual hydrographic conference, and in 1979 is a co-sponsor of the International Hydrographic Technical Conference in Ottawa.

The C.H.A. is an affiliate of the Canadian Institute of Surveying through its association with the C.I.S. Hydrographic Committee.

The C.H.A. is the co-sponsor of a series of hydrography seminars to be held in May, 1979. Other sponsors are Humber College, C.H.S. and C.I.S.

In the course of our short history, we may have been discouraged from time to time, but our achievements are many. The C.H.A., thanks to the foresight and hard work of a number of individuals, has a history to be proud of and a future to look forward to.

There is less need now for an inspirational message than there was five years ago in Victoria. But let us not rest on our laurels. I urge you all to take an active interest in our Association. Optimism and C.H.A. can be uttered in the same breath.

George Macdonald

The Canadian Institute of Surveying Hydrographic Technical Committee

The Hydrographic Technical Committee is one of a number of committees within the Canadian Institute of Surveying whose primary function is to look after the interests of specific disciplines. The objectives of the Committee are:

- to foster interest in hydrography within the surveying community and associated sciences;
- to arrange meetings and symposia on the subject of hydrography;
- to promote Canadian hydrography within the international sphere;
- to encourage the education and professional well-being of those engaged in hydrography;
- to encourage the development of technology within the profession of hydrography.

Hydrography in these objectives is defined as the surveying, charting and mapping of the marine environment in its broadest sense. The Committee is composed of people from the Canadian Hydrographic Service, industry, academic institutions and other marine government agencies. The members at the present time are:

G.R. Douglas	C.H.S. -- Chairman
N.M. Anderson	C.H.S.
B. Bishop	Canadian Engineering Surveys
J. Bruce	C.H.S.
Dr. G. Gracie	University of Toronto, Erindale Campus
R.W. Sandilands	C.H.S.
P.C. Wilson	Marinav Corporation
T.D.W. McCulloch	Director, Central Region, O&AS
M. Bolton	C.H.S. -- Past Chairman
C.A. Naldritt	Shell Canada

Activities within the Committee have been wide-ranging; such as, the recent affiliation between the C.H.A. and the C.I.S., soliciting and submitting papers for C.I.S. Annual Meetings and the upcoming International Hydrographic Technical Conference. The current thrust of the Committee deals with education and follows the lines of the C.I.S. policy on continuing education. A four day Hydrographic Seminar is planned for early 1979 and will be primarily oriented towards candidates preparing for C.L.S. certification Seminars for the practising surveyor will be scheduled for later dates if the demand arises. All of these seminars will be presented wherever the demand exists -- a travelling road-show concept.

Mr. T.D.W. McCulloch, as chairman-elect of the International Federation of Surveyors (F.I.G.) Commission IV (Hydrographic Surveys) continues to provide the Committee with timely briefings of FIG activity pertaining to Hydrography. The CIS/FIG interface maintained between the Hydrographic Committee and Commission IV is an effective method of inputting Canadian hydrographic ideas and activities to FIG.

G.R. Douglas, Chairman
Hydrographic Technical Committee

C.I.S. - C.H.A. Affiliation

A long-awaited ceremony took place during the national meeting of the Canadian Hydrographers Association held on April 21st, 1978 in Victoria, British Columbia. The occasion was the signing of an agreement formally recognizing an affiliation between the Canadian Institute of Surveying and the Canadian Hydrographers Association. Shown below, after signing the letter of agreement, are Mr. W.D. Usher, President of C.I.S., on the right and Mr. Gerry Wade, President of C.H.A, on the left.

The terms under which the affilitation was made are:

(a) The Chairman of the Hydrographic Committee is to be recommended for appointment by CHA and will be a member of the CIS in good standing;

(b) At least one member of the Hydrographic Committee is to be a marine cartographer;

(c) CIS will receive a token fee per year per member of CHA for each CHA member who is not a CIS member.

This affiliation promises to reap considerable benefits for the hydrographic and cartographic professions. The people who worked to bring it about - Earl Brown, Willie Rapatz, Gerry Wade and Mike Bolton - deserve an enormous vote of thanks.

At the present time, Mr. Ross Douglas is the Chairman of the Hydrographic Committee and his report on its activities appears in this issue of LIGHTHOUSE. It is anticipated that this will become a regular LIGHTHOUSE feature. Mr. Douglas is the newly-appointed Regional Hydrographer of the Central Region of the Canadian Hydrographic Service.

INTERNATIONAL HYDROGRAPHIC TECHNICAL CONFERENCE
CONFÉRENCE INTERNATIONALE TECHNIQUE SUR L'HYDROGRAPHIE
INTERNATIONALE HYDROGRAPHISCH-TECHNISCHE KONFERENZ
CONFERENCIA INTERNACIONAL TECNICO-HIDROGRAFICA
OTTAWA 1979

The Canadian Hydrographic Service, the Federation internationale des Geometres and the Canadian Institute of Surveying will jointly host an International Hydrographic Technical Conference in Ottawa at the Government Conference Centre May 14-18 inclusive, 1979. The theme of the Conference is "Development of Ocean Resources". In addition to invited papers on Hydrography, Ocean Engineering and Surveying, the Conference will include a major Exhibition. Further information may be obtained by contacting :

The Organizing Committee,
International Hydrographic Technical Conference,
Room 209, 615 Booth Street,
Ottawa, Ontario, Canada.
K1A 0E6

Arctic Hydrography - Past, Present and Future

S.B. MacPhee

Canadian Hydrographic Service
Ottawa

M. Crutchlow
D. Knudsen

Canadian Hydrographic Service
Central Region

Introduction

The Arctic Archipelago has long represented a major challenge to the Canadian Hydrographic Service. Short summers, capricious weather, unpredictable ice conditions, and the very remoteness of the area present formidable obstacles to a hydrographic survey operation. Despite this, major surveys have regularly been mounted. Because of the difficulties encountered by conventional shipborne surveys, development efforts over the years have centered on devising less conventional techniques which turn to advantage the Arctic's most intimidating feature: the ever-present ice. Winter surveys are now carried out using the ice cover as a platform for helicopters and tracked vehicles.

However, many Arctic charts still show areas which are sparsely sounded, if at all. Until recently, this was of little practical concern; however, the last decade has seen the prospect of extensive year-round shipping in the Arctic grow from a remote possibility into a virtual certainty as traditional reserves of fossil fuel have dwindled. The production of high quality bathymetric charts of the Arctic has taken on a new importance, and the development of the necessary survey techniques and systems has assumed a high priority.

Conventional Surveys

The first major survey program in the Canadian Arctic was carried out during the period 1955-58 in support of the DEW-line that spanned Arctic Canada. *HMCS LABRADOR* was used to carry out extensive surveys in Foxe Basin while the United States surveyed areas in the western Arctic and on the east coast of Baffin Island.

CSS BAFFIN, the first Canadian ship designed to work in the Arctic, was commissioned in 1957 and commenced work in Frobisher Bay in 1958. She carried two helicopters which were used for control surveys and the installation of shore-based electronic positioning systems.

In the western Arctic, the *CSS RICHARDSON*, a small survey ship, was based at Tuktoyaktuk during the period 1962-72 and carried out surveys of the approaches to major settlements. In the eastern Arctic, hydrographers have been assigned to two or more Canadian Coast Guard icebreakers each year, but the amount of work achieved varies greatly from year to year depending on ice conditions and the amount of traffic, as the prime commitment of the icebreakers is to escort duties.

In 1967, the discovery of oil at Prudhoe Bay on the Alaska north slope changed the entire picture in the Arctic and lent a new urgency to the task of the Hydrographic Service. In 1969, *MV MANHATTEN*, a specially reinforced 150,000 ton tanker with a draft of 17 metres sailed through the Northwest Passage (the Prince of Wales Strait route) in an attempt to assess the feasibility of moving oil from Alaska to the east coast of the United States. It was escorted by Canada's largest icebreaker, the *CCGS JOHN A. MACDONALD*. The *MANHATTEN* transited many areas with only reconnaissance survey coverage and it was during this period that underwater pingoes were first discovered in the Canadian Arctic. This discovery activated the mounting of a large scale hydrographic program in 1970 by *CSS BAFFIN*, *CSS PARIZEAU* and *CSS HUDSON*. A considerable portion of the deeper water in the Beaufort Sea was charted during this period.

Although the conventional ship surveys continue, they are often hampered by unfavourable ice conditions. This has brought about the need for less conventional survey techniques.

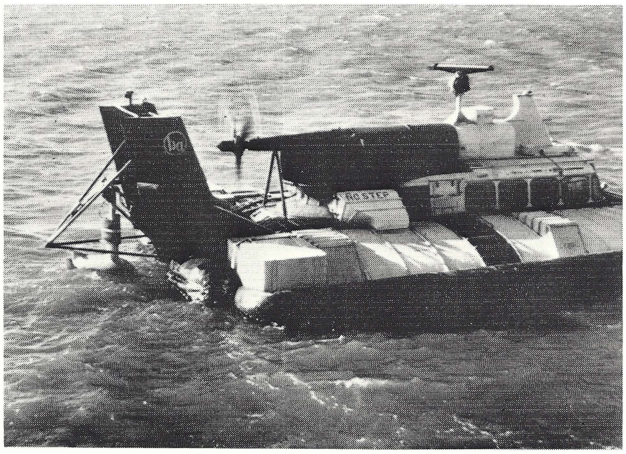
Early Development

The 1958 Geneva Convention on the continental shelf gave every coastal state sovereignty rights for the purpose of exploring and exploiting the natural resources of the continental shelf. A visionary Canadian public servant, Dr. W.E. van Steenburg, saw that these rights would be of little value without a comprehensive description of the continental margin. This was especially true in the Arctic Ocean as the extent of the shelf was unknown. To overcome this deficiency, the Polar Continental Shelf Project (PCSP) was established in 1959 and since then has provided the logistic support for major hydrographic programs in areas usually inaccessible to ships. The PCSP is an Energy, Mines and Resources program and since the logistic requirements are similar, the hydrographic program is usually combined with gravity observation.

During the first year of the PCSP operation in the Arctic Ocean, holes were drilled or blasted in the ice and a sounding lead lowered to obtain depths. This technique soon gave way to more modern acoustic sounding methods, initially with the transducer lowered through a hole in the ice and later with the transducer coupled to the smoothed ice surface with a film of oil. The prime means of transport has, from the beginning, been the helicopter. Initially, soundings were made on 10 and 6 km grids but this has been reduced to a 4 and 2 km grids in more confined waters.

In 1961, it became necessary to sound Hell Gate and Cardigan Strait, areas where a high current inhibits ice formation. These areas were surveyed using a transducer installed in a fish towed from a helicopter flying 6 metres above the water at speeds of 15-30 knots. Flying under these conditions placed a tremendous strain on the pilot and crew; however, a good deal of hydrographic data was obtained.

In 1968, interest shifted to the Beaufort Sea where open water occurs every summer between the shore and the Arctic pack ice. To facilitate soundings in this area, trials were carried out utilizing a SRN 6 hovercraft towing a transducer. Unfortunately, in this mode the transducer would break the surface at speeds greater than 20 knots. To overcome this problem, the transducer was mounted on the hovercraft itself in the form of a hydraulically operated strut. Although this assembly acted as a rudder under some circumstances, two extensive areas were surveyed in 1969 and 1970 at speeds of up to 25 knots.



Hovercraft with Fixed Strut

Recent Development

Although some success has been had with all of the methods described, the technique of spot sounding with a helicopter has provided the most extensive coverage to date. However, the helicopter's prime virtue is mobility, rather than economy, and it is inherently most suited to large scale reconnaissance surveys with a widely spaced grid. It is an expensive approach to detailed surveys of potential shipping corridors or harbour approaches. These surveys are becoming increasingly important with the accelerating pace of Arctic Development and the probability that deep draught-vessels, such as the Arctic Marine Locomotive and/or Liquified Natural Gas carriers, will soon be plying Arctic waters. To meet this need, the Canadian Hydrographic Service has, for several years, been investigating improvements and alternatives to the basic helicopter survey.

In 1974, Banister Technical Services combined the technology of through-the-ice sounding with tracked vehicles to produce a system for carrying out detailed surveys of pipeline crossings. The system developed by Banister employed a 3.5 kHz echo sounder and a unique non-linear amplifying system for processing the received signals. During these trials, a Nodwell FN 110 tracked vehicle was equipped with a mechanical auger to remove the snow cover and a hydraulically controlled ram to deploy the transducer. The transducer was contained in a rubber bag filled with an anti-freeze solution to ensure good acoustic bonding. Offline statistical processing of recorded data by computer permitted not only the water depth to be determined but also the type and thickness of sub-strata.

As this technique appeared to have an excellent potential for carrying out large scale hydrographic surveys, Banister Technical Services were contracted to carry out further through-the-ice sounding experiments in 1975. They studied methods of coupling transducers to the ice and gathered data to facilitate the design of an optimum hydrographic system. The most significant development was the introduction of the spike-coupled transducer which employed a metal spike clamped to the face of a standard marine transducer. The spike easily penetrated snow depths up to 35 cm, thus saving the time required to remove the snow cover and apply fluid to the ice.

The promising results of these trials led to further trials in 1976 utilizing a Canadian Flextrac (CF-23) with a weight of 4,100 kilograms. This vehicle was equipped with spike-coupled transducers mounted on hydraulic rams at each corner of the vehicle. Various sounding frequencies were investigated.

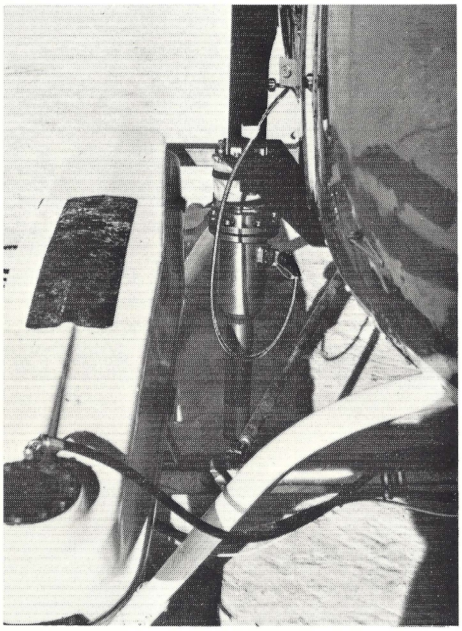
In addition to the Banister project, tests were carried out 'in-house' with a much smaller tracked vehicle, a modified Bombardier Bombi. This vehicle has the virtue of being DC-3 transportable, so that it can be landed anywhere in the Arctic. Special 24 kHz transducers employing an aluminum rod (spike) bonded directly to a single element vibrator were designed and constructed for this vehicle.

Bombi with Spike Transducer

Both vehicles were fitted with NavBox, a sophisticated navigation processor which gives a continuous CRT display of position, and direction and distance to next location. In this form, both vehicles were used extensively in 1977 and 1978.

Present Work

Because of the importance of adequate navigation in the development of frontier energy resources, the Canadian Hydrographic Service is being provided with special funding, over a period of several years, to undertake a program of applied research and development of optimum methods of surveying ice-covered waters. The goal of the initial phase of this program, which has just been completed, was to extend the remotely-actuated spike-coupled transducer technology to the traditional helicopter survey. Contracts were let for the development of a lightweight electrical actuator to be mounted directly to the outside of the helicopter; and for the development of a specialized 24 kHz spike-transducer. These components eliminate the tasks of clearing away the snow and pouring oil on the ice, and also permit the hydrographer to make the sounding without leaving the helicopter, greatly increasing the efficiency of the operation. This system was tested last spring and will be used for production surveying this coming winter.



Electrically Actuated Spike Transducer Mounted on Helicopter

Also underway at present is a somewhat different development project involving a sector-scanning sonar designed to be lowered through a hole cut in the ice. The transducer array scans a circular area about the hole to detect any navigational hazards in the area. This could provide complete bottom coverage but, as the area covered is directly related to depth, in shallow areas where the need is greatest, it may not prove to be of economic value.

Future Studies

Several development projects are in the early stages or are expected to get underway during the next few months. One such project is the development of a digital echo sounder employing microcomputer technology and a raster scan CRT as a visual display in place of the more conventional graphic recorder. This new sounder will be used on the helicopter surveys.

One of the most promising of the new developments involves a unique electromagnetic technique for remotely sensing acoustic signals at the ice surface. Although in the embryonic stage at present, the concept, if successful, will be a major step forward as it will permit continuous profiling in addition to spot sounding.

A major logistic problem for Arctic surveys is the provision of power supplies for positioning system transponders and other equipment located in remote and inaccessible areas. To overcome this problem, a program is underway to investigate a variety of novel power sources, particularly wind and solar power generators.

Also under review are several new positioning systems which will undergo trials in the near future. It is hoped that an optimum system will emerge that will enhance our positioning capabilities in the Arctic.

Methods of improving our capability for tidal and current measurements in ice covered waters will also be pursued. This is important as the handling of deep draft ships in narrow channels can be significantly affected by currents and the entry of these ships into port facilities may require accurate tidal reductions. A knowledge of currents is also required in projecting the course of oil spills and forecasting the movement of ice.

Conclusion

The Canadian Hydrographic Service will be active in the high Arctic for the foreseeable future, and the challenge this represents to hydrographers and hydrographic support groups is both formidable and exciting. The day is still sometime away when the Canadian Arctic will be completely and accurately charted, but current development efforts are helping to bring it about.

SYLEDIS - A New Medium - Range Positioning System

N. Stuifbergen

Canadian Hydrographic Service

Atlantic Region

Introduction

SYLEDIS (SYstéme LEgere de DIStance) is an interesting new product in the field of electronic positioning systems. It was designed and manufactured by SERCEL (Societé d'Etudes, Recherches et Construction Electroniques), a company with many years of experience in electronic positioning systems, whose headquarters and plant are located in Nantes, France, with subsidiaries located in Calgary, Alberta and Houston, Texas.

From June 5 to 14, 1978 a Syledis system was installed for a demonstration on *CCGS EDWARD CORNWALLIS*, a Ministry of Transport buoy tender vessel operating out of Halifax. The equipment was operated while the vessel was servicing buoys and lights in St. Margarets Bay and Mahone Bay along the coast of Nova Scotia between Halifax and Lunenburg.

The demonstration was organized by the Canadian Coast Guard with technical support provided by Messrs. J. Voisard, M. Guerineau and C. Wardrop of SERCEL.

Equipment Description

Each shore beacon consists of a short mast, about 25 feet, carrying a Yagi array, a directional antenna similar to a TV aerial. The electronics are contained in a weather-proof unit about the size and weight of a jerry-can, which draws an average of 2 amps at 24 volts, with peak currents of 7 amps. The transmitter radiates 13 watts. A UHF booster amplifier for extended range performance can be connected to transmit 320 watts, drawing an average of 20 amps, with peaks of 50 amps at 22-30 volts D.C. In addition a UHF filter is available for the booster to suppress sidebands and prevent them from interfering with other UHF equipment in areas where the UHF spectrum is crowded.

The shipboard installation on *CCGS EDWARD CORNWALLIS* consisted of a vertical omni-directional antenna, a collinear array, about 6 feet long, which was mounted at the top of the mast. A low-loss UHF coaxial cable connected the antenna to the mobile interrogator unit installed in the wheelhouse. Three LED displays provided smoothed numerical read-outs in metres for the three selected lines of position. Acquisition of the shore beacons is entirely automatic and the signals are tracked continuously. A ten kilometre ambiguity exists in the measurement so that the ten and hundred kilometre digits are set by the operator.

The measured lines of position are available in digital form (both serial and parallel BCD with special control signals) for use in data loggers or minicomputers for on-line fix computation, steering guidance and track plotting.

SERCEL have designed and built their own coordinate conversion computer, the UCM (Unite de Calcul Microprogrammée) which accepts the three measured LOP's (Lines of Position), checks them for anomalous readings by a prediction error filter and produces a smoothed output of rectangular coordinates to display the ship's position. The operator can select the type of grid reference (UTM, Lambert Conformal or plane rectangular X-Y coordinates) by entering defining parameters through a keyboard on the front panel. SERCEL is developing additional software to provide an output in latitude and longitude also. It is a policy of the company not to attempt to provide specially modified software to suit individual client's requirements.

The UCM computer also calculates the along-track and cross-track distance, and heading to steer with respect to a given line defined by the operator as waypoints in rectangular coordinates. This steering information is displayed on a separate device, the APG unit (Automatic Path Guidance), installed in front of the helmsman.

It is feasible to interface the mobile unit directly to the user's data logging or minicomputer system if careful attention is given to compatibility of digital signals and formats between devices.

Features of the Syledis System

The Syledis system is a sophisticated design containing many interesting technical features:

(a) Propagation of signals at a UHF frequency (420-450 MHz);

(b) A time-sharing sequence of transmissions so that the chain operates at a single frequency, occupying 2 MHz of the UHF spectrum;

(c) The use of a pulse compression technique by which modulated pulses of relatively long duration, transmitted at a low power level, are transformed electronically to short sharp pulses of equivalent high power on which accurate measurements can be made;

(d) Great flexibility in configuring a network of beacons to operate as one or more Syledis chains, in either range-range or hyperbolic mode.

UHF Propagation

Radio wave propagation at a UHF frequency (420-450 MHz) is not affected by skywave interference. The effect of overland signal paths and topographic obstructions are very mild compared to microwave propagation; there is some loss of signal energy due to scattering of the signal over rough terrain, woodlands and buildings.

Beyond line-of-sight up to twice line-of-sight, a diffraction mode of propagation occurs with signal strengths decreasing with distance at a rate of 0.7 db/km; beyond the diffraction zone a stable tropo-scatter mode of propagation predominates with signal strengths decreasing at a lesser rate of 0.15 db/km. Tropo-scatter propagation is the result of microscopic irregularities in refractive index of the atmosphere acting as diffusers of the UHF signal. By an analogy with light waves, the tropo-scatter effect could be pictured as similar to the faint light that one sees from a distant lighthouse below the horizon in the presence of a very light haze. A characteristic of tropo-scatter propagation is that relatively little advantage in range performance is gained by raising the elevation of the shore stations.

The Syledis system has not yet been tested under severe Arctic conditions; it is anticipated that there the tropo-scatter propagation mechanism might be less effective than in temperate or tropical regions.

Under certain meteorological conditions in the lower 500 metres of the atmosphere a ducting mode of propagation can occur by which signals travel much farther than the tropo-scatter curve predicts. Ducting occurs when the refractive index of radio-waves decreases with height at a rate that is sufficient to cause the ray paths to curve downward and be channeled along the surface. A very similar ducting of sound waves occurs in certain layers of the ocean.

SERCEL has found that the ducting effect sometimes results in anomalous distance measurements, with deviations of up to 100 metres for durations of up to 2 minutes. Fortunately such anomalies rarely occur on more than one measured line at a time, so that a prediction error filtering algorithm on three ranges can detect it and minimize its effect on the position computation. In addition it is possible to reduce refraction anomalies by a special arrangement of antenna arrays at the shore beacons.

Stability of the distance measurement is closely related to Signal-to-Noise ratio; within line-of-sight the readings fluctuate by ± 1 metre, up to twice line-of-sight ± 2 metres, thereafter it increases gradually to ± 30 metres at the fringe of reception.

Time - Sharing

The transmitters of a Syledis chain operate on a single UHF frequency, of 2 MHz bandwidth, which is time-shared between stations in the network. The basic time-slot interval is 3.33 milliseconds with a maximum number of 30 time slots available. Thus the time-sharing cycle is repeated ten times per second. In a single Syledis chain two time slots are assigned to transmit and receive a trigger signal, an "uncoded" pulse train (i.e., without the pseudo-random code modulation) which serves to synchronise the time-sharing sequence of all the units of the chain.

The time-sharing sequence is selected by setting jumper wires on a separate printed circuit board, known as the "Key". This procedure allows a great deal of flexibility in selecting an optimum time-sharing sequence for a chosen chain configuration.

Pulse Compression

The transmission consists of a phase-modulated signal of 66.66 microseconds duration, with phase reversals every 0.52 microseconds governed by a special 127 bit sequence of a pseudo-random code. This code sequence has the property that only at one point within the bit pattern an exact match occurs between the received signal and a replica of the bit pattern which is continuously recirculated within the receiver. When the two bit patterns match exactly, a sharp short pulse of 0.52 microseconds is produced by the correlation detection circuitry. Everywhere else the bit patterns effectively cancel to produce a zero output. The correlator output is fed to a tracking loop circuit which retains the measurement in a rate-aided "free-wheeling" mode during periods of the time-sharing sequence when a signal is not being received. During the interval of the time-sharing sequence assigned for transmission, the tracking loop controls the phase of the transmitted code sequence. The code sequence is repeated 40 times in the transmission time slot.

The length of the repeating code sequence (66.66 microseconds) is equivalent to 10 kilometres on the ground, thus the 10 kilometre ambiguity in the measurement.

The design of the correlation detection technique makes it possible to utilize a low power signal of long duration at a UHF frequency and convert it to an equivalent short pulse of high power, which otherwise could only be transmitted at a microwave frequency, with less favourable propagation characteristics.

Configuration of a Syledis Chain

The chain can be operated as a range-range system shared by up to four survey vessels; it can also be operated to provide hyperbolic coverage for an unlimited number of users, with similtaneous range-range capability for three survey vessels.

An optional extended network concept, the SNA - Syledis Net Arrangement, has been developed to provide positioning coverage along an extended length of coastline, using a large number of synchronised shore beacons; the survey vessel can select the three most favourable lines of position as it proceeds along the coverage area.

Trials off Halifax

Three shore beacons, without the booster amplifiers, were installed on surveyed control points at Cross Island Lighthouse, at Aspotagan and Hospital Hill; the latter two sites are located a few miles inland on hills of about 400 feet elevation. For the short duration of the demonstration the beacons were powered by large batteries.

The positioning system was operated while the regular buoy servicing task was carried out in Mahone Bay and St. Margarets Bay at relatively short distances from the transmitters - up to 40 kilometres - without any indication of islands and headlands blocking the reception of signals. Tracking of the stations could be maintained while running into Halifax Harbour, at a distance of 72 kilometres from Cross Island with about half of the signal path over lightly wooded rocky terrain.

A range test was conducted off Halifax to a maximum distance of 112 kilometres with a slight margin of signal strength remaining, indicating that 125 kilometres would be a practical range limit for the standard low-power beacons. Some fluctuation in signal strength was noticed when running beyond line-of-sight.

On one occasion at a distance of 102 kilometres one channel lost lock for a few minutes. It demonstrated the advantage of tracking three stations and processing the ranges in a smoothing filter because the position display was not affected by the brief loss of signal.

Calculations based on a graph of tropo-scatter signal strength vs. distance indicate that, with booster amplifiers installed on the transmitting stations and directional antennae installed on the shore beacons, a range of 270 kilometres can be reliably expected. Projections of range performance based on SERCEL's curves are very conservative to assure reliable predictions and many users have reported range performance considerably greater than predicted.

Cost of Equipment

Approximate costs of the items of the Syledis system, in $ Canadian as of September, 1978, are:

Shore Beacons	$22,775 each
Mobile Units	$31,675 each
Antennae	$150-700 each
Booster Amplifiers	$28,350 each
UHF Filter	$ 5,700 each

A standard (20 watts) system in hyperbolic or range-range mode with three shore stations would amount to $70,000 + $32,000 for each survey vessel.

Equipped with booster amplifiers for longer range, approximate costs are:

Range-Range	$155,000 + $61,000 for each survey vessel
Hyperbolic	$155,000 + $30,000 for each survey vessel

Conclusions

It is of interest to note that, by convention, positioning systems are often classed as either based on a phase-comparison or a pulse-matching technique. In concept Syledis combines the best features of both while avoiding the drawbacks of either. It represents a significant advance in the field of electronic positioning, which has overcome the line-of-sight limitations of microwave positioning equipment as well as the limitations of the 2 MHz phase-comparison systems.

In the range-range configuration, with a demonstrated range of 112 kilometres, it operates like the familiar microwave positioning devices with a much greater coverage area and much less effect of islands and headlands blocking the signal.

Configured as a multi-user hyperbolic system it offers the advantage of avoiding skywave instability and lane ambiguity of the phase comparison systems.

With booster amplifiers and special antennae a reliable operating range of 270 kilometres can be expected.

The lightweight shore stations, which can be installed at a low elevation with little loss of range performance, are a great advantage.

The Impact of Fundy Tidal Power on the Hydrography of the Area

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Introduction

The nautical chart is the primary product of the Canadian Hydrographic Service (C.H.S.). The heart of the chart is the coastline, determined by the High Water Level (HWL), and the bathymetry or soundings fixed by position and depth. The emphasis, of course, is to clearly delineate shoals and other dangers to navigation. Tide and current information also form an integral part of the presentation.

All elevations and depths portrayed are directly or indirectly related to Chart Datum. Chart Datum, defined at a specific location, is the plane which the water level will "seldom if ever fall beow." It is approximated by determining the Lower Low Water Large Tide (LLWLT) level in tidal areas.

The amount of water below a ship's hull at any given time is the sum of the charted depth and the tidal elevation at that time, less the vessel's draught. The tidal heights used by the mariner are usually predicted values based on a sufficient time series of previous observations. Tide Tables are also a publication of the C.H.S. The important point is that the chart datum plane established is used as the reference plane for tidal elevations, conforming to I.H.O. regulations.

Although this relationship between the tide and charted depth is easily stated, it is constantly changing. Crustal movement along the Atlantic Coast may contribute to a rise in Mean Sea Level (MSL) of the order of 0.15 m (0.5 ft.) to 0.30 m (1.0 ft.) per century. In areas like the upper reaches of the Bay of Fundy, the sea bottom is in a constant state of transformation by transport and deposition of sediments.[1,2] Even the large tidal range in this area is believed to have evolved over the past 6300 years, and continues to do so[1].

These relatively slow moving processes are indirectly monitored by the C.H.S. A national permanent water level gauging network and periodic surveys of important areas of high sediment activity perform these tasks.

Man's marine activity is usually much more dramatic. We dredge and dump; the sea erodes and deposits. But, independent of the agent, when changes reach a significant level they have to be reflected in our nautical charts and associated publications. Consequence of error in our work is high -- possible loss of life or very significant property damage.

Tidal Power Development in the Bay of Fundy is a project of great magnitude and complexity. The ramifications from a hydrographic perspective are the subject of this descriptive paper.

Tidal Power

Tidal Power is an old form and source of energy for man, tide mills date to the ancients, and although of varying formats continued to the end of the 1800's. They were then replaced by more productive and economic fossil fuel installations.

All generation is a transformation of the inherent potential and/or kinetic energy of the water mass produced by the phenomenon called tide. The tide is essentially a wave, produced by the sun, moon and earth system and the resultant of their gravitational forces and the centripetal force at any point on the earth.

Some basic concepts of design are:

(1) Single basin single-effect -- this is the oldest method of harnessing tidal power. Generation of power is only during the falling tide from the basin to the sea;

(2) Single basin double-effect -- similar to the above except generation is on the rising and falling tide;

(3) Linked basins -- this consists of a high and low pool with generation between the two; and,

(4) Paired basins -- two or more tidal plants are interconnected to the same electrical network to provide a more continuous form of energy.

The LaRance Project in France generates 240 MW with ten turbines operating under a single basin double effect scheme. The only other operating tidal plant in the world is a relatively small one at Kislaya Guba near Murmansk in the Soviet Union. This project incorporates at least one double effect La Rance type "bulb" turbine. A Fundy project will probably incorporate a single basin effect scheme[3].

Tidal generation produces "slugs" of power in two periods during a lunar day (24 hr. 50 min.) for a single effect system (see figure 1). The surge of water created as the basin empties into the Bay of Fundy during these periods is not expected to have any significant impact on the sea level in the Bay.

(The role of tidal power in the Bay of Fundy is the displacement of fossil-fueled generation presently on line and the reduction of fossil-fueled installed capacity to come. The expected reduced oil consumption for the Maritimes and New England in 1990 if the proposed sites shown on Figure 2 at A8 or B9 were developed would be 3 and 12 million barrels/year respectively.)

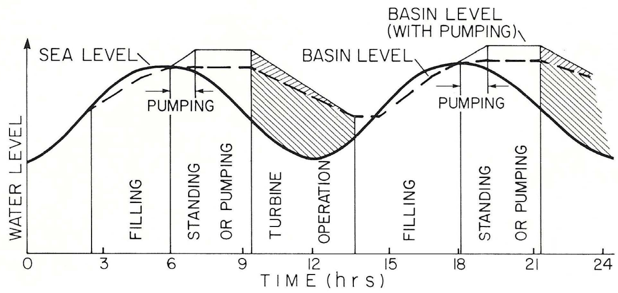

Fig. 1

The Bay of Fundy/Gulf of Maine

The tidal regime of the Bay of Fundy is semi-diurnal with very little diurnal inequality. (The two highs and two lows respectively attain nearly the same elevation daily.) The time period between successive highs or lows is 12.4 hours. When the tidal wave is resolved by harmonic analysis into its component wave forms (usually about 60), the M2* constituent is clearly dominant. (Yuen has calculated that M2 contributes to 86% of the Mean Spring Range at Saint John, N.B.[4]) The period of M2 is practically identical to that of the "whole" tide. So for simplification when studying this particular tidal regime, the M2 tide is used to represent the natural tide.

What is most striking about this system is the amplification of the tide. Along the continental shelf the maximum range is about 1.6 m (5.3 ft.). This range is continuously increased through the regime until the maximum of about 16.8 m (55 ft.) is achieved in Cobequid Bay.

One cause for amplification in the bay is the gradual shelving of the basin and the narrowing towards its head. But the major factor is believed to be the near 1/4 wave resonance between the M2 tide and the system. Understanding in this area has evolved over the past ten years. If one considers the outer boundary of the models of Rao[5] and Yuen[4] determined by a line from Jonesport, Maine to about Yarmouth, N.S., then "the Bay of Fundy is too short for a high degree of resonance to occur".[4] The natural period of this system is about 9 hours while the period of M2 is 12.4 hours. But as Duff[6], Garret[7] and Greenberg[8] have agreed, the regime should include the Gulf of Maine at least out to the Continental Shelf. Garret estimates the natural period of this larger regime to be 13.3 hours which is very close to full resonance conditions.

The basic geometry of the system is fundamental to the creation of the high tides in the upper part of the bay. Tidal barriers constructed in this area to extract energy, would effectively change the length of the tidal system, thereby changing resonance conditions.

Numerical Model

To determine the effects of placing barriers in the upper reaches of the Bay of Fundy, a numerical model developed by Greenberg was employed[8]. To complete the necessary tidal data base to drive and calibrate the model, a measurement program along the Continental Shelf and within the Bay/Gulf system was completed by the C.H.S. in 1976[9]. Resulting verification has indicated that confidence can be placed in the model results within a few centimetres of tidal range and a few degrees of phase (1 degree of phase equals about 2 minutes of time).

The primary aim of the modelling was to determine whether or not significant changes in tidal range would occur at the barrier sites possibly making tidal generation unfeasible. It was also hoped that other questions would be answered, such as, would increased amplification in the system occur resulting in reinforcement or creation of flood conditions in ports like Saint John or Boston?

Saint John, New Brunswick is a good example of the importance that the tidal regime plays in the navigation of this area. The least depth (maintained by dredging) in the harbour channel is 9.1 m (30 ft.). The maximum overall depth is achieved with the addition of the large tide range of almost the same magnitude 8.9 m (29.1 ft.). About 30-40% of the vessels depend on the high tide for safe pilotage in and out of the harbour[10].

Barrier Locations

Thirty sites were originally considered for power development, ranging in capacity from 50 to 10,000 MW (megawatts). As the result of technical and economic screening, the number of locations was reduced to three (see figure 2).

A6 - Shepody Bay, St. Mary's Point to Cape Maringouin; distance -- 4 mi.; installed capacity -- 1643 MW; total capital cost = $2.2 B (1976 dollars);

A8 - Cumberland Basin, Peck's Point to Boss Point; distance -- 1.4 miles; installed capacity -- 1147 MW; total capital cost = $1.2 B;

B9 - Minas Basin, Economy Pt. to Cape Tenny; distance -- 5 mi.; installed capacity -- 4028 MW; total capital cost = $3.6 B.

(The installed capacity of A6 and B9 is about equal to the total present installed capacity for Nova Scotia and Alberta respectively.)

*M2 is the major lunar semi-diurnal constituent.

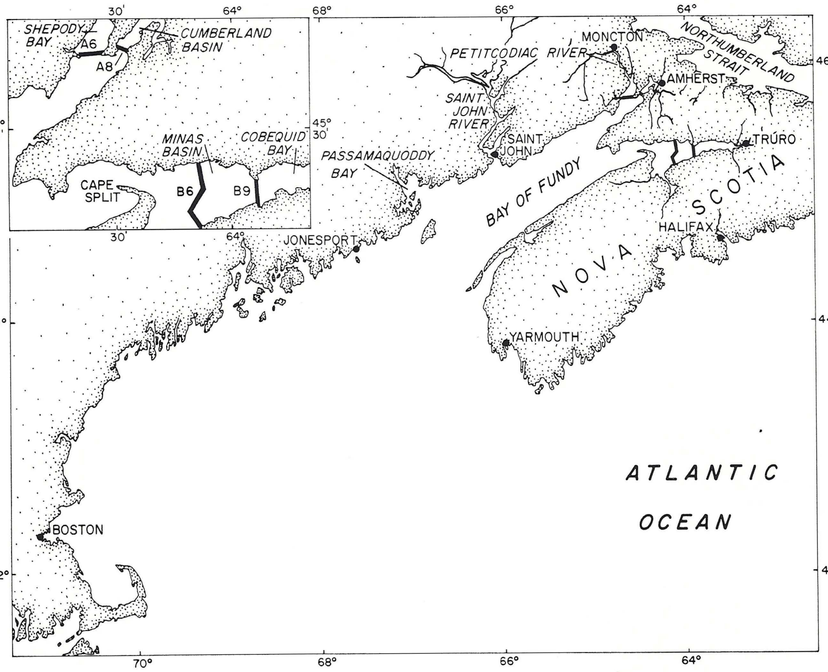

Fig. 2

Of these, the A8 site has been selected as the preferred candidate for initial development. (Authorization was recently given to proceed with pre-investment investigation and designs for Site A8 and an assessment of the practicality of sequential development of further projects.[3])

Model Results

The numerical model was run simulating a single-basin single-effect scheme at various dam sites. The general conclusion is that a barrier removes energy from the system and moves the Bay of Fundy proper further from resonance, thereby attenuating tidal ranges from the mouth of the bay to the head. This decrease is somewhat compensated for by an increase in range in the Gulf of Maine, the whole regime having been brought closer to resonance.[8]

Consequently there is a decrease in amplitude at the barrier and an increase away from it. The reduction at A6, A8 and B9 is of the order of 5% (not significant in terms of power generation). For larger sites further from the head of the bay (like B6) the changes are more dramatic.

The A8 dam would cause very little change in the regime from the barrier to the shelf. The amplitude and phase change at Saint John and Boston would be at most a couple of centimetres and a few degrees respectively. But for a dam at the B6 site in Minas Basin, the resultant changes in the same locations would be 30 cms at least in amplitude (60 cms in range about 2 ft.). High tide would arrive at Saint John about 15 minutes earlier and in Boston about 5 minutes later than normal.

The major effect of a project, independent of site selection, is the alteration of the tidal system in the vicinity of and especially behind the barrier. For the B9 site, in the headpond the MSL will rise by about 3.4 m (11 ft.). The low water level will approximate the old MSL and the old maximum water level will be anywhere from .4 m to .9 m below the normal HLW.

The changed water level regime in the vicinity of the barrage will have many consequences. In the basin, currents will be reduced, salinity lowered, water temperature stratification will increase, and wave energies will be reduced. Probably the most important change to result from these variations will be in the local sediment regime.

The question of siltation should have a very high priority in the final phase of pre-engineering studies. The reasons seem quite clear (despite the turbidity of the water).

From the work of Amos[2] in the Minas Basin area the potential magnitude of the situation is evident:

> "*A tidal barrage situated between Economy Pt. and Tenny Cape (B9) would occupy a site directly across the transport paths of a potential 4* x *$10^6/m^3/$ year of sediment*".

also,

> "*The volume of material derived from cliff line retreats in the Minas Basin ($3 \times 10^6/m^3$/year) is sufficient to cause the total siltation of an area extending from a tidal barrage (situated between Economy Pt. and Tenny Cape) to a point 600 m seaward, in 20 years*".

This possibility does represent one extreme. Dr. Amos also writes that, at the other end of the scale, the average accretion if the redistribution of sediment was to occur evenly over the whole area would be about 1 cm/year and hence insignificant. These extremes were determined to justify further investigation to realistically determine what will happen in terms of tidal power development.

(Field sediment studies in the vicinity of A8 are planned for the summer of 1978.)

Tidal Currents

The general result from the numerical model for a dam at A6, A8 or B9 is: a small reduction from 0-5% in the currents of the Bay of Fundy with a possible increase from 5-10% in the Gulf of Maine (Greenberg personal communication). This amount of change is not terribly significant from a navigational point of view, although it may well be in terms of the physical oceanography of the system (Garret[11]).

At present, a navigation lock is not planned for an A8 site (or B9). This is based on the present low marine activity in the area(s). (It is interesting to note that, although the LaRance area and Cumberland Basin are not similar tourist-wise, there was a "remarkable" increase in vessels using the lock in the French project: 1968 -- 5,287 vessels, 1976 -- 13,462[12].)

Conclusions

From a hydrographic viewpoint, the greatest need for revision to charting will clearly be in the vicinity of the barrage, especially for the area behind. The charted coastline will change because of a significant drop in the HWL coupled with the very low gradient existing in certain regions of the intertidal zone. Of course the charted depths will change drastically. (Chart datum will rise almost 6.7 m (22 ft.) above the present elevation behind A8.) Siltation in the area will aggravate this situation over time periods and magnitudes which are yet to be clearly determined.

In the large region of the system seaward from the barriers the degree of necessary chart revision will be directly proportional to the dam location(s) and the number of dams installed, and will have to take into account the sensitivity of various areas affected; shoal and harbour regions would have priority.

Any changes in the regime would also be reflected in the various related publications, especially tide and current predictions and bench mark notes.

The Canadian Hydrographic Service, in seeking to fulfill its mandate of charting the navigable waters of Canada, has provided, directly and indirectly, data which has been basic to the successful investigation of tidal power development in the Bay of Fundy. In its continuing work it will certainly chronicle the effects that such a project will have on the face of the sea.

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Sydney's Hydrographer

R.W. Sandilands

Canadian Hydrographic Service

Pacific Region

Reprinted from the Daily Colonist, Victoria, B. C., Sunday, 16th April, 1978.

This year, when all of British Columbia remembers Captain Cook, often referred to as "the father of hydrography," Sidney can also remember her own hydrographer, one who never visited her shores, whose name is not well known in Canada but who nevertheless made his mark on the charts of the world.

Sidney is the only town in Canada to honor the pioneer hydrographers who opened up the sea lanes into and along our rock-studded coast so making the colonization and development of the small coastal communities possible.

Though there are many examples in B.C. of features being named for hydrographic surveyors - Pender Harbor and Islands; Bedwell Harbor - and Victoria has named several streets after their ships - *HERALD, PANDORA, FISGARD* - only Sidney has honored the pioneer hydrographers by including them in her coat of arms.

The late Professor Albert Atkinson, a retired Royal Roads and University of Saskatchewan prof-fessor whose hobby was designing coats-of-arms for municipalities and institutions drew up a crest for Sidney which incorporated the hydrographic influence on the town's name by giving prime place in the coat-of-arms to a hydrographic surveying ship, *HMS PLUMPER* and surmounting the arms of the crest by a navigational beacon.

The arms of the crest are described as being: "Or, on the waves of the sea, barruly wavy of 12 azure and argent, *HMS PLUMPER* wearing the white ensign, rigged, sails furled and anchored proper; in chief between a pheon of the second and a Salish arrowhead inverted two clasped hands couped at the wrists all proper."

The crest: "Upon a wreath of the colors on a mount flanked by waves of the sea a beacon flammant all proper."

The motto: "On a scroll or lined and lettered azure the words Pharus Exclararet Nos." (Let a beacon enlighten us.)

Her Majesty's Ship *PLUMPER* surveyed the coast of Vancouver Island from 1859-61 under the command of Captain George Henry Richards who named Sidney Island in 1859 during the course of his surveys of the area.

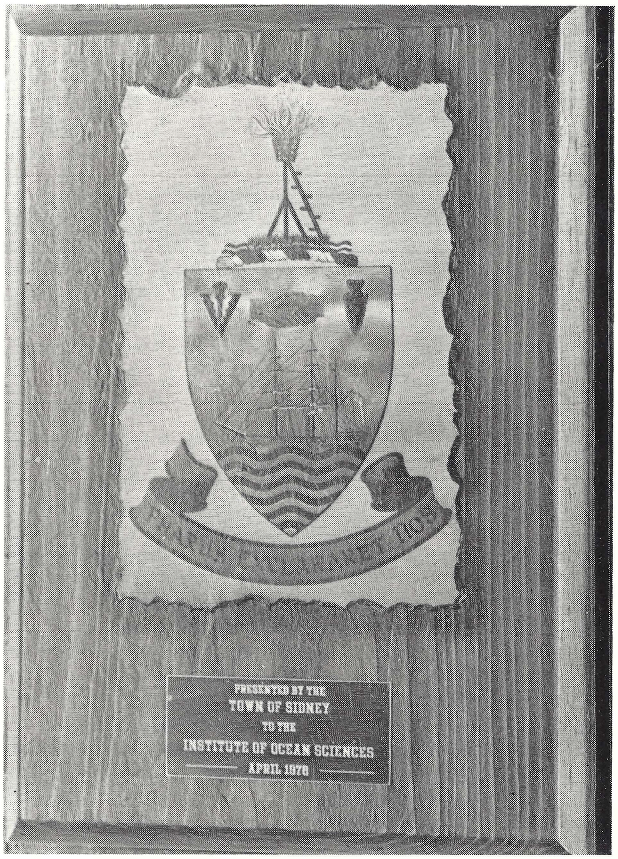
Some 32 years later surveyors for a townsite on the Brethour property gave the settlement the same name.

Richards named Sidney Island after his good friend and contemporary Frederick William Sidney. They both entered the navy in 1833 and eventually both became hydrographic surveyors. Richards went on to become Hydrographer of the Navy, attained the rank of Rear Admiral in 1870 and in 1877 became a vice-admiral on the retired list.

Sidney was promoted captain in 1867, but was invalided due to an eye injury in 1868 and retired in April, 1869.

His principal surveys were on the east coast of Australia but he had his first taste of hydrography in the West Indies under Richard Owen, nephew of the great surveying officer William Fitzwilliam Owen. Having suffered from yellow fever and after six arduous years in the West Indies he returned to England for reasons of health in 1839. The following year found him surveying in the Mediter-ranean under Thomas Graves. In 1841 he was appointed to a survey of the Cameroons and the Niger River. The arduous work in this whiteman's graveyard decimated the surveyors and ships crews but the charts produced eventually established safe communication by water with the interior. But this was a short appointment for Sidney and by the end of 1842 he was surveying the Azores with the well-known hydrographer A.T.E. Vidal on board *HMS STYX*, serving as chief assistant.

Both Fitzwilliam Owen and Vidal have Canadian connections as they worked together on the initial hydrographic surveys of the Great Lakes in 1815-17.



In 1845 Sidney joined Commander G.A. Bedford on surveys of the west coast of Ireland in various ships, again as second in command.

His first appointment as hydrographer-in-charge was to a survey of the entrance of the River Plate including the mouths of the rivers Parana and Uruguay. It was a small charge as his only assistant was a young Masters Assistant and his vessel was a locally hired one named the *INDIAN*. Though small in area the survey was of major importance as it covered the roadsteads of Buenos Aires and the banks lying off Montevideo, both major ports.

After three years on the South American coast Sidney rejoined the west coast of Ireland survey for a few months in 1857 and the following year was given charge of the Channel Islands survey.

While in charge of this survey he was promoted to commander with seniority of Jan. 1, 1859.

Two years later he was ordered to New South Wales in charge of surveys of that coast in a hired schooner, aptly named, the Captain Cook, and he spent the remainder of his active service on the Australian coast.

The President of the Royal Geographic Society in his 1869 presidential address said: "The seaboard of New South Wales, from Cape Howe on the south to Danger Point on the north, embracing 600 miles of latitude, has been completed; and its ports and anchorages surveyed with all the accuracy necessary for ocean navigation, or indeed for any purpose. The survey was commenced by Captain Sidney in 1861, who had retired after a long and meritorious service of 34 years, during which he was constantly engaged in surveying duties in various parts of the globe."

Sidney served at a time when the Admiralty Chart became synonymous with charting excellence and the small select group of field hydrographers were dedicated to maintaining the reputation of their product. Many of them paid for their devotion to duty by an early death. But the hydrographer, the colonizer and the merchant marched together and laid the foundations of a British commercial empire that was to endure for another 100 years.

Sidney can well be proud of her hydrographer and his part in making parts of the world's coastal waters safe for mariners of all nations.

Evaluation of Motorola's Mini Ranger Data Processor and Automated Positioning System

K.T. White and M.A. Hemphill

Canadian Hydrographic Service

Atlantic Region

Introduction

The Atlantic Region is evaluating various logging systems suitable for the acquisition of Hydrographic data. This paper describes the results obtained with Motorola's Mini-Ranger Data and Automated Positioning system (MRDP) used during the 1977 field season.

The MRDP is a microprocessor-based computing and control unit which may be combined with other system elements such as a positioning system, depth digitizer, track indicator, etc. Its basic function is to gather position information in the form of ranges to known points and from that range data, compute the position of the system in the users' grid coordinate system. The range data is also used to provide a left/right indicator with information enabling a vessel to be guided along a predetermined line.

Preliminary tests were conducted during the last week of July in the Bedford Basin area of Nova Scotia to familiarize personnel with operational procedures. The major evaluation was carried out later in the season in the Palcentia Bay area of Newfoundland (Fig. 1) using CSS *Maxwell* as the sounding vehicle. The navigation system worked well during the Palcentia Bay survey and assisted greatly in the manoeuvering of the vessel so it was decided to further utilize the equipment while conducting a survey in the Holyrood area, Newfoundland.

In mid October the equipment was returned to Bedford Institute and post processing of the raw data was carried out. We should note that data collected and processed automatically (Fig. 2) compared quite favourably with data collected and compiled manually using accepted methods as laid down in Standing Orders and directives.

System Description

Hardware: Hardware used in conjunction with the MRDP control unit was as follows.

Mini-Ranger III system (3 transponders)
EDO 9040 Echo Sounder
C-Tech Depth Digitizer
Texas Instruments TI 733 ASR Terminal (includes two tape cassette units)
Houston Instruments 6650 Plotter
Motorola Track Indicator

Fig. 1 Survey Area in Placentia Bay

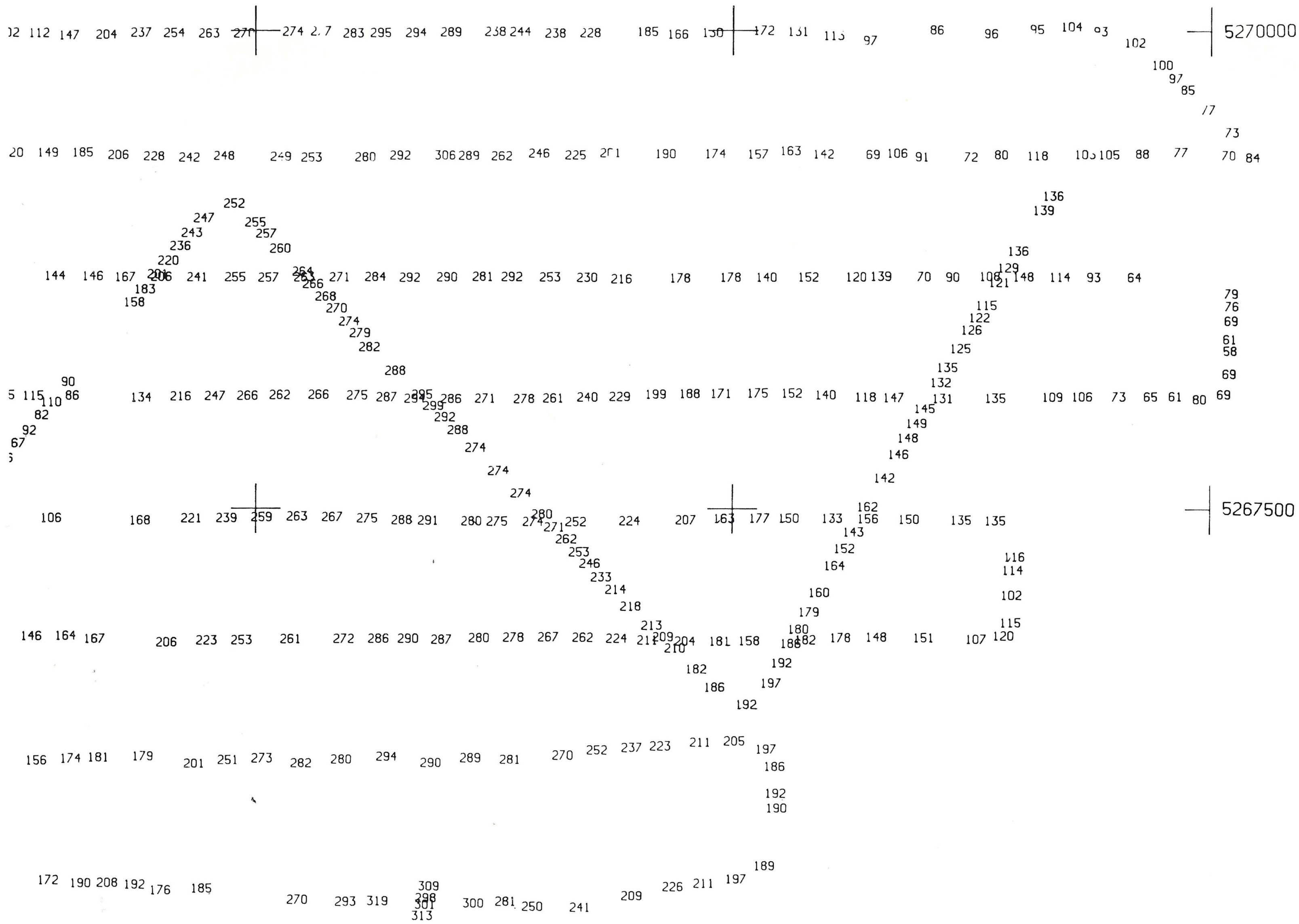


Fig. 2 Xynetics Plot of Processed Data

Software: The operating program (extended survey ROM with post plot) provides the capability to acquire and correlate depth information with position and time information, and then record that data on mag tape. In addition, other programs allow the operator to perform preplot and post processing functions. The system can also compare the present position with a previously planned line and output the results in the form of guidance information, which is used to position the system.

The standard position fixing rate of MRDP is twice per second, but the rate at which information is written to tape cassette and/or terminal printer is user controlled. This information consists of time, position data and depth information. The position data can be in the form of plane grid coordinates (i. e., U.T.M.) or right and left ranges, or the distance from the beginning and the distance offset from a predetermined baseline. Output to the plotter is in the form of a real time track plotted at a specified scale.

Guidance information received by the left/right indicator is displayed on two meters. One displays the offset distance left or right from a predetermined line while the other indicates the percentage of the distance travelled along this line (Fig. 3).

Exec Mode: This mode is the common point between all the various operating modes. Options are available to perform tests for maintenance, system self check, initialize the system and transfer to other modes.

Data Entry Mode: This mode is used to enter the preplanned site and line coordinate data into system memory. The data can be entered through the keyboard or read from tape cassette. In addition the data can be changed, listed and/or written to tape cassette.

Operate Set-up Mode: This mode is used to set up the operating parameters and provides a means for initiating a run. Parameters entered include site and line selection, sample interval for recording data, plotter scale, tape file number, depth correction, etc. The pause mode is entered automatically after input of the last parameter.

Pause Mode: If, when collecting data the "ESC" Key is hit, the system automatically enters the pause mode. This enables the operator to change most of the parameters entered in the operate set-up mode.

When the run command is given (pause or exec modes) a control block is written on mag tape before any

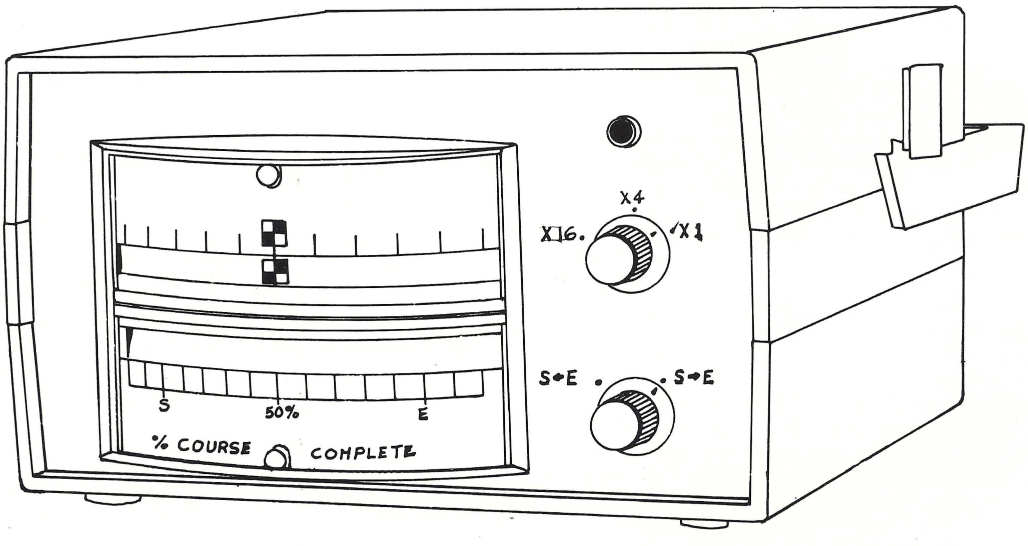


Fig. 3 Left/Right Track Indicator

data is collected. This block contains the file number currently assigned and all the parameters required for post plotting or processing.

Preplot Set-Up: This mode is used for plotting a predetermined baseline which has been entered during the data entry mode. After the line number and scale have been input the plotter will mark the start co-ordinates of the line, draw the line along the long axis of the plotter, mark the end co-ordinates of the line and return to the start point.

Post Plot: This mode is used for listing or plotting data recorded on the tape cassette. The depth values are plotted with characters .1 inch in height, perpendicular to the survey line. The decimal point indicates the position of the sounding.

Operational Modes

The system is programmed to interact with the operator through a series of messages designed to aid the operator in the correct preparation and operation of the system. The operator may enter one of six modes to input or change program parameters. To change parameters the "ESC" Key need only be hit to stop the system from processing data. This allows the operator to communicate with the system through the pause mode. Note that no data is collected while the operator is communicating. Pressing the "H" Key lists the options for the particular mode the user is in. In some cases a default value is printed and can be changed by inputting a new value before hitting the carriage return key.

The system prevents over plotting of data as the survey vessel proceeds along the line. The criteria is based on distance from the previous sounding plotted; therefore, shoal soundings may be overlooked. The plot techniques described above do not comply with the accepted method of post processing in the Canadian Hydrographic Service so that data was processed using existing hydrographic programs.

Survey Operation

A trial run was made September 27 to familiarize hydrographers with the operating system and ship's personnel with the left/right indicator. The concept of running on a set of ranges when using the left/right indicator was well accepted by the ship's crew and most of them had little difficulty following a predetermined line.

As this was a check survey, regular sounding was not commenced until September 29 due to poor weather conditions. The plotter performed satisfactorily when plotting the ship's track in real time and so it was decided to manually mark and number each fix on the plotter while running the sounding lines (Fig. 4). This eliminated manual plotting using the two ranges, as the fixes from the plotted tracks could be transferred directly to the boatboard at a later time. It is our understanding that an automatic fix annotation capability has been incorporated in the newer software package. All that required plotting was the start and end points of each baseline which were used for orienting the track plots. This also eliminated the need for additional lattice plots. The digitizer correction was determined and applied after the initial bar check.

Additional sounding lines were run on October 1 and October 2. Different site configurations were used and lines run on both sides of the baseline.

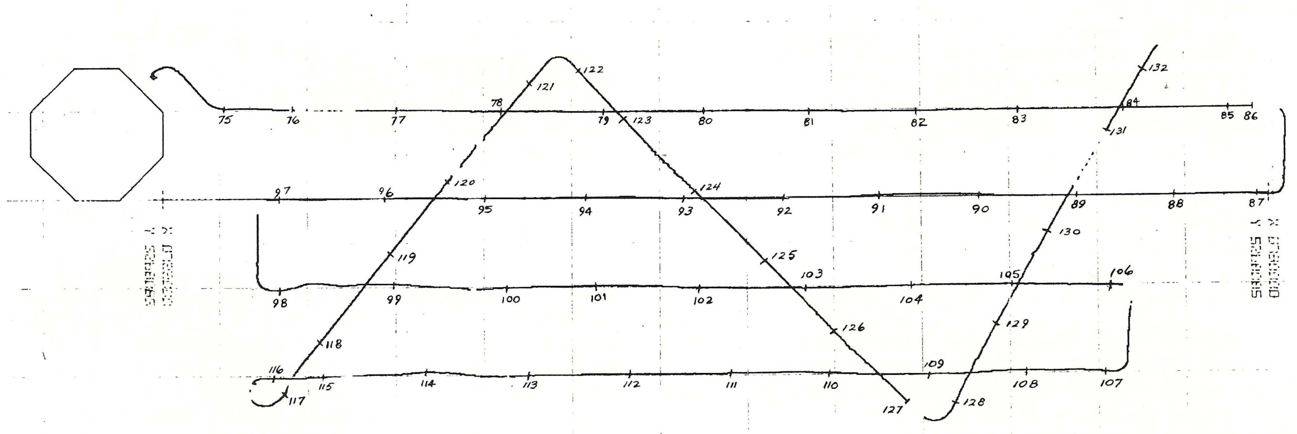


Fig. 4 Survey Vessel's Track Plotted in Real Time

Observations and Comments

Although we were favourably impressed with the MRDP, we felt that a number of additional features could have been incorporated into the system. Some examples are:

1. When operating, the two ranges normally displayed on the M.R.S. are suppressed. This is undesirable when UTM positions are being written on mag. tape as the ranges cannot be recorded for manual backup. (For this reason most of the evaluation data was recorded in the range/range mode.)

2. When parameters are changed in entering the pause mode no data are collected or processed. The resulting loss of data is unacceptable. The interruption should only occur when the altered parameters affect post processing (i.e., are contained in the control block). Parameters such as offsets which control the left/right indicator and depth corrections are not recorded in the control block.

3. If the signal from one or both of the slave stations are not received or if a position cannot be computed due to erroneous readings, a loop error is printed on the terminal and no data is recorded on the tape. During these periods if time and depth were still being recorded, data could be recovered manually at a later date.

4. When no data is being recorded or processed, the pen automatically lifts from the plot and the left/right indicator ceases to operate. One of the biggest causes of information not being recorded was the so-called M.R.S. range holes evident in a number of places in the survey area. One way around this might be to record three or even four stations to obtain the best possible fit or fix. Note that the pen can also be lifted from the plot and reset by pressing "G". The recorder and printer may also be turned off by pressing "R" and "P" respectively. On a number of occasions the pen lifted from the plot for no apparent reason and the "G" key had to be hit several times before the pen would return to the plot.

5. As stated earlier, data is recorded on tape cassettes. For our application the limited storage capability of the cassettes makes it

very inconvenient for our logging requirements. A warning signal to signify approaching the end of the tape would have been a desirable feature.

6. The manner in which the depth correction is entered should be further clarified in the operator's manual.

7. When fixing the sounder manually a signal should also be generated to mark the plotted track.

8. When listing data the headers for the left and right ranges appear to be reversed.

9. There appears to be no illumination on the left/right indicator.

10. For launch operation all voltages should be compatible, for example the M.R.S. and sounder were 24 V dc, all other equipment was 110 V ac.

Post Processing Operation

The system was returned to BIO in mid-October and post processing of the data tapes was started.

To utilize the existing processing programs, which run on the HP 2100 computer under the RTE system, the data recorded on the tape cassettes had to be transferred to the conventional 7-track mag. tape. This transfer proved to be the most difficult step during post processing.

The Texas Instrument terminal, used to record data on the tape cassettes, is RS-232C compatible, therefore no problems were anticipated in communicating with the HP 2100 system.

However, after a number of attempts to interface the two, it was realized that the interface board available was not compatible with the terminal. The only alternative left was to communicate with a CDC 6400 computer located at Dalhousie University via a phone link (MODEM). Problems were also encountered while using this method of transfer due to a number of nonprinting characters being written at the start of each data control block when the raw data was recorded.

The data were transferred to disc files on the CDC 6400 system using the text mode. When the above nonprinting characters were read they were interpreted as illegal characters by the system, which resulted in the text mode being terminated.

Fortunately the Texas Instrument terminal has the capability of tape editing so these characters could be skipped over, in the off-line mode, whenever a control block was read. This problem did result, however, in the loss of some data prior to the operator becoming completely familiar with the proper operating procedures and the off-line editing capability of the terminal. This loss of data occurred during the transfer of the first day's data and accounted for about 3.5% data loss for the day. Approximately three days were required to transfer all the data and during this time seven tape errors were encountered. Two of these resulted in two lost fix times and could be considered minimal.

After all the information on the cassettes was transferred to the disc files, a copy of each file was written to 7-track mag. tape. The data were now in a form to be read on the HP 2100.

At this time a short program was written to convert the data from its present format (one fix per physical record) to the HAAPS raw data format (one physical record per minute). As one of the values contained in the control block determines which position mode the subsequent data were recorded in, the range/range data were converted to UTM during program execution. Zero ranges recorded while logging, in addition to data gaps due to loop errors, were flagged as bad positions. Bad depths were also flagged and recorded at this time. The standard HAAPS program was then run to select and write soundings to a disc file. A final plot was produced on the Xynetics plotter for comparison purposes.

Range holes have more effect, with respect to data gaps, on the processed data than on the plotted track. This is due to the different sample rates. The standard position fixing rate of the MRDP is twice per second and the tracking information computed from these positions is supplied to the plotter at the same rate. However, the tape cassette was restricted to accepting the information at the rate of once every two seconds. Also, one-third of the HAAPS record must be good data before the record is accepted by the processing program. While logging data, a sample rate of one per second instead of one every two seconds should allow more good data to be recorded.

The data loss attributed to these range holes or loss of signal amounts to 3% of all the data processed. The proper operation of the C-Tech Depth Digitizer was of secondary importance but it worked reasonably well. Two types of depth errors occurred. The first was due to the unit not tracking the bottom properly and accounted for about 2% of processed data containing erroneous depths. The second was due to the digitizer locking on the transmission line and at times was ignored or overlooked by the operator, especially during the first day of sounding as most of his attention was focussed on the MRDP system elements. The second type of errors resulted in a 3% portion of the processed data containing erroneous depths.

Conclusion

One of the main advantages of using the MRDP is the elimination of manual plotting and the drawing of lattices. Another main advantage is versatility afforded the hydrographer when selecting the direction and spacing of sounding lines. It has been shown that to adequately cover a sounding area up to 24% of the sounding distance travelled can be saved when the sounding vehicle is not restricted to running along the circular range lines (1).

Although the various options for the operating modes are numerous, a hydrographer should have little difficulty in becoming a competent operator after one day's experience.

The loss of data that can be directly attributed to the MRDP processor is negligible. As stated previously most data loss was due to the lack of or the erroneous signals being received by the Mini-Ranger receiver.

The tape cassettes are not suitable for recording the large amounts of data normally collected by a survey vehicle during one sounding day. A recording system more compatible with the HP 2100 system is essential although the format is conducive to fast processing.

The method used for plotting depth appears completely unacceptable for applications of the Canadian Hydrographic Service. As mentioned previously the system prevents overplotting of soundings so that the shoalest depth may not be selected. We feel, however, that we could do without the sounder plot.

As in the past, it appears the weakest link in the system was the EDO 9040 sounder and the depth digitizer.

Scale of survey in Placentia Bay was 1:25,000 and at Holyrood Bay 1:10,000. No problems were experienced while conning the *CSS MAXWELL* along a predetermined line even at these scales.

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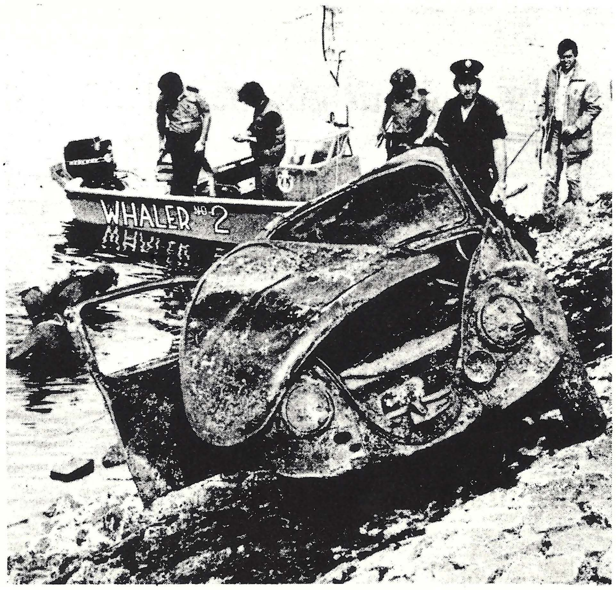
Feds solve 4 year old crime!

R.W. Sandilands

Canadian Hydrographic Service
Pacific Region



Vancouver Province

..........dateline Vancouver, 25 May, 1978

Vancouver City Police and the Insurance Company of B.C. today marked one of their crime reports closed when the body of a kidnap victim was recovered from the muddy depths of False Creek which lies near the centre of the city, an area with one of the highest crime rates in Canada.

Federal Investigator Rainer Schoenrank on special assignment from a Vancouver Island Investigation Unit was engaged on a case survey of the Creek area checking out deadheads, layabouts and sundry other suspicious undercover junkies who are known to infest the area. These undesirables lie in wait for unsuspecting mariners, ripping and slicing into their unprotected parts and their victims have no recourse but to go to the front men who fix them up at padded prices, a well known waterfront racket.

In an exclusive interview with Lighthouse Rainer stated that his first big break on the case was the consistent presence of old "one foot", known to his modern contemporaries by the code name of Om2. In the typically normal two footed population he stood out as an unusual character. When profiled on a special portable analyser he was recorded as being squat and hump backed with a low brow and wide set eyes.

He was carefully tracked and cautiously examined. A metallic ring came from his body when the intrepid investigator checked him out with an armed remote sensing device. Though this device was developed many years ago investigation squads still make recourse to it in extreme cases. This potential menace skulking in a main thoroughfare indicated that caution was necessary.

A quick radio call for back up was made to unit chief Barry Lusk who co-ordinated a concerted swoop by City Police, backed up by the Fire Department and frogmen of the special squad.

The area was sealed off to traffic and the special squad operatives quietly eased their way into the dark underworld of this cesspool that the City Fathers have been trying for years to clean up.

Minutes later they reappeared and after consultation with the onsite Police commander a flurry of activity brought the body ashore.

Agent Schoenrank fearlessly returned to his search but old 'one foot' had disappeared. No sinister threat remained in the area and for the time being nothing disturbed the dull monotony of the suburban flats.

Police later announced that the body was that of a 1974 kidnap victim and that pending someone claiming the body it would be kept in an old Volks home.

Federal Fisheries investigators are also interested in the case as an undersized crab was found in the glove compartment.

The "Amoco Cadiz" And All That

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A side benefit of being in the United Kingdom for a year studying marine law has been to have a grandstand view of what has been to date the largest marine oil spill. This article, prepared mainly from press reports, describes some of the events and possible consequences of this disaster. While hydrographers may not always be directly involved in events of this kind they, in company with all those whose work involves the sea, will most surely be in some way affected. The questioning of the charts and navigation, the need for detailed surveys to assist in the salvage, and the preparation of new routing charts are but a few of the possible repercussions for the hydrographer.

At 0945 on March 16 the steering gear of the supertanker *AMOCO CADIZ* failed[1] as the ship was rounding Ushant off the northwest coast of France. Just less than 12 hours later the tanker, carrying 230,000 tons of light crude oil[2], grounded on a reef opposite Portsall on the north west coast of Brittany[3]. The consequent pollution was eventually distributed along the coast northward from Brest and eastward to a point where it at one time endangered the Channel Islands. Although there was concern that the huge oil slick might reach the English coast, persistent westerly winds kept it away.

A number of factors have made this case particularly interesting besides its huge size. Between the time the steering gear broke down and the ship grounded, the Master of *AMOCO CADIZ* engaged a tug to tow the vessel away from the danger. Unfortunately, the tug was not powerful enough to carry out the task and during the operation, the tow rope parted. Another, more serious question has involved reports that the master of the tanker and the master of the tug could not agree on the form of the towage agreement. This also involved a three way exchange with the tanker owners, Amoco, part of Standard Oil of Indiana, U.S.A.[4] The matter is reported to have been whether the master of the tanker would accept the Lloyds "open form" of salvage agreement, which is based on the principle of "no cure no pay".

A matter of particular concern for the French authorities was that it was reported that the *AMOCO CADIZ* had given no indication that it was in danger until actually striking the rocks, in spite of the fact that the steering gear had broken many hours previously[5]. A number of other tugs, including two French naval tugs, were reported to have been in the vicinity and available to assist had they known of the ship's problems.

The timing of the accident could not have been worse for the Liberian government, under whose flag the ship was registered, as that country has recently been trying hard to improve its tarnished reputation as a "flag of convenience". Countries that have established themselves as bases for such ships have in recent years been under mounting pressure to improve their standards both with respect to ship construction and manning. Interestingly enough, the *AMOCO CADIZ*, which was built in 1974, is claimed to "rank among the world's best maintained, equipped and operated tankers, and met or exceeded all international and national safety requirements"[6]. It is reported to have had fully redundant steering mechanising - a fact which does not appear to have held up under examination and will be discussed further. The officers and crew were all Italians and the officers qualifications appear to have been beyond reproach. All were licensed both in Italy and Liberia, all were graduates of Italian nautical academies, and all held degrees equal to a Bachelor of Science in the U.S.A. Three held master's licences and three held chief engineer's licences[7]. The Liberian authorities have been quick to overcome an earlier source of criticism that they did not conduct proper enquiries. In this case they arranged an enquiry presided over by Sir Gordon Wilmer, a former Lord Justice of Appeal[8]. This enquiry was completed in June this year and to date only a few findings have filtered down through the press. A second enquiry is reported to have been held by the French authorities.

From a legal aspect the situation of the *AMOCO CADIZ* differed from that of the well known *TORREY CANYON* disaster which occurred almost exactly eleven years earlier and, in the words of the sea chanty, 35 leagues away near the Scilly Isles. While the *AMOCO CADIZ* grounded in French territorial waters, the *TORREY CANYON*, which grounded on the Seven Stones reef, was outside territorial waters and on the high seas. The intervention of one State upon another State's property on the high seas has for many years been considered a serious offence except when it is permitted for particular happenings such as piracy. Therefore, in the case of the *TORREY CANYON* the British authorities were extremely hesitant to carry out any action that would harm the Liberian owned ship until the salvage companies had made every attempt to save it intact. Eventually, when salvage efforts failed, the British Government ordered the bombing of the ship. The *AMOCO CADIZ* was a different situation and well within the authority of French Government, besides which, as a result of the *TORREY CANYON*, there is now a multilateral convention[9] permitting intervention in the case of certain circumstances involving pollution.

The *AMOCO CADIZ* was, at the time the steering gear broke, in an area where there is a traffic separation zone and ship routing. The zone extends only for the area rounding Ushant, with a further area up-Channel off the Cherbourg peninsula. The result of this accident has been to cause immediate questioning of the scheme as it was realized that the existing scheme could have several flaws. One such possibility is that the traffic routing will have the effect of concentrating traffic closer to Ushant than if each ship had chosen its separate path at varying distances offshore. Another possibility is that the inbound route, lying to starboard, takes the ships closer to the shore than the outward route. Considering that inward ships may be less sure of their position than those outward bound it might be better if the routes were reversed, except for the fact that that would be completely contrary to all present practice at sea. IMCO has been carefully studying the matter and a number of proposals have been put forward. Amongst these, the Trinity House, which is responsible for all navigation aids around the coasts of England and Wales, has proposed a "super highway" concept with a continuous routing scheme right up the centre of the English Channel.

During the earlier, hectic days after the disaster, various possibilities were considered for removing the remaining oil from the wreck. One possibility was to take in a smaller tanker alongside the *AMOCO CADIZ* and pump out the oil. A stated difficulty was the lack of precise knowledge of the bathymetry in the area of the wreck to allow a small tanker to get in. This point seems to have provided an example for hydrographic offices to claim that more resources are needed to survey all this inshore detail. It may be questioned how practical that would be. As it happened, continuing rough weather prevented any operation of that nature and most of the oil spilled out before the French Government provided the final coup de grâce by bombing the wreck.

No doubt the clean-up operation will provide a subject for many learned treatises, as did that of the *TORREY CANYON* spill. However, science seems to have moved slowly in this direction during the last eleven years, except perhaps in the development of much less toxic detergents. There was, though, the same hopeless brigade of rubber-booted volunteers, military personnel, firemen and others who, according to television coverage, waded day and night through the black oil. At sea, fleets of both French and British ships sprayed thousands of gallons of detergent in an attempt to reduce the huge oil slick. It was reported that the oil spill endangered the livelihood of many fisherman and tourist operators on the Breton coast. Unfortunately for them their pleas for help were somewhat overshadowed by the concurrent French general election. Since the *TORREY CANYON* several insurance schemes have been established to compensate property owners and governments for losses and costs incurred in oil pollution disasters; but whether they will cover all the losses remains to be seen.

Returning to the initial accident of the breakdown of the steering gear some comments may be made. The availability of alternative equipment for propulsion and steering in supertankers has been commented upon quite frequently prior to this accident. Mosfert[10], in his book *SUPERSHIP*, made particular reference to the liability of having only one engine and one screw on these huge ships. In the case of the *AMOCO CADIZ* it was reported that, although the ship had an alternative steering gear, both systems were dependent upon one hydraulic system which broke down. The rudder then apparently was free to flap about. The master tried to prevent this by going astern, but this did not stop the movement. At the court of inquiry the master, in a reply to the chairman, claimed that he could not go ahead because they were near the land[11]. As the danger of grounding became imminent, attempts were made to let go the anchors. Apparently only one was let go, with difficulty, but the extremely rough seas prevented the second anchor from being released.

The problems of the towing operation were touched on earlier. It has been reported[12] that the German tug *PACIFIC* put a line aboard at 1325 on March 16 and that the line parted around 1615. There has been some question of whether the tug actually put weight on the hawser for much of the intervening time, it being claimed that the tanker and tug drifted with slack ropes until they were within six miles from the mainland. A further line was put aboard but apparently the tug, with 10,000 bhp, was unable to stop the drift. A second tug, *SIMPSON*, arrived 1½ hours before the grounding, but apparently did not put a line aboard. The entire question of the towage agreements and the duties of ocean-going tugs seems likely to be in for a major review. It has been pointed out that in South Africa, where there have been numerous accidents involving supertankers, powerful government tugs are always at the ready. However, as the French Government may rightly say, they cannot help if they do not know about an accident.

The *AMOCO CADIZ* incident bears some comparison with that of the *TORREY CANYON* and, for Canadians, with the *ARROW* incident in Chedabucto Bay. The exact amount of oil spilt in each case has been variously reported but it appears that all the light crude from the *AMOCO CADIZ*, amounting to 220,000 tons[13], was eventually lost. It may be noted that this was light crude as compared with the Bunker Oil C, a much more viscuous oil, that was spilt, in the case of the *ARROW*, in the colder waters off the Nova Scotia coast. The amount of oil spilt from the *TORREY CANYON* has been variously reported, but appears to have been around 60,000 tons of crude oil[14], while the *ARROW* was relatively minor at around 16,000 tons[15]. Interestingly, there were some very close analogies. All three ships were registered in Liberia, although they were owned by Americans in the case of the *AMOCO CADIZ* and by a Bermudian company in the case of the *TORREY CANYON*. All three accidents occurred on coasts where the local populations are dependent upon fishing and tourism for their livelihoods.

Although the public may hear about the major incidents that effect them directly, such as the *TORREY CANYON* and the *AMOCO CADIZ*, the extent of oil spills as a result of accidents to ships is very large. In South Africa in particular there have been a number of very serious incidents. These include another Liberian registered ship, the *WAFRA*, that ran aground in 1971 and was subsequently towed off and sunk in deep water by the South African Airforce[16]. Another most amazing recent incident was the collision of two 330,000 ton sister ships off the South African coast. Off the coast of France and the United Kingdom, collisions and groundings of oil tankers in recent years have been numerous. Shortly after the *AMOCO CADIZ* disaster, a Greek tanker, the *ELENI V*, was cut in two in a collision with a French cargo ship off the Norfolk coast. That incident gained considerable publicity as the oil polluted large expanses of beaches at the start of the summer holiday season. However, the attempts by the authorities to remove the ship and its oil, viewed from the outside, was one of hilarious misadventure as attempts were made to ground the ship on unstable sandbanks and eventually tow it into deep water and sink it with explosives.

In concluding, the writer of this article does not claim to be an expert in pollution matters - there are enough of those already. The bright spot of accidents such as *AMOCO CADIZ, TORREY CANYON* and *ARROW* is that they galvanize the authorities, both national and international, into action. They have all been instrumental in moving lethargic governments to help prepare and sign conventions and municipal legislation. There continues to be a slow improvement in technical ability to handle oil spills, but large oil spills in heavy sea conditions still are proving extremely difficult to control. IMCO is steadily getting around to controlling the design and manning of ships. There remain outstanding problems of getting all States to ratify the conventions and their amendments.

In the hydrographer's realm it seems that there are still improvements to be made in ship traffic schemes and routing, although the Dover Straits system, as one example, appears to have helped considerably to minimize accidents. The concept of controlling ships from the shore lies hard with the "ancient mariners" belief that a shipmaster is truly master of his own ship; but it may be that the dreaded airport control system may have to eventually come into being. Whether or not it is really practical to provide hydrography of engineering precision for all shallow areas on which ships are likely to ground must be considered not only by the hydrographers but by coastal states that would have to foot the bill. Possibly, new methods of aerial photography and laser bathymetry will provide the solution. The prediction of the movement of an oil spill still seems as shaky a science as predicting the weather. Certainly it seemed that a glance at the weather map and a basic knowledge of the tidal streams provided as many clues as to where the *AMOCO CADIZ* spill would go as any scientific prediction. Finally, in the winter season's list of horror stories was the tale of a Saudi Arabian VLCC, inward bound through the Straits of Dover, which was seen by the Coastguard radar to be headed right across the opposite traffic lane and heading for a sandbank. Apparently, there were problems with all the navigation equipment including the gyro compass and the Decca. Only the intervention of the Coastguard appears to have saved the ship. It seems that ships, like aircraft, really must have completely duplicated navigation, control and propulsion systems.

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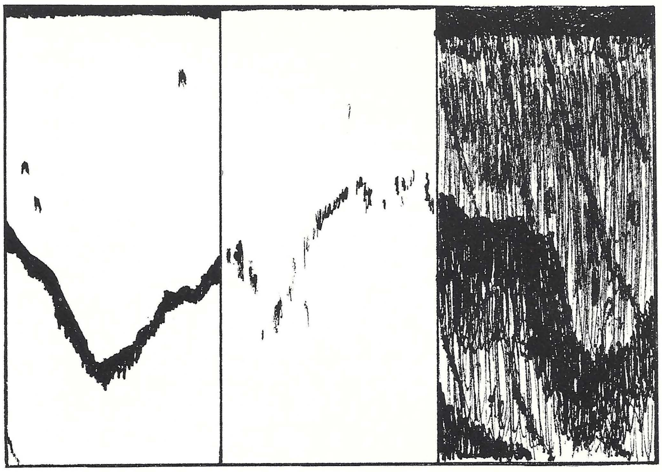
Dependable Digital Depths

John V. Watt, P. Eng.
Canadian Hydrographic Service
Pacific Region

Depth, that elusive variable long sought by Hydrographers, can be measured and recorded directly and automatically in digital form. The techniques presently available to accomplish this measurement continue to be very dependent upon the hydrographer and his abilities both to assess the echogram and to adjust the echo sounder, thereby ensuring that the digitized values represent the bottom correctly.

The present generation of depth digitizers still requires considerable attention by watchkeepers. They usually have a capability to 'gate-out' a limited degree of noise, to provide a limited degree of signal level slicing and amplitude dependent selection, and typically can be adjusted to select the first echo arriving within the gate. These features compare very poorly with the filtering, near infinite level slicing, fantastic visual integration and overall value judgement capabilities of a competent watchkeeper.



(a) **(b)** **(c)**

Fig. 1

The above figure dramatizes three qualities of echogram which could be achieved from the same recorder over the same type of bottom by using various selections of gain, output power, frequency, beamwidth, and launch speed. The depth digitizers available at present work reasonably well when provided with a signal which produces an echogram similar to Figure 1-A. It is important to note here that the quality of the echogram is a direct indication of the quality of the signal which the typical depth digitizer must decipher. The hydrographer has the capability to interpolate or integrate echograms such as Figure 1-B and to filter, level slice and integrate echograms such as Figure 1-C and thereby determine depth - the depth digitizer is not this sophisticated.

One of the primary responsibilities of the hydrographer during 'automated' survey operations is to ensure not just that data is recorded, but that the recorded data accurately reflects the measurements and the judgements made on-line by the hydrographer. To ensure that the depths recorded meet this criterion, the hydrographer must carry an on-line version of the value judgements he alone is trained and competent to make in the determination of the true bottom location on the echogram. He must then adjust the instrumentation such that he enhances this true bottom thereby providing the best opportunity of digitizing the depth correctly. The next step is, of course, to ensure, by checking the location of the verify mark relative to the adjudged depth, that the depth digitization is occuring as it should.

There are sure to be occasions and circumstances, probably many, which will preclude the achievement of good, dependable depth digitization - at times like this the hydrographer who collected the data should be confident that he has applied the equipment in an optimum manner and that the conditions were simply too severe.

In summary, to ensure that valid depth data is recorded during automated surveys, the hydrographer must make on-line value judgements of the location of 'true-bottom' using the echogram then adjust the instrumentation as necessary to provide the best possible echogram which enhances and depicts this adjudged depth in order to coax the digitizer to operate correctly.

Donations Solicited to Purchase Cook Charts

An opportunity has arisen for the Association of Newfoundland Land Surveyors to acquire a group of eighteenth century charts based on the surveys of Captain James Cook in Newfoundland. There are approximately a dozen charts in the series, drawn by French cartographers of the period.

As a project of the Silver Jubilee Year, the Association hopes to purchase the charts and display them in a public place, such as the lobby of the Howley Building. This is a unique opportunity to preserve the earliest accurate surveys of our country within the surveying fraternity, and the Association is asking for contributions to this worthy endeavour.

Should anyone or any organization wish to make a contribution the address is given below. All contributions will be acknowledged.

Mr. T.G. Seammell
Assoc. of Newfoundland Land Surveyors
Piper Stock Hill, Site 71
Box 32, Torbay Road
St. John's, Newfoundland

Book Review

Fundamentals of Marine Acoustics

Elsevier Scientific Publishing Co., 1977
Elsevier Oceanography Series, 18

This book, as the author points out in the preface, is intended for graduate and upper level undergraduate students who wish to better understand the principles of sound propagation in the ocean. It is based on the contents of a graduate course taught for several years in the Department of Oceanography of Texas A & M University and on a short course held at Texas A & M for two summers. It is written as a textbook and a number of chapters have problem sets for the student to solve. The author has included a lot of difficult math throughout the text but in almost every case has included brief explanations of the processes in laymans' terms before starting the deeper theoretical treatment. Although difficult to follow, the extensive mathematical treatment is necessary especially in the derivation and explanation of the "wave equation" and for several other similar explanations.

Electroacoustic and Chemical Transduction, Calibration, Theory of Sound Propagation, Reverberation, Noise and Signal Processing and several other topics are covered in a concise manner with none being considered in great detail. The author, in standard textbook fashion, has developed very good analogies to electrical and mechanical systems, making the text quite readable to persons with different technical backgrounds. He has also done several electromagnetic/acoustic propagation comparisons that clearly illustrate similarities and differences. Throughout the text, the microbar rather than the micropascal is utilized as the pressure standard. The author does mention on page 4 that the micropascal is now the accepted standard, and it is felt that he should have used the micropascal throughout.

The text contains a great deal of useful information. A considerable amount of it is similar to Urick's work (the model textbooks in acoustics), although in a number of cases the authors complement one another because of their differences in subject treatment and style. This book would form an excellent basis for sonar workshops and it is a useful reference for design engineers and educators. It also contains a great deal of readable and useful information for hydrographic surveyors. It does nevertheless lean towards theoretical rather than technical descriptions and I would advise that a library copy be perused before a personal copy is purchased.

Distributors for United States and Canada:

Elsevier North-Holland Inc.,
52, Vanderbilt Avenue,
New York, N.Y. 10017
U.S.A.

S. B. MacPhee
Canadian Hydrographic Service
Ottawa

News from Industry

Loran C Assists Consumers Gas in Monitoring Gas Wells

Gas wells drilled in Lake Erie by Consumers' Gas require service on a regular basis. The problem is -- how do you find a wellhead on the bottom of Lake Erie? Poor underwater visibility makes it necessary for the diving tender to locate the diver within 200-300 feet of the well location.

This year, Consumers' Gas evaluated the long-range Loran C navigation system in locating wellheads, using signals from transmitting stations in Indiana, North Carolina, and Massachussets. The diving tender was equipped with a Canadian-built Internav receiver coupled to Internav's CC-2 Internavigator.

In reporting the results of the trials, John Gillespie of Consumers' Gas stated "on a recent inspection mission, the Loran positioning error never exceeded 180 feet - well within our tolerances."

Consumers' Gas expects that the Internav equipment will also be valuable in inspections in fog conditions where operations have previously been restricted.

Magnetic Tape Compatible Sonar and Profiling System

Klein Associates, Inc. has recently announced its new Magnetic Tape Compatible Side Scan Sonar and Sub-Bottom Profiling Systems. This capability applies to both standard Klein graphic recorders, as well as the new Model SD-350 Transceiver/CRT Display. All Klein *HYDROSCAN* two and three channel recorders are now available with optional circuits and controls to record and play back records on magnetic tape. Called models 521T and 531T (for two or three channels respectively), these recorders may now record and play back data at 13 range scales (25 to 600 meters) and 10 paper speeds. The data being taped may be displayed on the graphic recorder, insuring good data is being magnetically recorded.

In addition, Klein Model SD-350 Transceiver/CRT Display Unit may be used to record and/or play back magnetic tapes. Single and dual channel Transceiver/CRT Displays are available.

The data is recorded in analog form with each channel of sonar or sub-bottom data on individual tape channels. An additional tape channel is used for synchronization. Standard instrumentation quality tape recorders may be used. Data may also be recorded and played back in digital form using the new Klein Model 600 Digital Processor.

Kits are also available for retrofitting older Klein recorders with this feature. This system has been thoroughly field-tested and is now is production.

New Loran C Research and Development Laboratory

Internav Limited opened a new 5,000 square foot research and development laboratory at their Sydney, Nova Scotia plant on 24 August, 1978.

The laboratory will be staffed by two engineers, two technicians and a draftsman and will perform studies of the Loran-C radio navigation system, utilizing advanced electronic techniques.

Tellurometer Relocated

Early this year, Mike Mogg, General Manager, Tellurometer, announced the relocation of his office from Ottawa to Downsview. For those who weren't aware of the new address, it is:

Tellurometer Division
Plessey Canada Limited
300 Supertest Road
Downsview, Ontario
M3J 2M2

Tel. (416)661-5224
Telex 065-24488

News from C.H.S.

Atlantic Region Supports Tidal Surveys

Atlantic Region has loaned a number of tide gauges to the Newfoundland Government in order to establish vertical control along the northeast coast of Newfoundland. This project is being supported by DREE funding and should supply a good chart datum through-out an area which is presently rather poorly covered.

Cartographic Training at Headquarters

The second full Cartography I Course started this year on September 12th with twelve trainees enrolled and will terminate on December 7th. This is the second full Cartography I Course but, the first with compilation and drafting integrated. The trainees are:

Pacific Region:	Peter Morton and Reg Pierce
Central Region:	Anthony Bonnici and Paul Warren
Quebec Region:	Claude Chantigny and Jean Villeneuve
Atlantic Region:	Marcel Chenier, Ed Belec, James Ross
Navigation Pubs.:	Joanne Glinski
Chart Production:	Ron Lemieux

The development of a Cartographic Career Development plan is expected to advance now that Mr. John Riley has returned on a part-time basis.

Niger River Reconnaissance

Dr. Warren Forrester, Chief of the Headquarters Tides, Currents and Water Levels Section, and Renaud Pilote of the Quebec Region spent the period from June 23rd to July 23rd in Mali carrying out a reconnaissance of the Niger River and investigating the existing horizontal and vertical control along the river with the purpose of reporting to CIDA on the feasibility of hydrographic charting of the river within the boundaries of Mali. This francophone country in West Africa has an economy that is closely linked to the Niger River, which provides communication, irrigation, fishing, and a little hydro-electric power. Life in Mali closely follows the flood stages of the river.

The team of Forrester and Pilote spent about three weeks in the capital city of Bamako in discussion with government officials and technical personnel, and the remainder of the time flying over the river in a small chartered plane and travelling along the navigable portion by Land Rover and by small boat. Stops were made at important ports along the way, the most famous being Tombouctou (Timbuktu). Some tourists, in search of a unique experience to report back home, go to Timbuktu to be photographed on a camel. Our intrepid team of adventurers did something much more unique: they went to Timbuktu and did not get photographed sitting on a camel. As Warren says, "Honi soit qui Mali pense".

CHA Personal Notes

Atlantic Branch

G. Henderson co-ordinated a 5-day Hydrography Course in May for 4 R.C.N. Navigating Lieutenants and 1 R.N. Lieutenant-Commander; *Al Adams* transferred to Ships' Division as Operations Officer; *Barry Mooney* transferred to Computing Services; *Bob Marshall* returned to Central Region in June after a one-year assignment as A/Assistant Regional Hydrographer; *Rollie Gervais*, *Malcom Jay*, *Grant MacLeod*, *Jim LaRose*, *Debbie Hepworth* and *Elizabeth Crux Cook* transferred from Ottawa to the Atlantic Region Chart Production Unit; *Fred Barteaux* retired July 31 after 40 years of service; *Ross Douglas* completed his studies at Dalhousie University, resumed his duties as Assistant Regional Hydrographer, won the competition for Regional Hydrographer, Central Region and transferred to Burlington - best of luck, Ross; *Rick Mehlman* and *Nick Stuifbergen* have departed to the University of New Brunswick on educational leave.

Ottawa Branch

Bob Steel, Chief of Production Control, is on educational leave and *Roy Petticrew* is filling in during Bob's absence; *Frank Hall*, the Acting Head of Survey Training, joined Central Region on a permanent basis at the beginning of the summer; *George Yeaton* spent part of the summer at Pat Bay helping with the horizontal control data base; two members of Cartographic Development, *Ms. V. Mahoney* and *Mr. W. Ho*, have left C.H.S. for jobs in private industry; *Ed Belec* recently transferred from GEBCO to Atlantic Region and has been replaced by *Paul MacMillan; Ed Besserer* of Reprographics will retire December 28th; *Sid Van Dyck* recently completed language training and is now working with Nautical Geodesy.

Central Branch

Ross Douglas, as noted above, has joined Central Region as Regional Hydrographer and is busy getting his family settled into the Golden Horseshoe -- welcome to Burlington, Ross; a welcome also to *Mike Mogg*, whose office of Tellurometer was recently relocated from Ottawa to Toronto (see·News from Industry); *Sam Weller* recently returned from a 6-month assignment in Quebec Region, and promptly left for UTP at McMaster; *John Gervais* left Central Region in spring to take a permanent position with Quebec Region; *Adam Kerr* recently returned from Wales with a Masters degree in some obscure field -- welcome back Adam; *Brad Tinney* moved from Tides and Water Levels to Hydrographic Development this summer -- his replacement is *Dennis St. Jacques*, who, although formerly employed outside of CHS, has been a CHA member for some time.

Pacific Branch

Tony Mortimer has now completed his U.T.P. and is to be congratulated on obtaining his B.Sc. (Maths); Cartographer *Bill Lyons* resigned to join the Provincial Government. New staff in the Region are *John Gould* from Ottawa, *Geoffry St. Gelais* and *Graham Whincup* (Chart Production), *Bill van Duin* (Hydrography), and *Al Smith* (Sailing Directions) on a temporary assignment; *Barry Lusk*, recently recovered from a broken leg while skiing, had better luck when a main engine bearing failed in a helicopter and the crew sweated it out to a crash landing at the Bull Harbour coast radio station pad.

Fred Smithers Retires

In June, about a hundred gathered at the Princess Mary restaurant vessel in Victoria for a dinner to honour Fred Smithers on his retirement as Regional Chart Superintendent (Pacific Region).

Fred joined the Hydrographic Service in 1940 as a cartographer, the first such position on the Pacific coast. He was hired by H.D. Parizeau who was Regional Hydrographer at the time. Training was on the job and Fred learned "the trade" under the supervision of Parizeau and later R.B. Young. Unlike today's compilers and cartographers, Fred went to sea with the survey party and was expected to generally assist in the survey in addition to his draughting duties. He reminisced about one typical day which encompassed assisting in the erection of a tide pole, doing some draughting, practicing lettering and ended up washing out the chart room!

Presentations were made by Ralph Wills - a C.H.S. plaque; John Rutley, Fred's predecessor as Regional Chart Superintendent - a scroll; Roy Petticrew - a radio from the Headquarter Staff; Pete Browning - a model robot.

Oliver Sommers and Ernie Harding of the Canadian Power Squadrons paid tribute to Fred's hard work in organizing and promoting the MAREP program on the Pacific coast.

Mike Bolton made the major presentation, a 10" radial saw, on behalf of Fred's friends and co-workers in the Region and expressed his appreciation of the support he had always received from Fred and of the happy co-operative atmosphere that Fred had always engendered in his 'shop' and with his fellow workers.

Fred, a young 55, and his wife Thelma have many plans for their retirement -- all the things they haven't had time for till now.

We wish them both a long, happy and healthy retirement together.

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