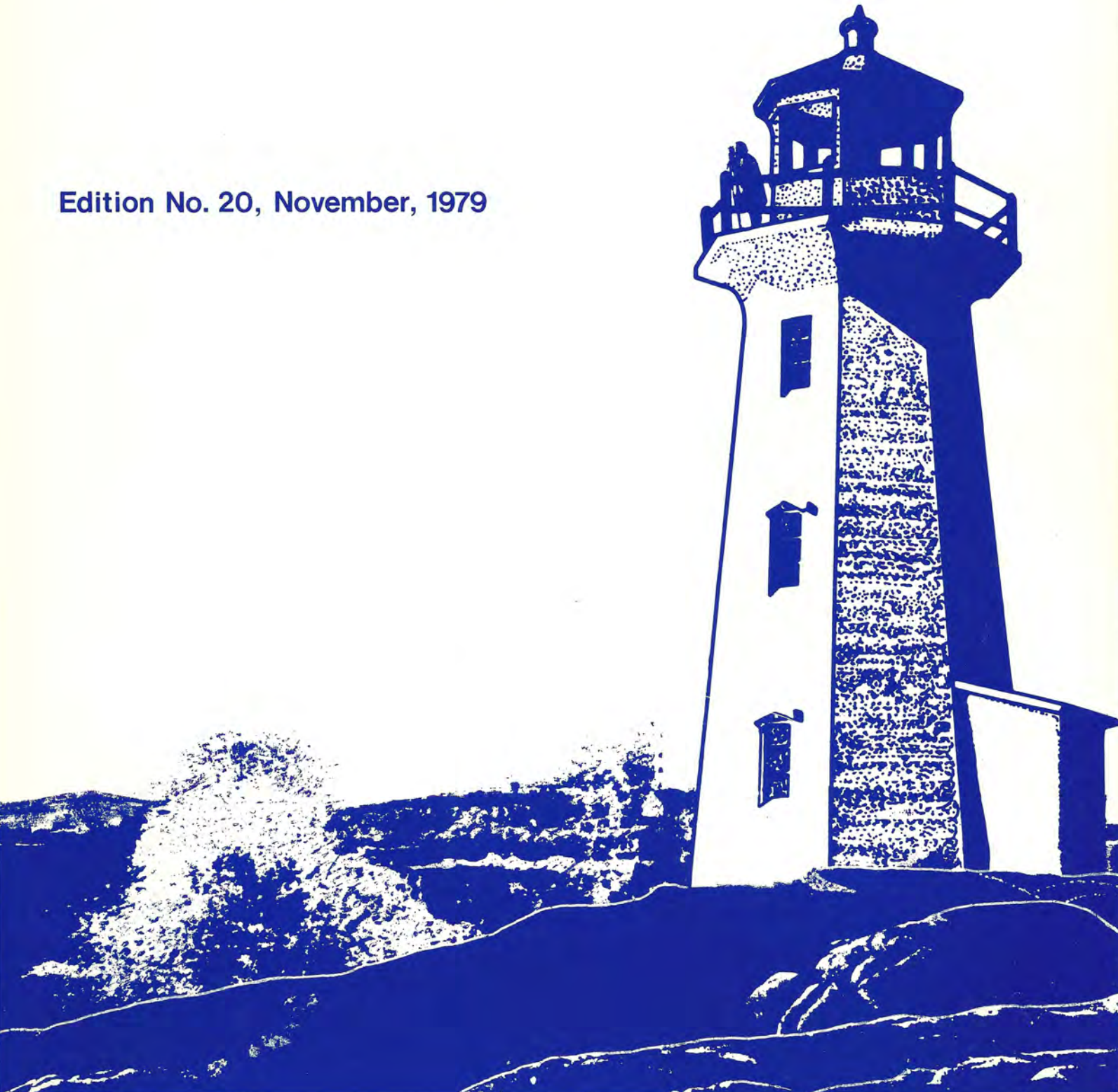
Lighthouse

JOURNAL OF THE CANADIAN HYDROGRAPHERS' ASSOCIATION

Edition No. 20, November, 1979



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General

The Kelvin Hughes Automatic Plotting Table (APT) System assists in navigation and general operational plots by its ability to compute, process and display the changing positions of submarine and surface vessels. Providing an accurate high speed, display of all available navigational and peripheral data.

Such an APT system (or variants thereof) that can now be offered may be used for new build installations or for replacement of existing older style navigational plotting tables.

The basic system comprises one or more plotting tables, a digital computer and various interfaces linking with a number of position indicating sensors. A continuous display of ships positions by means of a spot of light projected onto an Admiralty chart is the prime operational mode. By operator command, however, the light spot can be moved to any defined location to allow for plotting of other contacts or points. The computing size of the processor is such, that processing and update of other modes of operation can be continued within the computer, whilst the operator is concerned at the table with other plotting tasks.

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2. An innovative design approach with respect both to economical and future expansion considerations.
3. Standardisation of components.
4. A high level of integrity in terms of open and closed loop requirements.
5. A high level of reliability based on the Company's experience in the marine markets.
6. Ease and speed of maintenance.
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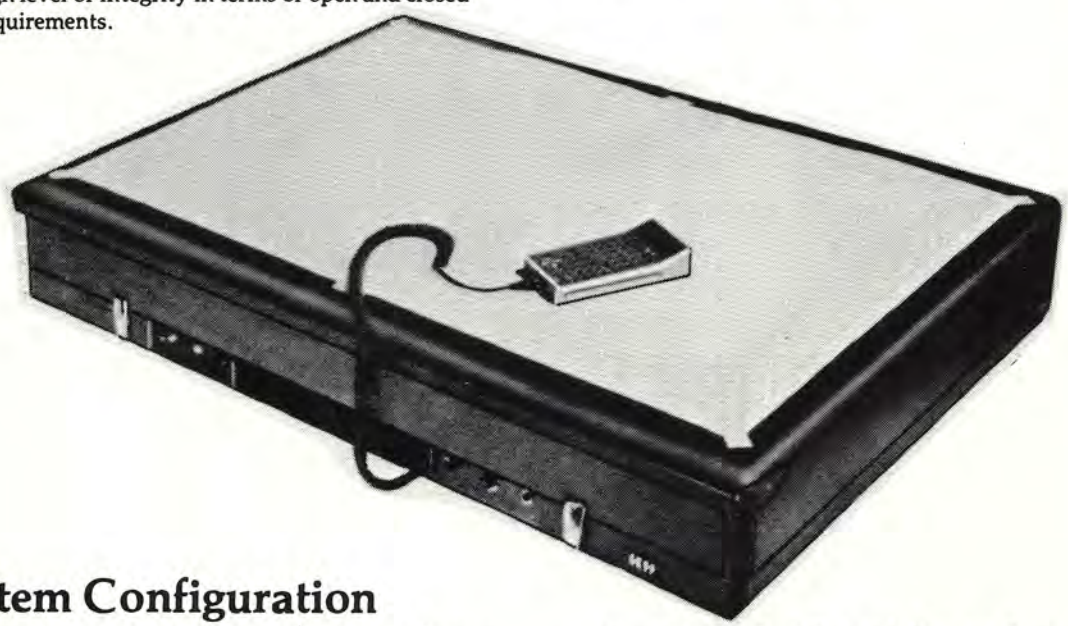
8. Low cost of ownership.



System Configuration

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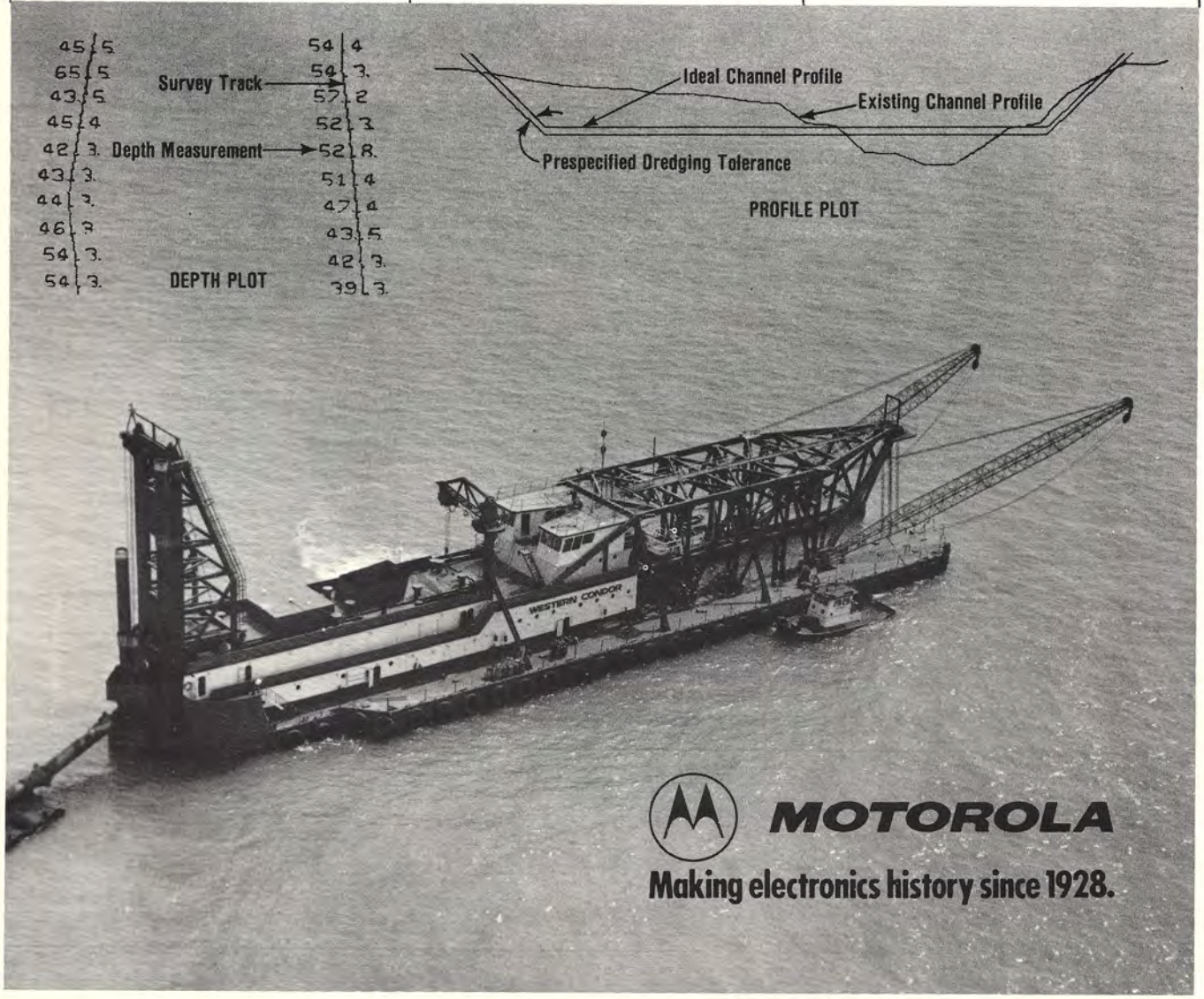

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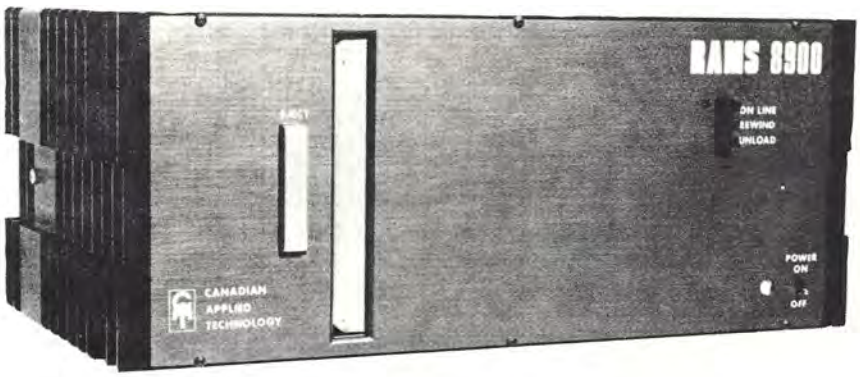

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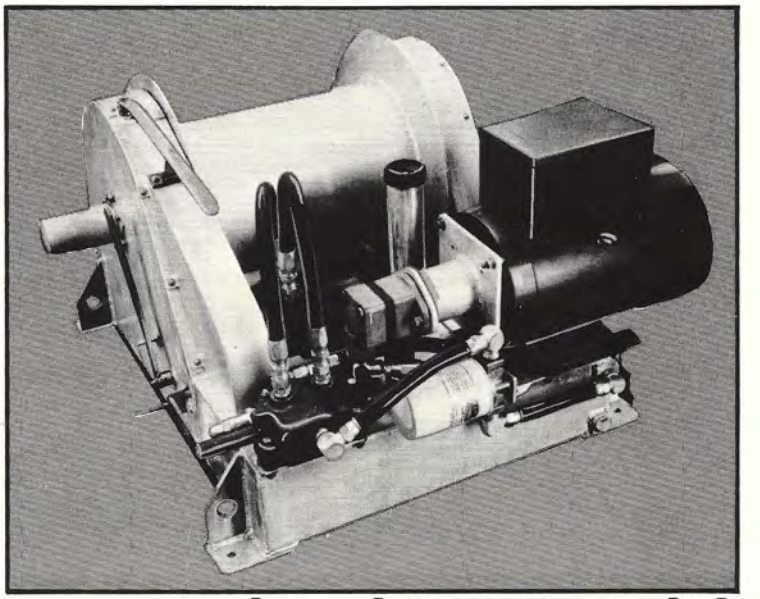

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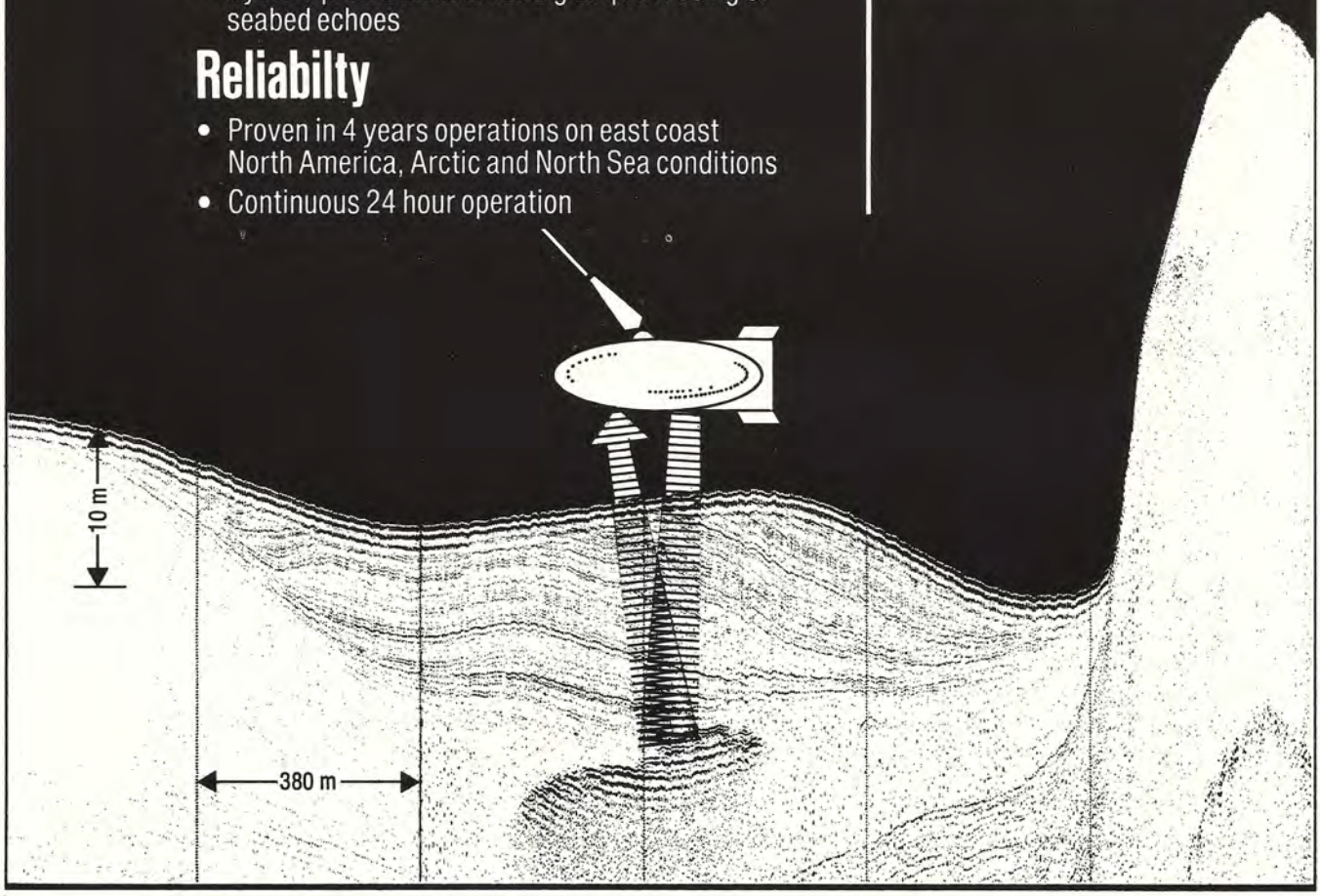

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Charlie Golf Foxtrot Quebec

R.W. Sandilands

Canadian Hydrographic Service
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Reprinted from the Islander Supplement, the Daily Colonist, Victoria, B.C., Sunday, February 11, 1979.

In Lloyds Shipping Register she is "5390876: Call sign CGFQ: Owned by the Government of Canada: Equipped with Echo sounder; gyro; position fixing device; radar; radiotelephone; 1295 tons gross twin screw hydrographic ship," but to west coast seamen and ship watchers she is better known as the *William J. Stewart*.

For 46 years the familiar white-hulled hydrographic survey ship has travelled the coast from her base in Victoria, carrying out surveys ranging from the busy bustling port of Vancouver to the quiet solitudes of the Queen Charlottes and mainland inlets. She has known the rock strewn coasts and the offshore Pacific swells.

Her contribution to the safety of mariners on our coast is beyond measure and the work carried out by her hydrographers has contributed to the coastal development of our Province out of proportion to her initial cost.

Shipping insurance rates are greatly influenced by the standards of the charts available and in her lifetime the *Stewart* has been involved in the initial surveys or upgrading of surveys originally carried out by the British Admiralty on Canada's west coast.

She was built at Collingwood, Ontario and launched in April, 1932, being named *William J. Stewart* to commemorate the late directing head of the Hydrographic Service, or Dominion Hydrographer in today's parlance.

Built of steel throughout she has twin screws with triple expansion engines and the soft slapping of water against her hull was the only noise heard as she made her way through the inner passage making her a joy to sail onboard considering the noisy vibrating diesels of the modern ships where earmuffs are mandatory in the engine rooms.

She was not outstanding as a sea boat and many a tyro seaman made his way to the ships rails in a good blow, particularly in a quartering sea where she managed to work up a stomach wrenching corkscrew motion.

There must be many hundred in the Victoria area whose first seagoing experience was aboard the *Willie J.* and many youngsters put themselves through university by signing on each summer.

Specifically designed for hydrographic surveying duties she carried the large crew necessary to man four surveying launches and other small boats. Her spacious chartroom, with its large chart tables, a seagoing office for her hydrographers, was situated directly under the bridge and was the focal point of her activities. Here the surveyors

(C.S.S. William J. Stewart)

did their calculations, reduced their soundings from observed tides and plotted the coastline on their field sheets, the embryo charts with their hundreds of soundings that eventually were reduced by the chart compilers to a fraction of that number, sufficient with depth contours, to convey the depth of water to the ship's navigator.

Befitting the era in which she was built, the hydrographers quarters were spacious and, in their style, comfortable, though as electrical equipment was added throughout the years and placed a greater load on her generators the wattage of the cabin lights was reduced and an underground war developed between the surveyors who slipped in brighter bulbs and the engine room staff who just as regularly replaced them with 25 or 40 watt bulbs.

The crew's quarters were perhaps adequate when she was built but the years took their toll and required standards of crew accommodation were improved leaving the *Stewart* badly behind the times. The *Daily Province* in February, 1948, reported that the Canadian Seamen's Union in Toronto called government ships the "slums of the sea" and two years earlier carried an editorial reporting a 300% crew turnover in six months, this following on the heels of a Victoria Chamber of Commerce charge made by their vice-president Mr. Walter Miles. The *Victoria Times* quoted the CSU agent on May 27, 1946, as saying that the men onboard the *William J. Stewart* had to sleep, eat and wash in the same quarters and that the bunks were worse than those at Oakalla.

In time the accommodation was improved and again in recent years it was brought up to standard, though by modern ship criteria with crew in double or single cabins, she would still seem to be below par to many.

The Annual Report of the Department of Marine, (1931-32), which was responsible for hydrographic surveys when she was launched, reported:

"The scientific and hydrographical equipment will comprise echo sounding recording machines of the latest and most efficient design, for both deep and shallow water; gyro compass equipment with the master gyro installed on the lower deck forward in a special room provided for this purpose and repeaters in the chart room, wheelhouse, and on the upper navigating bridge deck, one steering and two bearing repeaters. In addition to the echo sounding apparatus there will be several types of wire sounding machines."

For her day a comprehensive array of hydrographic instrumentation.

Her bunker capacity was 300 tons. Though originally designed as an oil burner she started life as a coal burner in deference to business interests in the Union Bay area where coal was plentiful. Until 1958 when she was converted to oil she was a regular caller at Union Bay where approximately every six weeks she berthed to bunker and the hydrographers, and officers and crew who could be spared, sped south for a well deserved weekend at home during the field season.

The names of her hydrographers-in-charge are still to be found in the title blocks of Canadian west coast charts: H.D. Parizeau, J. H. Knight, W. K. Willis, Bob Young, Wilf La Croix, Ralph Wills, 'Sandy' Sandilands, Vic Goodwill, Charlie McIntosh, and others who served for shorter periods.

Her Masters were all well known in Victoria and on the waterfronts of the coastal towns: Captains J. J. Moore, George Billard, Howie Mathieson, Dave Martin-Smith, Tom Scanlan, Frank Green and Kaj Sjoholm, Captain Billard being her longest serving Master.

The engine room was a gleaming palace of brass and steel under chief engineers Ascroft, Mackenzie and Henderson.

Until the 1960s when main communications were changed to radiotelephone she carried a full time radio operator who doubled as ships clerk and in some cases as electronics technician and among her sparkers can be counted Ray Hale, John O'Malia, Joe Haegert and John MacLeod.

No seaman who served onboard will ever forget her long time bosun, Alfie Logan, keeping an eye on them as they pushed their holystones backwards and forwards along the decks to bring them back to the accustomed white after coaling.

The well known book, *Walbran's British Columbia Coast Names* records the origin of the place names on the coast up to 1906, but in any updating of this type of publication the *Stewart* and her crew would frequently appear. To cite a few examples - Weinberg Inlet (Jake, ch. off.); Anderson Passage (John, quartermaster); Langthorne Island (William, oiler); Rutley Islands (John, hydrographer); and the ship herself commemorated by the naming of Stewart Passage.

The working season for the ship was normally mid-April to mid-October, a regimen adopted by experience as any extension of this season was not overly productive due to the shorter daylight hours and greater frequency of poor weather.

But it was not as result of a gale or thick weather that she had her greatest trial. Steaming north through Seymour Narrows on Sunday, June 11, 1944, she hit the notorious Ripple Rock, adding to the long list of ships that had fallen foul of this hidden hazard near the southern end of B.C.'s inner passage to the north.

It was a heyday for the Vancouver and Victoria newspapers. B.C. members of parliament leapt to the offsensive. G.G. McGeer (Vancouver Burrard) had been pressing the federal government to have the rock reduced to a lower level as in common with his fellow Liberal members James Sinclair (North Vancouver) and Tom Reid (New Westminster), he felt that the removal of the rock was as much a war transportation measure as the Alaska highway and that Canada should offer a seaway *quid pro quo* for the U.S. aid in building the land link to that state through our country.

The complement onboard was 65 at the time of striking but there were no casualties. Seven of the crew were women who served as cooks, stewardesses and launderesses. With their fellow crew members they did what they could to try to save the ship and while the engineroom staff drew the fires to prevent the boilers blowing, Captain Moore and his Chief Officer Ernie Betteridge worked the ship into Plumper Bay and beached her on a mud bottom.

A newspaper report of 16 June stated that: "Actual damage from contact with the rock pinnacles is not excessive, though it can be classified as extensive. Bottom of the ship received quite a ripping, though the fact that she remained afloat while she proceeded three miles to Plumper Bay, and was then beached safely, indicates that her pumps were almost able to cope with the inflow from the holes."

The Pacific Salvage Company tackled the difficult salvage operation and under the direction of Captain W. J. Jordan they managed to right her bad list and hold her on an even heel with long lines to extra anchors. After temporary patching and pumping she returned to Victoria on a 30-hour tow.

She was a sad looking ship as she entered port. Still carrying a slight list, her paintwork was marred, strings of kelp hung from some of her gear and a heap of wet blankets and linen from the steward's stores lay piled on her upper deck. The ship had taken four months' provisions onboard the day before she sank and on arrival in Victoria the crew were set to, removing thousands of cans of foodstuffs, washing them down with fresh water and drying them. After inspection by a government food inspector the cans were sold, but with the labels washed off it must have been a potluck sale.

The hull stood up well to the accident but the engine room was badly damaged, the electrical equipment was ruined and the beautiful maple panelling of the cabins and public rooms had to be completely removed.

The following year the *Stewart* was back in action again and from then till the end of the 1975 field season she spent every summer on surveys of the B.C. coast.

Throughout her life she has undergone many changes in silhouette detail. At various times her stack has sported different cowls and altered its rake. The crowsnest disappeared and in the mid fifties when using a electronic positioning system she was fitted with a lattice mainmast. Her wheelhouse, which was originally open, was closed in leaving the upper bridge with its large covered plotting table, irreverently known as the henhouse, still open for the hydrographers to use when shipsounding with sextants.

Modern echo sounders were fitted enabling deeper soundings to be taken at full speed though an old Kelvin wire sounding machine was retained aft for taking samples of the bottom with the tallow armed deep sea leads.

Orange and yellow-hulled high speed fiberglass launches replaced the old wooden hulled canvas canopied launches or "covered waggons." Before the launches were fitted with echo sounders these launches carried a crew of six making them expensive in manpower, but the sounder replaced two leadsmen and the launch engineers were phased out as remote engine controls gave the launch coxswains complete control. As sextant sounding gave way to various electronic position fixing systems the number of hydrographers dropped from two to one.

Onboard too the *Stewart* was expensive in manpower. Some reduction in crew came about when she converted to oil. Launch hoisting, lowering, turning out and in was only semi-mechanical and was heavy on manpower. The galley, situated amidships, was well removed from the crews and hydrographers messes requiring a large staff of stewards. All in all an expensive ship to man in terms of money and man years.

The ship was built exclusively for hydrographic surveys and with the emergence of the oceanographic requirements with their many different types of equipment and also Federal budgetary restraint, both monetary and in man years, she fell victim to these constraints.

No longer has the Canadian Hydrographic Service a dedicated ship on the west coast. Their new vessels *Parizeau* and *Vector*, along with the chartered *Pandora II* are multi-purpose ships, equally able to carry a hydrographic survey party or an oceanographic team. This permits year round utilization of the ship with the priorities of the many varied projects becoming the deciding factor in the assigning of ship time.

On September 20, 1975, Hydrographer-in-Charge Graeme Richardson came ashore with his survey party and the season's field sheets at the old hydrographic wharf beside Johnstone Street bridge and a lifetime of charting the coast came to an end for the *William J. Stewart*.

She was towed to the wharf at the new Institute of Ocean Sciences the following June and has lain there since "in mothballs."

A strange silence has fallen over the ship. No more does her chartroom resound to the chant of hydrographers reading off and reducing soundings to the background static of radiotelephone receiver. The clatter of dishes, pots and pans is stilled in the galley. The messes no longer echo with orders for meals or the evening cries of "full house" or "three no trump." The even tread of the off-watch crew exercising on the main deck, pacing out their daily quota is heard no more. The bridge and engine rooms are silent as the grave.

The old lady lies in state; her final disposal awaiting a decision of the Crown Assets Disposal Corporation.

But there should be no mourning at her departure. She has had a long and productive life and the work that she carried out, the charts that were produced from her voyages will endure as a monument to her for many years to come.

FOOTNOTE. - The closing date on bids for the C.S.S. WILLIAM J. STEWART was extended to 28 September to allow all prospective purchasers the opportunity to have the ship surveyed. In an article in the Vancouver Province on 23 August marine correspondent Mark Wilson suggested that if the ship was to go for scrap the engines, which are in excellent condition, should be removed and preserved at the Vancouver Maritime Museum as an example of working triple expansion engines and as a valuable contribution to industrial archaeology.

Computerized Chart Reproduction for Scientific Applications

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Introduction

A computer charting system was developed which digitizes and reproduces hydrographic charts and topographic maps for use by the scientific community in displaying various types of data.

The digitizing system is comprised of a digitizer, a programmable desk calculator and a tape drive. It produces a BCD tape of variable record length containing geographic coordinates.

Programs are written in FORTRAN IV. The plotting section of the system uses the digitized data files in order to plot survey stations and their respective parameter values at their true positions in conjunction with topographic features.

Reasons for Development

The computerized reproduction of charts and maps for the purpose of displaying and checking various types of collected data has been of interest to scientists for many years. The traditional methods of using overlays are time-consuming and require photographic equipment to reduce and/or reproduce charts containing different data sets. Considering the vast amount of oceanographic and bathymetric data collected in recent years, it became quite evident that a computerized chart reproduction combined with a data retrieval system was needed to effectively handle this problem.

The system was developed using facilities available at the Canada Centre for Inland Waters (CCIW), Burlington, Ontario and is independent of outside sources for digitized cartographic details.

Hardware and Software

The digitizing system consists of a Hewlett-Packard 9100A programmable desk calculator, with extended memory, a 9107A digitizer and a Kennedy Incremental 1600 tape drive. A 36" x 48" Bendix digitizing table is interfaced with the digitizing equipment.

The digitized tapes are edited, sorted and merged with the CYBER 171 computer at CCIW.

The plotter presently used at CCIW is a 1036 Calcomp drum plotter with a 925 tape drive.

The FORTRAN program which plots the cartographic and survey data is called AUTOP and was developed by Mr. Angelo C. Zingaro, the second author of "Computer Charting System".[1] It offers many features, such as: different types of outlines, rotation of geographic names, border lines, bar scale, geographic graticules and 3-colour display routine for easy contouring, making the plotted chart suitable for display purposes. Modules for Mercator and Polyconic Projections are presently included in the program[2,3,4]. A retrieval system can be readily merged with program AUTOP, or a suitable data file containing the pertinent parameters can be used as input to program AUTOP.

Planning the Digitization

To achieve efficiency a number of conditions must be considered in the planning and executing stages of the digitization of a chart.

Prior to the digitization, the outlines are divided into sections to define a start and end point for each section, and at the same time obtain a reasonable record length. Since the points can be digitized in automatic or single mode, it is easy for the user to vary the number of points digitized per unit length.

If two or more charts are to be joined, adequate overlap has to be provided. This is especially true if the charts have different projection centres or were compiled on different projections.

To include geographic names and other symbols, their positions may be digitized, identified by number code and put on tape file during the actual digitization.

A Calcomp plot of a section of the St. Lawrence River from Ile aux Oies to Les Escoumins is shown in Fig. 1. Three hydrographic charts 1207, 1201 and 1204 were digitized separately and their boundaries are shown by dashed lines. Some planning was necessary to obtain continuous outlines. In this plot dashed lines denote sandbanks, dash-dot and dotted lines represent 5 fathom and 10 fathom lines, respectively. Current vectors at various depths are also displayed with the length of the vector being proportional to the speed.

In order to obtain a plot of the Upper Canadian Arctic as shown in Fig. 2, three topographical maps were spliced together. These maps are at a scale of 1:1,000,000 and compiled on a Lambert Conformal Projection. They were digitized by approximating the Lambert Conformal Projection with 3 Polyconic Projections. Program AUTOP does not provide a module for a Lambert Conformal Projection, therefore the map was plotted with a Polyconic Projection, using 73^{0} - 30' and 104^{0} as a reference latitude and reference meridian, respectively. This map is used mainly for display purposes, primarily to show various phases of surveys in publications.

Method of Digitization

Once the projection and the point of origin have been decided upon or selected, the chart to be digitized is placed on the digitizing table with its reference meridian approximately perpendicular to the base of the table. The objective now is to digitize points whose geographic coordinates are known and compare them with positions obtained by digitization. The digitizing system converts the digitized coordinates to geographic coordinates and allows the user to check the accuracy of the process in the initial stages.

The digitizing program is set up to allow the user to change the scale and check points until the best fit is obtained, after which the actual

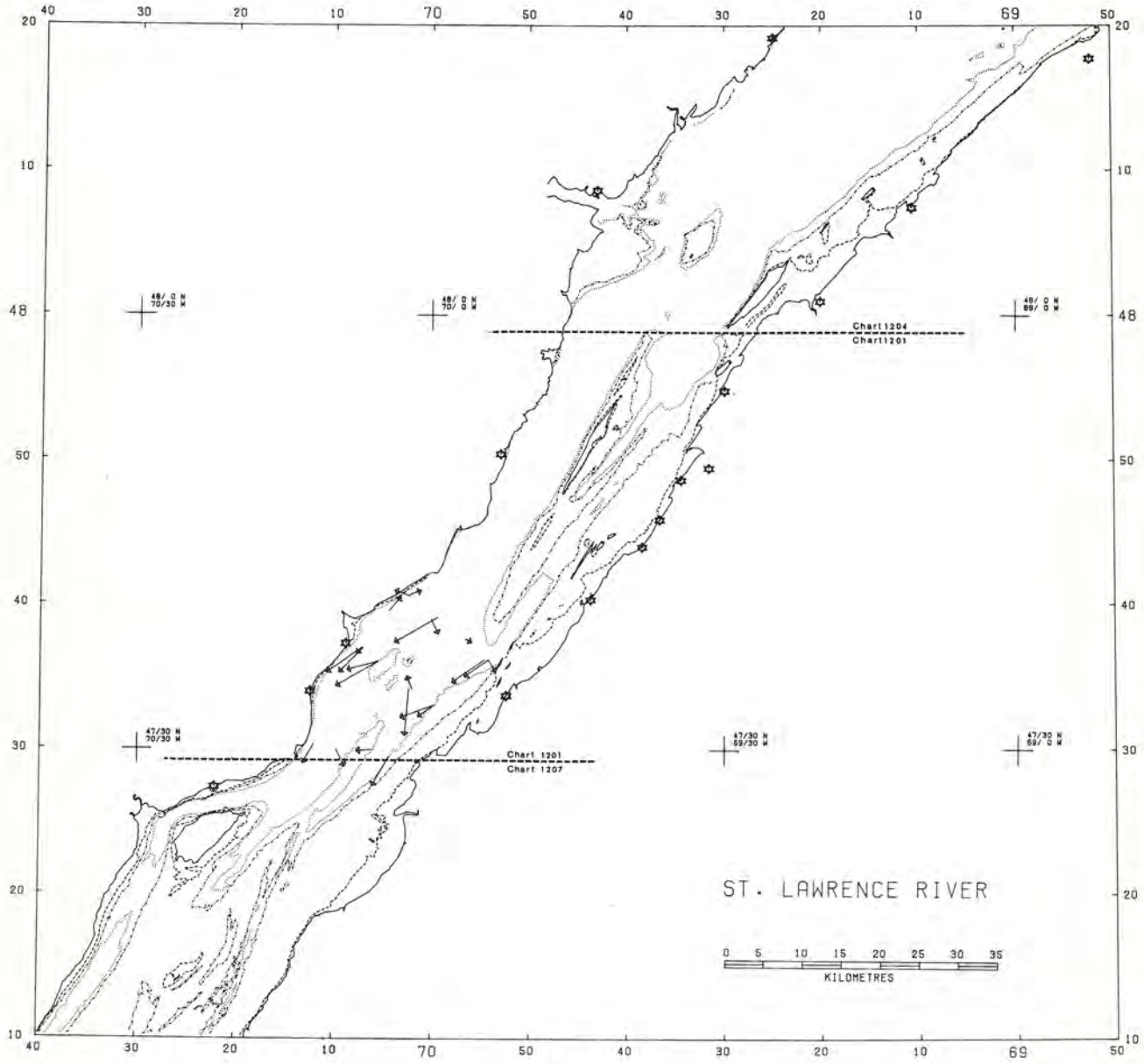

Figure 1. Multiple Chart Plot of St. Lawrence River from Ile aux Oies to Les Escoumins

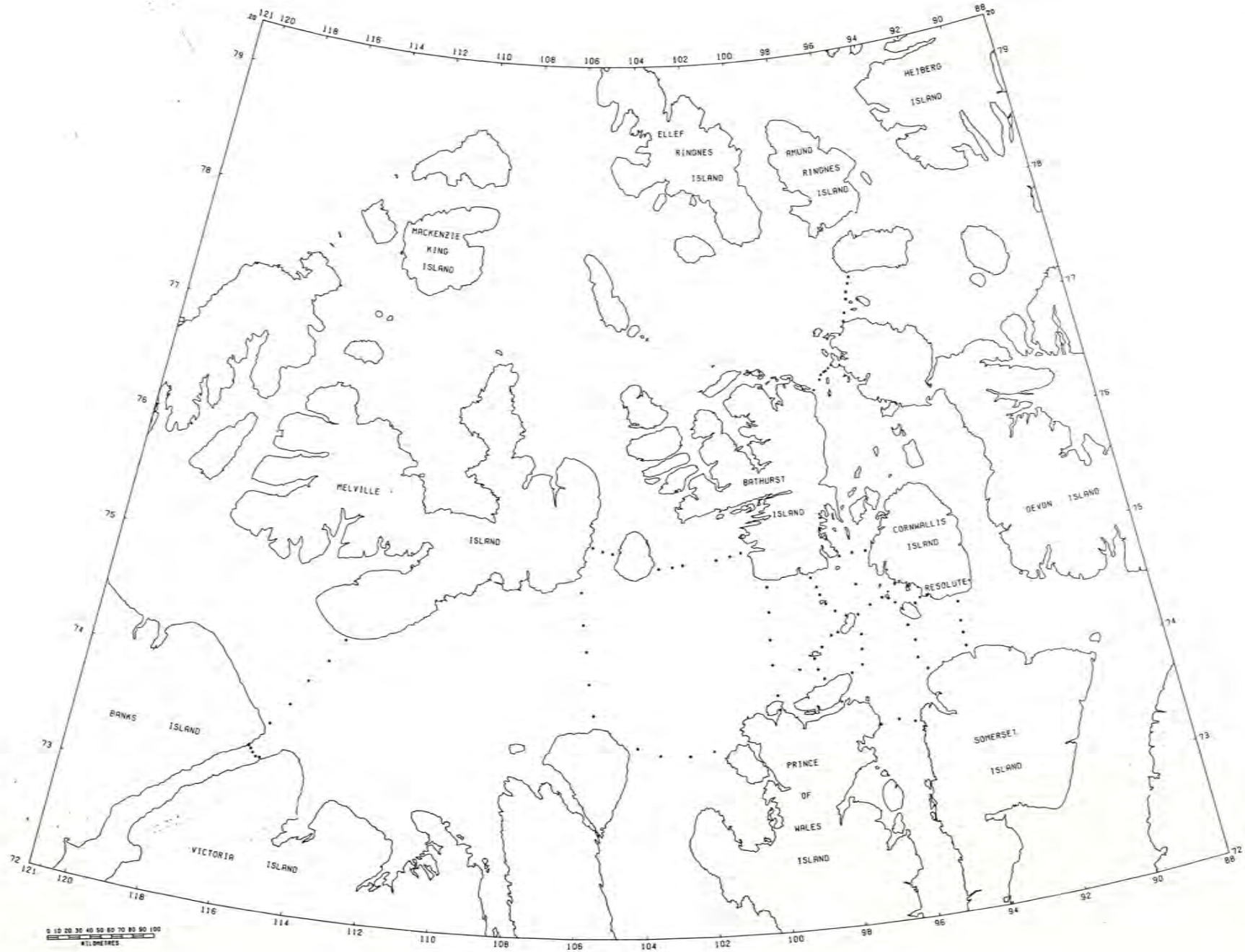

Figure 2. Calcomp Plot of the Canadian High Arctic

digitization is carried out.

Present Applications

The system described herein was used to create gridded depth values[5] (or bathymetry) for selected areas. Individual soundings were digitized from existing charts where no data tapes could be obtained for the area in question. Also depth contours on charts were digitized and, at pre-set intervals, positions of those depths in appropriate coordinates were computed. Using the same scale and projection as hydrographic charts, gridded depth values were verified and updated.

Oceanographic surveys were conducted in the Hudson/James Bay region to study the effects of hydroelectric development on the aquatic environment. With additional software developed and in conjunction with oceanographic and bathymetric data files, the Calcomp plots produced were used for display purposes in the publication and analysis of the data.[6]

Conclusions

A system of reproducing maps and charts on a computer has been presented that, combined with a retrieval system, offers complete flexibility to meet the requirements usually encountered in research work. The problem does not lie in the accuracy of the digitizing system, but in obtaining a base chart meeting the particular specifications. With the options, such as rotating names, different types of outlines and symbols to choose from, plots may be produced in qualities ranging from checking to display purposes.

Modules for additional projections - UTM's, Lambert Conformal and Polar Stereographic - will be added to the system in the near future. There are also plans to access data files digitized by an automated cartographic system.[7]

A user's manual, describing the digitizing process in detail is available upon request. Copies of program AUTOP and programs to sort and merge cartographic files are available for both the CYBER 171 and the CDC 3170 version. Both manual and programs may be obtained by writing to:

Department of Fisheries and Oceans
Research and Development Division
Ocean and Aquatic Sciences
Central Region
P.O. Box 5050
Burlington, Ontario L7R 4A6
Canada

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Storm Surge Amplitudes in the St. Lawrence Estuary

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The long period (30 minutes to about 48 hours) water level oscillations due to meteorological disturbances are defined as storm surge and, by this definition, one excludes the static water level set-up and the short-period wind waves and swell. In practice the storm surge is calculated as the difference between the observed water level and the predicted astronomical tide. Operational prediction and study of storm surges are useful for navigation, engineering works near the coast and even pleasure boats. However, prediction of the amplitudes of the surges is not adequate because a positive surge of 3 metres amplitude (for example, at Québec City) occurring at the time of a high tide of about 3 metres will cause a total water level deviation of 6 metres, whereas the same surge occurring at low tide will cause a total water level deviation of insignificant amplitude. Hence it is important to understand the interaction between the storm surge and the astronomical tide.

The St. Lawrence Estuary (Fig. 1) with an area of 10,800 square kilometres is the region where the waters of the Atlantic and those of the Great Lakes co-mingle. Five hundred kilometres from the Great Lakes and nearly 1000 from the ocean, it begins at Québec City and extends 400 kilometres downstream to Pointe-des-Monts, where its channel suddenly opens into the Gulf of St. Lawrence. Historically, the St. Lawrence Estuary formed the first section of the navigation routes which led to the settlement and development of much of Canada and central U.S.A. Today the estuary is still a vital artery to these areas, forming a navigable waterway from the Atlantic Ocean to the ports of Québec and Montrèal and through the St. Lawrence Seaway into the Great Lakes. A knowledge of the interaction between astronomical tides and storm surges in the St. Lawrence Estuary is necessary. Here we present a summary of the results obtained on this subject.

We analyzed all the storm surge data for the 11-year period 1965-1975 in the St. Lawrence Estuary. Table 1 lists the maximum amplitudes of the positive and negative surges observed at 9 stations in the estuary. The frequency (i.e. number of occurrences during this 11-year period) of positive surges exceeding 180 centimetre amplitude and negative surges exceeding 130 centimetre amplitude are also shown. The range of the spring tide as well as the state of the tide with which maximum amplitude positive and negative surges are associated are also shown.

The following deductions can be made based on these results. The maximum amplitude of positive surges observed is 300 centimetres and this occurred at the following five stations: Pointe-au-Père, Tadoussac, Rivière-du-Loup, St- Joseph-de-la-Rive and Québec. However, the frequency of positive surges and negative surges is not the same at these stations. Québec and St. François have the maximum frequencies; Pointe-au-Père, Rivière-du-Loup and Baie-Comeau have the lowest frequencies, whereas Tadoussac, Ste-Anne-des-Monts, St-Joseph-de-la-Rive and St-Jean-Port-Joli have intermediate frequencies. Thus, out of the 9 stations listed, Pointe-au-Père and Québec are at the lowest and highest ends of the storm surge frequency scale. The return periods of a storm surge of any given range (to obtain the range of the surge, we simply add the amplitudes of the positive and negative surges) can be obtained by a simple calculation. For example, at Québec City a positive surge of amplitude equal to or greater than 130 centimetres occurred 157 times in 11 years. Hence the return period for a positive surge of at least this amplitude is about 26 days, whereas the return period for a positive surge of the same amplitude at Pointe-au-Père is 5.5 years. On the other hand for a positive surge of amplitude equal to or greater than 180 centimetres, the return period at Québec City is approximately 3 months whereas at Pointe-au-Père it is still 5.5 years.

Similarly one can compute the return periods for the negative surges. For the negative surges the maximum observed amplitude is 250 centimetres at St-Joseph-de-la-Rive. The only other two locations where the amplitudes of the negative surges exceeded 200 centimetres are St-François (230 cm) and Québec (210 cm). The smallest amplitude negative surges occurred at Pointe-au-Père and Baie-Comeau. In terms of frequency, the negative surges are most prominent at St. François and least prominent at Ste-Anne-des-Monts. Based on amplitudes and frequencies for both positive and negative surges we can say that Pointe-au-Père, Baie-Comeau and Rivière-du-Loup are reasonably safe from storm surges and Québec City and St-François are extremely prone to storm surges.

However, one reassuring feature at Québec and St-François is that positive surges occur mostly at the time of low tide while negative surges occur at the time of high tide. Thus, to a certain extent, the surges and tides oppose here. At St-Jean-Port-Joli and St-Joseph-de-la-Rive positive surges occur at the time of high tide, which is a factor that makes the overall water level variations quite significant.

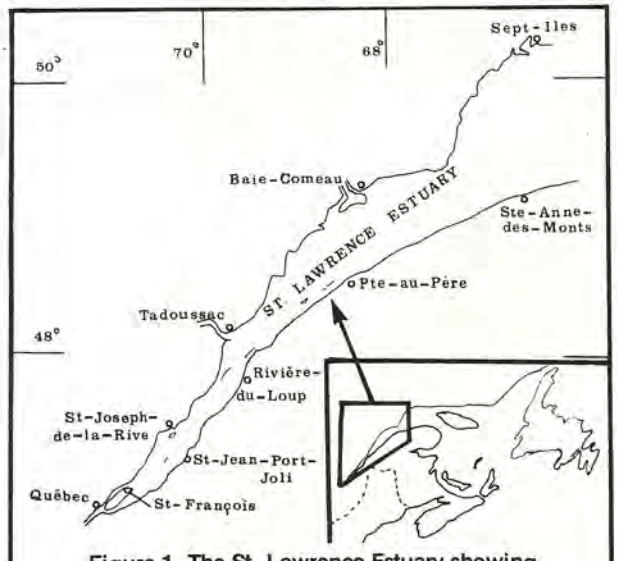

Figure 1. The St. Lawrence Estuary showing stations used in this study.

STATION	Amplitude of max.positive surge (cm)	Amplitude of max.negative surge (cm)	Spring tidal range (cm)	Frequency of positive surges with amplitude $\geq$ 180 cm. (Value in parentheses shows frequency for $\geq$ 130 cm.)	Frequency of negative surges with amplitude $\geq$ 130 cm.	State of tide with which max.positive surges are associated	State of tide with which max. negative surges are associated
Ste-Anne-des-Monts	180	140	347	2(24)	2	Falling	Rising
Baie-Comeau	290	130	402	2(5)	8	Rising	High
Pointe-au-Père	300	130	460	2(2)	5	Rising	High
Tadoussac	300	160	519	5(11)	16	Rising-high-low	High
Rivière-du-Loup	300	180	567	3(3)	21	Low	High-Rising
St-Joseph-de-la-Rive	300	250	695	5(29)	20	High-Rising	High-Falling
St-Jean-Port-Joli	190	180	573	4(34)	33	High	High-Rising
St-François	240	230	686	17(100)	93	Low-Rising	High-Rising
Québec	300	210	580	32(157)	20	Low	Rising-High

Table 1. Storm Surge Statistics

The Origin of `The Origin of the Species'
(The Beagle Expedition 1831—1836)

G. MACDONALD
Canadian Hydrographic Service
Central Region
Burlington, Ontario

Voyage of the Beagle

Charles Robert Darwin was born in Shrewsbury on February 12th, 1809. After taking part in the Beagle expedition, he became secretary of the Geographical Society in 1838. The following year he married his cousin Emma Wedgewood. With a grant from the government and a generous inheritance from his father, Darwin was able to devote his life to research and writing, up until his death on April 19th, 1882.

This travelog of Darwin's historic voyage will take us to many places around the world that were studied in great detail over a period of five years. It would be impossible to cover every aspect of the voyage here. As we skip from one location to another, the events may not always be discussed in chronological order. The reader might want to refer to the map at the beginning of the article or to the chronology of events at the end to help sort out the proper order of things.

Those of us who enjoy our work may, perhaps, go into the field each year yearning to discover some small piece of unexplored territory. It is with great anticipation that we leap ashore on a deserted and desolate coastline only to find a rusty beer can underfoot, or some more discreet evidence of an earlier human presence. Even Darwin had his beer can experience, as we shall see later on.

When the voyage was over Darwin wrote, in retrospect, about the pains and pleasures of undertaking such a trip. The losses such as friends, home and family were only partly relieved in the delight of anticipating the return home. The disadvantages of spending so much time at sea were balanced by the advantages of visits ashore, where there was "a growing pleasure in comparing the character of the scenery in different countries." Darwin enjoyed the cruise but, once he returned home, never left the shores of England again. He did, however, recommend the seafaring life to others. "The effect ought to be, to teach him good-humored patience, freedom from selfishness, the habit of acting for himself, and of making the best of every occurrence. In short, he ought to partake of the characteristic qualities of most sailors."

* * * * * * *

On September 5th, 1831, Charles Darwin met with Robert FitzRoy in London. FitzRoy was captain of *HMS BEAGLE*, a ship the Admiralty was sending on a long voyage. Darwin was offered the post of naturalist. The ship had two missions: to continue charting the South American coast and to carry accurate longitude measurements (by means of chronometers) around the world.

Darwin had just tried two universities. At Edinburgh he turned away from a medical career, after witnessing his first operation (performed in those days without anaesthetic). He entered Cambridge to become a parson. Here he met and became a friend of Professor Henslow, a botanist and mineralogist. It was Henslow who initially recommended Darwin for the position as unpaid naturalist on the *BEAGLE*.

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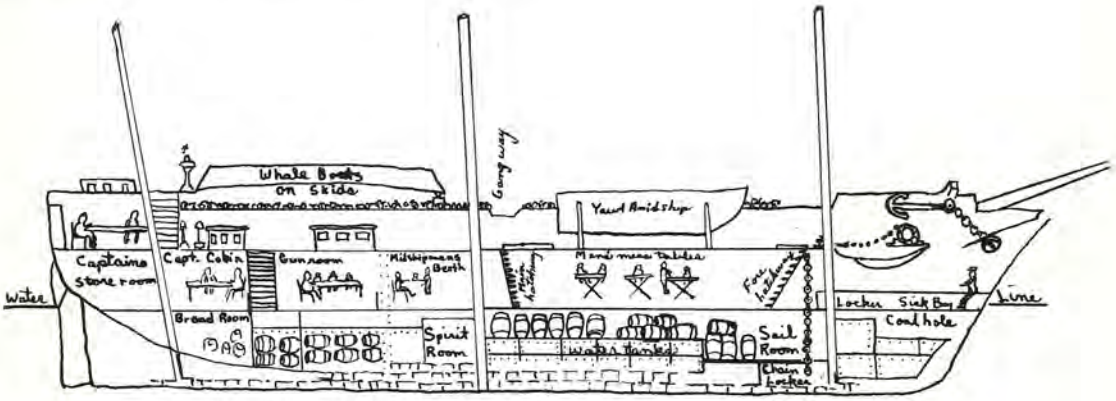
HMS BEAGLE sailed from Devonport December 27th, 1831, after being driven back twice by heavy gales. Darwin was seasick. He wrote home, "The misery I endured is far beyond what I ever guessed."



HMS Beagle

BEAGLE stopped to position the Cape Verde Islands, where she lay at anchor for twenty-three days. Later, off the coast of Africa near St. Domingo, Darwin collected dust from the *BEAGLE* and some that fell on a vessel a few hundred miles north of the islands. He heard numerous accounts of dust falling on vessels far out in the Atlantic. From the direction of the wind he felt sure it came from Africa. It is interesting that, of the many species of protozoa found in the dust, there were no known African species; but two species that had only been found in South America were present.

(The *CSS BAFFIN*, some 100 miles off the African coast during the 1976 Senegal cruise, picked up an estimated 0.7 tons of dust during a storm, as well as an owl that was blown off shore in the high winds.)

Crossing the Atlantic, the *BEAGLE* stopped at the island of St. Pauls. Here, Darwin observed, "the often repeated description of the stately palm and other noble tropical plants, then birds, and lastly man, taking possession of the coral islets as soon as they are formed in the Pacific, is probably not quite correct; I fear it destroys the poetry of this story, that feather and dirt feeding and parasitic insects should be the first inhabitants of newly formed oceanic land."

* * * * * * *

In San Salvador, Brazil, Darwin observed a fish called the Diodon (or Balloon fish) which can blow itself up into a spherical form by taking in water and air. Here Darwin heard the story of one of these fish that was found floating and alive in a shark's stomach and that, on several occasions, the fish had been known to eat its way through the side of a shark (killing the shark in the process). Darwin wrote "Who would ever have imagined that a little soft fish could have destroyed the great and savage shark?"

A few days after sailing from San Salvador the sea took on a reddish-brown appearance. "The whole surface" said Darwin, "seemed as if covered by chopped bits of hay." Captain Cook, in his third voyage, remarked that the sailors gave the name sea sawdust to this appearance.

In Rio de Janeiro, Darwin took a land excursion to visit an English estate north of Cape Frio. One night the travellers stopped at an inn and, after taking care of the horses, asked the innkeeper for something to eat. As Darwin related it, "Anything you choose sir!' was the usual answer. For the first few times vainly I thanked providence for having guided us to so good a man. The conversation preceding, the case universally became deplorable. 'Any fish ...?' - 'Oh, no sir!' 'Any soup?' - 'No, sir!' 'Any bread?' - 'Oh, no sir!' 'Any dried meat?' - 'No, sir!' If we were lucky, by waiting a couple of hours we obtained fowls and rice .... If we hinted we would be glad of our meal, the pompous and (though true) most unsatisfactory answer was 'It will be ready when it is ready.'"

Darwin also related about the journey: "As soon as any stranger is seen arriving, a large bell is set tolling, and generally some small cannon are fired. The event is thus announced to the rocks and woods, but to nothing else."

Darwin met slaves during the trip. While making a ferry crossing he tried to carry on a conversation with a negro slave, but the man was having trouble understanding. Darwin yelled and gestured with his hands to try and make the man understand. When his hands came near the slave's face, he looked frightened, and dropped his hands, thinking he was going to be hit. Darwin later talked of his feelings of surprise and shame at seeing such a powerful man afraid to defend himself. In discussions with FitzRoy, the captain, without condoning slavery, thought there was a good deal to be said in its favour.

Anti-Slavery Propoganda Used Before Darwin's Time

In Rio, Darwin observed similar relationships between plants and insects of the same families (though not of the same species) as those in England. He noted that when man introduced a new species into a country the relationship was often broken. Cabbages and lettuce leaves in Rio were untouched by slugs or caterpillars.

Darwin's observations extended to the smallest of insects. On one occasion he stopped to watch a fight between a wasp and a spider. The wasp swooped down, stung the spider, and flew off. The wounded spider hid, but when it finally moved, the wasp came in for the kill, and started to drag off the body. Darwin chased the wasp away. In another instance he saw a wasp become entangled in a spider's web, and despite the wasp's attempts to sting its adversary, the spider came out on top.

Darwin witnessed a march of army ants. It was three hundred feet long, and everything in its path became panicked. The ants corralled cockroaches, lizards and spiders, and then attacked their prey.

On July 5th, 1832, the *BEAGLE* left Rio de Janeiro. The second night out St. Elmo's fire lit up the mast head and yard arm ends. The sea was highly luminous and "the tracks of penguins were marked by a fiery wake."

* * * * * * *

It was a difficult job for FitzRoy to survey the South American coast, where storms frequently jeopardized his program. To help get the job done, in the spring of 1833 FitzRoy bought and manned an American sealing vessel that was nearly as big as the *BEAGLE*. He reconditioned the ship and renamed it *ADVENTURE*. Since he could not consult with the Admiralty, the money came out of his own pocket. He thought the Admiralty would reimburse him later on.

While FitzRoy surveyed, Darwin spent ten weeks in Maldonado. During a journey to the river Polanco his pocket compass became the object of attention and, as Darwin put it, "created unbound astonishment." In every house he visited he was asked to show the compass and, with a map, point out the direction of various places. He was surprised when he found that the natives thought England was a large town in London.

Darwin offered this comment on the Gauchos he met: "Their politeness is excessive; they never drink their spirits without expecting you to taste it; but whilst making their exceedingly graceful bow they seem quite as ready, if occasion offered, to cut your throat." Here Darwin became familiar with the lassos and bolas of the Gauchos. One day he tried the bolas himself. One of the balls hit a bush, fell to the ground, caught the hind

Hunting with Bolas

leg of the horse he was riding, pulled the other ball from his hand, and secured the horse. He left the Gauchos laughing; they had never seen a man catch himself before.

Bolas were not a recent innovation even in Darwin's time. There is evidence of bolas found recently in Argentina that are dated at over three million years old.

* * * * * *

The *BEAGLE* picked up Darwin at Maldonado on July 24th, 1833, and sailed for the Rio Negro. Here Darwin visited a salt lake (or salina) where a large amount of pure salt (99.9% pure) was drawn annually. It is interesting to note that this pure salt did not preserve meat as well as sea salt from the Cape Verde Islands. As a consequence, salt was imported and mixed with the local salt. The purity of the salt, Darwin supposed, was the reason for its inferiority.

While on a field trip to Rio Colorado, Darwin stayed one night in a rancho (which he translates as hovel) of a Spaniard who fought for Napoleon in Russia. Even then it was a small world.

On this trip Darwin met General Rosas and visited his estates. The general was well known for the laws by which he governed, and there were many stories about the manner in which his laws were enforced. One law was that no man should carry a knife on a Sunday. Lawbreakers were put in the stocks. (Sunday was the principle day for drinking and gambling; many quarrels were common and knives could prove fatal.) One Sunday the Governor paid General Rosas a visit. The general walked out to meet him with his knife stuck in his belt. The steward reminded him of the law, so he apologized to the Governor and had the steward lock him in the stocks. The steward was later persuaded to open the stocks and let him out, but the steward had broken the law by doing so, and was himself locked in the stocks. Darwin commented: "Such actions as these delighted the Gauchos, who all possess high notions of their own equality and dignity."

The *BEAGLE* arrived in Bahia Blanca on August 24th, and a week later sailed for the Plata. Darwin was left behind to travel by land to Buenos Aires. During the trip he observed the breeding habits of ostriches. He was told by his guides that several females laid eggs in the same nest. The number of eggs in a nest varied from 20 to 40 and they were incubated by the male ostrich. Darwin thought the reason for this was that ostriches (reported to lay up to 17 eggs) laid only one egg every three days. All the eggs in one nest were the same age and hatched at the same time. This would not happen if the hen had to hatch her own eggs.

Another bird Darwin observed was the Casarita (little housebuilder). It built its nest at the end of a cylindrical hole that extended horizontally six feet into a low bank such as those found by the side of a road or stream. In Bahia Blanca the walls around the houses were built of hardened mud and some had small holes bored through them. The birds mistook the walls for banks of mud and Darwin wrote, "I do not doubt that each bird, as often as it came to daylight on the opposite side, was greatly surprised at the marvelous fact."

Darwin found a toad that he thought needed help. It was dry, and "thinking to give it a treat [he] carried it to a pool of water; not only was the little animal unable to swim, but without help it would soon have been drowned."

Darwin also remarked on the hibernation of animals in this part of South America. "When we first arrived, we thought nature had granted scarcely a living creature to this sandy and dry country." By digging, he found several insects, spiders and lizards in a state of suspended animation. A week later a few animals began to appear and, three days later, spring had sprung. Over the two week period the mean temperature had increased by seven degrees, and awoke the dormant animals.

During his stay in Bahia Blanca, Darwin heard accounts of war between General Rosas and the Indians. Darwin told this story. "My informer said, when he was pursuing an Indian, the man cried out for mercy ... 'I however struck him with my sabre to the ground, and then got off my horse and cut his throat with my knife'. This is a dark picture ... but much more shocking is the ... fact that all the women who appear above twenty years old are massacred in cold blood." When Darwin suggested to his informer that this seemed rather inhuman, he was told, "Why, what can be done? They breed so!"

On his travels towards Buenos Aires, Darwin witnessed the results of a hail storm that, during the previous night, had killed a large number of wild animals. He counted twenty deer, fifteen ostriches, and numerous ducks, hawks and partridges that had been killed. He enjoyed a dinner of hail-stricken meat before continuing his journey.

Darwin noted that the Gaucho of the Pampas lived on an exclusive beef diet for months at a time. This surprised him, since the problems of existence only on meat (such as scurvy) were well known even then. He was aware that animal fat made up a large proportion of the diet. (It was not so many years ago in the Arctic, that the Inuit existed on an exclusive meat diet for up to eight months of the year. They also consumed a large proportion of animal fat. It has recently been found that raw meat contains Vitamin C, that is not present after the meat is cooked.) Darwin also took note of the length of time between meals and suggested that "it is perhaps from their meat regimen that the Gauchos, like other carnivorous animals, can abstain long from food."

Like all people involved in outdoor activities, Darwin was susceptible to insect bites. While travelling from Buenos Aires to Santa Fe he described the mosquitoes as "very troublesome. I exposed my hand for five minutes and it was soon black with them; I do not suppose there could have been less than fifty, all busy sucking."

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On November 19th, 1832, Darwin was travelling to Mercedes along the Rio Negro. He stopped at a large estate to sleep for the night, and had what he considered an amusing conversation with the owners. After discussing such things as whether the world was round, and whether a hole, if deep enough, would come out the other side, Darwin was asked, "Are the ladies in Buenos Aires not the handsomest in the world?" He assured them they were. "Do the ladies in any other part of the world wear such large combs?" He assured them they did not.

Ladies of Buenos Aires

The men were delighted. "Look there! A man who has seen half the world says it is the case; we always thought so but now we know it." Darwin, of course, was treated royally for the rest of his stay.

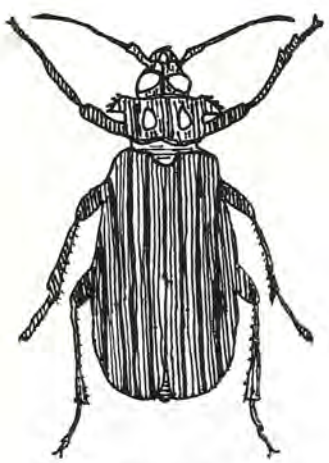
While staying at this estate Darwin had a chance to see how horses were broken. He described it

this way: "[One man] holds the animal's head while [the other] puts on the horse cloths and saddle and girths the whole together. During this operation the horse, from dread and astonishment at thus being bound around the waist, throws himself over and over again on the ground and, 'till beaten, is unwilling to rise. At last, when the saddling is finished, the poor animal can hardly breathe from fear, and is white with foam and sweat." The man then mounts the horse. "The horse, wild with dread, gives a few most violent bounds, and then starts off at full gallop: when quite exhausted, the man, by patience, brings him back to the corral where, reeking hot and scarcely alive, the poor beast is set free."

In Mercedes, Darwin asked two men why they did not work. One said the days were too long, the other that he was too poor. Darwin remarked: "The number of horses and profusion of food are the destruction of all industry."

On first entering society in these countries, two or three features struck Darwin as remarkable. "The polite and dignified manner pervading every rank of life, the excellent taste displayed by the women in their dresses, and the equality amongst all ranks ... . All this is what would be expected in a new country; nevertheless the absence of gentlemen by profession appears to an Englishman something strange."

Darwin sailed from Rio Plata on December 6th. During the trip he observed numerous insects some distance from shore. He picked beetles out of the sea seventeen miles off Cape Corrientes. At first he thought they had been blown from shore but later noticed that some were aquatic. There are several accounts of insects blown off the Patagonia shore. Captain Cook observed it. (On one occasion, 370 miles off the coast of Africa, a large grasshopper was blown aboard the *BEAGLE*.) Darwin also observed spiders that spun webs like a sail and used air currents to travel (you might say fly) several miles from the land.



Coleoptera

FitzRoy beached the *BEAGLE* at high tide, near the mouth of the Santa Cruz, in mid-April of 1834. The ship had hit a rock at Port Desire and the false keel had been damaged. While repairs were being carried out, the Captain set out with three whale boats to follow the course of the river. During the trip Darwin shot a condor so that he could study it. It measured eight and one-half feet from wing-tip to wing-tip. While studying the condors he noticed that, several hours before a condor died, all the lice with which it was infested crawled to the outside feathers.

On May 4th the trip up the river halted, 140 miles from the Atlantic and only 60 miles from the nearest Pacific water. Darwin wrote, "We had already been for some days on half allowance of bread. This, although really enough for reasonable men, was, after a hard day's march, rather scanty food: a light stomach and an easy digestion are good things to talk about, but very unpleasant in practise."

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On December 17th, 1832, the *BEAGLE* entered the Strait of Le Maire, Tierra del Fuego. Here Darwin met the Fuegians. "The language of these people", he stated, "according to our notions scarcely deserves to be called articulate. Captain Cook has compared it to a man clearing his throat, but certainly no European ever cleared his throat with so many hoarse, guttural and clicking sounds." Three Fuegians sailed with the *BEAGLE* when it left England. During a former voyage of the *ADVENTURE* and *BEAGLE* (1826-1830) Captain FitzRoy captured some natives as hostages for a stolen boat, and he took some back to England. Those that did not die of smallpox were being returned to their native land. On board were York Minster, Jemmy Button and Fuegia Basket.

Of Jemmy Button Darwin wrote, "When the water was rough I was often a little seasick, and he used to come to me and say in a plaintive voice, 'Poor, poor fellow!' but the notion, after his aquatic life, of a man being seasick was too ludicrous, and he was generally obliged to turn on one side to hide a smile or a laugh, and then he would repeat his 'Poor, poor fellow!' "

Near Wollaston Island, Darwin met a canoe with six Fuegians. He described them as "the most abject and miserable creatures I anywhere beheld." They were naked. In another harbour not too far away, a woman who was feeding her recently born child came alongside the vessel to watch, while sleet fell and melted on her naked bosom, and the skin of her naked baby. Darwin was shocked.

When starvation threatened the tribe in winter, they killed and ate their old women before they would kill the dogs. When asked why, the answer was, "Doggie catch otters, old women no." One boy described the way they killed the old women by holding them over the smoke of a fire until they choked. As a joke he imitated their screams, and indicated which parts were best to eat. Not unreasonably, the old women ran into the mountains and hid during times of famine, but were hunted by the men and invited back for dinner. Jemmy Button, though, would not eat land birds because they "eat dead men." On the west coast a mother

was seen holding her bleeding, dying boy that her husband had just dashed on the rocks for dropping a basket of sea eggs.

To reach Jemmy Button's tribe and family, Captain FitzRoy set out with three whale boats and a trawl for Ponsonby Sound. As the natives witnessed the boats heading in their direction, fires were lit on every point to attract attention and spread the news (hence the name Tierra del Fuego or Land of Fire).

Darwin described the meeting of the native Fuegians and the three Fuegians brought from England: "the next morning after our arrival [January 24th, 1833] the Fuegians began to pour in, and Jemmy's mother and brothers arrived. The meeting was less interesting than that between a horse turned out into a field, when he joins an old campanion. There was no demonstration of affection; they simply stared for a short time at each other, and the mother immediately went to look after her canoe. The women took much notice of, and were very kind to Fuegia ... . We had already perceived that Jemmy had almost forgotten his own language."

A missionary named Mathews was brought from England to be left with the Fuegians and (one supposes) to teach them the Christian ways. After only a short time ashore he was brought back to the *BEAGLE*, and was eventually left in New Zealand. In that short time, he had been threatened with stones and stakes by one party of Fuegians; another party wanted to strip him naked and pluck all the hairs from his face and body.

FitzRoy had naively tried to help the Fuegians by introducing religion, clothing and modern utensils (such as axes), and by teaching gardening techniques and English manners. Darwin was convinced that their only hope for survival was to be left alone. In Darwin's time there were more than ten thousand Fuegians inhabiting the Western channels. When the *CHALLENGER* visited Tierra del Fuego near the turn of the century, three tribes were almost extinct. Today there are less than one hundred Fuegians. FitzRoy was disappointed in the results of his experiment. He had done more harm than good by taking his Fuegians to England. "Wherever the European has trod", Darwin later wrote, "death seems to pursue the aboriginal."

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In the end of May, 1834, the *BEAGLE* entered the Straits of Magellan for the second time. During the previous visit (in January) the famous gigantic Patagonians were interviewed at Cape Gregory. Their average height was about six feet and Darwin described them as "the tallest race which we anywhere saw. This tribe has had so much communication with sealers and whalers that most of the men can speak a little English and Spanish; and they are half civilized and proportionally demoralized."

On the west coast of South America Darwin studied kelp. During the earlier voyage of the *ADVENTURE* and *BEAGLE* not one rock was discovered near the surface that was not covered by the weed. It served as a navigation aid to mark the shoals in the stormy waters and "has saved many a [vessel] from being wrecked." Captain Cook on his second voyage noted that the plant rose from depths greater than twenty-four fathoms "and as it does not grow in a perpendicular direction, but makes a very acute angle with the bottom ... it grows to the length of sixty fathoms and upwards." Captain FitzRoy found it growing from a depth of forty-five fathoms.

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On July 23rd, 1834 the *BEAGLE* anchored in the Bay of Valparaiso, the chief seaport of Chile. On one of his excursions Darwin met a Cornish miner who had married a Spanish woman and, though he was not inclined to return home, "his admiration for the mines of Cornwall remained unbounded."

Port of Valparaiso

Among many other questions, he asked Darwin, "Now that George Rex is dead, how many more of the family Rexes are yet alive?"

Copper pyrites, the common ore in Cornwall, was thrown away as useless in Chile. Englishmen bought up the richest veins and introduced the roasting process (to expel sulphur before smelting).

One night in a rancho, the host talked to Darwin about the State of Chile as compared to other countries. "Some see with two eyes, and some with one, but for my part I do not think that Chile sees with any."

One evening Darwin stopped at a comfortable farm house. The ladies found out he had been entering churches just out of curiosity. They were horrified and asked Darwin why he did not become a Christian. He assured them that he was but they would not believe him. The thought of a bishop taking a wife "particularly struck them: they scarcely knew whether to be most amused or horror-struck at the enormity."

A man Darwin met in Chile, a German collector of natural history, asked a Spanish lawyer who dropped by what he thought of the King of England sending people to Chile to collect lizards and beetles. The lawyer thought for some time and then said, "It is not well .... no man is so rich as to send out people to pick up such rubbish. I do not like it: if one of us were to go and do such things in England ... the King of England would very soon send us out of his country." The German himself had left some caterpillars with a girl, to feed until they turned into butterflies. The Padres and Governor con-

sulted and, when the collector returned, he was arrested and charged with heresy.

When Darwin returned to the *BEAGLE* he found an enraged captain. A letter had arrived from the Admiralty refusing to pay the expenses for the extra ship, *ADVENTURE*. Since FitzRoy had acted without instructions, he was to pay all the costs himself, dismiss the sailors he had hired, and sell the ship. Fortunately he was able to sell at a profit, but the move forced him to abandon his survey of Tierra del Fuego.

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On November 10th, 1834 the *BEAGLE* sailed from Valparaiso to survey the southern part of Chile and the island of Chiloe. The ship anchored in the Bay of San Carlos, the capital of Chiloe, on the 21st.

Darwin visited Castro, the ancient capital of Chiloe. The town was so poor that no one in the town owned a watch or clock. An old man who was supposed to have a good sense of time was hired to ring the church bell by guess.

On December 18th the *BEAGLE* headed north. During the trip a harbour was discovered along the dangerous coast. While FitzRoy surveyed, Darwin went ashore to climb. He uttered a sentiment often felt by a surveyor even in more populated areas: "A strong desire is always felt to ascertain whether any human being has previously visited an infrequented spot. Possessed with this feeling I was much interested in finding, on a wild part of the coast, a bed made of grass beneath a ledge of rock.... The fire, bed and situation showed the dexterity of an Indian; but he could scarcely have been an Indian, for the race in this part is extinct, owing to the Catholic desire in making, at one blow, Christians and slaves." Darwin suspected that it might have been the bed of a shipwrecked sailor.

Some days later another harbour was discovered and the *BEAGLE* anchored. Soon afterwards a man was seen on shore waving a shirt and a boat was sent to pick him up. A party of six had run away from an American sailing vessel, and had been wandering up and down the coast for fifteen months. One of the party had died in a fall from the cliffs. Had it not been for the chance discovery of the harbour, they might have all died on that wild coast.

On January 18th, 1835, the ship anchored in the bay of San Carlos for a second time. That night the ship's crew witnessed the eruption of the volcano Osorno, one hundred miles inland. The light cast a bright shadow on the water, but by morning the volcano "seemed to have regained its composure." Darwin later found out that the volcanoes of Aconagua, 480 miles north, and Coseguina, 2700 miles north, had erupted the same night.

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On February 8th the *BEAGLE* arrived in Valdivia. On the 20th Darwin was ashore when he experienced an earthquake that came on suddenly and lasted for two minutes, though he said "the time appeared much longer." Darwin described the motion as "something like the movement of a vessel in a little cross ripple, or still more like that felt by a person skating over thin ice which bends under the weight of his body."

Ruins at Concepcion After the Earthquake

On March 4th the *BEAGLE* entered the harbour of Concepcion. Not a house was left standing, seventy villages along the coast had been destroyed, and a great wave had washed away the ruins of Talcahuano. "The whole coast was strewn with timber and furniture as if a thousand ships had been wrecked", wrote Darwin.

On March 7th the *BEAGLE* left Concepcion bound for Valparaiso. By nightfall only the mouth of the harbour had been reached and, since it was becoming foggy, the ship dropped anchor. A large American Whaler appeared alongside and Darwin told this story: "We heard the Yankee swearing at his men to keep quiet, whilst he listened for the breakers. Captain FitzRoy hailed him to anchor where he then was. The poor man must have thought the voice came from the shore: such a babel of cries issued at once from the ship - everyone hallooing out, 'Let go the anchor! Veer cable! Shorten sail!' It was the most laughable thing I ever heard. If the ship's crew had been all captains and no men, there could not have been a greater uproar of orders. We afterwards found that the mate stuttered: I suppose all hands were assisting him in giving the orders."

In Valparaiso, Darwin set out to cross the cordillera. Of the mules used on the excursion Darwin noted, "That a hybrid should possess more reason, memory, obstinacy, social affection, powers of endurance and length of life, than either of its parents, seems to indicate that art has here outdone nature."

About halfway up Peuquenes Ridge Darwin found the red snow. The snow would color only when it thawed quickly or was accidentally crushed and it was first noted in the footsteps of the mules. At first Darwin thought it was dust from nearby mountains, but soon discovered it was a microscopic plant. Darwin stated that Protococcus nivalis (red snow)was "well known from accounts of Arctic navigators."

On March 22nd the party had reached an elevation of more than 11,000 feet. Here, the potatoes would not cook after remaining in boiling water for some hours. Two of Darwin's companions concluded "that the cursed pot (which was a new one) did not choose to boil potatoes."

"The increased brilliancy of the moon and stars at this elevation," said Darwin "owing to the

perfect transparency of the atmosphere, is very remarkable." Other mountain travellers attributed the difficulty in judging heights and distances to the lack of comparison objects. Darwin thought the transparency of the air was as much the cause.

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The Galapagos Islands were discovered by Fray Tomas de Berlanga, Bishop of Panama, in 1535. They were owned by Equador - 500 miles distant. The *BEAGLE* anchored in St. Stephens harbour September 15th, 1835. For the *BEAGLE* it was just another port of call. But as we all know, it was much more than that for Darwin. He said, "Here, both in space and time, we seem to be brought somewhat near to that great fact - that mystery of mysteries - the first appearance of new beings on this earth."

Darwin commented on the weather: "Considering these islands are placed directly under the equator, the climate is far from being excessively hot; this seems chiefly caused by the ... low temperature of the surrounding water, brought here by the great southern Polar current." The islands were by no means uninhabited. A penal colony on Charles Island had 200 inmates.

Darwin collected and catalogued every form of life. Most resembled known species but were somehow different. He was confronted with the evidence of natural selection, but it took several years for Darwin to grasp the whole principle, and it was a quarter of a century before he published his 'Origin of the Species'.

In some instances a lack of competitors on the islands led to creativity. In the absence of woodpeckers, a famous species of finch took to using the spine of a cactus to pick larvae from beneath tree bark. There were no natural enemies to this finch on the islands: it had been hundreds of thousands of years since it had seen a dangerous hawk.

Just before World War II the British ornithologist David Lack visited the Galapagos to study Darwin's finches. When he left the islands he brought back caged finches to be studied later. By the time he reached the Panama Canal war had been declared so, instead of shipping the birds home to England, he sent them to a colleague in California. Here the birds reacted with alarm at the site of predator birds such as hawks, vultures and ravens. A possible million years had been insufficient to erase an ancient experience of terror.

When the *BEAGLE* left the Galapagos, the bulk of her work was done. The survey of the South American coast was completed, and only the chronological readings to determine longitude remained.

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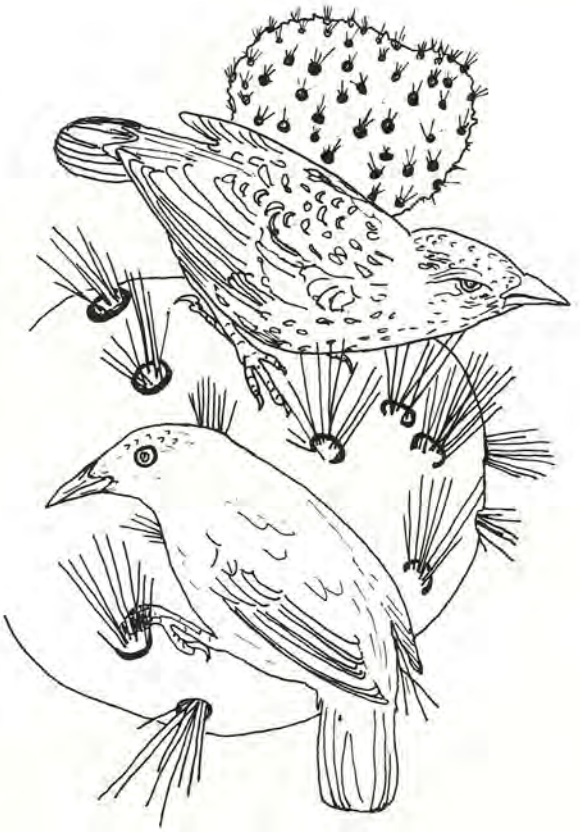
On November 15th the ship anchored in Matavai Bay, Tahiti, as Cook had done sixty years before. Darwin wrote of Tahitian pineapples, "they are of an excellent flavor - perhaps even better than those cultivated in England; and this I believe is the highest compliment that can be paid to any fruit."



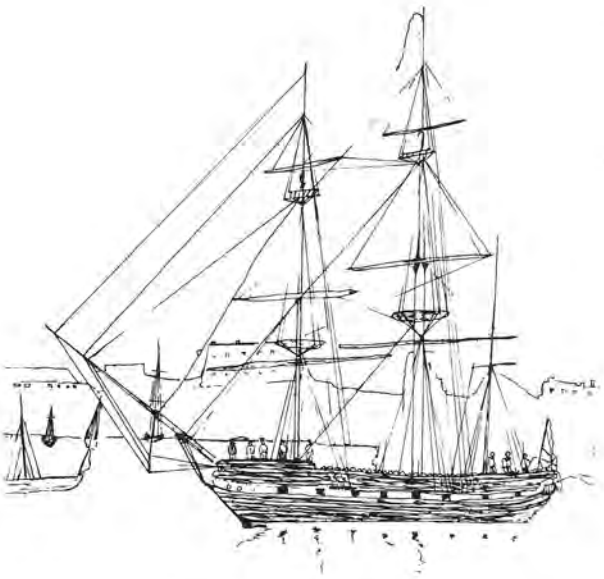
Cactus Feeding Finches

Two years before the arrival of the *BEAGLE* drinking was a serious problem among the natives. The missionaries on the island convinced the chiefs to pass a law forbidding the sale of alcohol. When the law came into effect, a general search was made, including the missionaries houses, and all the alcohol was poured on the ground. The use of alcohol was banished from Tahiti.

On November 26th the *BEAGLE* set sail for New Zealand, where it arrived on December 21st. "I should think a more warlike race of inhabitants would not be found in any part of the world than the New Zealanders", Darwin noted. "Their defiance of 'come on shore and we will kill and eat you all' shows uncommon boldness."

Nine days in New Zealand were enough. "I believe we were all glad to leave New Zealand", Darwin wrote. "It is not a pleasant place. Among the natives there is absent that charming simplicity which is found at Tahiti, and the greater part of the English are the very refuse of society."

Two weeks later, January 12th, 1836, the *BEAGLE* entered Port Jackson and anchored in Sydney Cove, Australia. During a short land excursion Darwin noted, "the number of aborigines is rapidly decreasing ... . This decrease no doubt, must be partly owing to the introduction of spirits, to European diseases (even the milder ones, which, such as measles, prove very destructive), and to



Beagle at Sydney Harbour

the gradual extinction of the wild animals." When Darwin left Australia on March 14th he wrote, "Farewell Australia! You are a rising child and doubtless someday will reign a great princess in the south: but you are too great and ambitious for affection, yet not great enough for respect. I leave your shores without sorrow or regret."

At Keeling Island Darwin observed fresh water wells that rose and fell with the tides. These ebbing wells are common on some of the low islands in the West Indies. As the water in the lower part of the sponge-like coral mass rises and falls with the tides, the fresh water (which has fallen as rain on the surface and sunk to the level of the surrounding sea) also rises and falls. "This will keep fresh if the mass be sufficiently compact to prevent much mechanical admixture", Darwin theorized.

In Mauritius, Darwin met Captain Lloyd, the Surveyor General known for his examination of the Isthmus of Panama, proving once again that it was indeed a small world.

Of St. Helena, Darwin wrote "it is very interesting ... to find that the arrival of animals in 1501, did not change the whole aspect of the island until a period of 220 years had elapsed." Imported goats and hogs destroyed the young trees and time took care of the old ones, changing woods into grassy plains. The change in vegetation affected land shells (causing eight species to become extinct), as well as a number of insects and forest animals.

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After visiting Ascension Island, the *BEAGLE* sailed for Bahia, Brazil to complete the world wide chronological observations. The ship arrived August 1st and stayed four days. Darwin wrote of his visit to the old town of Olinda, "I must commemorate what happened for the first time during our nearly five years wandering, namely, having met with a want of politeness: I was refused in a sullen manner at two different houses, and obtained with difficulty from a third, permission to pass through their gardens to an uncultivated hill, for the purpose of viewing the country."

On the last day of August the *BEAGLE* anchored for the second time at Porto Praya, Cape Verde. From there the ship proceeded to the Azores, and arrived in England on October 2nd, 1836. "At Falmouth I left the *BEAGLE*, having lived on board the good little vessel nearly five years."

Monkeyana

Parody of Anti-Slavery Cameo in Punch

Am I satyr or man?
Pray tell me who can,
And settle my place in the scale.
A man in apes shape,
An anthropoid ape,
Or monkey deprived of his tail?

The Vestiges taught,
That all came from naught
By "development," so called, "progressive;"
That insects and worms
Assume higher forms
By modification excessive.

Then Darwin set forth,
In a book of much worth
The importance of "Nature's selection;"
How the struggle for life
Is a laudible strife,
And results in "specific distinction."

Let pigeons and doves
Select their own loves,
And grant them a million of ages,
Then doubtless you'll find
They've altered their kind,
And changed into prophets and sages.

Excerpt from PUNCH May, 1861

Chronology of Events

1831

December 27	*Depart from Devonport*

1832

January 18-February 8	*Cape Verde Islands*
February 28-March 18	*Bahia*
April 4-July 5	*Rio de Janeiro*
July 26-August 19	*Montevideo*
September 6-October 17	*Bahia Blanca*
November 2-26	*Montevideo*
December 16	

1833 - February 26	*Tierra del Fuego*
March 1-April 6	*Falkland Islands*
April 28-July 23	*Maldonado*
August 3-24	*Rio Negro*
August 24-October 6	*Survey Argentinian Coast*
October 6-19	*Maldonado*
October 21-December 6	*Montevideo*
December 23	

1834 - January 4	*Port Desire*
January 9-19	*Port Saint Julian*
January 29-March 7	*Tierra del Fuego*
March 10-April 7	*Falkland Islands*
April 13-May 12	*Santa Cruz*
June 28-July 13	*Chiloe*
July 31-November 10	*Valparaiso*
November 21	

1835 - February 4	*Chiloe and Chonos*
February 8-22	*Valdivia*
March 4-7	*Concepcion*
March 11-17	*Valparaiso*
March 27-April 17	*around Concepcion*
April 17-June 27	*coast of Chile*
July 12-15	*Iquiqui (Peru)*
July 19-September 7	*Callao*
September 16-October 20	*Galapagos Islands*
November 15-26	*Tahiti*
December 21-30	*New Zealand*

1836	
January 12-30	*Sydney, Australia*
February 2-17	*Tasmania*
March 3-14	*King George's Sound*
April 2-12	*Keeling Islands*
April 29-May 9	*Mauritius*
May 31-June 18	*Cape of Good Hope*
July 7-14	*St. Helena*
July 19-23	*Ascencion Island*
August 1-6	*Bahia*
August 12-17	*Pernambuco*
October 2	*Arrive at Falmouth*

Chronology of Important Excursions

1832	April 8-23	*Various estates inland from Rio de Janeiro*
1833	August 11-17	*from El Carmen to Bahia Blanca*
	September 8-20	*from Bahia Blanca to Buenos Aires*
	September 27-October 20	*to Santa Fe and along the Parana*
	November 14-28	*to Mercedes*
1834	April 18-May 8	*up the Santa Cruz*
	August 14-September 27	*into the Andes*
1835	March 13-April 10	*from Santiago across Andes to Mendoza*
	April 27-July 4	*to Coquimbo and Copiapo*

The author would like to thank Eva Macdonald for the art work. Apologies to the artists whose work she interpreted at the author's request.

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*(if you can find a copy in your library)

All except * available in paperback.

Arctic Survey Uses Helicopter Mounted Spike Transducer

Paul V. Davies

Canadian Hydrographic Service
Central Region
Burlington, Ontario

The 1979 winter hydrographic survey carried out by Central Region, Canadian Hydrographic Service in the Queens Channel area of the Canadian Arctic may have broken the traditional method of sounding through ice, first started in the early 1960's. (A history of Arctic Hydrography is presented by S. B. MacPhee et al in Edition No. 18 of LIGHTHOUSE).

The first of five electrically operated ram transducers, known as "Actuators", was received at the Central Region Hydrographic camp on Baring Island on March 21, 1979. It was mounted on an Okanagan 206B Jet Ranger helicopter as shown in the accompanying photographs and placed in production within half a day. All did not go as smoothly and trouble-free as was expected, but after minor changes by the resident technician and mechanic, the actuator performed reasonably well. The hydrographer assigned to the helicopter did not abandon the oil can as yet. On many instances the oil method was still the only way to obtain a depth (oil is used to achieve an acoustic bond between the transducer and ice surface). The second actuator arrived on April 5, 1979 and was mounted shortly afterwards. After a few minor problems it too was soon in production. The oil method was seldom used on these two helicopters thereafter, except when ice conditions warranted. One helicopter continued to use the oil method for the duration of the survey. Any mechanical or electrical failures within the actuator system could usually be remedied or jury-rigged before the next flight.

The sounder used with the actuator was the 24 kHz Edo 9040 with a transmitter tune modification. This modification allowed the transmitter frequency to be more accurately matched to the receiver frequency.

The main reasons for failure to obtain a sounding with the actuators were:

i) Deep snow - deeper than the length of travel of the ram. As a result the transducer could not reach a hard surface on which to build up pressure.

ii) Hard crusty snow with softer layers underneath. The transducer would build up pressure on the top crust, but was transmitting through softer snow and hitting the hard ice surface. This situation was verified when the helicopter lurched as the transducer broke through the hard surface layer in the softer snow.

iii) Helicopter vibration due to low r.p.m.'s while taking a measurement. High winds would also vibrate the helicopter and the transducer interface with the ice, causing interference or noise.

The advantages of using the actuators were apparent after four to six weeks of surveying. These were:

i) The use of the actuator system was very much less tiring on the hydrographer. Climbing in and out of a helicopter up to 150 times a day is very exhausting, especially while wearing bulky Arctic clothing.

ii) Cabin heat could be built up in the rear compartment of the helicopter. When using the oil method the helicopter door is repeatedly opened and, with outside temperatures of $-35^{\circ}C$, the rear of the helicopter is constantly well below zero. The heating system of a 206B Jet Ranger simply cannot cope with this sort of heat loss.

iii) The use of the oil method is minimized. This will result in savings on expensive Arctic clothing that usually is ruined due to oil saturation. The helicopter engineers will also be happier with a less well-lubricated back seat area.

iv) The oil cans, shovel and standard transducer can be stored in the cargo compartment leaving more room in the back seat area for the hydrographer.

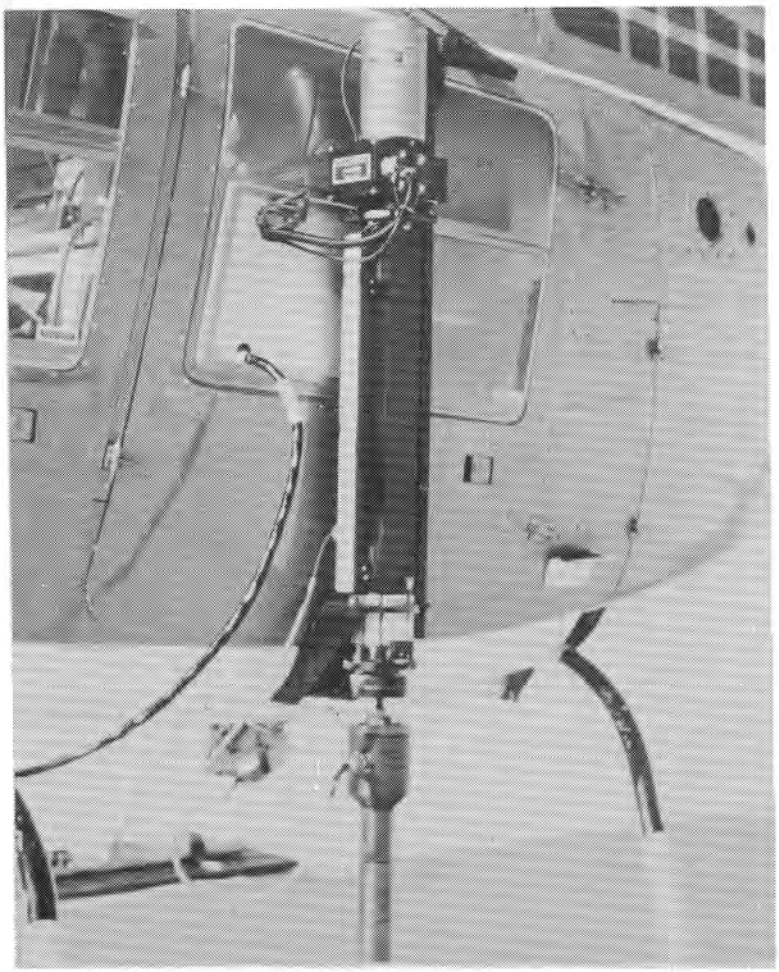
In 1979 the two helicopters equipped with actuators collected 6,414 spot soundings out of a total of 12,787 soundings gathered during the complete survey. The remainder were collected using a tracked vehicle equipped with hydraulically driven rams and the oil bonding method from helicopters.

To date the use of actuators has not proven to be a faster or more productive method of sounding. In fact, on occasion, while working in similar ice conditions, the oil method produced more sounding data per day.

There are too many factors involved to compare the methods. With the proper ice conditions the rams should prove more productive (if they can withstand the continuous punishment of the Arctic environment).

At present Central Region has five actuators that will be mounted on all the helicopters assigned to the Arctic winter survey in 1980 and perhaps the oil method will be relegated completely to a back-up role.


OKANAGAN



Comments on the Internav Loran - C Co-ordinate Converter Unit (CC-2)

A.R. Mortimer

Canadian Hydrographic Service
Pacific Region
Sidney, B.C.

Introduction

An Internav CC-2 Loran-C co-ordinate converter was purchased by the Institute of Ocean Sciences, Patricia Bay, in July, 1978, and has been used on geophysical and geological work off the British Columbia coast. These comments were originally written in 1978 to provide in-house users with an appreciation of the instrument's capabilities and as feed back for Internav's west coast agent, Comdev, but may be of more general interest in view of the correspondence between Mike Eaton and John Currie in the April, 1979, edition of LIGHTHOUSE. The CC-2 has not been used to provide survey control but as an aid in ship control for line and station keeping. It has also been interfaced to PHAS (portable hydrographic acquisition system).

The CC-2 is a microprocessor-based accessory to Loran-C receivers which converts the Loran-C time differences to geographic co-ordinates. This unit also provides course, speed, distance and time information for operator-defined way points.

Equipment

The CC-2 receives time difference data from the receiver in serial format and a microprocessor carries out the computations using Intel 8085 machine language. Data is shown on a 16 digit, 7 segment incandescent display. The operator controls the instrument through a 16 digit keyboard and mode and function switches.

There are three main components in the CC-2: (1) power supply; (2) microprocessor; and, (3) display/interface. Problems were experienced with the microprocessor board mounting and with the interface keyboard. The mounting slides for the microprocessor board were such a poor fit that the board fell out during transportation. The keyboard was not responsive and added to data entry errors. This type of keyboard has since been replaced by another, more satisfactory component. The preliminary operating manual for the unit is adequate, but a brief set of initialization and operation instructions should be placed on one page at the front of the manual.

Functions

The principle function of the CC-2 is to produce latitude and longitude for Loran-C time differences and it does this reliably and, within certain limitations, accurately. The initialization of the co-ordinate conversion routine is reasonably simple and requires that the operator input a Loran-C rate and an approximate latitude and longitude through the keyboard. Once the unit has been initialized the ship's latitude and longitude are displayed in degrees, minutes and seconds (to a resolution of one decimal place of seconds). It is doubtful if Loran-C positions warrant a resolution stated to a decimal of a second of arc. Also, the navigator would probably find the degrees, minutes and two decimal places of minutes format more suitable for chart work and off-line calculations.

The conversion program is claimed to have a calculation accuracy of $\pm$ 50 ft., which is more than adequate for most users. This program uses the United States Coast Guard model to correct for propagation delays along an all-seawater path. On the British Columbia coast the neglect of overland phase lags causes a position slip of over 0.5 nautical miles. Some observed differences between a "best" estimated position by Satnav and Loran-C (controlled by cesium clock) are given in Table 1.

Thus a systematic error of over 1000 metres exists in co-ordinate conversion. The manual emphasizes the existence of this shift and cautions the operator to allow for a margin of error when using the data from the CC-2. Constant corrections can be applied through the CC-2 program to allow for these systematic errors. The corrections are applied to the time differences (T.D.'s) to change the latitude and longitude. It is a pity that the corrected T.D.'s cannot be displayed. A 'smoothed', corrected T.D. would be useful in many applications.

The raw T.D.'s from the receiver are 'smoothed' considerably by the CC-2 program. When the ship is underway this smoothing has the effect of delaying the received T.D. The amount of the delay is proportional to the ship's speed. The effect of the smoothing on the T.D.'s when the ship is stationary is given in Table 2. It can be seen that the CC-2 makes the T.D.'s three times more stable than those taken directly from the receiver.

TABLE I

Difference of Position CC-2 -- Satnav/LC
(in seconds of arc at 53° N)

	Lat.	Long.
	21.5	39.4
	35.7	24.7
	35.4	23.3
	35.4	19.3
	36.5	20.3
	35.8	16.1
	6.2	19.8
	31.0	20.0
	37.8	17.4
	36.8	17.2
Mean Difference	+ 31.2	+ 21.8
St. Dev. of Mean	$\pm$ 3.3	$\pm$ 2.2

TABLE 2

Stability of CC-2 and Receiver Time Differences

	CC-2		Receiver (204)	
Rate 5990	TD-X	TD-Y	TD-X	TD-Y
Mean T.D.	12130.51	20332.94	12130.51	30332.97
St. Dev.	± 0.01	± 0.01	± 0.03	± 0.03

The CC-2 is capable of several navigation functions in relation to up to 9 selected way points. These functions, with some components, are given here:

1) Course to go - adequate resolution and sensitivity for the majority of users, but not for oceanographic survey work.

2) Distance to go - accurate for all requirements.

3) Time to go - based on current estimate of speed. The navigator's own E.T.A. is usually better.

4) Course made good - accurate for all requirements.

5) Speed made good - the filter necessary to reproduce a reasonably stable estimate of the ship's speed apparently has a response delay of about two minutes (see Figure 1). This yields neither a good instantaneous speed (which is required for survey applications) nor a good long-term speed (which is required to produce an accurate E.T.A.).

6) Cross track error - this is the most sensitive indicator for maintaining a good course, but still not as sensitive as following a hyperbolic co-ordinate (T.D.).

7) Left-right indicator - is too small to be of much use. The scale options are satisfactory.

8) Way point change - needs clarification in the manual. The automatic change is not completely practical, and would, perhaps, be better achieved when the ship is abeam of the way point, not just within 0.1 nautical mile (185 m) of the way point. The alert light is a satisfactory feature.

9) Signal light - an essential feature. It would also be useful to incorporate a warning of poor line-of-position gradient. The basic data required to compute gradient are already in the system.

Conclusions

1) This co-ordinate converter is a useful accessory to a Loran-C receiver. It provides position information that allows Loran-C to be used in areas where latticed charts are not adequate for the user's requirements. It also produces adequate course control facilities for most applications.

2) The navigation information is of satisfactory accuracy and sensitivity for the vast majority of potential operators. However, the data provided have only limited applications to survey work, buoy positioning or fisheries boundary regulation, where maximum accuracy must be achieved.

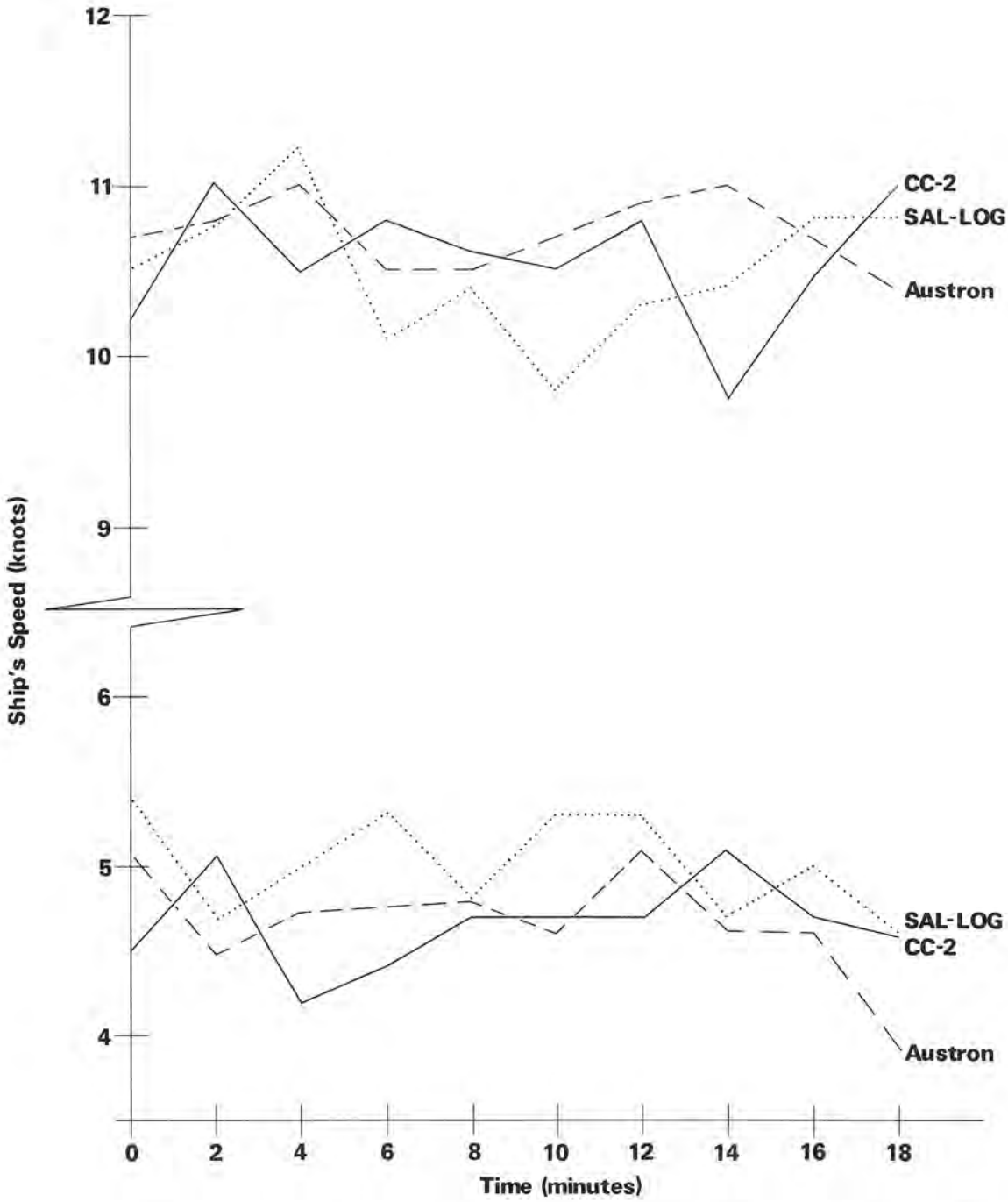
3) Although the CC-2 manual provides many admonitions to the navigator to always check the computed positions and courses against the chart, there always exists the possibility of large errors (such as poor Loran-C cycle identification) causing blunders.

4) The CC-2 is an expensive and quite a sophisticated navigation system. There is a requirement for a cheaper, simpler system such as the CS-101 that can provide steering information for fishing and other smaller vessels.

5) In Parizeau, three differing Loran-C positions were available:

   (a) from the Austron 5000 survey system which applied phase lag corrections for non-homogeneous transmission paths,
   (b) from the Internav LC204 through a latticed chart which applied another estimate of phase lag corrections, and
   (c) from the CC-2 which applied only phase lag corrections for a seawater transmission path.

Three estimates of one position from one navigation system points to a problem. There is a need for a more general method of estimating phase lags along non-homogeneous transmission paths that can be applied to survey mini-computer systems, to chart latticing and to microprocessor-based navigation boxes to achieve a uniform solution to the co-ordinate conversion problem.



Ship's Speed as Indicated by the CC-2, the SAL-LOG and the Austron System.

The Austron system obtains velocity from a second-order software servo which is used to maintain zero-crossing track of the Loran signals. Azimuth is obtained by coordinate conversion computation.

Figure 1

Book Review

Underwater Acoustics and Sonar and Echo Sounding Instrumentation

S.B.MacPhee
Canadian Hydrographic Service
Technical Report TR1 (Revised 1979)

This report is a recent edition of an introductory text and reference prepared by Mr. MacPhee for hydrographers on the subject of underwater acoustics and instrumentation. It is always stimulating to observe the approach an author takes to introduce a subject.

The report offers a substantial list of references for the motivated student to explore more fully the historical, mathematical and physical depths of the subject. One reference is reproduced as an appendix to introduce side scan sonar as a practical tool.

There are a few technical points which merit improvement. In the discussion of acoustic measurements, MacPhee shows a preference for the yard as the reference distance over the internationally accepted SI metre. I would prefer to see the yard retired to an historical role. He does use the micropascal rather than the retired microbar for pressure. I would prefer to see the decibel (dB) expressed consistently rather than as Db or Db (decabel ?).

The discussions on propagation demand little formal physical or mathematical skills. This section would benefit from the introduction of the concepts of refraction and diffraction. The parallels with RF and microwave propagation would seem a natural avenue for improving a novice hydrographer's grasp of the limitations on performance of sounding and positioning systems.

A shortcoming characteristic of many texts is that some sections do not lead the student gently through the development of a concept without introducing terms that are developed in later sections. The discussion on the sonar equation is not the exception. Presumably the accompanying lectures smooth over these imperfections.

In the way of omissions, I would suggest that sections on transducer calibration methods and near field, far field effects are increasingly important to the hydrographer as more complex, large aperture sonars are introduced. The questions of sonar system resolution and the effects of signal processing and display technology on dynamic range could be explored more fully so that the hydrographer might operate his instruments more effectively.

I have not come across any other texts written on this subject specifically for the hydrographic community. This report is a good start in that direction, and evidently Mr. MacPhee, in his senior position in the CHS, senses this deficiency sufficiently strongly to invest his time and energy. Hopefully, others will contribute to future editions, and hydrographers will benefit from them.

Bryan F. White, P. Eng.
National Water Research Institute
Burlington, Ontario

Letters to the Editor

Sir, --- Readers of LIGHTHOUSE may be interested in the following sequel to my "Sailing Strategy in the Face of the Gulf and North Atlantic Current" published in November, 1977.

Readers may recall that this article discussed navigation strategy on a crossing of the North Atlantic from the U.K. to the U.S.A. via the Azores. It was our custom on board to lighten the day by celebrating the sun's crossing of the yardarm by downing the odd glass of gin or vodka. Since these fiery spirits are made more palatable with a little mix, we carried several cartons of small bottles. As one or two of these bottles became empty each day we cast them overside after placing a small message inside.

In the spring this year I received a letter in spanish from Las Tunas, Cuba, recording how one of the bottles dropped overside not long after leaving England, had been picked up off the coast of Cuba on February 20, 1979. To quote part of the letter:

> "According to the mentioned message, the bottle was dropped to the sea during your way from Cornwall to the Azores Is., dated on June 12, 1977 and at the position 46°12'N 16°27'W...
>
> The finding of the bottle took place on the morning of the 20 of February (Sunday) 1979. That said day I found myself doing sport navigating on a small boat along the north coast of Provincia de Oreinte...
>
> Attentively,
>
> Faustino Perez Ramos."

A look at the Pilot chart will show that the bottle in its one-and-a-half years of sailing, probably went south with the Portuguese current, thence past the Canary Islands and Cape Verde Islands, where it was picked up by the westward flowing equatorial current and carried across the Atlantic to Cuba. That route is in the order of 5000 nautical miles and the Pilot charts show that currents of 0.5 knots prevail throughout the route. If in fact the bottle had averaged that speed and followed the route reasonably directly it would have made the journey in 416 days.

So far that's the only message that has been returned.

Adam J. Kerr
Canadian Hydrographic Service
Atlantic Region
Dartmouth, Nova Scotia

Notes

ADMIRAL MUNSON ELECTED PRESIDENT OF THE HYDROGRAPHIC SOCIETY

Rear Admiral Robert C. Munson, Associate Director for Fleet Operations, U.S. National Oceanic and Atmospheric Administration (NOAA), National Ocean Survey (NOS), in Rockville, Maryland, has been elected President of The Hydrographic Society in succession to Rear Admiral D.W. Haslam, OBE, Hydrographer of the Navy.

Most recently Admiral Munson was Director of the Atlantic Marine Centre (AMC) of NOS, managing NOAA's East Coast fleet of ships and field parties which conduct the hydrographic surveys of the U.S. waters of the Great Lakes, the Atlantic Coast, the Gulf of Mexico, the Virgin Islands and Puerto Rico as well as the marine resource assessment surveys and their associated oceanography along the East and Gulf Coasts. He was also a former Associate Director of the Office of Marine Surveys and Maps, National Ocean Survey, where he was Program Manager responsible for the total nautical charting operations in all U.S. waters.

Admiral Munson's period of Federal service has also included ten years at sea aboard seven survey vessels, three of which he commanded; he also served for a number of years as leader of geodetic triangulation parties on surveys in the south eastern and north western sections of the U.S. His many citations include a Department of Commerce Special Achievement Award, in May 1974.

Admiral Munson is a member of the American Congress on Surveying and Mapping and the Marine Technology Society. He is also U.S. Delegate and Executive Secretary to the International Federation of Surveyors (FIG) Commission IV, Hydrographic Surveying. Among other professional and civic activities, he is on the Board of Directors, Hampton Roads Maritime Association and Hampton Roads Post of the Society of American Military Engineers.

Proceedings of International Hydrographic Technical Conference Available

The first International Hydrographic Technical Conference was held in Ottawa, Canada from May 14th to 18th, 1979. Sponsored by the Canadian Hydrographic Service, Fédération Internationale des Gêomètres (FIG), Canadian Institute of Surveying, and the Canadian Hydrographers' Association, the conference brought together over 400 delegates from 47 countries.

Commercial exhibits by 26 companies were on display as well as exhibits by CHS, FIG (Commission 4), CHA, the International Hydrographic Organization, and the U.S. Defense Mapping Agency. As well, the CSS ADVENT, a high-speed hydrographic survey vessel from the Central Region of CHS, was berthed in the Rideau Canal close to the conference centre and was open to visitors throughout the conference.

Papers were presented during five plenary sessions, providing the delegates with a truly international view of hydrographic instrumentation, techniques, problems and philosophies. Authors came from the U.K., Netherlands, Japan, Venezuela, the U.S.S.R., U.S.A., Australia, France, India, Monaco, Norway, Egypt and Canada. A particularly interesting keynote address entitled "The Law of the Sea and the Developing Countries" was presented by L. H. Legault, High Commissioner for Canada, Lagos, Nigeria. The conference ended with an entertaining and informative luncheon address on "Boundary Delimitations and Their Implications on Natural Resources" delivered by Marcel Cadieux, Special Negotiator for Maritime Boundaries (Canada/USA), Department of External Affairs, Ottawa, Canada.

The conference committee, chaired by Mr. M. Bolton of the Canadian Hydrographic Service, is to be congratulated for doing an excellent job on the first of what is hoped will be a long line of international hydrographic conferences.

Proceedings for this conference are now available, $15.00 Canadian, from:

The Canadian Institute of Surveying
Box 5378, Station "F"
Ottawa, Canada K2C 3J1

A copy of the proceedings will be sent to all registered delegates.

International Symposium on Position Fixing

The Hydrographic Society announces a three day international symposium on Position Fixing, to be held at Southampton University on 15-17 April 1980. It is being co-sponsored by the Canadian Hydrographers' Association and the Institution of Electronic and Radio Engineers (IERE).

The symposium, which is being supported by a special manufacturers exhibition, will include presentations by leading world authorities on the primary positioning requirements of the offshore, deep sea and port survey industries. Subjects scheduled for individual presentation and discussion include satellites, inertial systems, microwave positioning equipments, as well as key aspects of current and future marine electronic and computer technology.

Full details on the symposium and supporting exhibition may be obtained from the Functions Organiser, The Hydrographic Society, North East London Polytechnic, London E17 4JB.

Proceedings of the Seminar on the Growth and Potential of the Surveying and Mapping Industry in Canada

Proceedings of the above seminar, held on February 28th, 1979 in Ottawa, Canada, and sponsored, amongst other, by the Canadian Institute

of Surveying, were recently received in the editor's office. The seminar was designed to acquaint senior officers in the federal government with the surveying and mapping industry in Canada and the proceeding would certainly serve the same purpose for anyone interested in obtaining a copy. Various specialty fields - geophysical surveying, remote sensing, thematic mapping, aerial surveying and, of particular concern to our readers, hydrographic surveying - were discussed along with the financial aspects of surveying and the profession itself. The keynote address by Mr. D. N. Kendall, National Advisory Committee on Surveying and Mapping, dealt with the history and development of the industry in Canada, as well as taking a look to the future.

Copies of the proceedings, $15.00 Canadian, are available from:

The Canadian Institute of Surveying
Box 5378, Station F
Ottawa, Ontario
K2C 3J1

Proceedings of International Symposium on Depth Measurement and Sonar Sweeping Published

The Hydrographic Society announces publication of the proceedings of the International Symposium on depth measurement and sonar sweeping held under its auspices at Southampton University last year.

The proceedings comprise a special 200 page publication incorporating 12 technical papers presented by leading authorities from the U.K., Japan, the Netherlands and the U.S.A.; these are supplemented by comprehensive accounts of exchanges between speakers and delegates. Subjects covered include Automation in the U.S.A. with special reference to Depth; Sonar Sweeping in Japan; Hydrosearch High Definition Sonars; Future Electronic Developments in Echo and Sonar Equipment.

Copies of the proceedings, price £15 each, are available from The Hydrographic Society, North East London Polytechnic, Forest Road, London E17 4JB.

The Hydrographer's Sketchbook

Hydrographers probably don't, as a rule, have many outlets for artistic expression in their work, except perhaps in inking field sheets and drawing bench mark sketches - although many a hydrographer has, no doubt, been known to his colleagues for his distinctive inking style. And so it is that the sketch shown above - discovered in a Central Region file for Churchill, Manitoba - finds its way into LIGHTHOUSE as a rare example of "hydrographic art." The artist won't be named since the readers might like to "discover" him on their own. The location and date should help. He still works for the Canadian Hydrographic Service.

Contest Winner

The contest announced in the last issue of LIGHTHOUSE asking for municipal place names with a hydrographic origin has been won by R. W. "Sandy" Sandilands of Pacific Region, C.H.S. with a list of 21 names. Congratulations go to Sandy, as will a cheque for $25.00 at the Hydrographic Conference in Halifax, March 1980. Here is the winning list:

Bayfield	P.E.I
Bayfield	Ont.
Bayfield	N.S.
Bayfield	N.B.
Bayfield Inlet	Ont.
Bellin	P.Q.
Bull Harbour	B.C.
Cartierville	P.Q.
Cook's Harbour	Nfld.
Fort Franklin	N.W.T.
Franquelin	P.Q.
Gabriola	B.C.
Galiano	B.C.
Mayne	B.C.
Owen Sound	Ont.
Parry Sound	Ont.
Pender Harbour	B.C.
Sidney	B.C.
Tofino	B.C.
Vancouver	B.C.
Zeballos	B.C.

News from C.H.S.

Dominion Hydrographer Appointed

Stephen B. MacPhee, of Ottawa, was appointed Dominion Hydrographer of the Canadian Hydrographic Service early this past summer. The position was formerly occupied by G. N. Ewing, now Assistant Deputy Minister for Ocean and Aquatic Sciences, Department of Fisheries and Oceans.

After obtaining a degree in electrical engineering in 1960, Mr. MacPhee was employed by E.M.I. Cossor Electronics on the design and evaluation of underwater acoustics instrumentation for military applications. During this period he spent a considerable amount of time on naval ships in various areas of operation.

After a period with Sperry Rand Canada Ltd., engaged in the design and operational aspects of naval sonar, radar, communications and fire control systems, he joined the Bedford Institute of Oceanography in 1967. While at BIO he was involved in the design and testing of hydrographic and oceanographic sensors and data acquisition and processing systems. He was also engaged in the development and evaluation of echo sounder digitizers, correlation systems for signal enhancement, and narrow beam echo sounders.

In 1975, after having become Head of Engineering Services at BIO, he joined the Canadian Hydrographic Service in Ottawa as Manager, Planning and Development. In this capacity he was responsible for hydrographic and cartographic training and standards, hydrographic planning, nautical geodesy and geoscience mapping and GEBCO (General Bathymetric Chart of the Oceans).

Mr. MacPhee is a member of the Canadian Hydrographers' Association, The Hydrographic Society, the Canadian Institute of Surveying, and the Association of Professional Engineers of Ontario.

New Regional Hydrographer for Atlantic Region

Adam J. Kerr was recently appointed Regional Hydrographer of the Atlantic Region of the Canadian Hydrographic Service in Dartmouth, Nova Scotia. He succeeds Mr. R. Melanson who retired earlier this year.

Mr. Kerr has been with the Canadian Hydrographic Service since 1958, occupying the position of Regional Hydrographer, Central Region, during the period 1973-1977.

In 1978 he obtained a Master's degree in Marine Law and Policy from the University of Wales while on education leave.

Prior to assuming his duties in Dartmouth Mr. Kerr had been on special assignment to the office of the Assistant Deputy Minister, Ocean and Aquatic Sciences, Ottawa.

Regional Hydrographer—Quebec Region

The most recently formed office of the Canadian Hydrographic Service, Quebec Region, saw the appointment of its first Regional Hydrographer when *Mr. Ken Williams* won the competition early this year. Mr. Williams moves to Quebec City from Dartmouth, where he has been employed by the Canadian Hydrographic Service since 1952. His most recent appointment in the Atlantic Region was Hydrographer-in-Charge of the survey party operating on board the C.S.S. BAFFIN.

Headquarters Position of Manager, Planning and Development Filled

Neil M. Anderson recently won the competition for the position of Manager, Planning and Development, with the Canadian Hydrographic Service in Ottawa, Canada. Mr. Anderson has served with the Canadian Hydrographic Service since 1960. Most recently Mr. Anderson held the position of Chief, Cartographic Development in Ottawa and, prior to that, was in charge of Pacific Region's Hydrographic Development Section.

Regional Positions Filled —Atlantic and Pacific

Competitions were held recently to fill the Assistant Regional Hydrographer position in the Atlantic Region and the Regional Field Superintendent position in the Pacific Region. The successful candidates were *T. B. Smith* in the Atlantic Region and *R. W. Sandilands* in the Pacific Region.

News from Industry

First Canadian Delivery of New Tellurometer MRD 1 SYSTEM

The Water Resources Division of the Canadian Department of Fisheries has taken delivery of a variant of the newly-developed Tellurometer MRD 1 microwave position fixing system. The fully automated, microprocessor-controlled MRD 1 is capable of realising repeatable dynamic accuracies of better than 1 meter over ranges up to 100 km. It requires no tuning or calibration.

A two-range configuration, together with ancillary echo sounding and track plotting equipment, has been used by the Water Resources Division for carrying out water and flood control surveys in Slave Lake, Alberta as well as latterly in British Columbia.

Elsewhere, MRD 1 configurations have been delivered to the Port of Hamburg for dredging operations in addition to Belco Petroleum, the Peruvian Government's principal offshore oil exploration and production concern. The Peruvian application has thus far involved the positioning of a 400 m high platform some 15 km off the coast of Peru. During the initial stages, around 585 positioning and depth recordings were realised within an hour using an MRD 1 system linked to printer, plotter and digitised fathometer facilities.

Internav Loran C Receivers Selected for DND Maritime Command Fleet

A contract has been awarded to Internav Limited, Sydney, Nova Scotia, to supply forty-four Model LC-204 Loran C receivers to the Department of National Defence. This order follows an initial DND contract for six LC-204 receivers placed with Internav in 1978.

The equipment will be installed in vessels of the Maritime Command fleet on Canada's East and West Coasts, and is expected to provide position fixing assistance to ships patrolling our 200 mile sovereignty limit and on other national defence missions.

Besides the Department of National Defence, other Canadian LC-204 users include the Canadian Coast Guard, the Department of Fisheries and Oceans, the National Research Council, and a broad spectrum of merchant, fishing, and private vessels. In overseas markets, the LC-204 is widely used by all classes of ships, from supertankers to ocean yachts.

Seagoing Chart Dealer

Regional Hydrographer Mike Bolton congratulates Pacific Region's first seagoing Chart Dealer, Ian Campbell while Regional Chart Superintendent Sev Crowther looks on.

Ian, owner and master of 'Coast Pilot' will operate a mobile Dealership in areas not serviced by shore dealers.

CHA Personal Notes

Ottawa Branch

Alain Gagnon rejoined CHS in May after a brief stint in a local township drafting office; *Marcel Chenier* has transferred to Atlantic Region; *Don Vachon*, an engineering grad. from Carleton U. joined the Cartographic Section in May; *Tim Evangelatos* completed his Master's degree in Systems Engineering recently; *Sandy MacDonald* resigned in September after 21 years with CHS and has moved to Nova Scotia.

Central Branch

Don Knudsen left CHS in May to work at the Canada Centre for Remote Sensing in Ottawa; *Dave Livingstone* is presently working for Atomic Energy of Canada in Sheridan Park, having left CHS in August; *Rob Tripe*, a CHS employee for many years in both Pacific and Central Regions, has forsaken hydrography to teach computer programming at Mohawk College in Hamilton; Central Branch welcomes its first female member, *Deborah Borris*, a hydrography student at Humber College in Toronto.

Pacific Branch

C.S.S. PARIZEAU, *Barry Lusk*, returned to IOS from a successful survey of Laredo Sound and his party, under *Mike Woods*, continued the survey of Harrison Lake and river commenced earlier in the season; *Graeme Richardson* and party completed a short but successful Western Arctic season where they made a large scale survey of Summers Harbour and Wise Bay and smaller scale surveys of the approaches; *Tony Mortimer* and *Peter Milner* continued their Loran C calibrations in the Beaufort Sea; *Hydrography I* field training was held in the Region and the beautiful B.C. climate cooperated with no down time due to weather; *Tony O'Connor* ended up in court but only as a jury member on a long drawn out murder trial - hard luck on summer rotation ashore and his planned long vacation; *Fred Stephenson* and *John Smedley* spent August on a one month tidal survey of Queen Maude Gulf and Victoria Strait; the *9th Annual Canadian Hydrographic Invitational Golf Tournament* was held in August and *Mike Foreman* retained his 'resident pro' status at the Institute with a round of 69.

Winning Season for Mariners

The *Institute of Oceans Sciences Mariners* recently completed a successful softball season with a 15 win 1 tie 5 loss record. They were also second place finishers in an eight team Hertz Invitational Softball Tournament.

Back Row - L-R: Laurie Thompson, Don Jodrell, Dave Harrison, Doug Sieberg, Rick Taylor, Ken Holman, Ardene Philp, Dave Fisher, Brian Watt

Front row : Sue McKenzie, Nick Said, Violet Vermette, Pete Browning, Sylvia Liudzius, Sev Crowther.

LOOKING FOR SHIPWRECKS...?

Klein HYDROSCAN Side Scan Sonar Record of an Old Wooden Sailing Barge in the Great Lakes.

American Schooner Hamilton which sank in Lake Ontario in the war of 1812 [Courtesy Royal Ontario Museum and Canada Centre for Inland Waters].

Klein HYDROSCAN Side Scan Sonar Record of the Ironclad U.S.S. Monitor [Courtesy of the Harbor Branch Foundation].

Schooner Turned into Barge.

YOU OUGHT TO HAVE THE BEST...

HYDROSCAN

Klein Side Scan Sonar

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MRD1 Boringly Repetitive

No matter how often you take a reading with MRD 1, the answer always comes up within a dynamic accuracy of 1 metre.

This level of repeatable precision is achieved automatically. And without any need to calibrate or tune.

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This is just one of the many features which puts MRD 1 way ahead in position fixing technology. You can find out about the others by sending the coupon or phoning today.

Photograph by courtesy of Hunting Surveys Ltd.

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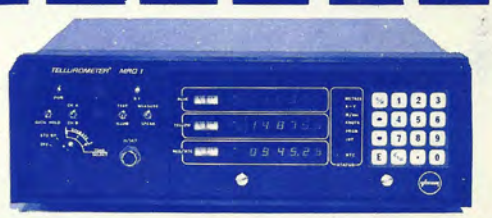

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