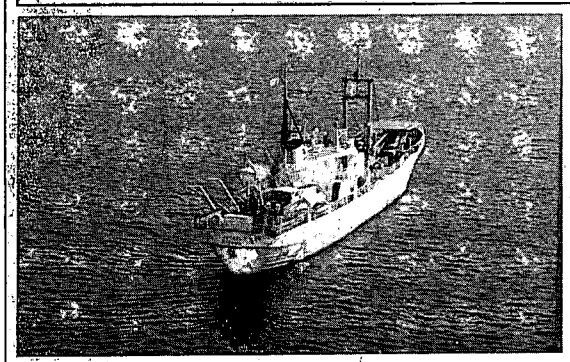
1978 ANNUAL REPORT



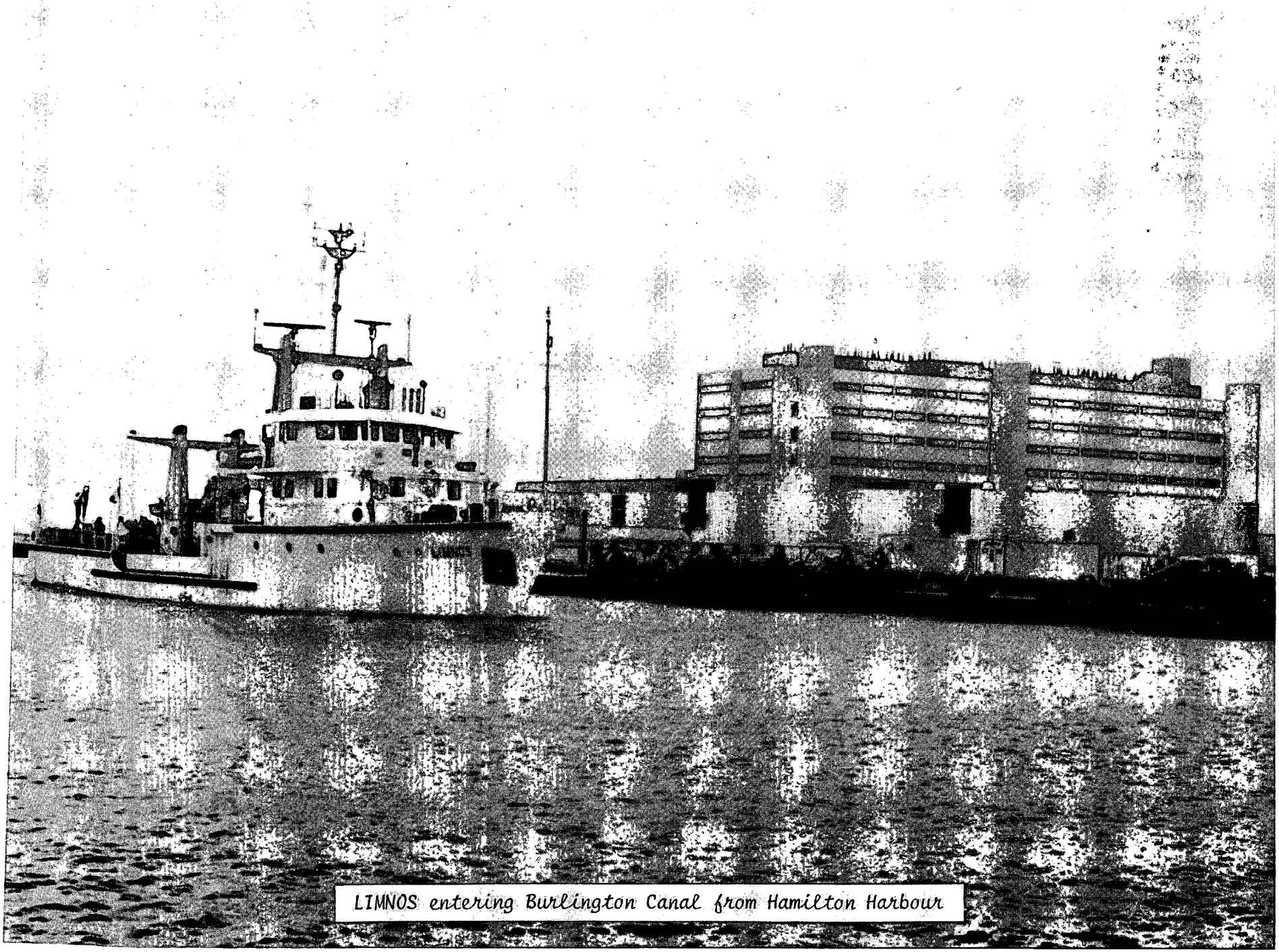
Ocean and Aquatic Sciences
Central Region
Fisheries and Oceans Canada
Burlington, Ontario

1978 ANNUAL REPORT

CENTRAL REGION

OCEAN AND AQUATIC SCIENCES

FISHERIES AND OCEANS, CANADA



LIMNOS entering Burlington Canal from Hamilton Harbour

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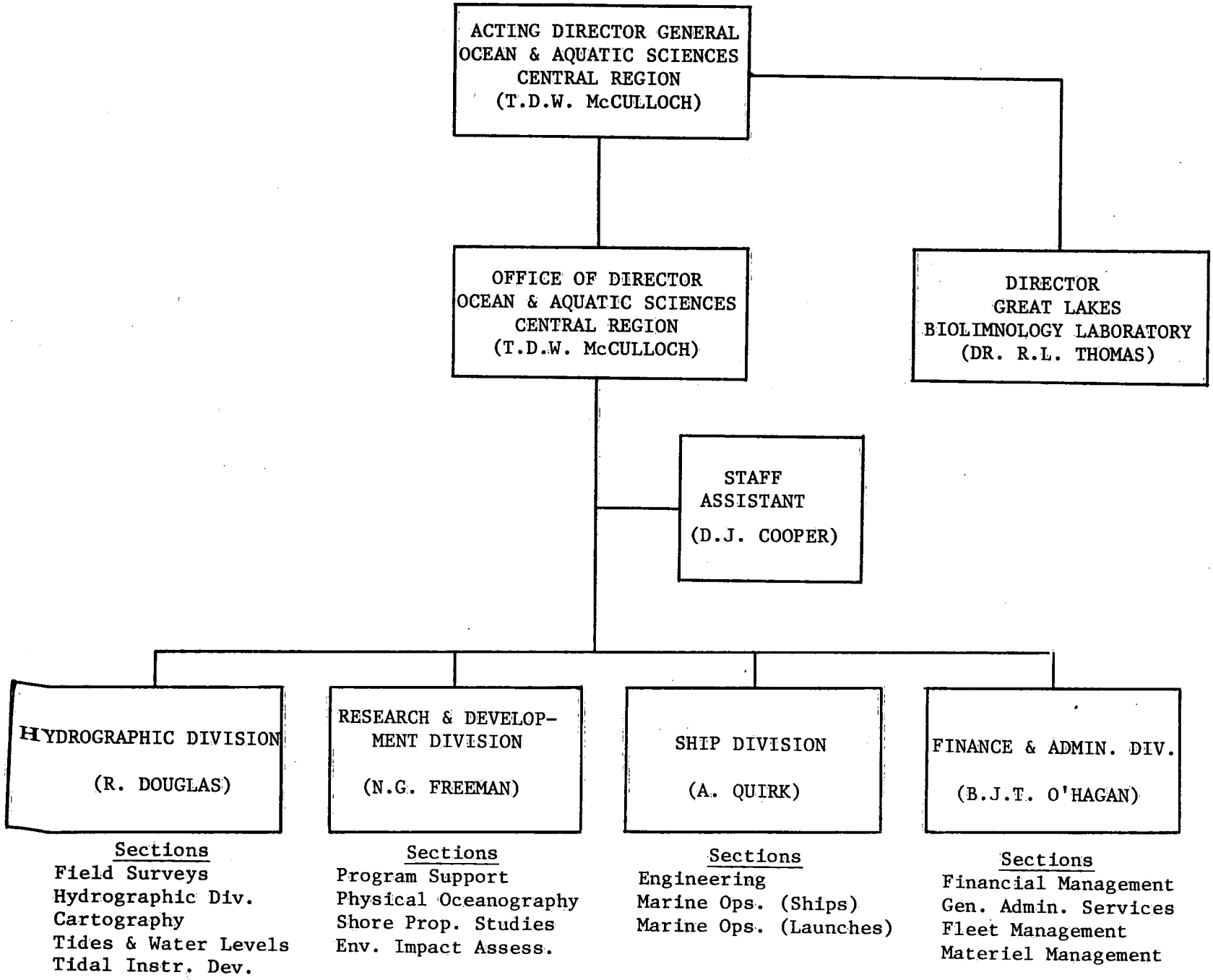
ACTING DIRECTOR GENERAL
OCEAN & AQUATIC SCIENCES
CENTRAL REGION
(T.D.W. McCULLOCH)
OFFICE OF DIRECTOR
OCEAN & AQUATIC SCIENCES
CENTRAL REGION
(T.D.W. McCULLOCH)
DIRECTOR
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STAFF
ASSISTANT
(D.J. COOPER)
HYDROGRAPHIC DIVISION
(R. DOUGLAS)
RESEARCH & DEVELOP-
MENT DIVISION
(N.G. FREEMAN)
SHIP DIVISION
(A. QUIRK)
FINANCE & ADMIN. DIV.
(B.J.T. O'HAGAN)
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

OVERVIEW

The Central Region of Ocean and 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, Ocean & Aquatic Sciences for Ontario and functionally for the development of national policy to the Assistant Deputy Minister, OAS. It consists of 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 expertise in matters affecting the coastal zone. The Ships Division provides both ships and launches required by OAS, other elements of the department and last but certainly not least, meets the varied and sometimes complex requirements of the National Water Research Institute, the major occupant of CCIW.

An addition to the organization was made towards the end of the year when the Great Lakes Biolimnology Laboratory (GLBL) became linked with the Central Region OAS as an interim measure. This change is reflected by the inclusion of their Annual Report within this volume for the first time. Welcome aboard.

In addition to its research activities on the relationships between water quality and aquatic resources in the Great Lakes, GLBL provides scientific and technical expertise to several inter-agency and inter-departmental committees such as the Surveillance Subcommittee of the International Joint Commission, Working Groups associated with EARP (Environmental Assessment and Review Process), Great Lakes Fishery Commission etc. Many of these activities are linked to OAS goals.

The Review & Planning Process, and the Planning Review Evaluation (RAPP-PRE) have been fine-tuned in accordance with the Zero A-Base decisions. The OAS report on its oceanographic and hydrographic programs has been completed successfully; this outlined both the review of all Central Region Projects in the past year and the directions for future projects being developed. Because of the scope of activities and studies carried out during 1977-78 only excerpts of the review are shown here, additional details may be found in this Annual Report.

Work in the Arctic included studies of vertical salinity and temperature structure transects across M'Clure Strait, Prince of Wales Strait and Viscount Melville Sound, and under ice freshwater plumes off the La Grande River in James Bay.

The over-the-ice hydrographic survey of western Viscount Melville Sound was completed and a good start was made on Bridport Inlet, the proposed site for the liquification plant and the shipping area for gas from the Sabine Peninsula. The natural resource survey of northern Hudson Bay in cooperation with EMR was completed.

Studies in the Great Lakes on arsenic toxicity to algae, lead and cadmium chronic toxicity to snails, and crayfish, and lead and selenium chronic toxicity to fish were completed. Synergistic toxicity to algae in culture and in a model ecosystem was demonstrated for 10 metals indicating that single metal objectives are not necessarily protective of aquatic biota.

Further activities and studies expected in the future are:-

A shift of some of the oceanographic and ecological program from southern areas to the Arctic Archipelago is planned for 1979/80.

The region is phasing out most of its hydrographic and all of its oceanographic program from the lower St.Lawrence and tranferring those responsibilities to the Quebec region.

An agreement between the Federal and Ontario governments concerning a program of shore erosion studies in the Great Lakes is due to terminate in two years. OAS participation in this program will be re-evaluated at that time.

The Great Lakes Water Quality Agreement has been revised and consequently will have a significant impact on the work of the Great Lakes Biolimnology Laboratory.

HIGHLIGHTS

The year 1978 was a peculiar one for the Region, with great achievements and an air of uncertainty going along hand in hand. We established ourselves as a viable cartographic entity and developed new thrusts in hydrography and oceanography in the Arctic while coping with major cuts in both personnel and funding, together with additional regional operational responsibilities and the gradual formation of a Department of Fisheries and Oceans.

At the beginning of the year, the Director became the first non-IWD manager to head the CCIW Executive Committee. This proved to be a demanding role, but hopefully helped in part to rejuvenate a feeling of common identity within this large, complex centre of research and survey. Coordination and cooperation do seem to have been enhanced by an active and interested Executive.

In March, the Director delivered the keynote address in Washington at the annual conference of the American Society for Photogrammetry and the American Congress of Surveying and Mapping, followed by a Law of the Sea paper at the Atlantic Region meeting of the Commonwealth Association of Surveying and Land Economy in Barbados in April. This was also the month when the Region suffered severe man-year and funding cuts, particularly damaging after going through a series of reductions in the previous three years.

The Director attended the centennial meeting of the International Federation of Surveyors during July in Paris, France as a member of the Permanent Committee of that body. Further useful visits were made to survey and scientific establishments in the UK and to the North Sea activity, in his capacity as incoming Chairman of the Hydrographic Commission of FIG (Federation Internationale des Geometres).

We were honoured in August by the visit of Donald D. Tansley, Associate Deputy Minister of Fisheries and Oceans and Mr. G.N. Ewing, Assistant Deputy Minister of Ocean & Aquatic Sciences for an OAS National Management Meeting. Mr.Tansley again visited with us on a familiarization tour which included several DFO field operations on Lakes Huron, Erie and Ontario. It was in this month also that drastic cuts in our 1979/80 budget were implemented.

The Regional organization improved somewhat in September when the Deputy Minister delegated interim responsibility for the Great Lakes Biolimnology Laboratory to the Director, OAS, Central Region enabling the resumption of a direct reporting relationship to the ADM, OAS. The resignation of Dr.Johnson from the position of Director-General, Ontario Region, made such a decision urgent, indeed imperative.

The Review & Planning Process/Program Review & Evaluation exercise commenced in September and was largely completed by the end of 1978. These review documents should provide useful information to departmental senior management and aid in making decisions on resource allocation. They should also provide line management with interesting comparison data in the future.

The Hydrographic Division of the Region was well served by the efforts of Earl Brown, the Acting Regional Hydrographer. We were further strengthened by the appointment of Ross Douglas as Regional Hydrographer in September 1978. Additionally, Nelson Freeman, Chief of the R&D Division went on full-time educational leave in September, being temporarily replaced by Ed. Lewis. This Division continues to operate as effectively and efficiently as ever.

The Coastal Management Society held its 4th Conference at CCIW in late September. The keynote addresses were given by Lee Botts, Chairman of the Great Lakes Basin Commission and the Director, OAS. The Conference was well attended and a number of staff participated in the proceedings.

The NOAA vessel PEIRCE visited CCIW on October 30 and 31st. We were particularly pleased by the visit of Rear Admiral Robert C.Munson, an old friend and another active officer of the International Federation of Surveyors.

Late in the year we received support for a stronger oceanographic remote sensing thrust in the Arctic

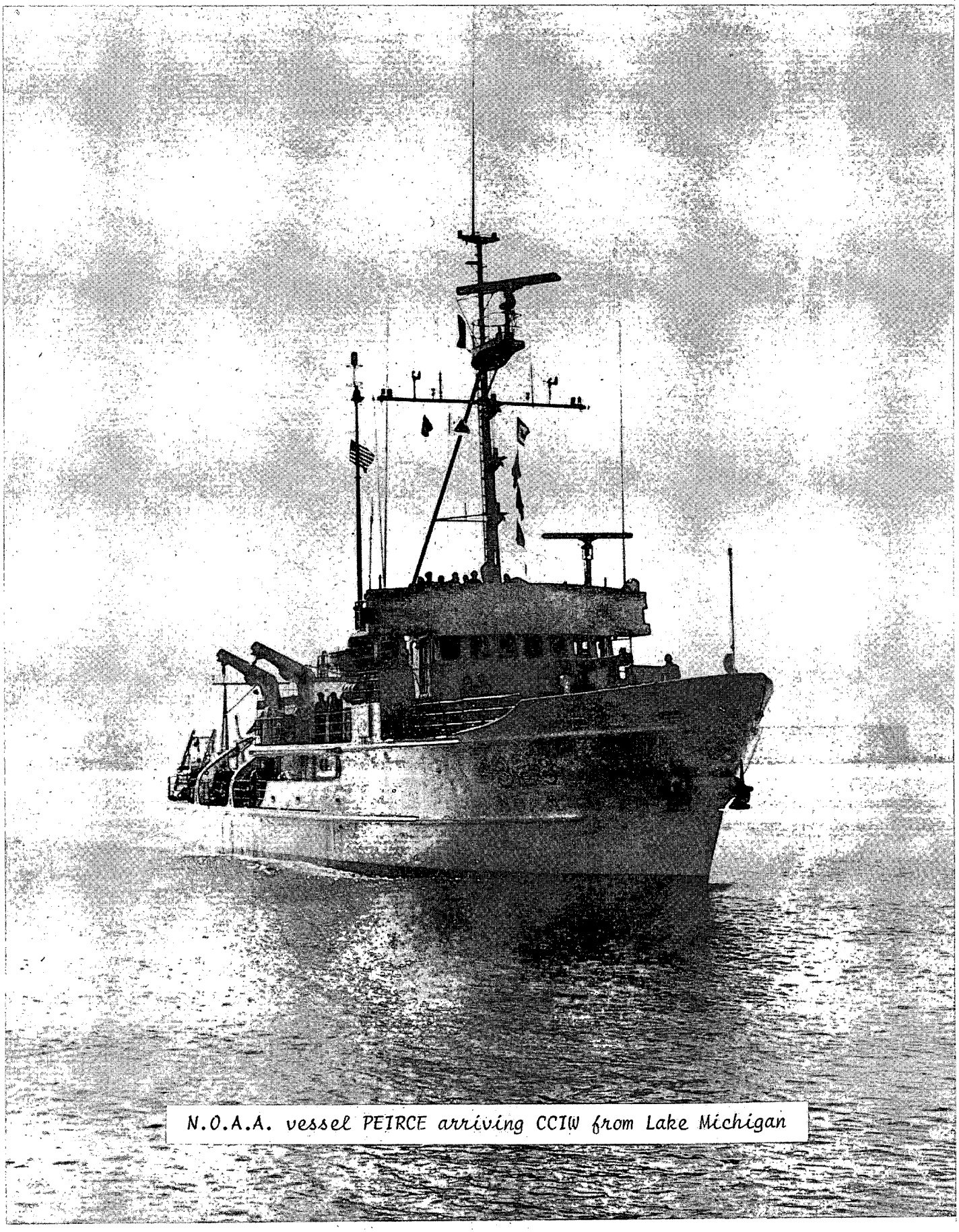
over the next few years. It is too early yet to tell, but such a thrust may well have a profound effect not only upon the R&D Division and the Region but also could enhance OAS prestige and position at CCIW.

We have only had Dr.Thomas and his GLBL team on board for a few months, but we have all enjoyed the experience of working with them. Whatever the final decision may be, the links that bind us in cooperation and enthusiasm will endure here at CCIW.

The federal government exhibit at the Toronto International Boat Show involving the Departments of Fisheries & Oceans, Environment & Transport, was once again coordinated and managed from the Region.

Finally, a thank you to Administration and Finance for keeping the Region relatively honest and protecting us from dire trouble, and an even bigger thank you to all our secretaries who work so hard to transform what we think we said into something readable and understandable.

T.D.W. McCulloch



N.O.A.A. vessel PEIRCE arriving CCIW from Lake Michigan

HYDROGRAPHIC DIVISION

Introduction

The Canadian Hydrographic Service, Central Region is an integral component of Ocean and Aquatic Sciences located at the Canada Centre for Inland Waters. This Regional office is responsible for hydrographic charting programs covering the area from the Manitoba-Saskatchewan border to the Upper St. Lawrence River and from the Canada-United States border to the Arctic Islands. The maintenance and development of a highly responsive and competent group to meet the present and future navigational and recreational charting needs continues to be the major thrust of the Region.

The effort required to meet this thrust 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 and publication of associated aids to navigation; and the development of new instrumentation and techniques to upgrade the systems for collecting and processing data.

Highlights

During the year, A.J. Kerr left the Region for a SAPP assignment in Ottawa and G. Ross Douglas was appointed Regional Hydrographer in September, 1978.

The Chart Production Unit is now firmly established in the Region and already there are signs of increased cooperation between the field and cartographic groups. This cooperation is of great significance to the chart-making process and one which will continue to be fostered in the future.

Research and development activities continued at a high level during the year. Of special significance is the approval in principle of an unsolicited proposal to develop a through-the-ice, continuous-profiling system.

The Tidal Section engaged in a variety of programs in support of hydrographic and scientific endeavours. The program to equip the main permanent gauging stations on the Great Lakes and the St. Lawrence River with Tidal Acquisition and Telemetry System (TATS) is well underway and should be completed in 1979.

Our Field Parties had another successful year. Major surveys of Baker Lake, Winnipeg River, and northern Lake Huron were completed and cooperative programs with Earth Physics Branch, EM&R, and the Hydraulics Division of the National Research Institute, CCIW, were brought to a successful conclusion.

Noteworthy visitors to the Region during the year included Associate Deputy Minister D. Tansley and Rear Admiral R.C. Munson of N.O.A.A. Mr. Tansley managed to pay flying visits to our hydrographic field parties on Lake Erie and Georgian Bay. Admiral Munson, Director of the Atlantic Marine Center, Norfolk, Virginia, arrived on the N.O.A.A. ship PEIRCE for a two-day visit in October, when various links in our Canadian-American surveying and charting interests continued to be forged.

Field Surveys - Review

The areas surveyed by Central Region in 1978 are shown on Figures 1 and 2. Table 1 shows details of survey vessels, vehicles, positioning systems and processing techniques.

Winter Surveys

In conjunction with the Earth Physics Branch of EM&R, through-the-ice surveys were carried out in Viscount Melville Sound and in Hudson Bay.

Using helicopters and tracked vehicles, bathymetry and gravity were collected at a grid spacing of 2 kilometres in the eastern part of Viscount Melville Sound. In addition, Arctic Development was supported by the field testing of a new spiked transducer and actuator system for a helicopter, to replace the conventional system of manually placing a transducer on the ice.

In the area northeast of the Belcher Islands, 3 helicopters were used to collect bathymetry and gravity at a

grid spacing of 6 km.

Summer Surveys

Productive surveys were carried out in Hudson Bay, Winnipeg River and the Great Lakes.

The Hudson Bay offshore multiparameter survey was continued from CCGS NARWHAL. The 9 km line spacing required for gravity and magnetics regional reconnaissance has now been completed.

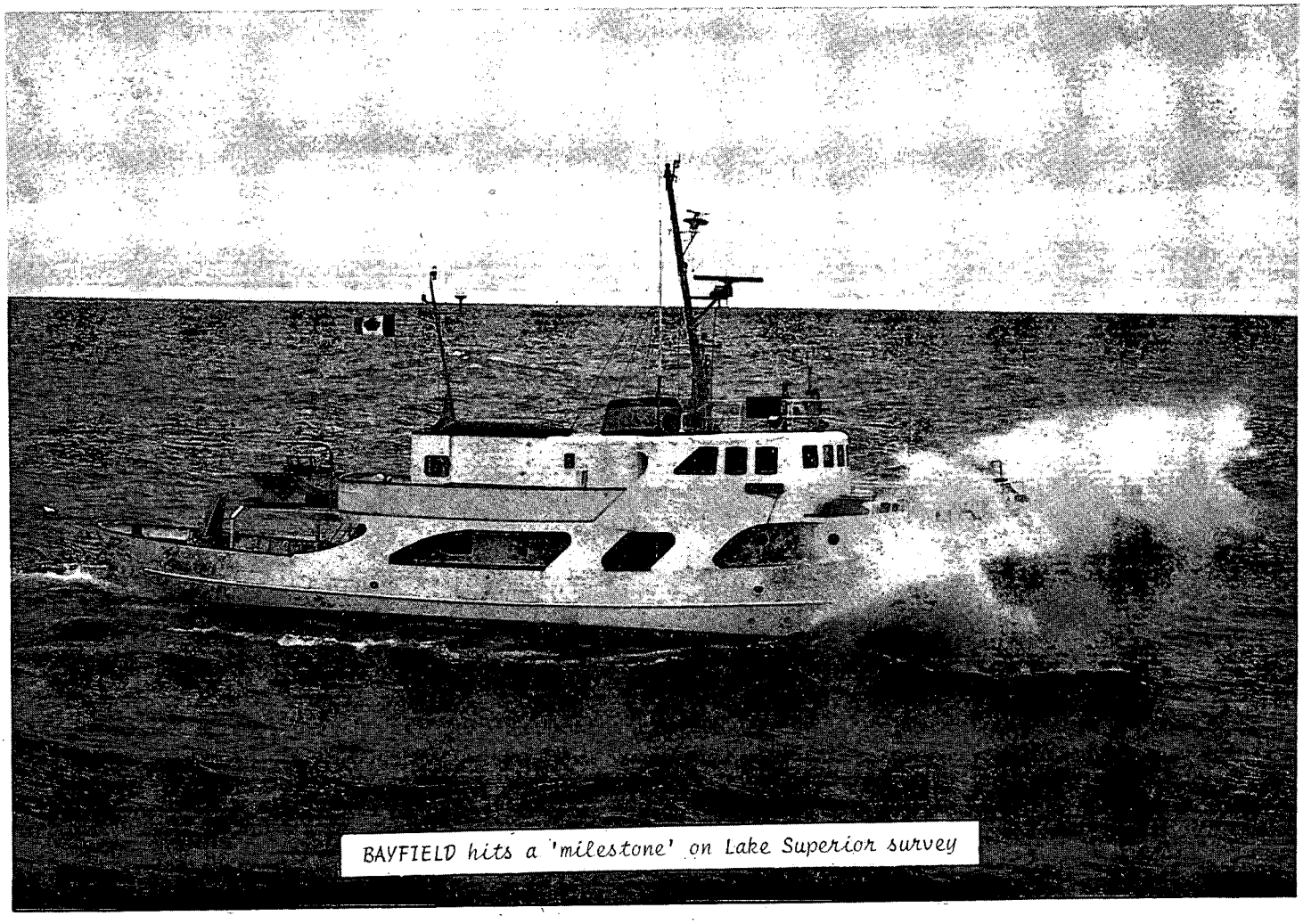
Baker Lake was completely surveyed with the result that modern surveys have been completed from the entrance to Chesterfield Inlet to the settlement of Baker Lake.

The survey of the Winnipeg River was completed to the Ontario-Manitoba border. This will enable 3 charts (scale 1:25,000) to be published covering the river from Kenora to Eaglenest Lake. Two charts from Eaglenest Lake westward to Seven Sisters Falls were previously published from data supplied by the Manitoba government.

Surveys in the Great Lakes were also successfully completed in 1978. In Lake Huron the inshore area along the south coast of Manitoulin Island was completed and in southern Georgian Bay, the Limnogeology program came to a conclusion with completion of the area between Christian Island and Cape Croker.

In Lake Erie, NavBox units interfaced with prototype cartridge recording units (Rams 8900) were used with mixed success to complete the area between Pelee Point and Amherstburg. This will enable publication of a new confluence zone chart of the west end of Lake Erie.

BAYFIELD had a successful season in Lake Superior. After initial problems getting the Accufix-Loran-C chain on the air, the survey progressed well and the scheduled 1,000 metre line spacing between Michipicoten Island/Ile Royale was completed. Additional lines were run over Superior Shoal.



BAYFIELD hits a 'milestone' on Lake Superior survey

In a departure from previous years (i.e., cyclical surveys) Revisory work was carried out only in those areas where chart construction action is scheduled during the next year. This resulted in a mobile unit, supported by a cartographer, carrying out surveys in Lake Superior, Georgian Bay, Lake Muskoka and Lake Erie.

One hydrographer was assigned to the U.S. Exchange program with National Ocean Surveys (NOS), two hydrographers on rotation were assigned to Chart Production, and five cartographers spent various lengths of time attached to field parties.

Marine Information Centre

The volume of charts and maps sold to the public continued to grow. Chart sales were up from 1,158 in 1977 to 1,205 in 1978; map sales were up from 356 to 503; and sales of other publications were up from 161 to 229. In addition, charts, maps and publications were distributed to other Branches, Divisions and Sections within the CCIW community. A total of 813 members of the general public visited the MIC facility.

Hydrographic Data Centre

The growth of Chart Production in the Region has resulted in the expansion, both physically and operationally, of H.D.C. to enable it to handle a large influx of source material. In the first 9 months of 1978, 2,550 documents, including field sheets and chart correspondence files transferred from Ottawa, were "logged in" and filed.

This large amount of material resulted in refinements being made to our data handling methods and doubled our storage requirements for field sheets. All post-1940 field sheet originals are now on file within the Region.

Chart Production Section

At the end of this reporting period, all but one of Central Region's Cartographers were physically located in the Regional Office, bringing the total to fourteen. The strength of the unit was supplemented by the addition of resources available through the Federal Labour Intensive Program and by rotational hydrographers.

Twenty-two new edition charts, fifty-five draft Notices to Mariners, twelve chart correction patches and numerous special projects were some marks of success. Efforts were principally expended on twenty new chart projects, none of which will realize printing until 1979. An additional seventeen charts were assessed and determined to require reprint action. In addition to these activities, over one hundred hydrographic field sheet documents and nine hundred chart-related documents were reviewed. Significant special projects were the preparation of the 1979 Guide to Federal Harbours, Ontario (for Small Craft Harbours, Ontario Region) and four display maps for the Canadian Conference for Resource and Environment Ministers at Vancouver.

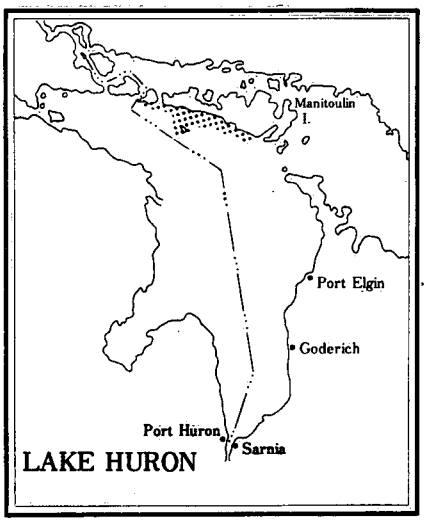
Important capital purchases made during the year included a Kargl reflecting projector, an "OTT" pantograph and a process camera. Reprographic work was carried out for all Branches at CCIW, and several projects were undertaken for Headquarters in Ottawa.

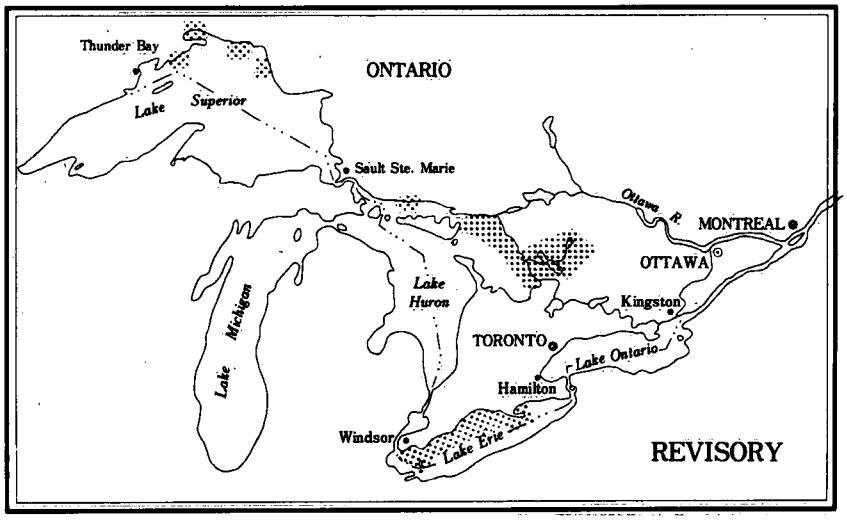
Several important rotational and training assignments were completed in 1978. Three cartographers participated in the Cartography training program, five cartographers spent varying periods of time in the field working with hydrographers, and three hydrographers carried out cartographic assignments with the Section for most of the year. R. Chapeskie, CHS, exchanged working assignments with R. Ross, NOS, in the continuation of the cartographic exchange between our two agencies and a one-week working visit was made by B. Thorson to the Marine Cartography Section, NOS, Rockville, Maryland.

Hydrographic Development

NavBox

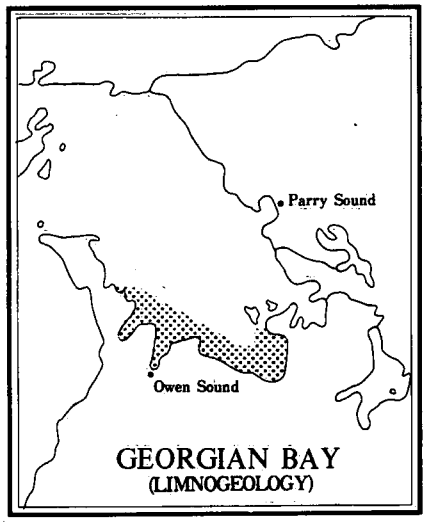
NavBox software development has continued as a result of user comments; a range-gating scheme was implemented for operations with Mini-Ranger III as well as a point-to-point navigation mode for shoal

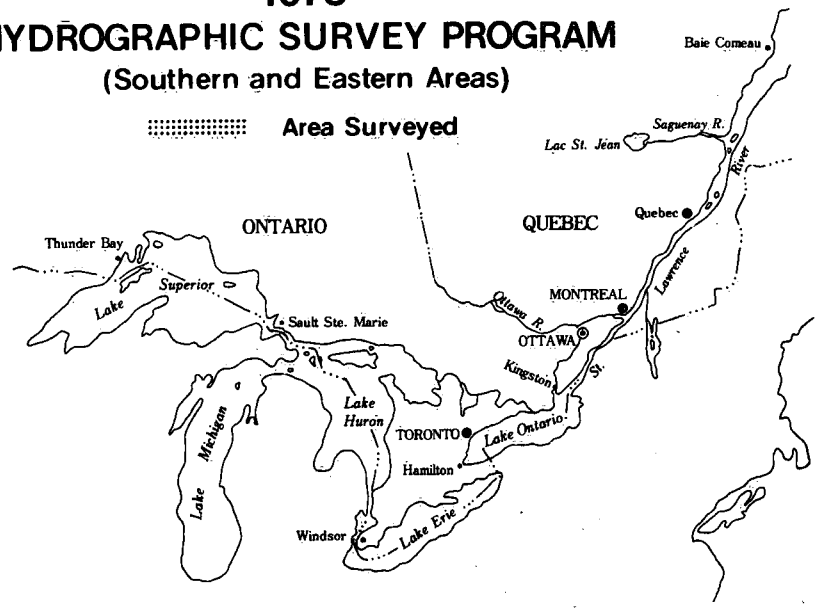


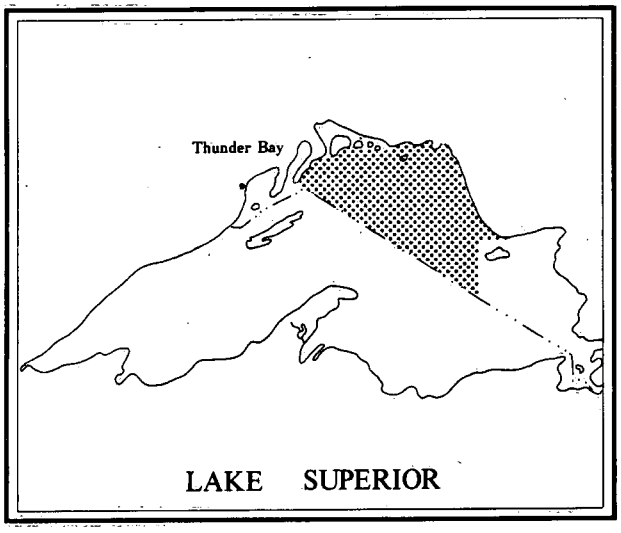


CENTRAL REGION
1978
HYDROGRAPHIC SURVEY PROGRAM
(Southern and Eastern Areas)

Area Surveyed







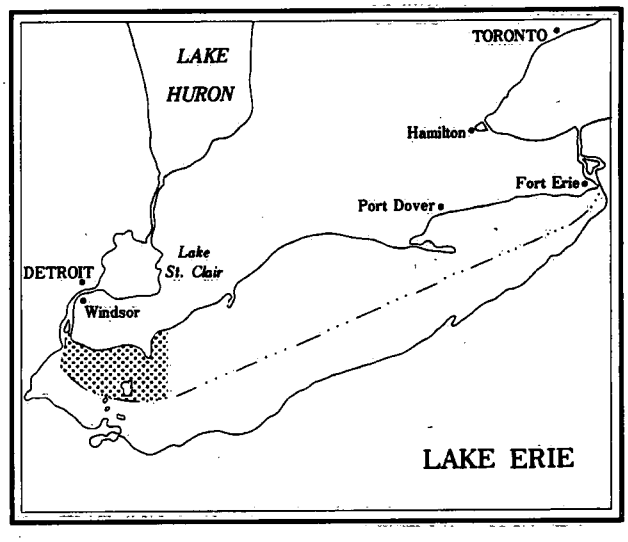


Figure 1

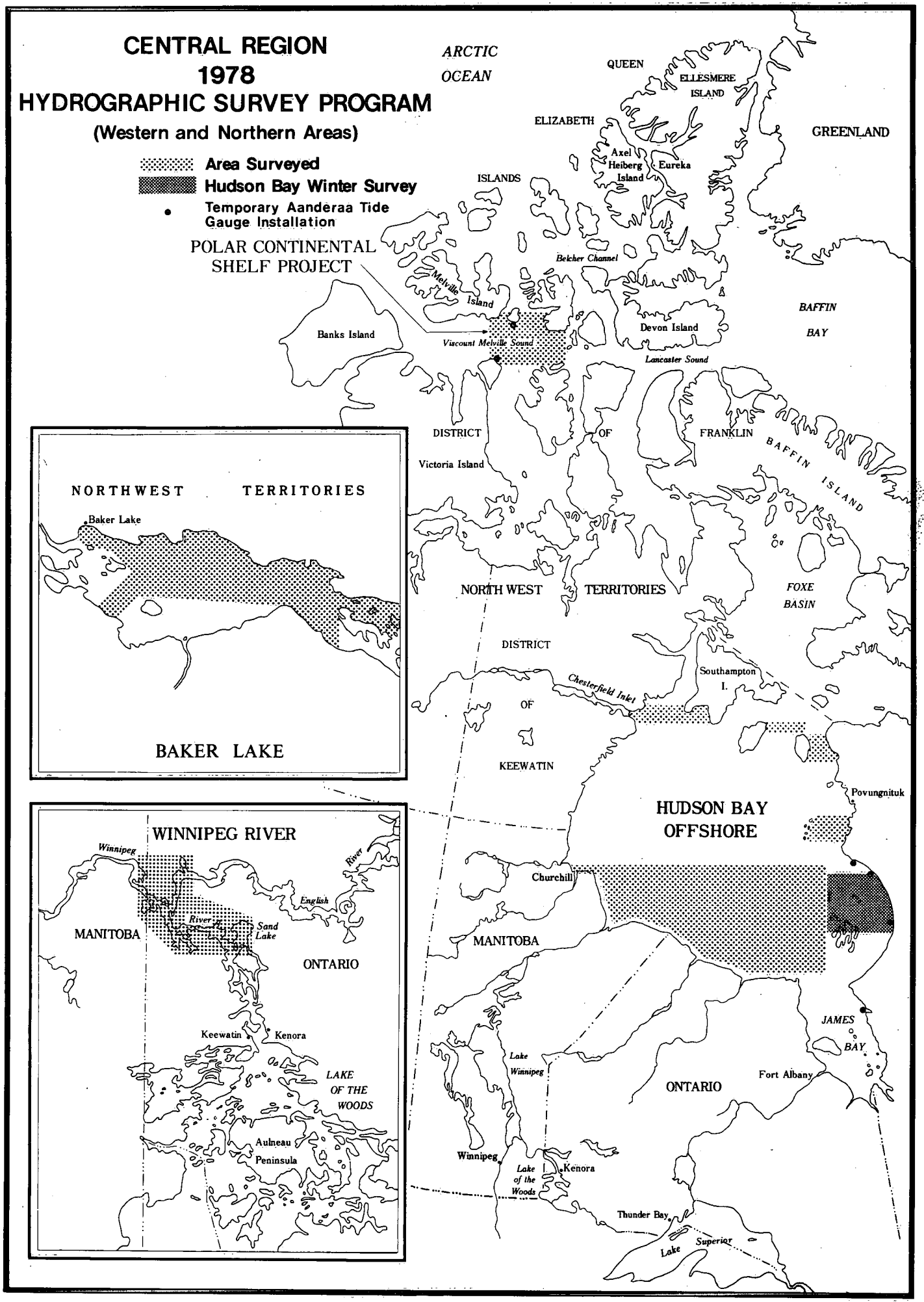

CENTRAL REGION
1978
HYDROGRAPHIC SURVEY PROGRAM
(Western and Northern Areas)
Area Surveyed
Hudson Bay Winter Survey
Temporary Aanderaa Tide Gauge Installation
POLAR CONTINENTAL SHELF PROJECT
ARCTIC OCEAN
QUEEN ELLESMERE ISLAND
ELIZABETH ISLANDS
Axel Heiberg Island
Eureka
GREENLAND
Bekcher Channel
Melville Island
Banks Island
Viscount Melville Sound
Devon Island
Lancaster Sound
BAFFIN BAY
DISTRICT OF FRANKLIN
BAFFIN ISLAND
Victoria Island
NORTH WEST TERRITORIES
FOXE BASIN
DISTRICT OF KEEWATIN
Chesterfield Inlet
Southampton I.
Povungnituk
HUDSON BAY OFFSHORE
Churchill
MANITOBA
ONTARIO
JAMES BAY
Lake Winnipeg
Fort Albany
Winnipeg
Lake of the Woods
Kenora
Thunder Bay
Superior Lake
NORTHWEST TERRITORIES
Baker Lake
BAKER LAKE
WINNIPEG RIVER
Winnipeg River
English River
Sand Lake
MANITOBA
ONTARIO
Keewatin
Kenora
LAKE OF THE WOODS
Aulneau Peninsula

Figure 2

Summary of 1978 Survey Activities, Central Region

Survey Area	Vessels	Positioning System	Field Data Processing
P.C.S.P.	2 tracked vehicles 4 helicopters	Decca - 6F M.R.S. III	Manual
Hudson Bay - Winter	3 helicopters	Decca - 6F	Manual
Hudson Bay - Offshore	NARWHAL (251')	Satnav/Doppler Sonar	Interdata Model 70
Baker Lake	2 Botveds (21') 1 Monark 1 helicopter	M.R.S. III	Manual
Winnipeg River	2 Botveds (21') WOODCOCK (26') PACER (25') 1 Whaler (17')	Sextant M.R.S. III	Manual
L. Erie-Coastal	NAUTILUS (34') BROCK (26') HYDRO II (26') 1 Whaler (17')	M.R.S. III	NavBox with Prototype Cartridge Recorder-Rams 8900
L. Huron-Coastal	2 Botveds (21') 2 Whalers	R.P.S. M.R.S. III	Manual
Georgian Bay - Limnogeology	AGILE (44')	R.P.S. M.R.S. III	Manual
L. Superior-Offshore	BAYFIELD (106')	Loran-C (Accufix) R.P.S.	Indaps
Revisory	L.F.G.B. #2 (18') Boston Whaler (17')	Sextant	Manual

TABLE 1.

examinations. In addition, software to permit optional recorder output was written. Further software refinements in 1979 include an increase in computational precision from 6 to 10 digits, increased flexibility in the operator data entry procedures and provision for multiple Mini-Ranger III transponder sites to permit the operator to easily optimize positional geometry.

Three NavBoxes were deployed in tracked vehicles and helicopters operating on Arctic surveys during the spring and aboard survey launches operating in the Great Lakes during the summer of 1978. The operational reliability and high user acceptance has led to a manufacturing contract with D.G. Instruments of Ottawa. An initial order has been placed for ten units to be delivered in the spring of 1979 prior to the summer survey season. Three of the new units will be deployed in Central Region with the remaining units going to the Atlantic Region.

Two prototype, microprocessor-controlled cartridge tape drives developed by Canadian Applied Technology were delivered in late March and were deployed with NavBoxes on the Lake Erie Survey. The tape drives have not performed as well as expected and were returned to the manufacturer twice to have faults corrected. Unfortunately, problems still remain and further field trials will be necessary.

Rho-theta

After preliminary studies in late 1977, hardware has been purchased to implement a semi-automated range-bearing survey system. On shore, a transit mounted on a tripod is attached to a digital shaft encoder and is manually trained on a survey launch. The shaft encoder output is converted to an angle and transmitted to the launch as a 'pseudo' range on channel B of a standard Mini-Ranger III while channel A provides true range. A NavBox aboard the launch will collect the range and bearing continuously and, on operator 'fix' command, will compute and print out time, range, bearing, and U.T.M. position as well as generating an event mark on the echo sounder graph. The system is expected to be ready for field trials in 1979.

Graphical Online Manipulation and Display System (GOMADS)

Sufficient hardware to implement the digitizing and interaction editing systems developed at CHS Headquarters for computer-assisted cartography was delivered in the late spring. A room in which to house the equipment was prepared and in mid-June the systems were installed. Unfortunately, staff shortages and hardware problems delayed system integration with the result that full implementation was pushed back from September to December. Once operational, the systems will see extensive use in final field sheet preparation as well as chart production.

Loran-C

Software support was provided to the Lake Superior survey to provide for Accufix input to an INDAPS logger for data recording and straight line navigation. Software was written to permit the use of a Motorola R.P.S. system to calibrate the Accufix chain for fixed off-sets and clock drift in areas where the two systems could be simultaneously received. Data processing software was also appropriately modified to accept Accufix input.

Tides and Water Level Section

Field Activities

1978 field activities began, for the Tides and Water Levels Section, with the installation of Aanderaa tide gauges as part of winter surveys in Viscount Melville Sound and Hudson Bay. The tidal records from gauges installed at Byam Martin Island and Stefansson Island in Viscount Melville Sound give, together with data collected in 1977, a clear picture of the tidal characteristics in this area, where little data previously existed. In southeast Hudson Bay, gauges installed at McTavish Island and Anderson Island returned good records, again from areas where little tidal data had previously been obtained.

The Section spent two weeks in the early summer completing the work, started in 1977, of measuring the hydraulic gradient on the Winnipeg River and establishing chart datum. Benchmarks were installed and

gauging sites and sounding zones established in advance of the hydrographic survey party.

Six Ottboro and four Aanderaa tide gauges were loaned to Central Region's Research and Development Division in support of their Chesterfield Inlet survey. The Section's Tidal Technician installed four of the Ottboro gauges and instructed field personnel on their operation.

Aanderaa gauges that were installed last summer at Fort George in James Bay and Inoucdjouac in Hudson Bay were recovered during September, each returning a full year of tidal data. At the same time, an Ottboro gauge was installed at the permanent gauging station in Inoucdjouac.

Gauges were loaned to McGill University during 1978 for scientific studies in the St. Lawrence River, to the Shore Processes Section for investigation of Burlington Beach, and to Quebec Region for hydrographic survey support.

Permanent gauging stations

Modernization of gauging station instrumentation was undertaken with the installation of Tidal Acquisition and Telemetry System (TATS) units at 5 stations - Goderich, Belle River, Port Colborne, Kingston, and Montreal Harbour - replacing the existing TELEX equipment.

Major reconstruction of the gauging stations at St. Joseph-de-la-Rive and St. Francois d'Orleans, on the St. Lawrence River, was undertaken this year. The gauge house at Pte. aux Trembles, located near a petroleum handling facility, was renovated to meet explosion safety standards. Major repairs are also being made to stations at Pt. St. Francois, Lavaltrie, and Contrecoeur, on the St. Lawrence River, and at Hull and Britannia on the Ottawa River.

Stations at Oshawa and Pt. Petre, on Lake Ontario, were discontinued after a survey of data users had established that they were no longer required.

Due to a recent reduction in the level of support available from Geodetic Survey of Canada in carrying out annual levelling programs at permanent gauging stations, it has been necessary to review this aspect of station operation. The benchmark net at each station site was reviewed from the point of view of reducing its size to 3 benchmarks, and the length of the lines required to level between the benchmarks and the gauge house. Working with the revised nets, Water Survey of Canada agreed to take on the annual levelling check as part of their task of operating the stations on behalf of CHS.

Publications

The Central Region Tides and Water Levels Section continues to publish the Great Lakes Monthly Water Level Bulletin on a monthly basis. Approximately 2,000 copies of each issue are mailed free-of-charge to subscribers.

A major project this year has been the compilation of a descriptive article on the surface currents in Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence River (above Montreal) for inclusion in the next edition of the Sailing Directions.

Coordinating Committee for Basic Hydraulic and Hydrologic Data

The Section represents CHS on the Vertical Control Water Level Subcommittee of the above Committee. Major projects undertaken this year include the planning for a re-evaluation of International Great Lakes Datum and the development of a method for computing general lake levels. A pilot study for the latter project was carried out by the Section this summer using a weighted averaging technique.

Tidal Instrument Development

The development of a very low power water level recorder and telemetry system has been the major activity of this group during the past year. The new gauge, which is intended primarily for temporary installations in support of hydrographic and oceanographic surveys, is based on the RCA Cosmac microprocessor. Similar in concept to TATS, which was developed for the permanent gauging network, the new system has extremely low power requirements to per-

mit long-term deployments in remote areas. Although the gauge is equipped with a digital cassette data logger, it is also capable of providing real time water level data to a hydrographic field party over a radio telemetry link.

Also undertaken this year was the development of an experimental tsunami warning station to be installed shortly at Bamfield Inlet on Vancouver Island. Employing two Digiquartz pressure sensors, for hydrostatic and barometric pressure, and a modified TATS unit, the station will transmit water level data to the GOES geostationary satellite.

In addition to its development activities, this Section also carried out ongoing programs including a calibration and maintenance service for field instrumentation, operation of the water level telemetry network throughout the Great Lakes and St. Lawrence River, and installation of TATS units.

Hydrographic Arctic Research Project

A program of applied research and development relating to Arctic hydrography is being carried out by the Canadian Hydrographic Service with financial support from Ministry of Transport's office of Energy R & D. This program, which is being coordinated by Central Region, includes investigations of Arctic positioning technology, solar and wind energy sources for survey operations, air-photo interpretation, and tide and current propagation in the Arctic Archipelago, as well as development of specialized Arctic survey equipment and tide gauging instruments.

To date, this program has focussed primarily on extending the remotely-actuated, spike-coupled spot sounding technique to helicopters. This technology, originally developed for tracked vehicles, greatly increases the efficiency of the survey operation by permitting the hydrographer to remain inside the vehicle while the sounding is being made. A helicopter mounted actuator and a specialized spike-coupled acoustic transducer have been developed under contract and will be used for the first time on a production survey in early 1979.

Just getting underway is a contract program to develop a fully digital echo sounder which uses a raster scan CRT as a visual display in place of the more conventional chart recorder. This new sounder will be used in helicopters with the actuator/transducer combination referred to previously.

A promising development which is nearing completion is the MARRS (Marine Arctic Route Reconnaissance System) project. This is an extremely high resolution sector scanning sonar designed to be lowered through a hole cut in the ice and to provide complete bottom coverage within its range. The prototype MARRS unit will undergo field tests early in 1979.

Another development being carried out under the Hydrographic Arctic Research Project is the development of a new generation of submersible tide recorders for the Arctic. This project, which is being managed by the Tidal Instrument Development Group, is scheduled for completion in 1979.

Plans for 1979

The Polar Continental Shelf Project will continue during the 1979 Winter Season but without the involvement of the Earth Physics Branch. New systems and techniques as developed through the M.O.T.-funded contracts will be used and evaluated as available.

As a charter vessel will not be available because of budget cutbacks, CCGS NARWHAL will be diverted from the offshore program to conduct a survey of the approaches to Chesterfield Inlet. However, some seismic work, in conjunction with the Atlantic Geoscience Centre (AGC), may be done in the southern part of Hudson Bay.

The Lake Superior and Lake Erie surveys will continue and the survey of the St. Lawrence River from Brockville to Gananoque will be resumed after a delay of several years. This latter survey will work closely with personnel involved with the Aerial Hydrography project and test flights over a part of this area are scheduled for 1979.

A two-year survey of Lake Nipissing will commence and Revisory Surveys will be conducted in those areas where chart construction action is scheduled for 1980.

The Tidal group have a full schedule for 1979. Field activities will include a major tidal survey of the Arctic Archipelago, both winter and summer, that will be supported by the MOT Arctic Transport Development funds. This survey will be a cooperative effort involving tidal sections in Atlantic, Central, and Pacific Regions. A current survey will be carried out in the upper St. Lawrence River in connection with a hydrographic survey in that area. The intention is to collect surface current data which will be useful to ships navigating the Seaway.

The installation of more TATS units in gauging stations is expected to take place as funds become available.

Further work on current atlases for various areas that are the responsibility of this Region will be carried out and will be integrated with the work of the recently-formed Current Atlas Working Group.

Hydrographic Development will continue software efforts in the area of computer-assisted cartography as users become more familiar with system operations and capabilities. A number of studies will be undertaken in relation to field data acquisition and processing. One will be an examination and field trials of cassette tape drives as an alternative to cartridge tape drives. The feasibility and cost of converting an INDAPS logger into a field data processing system will be undertaken. Interactive graphics software will be developed to permit more flexible and convenient field data processing and editing in the field. A small microprocessor-based processing system will be deployed on a manual survey to determine techniques for easily converting manually-collected data into digital form in the field. Strong support will also continue on Arctic research and development projects, particularly in the drawing up and monitoring of contracts to industry.

The decentralization of Chart Production personnel will be completed in the coming year with the transfer of the final position from Ottawa to the Region.

RESEARCH AND DEVELOPMENT DIVISION

Introduction

The main scientific programs of the Research and Development Division continue to be Physical Oceanography, Shore Properties Studies, and Environmental Assessment. In Physical Oceanography, although studies continued in the Bay of Quinte, the St. Lawrence River, and in Hudson/James Bay, we are shifting our emphasis to studies in the high Arctic. This shift in thrust was further supported by an announcement in early December of the proposed establishment of an Ice Research capability in Central Region. In Shore Properties Studies, we continued ongoing monitoring of 162 erosion stations on Lake Ontario, Lake Erie, and Lake Huron, in addition to specific studies at Port Alma, Bluffer's Park, Long Point, and Fifty Mile Point. In Environmental Assessment, we were involved with reviews of projects at Point Pelee, Long Point, and Oshawa and in further reviews of Eldorado Nuclear proposals. Field programs ranged from erosion studies on the Great Lakes to a winter oceanographic survey in Barrow Strait and included a major multidisciplinary shipboard survey in Chesterfield Inlet. In addition to technical support provided to our own projects, the Division continues to provide marine electronic support to other Divisions of O&AS as well as to other Services at CCIW.

During the year, research results were presented at several conferences, including the Liège Colloquium. Papers were published in the Hydrodynamics of Estuaries and Fjords, the International Hydrographic Review, Lighthouse, and in our manuscript and report series.

Members of the Division continue to serve on numerous boards and committees including the Western and Northern Regional Board, the Arctic Environment Steering Committee, the Great Lakes Basin Commission, the Regional Screening and Coordinating Committee of EARP, the Coastal Zone Subcommittee of the International Lake Erie Regulation Study, and the Canada-Ontario Coordinating Task Force on Shore Damage Follow-up Programs.

Physical Oceanography

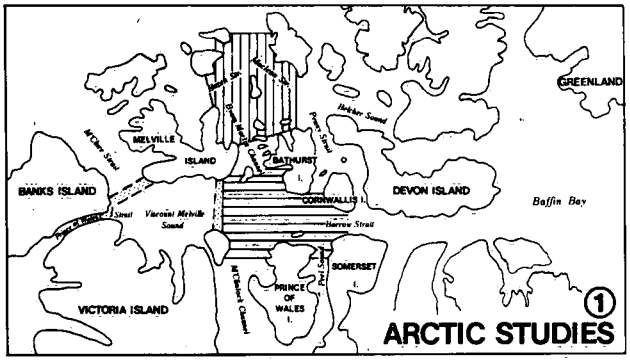
Physical oceanographic and limnological studies are conducted in the regions of Hudson Bay and James Bay, the middle estuary of the St. Lawrence River, Chesterfield Inlet, Bay of Quinte, and the Arctic. The Hudson/James Bay programs deal with the effects of hydroelectric developments on the aquatic system. The modification to the circulation of James Bay as a whole was studied analytically with the use of current and conductivity/temperature/depth data. Winter oceanographic studies are continuing, with emphasis on the plume of brackish water extending beyond the mouth of the La Grande River. This plume will be modelled numerically to predict changes in its vertical and horizontal extent, stability, and rate of entrainment in response to a four- to five-fold increase in runoff through regulation.

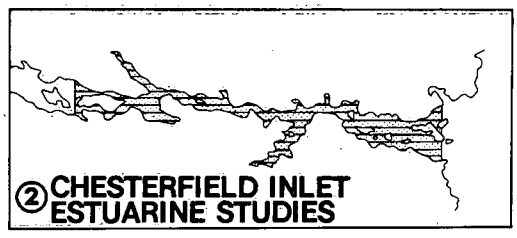
The current and CTD surveys of the St. Lawrence River estuary and Chesterfield Inlet (N.W.T.) have been completed and will be used to obtain the spacial and temporal variation in tidal heights, tidal currents, non-tidal currents, temperature/salinity structure, and internal wave structure. A two-dimensional salt intrusion and tidal propagation model is being developed and will use the Chesterfield Inlet data in order to study which physical processes cause the observed distributions. The internal wave structure and propagation observed in the St. Lawrence River data is being studied analytically.

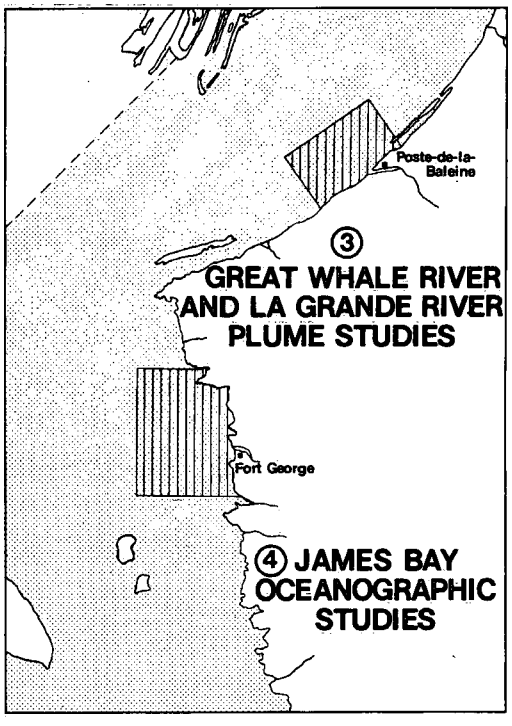
Since 1976, winter physical oceanographic surveys have been conducted in the Arctic. These studies reflect not only environmental concerns over the impact of oil spills or blow-outs but also are providing data which marine transportation and pipeline projects are using in feasibility and design studies. While the primary objective of these programs is to describe the circulation and the magnitude of tidal and non-tidal motion in the Archipelago, the scope will be enlarged to include air-sea-ice interaction studies with other agencies, notably the Atmospheric Environment Service (DOE) and the Ministry of Transport.

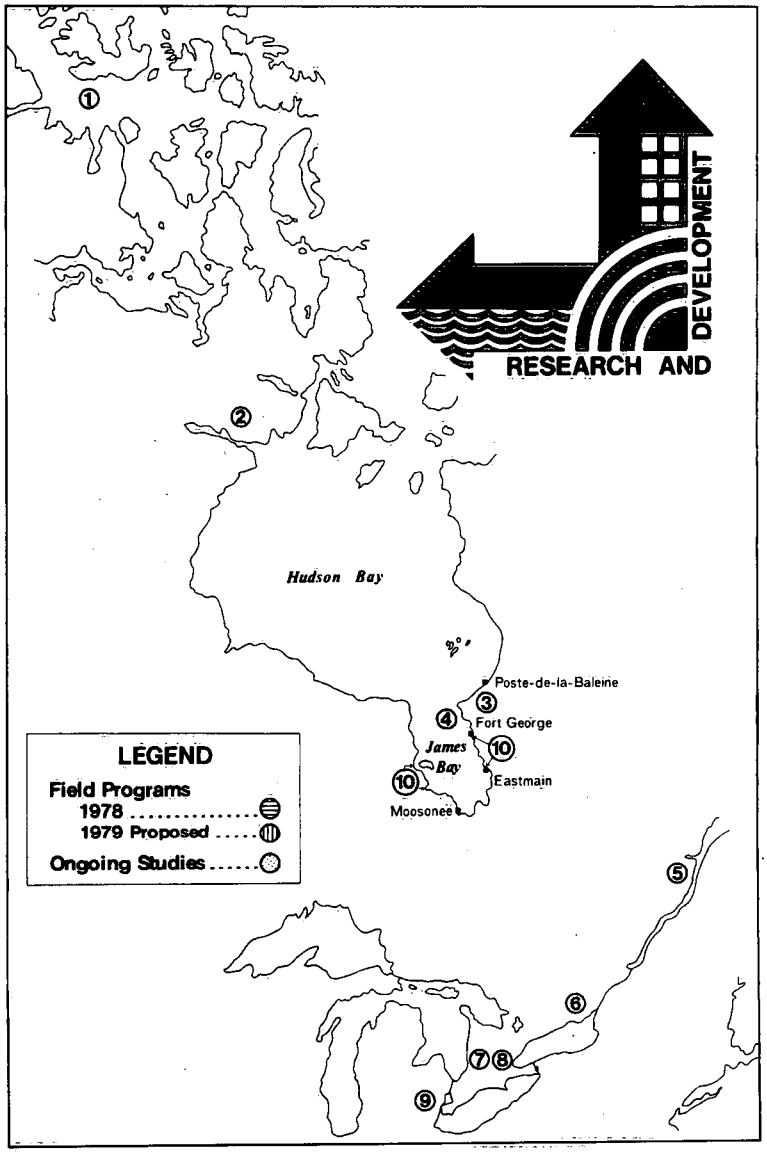
Bay of Quinte

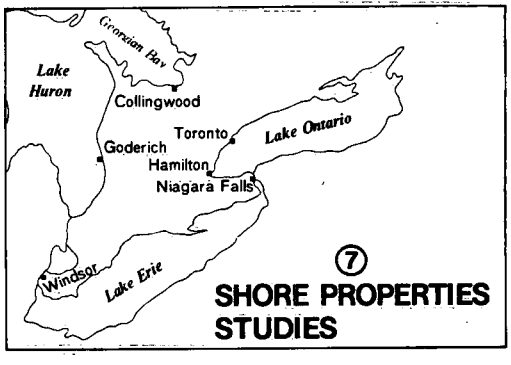
Hydrodynamic studies of the lower Bay of Quinte,

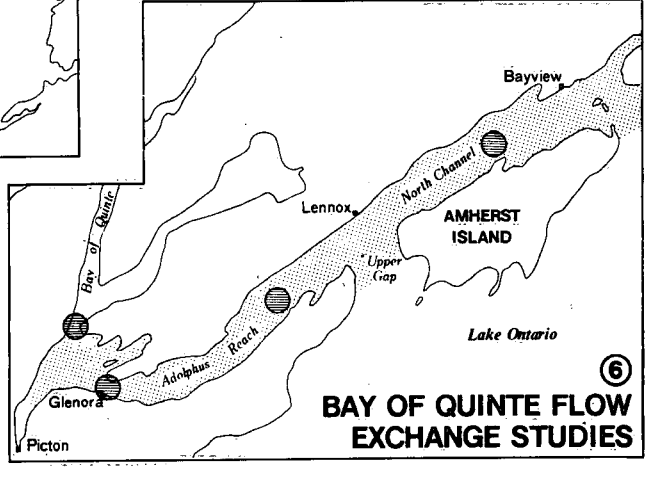












OTHER STUDIES

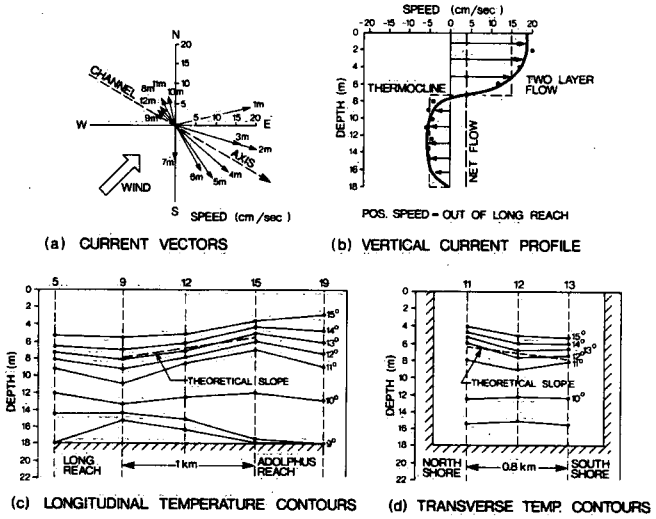
⑤ ST. LAWRENCE RIVER ESTUARY

⑧ ENVIRONMENTAL ASSESSMENT

⑨ LAKE ST. CLAIR STORM SURGE MODEL

⑩ JAMES BAY ESTUARINE EROSION

begun in 1976, have looked at water mass exchange processes with Lake Ontario and with the upper bay. The 1976 data revealed the existence of a two-layered, density-controlled flow exchange through the Glenora gap which was further investigated by observational work carried out in the past summer. Preliminary hand-held current and temperature profile observations of the Glenora gap are used to compare to the theoretical two-layered flow. Wind stress was shown to have the following effects: a deviation of the flow in the upper few metres away from the channel axis and toward the wind axis (Fig. a), and a movement of warm surface water from the Picton Bay-Long Reach basins to the western end of the Glenora gap. The latter phenomenon depressed the thermocline there (Fig. c) and drove the two-layered flow, shown in Fig. b, through the gap.



(a) CURRENT VECTORS (b) VERTICAL CURRENT PROFILE

(c) LONGITUDINAL TEMPERATURE CONTOURS (d) TRANSVERSE TEMP. CONTOURS

Bay of Quinte

A two-layered, open-ended model of flow through a strait was used to study the balance of forces. Using mean flow and temperature data from the figure, a theoretical thermocline slope of 2 m over 1 km was obtained (Fig. c). The principal balance of forces is between interfacial stress and pressure gradient. The cross-channel balance of forces was also examined and the computed interface slope compared with actual observations, (Fig. d). The balance was primarily between interfacial slope and Coriolis acceleration, but centrifugal acceleration was also included. The interface slope was calculated as 1.8 m in .8 km width.

Future work will consist of detailed analyses of the extensive current meter and temperature time-series records collected from May to September, 1978, in the central section of the Glenora gap, as well as in the Long Reach and North Channel sections. It is planned to use the data to develop a long-term, two-layered flow model with entrainment and to better resolve the internal oscillations in the lower Bay of Quinte.

St. Lawrence System Current Studies

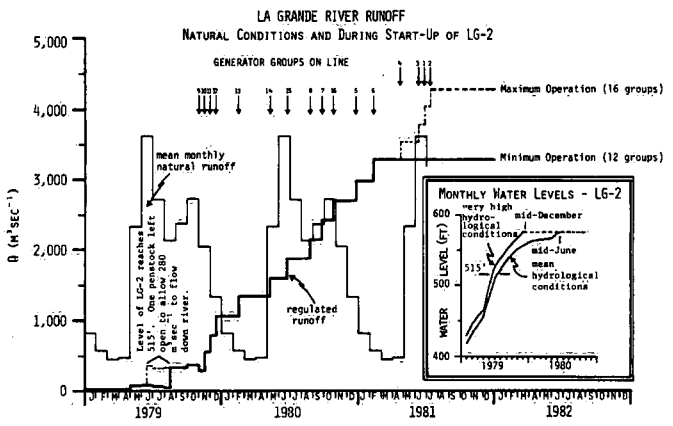
The St. Lawrence system of river, estuary, and gulf is of major importance to Canada. Approximately 65% of all Canadian shipping traverses this system, which provides access to 60% of the Canadian population. About 50% of the freshwater input to the gulf takes place in the middle estuary which extends from Ile aux Coudres to the Saguenay River. This runoff carries effluent from large population centres into the gulf (an exclusive Canadian Fishing Zone accounting by weight for 50% of all the Canadian sea fish catch).

During 1974, 1975, and 1977, surveys were carried out in the middle estuary gathering baseline physical oceanographic data to investigate the processes controlling circulation in the middle estuary.

Analysis shows that the partially-mixed estuary is very energetic with the data exhibiting a high spatial and temporal variability. The analysis of the current records (1974 and 1975), using both the traditional harmonic and admittance method, did not bring any order into the phase relationships between various records. The admittance method was used on shorter sections of a total record and revealed that the phase of the M_2 tidal current could vary by up to 33 minutes from one 10-day section to the next 10-day section. The CTD data from 13-hour stations were used to plot the isopycnal surfaces for sections across the river and showed large internal wave motion whose amplitude varied across the river. Moreover, the amplitude and phase changed from neap to spring tides. The analysis therefore has to include the effect of the internal wave field, and research is continuing into the generation and propagation of internal waves in the middle St. Lawrence estuary in order to explain the high variability in the current meter data.

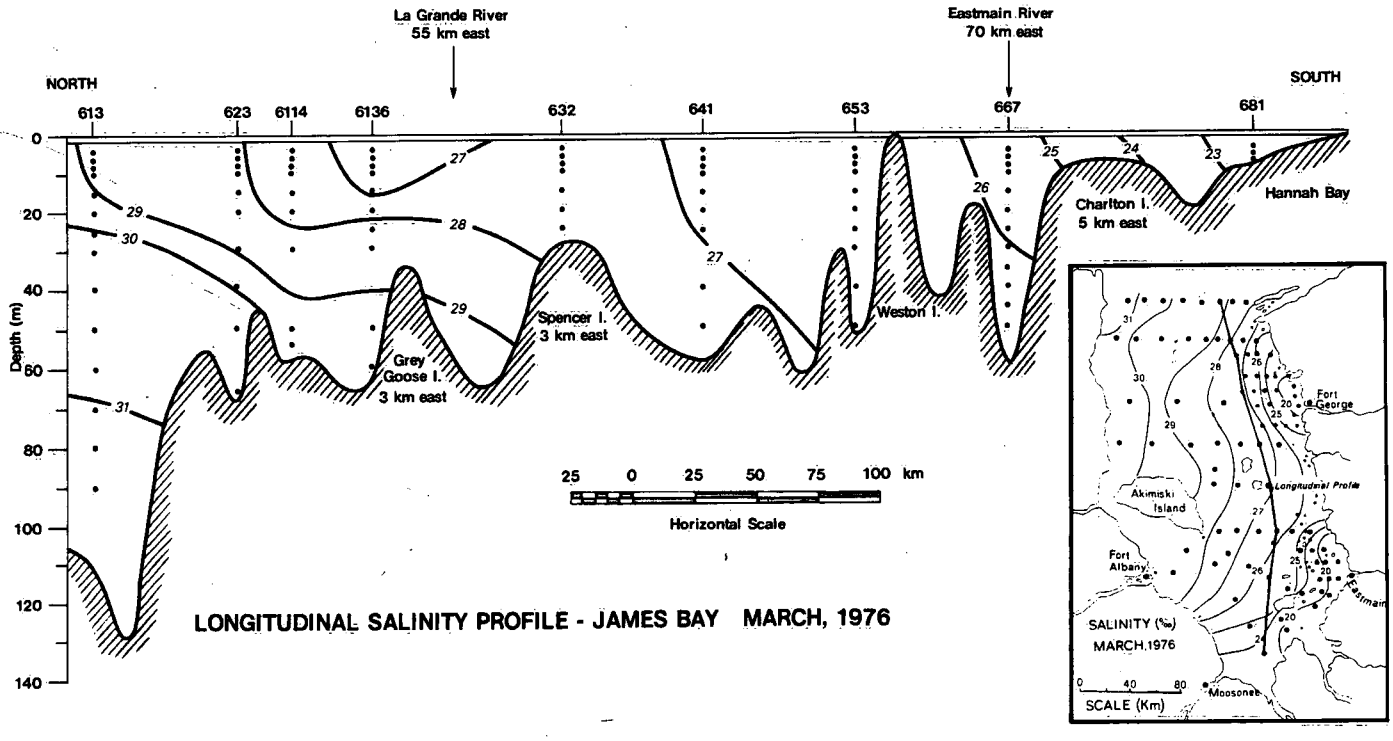
On November 27, 1978, the James Bay Energy Corporation closed the diversion tunnel at LG-2 and commenced filling the first and largest reservoir in the Complexe La Grande. This project will eventually generate over 13,000 MW of hydroelectric power. Central Region has been conducting physical oceanographic studies in James Bay to assess the changes to the marine and estuarine environment caused by runoff modifications associated with the project.

As can be seen in the following diagram, the hydrologic conditions of the La Grande River will be altered drastically. During the filling of the reservoir at LG-2, the river's outflow will be essentially cut off until late spring, when some water will pass through to maintain a viable habitat for fish in the lower reaches of the river. Beginning in November, 1979, and as each generator group comes on line, the river's outflow will increase until it achieves a constant value of about 3,400 m^3/sec, or an increase of 88% over the pre-project yearly mean. The effects will be particularly dramatic in the winter months when the river's runoff will increase over 500%, thereby doubling the entire freshwater input into James Bay for February and March.



The major portion of our studies has therefore concentrated in the winter months. The importance of freshwater runoff is evident in James Bay. As the relatively high saline water enters from Hudson Bay along the western coast, it is gradually diluted by the progressive addition of runoff from rivers along the southwestern, southern, and eastern coasts. The counterclockwise motion is reinforced by the Coriolis force, thereby restricting the outflow in a northward-flowing coastal current. The following longitudinal salinity profile shows that the eastern portion of the bay can be treated as an estuary for analytical purposes.

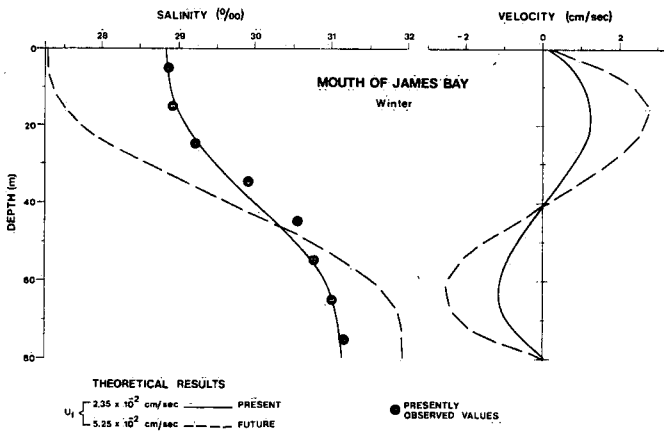
In order to predict the expected changes in current and salinity distributions by an analytical model, up-



LONGITUDINAL SALINITY PROFILE - JAMES BAY MARCH, 1976

stream salinity conditions are kept constant. The other input variable for the model is the mean salinity gradient which was estimated from the present winter and summer values and assumed to be linearly related to their corresponding mean drift velocity values.

The cross-sectional mean current speeds more than double from their maximum in and outflow values of 1.4 cm/sec to 3.2 cm/sec, respectively. The mean salinity structure becomes more stratified as the surface salinity value reduces by 1.25 °/oo and the bottom value increases by .3 °/oo. The increase in current reduces the surface salinity and brings water with a higher salinity further into James Bay. These are cross-sectional mean values and, as seen in summer data, they underestimate the surface values on the Quebec coast as the Coriolis effect is not taken into account. The summer outflow current values were twice as large on the Quebec coast as those for the mean values predicted by the model. When the winter outflow current values at the James Bay entrance are also doubled, then, under the present runoff rate condition, the outflow current value will be 2.8 cm/sec along the Quebec shore and, for the future runoff conditions, 7.5 cm/sec. At present, a tracer in the surface layer would drift from the La Grande River area to the entrance of James Bay (a distance of 90 km) in 37 days, while after completion of the hydroelectric development the time would be 14 days. The surface salinity distribution at the mouth of James Bay suggests that part of the surface outflow moves directly northward. Thus the Belcher Islands, 90 km away, could experience some dilution in the surface salinity. Even at a very slow drift velocity of 2 cm/sec, they could be reached in 50 days, while ice-covered winter conditions exist for at least 120 days between January and April.



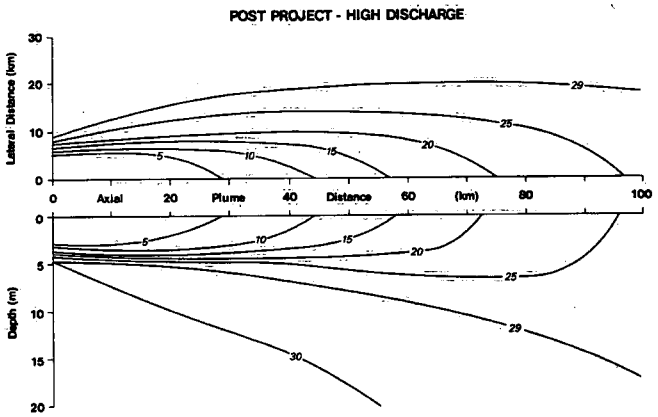
In addition to Complexe La Grande, two more hydroelectric projects are planned for the near future. The N.B.R. scheme (Nottaway, Broadback, and Rupert Rivers which flow into Rupert Bay in southeastern James Bay) will produce 8,500 MW and the Great Whale project in southeastern Hudson Bay will generate 2,500 MW. The cumulative effects of these developments, coupled with the Churchill/Nelson River project in western Hudson Bay, may be significant not only in the James Bay/Hudson Bay system but could also extend down the Labrador coast.

La Grande/Great Whale Plume Studies

Studies of freshwater plumes under an ice cover off the La Grande River, James Bay, and the Great Whale River, Hudson Bay, continued this year. These research and monitoring programs are aimed at investigating the offshore and inshore effects caused by alterations in natural river discharge by existing and proposed hydroelectric developments in the surrounding drainage basins. While no field observations were collected in 1978, considerable progress has been made in the analysis of past data and the investigation of analytical and numerical models of plume dynamics.

Such general properties of the La Grande River plume as accumulated volume of freshwater, plume flushing time (34 days), and a mean centreline velocity (1-2 cm/sec) were computed. It was found that the stream-wise advection in the La Grande plume was 10 times the stream-wise diffusion. Scale analysis showed that the advective and diffusive contributions to the total circulation changed from the inshore region (the river mouth area) to the offshore region. In the inshore region, the circulation is dominated by the river (i.e., volume addition), while offshore it is determined by the pressure gradient (differential dilution). A simplified integral equation model was developed for the inshore region to examine the effect of the river discharge rate on the depth of the freshwater plume. It found that the plume depth increases with distance from shore when the contribution to the circulation by the river discharge is larger than that of the density field (dilution).

For the offshore region, an advection/diffusion analytical model was developed to examine horizontal and vertical diffusion properties of the pre- and post-project plume. The simulated post project plume, shown in the following figure,has a higher vertical mixing rate and is more elongated than the simulated pre-project plume.

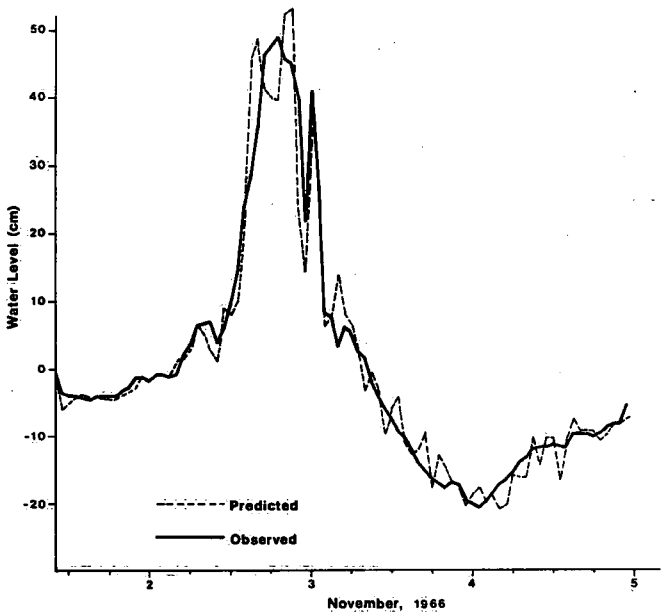


Since the above simple solutions do not permit coupling of the dynamics and the dispersion, a more physically realistic numerical model is being developed to study the plume dynamics and compare the results to field data. A five-week field program in January-February 1979 in James and Hudson Bays will obtain vertical velocity distributions and time-series velocity data, as well as salinity distributions. Two weeks will be spent off the mouth of the La Grande River, where the lack of a freshwater plume due to filling of the LG-2 reservoir provides a unique opportunity to collect background salinity, tidal current, and circulation information in northeastern James Bay. The last three weeks will be spent measuring vertical profiles of currents and density in the freshwater plume off the mouth of the Great Whale River to study its dynamics.

Lake St. Clair Storm Surge Model

A real-time forecasting technique was developed for predicting storm surges on lakes. The method used was statistical in nature, using water level and wind stress time-series to estimate a Box-Jenkins time-domain transfer function which relates the two variables. The transfer function model uses past and future wind-stress values as well as previous water level observations to predict future water levels.

The modelling technique was used to simulate storm surges on Lake St. Clair at Belle River. Water levels recorded at Belle River and wind-stress values obtained from meteorological observations at Windsor airport were used in the application. It was found that the Box-Jenkins model produced more accurate results than regression or analytical impulse response methods. For accurate prediction of Lake St. Clair Storm surges, it is essential that the previous water level history be taken into consideration and that an adequate representation for system noise be developed.



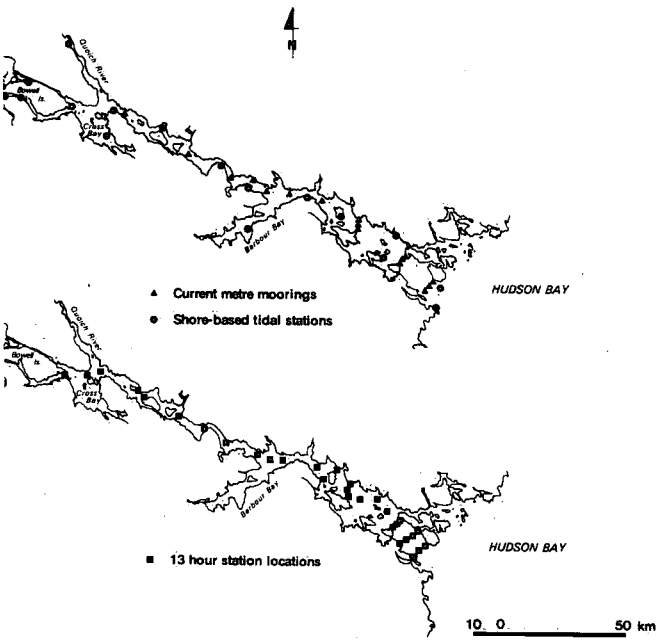
Chesterfield Inlet Oceanographic Survey

The 1978 Chesterfield Inlet oceanographic field program was designed to provide data for multidisciplinary research of the estuary. The program was divided into five sub-programs: 1) physical oceanography; 2) nutrient chemistry; 3) planktonic biology; 4) benthos; and 5) geochemistry. The study will provide a wealth of information on the marine environment of a sub-Arctic inlet which spans fresh water to marine conditions.

The physical oceanographic program consisted of 49 13-hour profiling stations, 20 current meter moorings, and 17 shore-based tidal stations. Tidal water level and velocity data will be required to ensure safe navigation should Polar Gas build the Eastern Arctic Pipeline, using Chesterfield Inlet as a shipping corridor during the construction period. Tide and current measurements will be used to extend the previous numerical modelling study of tidal propagation in the

inlet. Velocity, temperature, and conductivity data collected from the 13-hour stations and moorings will be used to describe mixing processes, non-tidal circulation patterns, and internal wave fields within the estuary. Knowledge of these physical processes is essential if the chemical and biological studies of the inlet are to be meaningful.

The baseline study of the marine chemistry and biology of the inlet, carried out in conjunction with the University of Guelph, will permit the determination of nutrient and biomass distributions. Samples were collected at 49 13-hour station locations. Species compositions of the phytoplankton and zooplankton populations will be determined and the community structures will be related to chemical and physical processes taking place within the estuary.



1978 CHESTERFIELD INLET FIELD PROGRAM

The benthic program, which was conducted in cooperation with the University of Toronto, will provide information on the kinds and numbers of shelled invertebrates inhabiting Chesterfield Inlet. In particular, it is desired to establish the gradation in marine ostracodes from marine to fresh water habitats.

In order to establish the chemical properties of sediments within the estuary, a geochemical study was conducted. Geochemical analyses will be performed on the bottom samples collected to determine concentrations of major elements, with particular emphasis on heavy metals. Differences in composition between freshwater and marine portions of the inlet will be examined. Furthermore, the compositions of the Chesterfield Inlet samples will be compared to those of samples collected in Hudson Bay and James Bay. Particle size analysis will be performed to provide information on the physical characteristics of Chesterfield Inlet sediments.

Data processing and analysis is already underway in most of the sub-programs. Once preliminary results have been obtained, it is planned to coordinate research in the various projects so that relationships between chemical, biological, and physical processes can be examined.

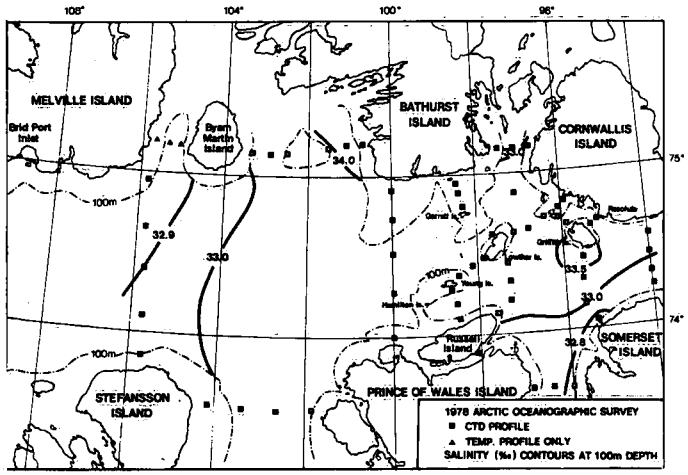
Arctic Oceanography

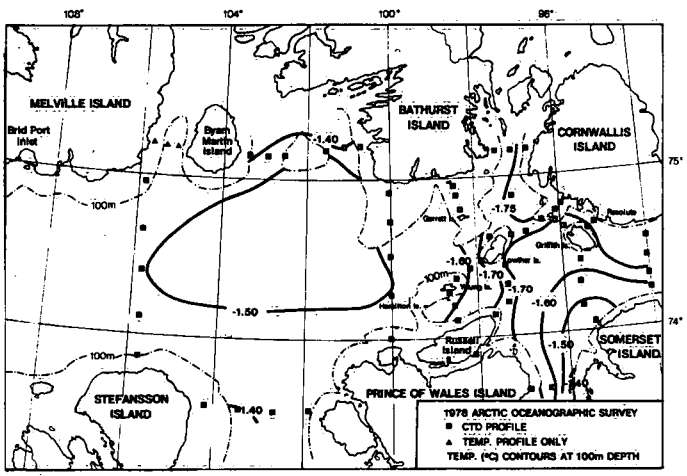
The 1978 Arctic oceanographic project concentrated on the transport and surface current distribution in the area west of the Barrow sill. The sill area is the shallowest part of the North West Passage and, with its arc of islands south of Bathurst Island, marks a change from a non-mobile ice cover to the west, Viscount Melville Sound, to a dynamic ice cover to the east, Barrow Strait. Much emphasis is being placed on Arctic marine transportation of energy commodities, pointing out the need for surface current data and related ice condition information. These data for the winter and spring periods are required for the design of ice breakers and ice-breaker tug and barge systems as well as for a real-time ice prediction model being developed for the Arctic.

To the east of the Barrow sill, the conductivity/temperature/depth results show that for both the surface layer (0-10 metres) and the 100-metre layer, higher salinity values are found toward the north. An intrusion of relatively low salinity water (32.8 $^{o}/_{oo}$) enters the area at the 100-metre depth between Prince of Wales and Somerset Islands and appears to turn eastward in Barrow Strait. In the western part of the survey area, a small westward decrease in salinity values was observed representing the Beaufort Sea water intrusion.

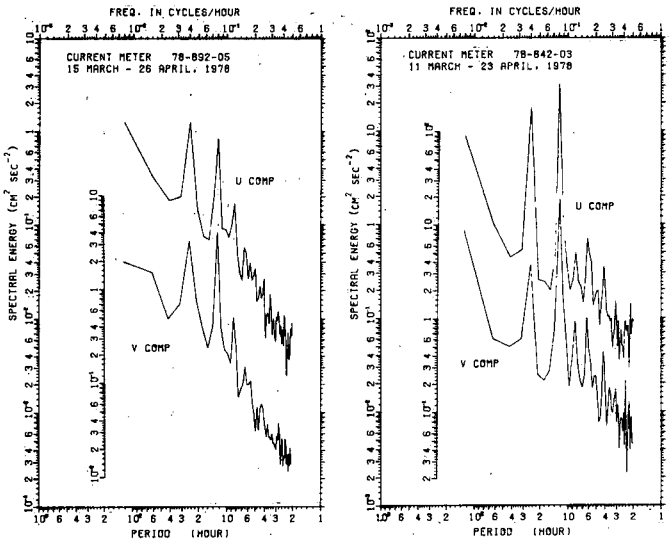
The temperature distribution at the 100-metre depth

level shows an intrusion of cold water from the north (less than -1.75°C) between Bathurst and Cornwallis Islands and an intrusion of relatively warm water from the south (more than -1.40°C) between Prince of Wales and Somerset Islands. The western part of the survey area doesn't show much structure, although somewhat colder water is found in the center of the area.





Currents are tidally-dominated and influenced by bathymetric effects. Records obtained just west of Bathurst Island in Austin Channel showed maximum speeds of only 12 cm/sec. The spectra are very similar in shape to those obtained in Penny Strait in 1976. The records from the western side of the Barrow sill resemble those found in M'Clure and Prince of Wales Straits in 1977. They exhibit higher speeds, sometimes over 30 cm/sec, and have significant diurnal and semi-diurnal components. The effects of the Barrow sill and the islands across it are evident in the higher frequencies, shown in the spectra as quarter-diurnal and possibly shorter periodicities resulting from over-tides.



The 1979 Arctic project will concentrate in the central Sverdrup Basin as Central Region continues to respond to oil and gas exploration activities in the far north.

Shore Properties Studies

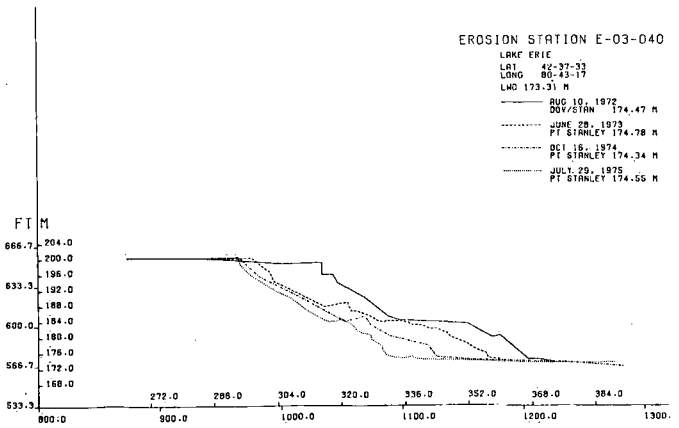
Since this Section has now passed its '7-year itch', it may be appropriate to examine the role of Shore Properties Studies in coastal zone management. Its early beginnings lie in the International Joint Commission's 1966 International Great Lakes Levels Board Task Force investigating the effects of water level regulation on shore property. This study recognized the dearth of basic data and therefore produced the Shoreline Inventory and original data base to at least fulfill the needs of the Levels Board study. It was soon realized, however, that more comprehensive shoreline information regarding rates and processes of erosion was necessary, as well as data on socio-economic impacts. The nature and extent of these impacts and damages for the 1972-73 period was assessed by the Canada-Ontario Great Lakes Shore Damage Survey, while the Coastal Zone Atlas provided an inventory of shoreline information from Port Severn in Georgian Bay to Gananoque on the easterly end of Lake Ontario. A program to monitor erosion was continued to fill the need for specific information regarding rates and processes of erosion.

In summary, the history of Shore Properties Studies lies in the early collection of data for specific Great Lakes Levels Board purposes. Recognition of shoreline problems sustained interest, so a more comprehensive survey of erosion and damage was completed. The survey demonstrated the need for a continued study of

basic erosion data at variable stages of lake levels as well as a number of other related projects aimed at improving the management of coastal resources. This extended program involves public awareness projects and the publication of remedial measures and data meaningful to riparian property owners, as well as to shoreline resource managers and municipal planning boards.

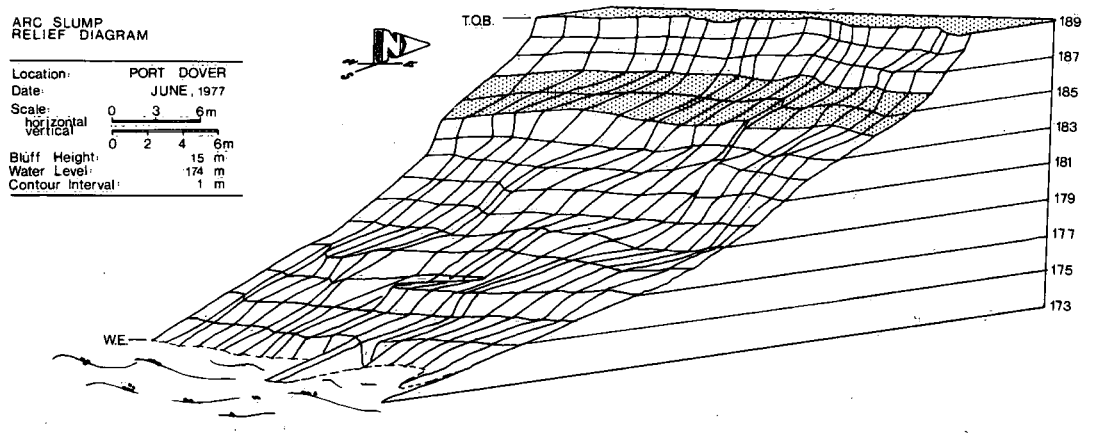
This overview encompasses cooperative work done by many agencies of both the federal and provincial governments. A summary of O&AS Shore Properties Studies' involvement follows.

This was the third year of the five-year Shore Erosion Monitoring program which serves as the basis for many of the other projects. Its aim is to provide qualitative and quantitative information on the rates and processes of erosion for the Canadian shoreline of the Great Lakes. This is accomplished by the annual measurement of 162 locations, both onshore and offshore, which are intended to represent the entire erodible shoreline. Intermediate areas are documented by sequential oblique photographs but this year, for the first time, the shoreline was taped using a video tape recording system for the Lakes Ontario, Erie, St. Clair, Huron, and Superior shorelines. Also new this year, a quick survey of vegetation at each monitoring station was included to add to the information available in assessing the rate of erosion. In conjunction with the study of erosion and accretion on such a large scale as the Erosion Monitoring program, smaller studies of specific areas or processes are necessary. These include a survey of a classic deep-seated arc failure near Port Alma and a continuing study of the life history of a slump, with some toe protection, near Port Dover.



With the advent of headland technology on the Great Lakes, examination of the headlands at both Bluffer's Park at Scarborough and the one at Fifty Mile Point near Grimsby has begun. Although the survey at Bluffer's Park commenced after construction started, initial surveys for Fifty Mile Point were early enough to allow a view of the pre-construction environment and, in the future, an analysis of the impacts and effectiveness of this technique.

In tandem with the Scarborough headland study, methodological alternatives are being examined. Principally, a method to digitize and quantitatively assess bluff erosion from 1946 to present, using contour maps developed from air photographs, is being compared to the traditional cross-sectional profile technique. Dependent on accuracy requirements, this method may



be economically attractive in this special type of high-bluff, extensively-developed area.

At Point Pelee, two concerns are being addressed. Firstly, the overall problem of erosion of this unique landform is being monitored on a continuing basis. The second is a more immediate problem; a breach of the barrier beach threatened the marsh and possibly nearby farmland dyking. A berm of artificial fill was constructed this year for Parks Canada, and the impact and effectiveness of this structure is being monitored and assessed.

The collection and analysis of the aforementioned information is vital for coastal zone management, but it was never intended to be an end unto itself. To assist in the meaningful use of the data, this Section has participated in a number of Canada-Ontario joint projects. The 100-year Flood and Erosion Prone Area Maps have been published and distributed for local zoning and planning purposes, and a joint Shore Management Study continues with its aim to be a model for similar studies which attempt to develop activities for proper coastal zone management on a regional basis.

In addition, public meetings are attended and displays and brochures are published to aid shore property owners and local planners in coping with the coast.

Finally, interest in the shoreline also extends to other geographical areas. Work at the James Bay estuaries of Eastmain and La Grande, as well as at Akimiski Strait, attempts to gather baseline information prior to any development and to assess impacts to the shoreline from increased discharges from hydro-electric projects such as the La Grande River Power Development.

Environmental Impact Assessment

Through the Ontario Regional Screening and Coordinating Committee (RSCC) of the federal Environmental Assessment and Review Process (EARP), there were a number of development proposals which were reviewed for potential detrimental effects to the environment. Assessments under EARP are based on a self-evaluative approach whereby the proponent determines whether or not a project is a candidate for the federal review process. The RSCC, however, encourages the proponent to consult with it in making this judgment. Fisheries and Marine Service (FMS) - subsequently changed to O&AS Central - participates primarily in assessing the significance of impacts of those projects related to the aquatic environment, including shoreland.

During the year such development proposals included federally-funded shore protective works, marina and harbour construction and expansion projects, a pipeline crossing of an international waterway, proposals for 2 various ice control works to be constructed in the St. Lawrence River in relation to an overall extension program of Great Lakes' winter navigation, and a water-based site for a new uranium hexafluoride refinery of Eldorado Nuclear Limited.

Following is a summary of those reviews in which FMS played a more significant role due to some of the ongoing work of the Division.

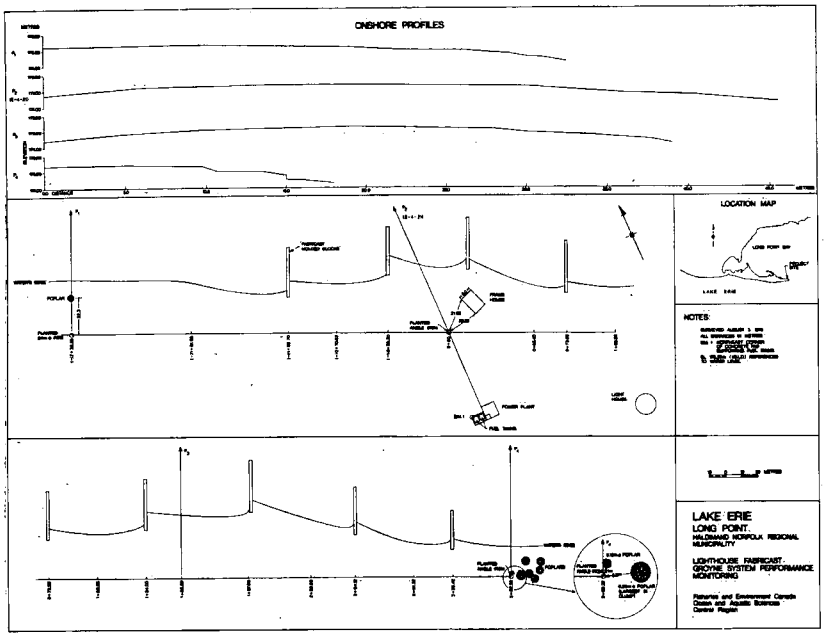
Point Pelee

One of the most significant advances in Great Lakes coastal zone management occurred when Parks Canada revised a massive structural protection scheme to one of artificial nourishment (sand replenishment). Throughout the history of beach erosion at Point Pelee, various structural methods have been attempted but have had only limited remedial effect. The present beach restoration plan resulted from an interservice review late last year by FMS, EMS, and EPS. Periodic surveys are being undertaken by FMS and Parks Canada in order to assess the stability of the newly-added beach material.

Long Point

Continuous erosion of the beach at the tip of Long Point, fronting the Ministry of Transport lighthouse facilities, resulted in the construction of eight low-profile groynes. This type of structure reduces erosion by building up the existing beach by trapping the natural supply of sediment moving along the shore. The project proposal was reviewed by an interservice group consisting of representatives from FMS, EMS,

EPS, and CWS, which expressed concern for the impact of the groyne structures on adjacent property and consequent effects to the ecology of the shorezone.



Long Point Groynes

Some changes were incorporated into the design of the structure as a result, including a recommendation that the sand required to build the groynes be removed from the extreme tip of the Point. This location was preferred to the proposed sand dune areas, as it is constantly being renourished by longshore sediment from the eroding bluffs to the west and would, therefore, have little potential for permanent environmental disruption.

A monitoring program to assess the effects of the groyne system on MOT property as well as adjacent Canadian Wildlife Service (CWS) property is being undertaken with support from the Shore Properties Studies Section of FMS. Three surveys have been undertaken since construction in July, each of which indicates a loss of beach material.

Oshawa Harbour

Oshawa Dredge Spoil Containment and Landfill Reclamation Area

A 63-acre landfill project is proposed for the waterfront at Oshawa on Lake Ontario. The present concept facilitates an expansion of industrial lease property available to the Oshawa Harbour Commission and disposal of contaminated sediments from maintenance dredging activities in the present harbour. Eighty per cent of the 1.6 million cubic metres of material

required for the landfill will be contributed by levelling of the shoreland at the site, while the remainder will be provided from the maintenance dredging.

The impact of the project on the stability of the barrier beach fronting Oshawa Second Marsh (considered the most significant marsh and wetland habitat on the north shore of Lake Ontario by the Minister of Natural Resources and CWS authorities) is a major environmental concern. It is particularly important for migratory and resident waterfowl and shorebirds and also provides spawning and rearing habitat for a variety of sport and forage fish.

Because the Oshawa Harbour Commission is depending upon significant federal assistance, and since there is considerable public interest for the preservation of the marsh, the RSCC is presently reviewing the landfill proposal. The fill is to extend 500 m offshore and consequently has the potential to alter water circulation and sediment transport processes which are important parameters in sustaining the existing quality of the marsh.

Eldorado Nuclear Limited

Following rejection of the Port Granby site by the EARP Panel early this year, ENL has produced an Environmental Impact Statement for each of the three possible sites upon which it plans to build a new $100 million uranium hexafluoride refinery. The sites under consideration are Port Hope, Sudbury, and Blind River, which are essentially non-agricultural in character. Technical review by the RSCC of the Impact Statements was undertaken within a constrained time period (6 weeks) in order to meet Panel deadlines. The EARP Panel will present its recommendations early next year on the acceptability of each of the three sites following review of the RSCC report and other submissions presented at public hearings.

Small Craft Harbours

Other reviews undertaken this year were for marina developments under the Marina Policy Assistance Program administered by Small Craft Harbours Branch of FMS. Those requiring extensive landfill or structural armouring of an eroding shore were the most significant in terms of potential environmental impact. These included a preliminary review of water quality and erosion data for a scheme by the Hamilton Region Conservation Authority to construct a landfill spit to extend 500 m offshore and occupy 20 acres of the foreshore at Fifty Mile Point on Lake Ontario; a 350 m breakwater to be constructed by Devitt Development Ltd. for marina and erosion protection at Stoney Creek on Lake Ontario; and a landfilling proposal of a federally-owned waterlot for Bewdley Waterfront Park on Rice Lake.

Canada-Ontario Great Lakes Shore Damage Survey Follow-up Programs

Public Awareness Program

Work was completed for a new information booklet entitled "Shore Property Hazards" to be released early in the new year. It is aimed at cautioning prospective buyers of shore property of the potential hazards. The booklet provides a brief description of physical features or indicators to assist in evaluating the property's susceptibility to flood and erosion. Various recommendations in the selection of structural and non-structural protective measures are also presented.

Shoreland Management Study

Throughout the year, work continued on the Canada-Ontario Shoreland Management Study being undertaken in Essex County on Lake Erie. The Section was primarily responsible for evaluating the property damages from erosion incurred under various management scenarios for the 25-, 50-, and 100-year planning periods. This involved calculation of depreciation losses for buildings within a short distance of an eroding bluff at the end of a planning period, as well as direct erosion damages.

Examples showing detrimental effects to the physical and ecological regimes in response to structures placed in the shorezone were also prepared for input to the multidisciplinary study.

Results of the study are presently being prepared in

the form of an Overview Report. This report outlines, in general terms, the study procedures with: 1) Guidelines (as appendices) to assist coastal agencies on the Great Lakes in selecting management alternatives for their particular reach of shore; and 2) a Site-Specific Study recommending solutions for reducing erosion and flood damages for the study area in Essex County based on environmental and economic benefits only.

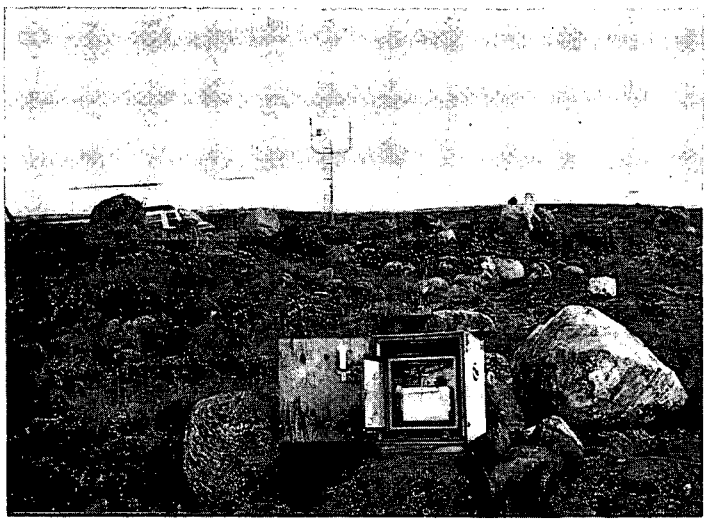
Program Support

Three of the four Sections of Program Support, Ocean Instrumentation, Ocean Operations, and Computer Programming, exclusively support the activities of the Research and Development Division. The fourth, Survey Electronics, provides most of its support to the Canadian Hydrographic Service and to other users at CCIW. During 1978, two major oceanographic surveys were conducted and support was provided to several other ongoing projects. In addition, there were several successful instrument development programs in Ocean Instrumentation and in Survey Electronics. During the year, software for the Hewlett-Packard (HP) 9825 for field data collection was perfected and additional software was developed for the Interdata 70. Areas of major emphasis in 1979 will include computer graphics, a profiling current meter, and continued work on solar power.

Ocean Operations Section

During 1978, Ocean Operations supported two major oceanographic programs; the high Arctic (Viscount Melville Sound) and sub-Arctic (Chesterfield Inlet). The Arctic oceanographic project entailed the use of a Twin Otter aircraft to place current meters and tide gauges at various locations in the west Barrow Strait area and to provide logistics support for 13-hour CTD stations, while a Bell 206B Jet Ranger helicopter was used in the CTD survey. Modified Aanderaa current meters were moored from the ice surface utilizing 1½" O.D. aluminum pipe to depths of 50 m. This pipe was connected in 10-foot sections to depth and, as the current meters required a non-magnetic reference, the mooring was aligned at the surface by using the Twin Otter gyro compass. Tide gauges were moored through a single 9"-diameter ice hole by using lead weight as an anchor and 8"-diameter, five-foot, cylindrical sub-surface buoys as the instrument supporting buoy. These methods to moor tide gauges and current meters proved quite successful and both systems of instrumentation installations will be used in 1979. The Guildline Mark IV CTD probe was again successfully utilized to do the single and 13-hour CTD casts with a total of 96 single casts and 60 time-series profiles at four stations being completed.

The Chesterfield Inlet survey (July 14-October 10) was by far the largest and most complex oceanographic survey carried out by the Division. In addition to physical oceanography, the program consisted of nutrient chemistry, planktonic biology, benthos, and geochemistry studies. The program was conducted from the charter vessel MV PETREL which had been fitted with a helicopter deck and from Mon Ark launches carried by PETREL.



Tide Gauge - Chesterfield Inlet

The project required the installation of 20 current meter moorings during the three-month survey, along with collection of several hundred biological samples, 63 single CTD profiles and 49 13-hour CTD and current meter profiles. Aanderaa current meters were used for the moorings and a Guildline Mark IV probe combined with Endeco speed and direction sensors were interfaced to an HP 9825A for CTD and current measurements. The helicopter, an MOT Bell 206A Jet Ranger, was used to install weather stations and tide gauges throughout the Inlet. The launches were utilized to collect CTD and bottom samples at locations inaccessible by ship. Although problems did arise with moorings due to high currents, all were retrieved and

redeployed without any major incidents.

Ocean Instrumentation Section

During 1978, Ocean Instrumentation supported two oceanographic surveys, one in the high Arctic and the other in Chesterfield Inlet. The Arctic project was supplied with 14 modified through-the-ice Aanderaa current meters and two Guildline Arctic Mark IV CTD helicopter packages and was also field-supported by an Instrumentation technician. During the survey, assistance was given to Guildline Instruments Ltd. in field testing their new low-cost CTD system.

The summer shipboard survey of Chesterfield Inlet, N.W.T., was the Section's major effort of the year. This project was supplied with 30 Aanderaa current meters and peripheral equipment for in-situ time-series measurements. For CTD and current profile measurements, two Guildline Mark IV CTDs were modified to be neutrally buoyant, and speed and direction sensors were installed. The data from this device were combined with a real-time clock and header information at the surface and fed to the HP 9825A for selection and processing. Four man-months of instrumentation field support were supplied to the project.

The usual supply of equipment and personnel services to other Regions and Services continued throughout the year. Several small projects were supported with the main effort in this area being to the Institute of Ocean Sciences at Patricia Bay for the supply and calibration of CTD devices.

Year-end work included calibration and maintenance of 16 through-the-ice Aanderaa current meters and two Guildline Mark IV CTD systems for the James/Hudson Bay and high Arctic projects. Extensive effort through the December/January period completed the design, development, and construction of two in-line profiling Aanderaa current meters for through-the-ice on-station work for the James/Hudson Bay and high Arctic projects. These devices contain two compasses, one for case orientation and one for vane alignment. Repeated tow-tank testing of the instruments revealed a threshold in the area of 2.5 cm/sec.

Our planned projects for 1979/80 will be centered around the long-term development of a streamlined 3-axis, low-threshold current meter CTD package for use in high Arctic environments.

Computing and Data Processing Section

During the year, the Computing and Data Processing Section continued its support of oceanographic field survey programs and scientific research activities in the Division.

Software developed early in 1978 and in the previous year was used successfully for in-field quality control, data reduction, and editing of CTD data for the 1978 Arctic survey. Use of this software enabled the scientists to publish a data report within a relatively short time after survey completion. The same software will be used in the 1979 James Bay and Arctic surveys.

In support of the 1978 Chesterfield Inlet survey, software was developed for the HP 9825A programmable calculator to perform in-field processing of CTD data. The production of listings and plots of selected data enhanced the ability of scientific and operational personnel to make decisions while in the field concerning the conduct of the survey.

Early in the year, hardware and operating system software modifications (to O&AS specifications) to the Division's Interdata Model 70 computer were completed by Canadian Applied Technology. These changes enhance the system's capabilities and will facilitate its use as an in-house minicomputer dedicated to oceanographic data processing.

The first new application developed for this system was a means of transferring CTD data from Hewlett-Packard data cartridges to 7-track magnetic tape. This procedure is necessary because further processing (beyond what was done in the field) and analysis of data was usually carried out on the CTD 3170, and magnetic tape was the only common storage medium which could be used. The method was successfully used to transfer 1978 Arctic survey data from cartridge tape to the data base on the CCIW computer.

In addition to extensive use of the CCIW computer centre, the Division also had access to the Honeywell 66/60 system at the University of Waterloo. This computer was used primarily for statistical modelling applications because of its extensive library of specialized analytical programs. A CRT terminal and printer were purchased in support of this work and to enable future remote time-sharing access to the CCIW computer system. During the year, the Division received approximately 20 man-months of programming and data processing support from the Data Management Section of the National Water Research Institute. A considerable part of this effort consisted of consolidation and documentation of previous programming work and resulted in two technical reports. New developments included a system to digitize and calculate the area and volume of shoreline physical features such as bluffs from contour maps. This information is then used to study physical changes such as erosion rates.

Data processing support was provided for several oceanographic surveys including Chesterfield Inlet 1977, St. Lawrence River 1977, Arctic 1977, Great Whale River 1977, Arctic 1978, and the Bay of Quinte project. In some cases, the work will continue in 1979.

Continuing data processing support was also given to the Shore Properties Studies Section. This consisted of digitizing and plotting of onshore and offshore erosion monitoring profiles measured at various stations in the Great Lakes, digitizing and processing related to headlands erosion monitoring studies using contour lines (e.g., the Scarborough Bluffs), and general clerical duties in support of the Section's programs.

At the year's end, the Section was in the midst of developing software for the HP 9825A to provide data processing support for an Aanderaa profiling current meter. This software will provide in-field data quality control, data reduction, editing, and plotting and will be used in the 1979 James Bay/Hudson Bay and Arctic surveys.

In 1979, the Section's development activities will concentrate on two areas. Because of the planned upgrading of the CCIW computer centre (to a CDC CYBER 171), considerable time and effort will be required to convert the Division's computer programs to the new system. In some cases extensive program revisions will also be carried out at this time. The other major area of interest is the development of applications software for the graphics terminal to be delivered in early 1979. The first major application planned is the interactive editing of time-series and CTD data.

Survey Electronics Section

Survey Electronics continued its electronic support to O&AS, other Services at CCIW, and external agencies. With the increasing utilization of sophisticated electronics, serious strains have been put on the resources of the Section. The group now services and supports more than $3.5 million worth of electronics. In addition to overhaul and maintenance and equipment installations, technicians were provided to Hydrographic surveys in the Arctic, at Baker Lake, on CCGS NARWHAL in Hudson Bay, at Rossport on Lake Superior, and on Manitoulin Island.

In support of the field equipment and survey requirements, considerable development work was again undertaken this year. Modifications were made to the EDO 9040 sounder including improvement to the paper advance drive. In order to improve the stability of the stylus speed on the Raytheon sounders, a microprocessor speed control card was developed and will be tested in 1979. In addition, a shallow water, high-accuracy, high-stability echo sounder was developed to measure sediment drift. The sounder, which employs a transducer mounted 1 m off the bottom, has a resolution of better than 1 cm.

The alternate energy project for Arctic electronic gear received added stimulus this year with infusion of funds from MOT and broadened in scope to include power sources for navigational aids. Many government departments and companies in private industry are providing assistance and taking an active interest in the work, since the results will be applicable to a wide variety of cases. Solar electric systems are being prepared for field testing in the Arctic in 1979. As well, extensive laboratory testing has begun this year and will continue into next year. The data gathered will be used to optimize performance and economy for

a wide variety of future systems. Also, it is anticipated that some of the systems being tested will be available for use in powering survey transponders during the 1979 Polar Continental Shelf Hydrographic Survey and will provide an immediate benefit by reducing helicopter time needed to service transponder sites.

During 1978, the Electronics Section designed and developed a micro-computer-based data display unit for Ocean Instrumentation Section. This display can be used to view extra channels of data in corrected scientific units from a modified Guildline Mark IV probe. The display unit was developed around off-the-shelf micro-computer modules and constructed for a fraction of the cost of a new Guildline deck unit. The Section also designed and constructed a timer for firing Aanderaa current meters at accurately-controlled intervals. This will facilitate accurate through-the-ice profiling of low currents.

Last year's work on developing a short Loran-C antenna came to fruition this year on the Lake Superior Hydrographic Survey. Antenna towers, designed on the basis of that study, were erected at Rossport and Marathon. They performed exactly as predicted, resulting in a useful range for the system of about 150 miles. Performance of the system was also enhanced by a small blue box developed in the shop this year. This device made it possible to operate in the Rho-Rho mode using conventional (inexpensive) receivers with no loss of lock due to lost signal. Because of these developments, Loran-C can take its place among the resources of Central Region and the Electronics shop takes pride in its role in bringing this about.

GREAT LAKES BIOLIMNOLOGY LABORATORY

Introduction

The Great Lakes Biolimnology Laboratory (GLBL), at the Canada Centre for Inland Waters, conducts a research program on the relationships between water quality and aquatic resources in the Great Lakes. Excess nutrient loadings, increased primary production and altered species composition at all trophic levels constitute "cultural eutrophication", which continues to be examined on a regional and local basis using a variety of approaches. Studies initiated in 1973 under the terms of reference of the Canada/U.S. Agreement on Great Lakes Water Quality, to determine the effects of more recent perturbations such as the discharge of heated effluents from thermal generating stations, destruction of larval fish in pumping and cooling systems and contamination of the aquatic environment by persistent toxic substances were carried on in FY 1978/79. Research into the effects of land-use activities on the aquatic environment under the auspices of the Pollution from Land Use Activities Reference Group (PLUARG) was completed this year with the production of a final report and several technical reports.

In addition to its research activities, GLBL provides scientific and technical expertise to several inter-agency and inter-departmental committees such as the Surveillance Subcommittee of the IJC, Working Groups associated with EARP (Environmental Assessment and Review Process), Great Lakes Fishery Commission, etc.

The work of the Great Lakes Biolimnology Laboratory is divided into three main programs: 1) Surveillance, 2) Environmental Toxicology, and 3) Ecosystem Studies. The programs represent different, yet complementary, approaches to the total array of problems confronting the Great Lakes aquatic ecosystem, with each program differing in its need for sub-disciplinary expertise and logistic support.

Surveillance

Nutrient-Related Studies

Chlorophyll a samples were obtained on a weekly basis from three depths at two nearshore stations in Lake Ontario. Samples were collected from early March to the end of November. The data, along with other related parameters collected, will be used to establish a model which will give insight into time-series analysis of phytoplankton biomass. The model will then be applied to the surveillance strategy to develop a more cost-effective surveillance programme.

The phycological component of surveillance focussed on three phases of research simultaneously. Firstly, projects were initiated and developed to establish an ongoing algal indicator surveillance programme with linkage to the past data base on phytoplankton composition. This would enable GLBL to monitor floristic response in relation to water quality conditions on a long-term basis with some predictive potential.

Secondly, work was carried out on the coordination and editing of the Lake Superior volume to be published by the Journal of Great Lakes Research. This volume will deal with the Limnology of Lake Superior and contains 26 research papers contributed by various Canadian and U.S. agencies.

Thirdly, research was carried out to study the micromorphology on nannoplankton and ultraplankton with scanning electron microscopy which resulted in the development of a new processing technique. Papers dealing with various aspects of phycology are either published or in press.

Additional nutrient-related work was carried out on the biological availability of phosphorus from Great Lakes sediments. The work showed conclusively that the non-apatite, inorganic phosphorus fraction of sediment is potentially available for algal uptake, and that phosphorus from eroded bluff material is quite unavailable for algal growth.

Contaminants Programme

In response to the goals of the Great Lakes Water

Quality Agreement, the International Joint Commission initiated the Great Lakes International Fish Contaminant Surveillance Program. The objectives of this program are to survey collectively, the concentration of contaminants in selected species of Great Lakes fish and other biota with the specific purpose of determining environmental trends in contaminant levels, and relating these, where possible, to sources of such pollution; the effectiveness of remedial actions; and the potential implications to the fish and other biota of the Great Lakes System.

Other agencies involved in this program include the provincial Ministry of Natural Resources and the U.S. federal Fish and Wildlife Service. A minimum of four stations on each of the Great Lakes are sampled annually for valuable sport and commercial fish species. These samples are analyzed on a whole fish basis for persistent organic contaminants and trace metals. Selected samples are analyzed for non-routine organic compounds in order to identify new contaminants of potential concern. Additional samples of water, plankton and invertebrates are analyzed in an attempt to detect the accumulation of toxic substances in the food chain.

Currently the data on the 1977 analysis is being reviewed to determine if there are any geographic trends in contaminant burdens in each of the lakes. Future data will allow for trend in time information to be generated on the health of the Great Lakes ecosystem with respect to persistent toxicant levels.

Algal Toxicology

A simple and rapid technique for extracting tetraalkyllead compounds from water, sediment and fish samples was developed. The method was developed to investigate the possible occurrence of these compounds in environmental samples. Of some 40 fish samples analyzed so far, only one sample was found to contain tetramethyllead in the fish fillet. Other samples are being analyzed.

A mixture of 10 metals at Great Lakes Water Quality Objective levels was found to be toxic to algae. The toxicity depends on temperature, algal species, biomass and complexing capacity of the water.

Invert Toxicology

The effects of lead and cadmium on the survival and development time of eggs of the freshwater snail Physa gyrina were examined. Tests were conducted on single metals at 4 temperatures (10, 15, 20 & 25 ^{o}C) and on lead: cadmium mixtures at room temperature. The LC50s for lead lie between 180 + 320 µg Pb/l and for cadmium lie between 42 + 56 µg Cd/l regardless of temperature.

The metal induced mortality rate is approximately proportional to $(Pb)^2$ or to a function of cadmium lying between $(Cd)^3$ and $(Cd)^4$. No synergistic effects on mortality were detected between lead and cadmium. The increase in development time was related approximately to $(Pb)^{1.5}$ or to $(Cd)^2$ and increased with increasing temperature. An antagonistic effect between lead and cadmium on development time was observed. The effects of arsenic on the eggs and young of P. gyrina were also determined. Arsenic is non-toxic up to 1 mg/l. The effects of heavy metals (Cd, Cu, Hg, Pb) and arsenic on copepod production under conditions as close to natural as possible were also studied. Natural populations of copepods were exposed to metals for 2 weeks in natural water providing only the micro-organisms already present in the water as food. In most cases, metals were observed to affect growth at lower concentrations than survival. Each metal was tested several times throughout the year to determine seasonal variability in toxicity. Data on the effect of several other factors such as temperature, time of year, food concentration, and organism density on copepod growth rates were also obtained. Other studies included the measurement of the effect of cadmium or PCBs on electron transport system activity in snails, crayfish and Daphnia, and a study on the effects of lead and cadmium on light responses of freshwater zooplankton.

Fish Toxicology

Preliminary results from a chronic exposure of rainbow trout to arsenic indicate that the IJC's water quality objective for arsenic is adequate. No interaction was found in the response of rainbow trout to elevated water-borne lead and an ascorbic acid (Vitamin C) deficient or supplemented diet, despite similarities between the symptoms of chronic lead toxicity

and ascorbic acid deficiencies. Studies of lead uptake as an indicator of lead toxicity in raw lake water demonstrated that filtering organic particulates from lake water provided a good correlation between lead in the filtrate and lead taken up by the trout. Aqueous-saturated solutions of hexachlorobenzene (2.5 - 3.5 $\mu g.L^{-1}$) were found to be non-toxic to early life stages of trout. Pentachlorophenol added to a laboratory model ecosystem had little effect on the biota but degraded to lower chlorinated phenols in anaerobic sediments.

Contaminants Dynamics

Hexachlorobenzene (HCB) levels were examined in lake trout, rainbow trout, and coho salmon collected from Lake Ontario. Mean HCB levels of whole fish homogenates were 80, 62, and 36 ppb for the respective species. HCB levels increased significantly with body weight for all species. An oxidative combustion method was adapted to measure ^{14}C labelled HCB and PCB in the picogram to microgram range. Recovery rates averaged 93 - 104%. This method provides an alternate technique of sample preparation for biological materials that may yield a highly quenched solution following conventional sample preparation procedures for liquid scintillation measurements.

Lake Column Simulators

The lake column simulators research group has carried out experiments investigating the processes which are involved in PCB flux in the natural environment and ultimately result in biomagnification at higher trophic levels such as fish. All experimentation has been with radioisotopes labelled PCBs added to stainless-steel columns 4 m high and 1 m in diameter under controlled light, temperature, mixing and nutrient regimes. The relative influence of contaminant loading rate, partitioning between soluble and particulate phases, phytoplankton biomass and direct uptake of PCBs from the water by zooplankton and fish are all factors under investigation. Comparative studies using HCB have also been conducted.

Ecosystem Studies

The Ecosystem Studies Program of GLBL is a collection of primarily field-based projects whose overall objectives relate to understanding the effects and consequences of man's environmental practices on the well-being of the freshwater ecosystem in general and the fisheries in particular in the Great Lakes Basin.

In 1978, as in the past several years, the heaviest field involvement occurred at 2 permanently-based field sites at Batchawana Bay on Lake Superior and at the Bay of Quinte on Lake Ontario. In addition, some field work was carried out in the vicinity of the Lambton Generating Station on the St. Clair River, at Black Bay on Lake Superior and on a small lake in north central Ontario.

The Bay of Quinte was an area of intense research activity in 1978, unequalled in any of the past 7 years during which this study has been functional. This multi-disciplined, multi-agency project involves commitment and involvement from the Ontario Ministries of the Environment and Natural Resources in addition to several southern Ontario universities. Briefly, the objective of the study is to understand and determine the impact that reduced inputs of phosphorus have on the well-being of the fishery resource. Much of 1979 will be spent in analyzing and interpreting the data that have been collected from this project over the past seven field years. The information gained from this project will be of much use to the federal

government's Fisheries' Habitat Protection Program.

The contaminants study in Batchawana Bay has, as an objective, to determine how contaminants such as PCBs and heavy metals move through the aquatic food chain, and will provide data necessary to prevent the further deterioration of an important natural resource.

Early in 1978 Ecosystem personnel were asked to assist Ontario Hydro in determining the impact of Walleye larval fish mortality entrained at the Lambton Generating Station. Much concern had been expressed over this impact due to the desirability of Walleye as a sport fish. Much to the relief of the power utility, our studies showed that original samples had been misidentified and, in fact, the larval fish being entrained was the deep water sculpin.

For the last several years Ecosystem has been assisting the Ontario Ministry of Natural Resources in determining the size of the breeding stock of lake herring in Black Bay. Since almost all breeding for this species occurs in this Bay, this information is essential if future management practices are to protect this species.

SHIP DIVISION

Operations

Ship Division experienced another successful year in 1978. Ship and launch support was provided throughout the field season to both Hydrographic and Scientific programs, meeting virtually all demands. Surveys, ranging from the Winnipeg River to the Lower St. Lawrence and Saguenay Rivers, as well as two ship-borne surveys and one shore-based launch survey in the north, were provided full technical and logistical support.

One Charter vessel, MV PETREL V, operated on both the Great Lakes and at Chesterfield Inlet in Hudson Bay. A charter tug, MV LAC ERIE, operated on an opportunity basis out of Burlington throughout the winter months when ice and weather conditions permitted and during the summer field season on Lake Ontario and Georgian Bay.

All departmentally-owned major vessels operated trouble-free with no time lost due to mechanical failure.

As with other Divisions, budgetary and man-year constraints created difficulties. The situation was further exacerbated by new demands for statistical reports and by considerable effort to plan and implement a double tasking role of vessels for Search & Rescue.

CSS LIMNOS

After a major refit, LIMNOS was prepared for a Great Lakes Biolimnology Laboratory (GLBL) sediment and sampling cruise in the St. Lawrence and Saguenay Rivers. With this cruise completed, the vessel returned to Burlington and resumed operations on the Great Lakes. Throughout the summer months LIMNOS participated in cruises on all of the Great Lakes, with the exception of Lake Superior, steaming a total of 16,388 nautical miles during the 252 operational days.

In December the vessel spent five days at Port Weller Dry Docks for the normal five-year inspection. Following dry-docking, LIMNOS resumed operations on Lake Ontario until December 14, at which time the vessel returned to Burlington for winter lay-up.

MV PETREL V

The charter vessel MV PETREL V, after preparing for operations on the Great Lakes, departed Burlington for the first Surveillance Cruise of the season on March 20. The normal heavy ice conditions at this time of year in the eastern end of Lake Ontario prevented the vessel from completing this cruise. However, eighty-three of the ninety-four planned stations were completed before the vessel returned to Burlington.

MV PETREL V participated in Lakes Erie and Ontario cruises until July 14 when, after being equipped for an oceanographic survey, the vessel sailed for Chesterfield Inlet. Two 21-foot Mon Ark launches participated in this survey using PETREL as a mother ship. Radio communications appeared to be the only major problems during this survey, while the vessel and launches operated trouble free throughout the summer months. On October 15, the vessel returned to Burlington to resume operations on the Great Lakes.

On December 15, after all equipment was removed, the vessel was taken off charter and returned to the owners at Quebec City.

CSS BAYFIELD

After an extensive engine overhaul, BAYFIELD was prepared for Hydrographic surveys in northern Lake Superior. The vessel was delayed at Burlington mainly due to installation of electronic equipment both on board ship and at the positioning sites in Lake Superior.

On June 5, BAYFIELD sailed from Burlington to Lake Superior. Two NWRI current meters were retrieved from Black Bay after which the vessel was turned over to the Hydrographic Division. However, a malfunction in the positioning system caused a further delay until June 22 when sounding commenced.

Rossport was used as a safe port of refuge but BAYFIELD returned to Thunder Bay every second weekend for fuel and supplies. By September 27 survey operations were discontinued for the season. After 11,600 miles of sounding lines were completed,

BAYFIELD sailed to Burlington and on October 15 returned to Lake Erie to participate in a one-day operation on the Lake Erie survey. BAYFIELD returned to Burlington on October 19 and remained on standby until December when she was secured for the winter months.

During this standby period, BAYFIELD provided support on two occasions at Niagara-on-the-Lake for Technical Operations (NWRI) in mooring recovery.

Hudson Bay Offshore Survey

As in the past, CCGS NARWHAL was made available by MOT Dartmouth for northern surveys. Since 1972, this vessel has been used during the summer months for both Hydrographic and multi-disciplinary surveys.

After all the equipment for both the Hudson Bay survey and Baker Lake survey was loaded and secured, NARWHAL departed Dartmouth and proceeded to Hudson Bay. Sounding operations began on this survey on July 24. On August 5, the vessel proceeded to Schooner Bay, where it unloaded the Baker Lake survey equipment.

NARWHAL continued the survey operations in Hudson Bay, making two calls at the port of Churchill, one on August 22 to exchange crew and one on September 21 for refueling. On September 26, the vessel proceeded to Chesterfield Inlet to retrieve the Baker Lake survey boats and equipment. NARWHAL continued survey operations until September 29 when the vessel proceeded southward arriving at Dartmouth on October 5. All equipment was off-loaded and the vessel once again turned over to MOT.

Baker Lake Survey

This was the first year Ship Division supported a shore-based survey in Baker Lake. Situated at the head of Chesterfield Inlet on the northwestern side of Hudson Bay, the Baker Lake survey was carried out with three launches and one helicopter.

The two Botved launches, HELIX and HORNET, and a 21-foot aluminum Mon Ark were road transported to Dartmouth, Nova Scotia, and loaded on board CCGS NARWHAL for shipment to Chesterfield Inlet. However, on arrival at Hudson Bay, delivery of the launches was delayed due to ice conditions. On August 5, NARWHAL proceeded to Schooner Harbour to deliver the launches and as much of the equipment as was possible for the launches to safely carry. The three launches were escorted through the shoal-strewn lake to the hamlet of Baker Lake where the survey camp was located. Sounding operations began immediately and continued throughout the summer months relatively trouble free.

By September 25, the survey was completed and the launches were again loaded on board CCGS NARWHAL. Upon arrival at Dartmouth, the launches and equipment were road transported back to Burlington.

Lake Huron Coastal

Two Botved launches, HYDRA and HASTY, and two Boston Whalers were used to support this Hydrographic survey. All launches and equipment were prepared and road transported to Manitoulin Island on May 1. Survey operations began immediately working out of Providence Bay until the end of May when the Base was moved to Burnt Island Harbour.

Launches and Boston Whalers worked relatively free of mechanical problems throughout the summer and by September 9 the survey was completed and all launches and equipment were returned to Burlington.

Lake Erie Survey

CSL NAUTILUS, the newly-acquired Nelson 34 launch, and launches CSL BROCK, HYDRO II, and a Boston Whaler supported this survey. They were, with the exception of NAUTILUS, trailered to the survey site based at Leamington. NAUTILUS was delayed at Burlington due mainly to the late arrival and installation of electronic equipment. She arrived at Leamington early in June and all launches worked out of this area for the remainder of the field season.

By mid October the survey was terminated and all launches and equipment returned to Burlington.

Winnipeg River Survey

This was the second and final year for the Winnipeg River Hydrographic Survey. All launches and equipment were transported to Kenora by transport truck and low-beds, leaving Burlington on May 21.

Based at Minaki, survey operations began immediately using the launches HUSTLE, HUNT, PACER and WOODCOCK. One Boston Whaler which had been stored at Kenora from the previous season also was used as a support craft.

The survey was completed in September and all launches and equipment were returned to Burlington.

Georgian Bay Survey

The combined Hydrographic and Geolimnology survey located in the southern end of Georgian Bay was supported by CSL AGILE, MV LAC ERIE and one Boston Whaler. AGILE departed Burlington in early May and sailed to Collingwood where the survey operations were based.

Mechanical problems caused minor delays and late in the season AGILE had the misfortune of damaging both propellers and rudder. The launch was temporarily replaced with a Bertran launch for nearshore work.

In November the survey was terminated and all launches and equipment returned to Burlington.

CSS ADVENT

CSS ADVENT participated in CCIW-based training courses during the months of April and May on Lake Ontario. The vessel departed Burlington on June 3 for scientific survey operations in eastern Lake Erie.

Various scientific programs were supported throughout the field season on a day-to-day basis out of Port Dover. ADVENT returned to Burlington in October and remained on standby for further operations until December when the vessel was taken out of service for the winter months.

MV LAC ERIE

The charter tug MV LAC ERIE was used on a part-time demand basis throughout the winter months, providing transportation to the scientific tower off Confederation Park.

During the first part of the navigation season, LAC ERIE provided support to the Dive Unit as well as to various scientific programs on Lake Ontario. In June, LAC ERIE joined the Georgian Bay survey party for the summer months returning to Burlington again in September.

LAC ERIE assisted in various programs on Lake Ontario until October 6 when the charter expired and she was returned to her owners.

CSL SHARK

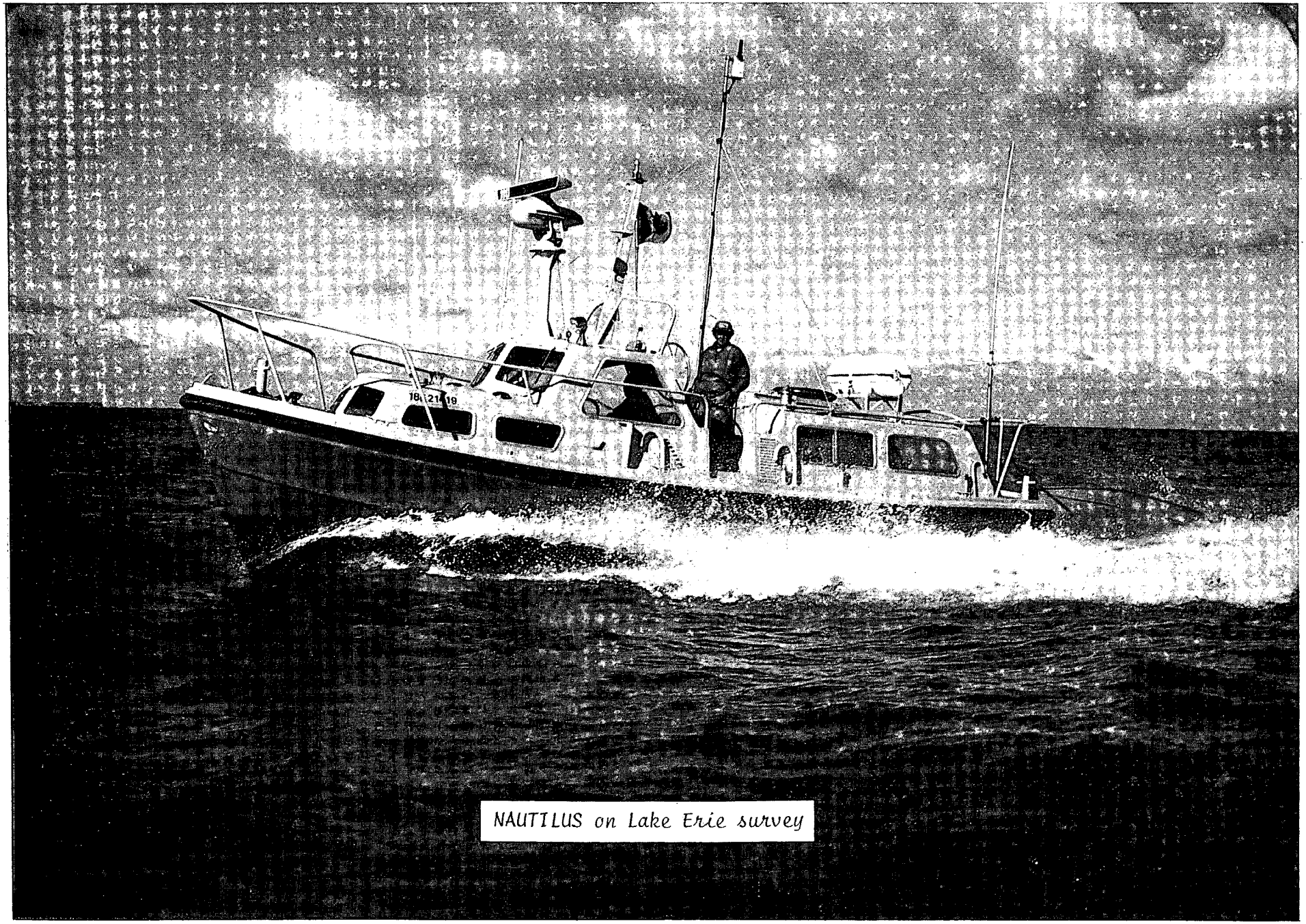
CSL SHARK was used locally out of Burlington to support the Dive Unit and various scientific programs, both on Lake Ontario and Lake Erie. This launch, although getting along in years, is still a very popular working platform with Central Region personnel. SHARK began operating as soon as ice conditions permitted in the spring and was one of the last launches to be removed from the water in December.

Great Lakes Biolimnology Laboratory

Ship Division provided support to two ongoing programs for GLBL. At Batchawana Bay in Lake Superior, CSL AQUA was once again the major support craft while several small craft were also used in this area. AQUA was removed from the water at Sault Ste. Marie in November and will remain there until spring.

In the Bay of Quinte, CSL SURF was used as the main support launch and, in addition, two 17-foot Mon Ark boats and a Boston Whaler were operated by program personnel.

Ice conditions in the Bay of Quinte prevented an early start in May. When the ice cleared, SURF sailed to Picton and operated there until October when the launch returned to Burlington.



NAUTILUS on Lake Erie survey

Hydrographic Training

As in the past, Central Region was the host for the Hydrographic Training programs. Two programs were supported this year, the Step I Course and the Humber College Course.

CSS ADVENT and three launches were provided as support craft for these courses.

At Burlington

Boston Whalers and small craft were issued out to personnel throughout the Centre on a short-term basis as well as for long-term programs. In addition to Central Region requirements, boats were on loan to Canadian Wildlife Service and the International Boundary Commission. One 31-foot launch, CSL BRUCE, was on loan to the Canadian Coast Guard and was used as a Search & Rescue vessel at Kingston.

Two Coxswain Courses were given during the year. The spring course was held for O&AS, Ship Division personnel, and in the fall SAR personnel were provided with the same course.

Search & Rescue

In June, authority was received to proceed with Search & Rescue multi-tasking for CSS BAYFIELD, CSS ADVENT and five designated launches.

Immediate staffing action was taken; however, due to the inability to supply sufficient experienced personnel and the lack of a "Letter of Understanding" from the respective Unions to cover the employment situation, very little time was put to use for the multi-tasking role. CSS BAYFIELD and CSL NAUTILUS were, however, multi-tasked by September using the current collective agreements for Ships Officers and Ships Crews.

The multi-tasking role continued for these vessels until the end of the field season, while preparations were being made for full participation during the 1979 season.

Helicopter Support

During the year, helicopter support was provided to a total of seven surveys for Hydrographic and Research and Development Divisions.

The majority of helicopter support was for Hydrographic surveys, both in the north and on the Great Lakes, totalling 1,423 hours of flying time. Research and Development was provided with helicopter support for two programs, one Oceanographic survey in Chesterfield Inlet and one for Shore Properties Studies on the Great Lakes.

Engineering

For the early part of the year, the Boatshop was occupied with two major projects, the first being the preparation of the two new Nelson 34 launches for operation in Hydrographic Service and the second being the complete disassembly and overhaul by contractors of both main engines of CSS LIMNOS.

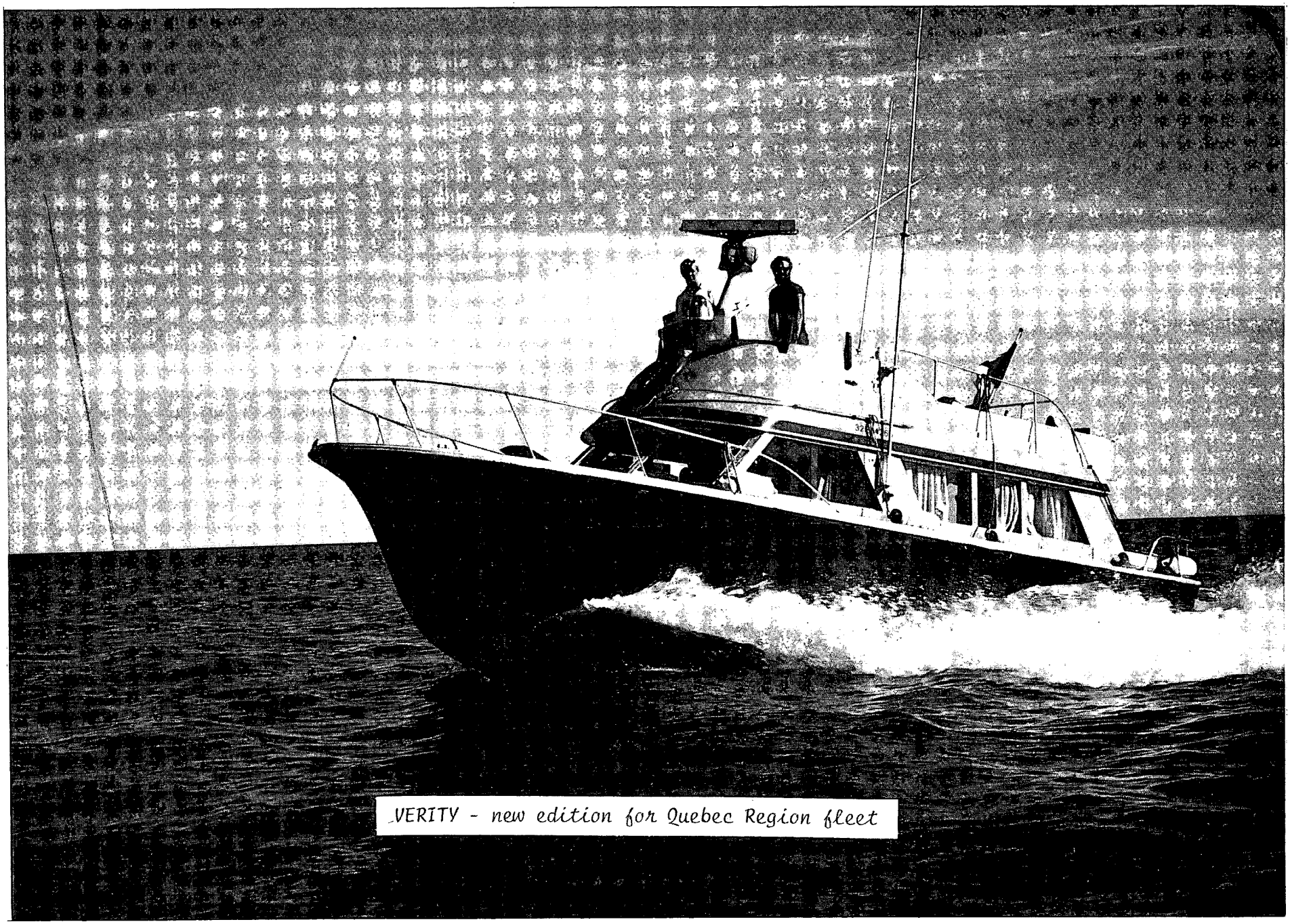
In order to bring the new vessels up to Department standards, they had to be practically re-outfitted, fastenings and hardware removed and replaced with those acceptable in a marine environment, doors renewed, adequate ground plates installed, transducers installed externally on the keel, equipment relocated and new masts for radar scanner and lights fabricated and installed.

Unfortunately, it was not possible to make the machinery any more accessible for maintenance or repair.

The "Nelson 34" NIMBUS was not used this season and NAUTILUS performance during the season left something to be desired, being plagued by many teething troubles.

Despite all the difficulties during her regular season, NAUTILUS remained in service longer than any of the other launches on base. She was used until December 1 on Coxswain Training exercises and then on equipment trials using newly-installed transducers and a rented sounder, earning the distinction of being the last boat to be hauled in in 1978.

This year saw the last fit-out in this Region for CSL



VERITY - new edition for Quebec Region fleet

VERITY, which departed Burlington as the latest addition to the fleet of the new Quebec Region. The full facilities of the base, including shipwright and mechanics, were made available to ensure that the vessel was, on her departure, in a sound mechanical and seaworthy condition.

A somewhat unusual task performed by Boatshop personnel this year was the repainting of CSL BRUCE in Coast Guard colours of red and white for service as a Search & Rescue vessel in the Kingston area. The colour change, we are reluctant to admit, made for a fine looking vessel although the change in colour and the fact that she was operating in charted and somewhat sheltered waters did not cure her of her habit of striking hard bottom. Back in Burlington we were kept busy supplying new propellers; in fact, it looked for a while that the supply would not meet the demand, but having experimented extensively in earlier years with prop sizes for this vessel, we were able to maintain supply lines and the vessel appears to have had a useful and a successful season.

Preparation and testing of the Botved launches prior to departure for the field was somewhat delayed awaiting the return from the northern surveys of the Edo through-hull transducers which had been removed for use in sounding through the ice. This, coupled with the fact that various vessels, including VEDETTE and ADVENT, had been put into service earlier than usual for the Hydrographic courses scheduled for the early part of the season made a hectic period of time for Boatshop personnel in their efforts to have launches ready for departure to the field on schedule.

CSL NUCLEUS returned from trials and evaluation at AOL.

Apart from being in poor condition externally from her journey, coated with road salt and mud from weather experienced on her way, she was found to be badly holed on the keel and bilge where she had been tied down to her cradle for shipping.

Repairs to this vessel prior to being shipped to the West Coast proved to be a major item as oil and salt water from the bilge had impregnated the lay-up, requiring cropping back to get to sound uncontaminated material.

Following repairs, the boat was cleaned and repainted throughout. During sea trials, it was found that the seals between the two rotors of the turbo blower had failed, allowing exhaust gases and air to form an explosive mixture which would ignite periodically exploding with such force in the casing as to flake the paint from the blower and shower insulation everywhere. The vessel was repaired and shipped to the West Coast in first-class condition.

Mechanics

In addition to carrying out repairs to engines that had failed or had been damaged during sevice, a total of one hundred and twenty-four outboard engines of various makes and sizes passed through the shop for inspection and repairs as necessary, ranging from complete rebuilding to test, tune-up, and re-store. However, the greater number fell into the middle range, consisting of the complete rebuilding of lower units damaged in the field.

Toward the end of the season, it was noted that it was becoming increasingly difficult to obtain Chrysler outboard parts. Chrysler were phasing out their Canadian operation and, in future, all parts will have to be purchased in the United States. This will necessitate keeping a somewhat larger inventory of parts on hand in order to maintain a high standard of service.

As the number of operating hours increase on our Volvo gasoline engines, so does the incidence of camshaft failure which follows closely the fail rate of the automobile version of the engine. Three volvo engines were returned from the field during the year, all of which had such failures, manifested only by poor running and low power, but with no physical evidence such as knocks or other noise.

It was necessary to rebuild 14 of these engines this year in addition to the normal post- and pre-season service, the main reason being due to overheating and its after effects, in two instances serious crankshaft damages had been sustained.

Two OMC 185 engines and one Chrysler Crusader engine ex "WOODCOCK" and "PACER" were also rebuilt prior to the start of the operating season, all subject to serious overheating. PACER subsequently

returned from the field in a badly-holed condition with the engine again having been overheated and also showing some evidence of partial submersion.

CSL SURF

The re-powering of this vessel with a Detroit 453 diesel engine following the 1977 season presented some early problems, one being the shaft which, due to the new horsepower-to-shaft speed ratio, occasioned a skipping rope effect of the shaft at the new lower speed. This was corrected by reducing the shaft diameter slightly between bearings. The speed of the vessel with the new power plant was somewhat disappointing, there being no increase. However, fuel consumption was something else, an average consumption of 1.5 gallons per hour over the operating season has to be some sort of record for a 38-foot steel vessel. Experiments with different propellers in the post-season period resulted in a speed increase of 1.33 knots and governor modifications presently in progress will, hopefully, give an increase of a further .5 knots with no appreciable increase in fuel consumption.

CSL AGILE

Again this year the "fragile AGILE", as she has been known for some years, was the Peck's bad boy of the Region, suffering an engine failure due to a siezed water pump enroute to Collingwood at the start of the season and electrical problems in the 24-volt system periodically all season.

One independent auto electric consultant was retained to investigate the cause without success, again finding no defects in the wiring. Finally the contractors who installed the system originally under Steamship Inspection were asked to inspect the system. Again nothing unusual was found.

The cause was finally determined quite by accident following the grounding of the vessel toward the end of the season. The shop mechanic attended to prepare the vessel for her voyage back to base, at which time it was determined that the bolts holding the mounting bracket to the alternator were of such a length as to practically ground the rotor to the casing if the washers were switched when reinstalling an alternator. It was determined from log books that the wiring failure in all cases had been accompanied by an overheating condition of the main engine. It is certain that the engine overheating caused the alternator bracket bolts to expand so that the already close gap between the end of the bolt and the rotor closed enough to cause the rotor to arc across to the bolt, putting full alternator amperage to ground through the wire that overheated, bypassing the 7 amp fuse installed when it thought that the operation of the overheat alarm buzzer was in some way causing an overload.

CSS ADVENT

Both main engines were given major tune-ups by manufacturers' representatives during the off-season, but due to commitments for the vessel to be used in the various pre-season Hydrographic and student training programs, hull repairs necessary as a result of ranging damage sustained the previous year had to be commenced somewhat earlier than was ideal. However, with modified procedures and the use of a shelter constructed in the Boatshop, it was possible to carry out the repairs in an efficient manner despite lower than ideal temperatures and blustering winds.

A leak in the after fuel tank which had always defied detection despite hydrostatic testing, dying the fuel, etc., suddenly became quite apparent as the vessel was about to proceed to the field, apparent and inaccessible. Temporary repairs were carried out in a successful manner; however, a similar leak appeared in yet another and unrelated area of the tank during the season. This also was repaired temporarily. The tank was emptied, gas freed and inspected at the close of the season and repair procedures and specifications prepared to be carried out prior to the start of the 1979 season.

The vessel itself had a successful operating season in Lake Erie with no time lost due to breakdown.

CSS BAYFIELD

On arrival back in Burlington, both main engines were subjected to an analysis program developed by the engine manufacturer to determine the state of the machinery and to point out areas where maintenance was required.

As both main engines were due for 5-year inspection, although the engine hours did not call for complete disassembly, it was decided to determine what exactly had been done to the engine at the last 5-year survey, no details being available from ships records nor from classification, just that a "survey had been carried out." Information from the manufacturers was equally scant, so that it was determined that preparation for survey and reassembly of one engine would be carried out by Ship's staff and deferral requested for one year on the other engine based on the manufacturer's analysis report.

This was done and the complete overhaul was carried out by the Chief Engineer and Oiler, and endorsements provided by both Ship Safety Branch, Canadian Coast Guard, and Lloyd's Register.

A problem relative to the 3 K.W. scientific power system had come to light during the 1977 operating season with the installation of a more sophisticated computer system and Atomic clock. These suffered by the split-second power interruption occasioned when it was necessary to change over from either main generator to scientific or vice versa, due to overloads, or for service or maintenance of equipment. This was solved by the installation of a 220/110 controlled voltage transformer to supply the scientific instrumentation.

The installation proved to be highly successful, although the problem of power interruption still exists during the generator changeover and shutdown procedures. However we feel that the installation of paralleling equipment planned for the 1979 season will alleviate even this problem and further enhance the vessel's value for Hydrographic purposes in the future.

The heat generated by computers and ancillary equipment in the lab was lessened to a great extent by the installation of a separately-controlled cooling unit in the lab supplied by gas from the main air conditioning system.

BAYFIELD departed Burlington for Lake Superior following extensive equipment and machinery trials. A successful season followed with no time lost due to equipment failures; one problem with a steering relay was corrected at Port Weller during canal transit occasioning no delay.

CSS LIMNOS

The early part of 1978 saw an ambitious work schedule undertaken, removal of both main engines which were completely disassembled, inspected and reassembled in the Boatshop for 5-year survey prior to being re-installed on board.

As 1978 was the designated year for dry-docking and completion of this 5-year survey period, all tanks were prepared for survey by Ship's staff. However, it was discovered during inspection by the regulatory bodies that plastic piping installed in the new vacuum sewage system and grey water systems funded by the federal activity clean-up program 3 years previously, and approved at that time, had now been outlawed; although with certain modifications the installation could be made acceptable. These modifications, consisting of stop valves at either side of each bulkhead with remote opening and closing above the main deck, were like the proverbial cure, worse than the complaint and totally impractical so that it was decided to replace all the offending plastic piping with steel, a project which incidentally proved easier than the original installation of the plastic pipe.

Dry-docking was scheduled for July, 1978, but was of a necessity postponed due to the dock being occupied by a vessel that had been holed as a result of grounding. This was rescheduled to fit in with survey commitments later in the year and it was therefore decided to carry out work that could save time while the ship was at CCIW on a progressive basis, particularly the windlass survey which could conceivably have caused delays if carried out at drydock.

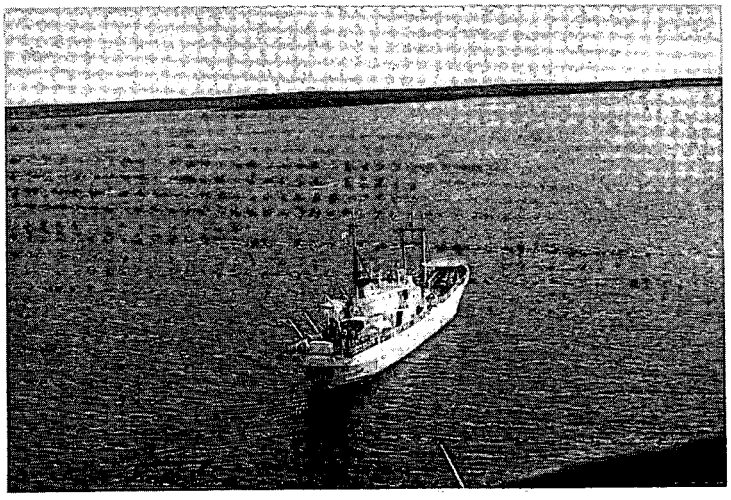
Dry-docking was finally accomplished December 4, 1978, and for a while it looked as if we had a docking that would go as scheduled, on "on time", off "on time." However, it was not to be. The first ominous sign was a deep gouge on the trailing edge of one blade of the starboard propeller, the second a piece of gear tooth clinging to the magnetic plug of the starboard Harbourmaster lower unit. From then on, it was a 24-hour-a-day operation, removing the lower unit, changing gears and replacing the unit, the work being finally completed December 9, earlier than originally sched-

uled but one day later than we had hoped for. LIMNOS returned to Burlington in time to carry out her last cruise of the season. A whole season with NO LOST TIME!

MV PETREL V

Major modifications in all areas of the vessel were carried out on a progressive basis prior to her departure for the Chesterfield Inlet Oceanography survey, funded both by owners and the Department as Charterers. The major item was the fabrication and installation of a portable aluminum helicopter deck, on the forecastle head, so designed as to not interfere with the vessel's normal operation, but simple to remove for ocean passages (where bad weather may have been experienced) and subsequently reinstalled.

The Chesterfield Inlet survey was carried out successfully and for a time it appeared that at last the vessel was entirely suitable for all phases of our requirements but cuts in Department spending made the cancellation of the charter necessary.



PETREL Chesterfield Inlet

Following her last cruise of the season, work commenced removing all Department-owned equipment and returning the vessel to a condition acceptable to the owners.

Fortunately the owners did not insist on the reinstallation of the original big, ungainly structure removed from the afterdeck but requested that it be cut up and stowed aboard in pieces. Following this final action, the vessel departed Burlington for Quebec City.

FINANCE AND ADMINISTRATION DIVISION

The Regional Organization remained in a state of flux throughout the year with attendant communication problems and uncertainties. The situation was improved somewhat in September when the Associate Deputy Minister delegated interim responsibility for the operation of the Great Lakes Biolimnology Laboratory, in addition to Ocean and Aquatic Sciences, to the Director-General, O&AS Ontario. The resulting direct reporting relationship with Fisheries and Oceans Headquarters, which places Central Region in a comparable organizational position to the O&AS Atlantic and Pacific Regions, is highly desirable from a Support Services standpoint.

Financial Management

A total of $7.6 million was spent from Departmental appropriations during 1978. Personnel costs accounted for $3.6 M; Operations and Maintenance $3.4 M and Capital $.6 M. Salary costs were understandably higher than in 1977 as a result of wage settlements, however both O&M and Capital expenditures were lower in 1978; a reflection of the restraint program. In addition to the Departmental appropriations mentioned, the section administered $432 K received from other government Departments to fund joint programs conducted on their behalf by Hydrography and Research and Development.

The automated financial accounting system (FACS) operated successfully throughout the year without the necessity for a parallel manual system. Timely and detailed financial information was provided to managers. We are looking forward in 1979 to improved financial analysis as a by-product of FACS.

During the year the Region lost the services of Irene O'Connor, the Regional Financial Officer, who left to take up a position with the Environmental Protection Service in Yellowknife. Fortunately, a very capable replacement was found in the person of Barbara Davis.

Materiel Management

A significant happening in Materiel Management during 1978 was the close-out of field party sites at Inoucdjouac, Poste-de-la-Baleine and Sanikilaug on Hudson Bay and at Fort George on James Bay. This was coordinated by Eric Gibbons, Materiel Management Supervisor, entailing considerable ingenuity not to mention hard labour. Some of the equipment was air lifted to Resolute Bay for future use by Polar Continental Shelf and Arctic Development Project teams and some was returned to Regional Headquarters in Burlington using a combination of Austin Airway Charters and Departmental vehicles. Five 150-foot towers used in conjunction with the Decca positioning system and considered too bulky to airlift, were left in storage on site. These will be recovered at a later date when needed; quite possibly by sealift.

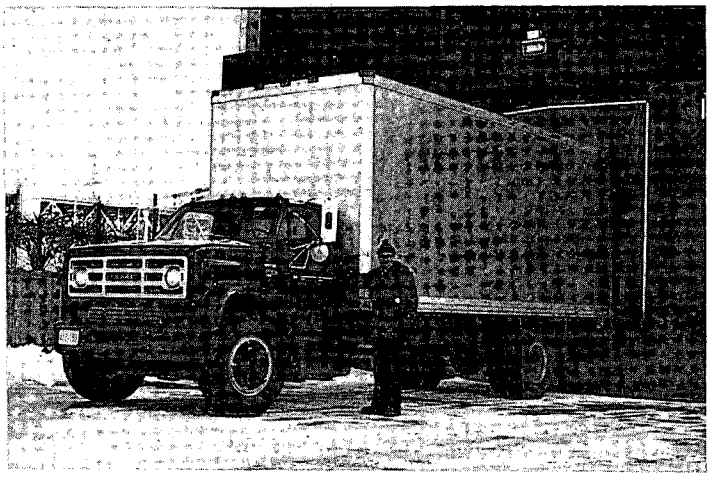
Fleet Management

Departmental vehicles travelled a total of 312,316 miles in 1978. Short-term rentals accounted for an additional 21,000 miles.

There were four property damage accidents. Resulting repairs to Department vehicles cost $2,800. and third-party claims totalled $890. The accident frequency rate per 100,000 miles was 1.2.

A defensive driving course was held in March in preparation for the 1978 field season. Twenty-two hydrographers, ships crew and support staff successfully completed the course.

A newly-acquired 22-ft. van was used to good advantage during the year in transporting field equipment to



and from such points as Dartmouth, Fort George and Timmins. At the present rate of usage, this vehicle should pay for itself in two years.

General Services

With a man-year allocation of 168, the staff peaked to a total of 219 in July. This of course is due to the high number of seasonal ships' crew on strength at that time. There were 23 industrial accidents reported in the year, five of which resulted in lost time totalling 37 man-days.

Due in part to the Ship Division Search & Rescue role, there were a high number of classification actions (110) and staffing actions (222) in the year. The latter figure includes 52 acting pays, 34 acting appointments and 17 promotions.

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Tripe, R.L.K. Automated Data Acquisition and Processing, Within the Canadian Hydrographic Service, Second Working Conference on Oceanographic Data Systems, Woods Hole Oceanographic Institute, September 28, 1978.

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