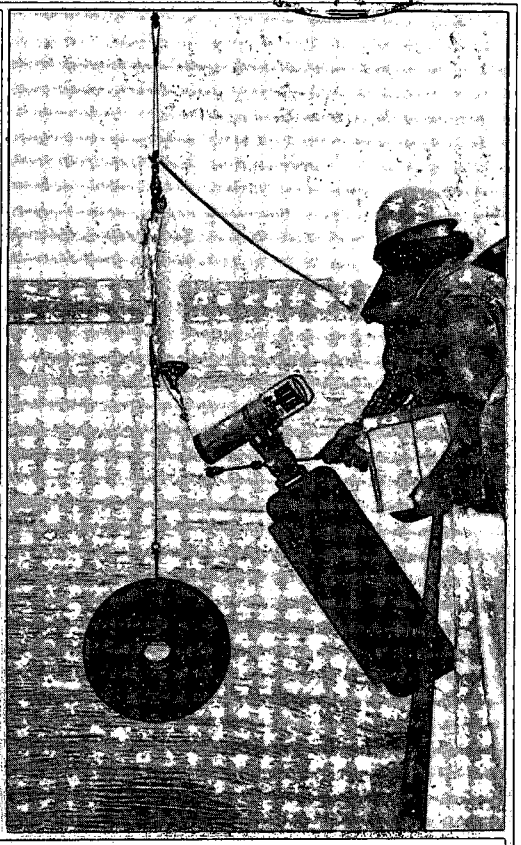
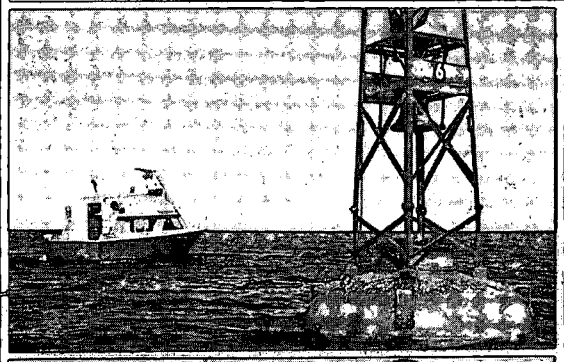
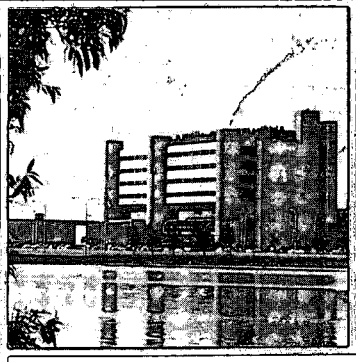
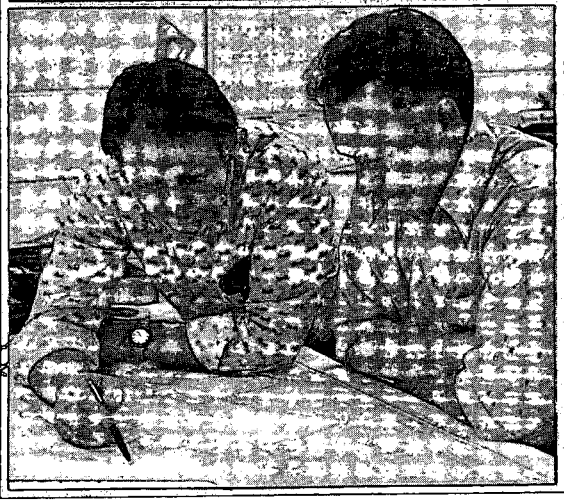
1977 ANNUAL REPORT









Ocean and Aquatic Sciences
Central Region
Fisheries and Environment Canada
Burlington, Ontario

1977 ANNUAL REPORT

CENTRAL REGION

OCEAN AND AQUATIC SCIENCES

FISHERIES AND MARINE SERVICE

TABLE OF CONTENTS

C.S.S. BAYFIELD and N.O.S.V. MOUNT MITCHELL rendezvous in Lake Huron to calibrate positioning systems. (Courtesy U.S. N.O.S.)

OVERVIEW

The Central Region of Ocean & Aquatic Sciences has its headquarters at the Canada Centre for Inland Waters, Burlington, Ontario. The operating area of the Region stretches beyond the Great Lakes to the Saskatchewan-Manitoba border in the west, the Upper St. Lawrence River in the east, and James Bay/Hudson Bay and the Queen Elizabeth Islands in the north.

The Region reports operationally through the Director to the Director-General, Fisheries and Marine Service for Ontario and functionally for the development of national policy to the Assistant Deputy Minister, O&AS. The Region is sub-divided operationally into four divisions: Hydrographic, Research & Development (Oceanographic), Ships, and Administration, with an allocated man-year total of around 160 and a budget in excess of $7.0M. The Hydrographic Division is the largest group and provides the central core of strength around which the Region is constructed. The R&D Division is largely oceanographic in content, with additional expertize in matters affecting the coastal zone. The Ships Division provides both ships and launches required by O&AS, other elements of F&MS and last but certainly not least, meets the varied and sometimes complex requirements of the Inland Waters Directorate, the major occupant of CCIW.

As in past years, the Region was engaged in a multitude of activities and completed all commitments although hampered by a reduction in man-years for field operations together with escalating costs and a slightly diminished budget. Some field programmes, particularly in the northern regions, are rapidly becoming prohibitive in costs and resources. A diminished or even static budget coupled with the cumulative effect of man-year reductions in 1978-79 will seriously jeopardize some northern programmes and in one case, the joint EMR-DFE Winter Bathymetric/Gravity survey of James Bay/Hudson Bay, has caused the region to cancel the survey for the winter of

We have aided in the establishment of a Quebec Region during 1977 by transferring staff members and by supplying several fully equipped launches and survey systems.

Regional highlights in 1977 were the Canadian Hydrographic Conference held by the region in March, with the Deputy Minister, Blair Seaborn giving the opening address and Admiral Haslam, Hydrographer of the Royal Navy speaking at the Conference luncheon on Hydrography and the North Sea. Later that month the Director was appointed to the Executive and the Commonwealth Survey Board of Education of CASLE (Commonwealth Association of Surveying and Land Economy). Cooperative charting by U.S. National Ocean Survey and the region resulted in a general chart of Lake Ontario produced by Canada and one of Lake Erie produced by USNOS. Much appreciated visits of "MOUNT MITCHELL" (USNOS) to CCIW. The publishing of the FIG Working Group 414a report on Data Systems in September. That month also the Regional Hydrographer, A.J. Kerr, left us to pursue a Masters Degree in International Law and Policy at the University of Wales.

During 1977 the CCIW Executive Committee commenced meeting each month and started to tackle important inter-service issues. In November 1977 the Director OAS was elected to preside over the CCIW Executive Committee for 1978, recognition of the tri-service occupancy and involvement at the Centre.

Additional Hydrographic highlights were the development of a sector scannery sonar for through-ice surveys and the completion of the Tidal Acquisition and Telemetry System project, with one prototype already in service, and of course the establishment of a Cartographic Section who are presently involved in processing 22 nautical chart editions and twelve brand new nautical charts.

Highlights in physical oceanography, shore property studies and environmental assessment were completed of St. Lawrence River Middle Estuary Current Study,

a hydrodynamic study of Adolphus Reach/North Channel of the Bay of Quinte, research on freshwater plumes under ice cover off La Grande River in James Bay, vertical salinity and temperature structure transects across McClure-Strait, Prince of Wales Strait and Viscount Melville Sound, initiation of a joint OMNR/EMS/OAS shoreland management study around Colchester in Lake Ontario and environmental assessment activities at Port Granby and Point Pelee.

Oceanographic publications this year included manuscript reports on the Freshwater Budget of Hudson Bay and the Coastal Responses at Point Pelee and a report on the AGAWA CANYON claim against the Crown was prepared in conjunction with DPW.

Ship Division highlights were the highly successful cruise of "PETREL" in Hudson Bay, the modifications to "BAYFIELD" and the arrival of the Nelson 34 launches "NIMBUS" and "NAUTILUS".

Administration and Finance continued to do a fine job of supporting operational and other regional activities. This was particularly noteworthy in coping with the bureaucratic filter and in continuing to conduct business in the period of flux after the departmental split was announced. For a while it was almost as if the dialogue between HQ and regions was at an end. Business as usual became our motto as the flood of paper from Ottawa subsided to a trickle. Surely we have a lesson here that we must always remember.

The region continued to play an effective role in various government committee structures CTF (Canada-Ontario Great Lakes Shore Damage Co-ordinating Task Force), GLBC (Great Lakes Basin Commission), Great Lakes Charting Advisors, and a prominent role in professional matters through senior management involvement in the CIS (Canadian Institute of Surveying), FIG (Federation Internationale des Geometres), CASLE (Commonwealth Association of Surveying and Land Economy), ICA (International Cartographic Association), etc. Examples are the role played by the Director in bringing an IHTC (International Hydrographic Technical Conference) to Canada next year and by the Regional Hydrographer in becoming a founding member of the FIG/IHO (International Hydrographic Office) Board of Education.

In the 1976 report I indicated that the region was very much alive and well. I believe that comment also holds for the 1977 report. However, the bureaucratic filters I have mentioned previously worry me considerably. Additionally, we still lack solid continuing encouragement for our considerable efforts, with no new resources, in physical oceanographic research in James Bay, Hudson Bay, and the High Arctic. We believe we have a mandate that can be supported by legislation. The Canada Water Act, the Fisheries Act, the Arctic Waters Pollution Prevention Act and others provide a basis for carrying out research in the fresh and marine waters of Canada; however, the requirements for research extend beyond strictly legislative responsibilities.

Dr. A.E. Collin, in a recent presentation to the CMS Congress, pointed out the need for extensive oceanographic baseline information and environmental services in the data-deficient Arctic. Dr. C.R. Mann, in his recent study of Physical Oceanography in Canada, said at one place that "the knowledge of the oceanography of the Bay (Hudson Bay) is rudimentary," and in another paragraph, "regrettably, modification of the run-off is progressing without a great deal of effort to describe the characteristics of the oceanography (of Hudson Bay), ..."

Thus the underlying mandate for the conduct of our scientific studies and research is "a need-to-know basis", with priorities determined by the solution of pressing practical problems. By virtue of our scientific make-up and our piggy-back relationship with the hydrographic surveys, a major proportion of our scientific effort is directed toward applied research to support the management of the ocean and aquatic environment, rather than the more basic research to acquire new knowledge.

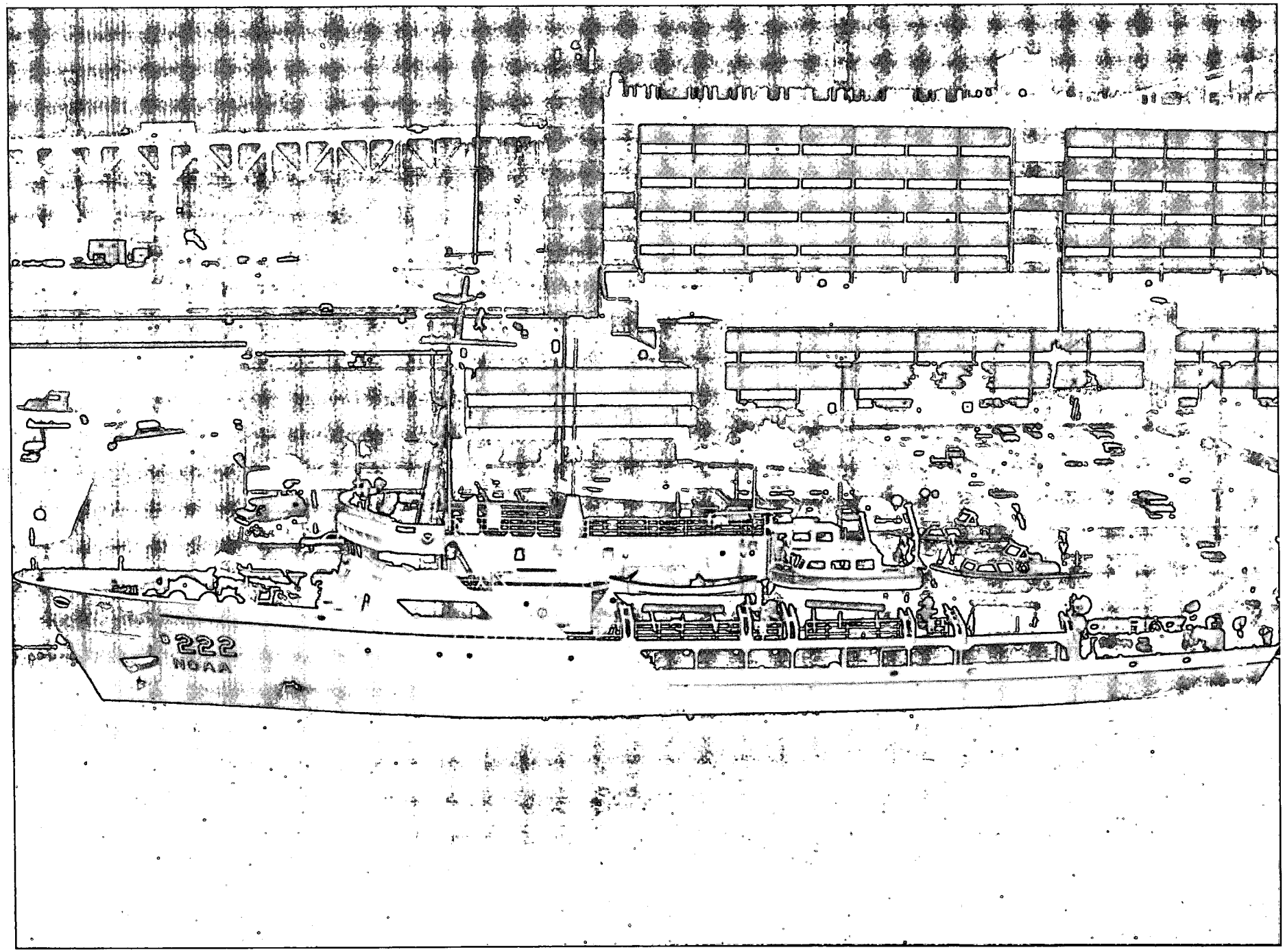
In physical oceanography this means that our Hudson/James Bay studies are directed: firstly, to delineating changes in the marine environment

downstream of the hydro-electric development; secondly, to evaluating the completness and soundness of the corporations' environmental assessments; and thirdly, to acquire new knowledge on freshwater plumes and estuarine circulations. In the high Arctic our studies are directed toward delineating ocean currents in the interconnecting channels of the Archipelago to provide the main flow field for oil spill trajectories. On the Great Lakes the physical limnological studies are directed toward flow exchange and water mass budgets as input to the eutrophication studies of the Great Lakes Biolimnology Laboratory.

An example of how our applied research has found application, even many years after the fact, occurred this year. A theoretical analysis of Helmholtz Resonance in harbours of the Great Lakes, carried out in 1972/73, determined that Goderich harbour would have a natural Helmholtz resonance of 14 minutes. On November 17-18, 1973, a severe storm over Lake Huron caused a number of the grain carriers, moored in the harbour for the winter, to break their mooring lines and crash into the AGAWA CANYON. The allegation against the Crown was that modifications to the harbour had caused these oscillations to occur, and that the Crown should be liable for damage. The research, however, has shown that these are natural oscillations for a harbour of this size and configuration, and that allowance must be made for them in the mooring design.

The outlook for the future is a little more cloudy this year than last, due to uncertainties in the departmental split. However, we are planning a major estuarine circulation study in Chesterfield Inlet, and a winter oceanographic study in Barrow Strait in the high Arctic. Also, as a result of our preliminary analysis of the Bay of Quinte data, we will be carrying out a field study at Glenora to delineate the flow exchange between the Adolphus Reach and the Bay of Quinte.

Our research activities are looked upon with favour and perhaps some envy by the scientific community at CCIW. We have the reputation of getting things done. We deserve no less from OAS nationally.



MOUNT MITCHELL visits Canada Centre for Inland Waters in November

(Courtesy U.S. N.O.S.)

HYDROGRAPHIC DIVISION

INTRODUCTION AND HIGHLIGHTS

The Hydrographic Division of Central Region, O&AS, is responsible for the programs of the Canadian Hydrographic Service (C.H.S.) within the area stretching from the Manitoba-Saskatchewan border to the Upper St. Lawrence River, and from the U.S. border into the Arctic Islands.

The work encompasses the planning and execution of summer and winter surveys in the Arctic, sub-Arctic and temperate zone areas to meet navigation resource planning and scientific requirements; the construction of navigation charts for small craft and commercial operations and the publication of associated aids to navigation; and the development of new instrumentation and techniques to upgrade the systems for collecting and processing data.

A significant development during the year was the accelerated pace of decentralizing staff and certain operations from C.H.S. Headquarters in Ottawa to the Region. The largest group which moved during the year was the major portion of the Region's chart production unit. The cartographic staff increased to eleven persons and a modern reprographic unit was installed.

Cooperative charting between the United States and Canada saw the production of general charts of Lake Erie by the U.S. National Ocean Survey, and of Lake Ontario by Central Region, with the achievement of significant compatibility in the specifications for the two charts. The continued exchange of survey results will enable each agency to provide the latest information available in the production of both new charts and new editions. An important highlight of the year was the visit of the National Ocean Survey vessel MOUNT MITCHELL. The ship was at the Centre in June on her way into the Great Lakes, and again in early November on return from a successful survey season in Lake Huron. The later visit coincided with a Canada-U.S. Charting Advisors meeting which was held at the Centre on November 1.

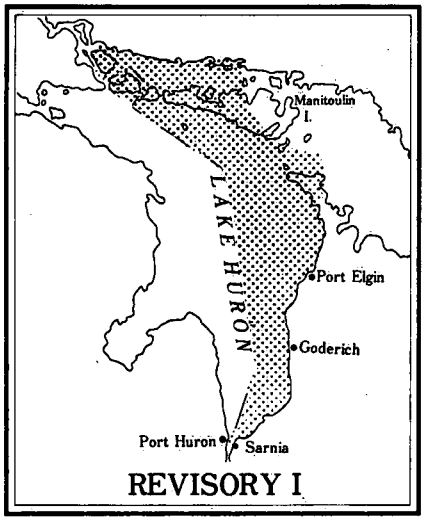
Another event of significant national and international importance was the Canadian Hydrographic Conference which was hosted by the Region and held at the Centre on March 7, 8 and 9, 1977. The Conference was honoured by the presence of Mr. Blair Seaborn, our Deputy Minister, who presented the Opening Address, as well as several Heads of Hydrographic Offices from the two countries with which we have the closest association, U.S. and U.K.

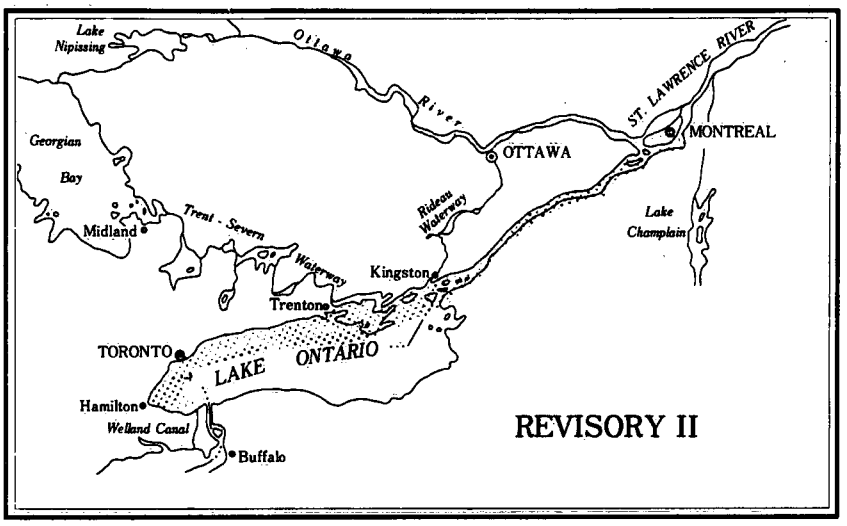
Research and development activities aimed at improving Central Region's capability to carry out winter Arctic surveys increased substantially during 1977. With the approval of the Interdepartmental Committee on Energy Research and Development, Central Region has undertaken the development, under contract, of improved equipment and techniques to measure ice thickness and bathymetry in ice-covered waters. $100,000 in funds have been made available this fiscal year, and considerably more is expected for each of the next several years. One of the most interesting systems now under development is a spike-coupled transducer which can be deployed internally from a helicopter.

Of special interest during 1977 was the development of a microprocessor based navigation display which provides straight line navigation information based on various positioning systems. Prototypes are being tested this year in operational survey situations on tracked vehicles, helicopters and survey launches. The development of this NAV BOX has generated considerable interest and a European company has already expressed interest in marketing the units throughout Europe.

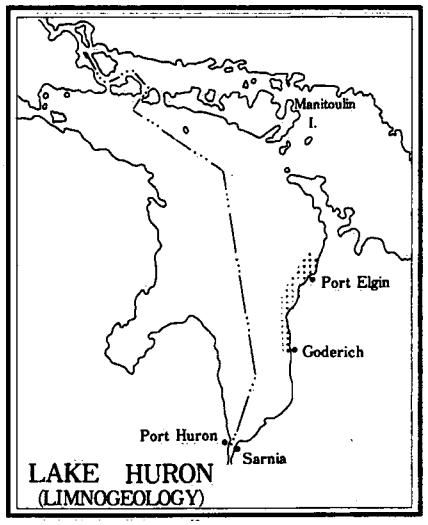
1977 field activities in the north included winter surveys in Viscount Melville Sound, and the Belcher Islands of Hudson Bay, and summer operations both offshore and inshore, at Eskimo Point and Whale Cove, in Hudson Bay.

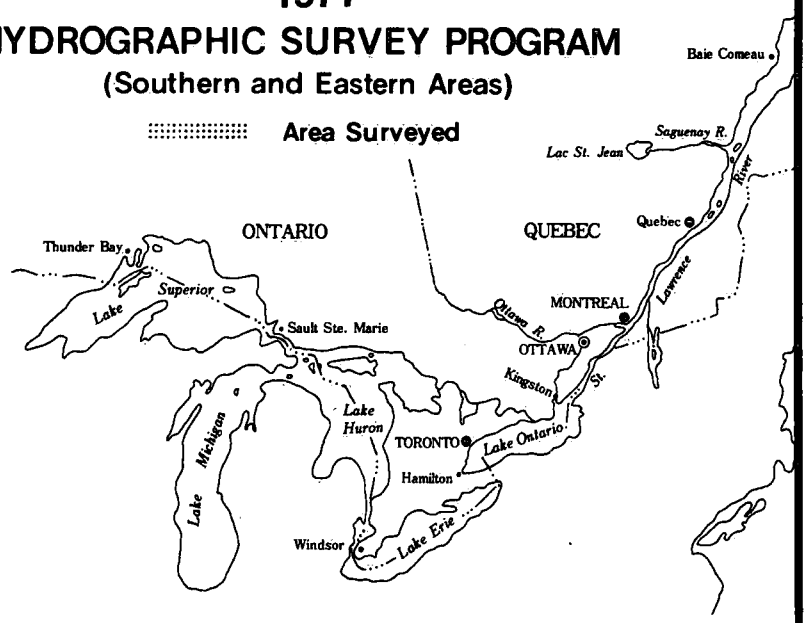
Southern areas surveyed included the Winnipeg River north of Kenora, various areas in Lake Huron, eastern Lake Erie, and, on a revisory basis, Lakes Ontario, Erie, Huron and the Upper St. Lawrence River.

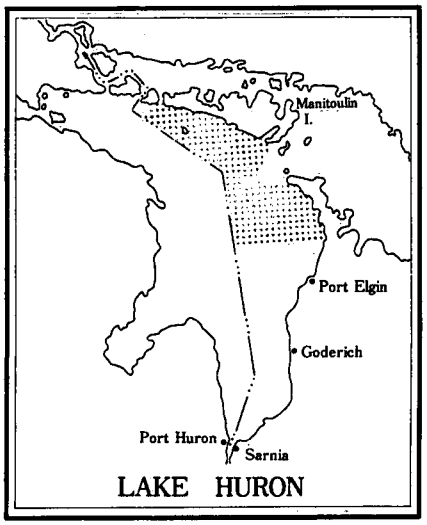


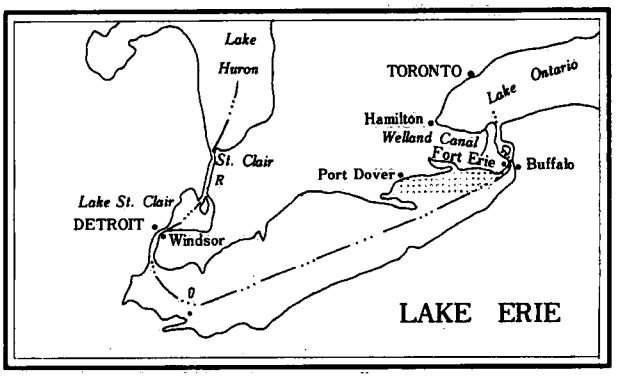


CENTRAL REGION
1977
HYDROGRAPHIC SURVEY PROGRAM
(Southern and Eastern Areas)



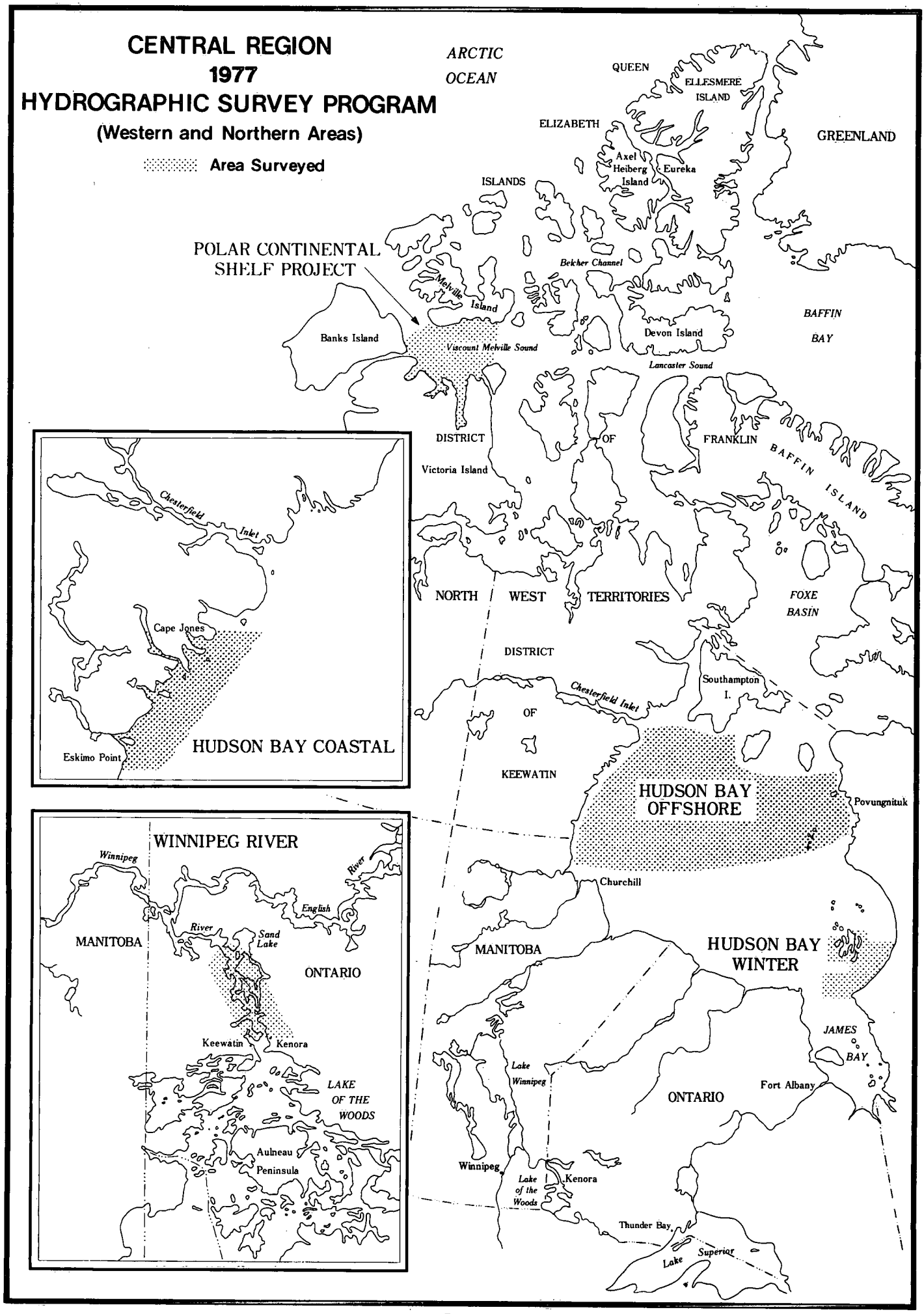






CENTRAL REGION
1977
HYDROGRAPHIC SURVEY PROGRAM
(Western and Northern Areas)

Area Surveyed



FIELD SURVEYS

The areas of Central Region that were surveyed during 1977 are illustrated on the following pages. In addition, details of the survey vessels, positioning systems and processing techniques used are given in Table 1.

WINTER SURVEYS

Early in 1977 two winter projects were carried out, one in the high Arctic and the other in Hudson Bay. Both were cooperative projects with the Earth Physics Branch of E.M.R.

The Arctic Survey with the Polar Continental Shelf Project utilized four helicopters and two tracked vehicles to survey the entire western portion of Viscount Melville Sound including the bays of northern Victoria Island. Through Viscount Melville Sound a shipping corridor 30 kilometres wide was surveyed with a closely spaced grid. Bridport Inlet on Melville Sound (which is of great interest to Petro Canada for a liquid natural gas terminal) was surveyed in detail using the tracked vehicles.

The Hudson Bay winter program operated in the area south and east of the Belcher Islands where soundings and gravity observations were made on a 6 kilometre grid.

SUMMER SURVEYS

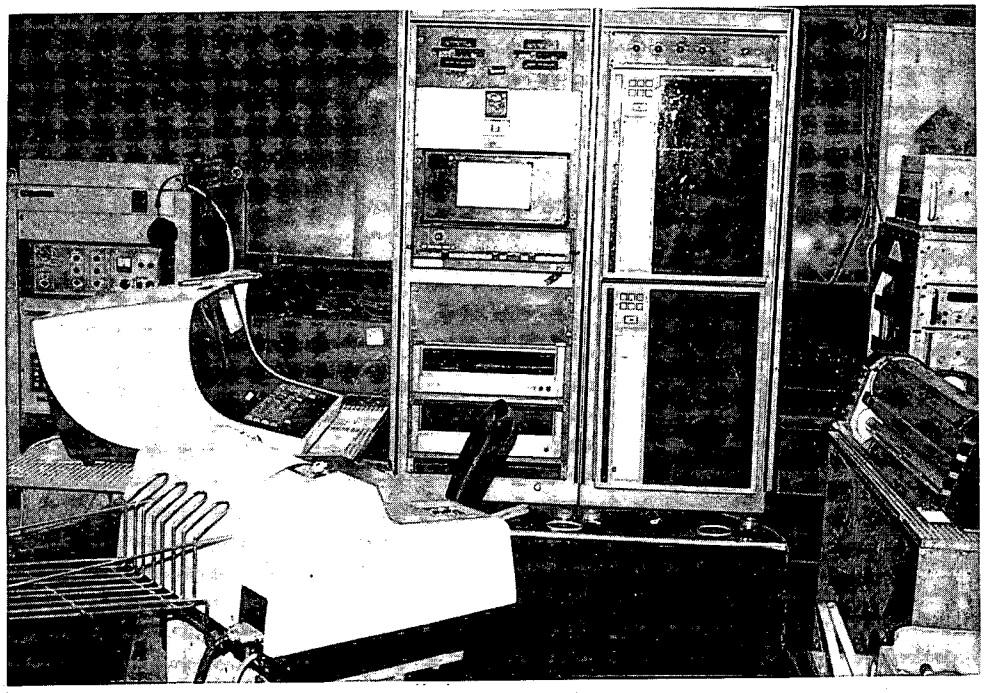
1) Hudson Bay

An active and very productive program was maintained in Hudson Bay with two major vessels operating during the summer months. The offshore milti-parameter survey of the Bay continued using the Ministry of Transport vessel NARWHAL. On the western side of the bay the chartered ship PETREL completed detailed surveys of Eskimo Point and Whale Cove, as well as a corridor from Marble Island to Walrus Island.

2) Great Lakes Surveys

In the Great Lakes five projects were conducted in 1977. A survey of the eastern end of Lake Erie was completed which will provide up-to-date data for the proposed new international confluence chart of this area of the lake. The data will also be used to compile the approved strip chart of this area.

In south-eastern Lake Huron work was carried out



Processing system used aboard NARWHAL in Hudson Bay.

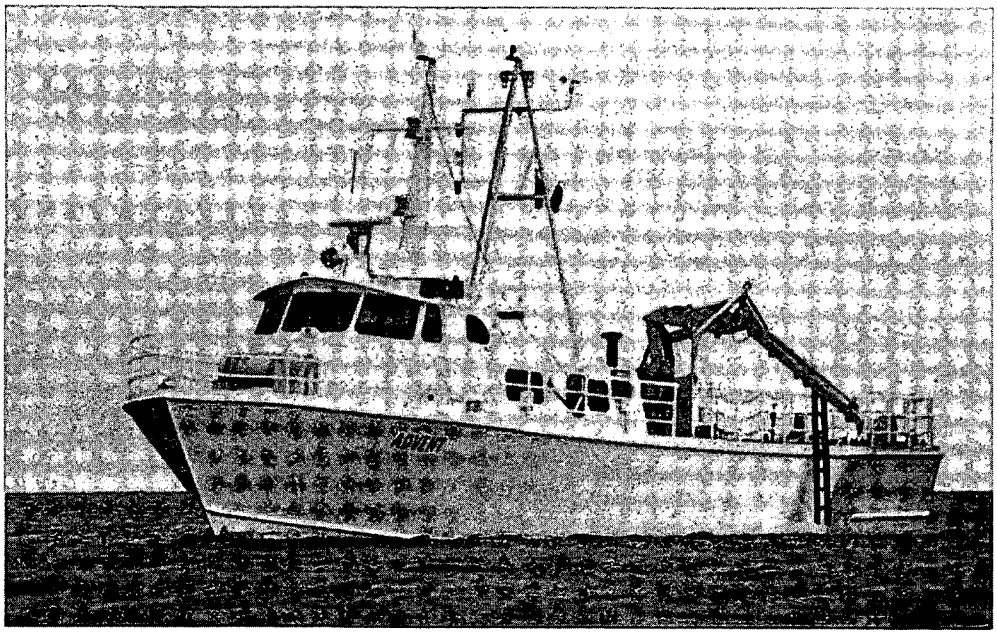
Spot sounding and gravity measurements using helicopter support. P.S.C.P.

Navigation display tested with tracked vehicle during P.S.C.P.

Summary of 1977 Survey Activities, Central Region

Survey Area	Vessels	Positioning System	Field Data Processing
Hudson Bay (winter)	3 x Bell 206 Helicopters	Decca	Manual
Polar Shelf (Viscount Mellville Sound)	4 x Bell 206 Helicopters 2 tracked vehicles	Decca Mini-Ranger	Manual
Hudson Bay Offshore	Narwhal (252 ft.)	Satnav & Doppler Sonar	Interdata Model 70
Hudson Bay Coastal	Petrel (195 ft.) 2 Botveds (22 ft.)	Mini-Ranger	Manual
Winnipeg River	Woodcock (26 ft.) Pacer (25 ft.) 2 Botveds	Sextants RPS	Manual
Lake Huron Offshore & Coastal	Bayfield (103 ft.) Nucleus (34 ft.) 1 Hydro (25 ft.) 1 Botved	Mini-fix Mini-Ranger Hydrodist	INDAPS
Lake Huron Limnogeology	Agile (44 ft.) LeMoyne (44 ft.)	RPS Mini-Ranger	Manual
Lake Erie Coastal	Advent (77 ft.) 1 Hydro (25 ft.) 1 Monark (20 ft.) 1 Botved	Mini-Ranger Hydrodist	INDAPS
Revisory I, Lake Huron	Vedette (48 ft.)	Sextant	Manual
Revisory II, Lake Ontario - Upper St. Lawrence River	Verity (37 ft.) 1 Botved	Sextant Mini-Ranger	Manual

TABLE 1.



ADVENT was the main survey vessel on the Lake Erie survey.

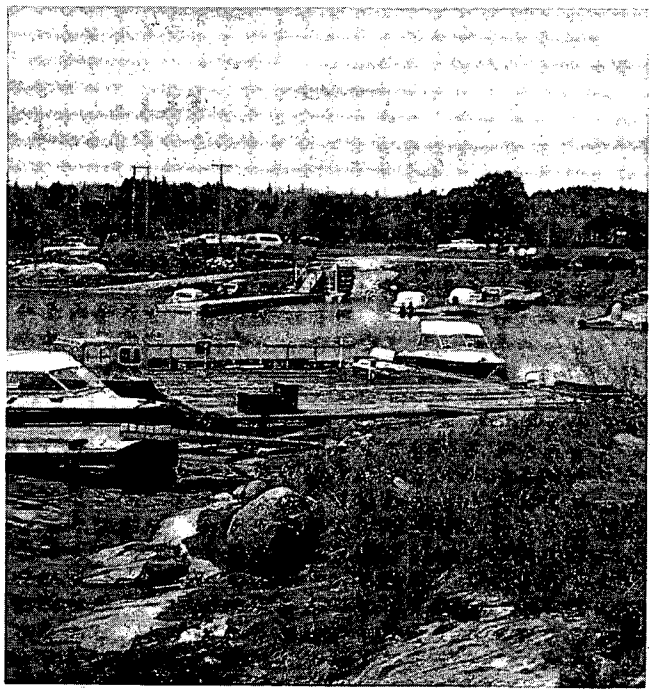
in conjunction with inshore surficial geology studies. The program was further expanded to provide sufficient data for the southern Lake Huron confluence chart as well as the coastal strip charts.

A survey of all waters in northern Lake Huron was undertaken in cooperation with the U.S. National Ocean Survey. The Americans utilized the ship MOUNT MITCHELL to survey the offshore areas. A close liaison was maintained with our U.S. counterparts and on two occasions the two ships rendezvoused to ensure that the sounding and positioning systems were correlated. The program will provide data for the general chart of the lake, the confluence chart of the northern end of the lake and for the small boat strip charts of southern Manitoulin Island. The offshore portion of the survey was completed but work remains inshore.

The cyclic program of revisory surveys was conducted again. The large survey launch VEDETTE worked in Lake Erie, Lake Huron and Georgian Bay and VERITY worked in Lake Ontario on the Upper St. Lawrence River. The VEDETTE survey also positioned all navigational ranges within its area of operation. The VERITY survey had an additional project of expanding the limits of the 1975 Toronto harbour survey to complete coverage of the new harbour chart.

3) Winnipeg River

Our most westerly survey was on the Winnipeg River where coverage for one chart from Keewatin to Minaki was completed. This survey party operated under the unusual conditions of all-time recorded low water levels on the river.



Winnipeg River survey base camp.

4) Exchange Program

As part of a continuing program, Central Region and NOS, Norfolk, Va., exchanged technical staff for participation in and exposure to respective programs and techniques.

5) Contract Programs

Apart from the contracts mentioned in the Development areas, contract personnel were used for collecting data, and operating the Decca chain on the Hudson Bay winter program.

HYDROGRAPHIC DEVELOPMENT

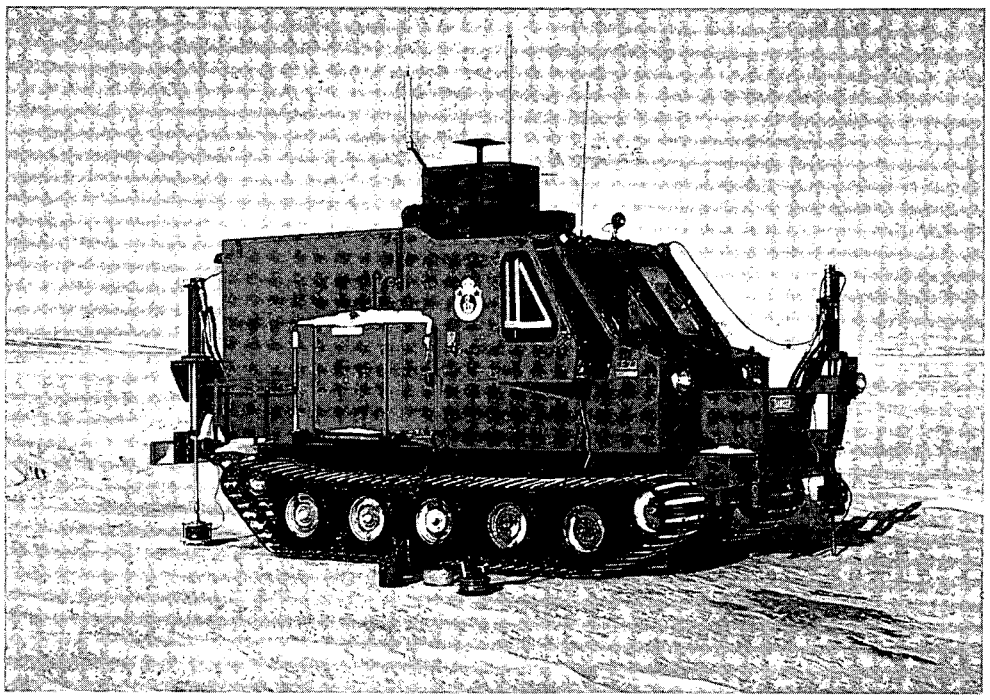
A microprocessor-based navigation-display unit, NAV BOX, has been developed which provides straight line navigation information derived from either hyperbolic or range-range radio positioning systems. Four prototype units have been constructed using off-the-shelf components wherever possible to keep costs at a minimum. The units provide steering information on a standard television monitor, operate on 24 volts D.C., and are compact and rack-mountable. Units have been deployed in tracked vehicles and helicopters operating on Arctic surveys during the early spring of 1977 and will again be used in 1978. One unit, modified to include depth input, was used aboard a survey launch in Lake Huron from May to October, 1977. A contract to have three units manufactured commercially will be let in 1978.

The Development group is monitoring a contract, awarded through an unsolicited proposal, with Canadian Applied Technology for the development of a special microprocessor controlled, ruggedized cartridge tape drive. These tape drives should alleviate compatibility and reliability problems experienced with our present drives. Two prototype units will be deployed with NAV BOX on a production survey in Lake Erie in 1978.

A system is being developed that will convert a standard Mini-Ranger III into a semi-automatic, range-bearing navigation system. The angle will be derived from a shaft encoder attached to a transit which will be encoded on the second range channel. An operator will be required to track the survey vessel with the transit, as in the conventional manual range bearing method.

Through-ice sounding trials were conducted on Lake Simcoe and in the Arctic to determine operational requirements for a metal spike transducer and actuator for tracked vehicle deployment. Further to these trials, a joint MOT/Hydrographic project to develop an echo sounder, a spike coupled trans-

The NAV BOX in use on the southern Lake Huron survey.



Acoustic tests of spiked transducers in the Arctic.

ducer and an actuator for helicopter operations has been contracted out.

A study to familiarize electronic field support staff and hydrographers with the ACCUFIX positioning system was undertaken. A 150 foot transmission tower was erected and range, signal strength and propagation characteristics measured.

Sufficient hardware to implement a PDP-8E/Gradicon digitizing system, a GOMADS interactive graphical data editing system and a Calcomp 960 plotter for use in computer-assisted cartography will be purchased in early 1978. System integration and testing will be carried out during the summer of 1978. The implementation of these systems will increase our field sheet production throughput for surveys with automated data acquisition and processing systems. In addition, we will have enhanced capabilities with respect to manually produced field sheets. As experience is gained with the systems, a gradual program to phase them into cartography will be undertaken.

Another project, which is being funded by the Department of Supply and Services through an unsolicited proposal, is for the development of a sector scanning sonar that is lowered through a hole in the ice to measure depths and determine whether any hazards exist over a radius which is dependent upon water depth and the instrument resolution. If successful, the project which will cost approximately three quarters of a million dollars over the next 2 years, could go a long way towards providing the clearance sweeping which is becoming increasingly necessary as deeper draft vessels come into use in the Arctic.

TIDES AND WATER LEVELS

The level of field survey activity in the Tides and Water Levels section was exceptionally high during 1977. Beginning with the winter Polar Continental Shelf Project in Viscount Melville Sound the section carried out a program of tidal measurement which included six stations using Aanderaa gauges installed through the ice cover.

In support of the hydrographic survey of the Winnipeg River the section carried out a field trip to measure the hydraulic gradient of the river in the section being surveyed. This work was required to establish sounding datums for the use of the hydrographic survey party, and to obtain information for the eventual establishment of chart datum. Both field data and water levels from permanent gauging stations along the river were analyzed in determining sounding datums.

In support of a research survey of the lower St. Lawrence River this summer, the section supplied and installed tide gauges at a total of six locations. Some of the work of reducing the tidal records obtained is also being carried out by Tides and Water Levels personnel.

1976 winter ice conditions on the St. Lawrence River below Montreal resulted in the destruction of permanent gauging stations at Lavaltrie, Lanoraie, Contrecocur and Port-St-François. These stations have since been rebuilt and are back in operation. On the Lower St. Lawrence River reconstruction of the gauging station at St-Joseph-de-la-Rive began this summer in conjunction with the reconstruction of the ferry slip at that site. On the Upper St. Lawrence River the gauging stations at Prescott and Long Sault have been discontinued. These stations were originally constructed in connection with the St. Lawrence Seaway development and are no longer required.

Personnel from the section participated with Water Survey of Canada, Guelph, Ontario in annual inspections at 12 permanent gauging stations on the Great Lakes and St. Lawrence River during the summer. Participating jointly with Water Survey of Canada, Montreal and the Technical Operations group at the Canada Centre for Inland Waters, the Tides and Water Levels section installed Aanderaa pressure gauges at Fort George, in James Bay, and Inoucdjouac, in Hudson Bay, as permanent gauges. These instruments will be recovered after one year and redeployed if required.

A thorough review of the Central Region contributions to the International Hydrographic Bureau's Tidal Constituents Databank was carried out early in the year.

TIDAL INSTRUMENT DEVELOPMENT

The major activity of the Tidal Instrument Development Section during 1977 was the completion of the Tidal Acquisition and Telemetry System (TATS) project. One prototype is now in service at Lauzon. Five production units have been ordered and implementation of an automated permanent gauging network will begin soon.

Development is underway of a very low power, portable telemetry gauge, similar in concept to TATS, which will be used for temporary installations in support of hydrographic surveys. Field trials of this system will take place early in 1978.

Ongoing activities of the Tidal Instrument Development group include monitoring the water level telemetry network contract throughout the Great Lakes and St. Lawrence River, and operating a calibration facility for tide and water level gauges.

CARTOGRAPHIC SECTION

The Cartographic Section in Central Region has expanded from a unit of five persons at the beginning of 1977 to eleven persons at the present time. Space and equipment for a modern reprographic unit were established, and the staffed unit is now functional. The relocation of cartographic furniture and equipment from the Ottawa office as part of the decentralization process has been completed. The task of identifying chart documents and records requiring duplication and transmittal is nearing completion, and, when these are received, the relocation exercise will be near completion. The charting responsibility for all but a dozen Central Region charts is now in the region. Those charts still at Ottawa are being processed by Central Region staff who are scheduled for relocation to Burlington at a later date.

Two Central Region cartographers completed the first in-house Cartography I course in Ottawa, and two of the Central Region Cartographic staff participated in the course presentation. Two summer students were hired and conducted a small craft charting survey to determine user requirements. Another cartographer has been hired under contract to handle the qualified data base project relevant to the production of the confluence chart of the south portion of Lake Huron. This is another cooperative charting venture between the U.S. National Ocean Survey and C.H.S.

A significant special project of the unit in 1977 was the prompt and expert production of the

proceedings of the 16th Canadian Hydrographic Conference.

The Cartographic unit is presently involved in processing twenty-two new editions and twelve new charts.

PLANS FOR 1978

During the winter season, surveys will continue in Viscount Melville Sound and in the Belcher Islands area of Hudson Bay. The eastern portion of Viscount Melville Sound will be sounded this winter employing the navigation corridor principle for delineating areas to be surveyed on a smaller grid size. The northeastern portion of the Belcher Islands in Hudson Bay, up to the approximate latitude of Inoucdjouac, will be surveyed, again gathering both bathymetry and gravity data.

The multiparameter offshore program in Hudson Bay will continue during the summer using the NARWHAL as the survey vessel. Elsewhere in Hudson Bay a survey of Baker Lake, at the head of Chesterfield Inlet, will be carried out.

The work of surveying the Winnipeg River, begun in 1977, will be completed in 1978. This survey will supply charting information for the stretch of the river from the Lake-of-the Woods outlet to the Ontario/Manitoba border.

A number of surveys are planned on the Great Lakes during 1978. The offshore area in the eastern end of Lake Superior will be sounded. The coastal work on the south shore of Manitoulin Island, started in 1977, will be completed. The limnogeology program will move into the southern part of Georgian Bay. In southern Lake Huron a survey is planned to verify and complement available bathymetry for use on a confluence chart of that area. In Lake Erie nearshore soundings will be carried out in the western basin.

In 1978 the traditional cyclic revisory survey plan will not be followed. The revisory survey party will be a completely mobile unit and will revise only those charts identified as requiring chart construction action within the following year.

In 1978 the Region plans to accelerate the integration of the activities of hydrographers and cartographers. Hydrographers will become directly involved in the chart construction process and cartographers will become involved in field programs.

The Region also plans to develop a closer liaison with other agencies such as MOT and DPW to avoid duplication of work and to reduce the time lag in exchanging data.

RESEARCH AND DEVELOPMENT DIVISION

INTRODUCTION

As in previous years, the main scientific activities of the Research and Development Division are physical oceanography, shore property studies, and environmental assessment. In physical oceanography, studies were conducted on exchange flows in the Bay of Quinte, internal waves in the St. Lawrence River, the freshwater budget of Hudson Bay, freshwater plumes under an ice cover in James Bay, estuarine modelling of Chesterfield Inlet, and geostrophic flows in the high Arctic. The Shore Properties Studies Section was involved in a number of Canada/Ontario programs: the Shoreland Management Study, the Erosion Monitoring Program, the Hazard Land Mapping program; and in a number of Canada/U.S. programs including the Role of Vegetation in Shoreline Management and the F.I.A. Erosion Insurance Study. The environmental assessment program provided input to EARP on the Eldorado Nuclear project on Lake Ontario and to the dredge disposal project at Thunder Bay. In support of our scientific activities, field surveys ranged from erosion monitoring on the Great Lakes to a winter helicopter-borne physical oceanographic study of M'Clure Strait and a summer ship-borne survey of the St. Lawrence River.

As a result of our activities, papers were presented at the Canadian Meteorological and Oceanographic Congress, the Liége Colloquium, the International Association for Hydraulic Research, the Coastal Sediments '77 conference, and the Plessey STD conference. Also, reports were written in both our Manuscript and Data Report Series. The former included "The Freshwater Budget of Hudson Bay", Coastal Responses at Point Pelee, Lake Erie", and "The Study of the Tides in James Bay", while the latter were entitled "Hudson Bay Oceanographic Data Report 1975, Volume I" and "Arctic Oceanographic Data Report 1976, Penny Strait". Papers were published in scientific proceedings on "The Numerical Simulation of Tides in Chesterfield Inlet", "A One-Dimensional Tidal Model for Estuarine Networks", and "Bernoulli Effects on Pressure-Activated Water Level Gauges".

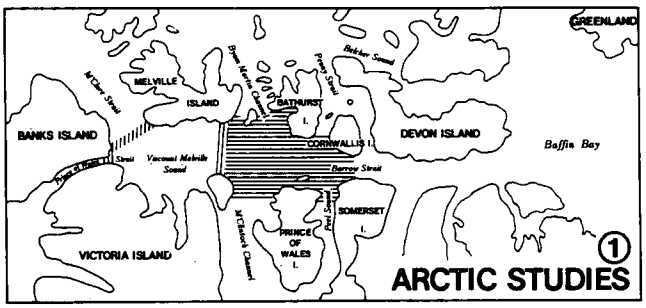
Members of the Division attended meetings and, in most cases are members, of: The Western and Northern Regional Board, the Arctic Environmental Steering Committee, the Great Lakes Basin Commission, the Regional Screening and Coordinating Committee of EARP, and the Canada/Ontario Task Force on Shore Damage Follow-Up Programs. Other activities in 1977 included input into a number of management exercises such as Zero A-Base Review, FMS Program Forecast, and Review and Program Planning. An overview document, outlining historical development, ongoing programs, organization and operation, and future thrusts of the O&AS Central Region oceanographic program, was written for the Zero A-Base Review Committee.

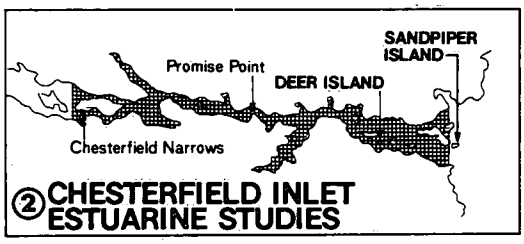
PHYSICAL OCEANOGRAPHY

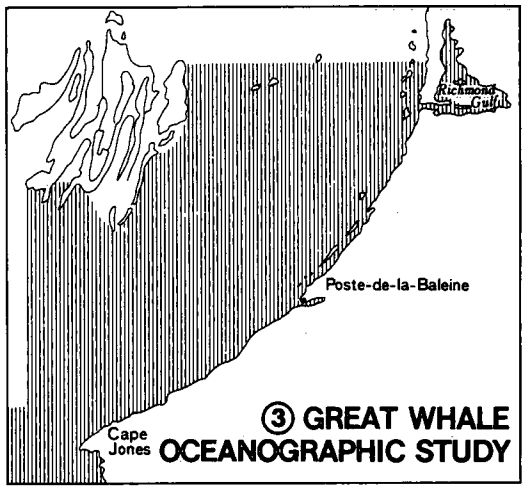
Our physical oceanographic program, while small in terms of personnel and resources, covers a broad geographic region and a diverse disciplinary interest. Highlights of this year's program are as follows: in the middle estuary of the St. Lawrence River, it was found that a simple linear theory could be used to reproduce the principal internal tides; in the Bay of Quinte, an unexpected two-layered, quasi-steady exchange flow was observed and will be investigated further in a field program to take place in the summer of 1978; in Chesterfield Inlet, a reconnaissance study revealed the existence of strong currents and a partially-mixed salinity estuarine structure. In James Bay, work is just starting on the modelling of freshwater plumes under an ice cover and, in the high Arctic, we are continuing with our current measurement program in the interconnecting channels.

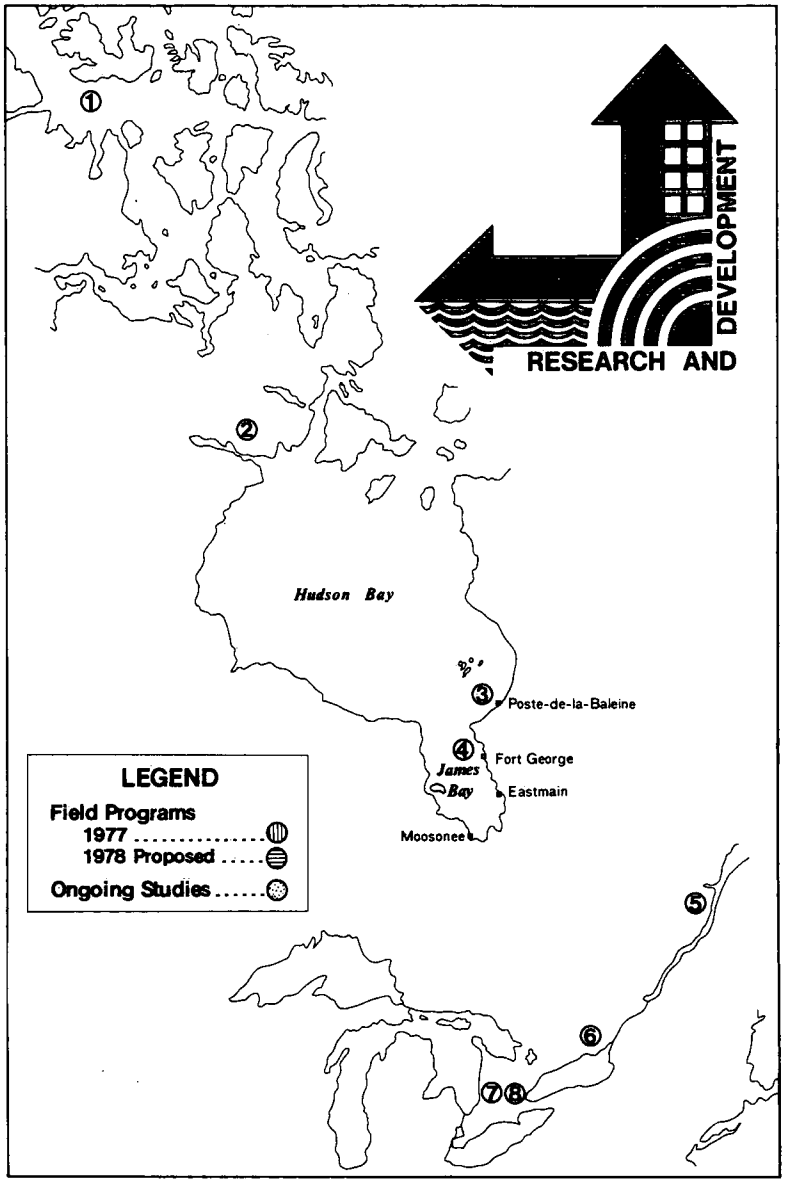
1) Bay of Quinte Studies

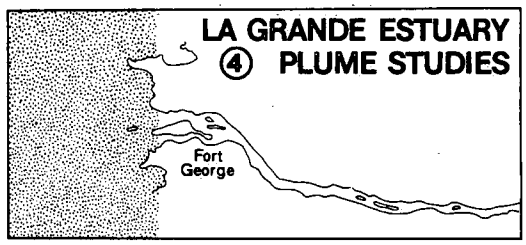
In order to investigate the exchange processes between Lake Ontario and the Bay of Quinte, current meters were placed in the three interconnecting channels in 1976. While extensive episodal water mass transports were found at all stations, some interesting oscillatory and steady components of the flow were observed in the Glenora current

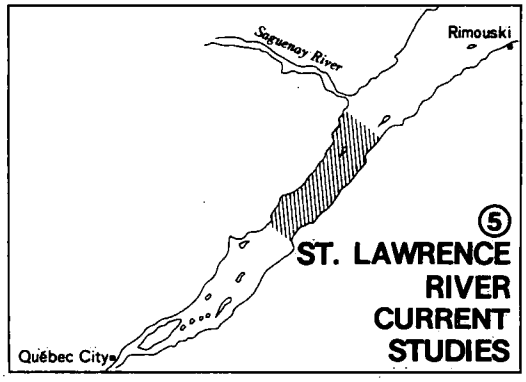

GREENLAND
MELVILLE ISLAND
BATHURST I.
BANKS ISLAND
CORNWALLIS I.
DEVON ISLAND
Baffin Bay
Barrow Strait
SOMERSET I.
PRINCE OF WALES I.
VICTORIA ISLAND
① ARCTIC STUDIES

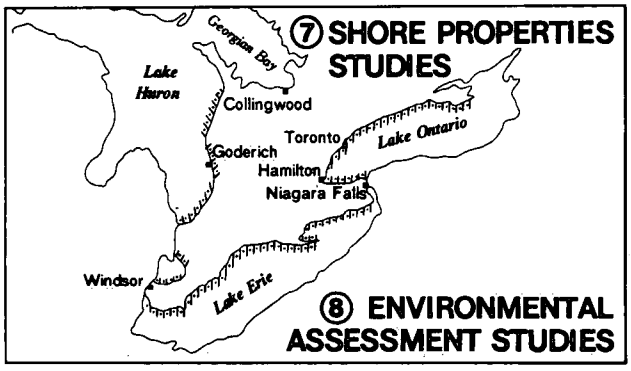

SANDPIPER ISLAND
Promise Point
DEER ISLAND
Chesterfield Narrows
② CHESTERFIELD INLET ESTUARINE STUDIES

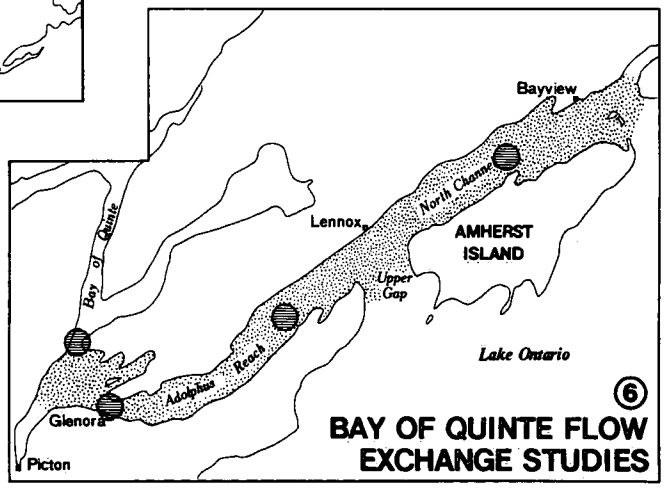

Richmond Gulf
Poste-de-la-Baleine
Cape Jones
③ GREAT WHALE OCEANOGRAPHIC STUDY


RESEARCH AND DEVELOPMENT
①
②
Hudson Bay
③ Poste-de-la-Baleine
④ Fort George
James Bay
Eastmain
Moosonee
⑤
⑥
⑦⑧
LEGEND
Field Programs
1977
1978 Proposed
Ongoing Studies

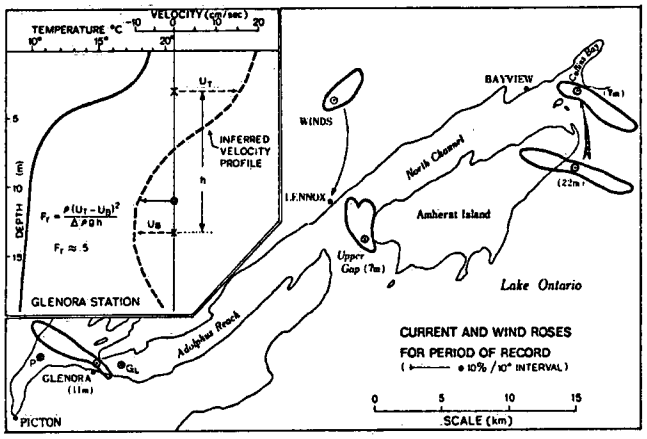

LA GRANDE ESTUARY
④ PLUME STUDIES
Fort George


Saguenay River
Rimouski
⑤ ST. LAWRENCE RIVER CURRENT STUDIES
Québec City


⑦ SHORE PROPERTIES STUDIES
Georgian Bay
Lake Huron
Collingwood
Goderich
Toronto
Lake Ontario
Hamilton
Niagara Falls
Windsor
Lake Erie
⑧ ENVIRONMENTAL ASSESSMENT STUDIES

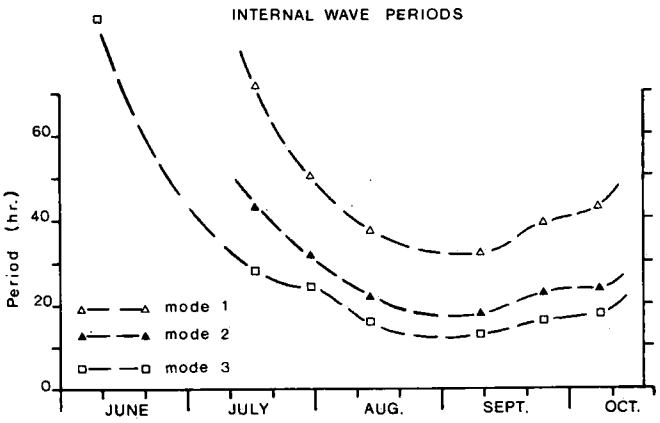

Bayview
Bay of Quinte
Lennox
North Channel
AMHERST ISLAND
Upper Gap
Lake Ontario
Adolphus Reach
Glenora
Picton
⑥ BAY OF QUINTE FLOW EXCHANGE STUDIES

meter record. A quasi-steady current of some 7 cm sec^{-1} was observed flowing into the Bay of Quinte at 11 metres depth, and not out, as had been anticipated. Thus a two-layered flow regime is inferred and must have a significant effect on the transport of biota, sediment, and nutrients into and out of the Bay of Quinte. This prevailing current appears to die off in mid September when the thermal stratification has progressed below 11 metres depth, or overturn has occurred. Fairly low values of interfacial densimetric Froude Number are obtained, indicating that there is a densimetric flow taking place. A detailed survey is planned for spring and summer, 1978, to delineate more accurately the volume of the flow exchange and to investigate the driving mechanism.



The free oscillation periods were obtained for the lower Bay of Quinte by a two-dimensional, numerical model which adapted the Defant method to the internal modes. The energy found in Lake Ontario at the 1.4-hour period can cause surface modal resonant conditions in the lower Bay of Quinte when it enters through the northeastern entrance. The 2.2-hour period is associated with free oscillation of the total Bay of Quinte, as energy enters the region through both entrances.

The resonance periods of internal modes depend directly upon the vertical density structure and vary with it throughout the season. Internal resonant forcing can only occur between Lake Ontario and the lower Bay of Quinte through the deeper southern entrance (Upper Gap). The third modal period varies around the inertial period of this latitude. Inertial disturbances generated in

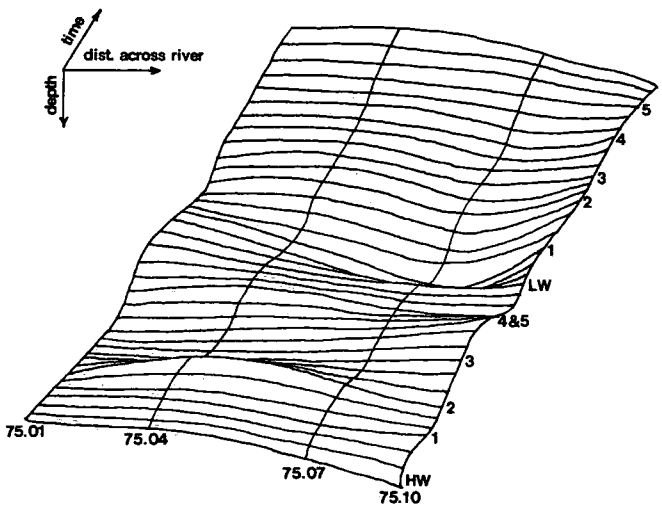


Lake Ontario by storms during the fall cause resonant conditions within the lower Bay of Quinte. The first modal peak at 45 hours and a weak second modal peak at 25.7 hours are also present in the fall spectral.

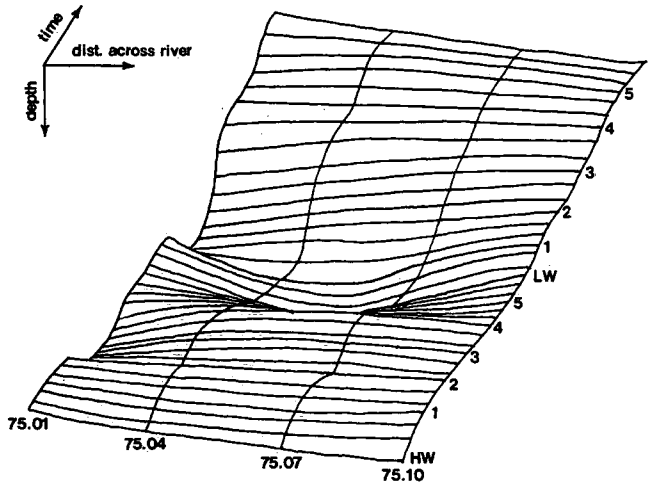
2) St. Lawrence River Current Studies

The St. Lawrence River and estuary comprise one of Canada's most important navigable waterways. Since 1974, surveys have been carried out in the middle estuary gathering baseline physical oceanographic data. The analysis of data from the 1974 and 1975 surveys has provided much information about the complexity and variability of this highly-energetic, partially-mixed estuary. Using the results from the 1974 and 1975 field operations, a very comprehensive survey was carried out in 1977 which was designed to fill in gaps in the existing data and to extend the data base. The first phase of the data collection process has now been completed, and a sufficient data base now exists upon which to start building theories of the physical processes controlling circulation in the middle estuary.

Two of the major processes seem to be the internal wave field and the spring-neap tidal cycle. Three-dimensional plots of the 20 sigma-t surface, which passes section 75.A just downstream of Pte. au Pic, are given for both neap and spring tides. These plots show the very large internal waves present at this section. These internal waves have a significant cross-channel component as well



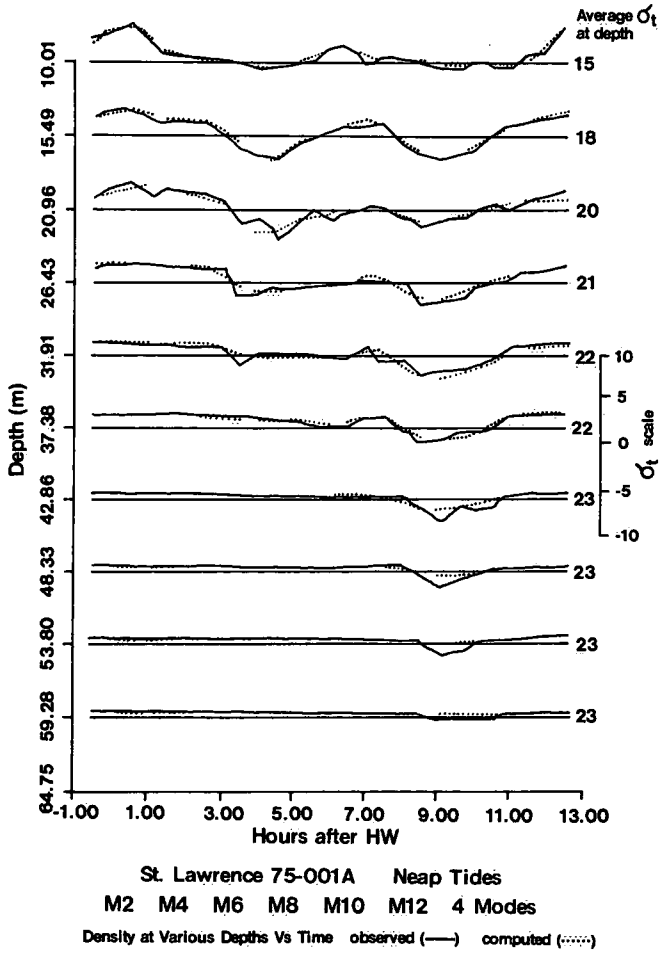
1975 St. Lawrence
Isopycnal Surface - depth vs time at Section 75-A
NEAP TIDES
σ_t = 20



1975 St. Lawrence
Isopycnal Surface - depth vs time at Section 75-A
SPRING TIDES
σ_t = 20

as a long-channel component. The difference between the wave field at spring tide and the wave field at neap tide is striking and reflects the large differences in energy available to the internal wave field. From scale analyses using the data collected in 1974 and 1975, it would seem that both Coriolis forces and nonlinear effects are very important factors influencing the propagation and generation of these waves. The major factor, however, in the generation of the waves seems to be the highly-variable topography in the area and, in particular, the English Bank which is directly off Pte. au Pic and which seems to represent a barrier to the flow both on flood and ebb tides.

An attempt has been made using linear theory to estimate the properties of the internal waves using data collected in 1975. Although the theory has been developed and the computer program written, only one station has been analyzed so far. This station, on the north side of the river downstream of Pte. au Pic, has some very large internal waves. For example, for the M_2 constituent, the internal waves have amplitudes of 9.3, 14.5, 2.7, and 6.8 metres for the surface and the first three internal modes. The amplitude of the first internal mode for the M_4 constituent is 13.5 metres, and its wave length is very close to the width of the estuary. This would explain why the M_4 constituent has its orientation across, rather than along, the river. Estimates have been obtained for the amplitudes, phases, phase speeds, and wave lengths of the surface and first three



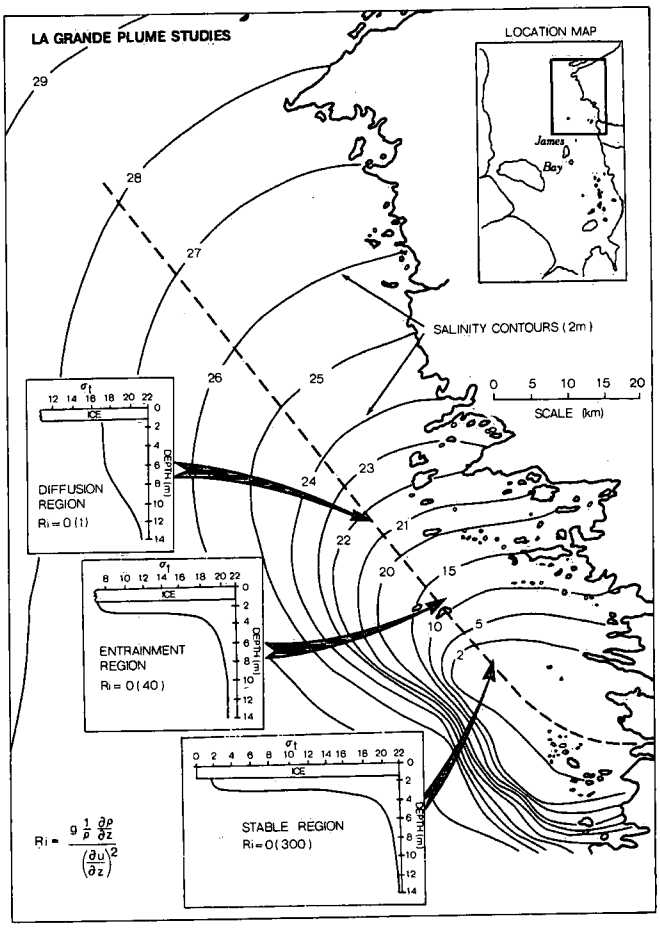
St. Lawrence 75-001A Neap Tides
M2 M4 M6 M8 M10 M12 4 Modes
Density at Various Depths Vs Time observed (——) computed (·····)

internal modes for the M_2, M_4, M_6, M_8, M_{10}, and M_{12} constituents. These have been used to predict the density fluctuations with time, and the results are as shown. About 90% of the variation in the density fluctuations can be explained by means of this linear theory.

3) La Grande Plume Studies

The research on freshwater plumes under an ice cover will be used to predict changes in the vertical and horizontal extent, stability, and rate of entrainment of the La Grande River plume after the James Bay hydro scheme increases the winter discharge by some 500%. This information can then be used to assess possible changes in freeze-up and break-up in the estuary, altered distributions of freshwater and brackish species of planktonic communities, and changed levels of entrained nutrients. The theoretical models may also be used to investigate the individual and cumulative effects of the freshwater modifications of planned hydro developments on the Nelson/Churchill Rivers, the Great Whale/Little Whale Rivers, and the Nottaway, Broadback, and Rupert Rivers.

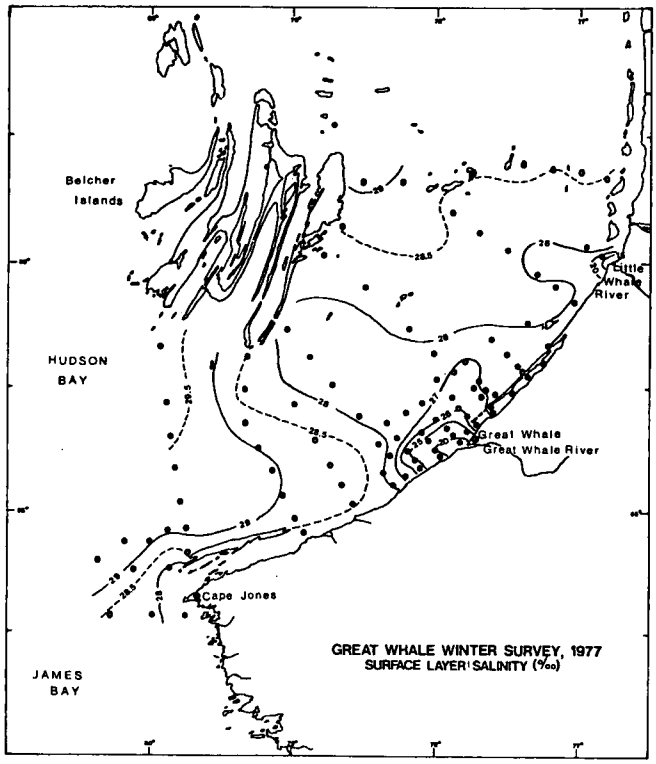
Through-the-ice salinity and temperature data were collected by personnel of the Research and Development Division off the La Grande River estuary in the winters of 1975 and 1976. This data reveals a steady, two-metre, brackish water layer under the ice cover which is coherent up to 60-80 kilometres from the source. If the salinity profiles are examined moving downstream from the source along the plume axis, the three principal estuarine types, as outlined by Bowden, are observed: 1) Salt Wedge Estuary - for the first 20 kilometres, there is little or no exchange with the bottom layer, and the fresh water spreads out due to buoyancy without significant vertical mixing or entrainment; 2) Two-Layer Flow with Entrainment - for the next 20 kilometres, very little vertical mixing is taking place as indicated by the sharpness of the halocline, but salt water is being entrained through the interface; and 3) Two-Layer Flow with Vertical Mixing - for the remaining 20-40 kilometres, the increased activity of the tidal currents and the reduced stable stratification cause significant vertical mixing, and, thus, erosion of the halocline.



The gradient Richardson Number estimates for the three regimes are also presented in the figure and support this analysis. The halocline Richardson Number decreases three orders of magnitude from the source to the plume edge. A decreasing Richardson Number indicates decreasing vertical stability with entrainment occurring before vertical mixing (i.e. at higher Richardson Number). This simplified analysis is based upon the assumption of a laterally-confined estuary and, thus, lateral entrainment and mixing, the Coriolis force, and the mean flow field are not included but will undoubtedly play a significant role in the La Grande plume studies. Future work will consist of developing analytical and numerical models of the plume dispersion and carrying out a post-project field project in the winter of 1980.

4) Great Whale Winter Study, 1977

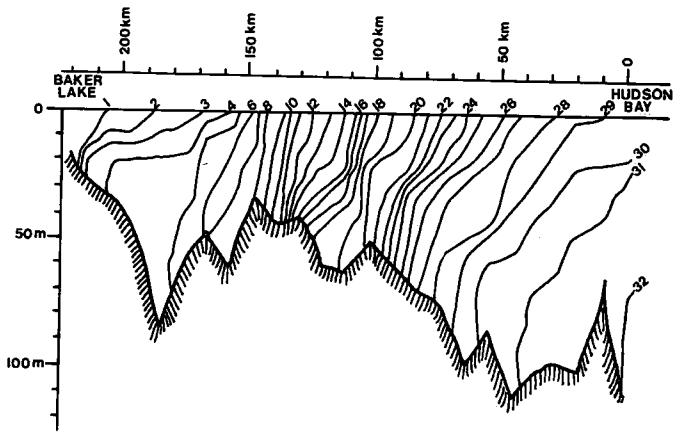
The Great Whale Winter Survey collected salinity and temperature profiles at 102 separate station locations. The integrated surface layer salinity



distribution, as given in the above figure, shows that the dilution of the La Grande River can be traced twenty kilometres into Hudson Bay where it joins the easterly surface drift around Cape Jones. The Great Whale River plume extends only twenty kilometres alongshore in the westerly and easterly directions, respectively. The rectilinear tidal currents along the shore cause the plume to disperse more in the alongshore direction than in the offshore direction. The plume breaks away from shore in a northeasterly direction, depicting a mean drift in that direction during the ice-covered season.

5) Chesterfield Inlet

A preliminary oceanographic survey was carried out in September aboard MV PETREL in preparation for a major field program in 1978. Eight 13-hour profiling stations and 25 single profiles were completed. Analysis of the collected data reveals that the salinity concentrations in the inlet vary from a maximum of 32^{o}/oo at its mouth to a minimum of 0.3^{o}/oo at the entrance to Baker Lake. The temperatures measured in Chesterfield Inlet varied from a minimum of 4.2^{o}C near Hudson Bay to a maximum of 7.0^{o}C in the Bowell Islands.



Salinity Profiles - Chesterfield Inlet

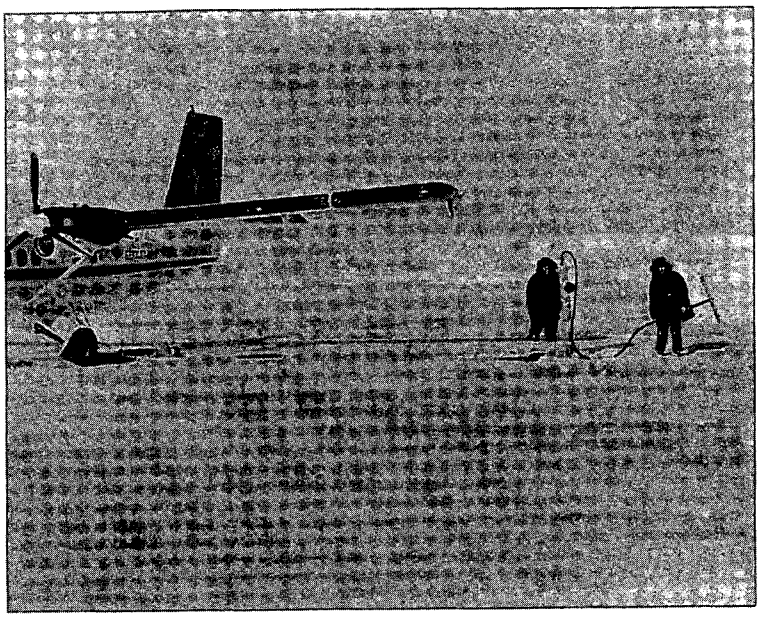
Plots of density contours versus depth and time at individual 13-hour stations indicate that internal waves of periods between 2 to 4 hours with 4-metre amplitudes are present in the lower reaches of the estuary, whereas internal semi-diurnal tides occur in the middle portion of the estuary and possess amplitudes of roughly 12 metres.

Aanderaa current meters sampling at 30-second intervals were used to measure current speed and direction. Although analysis of the data has just begun, preliminary results reveal that current speeds in excess of 150 cm sec^{-1} can be expected even in embayments within the estuary. Thus, current speeds throughout most of the inlet are likely to exceed 200 cm sec^{-1}.

6) Arctic Studies

Working out of the Hydrographic Service's base camp off Cape Bounty, Melville Island, the 1977 Arctic project investigated the vertical salinity and temperature structure along three transects across M'Clure Strait, Prince of Wales Strait, and Viscount Melville Sound. Current meters were moored in M'Clure and Prince of Wales Straits.

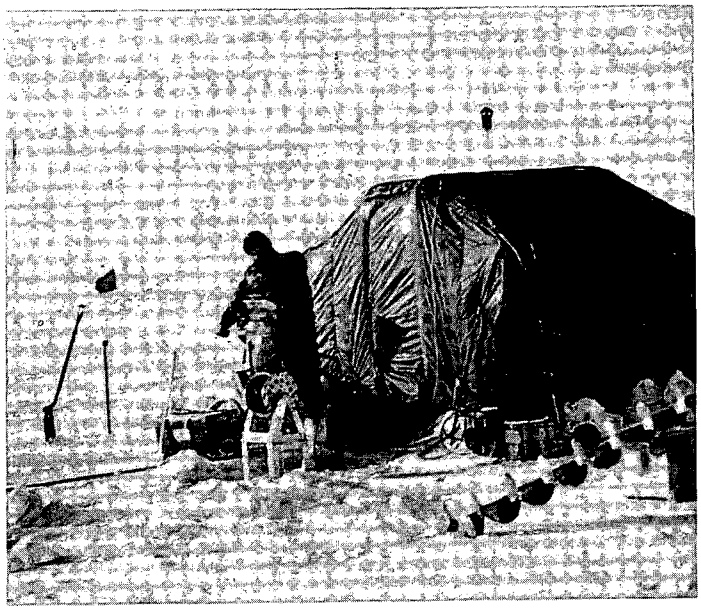
Results of tidal streams (harmonic) analysis show a largely semi-diurnal current regime. Prince of Wales Strait exhibited high speeds (30 cm sec^{-1}) and rectilinear flow, whereas M'Clure Strait had lower speeds (10 cm sec^{-1}) and nearly circular flow. Mean flows were on the order of 5 cm sec^{-1}, respectively, eastward.



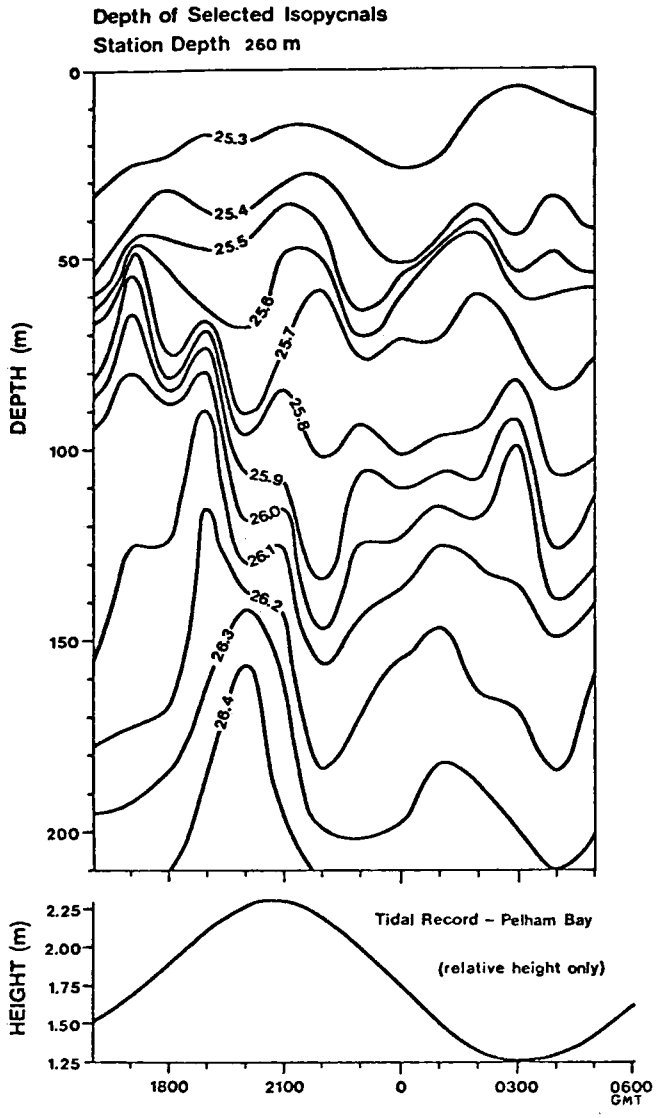
Mooring a Geodyne current meter off Cape Hay.

A camp visitor.

Base Camp with Cape Bounty in background.



Cell Arctic Tent set up in Prince of Wales Strait



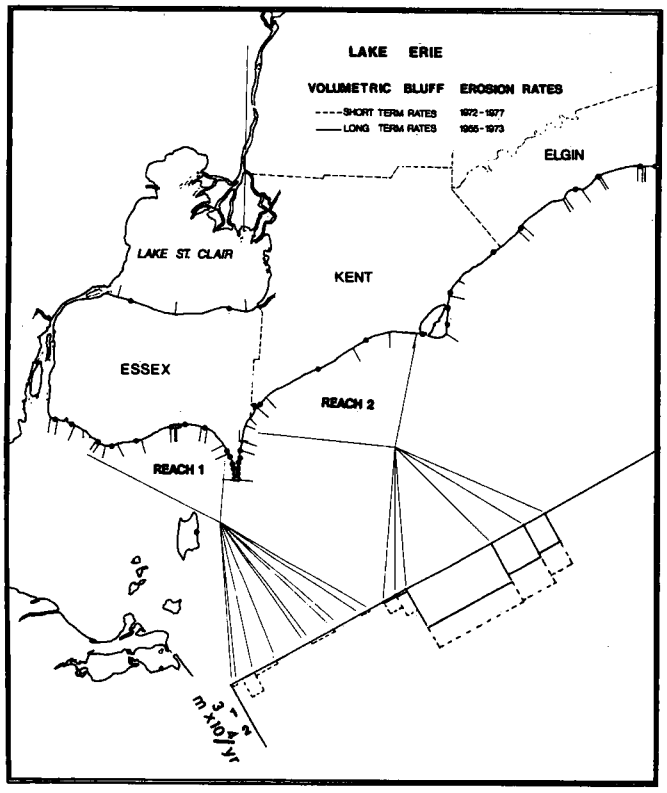
Penny Strait
April 16-17, 1976

Power spectral analysis further showed the predominance of the semi-diurnal tide. Although current speeds of a similar magnitude were observed in Penny Strait in 1976, the shallow-water constituents were more important. Both M'Clure and Prince of Wales Straits are U-shaped, regular channels unlike Penny Strait where the bathymetry is highly irregular. Large-amplitude, internal waves, which are shown in the above figure, have been found in Penny Strait and are presently being investigated.

Bailey (1957) reported high surface outflow (east-northeast) from Prince of Wales Strait based on observations made in the fall of 1954. By contrast, winter conditions evidence very low mean (non-tidal) drift, indicating Bailey observed low saline water from the southern Beaufort Sea and Amundsen Gulf resulting from ice melt and the high discharge of the MacKenzie River. Surface salinities in Prince of Wales Strait were $30^{o}/oo$ in March, 1977, compared to $25^{o}/oo$ in September, 1954.

SHORE PROPERTIES STUDIES

The focus of this Section continues to be research concerning shore properties. Many of these concerns are documented in the previously-published Canada/Ontario Great Lakes Shore Damage Survey Technical Report and the Coastal Zone Atlas. The goal is to provide research and information about the shoreline to assist in the proper coastal zone management of our shoreland resource and to advise the property owner of the hazards of building in this dynamic zone.



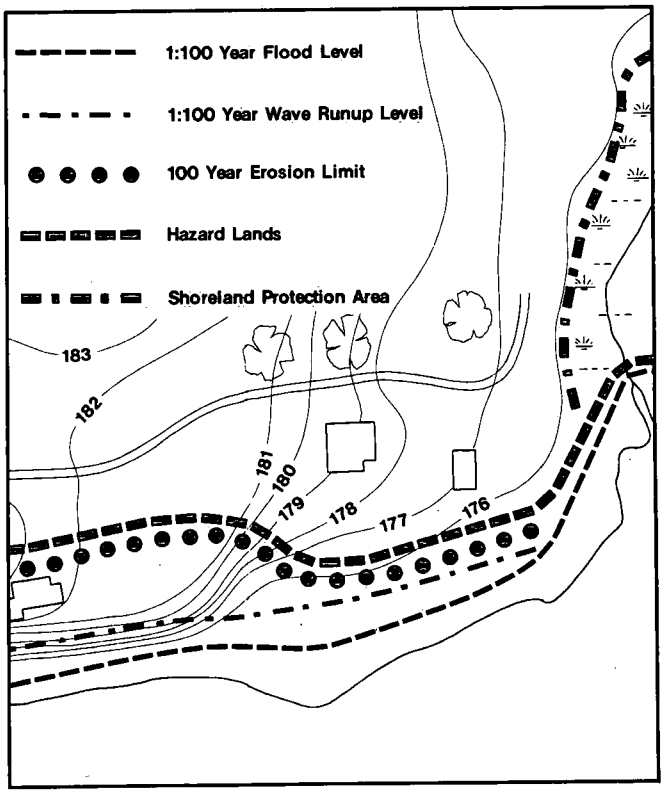
1) Canada/Ontario Programs

The Great Lakes Erosion Monitoring Program involves the measurement of onshore and offshore profiles at 162 strategically-located sites along the erodible portion of Lakes Huron, St. Clair, Erie, and Ontario. This ground survey is supplemented with sequential, oblique aerial photography and provides

not only information on a local scale of erosion but also a comparative overview of the total shoreline. Research continues on the effect of geological structures, susceptibility to wave attack, water level variations, and frequency and duration of storms on erosion rates.

Much of the aforementioned research led to the initiation of a joint Canada/Ontario shoreland management study to develop methodologies for evaluating shoreland management alternatives and to present viable alternatives for the study site. The area selected was the Lake Erie shoreland of Gosfield South and Colchester South Townships in Essex County. The components of the project include mapping at a scale of 1:2,000, a geotechnical soils investigation, an offshore bathymetry survey, an evaluation of present and possible future structural and other protection methods, a shore damage evaluation, and a planning and environmental analysis. A comprehensive report is scheduled to be published in 1978.

One of the principal recommendations of the Canada/Ontario Great Lakes Shore Damage Survey Technical Report was to define and to delineate hazardous lands. As a result, flood- and erosion-prone area maps were produced in conjunction with the province which show a 1:100 year flood contour, a value for a 1:100 year wave uprush level, and a 100-year erosion limit for the erodible portion of the Canadian Great Lakes' shoreline. The 1:100 year flood level is defined as the water level, due to the combined occurrences of mean monthly lake levels and wind set-up, having a total probability of being equalled or exceeded during any year of 1%. This 1:100 year flood level is not based on a specified lake level combined with a fixed wind set-up but represents the total probability of all possible combinations of different lake levels and wind set-ups which could produce the flood level. The 100-year erosion limit is determined from historical recession rates and slope stability analysis. In bluff areas, the 100-year erosion limit is the average annual recession rate extended 100 years from the eroding edge of bluff plus an allowance to achieve a stable slope. The base maps used are the 1:10,000 airphoto mosaics compiled for the Canada/Ontario Great Lakes Shore Damage Survey Coastal Zone Atlas and include sheet numbering in the Atlas to provide a common cross-reference.



Hazard Land Map

2) Canada/U.S. International Joint Commission

Although the Canadian shoreline is a primary concern, not all of the problems and alternatives can be considered entirely Canadian. Similar shoreland characteristics and problems exist in the U.S., which has fostered the transfer of information and involvement in joint Canada/U.S. committees and projects. Thus, this Section has representation on the Coastal Zone Sub-Committee of the IJC International Lake Erie Regulation Study, which is examining erosion and inundation of the shoreline caused by fluctuating water levels and storm conditions. This Section also has membership on the U.S. GLBC Standing Committee on the Coastal Zone Management and Erosion Hazard Sub-Committee for the F.I.A. Erosion Insurance Study. This Committee is examining the range of issues regarding erosion hazard area management, methods for hazard area delineation, land use management techniques, appropriate means of compensation, and how these elements relate to an insurance program

for the Great Lakes region.

In conjunction with the Great Lakes Basin Commission, a guide was published for Great Lakes' shoreline property owners entitled "The Role of Vegetation in Shoreline Management". It was prepared to provide a comprehensive view of Great Lakes erosion problems, guidelines to help the property owner, and suggestions concerning possible remedies for erosion problems. These brochures were distributed to the appropriate conservation authorities and are generally available upon request.

As input into the IJC PLUARG activities, the Shore Properties Studies Section and the Great Lakes Biolimnology Laboratory responded to Task D, Activity 1. The task was to assess the contribution of sediment and associated elements to the Great Lakes from erosion of the Canadian shoreline. To accomplish this, long- and short-term bluff sediment inputs were calculated and analysis of texture, major and trace elements, provided data to establish the long- and short-term sediment loadings attributable to the shoreline bluffs. The results are to be submitted in a joint report to Task D.

3) Shore Properties Studies/Environmental Assessment

In order to predict the magnitude of erosion in response to discharge modifications resulting from the James Bay hydroelectric power development, onshore and offshore profile measurements were continued in conjunction with the Environmental Assessment Section. Also, several alternative sites for the relocation of the town of Fort George were examined in light of the river bank erosion which has been monitored over the last three years. As a result, the James Bay Development Corporation decided to acquire more detailed sub-soil data.

In addition, studies of the estuarine ecosystem were expanded to include the Attawapiskat and Albany Rivers to support the need for environmental baseline data in the Hudson Bay lowlands. This involved nearshore and estuarine current measurements, additional shore profile stations, soil sample analysis, and saltwater intrusion measurements.

Other studies related to the Environmental Assessment Section include the investigation concerning headland landfill at Scarborough's Bluffers Park in Toronto, Fifty Mile Point near Hamilton, and a proposal to close a breach at the Point Pelee barrier beach. Due to past and current research in this area, this Section was designated lead agency for the Point Pelee project.

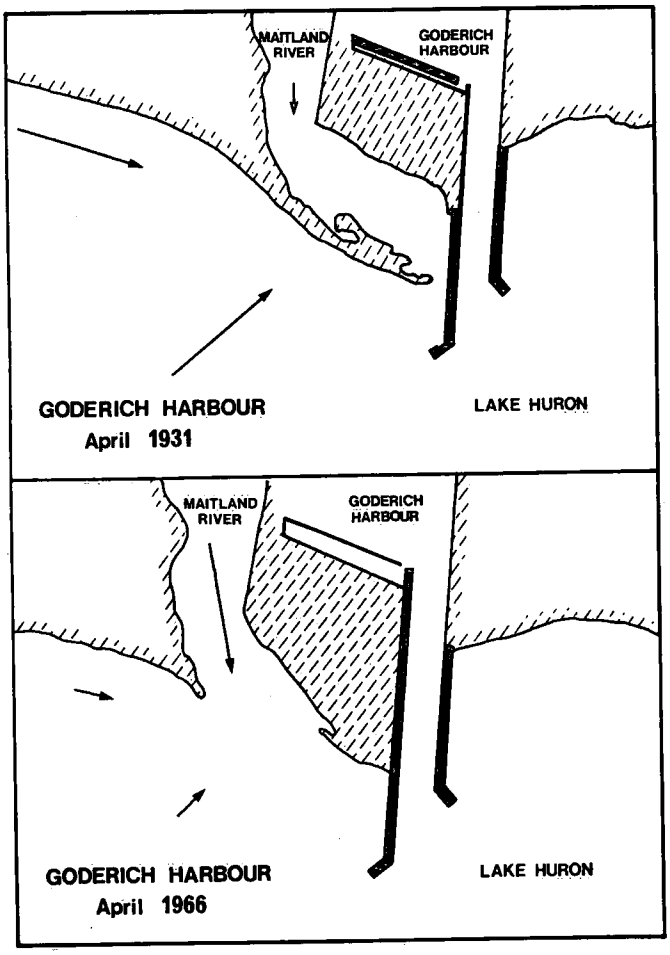
4) Shore Properties Studies/Hydraulics Research Division, IWD

To understand bluff erosion on a large scale, it is necessary to investigate small-scale local erosion processes and interactions. To meet this need, a joint study is underway at a recent arc slump east of Port Dover. This type of bluff failure is common in this area, yet this particular slump has been protected at the toe and the ground water was drained from the top of the bluff. It is therefore possible to investigate not only the post-slump bluff stabilization patterns but also how this stabilization process is influenced by the protection and drainage control.

5) Special Studies

a) Maitland River Report

This study was undertaken, at the request of the Maitland Conservation Authority, in response to the concern about siltation at the mouth of the Maitland River at Goderich. The major focus of this concern was the sand bar development at the river mouth which inhibits boating access to the river, and therefore access to the public ramp, as well as possible upstream marina development. It was found that high spring discharge flushes the material away from the river mouth while, during low river flow, waves and littoral drift re-form the bar. This cycle pre-dated harbour modifications and was considered the prevailing factor in the development of the bar.



b) Scarborough Bluffs

Not all of the erodible Great Lakes' shoreline can be measured using the same technique; therefore a new methodology is being developed for highly-dynamic large bluffs such as are found in the Scarborough and Port Burwell areas. A test area was selected at Scarborough's Bluffers Park landfill site, and 1:2,400-scale, 2-metre contour interval maps were produced from air photos for seven years, from 1947 to 1977. At present, a digitizing and computer package is being developed to calculate volumetric erosional losses from these bluffs for the different time intervals to assess the variation of rates of change.

ENVIRONMENTAL ASSESSMENT

With the representation of Fisheries and Marine Service on the Ontario Regional Screening and Coordinating Committee, Central Region Ocean and Aquatic Sciences participated in the assessment of a number of project proposals related to shoreline developments. As part of the approval process, applications for federal assistance under the Marina Policy Assistance Program administered by Small Craft Harbours Branch require an environmental evaluation for each proposal. Those which were reviewed this year include Humber Bay West Small Craft Facility - Mimico, Lakeview Park and Marina - Windsor, Ontario Cruisemarine - Oshawa, and Whitby Harbour - Whitby.

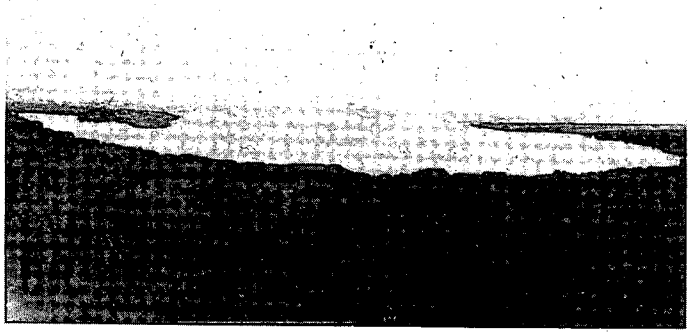
Major environmental assessments were also undertaken, some of which required meetings with representatives, participation at public hearings, and coordination with provincial and U.S. reviewing agencies. These included proposals which have high potential for significant detrimental effects upon the coastal environment, especially with regard to water quality and shoreline processes.

1) The Port Granby Project

Eldorado Nuclear Limited proposed to construct a new refinery and waste management complex to produce uranium hexafluoride (UF_6) on the north shore of Lake Ontario near Port Granby. There were a number of deficiencies identified within the Environmental Impact Statement which largely focussed upon the disposal methods and storage of naturally-radioactive waste materials. Of particular concern is the potential for the release of the buried radioactive wastes through natural processes. One of these is shoreline erosion. Based on average rates of bluff recession of up to 1 m yr^{-1}, the waste management site could be exposed well within the time required for the radioactive waste deposits to become uncontaminated.

2) Point Pelee National Park

Continuing high erosion rates to the east shore of Point Pelee have resulted in a breach to the northeast beach of Point Pelee National Park. Because this may result in detrimental effects to the ecology of the marsh hinterland, and as it threatens the structural integrity of the adjacent farm drainage dykes, a proposal to close the breach was submitted by Parks Canada for review. As the breach is now showing evidence of natural infilling, it was decided that artificial sand nourishment, supplemented with a core protective



A Breach in the Barrier Beach
Point Pelee National Park

device if required, would be the most appropriate means of rehabilitation.

3) Dredge Material and Disposal at Thunder Bay

In both the U.S. and Canadian portions of the Great Lakes, dredging for all purposes amounts to an average of 9.5 million cubic metres annually. Until the early 1970s, little consideration was given to the quality of material being dredged and no special efforts were made to control the dispersal of such material either during dredging or disposal operations. At Thunder Bay, up to 400,000 cubic metres of sediment, much of which is contaminated with organic oxygen-consuming materials and mercury, are dredged annually to maintain shipping channels. Because of recent constraints on open-water disposal activities, a long-term solution was required for dredge spoil at Thunder Bay. A proposal by the Department of Public Works for a disposal area to confine the contaminated organic sediments near shore over an extended period of up to 20 years was submitted to the RSCC for review. Because this project involved the creation of an extensive landfill site on the shoreline, this Section was asked to assess its impact on shoreline processes. There was some debate as to the effect of interrupting the longshore current, which becomes sediment-charged by the Mission River, on the stability of beaches adjacent to the proposed site. It was resolved that there would be no significant impact on shore processes from this project as it is being constructed within the shelter of an existing breakwater. The landfill could only augment longshore transport by streamlining the shoreline configuration.

4) Canada/Ontario Great Lakes Shore Damage Survey Follow-Up Programs

In the Shoreland Management Study, this Section has been responsible for, and is continuing work on: 1) the description of the potential detrimental effects on aquatic and terrestrial environments associated with the use of contemporary structural protective methods; 2) development of a complete property assessment inventory for each property within the 18-mile-long study area on the north shore of Lake Erie in Essex County; and 3) in conjunction with Water Planning and Management Branch of Inland Waters Directorate, development and application of the methodology in deriving the cost benefits of various management scenarios developed for the study site.

Because considerable erosion and flood damages observed in 1973 were attributed to a lack of awareness of the hazards associated with living in the shore zone, an intensive public awareness program is underway to provide information to riparian and prospective buyers of shoreline property. Information produced from this program will be under a common theme of "Coping with the Great Lakes". Preparation began in late fall of this year on the text for one of a series of brochures, "Shore Property Hazards". This brochure will provide the prospective buyer with guidelines to assist in identifying flood and erosion potential as well as an outline on shore protection techniques.

PROGRAM SUPPORT

Well into its third year of operation, the Program Support Section, consisting of Ocean Operations, Ocean Instrumentation, Data Processing, and Survey Electronics, continues to strengthen its support to Research and Development programs and, in the case of Survey Electronics, to outside users.

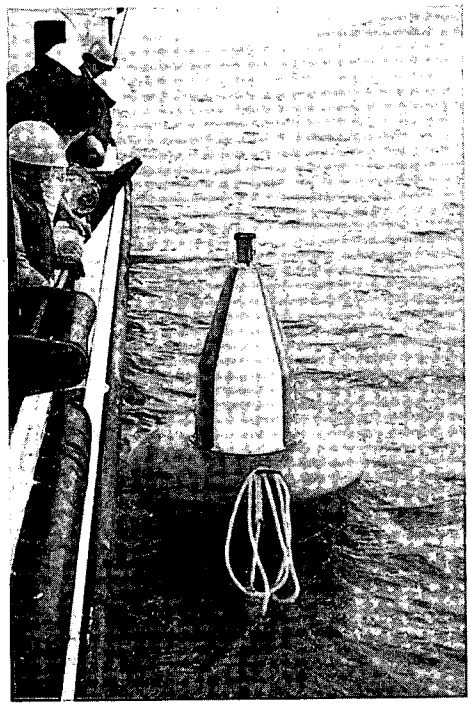
During 1977, several key positions were filled, including the Head, Data Processing. Major thrusts for 1978/79 will include the development of an interactive computer graphic system, the implementation of the mini Loran C system, and continued investigation of new current sensing techniques.

l) Oceanographic Operations

Three field projects were provided operational support during 1977: 1) the Hudson Bay/Great Whale Oceanographic Survey, January 28 - March 9; 2) the Arctic Oceanographic Survey, March 22 - June 3; and 3) the St. Lawrence River Oceanographic Survey, April 28 - July 8; of which the largest was the St. Lawrence River Survey.

The Hudson Bay/Great Whale Oceanographic Survey was a continuation of past multi-disciplinary projects coordinated by the Canadian Hydrographic Service in the southeast Hudson/James Bay area. The Research and Development Division's portion of the survey consisted of CTD measurements between Long Island and Richmond Gulf extending to the Belcher Islands, with a heavier concentration in the Great Whale River area. As in the past, a Bell 206A Jet Ranger helicopter was utilized as the sampling platform, and a Guildline Mark IV CTD system was used throughout the survey as the major sampling system. The lightweight, portable winch, previously designed in-house, was again used successfully throughout the survey. This winch has since been licensed for manufacture by Guildline Corporation through the Canada Patents Office.

The Arctic Oceanographic Survey, undertaken in the M'Clure Strait/Viscount Melville Sound area, consisted of through-the-ice CTD measurements and surface-referenced current meter moorings. The CTD program was comprised of three transects located from Cape Hay to Russell Point, Russell Point to Peel Point, and Ross Point to Stefansson Island, while surface-referenced current meter moorings were placed along the first two transects to compute and compare mean flow with the calculated geostrophic flow. Geodyne current meters, physically oriented to true north, were used, omitting magnetic compass readings due to the close proximity of the magnetic North Pole to the project area.



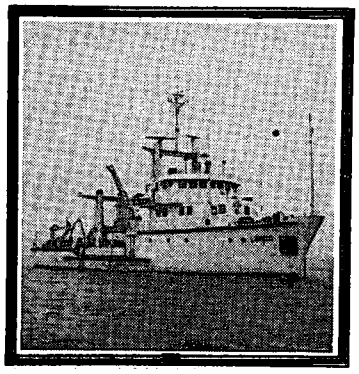
Surface Float
St. Lawrence Current Survey

The third, and by far the largest, of the three projects was the St. Lawrence River Oceanographic Survey. This project, utilizing the CSS LIMNOS as the survey platform, took place between Pt. de la Rivière Ouelle and Cacouna in the middle estuary of the St. Lawrence River. The project consisted of a total of 16 CTD and current monitoring stations sampled over 13- or 25-hour periods along with 17 in-situ current meter mooring stations. An additional station was occupied with a current meter string comprised of 7 current meters sampling at a high rate (30-second intervals) for two complete days to help deduce the internal wave structure of the estuary. A total of 6 shore tidal stations, along with one meteorological station, were also established and monitored throughout this survey to supplement the CTD and current meter data.

A reconnaissance survey was carried out by operations staff during September, 1977, in Chesterfield Inlet, utilizing the MV PETREL, after com-

Fisheries and Environment Canada
Pêches et Environnement Canada

ATTENTION: fishermen, boaters, mariners, please assist in our research project



Environment Canada is carrying out a two and one-half month project in the St. Lawrence River, May 1 - July 15. The purpose of this survey is to obtain accurate scientific measurements of the currents and other oceanographic properties in the river. This will allow future prediction of current speed and direction in areas of the river surveyed, and provide knowledge of the water quality and biology of the river with regard to local marine life.

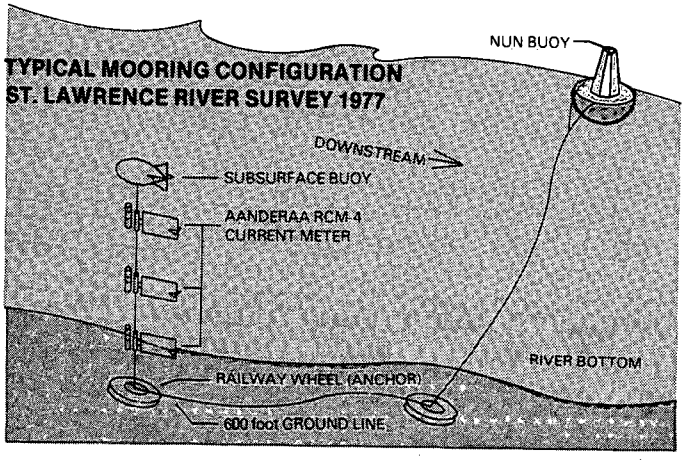
Scientific instruments will be placed in locations as shown in the area charts by the research ship CSS LIMNOS. These instruments will be marked by a nun buoy, with radar reflector and red and yellow vertical stripes.

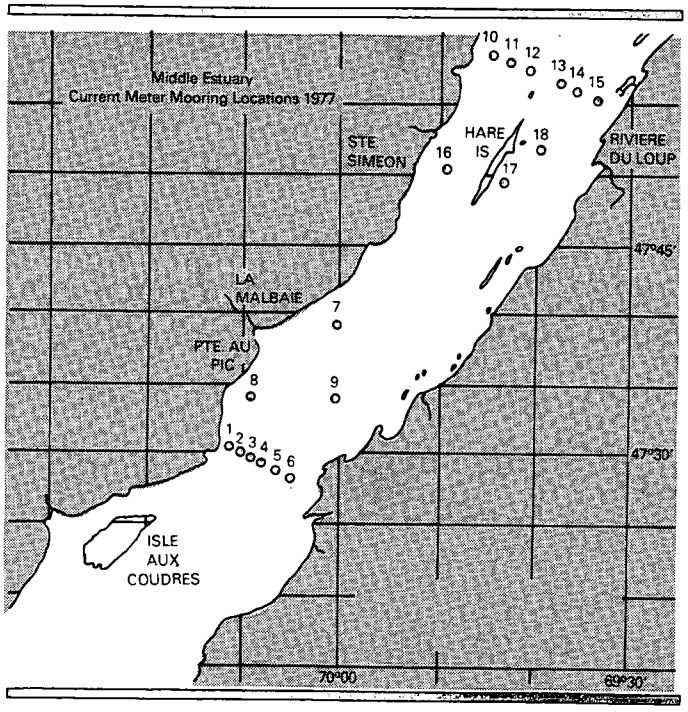
Mariners are requested not to approach these buoys closer than one cable (600 ft.) to avoid possible damage to the instruments beneath the surface.

Your assistance in reporting any accidents with these buoys or the recovery of any lost equipment will be appreciated.

CURRENT METER MOORING LOCATIONS 1977
St. Lawrence River Middle Estuary

Mooring #	Latitude	Longitude	Inst. Depths (M)	Water Depth (M)	
77-07C-01A	47°30'15"	70°11'48"	10, 30, 55	62)	
77-07C-02A	47°30'00"	70°11'06"	30, 55, 70	80)	
77-07C-03A	47°29'40"	70°10'12"	10, 30	42)	
77-07C-04A	47°29'03"	70°08'20"	5, 15	20)	Approximate Installation Dates May 1 - 30
77-07C-05A	47°28'33"	70°06'58"	5, 15, 30	36)	
77-07C-06A	47°28'00"	70°05'45"	5, 15	20)	
77-07C-07A	47°33'50"	70°09'40"	10, 30, 55	74)	
77-07C-08A	47°39'50"	70°01'35"	10, 30, 55	90)	
77-07C-09A	47°33'50"	70°01'10"	5, 15, 40	55)	
77-07C-10A	47°58'30"	69°44'40"	10, 30, 50, 70, 100	110)	
77-07C-11A	47°57'50"	69°42'30"	10, 30, 50	70)	
77-07C-12A	47°57'30"	69°40'55"	5, 20	28)	
77-07C-13A	47°56'40"	69°37'40"	5, 15	28)	
77-07C-14A	47°56'12"	69°35'35"	5, 15	22)	
77-07C-15A	47°55'50"	69°33'50"	5, 15	28)	Approximate Installation Dates June 1 - 30
77-07C-16A	47°50'30"	69°49'10"	10, 30, 50, 70	22)	
77-07C-17A	47°49'40"	69°42'35"	5, 15	24)	
77-07C-18A	47°52'50"	69°39'00"	5, 15	34)	





Please contact the vessel CSS LIMNOS via Marine Radio Riviere Du Loup or Quebec City, or Environment Canada, Research and Development Division, P.O. Box 5050, Burlington, Ontario. Telephone (416) 637-4358 (collect).

pletion of a Hydrographic survey in northwest Hudson Bay. This consisted of CTD and current measurements at eight 13-hour stations throughout the length of the inlet along with an aircraft reconnaissance in preparation for a major survey in 1978.

During the latter part of the year, a miniature submarine was developed and is presently under test to assist in mooring installations in the Arctic. At times, there are requirements to connect two ice holes that may be spaced up to 100 feet apart. Short of using divers, this is a very time-consuming and difficult process. This submarine, when tethered by one hydroplane, dives to a pre-selected depth and travels in a large circle (length of tether). The tether line will catch a grappling hook lowered through the second hole, thus joining the two holes. Initial in-house testing has been very promising, with field testing to commence at the earliest opportunity.

2) Ocean Instrumentation

During the first two surveys of the year, the Great Whale Survey and the M'Clure Strait Survey, the Guildline Mark IV CTD system was again successfully used. The Mark IV has now completed more than two years' work and has proved to be state-of-the-art in Arctic CTD operations. In addition to the deck unit and recorder designed to run on 28-volt helicopter power, the system includes a specially-designed, lightweight winch. The winch features internal sliprings and derives its power from the ice auger motor. The total system, including deck unit, recorder, winch, and 500 metres of cable, weighs less than 160 pounds.

During the Great Whale Survey, a Plessey 9400 CTD system was also tested for possible Arctic work. However, due to temperature-induced stability problems, conductivity head magnetization, and channel crosstalk, the system was determined to be unacceptable for this application.

Final development and re-design was completed on the CODAS (Computerized Oceanographic Data Acquisition System) to resolve A/D converter problems encountered during the 1976 Hudson Bay Survey. The updated CODAS system, our older PROM controlled high-speed data acquisition system, and a back-up HP9825 calculator-based system were used with the Guildline Mark III CTD system and a modified Endeco current meter during the St. Lawrence River Survey. The project also utilized 30 Aanderaa current meters which were deployed three times and was field-supported by two instrumentation technicians.

With the ongoing requirement to supply current meters for under-the-ice measurements, the Section examined what other groups were doing. Since we have a sizeable inventory of Aanderaa RCMs, it was decided that, for the short term, this instrument should be adapted for through-ice use. After investigating the designs of other groups and modifying these designs to suit our project requirements, 14 instruments were modified for the Barrow Strait project. Work will continue during 1978/79 to determine the feasibility of either acoustic or electro-magnetic current meters to perform the geodetic reference current meter role.

The latter part of the year saw completion of the in-field data processing system to complement the Arctic CTD package. This system, which is based around the HP9825 calculator, is used for in-field processing, quality control, and presentation of the CTD data collected by the Guildline Mark IV helicopter package. The system allows greater flexibility to the field scientist, in that it provides a complete listing and graphic presentation of all stations completed each day only hours after the helicopter returns to base camp.

3) Computing and Data Processing

The activities of this group during the past year can be divided into four general areas: 1) software development for data acquisition and quality checking in the field; 2) development of programs for in-house data reduction and processing; 3) writing data analysis and presentation software; and 4) computer program maintenance.

At the beginning of the year, considerable effort was expended in developing the data acquisition software for the St. Lawrence 1977 Survey. These

programs were written in Real Time Interactive Fortran for the CODAS system using a Mark III CTD probe. Another major project of this type was the development of data quality checking, reduction, and plotting programs for the Arctic 1978 Survey, using the HP9825 programmable calculator.

In the area of software development for in-house reduction and processing, a set of programs were written to process Mark III data from the St. Lawrence Survey and a system to filter and reduce profile (Mark IV) data from the Chesterfield Inlet Reconnaissance Survey. The latter will require further developmental work in 1978.

Data analysis and presentation programs worked on during the year included, among others: modifications to the "Oceans" program and a spectral analysis program; programs to determine the resonant frequencies (both surface mode and internal mode of a two-layered system) for open and closed bodies of water; a land use reporting program for the Environmental Assessment Section; and numerous plotting programs, especially for the Bay of Quinte project.

Three primary types of data were processed by the Section, including time-series (current meter) data, profile data, and shore properties data; current meter data and profile data were processed for the Hudson Bay Survey (1975 current meter data and 1976 profile data), the St. Lawrence 1977 Survey, and the Chesterfield Inlet 1977 Reconnaissance Survey.

Data processing support was provided to the Shore Properties Studies Section on a continuing basis during the year. This support consisted primarily of the conversion of data from shoreline erosion monitoring stations on the Great Lakes into computer-compatible form, using equipment such as a digitizing table, and execution of the various procedures and computer programs which process and plot this data.

During the year, the Division received approximately 24 man-months of support from programmers in the Data Management Section of IWD. This support was primarily utilized in the area of oceanographic data analysis and presentation. Multiparameter and multimeter plotting programs were developed to serve as an aid to visual analysis and intercomparisons of current meter data. Other work included the adaptation of a cruise surveillance program for use by this Division and the continuing development of a system for an accurate visual presentation of the oceanographic data collected during a ship's cruise.

In 1978, the Section plans to develop a graphics facility (in conjunction with the Interdata Model 70 computer) to permit the interactive selection and editing of profile and time-series data. Another project which will utilize the Interdata computer is the development of an intelligent data translation system to transcribe Mark IV and, perhaps, current meter data into a standard computer-readable form.

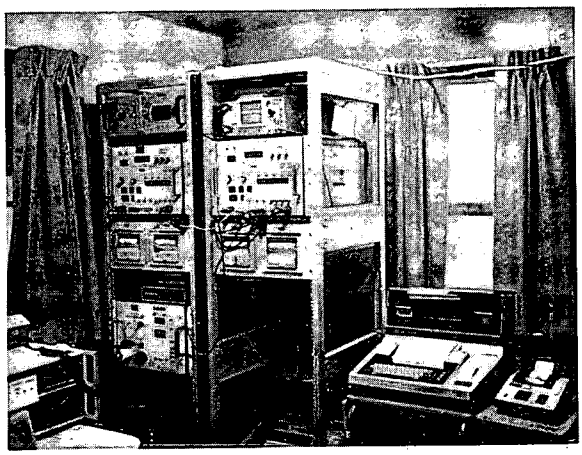
4) Survey Electronics

Survey Electronics continues to perform its primary function of providing electronic support to the Hydrographic Division, to other users at Canada Centre for Inland Waters, and to other government departments. For major Hydrographic survey parties, this service includes providing technicians to accompany the survey party and maintain equipment in the field. Because of this close contact with field operations, the personnel in the shop are well equipped to implement modifications to existing equipment and to develop new equipment to improve the efficiency of survey operations. During the field season, technicians were supplied to field parties in the high Arctic, on Hudson Bay offshore and nearshore, and on Lake Huron. Field parties on Lake Erie and Lake Huron were serviced from Burlington.

In addition to the ongoing service work, there were several important development projects carried out in the shop this year. The Mini-Fix system once again benefitted from modification. This system has been under continuing development since it was first brought into service and is an excellent example of this type of evolutionary development work. Over the years, additions have been made to the circuitry and hardware such that

the system is now capable of a much stronger and more reliable signal. This year, circuitry was developed to make the receiver less sensitive to losses of signal caused by static from lightning storms and other causes. Basically, the circuitry enables the receiver to remember the signal it saw before the disruption and to immediately lock on to it again after the disruption has passed.

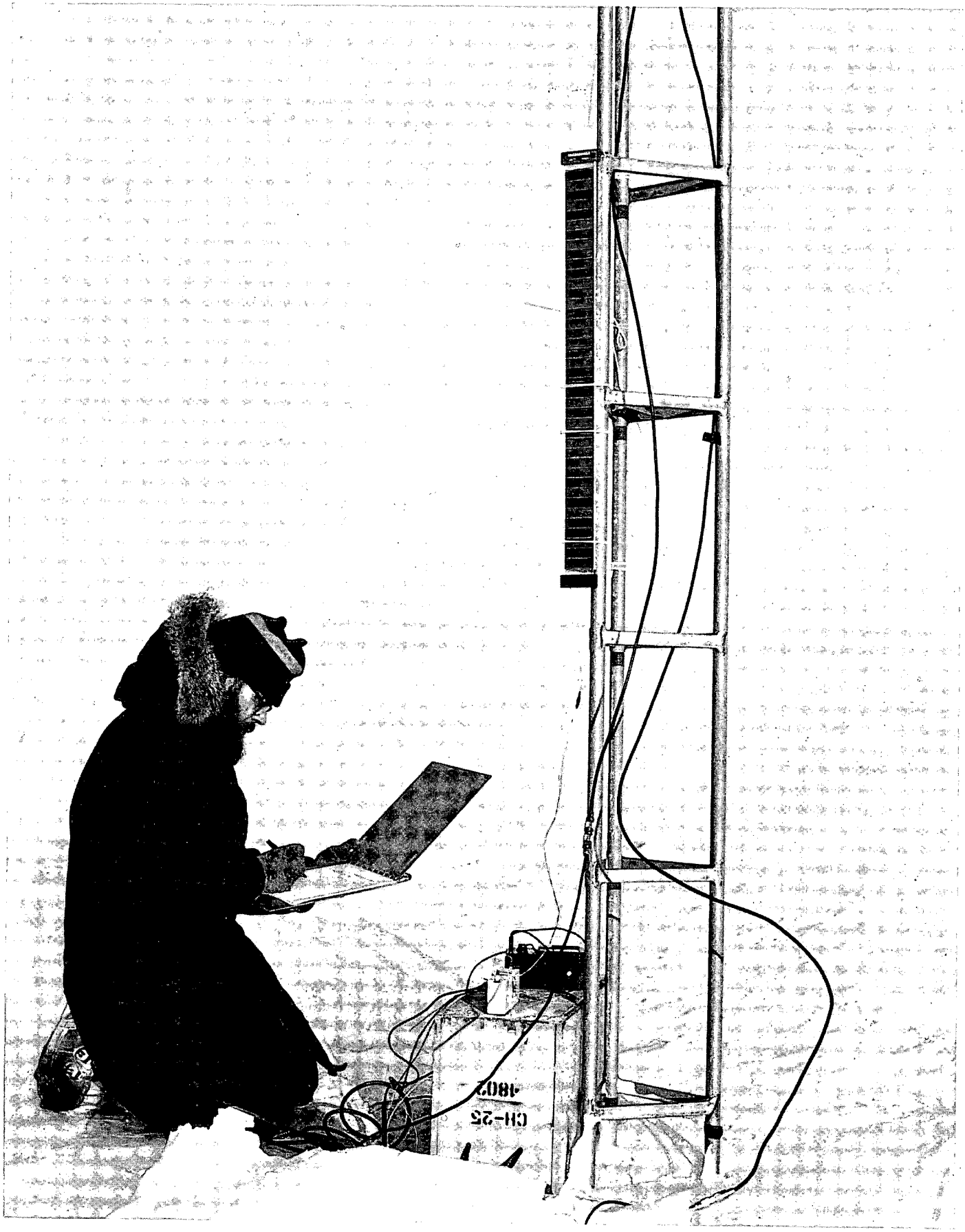
Another development activity is an ongoing project to find alternative power sources for remotely-located equipment. The stimulus for this work was the high cost of providing fresh batteries to survey system transponders in the Arctic. Solar power has been studied and data was gathered under field conditions. This study indicated that solar power is not yet cost-effective but, with the continued decrease in the cost of solar panels, it soon will be. It was realized, however, that considerable savings could be achieved by reducing power consumption of the field equipment. This led to the design and construction of a timer to turn off equipment when it is not needed.



Typical Loran C Installation

In anticipation of a major Accufix (Loran C) survey on Lake Superior in 1978, an extensive evaluation of Loran C antennae was carried out. Conventional Loran C antennae are normally in excess of 300 feet high and are thus inconsistent with the relatively portable operation required by the Hydrographic surveys. After consulting with recognized experts in the field and scale-model studies, a full-size antenna was constructed and field-tested. After various loading and matching techniques, a 150-foot tower was developed which has a range sufficient for Hydrographic purposes in the coming year. As for the new Loran equipment itself, the shop is already developing new servicing techniques and has designed and constructed an instrument for synchronizing the atomic clocks used with the system.

In response to a request from Ocean Instrumentation, the shop developed an instrument for use in servicing Aanderaa current meters. This microprocessor-controlled instrument is capable of decoding and displaying sequentially the output from up to six Aanderaa current meters. In addition to the microprocessor, the unit consists of a CRT and printer to display and output the data.



Experimental use of solar panel (attached to tower leg) to charge batteries at Polar Continental Shelf Project camps, Viscount Melville Sound.

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SHIP DIVISION

OPERATIONS

Ship Divison provided ship and launch support to both hydrographic and scientific field parties from the Winnipeg River, at Kenora, to the lower St. Lawrence and northward to Hudson Bay. In addition to the chartered vessels M.V. PETREL V and M.V. LAC ERIE, the DOT vessel CCGS NARWHAL was once again acquired for the northern surveys in Hudson Bay.

With the transfer of two Botved launches and two Boston Whalers to the Quebec Region, Ship Division welcomed two new Nelson 34 launches to the fleet. These launches NIMBUS and NAUTILUS arrived at Burlington late in December and will be ready in the spring to join the work force.

1) CSS LIMNOS

After winter refit, LIMNOS was unable to participate in the first scheduled cruise due to heavy ice conditions on Lake Erie. A scientific cruise on Lake Ontario was scheduled and when completed LIMNOS was prepared for an oceanographic program in the lower St. Lawrence.

The vessel departed Burlington on April 28 and carried out survey tasks in the Rimouski area until the program was completed, returning to Burlington on July 8.

After refit for scientific operations, LIMNOS then supported 16 scientific cruises on Lakes Erie and Ontario during the season.

The vessel ran a total of 12,204 nautical miles during 214 operational days returning to Burlington on November 18 for winter lay-up, refit and engine overhaul.

2) Lake Huron Off-Shore - CSS BAYFIELD

Major modifications to the vessel were carried out throughout the winter months. Two new masts were installed, also a new lab as well as a new HIAB crane capable of a one ton lift at five metre range.

BAYFIELD departed Burlington on May 11 and proceeded through Tobermory where the vessel was operated relatively trouble free throughout the season participating in hydrographic surveys for two week periods and returning to Tobermory on the second weekend to refuel and replenish stores.

The vessel returned to Burlington on October 28, after completing 171 operational days and steaming a total of 14,122 miles.

On the same program the launches NUCLEUS and HYDRO IV participated throughout the summer months. NUCLEUS performed well on this survey with very few days lost due to mechanical breakdown. HYDRO IV was replaced by HYDRO II late in the summer, due to lack of speed and excessive exhaust fumes.

3) Winnipeg River Survey

The Winnipeg River Survey based at Kenora, Ontario was supported by CSL WOODCOCK which was transported from Selkirk to Kenora. In addition, two Botved launches, HUNT and HUSTLE and the tunnel drive PACER were road transported from Burlington arriving at Kenora on May 11.

Once again the very popular launch WOODCOCK was the work horse of the field party. Although WOODCOCK had a fair share of mechanical problems, it was still the favorite launch on this survey.
CSL PACER had a fair workout this season and reports are that the launch was highly maneuverable and comfortable and proved to be an excellent craft for visual fixing due to the low cabin structure.

One Botved launch was kept as a standby launch while the other worked on the survey throughout the field season, until the survey terminated on September 21, when all launches and equipment

were returned to Burlington.

4) Lake Huron Coastal

The combined Hydrographic and Geolimnology Survey in the southern end of Lake Huron was supported by two major launches, CSL AGILE and CSL LEMOYNE. Both launches departed Burlington on May 2 and proceeded to Lake Huron where they were stationed for the season. Both launches worked fairly well throughout the season with minimum downtime due to mechanical failure. AGILE and LEMOYNE continued on these surveys until October when they both returned to Burlington for winter lay-up and overhaul.

5) Revisory Surveys

Revisory Surveys were away to an early start and continued throughout the summer months. CSL VEDETTE supporting Revisory I in Lake Huron while CSL VERITY operated from Beauharnois to Toronto and down the south shore of Lake Ontario to the Niagara River.

As VEDETTE was no longer required on Revisory I, it was returned to Burlington early in August and a Boston Whaler was used to complete the survey.

Revisory II continued to work in the Toronto area along with one Botved launch on a harbour survey until November when all launches and equipment were returned to Burlington.

6) Lake Erie Survey

Based at Port Dover, this survey was supported by CSS ADVENT and CSL HYDRO II which was replaced in August by a Botved launch and a 21 ft. Monark.

Positioning problems were the main cause of delay on this survey. However, ADVENT ran a total of 8,148 miles during the season with 183 operational days of which 94 were spent at sea.

On August 22, ADVENT had the misfortune of striking a submerged object, damaging both propellers and two days were spent at Erieau for repairs.

On October 23, the survey was terminated for the season and ADVENT returned to Burlington where it was used for Loran C tests until November 28 when the vessel was withdrawn from service for the winter months.

7) M.V. PETREL

The charter vessel M.V. PETREL departed for the first scheduled cruise on Lake Ontario on March 15. High winds and heavy ice conditions made a very difficult passage and only part of the first cruise was completed.

During the early part of the season, PETREL participated in various scientific programs on Lake Erie and Ontario and after outfitting the vessel sailed for Hudson Bay on July 13. New davits were installed during the winter months to accommodate two Botved launches which were used for a hydrographic survey in Hudson Bay.

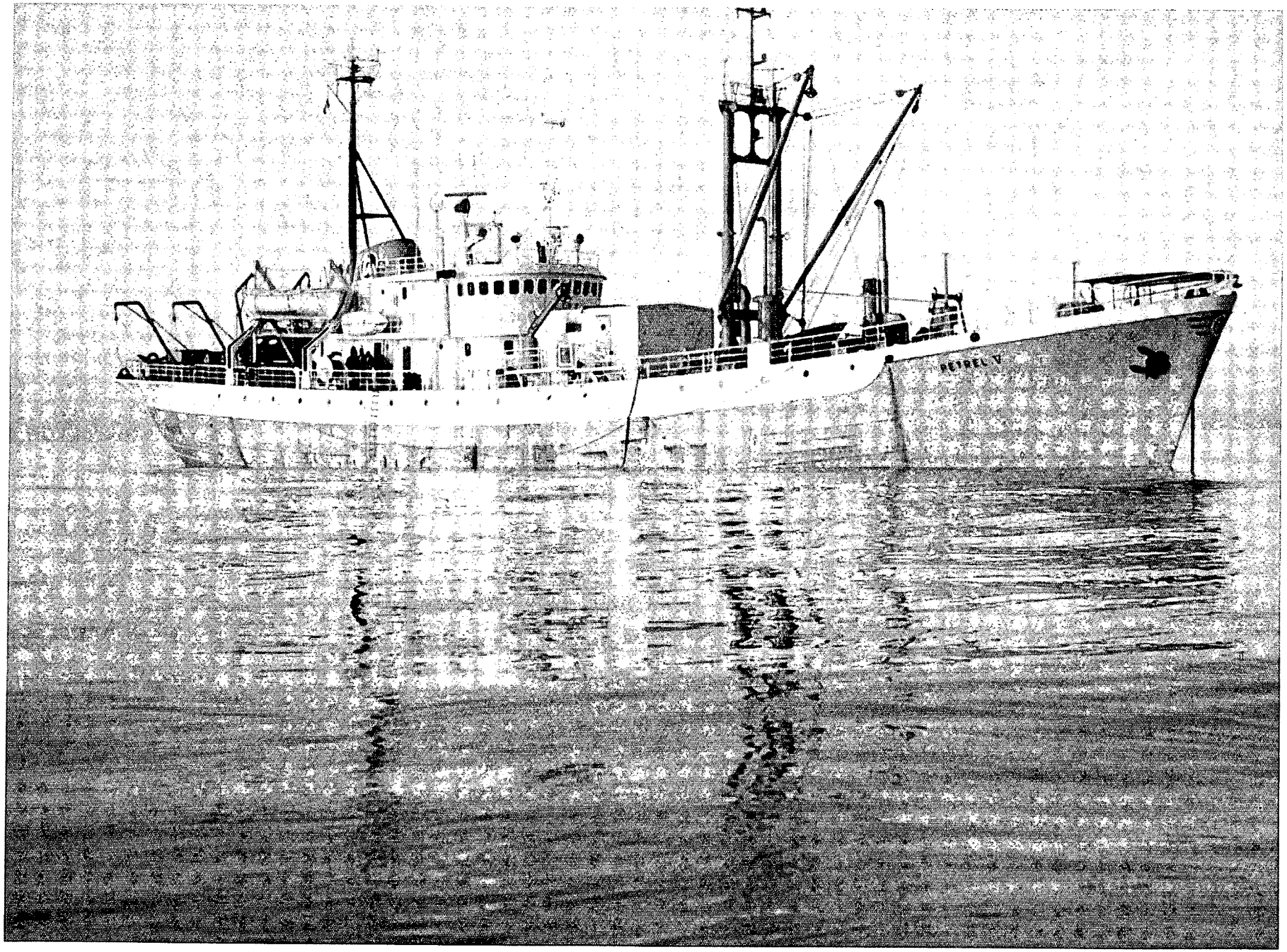
The hydrographic survey continued using PETREL for both survey vessel and mother ship for the launches until September 18, when the hydrographic crews disembarked at Churchill and R&D personnel from Central Region equipped the vessel for an oceanographic program.

With this program completed, the vessel departed on the homeward voyage on September 29. After off-loading survey launches and equipment at Quebec City on October 7, the vessel then proceeded to Burlington arriving here on October 14.

On November 19, PETREL once again proceeded to Lake Huron where the vessel was used to evaluate Loran C for the purpose of overland pattern errors returning to Burlington again on November 26 for winter lay-up.

8) Hudson Bay Off-Shore

Once again Ship Division acquired the services of the MOT vessel CCGS NARWHAL. NARWHAL after dry docking and outfitting for hydrographic surveys departed Halifax on July 23 and continued operations in Hudson Bay until September 30 when the



PETREL was used on the west side of Hudson Bay.

vessel departed, arriving Halifax October 9.

9) Great Lakes Biolimnology Laboratory

Two continuing programs were again carried out throughout the 1977 season. At Batchawana Bay in Lake Superior, CSL AQUA, again proved to be a very successful platform for this type of work but subsequent plans to sail the launch to Black Bay in November were cancelled due to latent hull defects. Two joe-boats were used at Batchawana Bay and a new Crestliner was purchased to give further support to this program.

Further south, at Bay Quinte, the GLBL program was supported by CSL SURF, two Boston Whalers and a 17 ft. Monark. Reports from the field indicate that SURF has provided excellent support to this program. The launch suffered a fair share of mechanical problems. However, repairs were carried out as quickly as possible minimizing the downtime.

10) At Burlington

The only active vessel during the winter months had been the chartered tug LAC ERIE which provided support to both scientific personnel and the diving unit. During the regular navigation season, LAC ERIE operated between Lakes Ontario and Huron and Georgian Bay.

CSL SHARK provided support to scientific programs on Lake Ontario and one hydrographic program on Lake Erie. There were very few mechanical problems on SHARK this season and downtime was due mostly to inclement weather.

The highlight of the season occurred when the NOAA ship "MOUNT MITCHELL" docked at Burlington on June 15. The 231 ft. vessel departed Burlington again on the morning of June 17 and sailed to Lake Huron to participate in hydrographic surveys on the U.S. portion of the lake.

Another visit to the Centre by MOUNT MITCHELL was on October 31. During this visit MOUNT MITCHELL held open-house for CCIW employees on November 1. Throughout the day, the vessel was toured by many interested people from the Centre and on the same day tours of the Centre were arranged for crew members of MOUNT MITCHELL. The vessel sailed for Wood's Hole, Mass. on November 2.

ENGINEERING

1) Boatshop & Engineering

While vessel requirements for the second year in a row were somewhat reduced from those of previous years, work in the boatshop continued at a steady pace being more evenly spread over the year, and of a necessity more diversified than previously, due mainly to shortage of funds so that jobs were tackled and completed in the boatshop which normally would have been contracted out.

Following the early season rush to get field parties outfitted and away, work was commenced to completely rebuild three diesel generator sets that had been practically totally demolished during transit from their winter survey base in the Arctic back to Burlington.

For a while, it appeared that we had bitten off more than we could chew as some required parts were such that manufacturers did not keep them as spares. However, due diligence prevailed and the generators were ready, tested and crated for shipment on schedule.

The new system of trailer log books was put into operation this year, each trailer having its own log sheet and all repairs or renewals duly recorded. Two Botved launches, "HAWK" and "HUSKY" and two Boston Whalers were outfitted and together with two trailers delivered to the new Quebec Region. Unfortunately the first Botved "HAWK" was involved in a highway accident in the early stages of the journey, as a result the entire cabin area was demolished when the vessel landed upside down at the side of the highway.

"HAWK" was returned immediately to Burlington, where repairs commenced along with a speeded up effort to prepare HUSKY for transit to Quebec in its place. Both boats were delivered within

schedule although the sequence of delivery was reversed.

CSL VERITY, another vessel destined for the Quebec Region was serviced completely at the close of the operating season in readiness for her departure at the opening of the 1978 season. Repairs were necessary as a result of heavy damage in way of the starboard rub rail section sustained as a result of the vessel ranging while secured at H.M.S. YORK, Toronto during a heavy storm on the Thanksgiving Day weekend.

2) NUCLEUS

Following a successful season on Lake Huron, the vessel was stripped of all survey equipment, winterized and prepared for transfer to the west coast by road on a low-bed trailer.

3) Monark Launches

The replacement of the 65 h.p. Johnson motors (which have now been phased out completely) with 75 h.p. Chrysler units revealed a weakness in the transome areas of these vessels. Fractures caused by this weakness were arrested and prepared for welding by boatshop personnel and welding repairs were carried out by contractors who also installed stiffening in the area of the weakness as directed. This turned out to be premature as the users of the vessels, (mainly hydrography) are now requesting smaller engine, viz. 55 horse power.

Access from the wheelhouse to the foredeck part of these vessels has been provided in the form of a watertight hinged opening which will allow slings or falls to be hooked to lifting points without the crew leaving the cockpit/cabin area, thus making a safer operation when lifting or lowering from the ships davit.

4) CSL SURF

Following a minor accident when the propeller struck a rock the vessel developed shaft problems which on later investigation proved to be the result of a somewhat unusual design in the original construction, necessitating changes too major to be attempted in the field although certain modifications of a temporary nature were carried out in order to allow the vessel to successfully complete her project.

Immediately on her return to Burlington, the entire shafting was changed to a more conventional design and the original gasoline engine replaced with a Detroit Diesel which had been rebuilt by boatshop mechanics rather than by manufacturers as had been the normal practice.

5) CSL SHARK

For the first time in many years, the main engine of this vessel, instead of the usual pre-season tune-up by manufacturers, was stripped down and rebuilt by shop mechanics with the reverse/transmission gear removed and completely rebuilt in the shop. With the exception of injectors and gasket kits the entire project was carried out more or less without cost using parts originally supplied as spares with the acquisition of the now defunct RADEL II.

6) CSL AQUA

This vessel having been wintered in Sault Ste. Marie, performed in a satisfactory manner through most of the season. However, towards the end of the year hull fractures appeared in way of the old engine beds, not now in use as such, but which provided a base for a hydrographic winch and subject to upward force when the winch was in operation rather than the designed down forces. External doublers were installed in way of these fractures, however it has been reported that a similar condition manifested itself at the port side during the last week of the season.

Permanent repairs will be carried out prior to the commencement of the 1978 season and will include the repositioning of the hydrographic winch on deck.

7) CSL VEDETTE

As a result of transmission problems and a leaking water cooled exhaust riser together with the fact

that the main engines were due for major overhaul, work was commenced as soon as the vessel arrived back in Burlington. Both engines and one transmission were rebuilt by manufacturers while the main generator was removed and overhauled by boatshop staff. On completion the vessel was steamed to Hamilton Harbour Commission Dockyard for winter storage. The generator will be reinstalled when the vessel returns to Burlington.

8) CSL AGILE

Certain reports of wiring defects on this vessel were reported by the users early in the season. However, requests for clarification were ignored until a somewhat vague report was received in December which indicated that as a result of somewhat erroneous observations made in the field, a dangerous condition existed throughout the rest of the operating season.

Similarly a somewhat overzealous tearing apart of a Vee-drive by contract labour when the request was only to remove a small pump cover initiated a chain of events that resulted in a loss of 12 days operating time for the vessel.

9) General

For the first time ever CCIW's entry in the Burlington Santa Clause Parade was designed and built solely by Boatshop personnel, competing with the big boys in the commercial class. We took First Prize. The float was carefully dissassembled following the parade to be re-used next year in another original guise.

10) CSS LIMNOS

Following a winter refit period during which the 5 ton Austin Western Crane was removed from the vessel and rebuilt, the usual Harbormaster repairs carried out and all main engine cylinder heads removed, reconditioned and replaced the vessel departed for an extended survey on the Lower St. Lawrence followed by the usual Lake Erie and Ontario surveys.

An outstanding feature of this year's operation was the fact that only 10 hours of survey time was lost through mechanical failure this being caused by sticking cylinder head valves. Investigation indicates that this condition was probably caused by wrongly supplied fuel towards the end of the season.

11) CSS BAYFIELD

The long awaited structural modifications were completed prior to the start of the operating season giving us time to carry out some further modifications of our own (mostly of a cosmetic nature) to smooth out the profile of the vessel which was somewhat odd when contracted work had been completed.

The additional modifications consisted of the design and construction of a streamlined, unstayed after mast atop the new laboratory and the fairing in of the laboratory to the after part of the wheelhouse, which in addition to its cosmetic value provides valuable closed storage space for deck equipment.

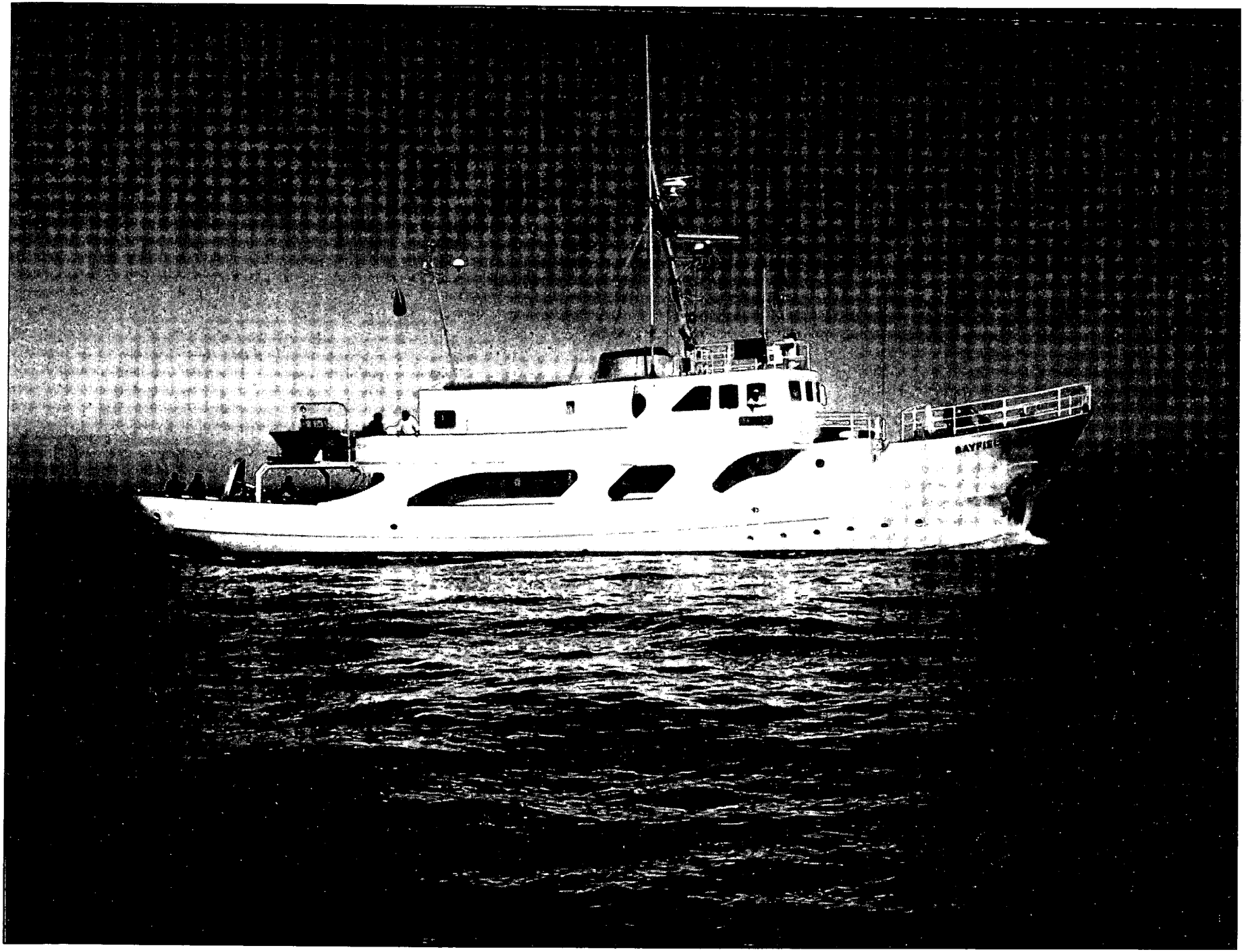
On completion of modifications the vessel departed for the Lake Huron/Georgian Bay off-shore survey where she performed well with only one delay due to a minor steering gear problem, quickly corrected by the chief engineer and some problems with the small diesel generator supplying scientific power. This problem could not be corrected on board so a spare generator was installed.

Investigations carried out at Burlington revealed that the original problem was fuel oriented causing the primary fuel pump diaphram to become porous allowing it to include air in the fuel to the injectors.

12) CSS ADVENT

Prior to the start of the season the vessel was dry docked at Kingston in order that new propellers of different pitch, diameter and design could be installed.

Preliminary information indicated that these



BAYFIELD shows her new silhouette after cosmetic surgery

(Courtesy U.S. N.O.S.)

propellers vastly improved the vessel's performance both in speed and reduced fuel consumption. However, due to equipment troubles that plagued the early stages of the Lake Erie survey it was not possible to get a documented distance/fuel consumption run before the vessel struck a submerged object damaging the new propellers beyond repair, necessitating the hauling out and reinstallation of the original propellers. New propellers are now on hand and will hopefully be fitted prior to the start of the 1978 season.

Early in October, the vessel suffered heavy damages to her port quarter due to ranging at the dock under storm conditions at Port Dover, fortunately damage was confirmed to the above water parts and the vessel was able to continue operating until the close of the season.

13) M.V. PETREL V

A somewhat ambitious conversion program was carried out on a progressive basis, commencing in the off season and continuing between cruises until the vessel departed in mid July for Hudson Bay.

Primarily the conversion was from an oceanographic to a hydrographic survey vessel which entailed the removal of the aft deck awning structure, the procurement of second-hand boat davits with subsequent modification and installation on the vessel for the carriage of two Botved survey launches. Due to the space limitations of the deck, it was necessary to modify the normal Botved cradles by cropping them on the outboard sides so as to allow the vessel to proceed through the seaway without any outboard protrusions.

The Botved launches were then carried by road for loading aboard the ship at Quebec for the voyage north.

As an oceanographic survey vessel PETREL was not equipped with any survey sounder so it was necessary to dry dock at Port Weller for the installation of two Ross Transducers. The somewhat old fashioned construction of the vessel, having a keel protruding 8" below the garboard strake lent itself admirably to this installation as it was possible to install the transducers with adequate fairing and still not protrude below the keel.

The manoeuvre of towering and raising the launches from the davits was only a limited success due to the fact that when fully equipped they weighed considerably more than was estimated when the davits were obtained. However, the ship's staff were able to modify an existing winch as a hoist replacing the portable lifting arrangement installed at Burlington.

14) CCGS NARWHAL

For a while, at the beginning of the year, it appeared that progress had at last been made to improve the sub-standard accommodation supplied to hydrographic and scientific personnel who would be aboard the vessel for yet another long season on Hudson's Bay Off-shore surveys.

This progress actually extended from meetings in Ottawa, allotment of funds, drawing up specifications, preparation of drawings and finally inclusion in the vessel's refit list and input and discussion at a bidders conference. Ship Division were involved in all phases except the final stage when improvements to accommodation were cancelled entirely following the receipt of tenders resulting from the bidders conference.

Some improvements were however made which further increased suitability for hydrographic service, these being the installation of three separated electrical circuits in the navigation control centre, the addition of an Auto Pilot and the installation of a bank of 6 Raytheon TR 109 Transducers in a specially designed cofferdam constructed in one of NARWHAL's fresh water double bottom tanks and the repositioning of the SAT/NAV antenna.

Although it was necessary to make two trips to Marystown, Nfld. to advise and supervise the final installation of the transducers; it proved to be well worth while, as the transducers

designed for sub-bottom soundings worked admirably.

All the above improvements were funded by Ship Division, and reviewing the overall installation of navigating and survey equipment we have installed over the years on this vessel, it would appear that apart from launch carrying facility, NARWHAL is as well, if not better, equipped as a hydrographic survey vessel than any owned by the Department.

15) New Additions

Early in December, we took delivery of two Nelson 34 hydrographic launches to be named NIMBUS and NAUTILUS, supplied as a package by Ship Branch in Ottawa who funded, contracted and finally accepted the vessels on behalf of the Department. Hydrographic launches at this time may be a misnomer as neither vessel came equipped with sounders nor is there any provision for transducers.

All in all except for their design, these vessels appear to be quite a disappointment, particularly in the fields of outfitting, hardware and noise levels which far exceed that specified on the contract. Many hours of labour on the part of the boatshop staff will be required before we have a presentable boat that justifies the purchase price.

ADMINISTRATION AND FINANCE DIVISION

FINANCIAL MANAGEMENT

A total of $7,700,000. was spent from Fisheries & Marine Service appropriation during the calendar year 1977. Personnel costs accounted for $3,376,000. - operating and maintenance costs $3,531,000. and capital acquisitions $793,000. These figures include $473,500. provided under the Surveillance Program of the Canada/U.S. Great Lakes Water Quality Agreement and used to partially defray ship charter costs.

External sources of funding consisted of $120,000 from Energy Mines & Resources for the continuation of a co-operative survey in the Belcher Islands; the Province of Ontario and the Environmental Management Service of D.F.E. each provided $50,000 toward the shoreline erosion monitoring program. The Ministry of Transport contributed $35,000 to an oceanographic survey in Barrow Strait and $100,000 towards a hydrographic Arctic research project.

The Departmental financial accounting control system - FACS - was successfully introduced in the Ocean & Aquatic financial section in August. The system is designed to provide managers with timely and detailed financial information. Manual systems will continue to be maintained in parallel until April 78, at which time complete conversion to the FACS system will be made.

MATERIEL MANAGEMENT

Northern re-supply increased during 1977 and created some of the more interesting (and sometimes thorny) logistic problems. An explosion and fire in a generator tent at Cape Bounty, N.W.T. occured in April resulting in the loss of considerable equipment, vital to the operation of this Polar Continental Shelf survey. Fortunately there were no injuries. Although the dollar value of the lost equipment was not high the fire emphasized the importance of dispersing tents at a safe distance from one another so as to minimize the possibility of fire spread.

O&AS supplies destined for Field Party Sites at Poste-de-la-Baleine, Sanikilauq and Inoucdjouac were readied for sea shipment at Burlington and transported to the Port of Montreal in June for inclusion on the manifest of the MOT sealift. Included in the shipment was 450 drums of helicopter and diesel fuel, lumber, propane and miscellaneous survey equipment. Our Materiel Management Supervisor, Eric Gibbons made a flying visit to the northern sites in advance of the sea lift to make arrangements for stevedoring and storage of the equipment since no Departmental staff was on-site at the time.

Five ton of equipment, including parcolls and generator, not received from suppliers in time for the sea lift, was trucked by Materiel Management staff to Cochrane where it was loaded aboard an Ontario Northland Railway car for Moosonee. Thereafter the shipment was placed on a Moosonee Transportation barge for delivery to survey sites on Hudson Bay and the Belcher Islands.

Amazingly all equipment except for three drums of fuel arrived at the proper destination undamaged.

Supplies being readied for shipment to Arctic surveys

FLEET MANAGEMENT

Departmental vehicles traveled a total of 330412 miles in 1977 and were involved in three minor property damage accidents; the frequency rate for the year being 0.9 per 100,000 miles. The total cost of accidents was $1,412.

In two of the three accidents, Departmental Drivers were at fault.

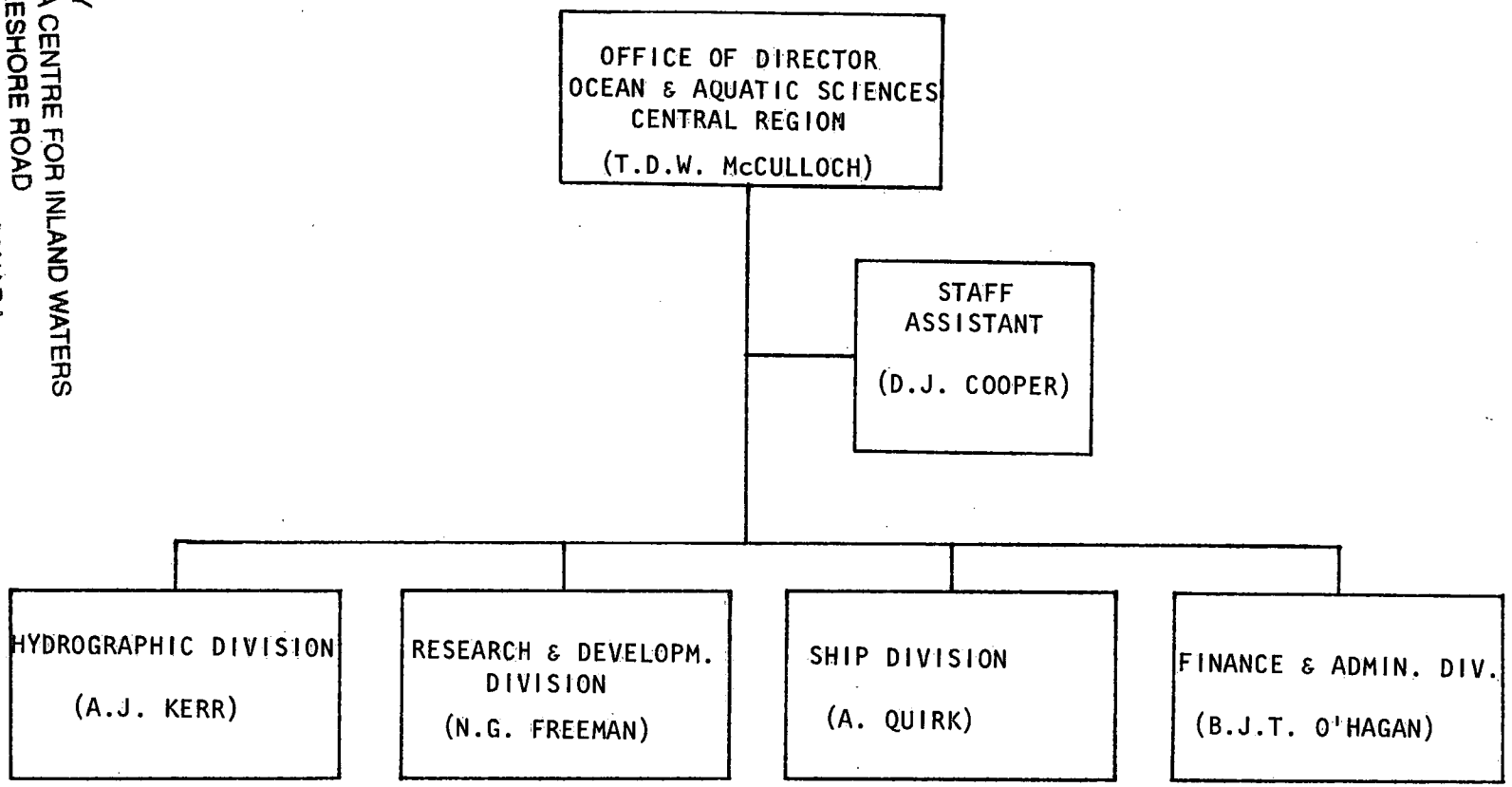
In the third; our station wagon was struck by a vehicle which left the scene and sustained $477. in damages.

GENERAL SERVICES

Within a man-year allocation of 162, the staff peaked in July to a total of 198, the result of 119 staffing actions.

A concerted effort was made this year to update position analysis schedules with the result that 170 positions were submitted to classification.

Twenty two minor industrial accidents were reported, two of which resulted in lost time. Sixteen of the accidents involved ships crew, the most common cause being inattention associated with hoisting and winching.



Sections

Field Surveys
Hydrographic Div.
Cartography
Tides & Water Levels
Tidal Instr./Dev.

Sections

Program Support
Physical Oceanography
Shore Prop. Studies
Env. Impact Assess.

Sections

Engineering
Marine Ops (Ships)
Marine Ops (Launches)

Sections

Financial Management
Gen.Admin Services
Fleet Management
Materiel Management

Date Due