ENVIRONMENTAL MEASURING SYSTEMS

RECENTLY PROTOTYPED BY STAFF OF
THE ENGINEERING SERVICES SECTION
CANADA CENTRE FOR INLAND WATERS,
FOR LIMNOLOGICAL AND OTHER WATER
RESEARCH STUDIES

ES 514

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ENGINEERING SERVICES SECTION

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INTRODUCTION

ENGINEERING SERVICES AT THE CANADA CENTRE FOR INLAND WATERS BACKGROUND INFORMATION

The Canada Centre for Inland Waters is a major multi-disciplinary national water resources research establishment of the Department of Fisheries and the Environment. The survey and study programs of the C.C.I.W. are concerned with water management problems of national interest.

The Engineering Services Section of the Scientific Support Division serves all divisions and agencies at the C.C.I.W. as well as detachments in various regions of Canada. These services include the design, development, implementation and maintenance of a wide variety of systems used to sample characteristic environmental variables and to process, record and display the information collected. Where calibration services are not economically available through local industry, special facilities are maintained at the C.C.I.W. to ensure quality control for scientific measurement instrumentation.

The engineering problems involved often require innovative solutions because of the scientific, environmental and operational constraints which apply. To prevent duplication and to be cost-effective, much of the engineering effort is applied to evaluating, adapting and improving commercially available technology for the task at hand. When novel approaches are required, development is normally contracted. Should a suitable supplier not be available, or should the initial development require close liaison between scientist and engineer, development may be undertaken within the C.C.I.W.

The Engineering Services Section has 11 professional and 20 technical and trades staff members. When necessary, additional personnel are employed under contract for specific activities.

The following pages depict the developments completed in the calendar year, 1977. This report is in a format similar to the original report of a similar title (ESS 10). It is printed as an addendum to the original.

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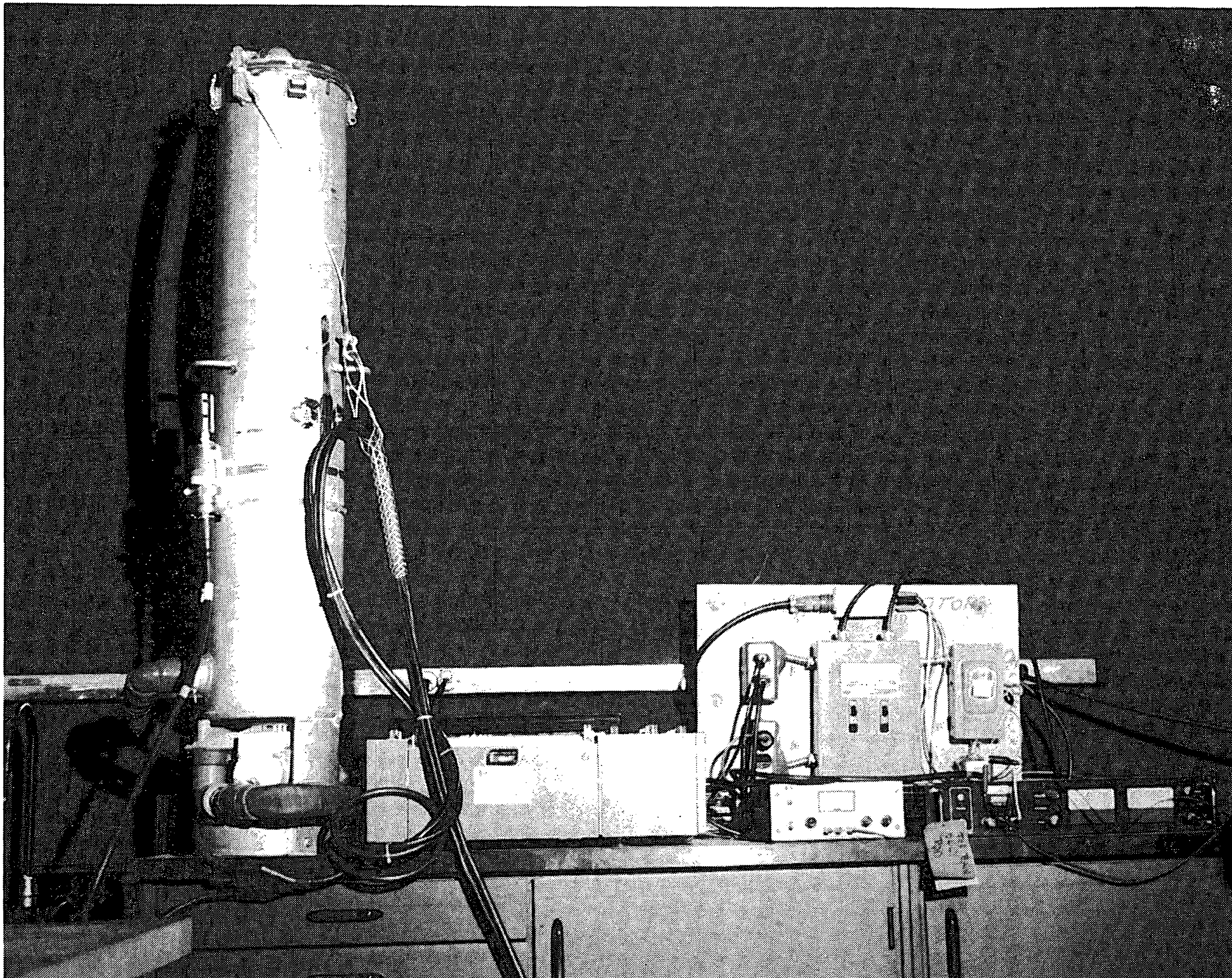


BACKSCATTER AND ABSORPTION CHAMBER

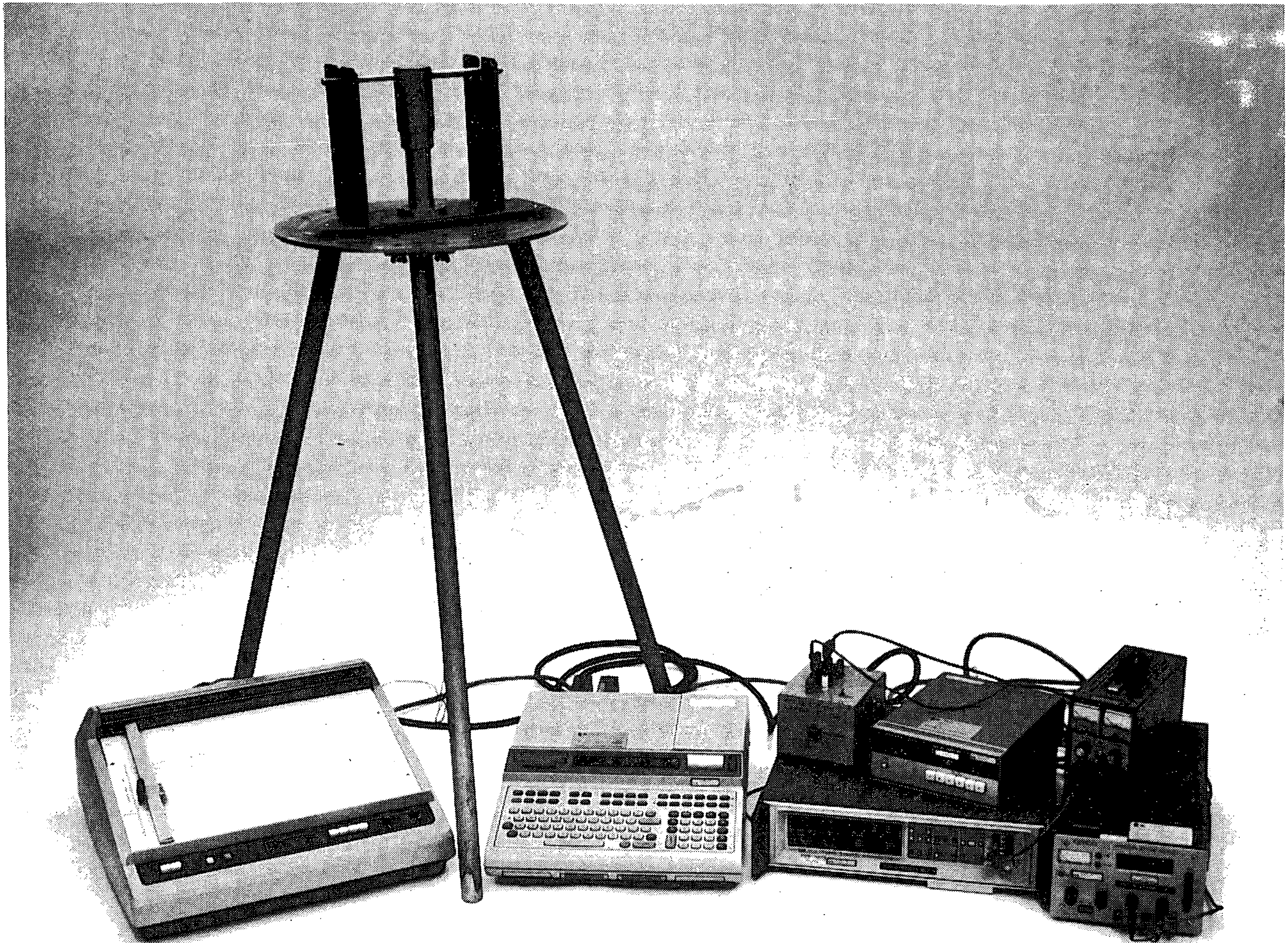
In connection with CCIW's program in remote sensing of lakes, one important physical property which impacts on image interpretation is the characteristic light return volume-reflectance for the water body in question. This return is chiefly determined by backscatter-coefficient and absorption-coefficient. Because conventional transmissometers (i.e., attenuance meters) really only measure the total optical path loss from all causes, a BACH system concept evolved. This system features a light-tight, but flow-through, light chamber in which reflective targets are illuminated by a source and viewed by a sensitive optical detector. If the target reflectivity is altered in a controllable fashion (say, from black to white) it is hypothesized that the corresponding values of irradiance measured by the detector will provide sufficient information to extract the backscatter and absorption coefficients by relatively straightforward data reduction.

Shown opposite are sketches of the system and the BACH chamber, which is undergoing scientific laboratory evaluations.

The initial arrangement of this BACH system features narrow-spectrum operation at one detected wavelength. Thereafter, multi-band operation at wavelengths-of-interest is anticipated.

TARGET PERFORMANCE SPECIFICATIONS

BACH Chamber Active Volume	Approx. 20 cm dia. x 40 cm length
Optical Target's Size/Contrasts	20 cm dia. / 87% and 1% reflectivities
Source Illumination of Target	Approx. 0.5 mW/cm^2 (20° beam)
Spectral Coverage	400 - 700 nm
Detector Measurement Range	Six decades (10^{-11} to 10^{-5} W/cm^2), min.
BACH Chamber Flushing	Pumped, with 30 sec flushing time
Data Recording	By stripchart and DMM, initially
Profiling Range	0 to 100 m submergence



CALCULATOR AIDED CALIBRATIONS

The repetitious task of calibrating sensors against known standards has been eased through the use of the latest generation of calculators. These calculators have an interface bus which allows rapid transfer of meter readings directly into the calculator's processor. From there, corrections and data messaging are easily accomplished from the calculator's keyboard and cassette reader. One immediate benefit is that anomalies are quickly recognized because of the large number of calibration points on the calculator. The calibration outputs are printed for archive purposes.

This year, three classes of sensors have their calibration procedures semi-automated through the calculator. They are specified below.

SPECIFICATIONS

SENSOR TYPE: DIRECTION SENSORS, COMPASS, WIND WAVE

Inputs to calculator
- clamping voltage (auto)
- reference voltage (auto)
- orientation of sensor (entry)
- sensor identification (entry)

Outputs from calculator
- plot of error vs direction
- printout of
  - orientation set
  - sensed direction
  - error in degrees
  - average error
  - hysteresis

SENSOR TYPE: SOLID STATE, TWO-AXIS, WATER-CURRENT METERS

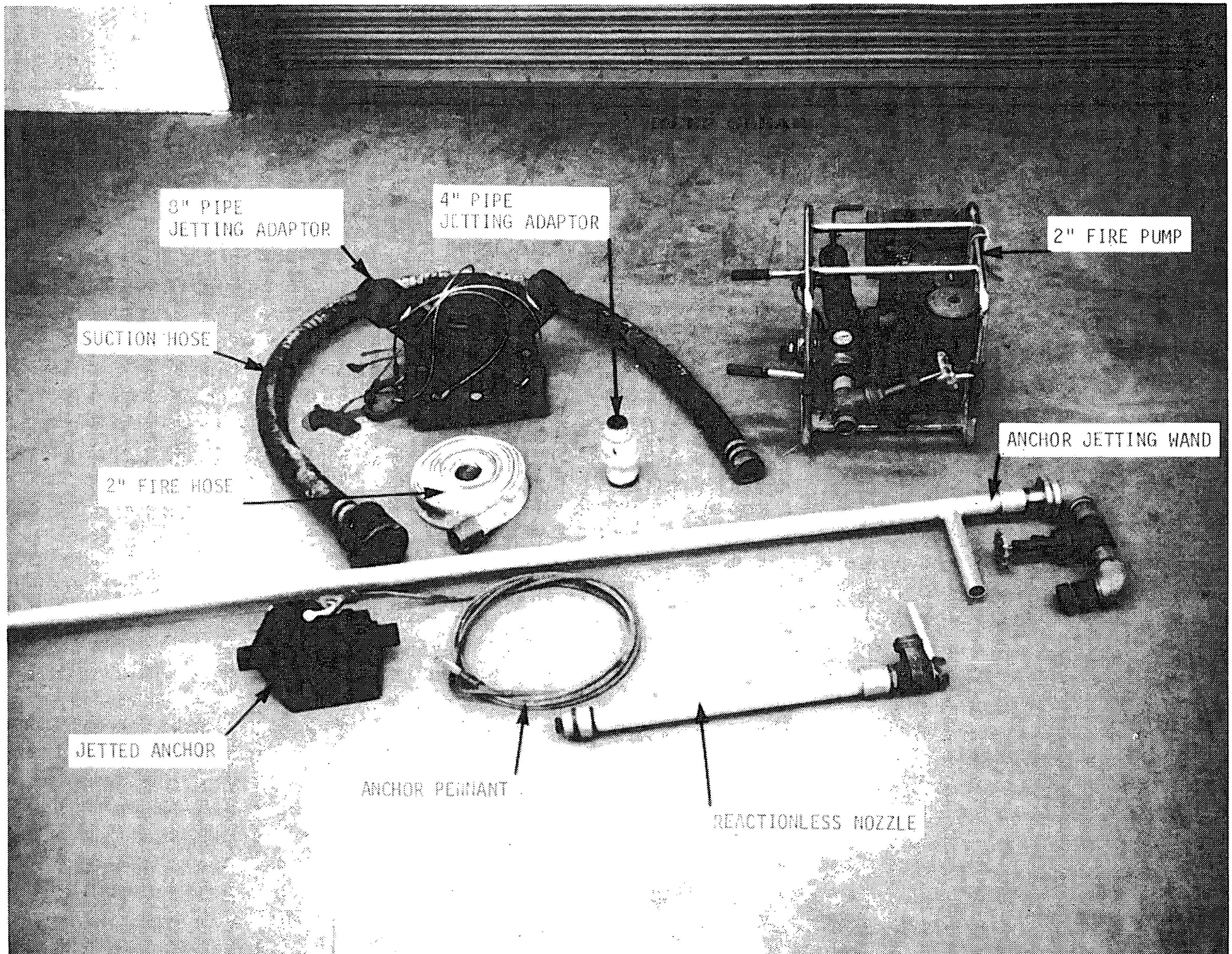
Inputs to calculator
- towing carriage speed (entry)
- compound angle of tow (entry)
- current meter output X-axis (auto)
- current meter output Y-axis (auto)
- optional Z-axis entry (entry)
- file number (entry)

Outputs from calculator
- plot of X and Y averages in polar co-ordinates
- printout of (ten items per point)
  - entered data
  - measured data
  - preprocessed data
- magnetic tape cassette recording for further processing

SENSOR TYPE: HUMIDITY

Inputs to calculator
- wet bulb reading (enter)
- dry bulb reading (enter)
- barometer reading (enter)
- sensor output (auto)

Outputs from calculator
- plot of
  - actual vs measured humidity
  - or actual humidity vs error
- printout of
  - wet bulb reading
  - dry bulb reading
  - derived relative humidity
  - sensor output
  - sensor's relative humidity from its transfer function.


8" PIPE
JETTING ADAPTOR
4" PIPE
JETTING ADAPTOR
2" FIRE PUMP
SUCTION HOSE
ANCHOR JETTING WAND
2" FIRE HOSE
JETTED ANCHOR
ANCHOR PENNANT
REACTIONLESS NOZZLE

EMBEDMENT EQUIPMENT FOR ANCHORS AND PROBES

A set of equipment has been developed for use in sandy lake bottoms to insert anchors, piles and pipes, or to trench, measure sediment thickness, and uncover buried equipment.

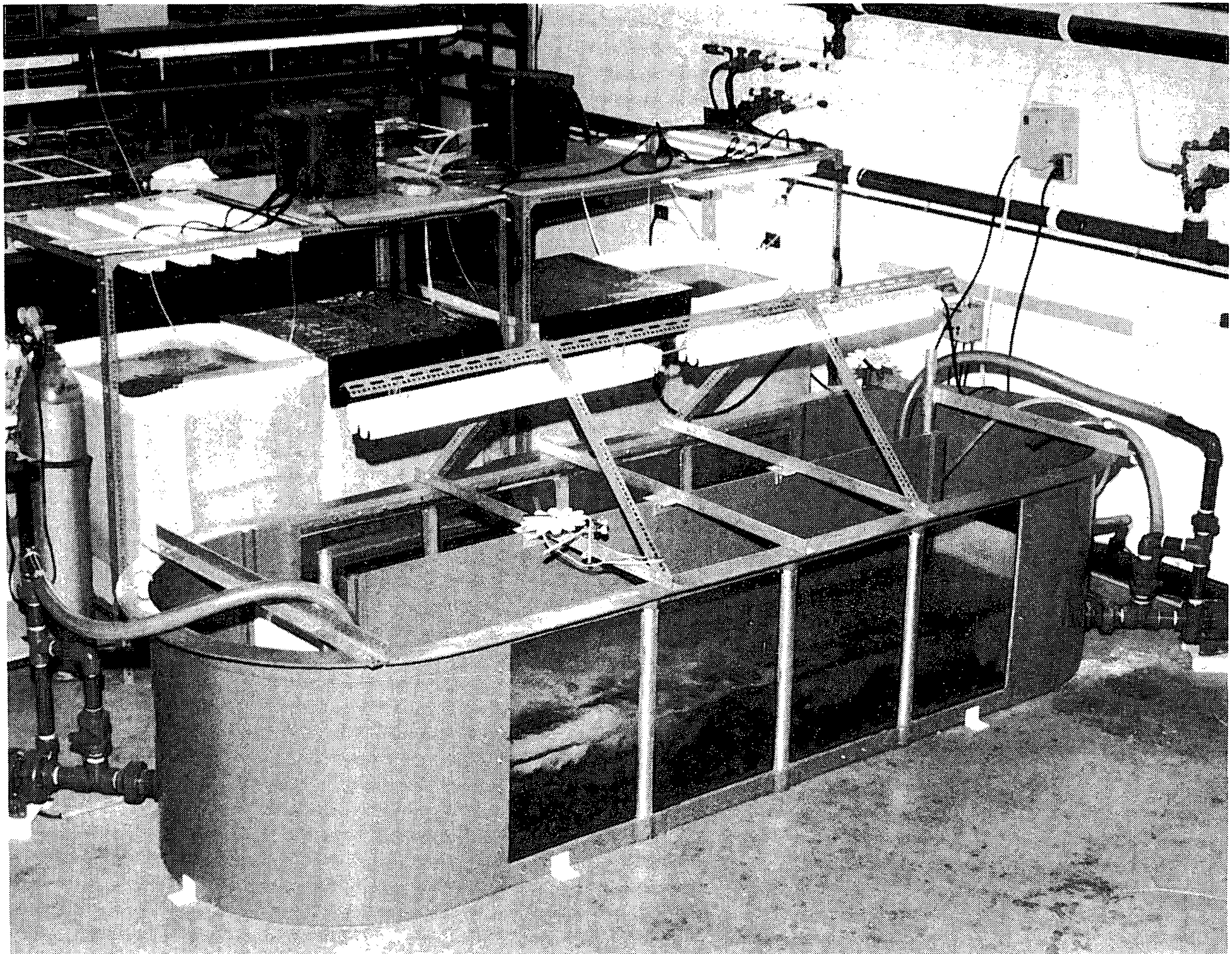
The central unit is a 5 cm (2 inch) capacity portable fire pump, 6.7 kW (9 HP) gasoline engine powered, equipped with self-primer, intake hose and lightweight fire hose in various lengths. A variety of reactionless nozzles, sand suckers, and an anchor are available for special jobs and development of new equipment is ongoing.

The standard anchor to be applied with the system is an N.C.E.L. quick-setting fluke modified to cut manufacturing costs and to minimize jetting resistance. A test model of the anchor having a projected area of 400 cm^2 (64 $in.^2$) buried to a depth of 2.8 m (8 ft.) withstood a short term pull of 42.7 kN (9400 lbs) without apparent movement. Failure load is unknown due to lack of capacity in the test equipment, but is estimated to be at least 50 kN (11,200 lbs). Greater loads can be generated by increasing penetration depth and anchor size. Penetration depths of 4.5 m (15 ft.) with a production anchor of 850 cm^2 (0.9 $ft.^2$) were routinely achieved.

The driving wand, which is used to flush water through the sand, can be lengthened by additional pipe lengths for extra penetration. It is equipped with a rotating swivel and a quick closing valve, which allows the diver to unscrew the fixture at depth while maintaining water flow to avoid the hole collapsing. Up to 23 cm (9 inch) diameter pipes have been driven to 5 m (16 ft.) depths to provide tower and instrument bases in surf zones to resist wave action and bottom movement.

For depth measurements of sand or other fluidizable overburdens, these wands have penetrated to about 10 m (33 ft.) routinely, either from a boat or with diver assistance.

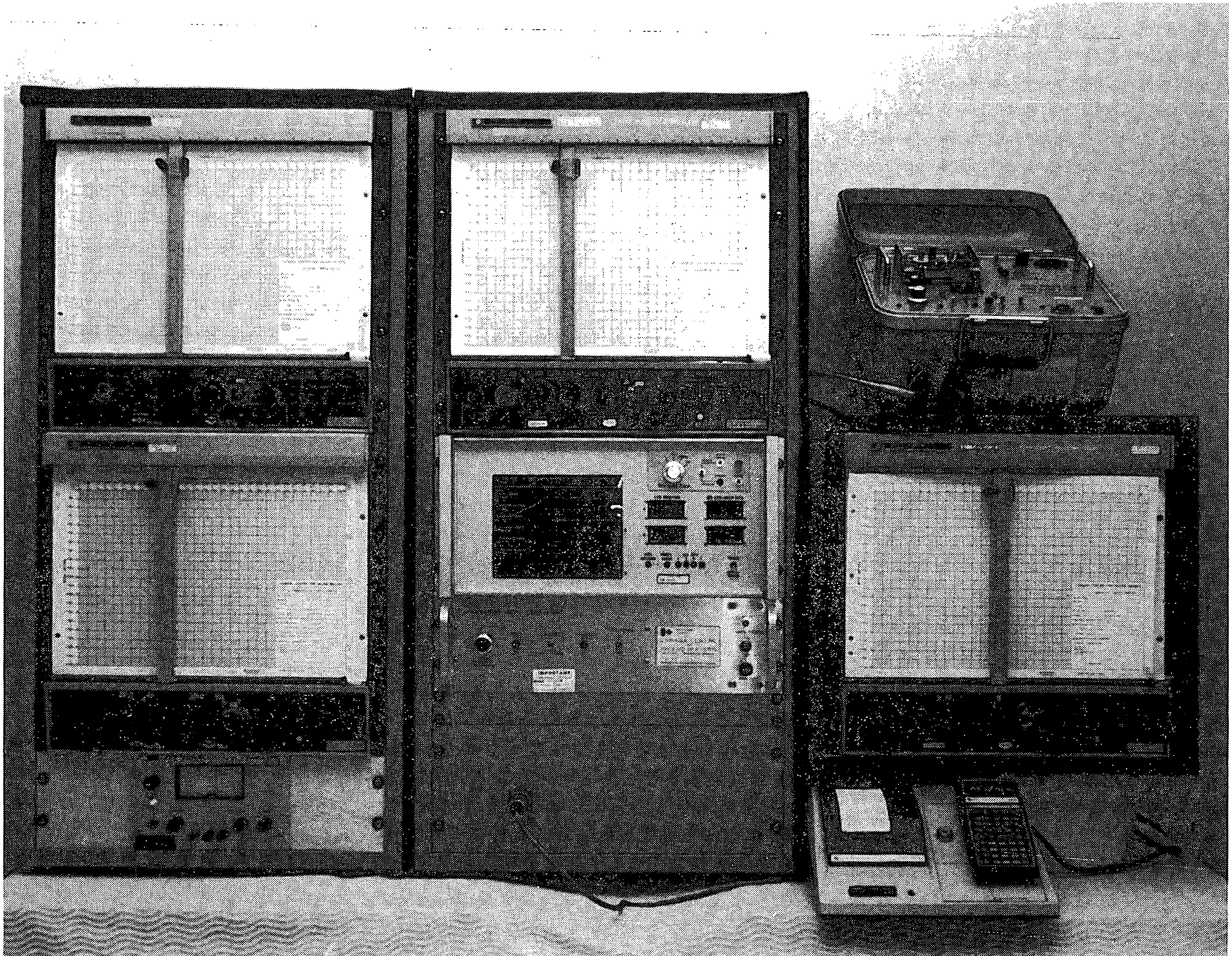
For rock bottoms, a hydraulic powered hammer drill is available for the installation of masonry anchors and rock bolts up to 31 mm (1¼ inch) diameter and 60 cm (24 inch) length.



FISH STRESS CHANNEL

This system is used to evaluate the responses of toxicant-treated fish exposed to simulated, natural stream stresses. The fish stress channel, made of fibreglass reinforced plastic, has 2 straight working sections, each being 2.4 metres long x 0.6 metres wide and having a full length viewing window. The water in the channel is variable in both depth from 25 - 60 cm and speed 0 - 60 cm/s. Flow is induced by two 375W (½ HP) high-flow pumps discharging through two banks of nozzles. The banks of discharge nozzles are also adjustable in height in order that different flow behaviours may be obtained.

Heat budgets were calculated in case chillers were necessary to extract the waste heat from the water.

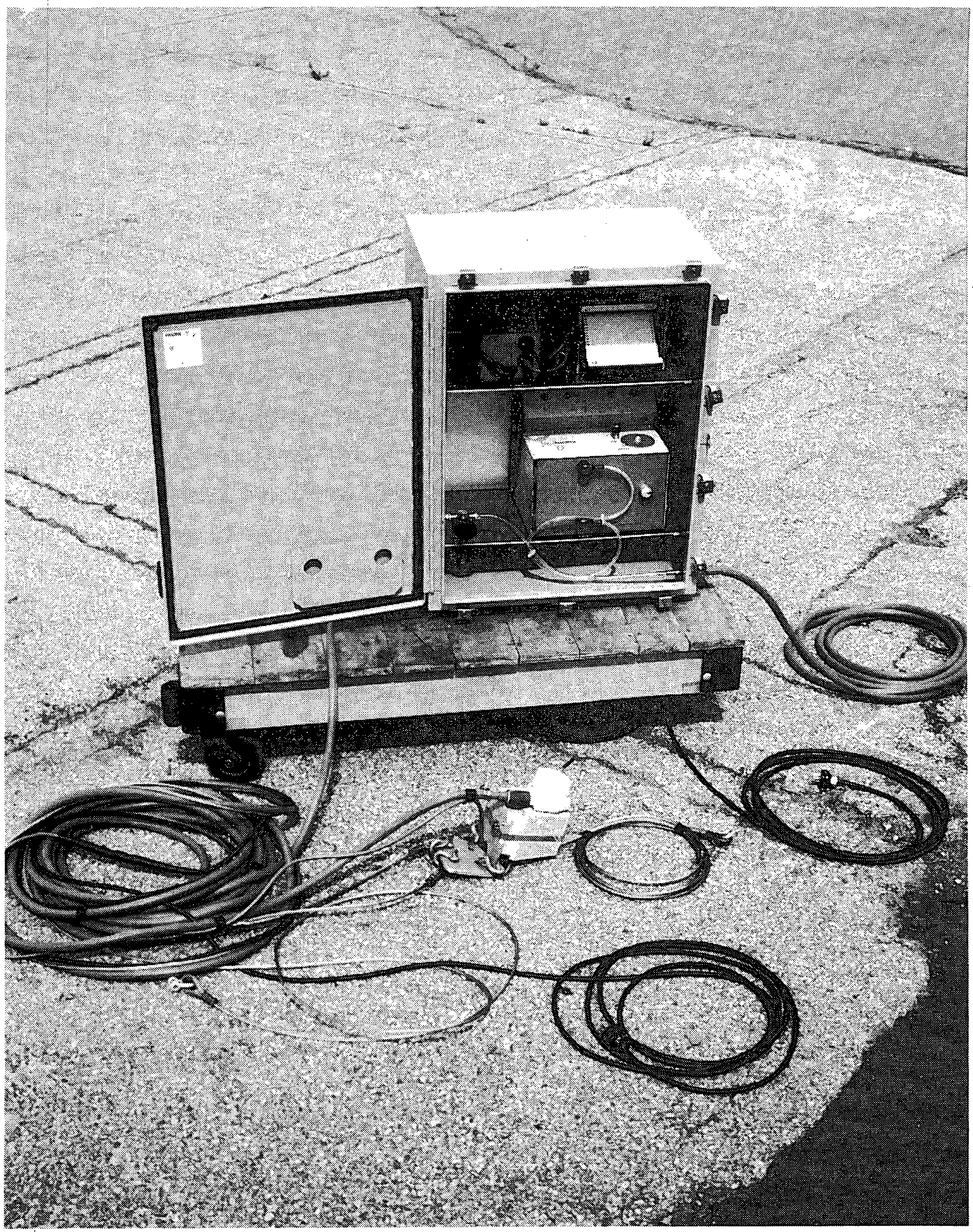


FLUOROMETER ADDITION TO PROFILER

This system was developed for the 1977 Kootenay Lake study. It is essentially a copy of the 1976 profiler, except that a submersible fluorosensor tuned to the chlorophyll "a" spectral line was added. Thus, vertical profiling of turbidity, temperature, chlorophyll "a", fluorescence and conductivity could be performed using in-situ sensors. As in the previous system, data are presented both directly (on analog chart recorders) and logged digitally on magnetic tape. The many thousands of measurements taken during 1977 provided an excellent basis for the descriptive limnology of Kootenay Lake. The following specification is for the fluorometer addition. See ES-512 Addendum, page 52, Jan. 1977, for a description of the rest of the system.

PERFORMANCE SPECIFICATION

Chlorophyll "a" Measurement Range	1 to 100 $mg.m^{-3}$ typ. (varies with chlorophyll type)
Measurement Precision	±10% of reading using same solution
Sensor Time Response	1.5 s fall time limiting time response
System Data-Recording	Sensor signals digitized (at 1 scan/second) with 12-bit digital words stored on cassette tape. (Tape capacity: 300,000 samples or 100 T.T.C.F. profiles)
System Data-Displays	X-Y analog displays (of temp./turb./fluorescence cond. profiles). Four X-Y recorders. Digital display option.
Profiling/Winching Speed	0.3 $m.s^{-1}$ (approx.)
System Configuration/Size/Mass	As per photograph; profiler body 60 kg mass
Electrical Power Requirement	0.5 kW, 110V AC, 1 Ø
Operating Temperature Range	$0^{\circ}C$ to $+30^{\circ}C$
Depth Operating Range	Instruments Rated 200 m minimum



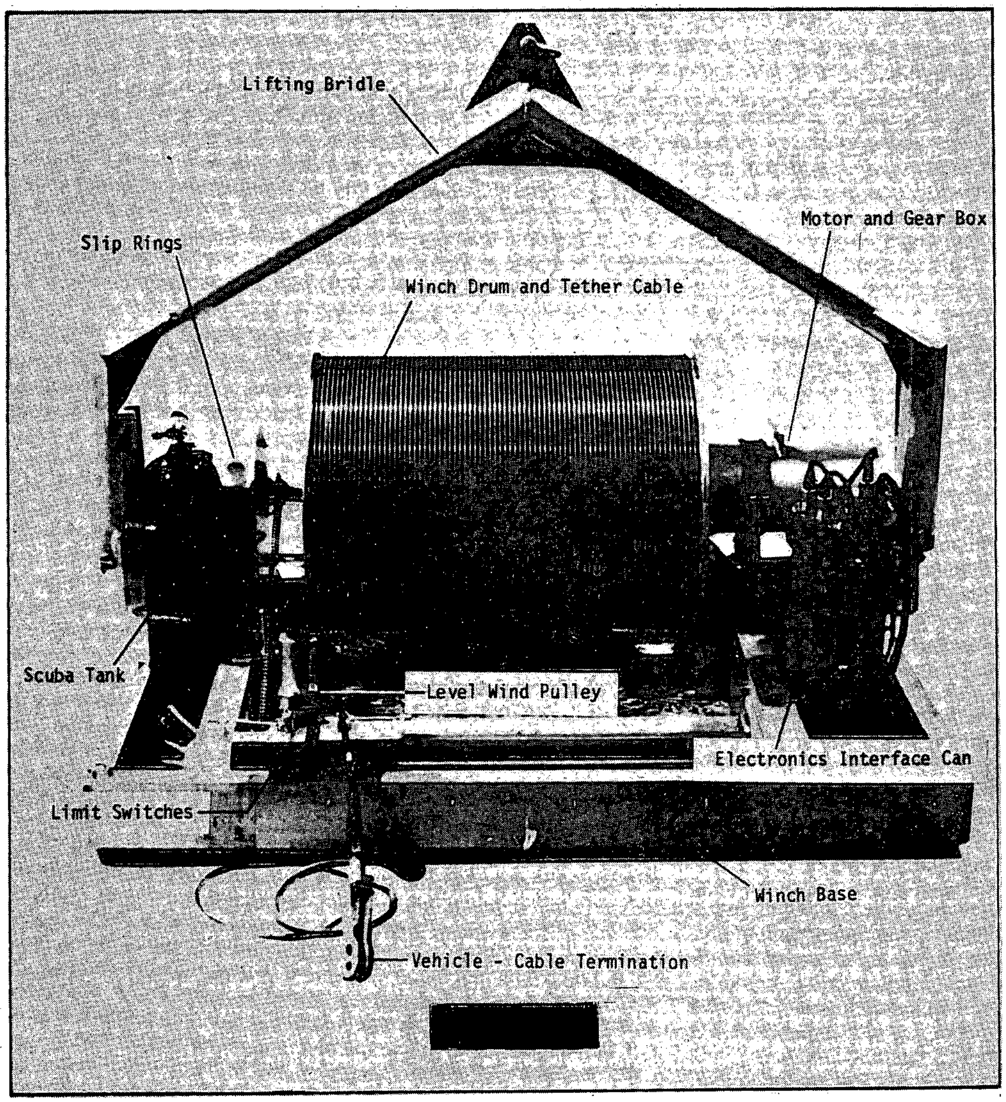
FLUOROMETER, TOWER MOUNTED

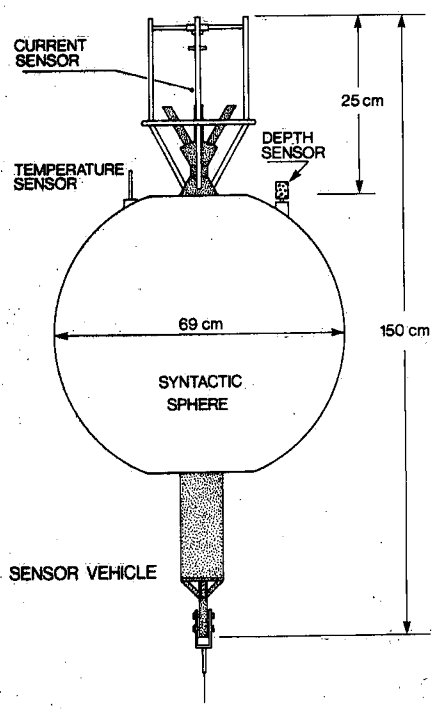
One of the study areas at CCIW is surveillance strategy and methodology, a subject which requires much information on the short-term, mid-term, and long-term fluctuations in environmental parameters of interest. One area, where this information is sparse, is time series, lacustrine and chlorophyll concentration, chiefly because much of past monitoring has been done by pumped or bench fluorometer techniques onboard ship. Thus, because it is uneconomical for ships to stay at one position for long periods, available information on fluctuations in chlorophyll with time is poorer than information on spatial distribution.

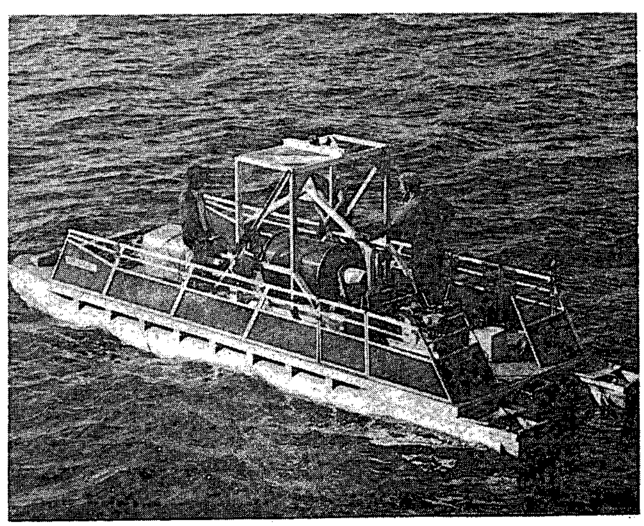
To augment CCIW's data-base on this subject, a simple continuous chlorophyll monitoring experiment was conducted about 2 km offshore, for a few months on CCIW's research tower by GLBL biologists. As shown opposite, the measuring system comprised a submersible pump, a flow-through bench fluorometer, stripchart, and AC power supplies (powered from shore). Modifications were made to allow easy access to the cuvette for cleaning and flushing purposes. The system operated unattended in its weatherproof enclosure and was visited by CCIW field support staff at appropriate intervals to ensure the optics and flow-through cuvette remained unfouled. Time related data for chlorophyll-fluctuations per-minute to monthly-cycles were covered in the lengthy record obtained.

PERFORMANCE SPECIFICATION

Fluorometer Measurement Ranges	1x (least sens.) 3x (low sens.) 10x (med. sens.) 30x (high sens.) selected
Fluorometric Sensitivity	3mg/m^3 alpha-chlorophyll extract full scale on x30 range (pre-field calibration)
Sampling Flow	20 litre/minute
Speed of Response	Varies with concentration level, approx. 1 min
Display	Chart Recorder HP #680, continuous operation, speed 2"/h, 1 V F.S.
Chart Recording Capacity	16 days (max., continuous)
System Power	115 Vac, 60 Hz, 250 V.A
System Size & Mass	0.6 x 0.8 x 0.5 m<100 kg







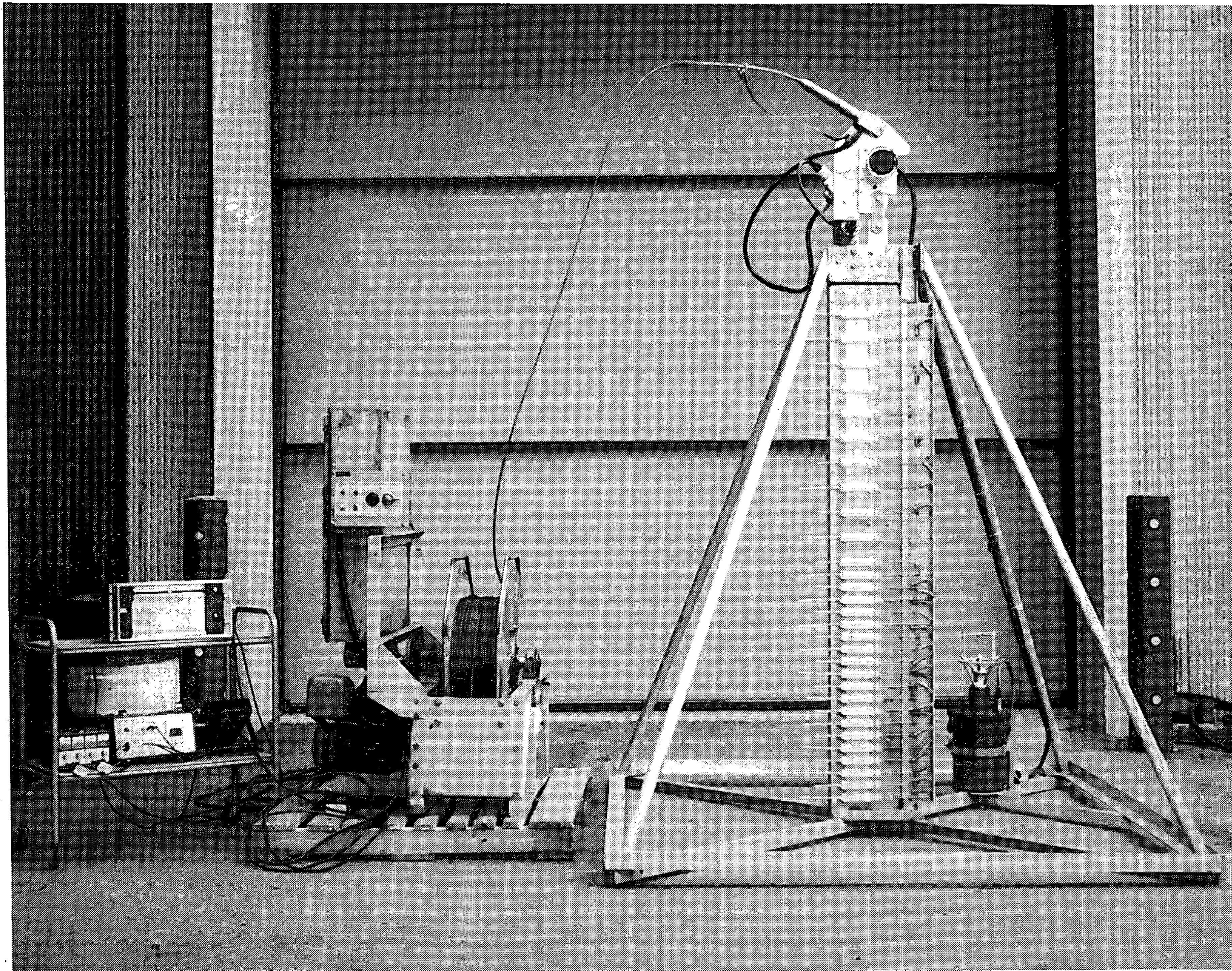
PONTOON CRAFT

KOOTENAY VERTICAL AUTOMATIC PROFILING SYSTEM (K VAPS)

Improved understanding of energy dissipation processes within lakes requires measurements with high spatial and temporal resolution. Such measurements can now be obtained with a continuously profiling system called VAPS.

The system consists of a winch, located on the lake bottom; a combined power/signal cable from winch to shore; a shore-based winch controller; data acquisition system; a sensor vehicle; a tether cable and a deployment vehicle.

Winch	The underwater profiling winch has a large grooved drum on which the tether cable is single-wrapped via a level-wind mechanism. Power is through a regenerative silicon controlled rectifier drive. A tachometer feedback assists the accurate speed control. Speed reduction between motor and drum is by a 385:1 gearbox. The lower and upper limits of the sensor body are adjustably controlled by limit switches, activated by the level wind.
Power/Signal Cable	Connecting the winch and sensor vehicle to the shore is a 2 km long electrical cable, split and connected in the middle for easier deployment from a tugboat. The cable consists of 4 #14 AWG power conductors and 6 #20 AWG signal coax conductors, plus a central strength member.
Controller	The winch speed is controlled by an electronic (Beel Inc.) control subsystem located on shore. The winch tachometer provides an analog display of profiling speeds. Speeds are set at 2.5 cm/s up and speed of 21 cm/s down. The winch is automatically reversed by means of logic circuitry, which was custom designed by Ludbrook Associates.
Data Acquisition System (DAS)	See Unpublished Report ESS-512, addendum 1, Jan. 1977.
Sensor Vehicle	A standard 22 cm diameter electronics cannister mounts and interfaces a sensor array described in Unpublished Report ESS-512, addendum 1. A 69 cm diameter syntactic foam sphere surrounds the electronics package giving a net positive buoyancy of 600 N (150 lbs) force. This shape has been tow tested and found to be stable in pitch, roll and yaw at velocities up to 100 cm/s, and has moderately low drag, thereby minimizing lateral drift.
Tether Cable	The sensor vehicle is tethered by 160 m of six conductor, electro-mechanical cable, 0.8 cm diameter. The strength member is of braided KEVLAR to give minimum cable weight in water, good fatigue life and a breaking strength (new) of approximately 1 metric ton.
Deployment Vehicle	To facilitate the field operations of deployment and retrieval, a pontoon craft was developed to raise and lower the winch through the deck with the aid of a gasoline driven winch. The illustrations opposite give a view of the craft.

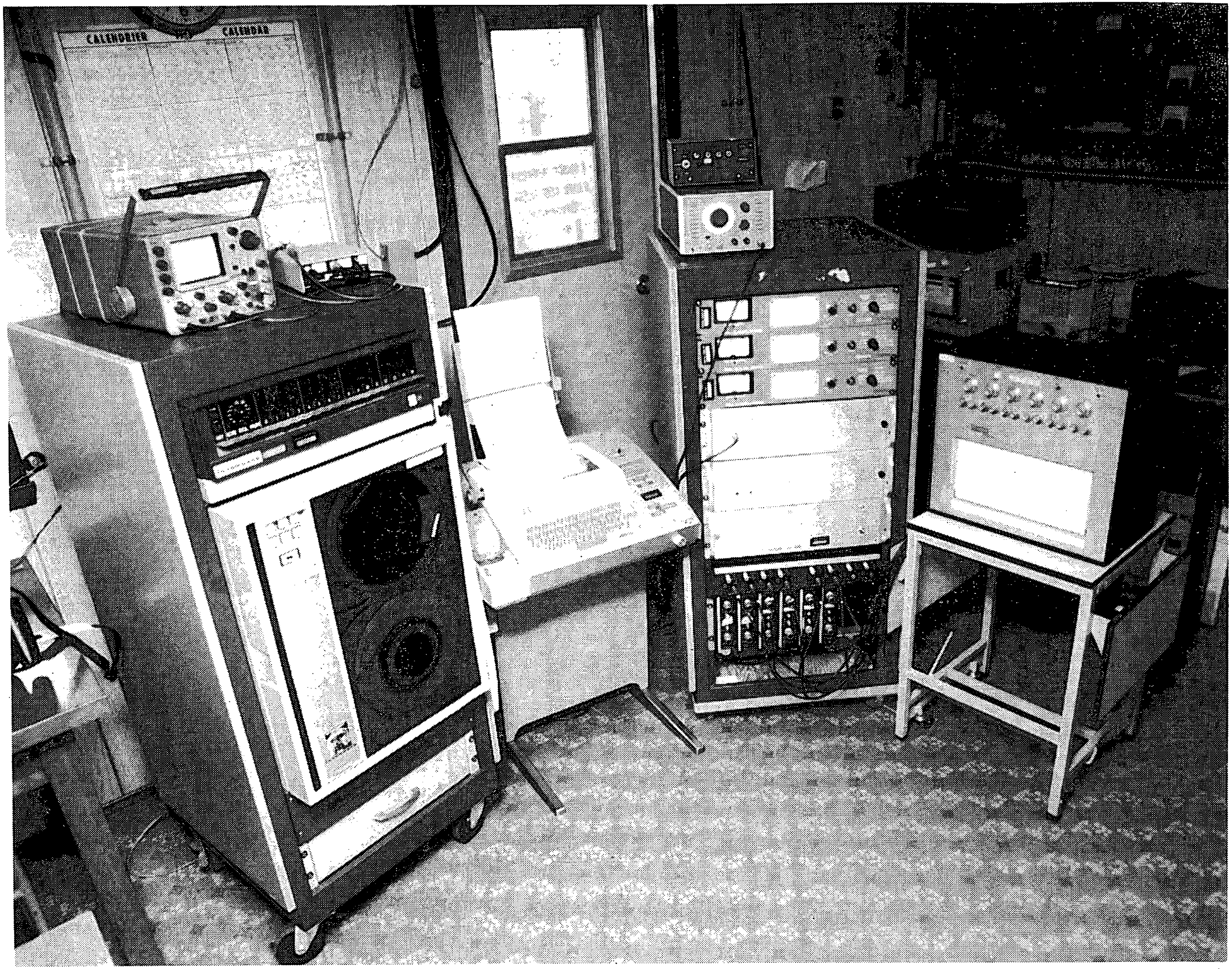


LAKE BOTTOM WATER SAMPLER

A special sampler has been designed to simultaneously collect many water samples, ranged from about zero up to two metres above the lake bottom. The design consists of a pyramid structure which supports an array of glass syringes. It is equipped with an acoustic current sensor for current readings, a tilt sensor for the system orientation as it sits on the bottom, and has an electrically commanded release mechanism for actuating the syringes. After lowering the array to the bottom and ensuring that bottom currents are suitable, the release is activated. This allows the trigger bar to fall and simultaneously trip all of the syringes. Their plungers are actuated by preloaded springs. The sampler is then pulled to the surface for unloading water samples, cleaning of the syringes and cocking the system for the next deployment.

SPECIFICATIONS

Number of Syringes	30
Syringe Capacity	50 cc each
Working Depth	to 300 m
Dimensions	244 cm high x 213 cm square base
Mass	90 kg


CALENDRIER
CALENDAR

LITTORAL ZONE INSTRUMENTATION SYSTEM

The Littoral Zone Instrumentation System is used to obtain field measurements of waves incident on the littoral zone and associated on-shore and alongshore currents. The intent is to support investigations of the transport of bed material in this zone.

The necessary measurements are obtained using an array of sensors mounted on three tower structures up to 200 metres offshore in Lake Ontario. As well, supportive data are collected from a waverider and a fixed platform 1 km offshore (see Waves '76 Resume, ES-512 Addendum 1, pg. 60). The near-shore sensor complement is described below. The platform sensor suite includes: one wave sensor; a water temperature sensor; a 2-axis water velocity sensor; a meteorological sub-system consisting of air temperature, humidity, wind speed, direction and elevation sensors described in ES-512/1.

The nearshore sensors are individually cabled to the shore-based signal conditioners, power supplies, and the computer-controlled data acquisition system used for the platform. The platform sensors are sampled with serialized data telemetry to and from the shore facility at 20 kilo baud. The data acquisition sub-system selectively scans the sensors, reformats the data, stores it on computer compatible magnetic tape and displays six parameters on an analog strip chart recorder. The photograph shows the shore based equipment.

PERFORMANCE SPECIFICATION

WAVE SENSORS

Kelk (Zwarts Type) Wave Gauge Sensing Mechanism	electronic wave guide of non-fouling construction
Dynamic range	±3m (±2.5 m on chart display)
Sensitivity	1 $V.m^{-1}$ nominal
Resolution	2.5 mm (1 LSB)
Frequency response	DC to 5 Hz (-2% at 5 Hz)
Linearity	±0.1% FS
Accuracy	±0.2% (static) 5 mm water height zero drift
Number Deployed	3 (one per location)
Placement	on towers or piles outside of surf zone approximately 200 m offshore

CURRENT SENSORS

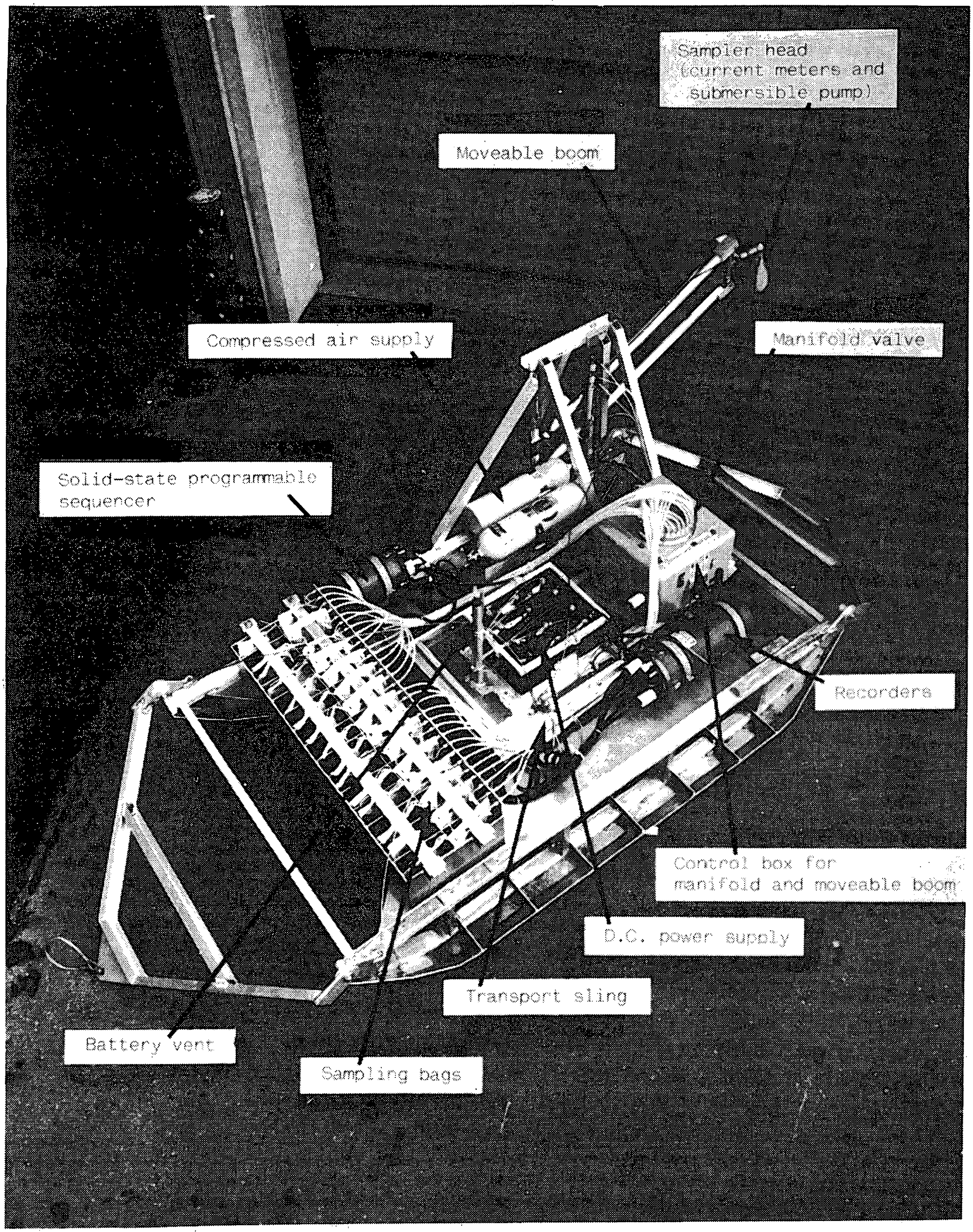
Bendix B-10 Current Sensor	
Sensing Mechanism	hydromechanical rotor
Dynamic Range	±2.5 $m.s^{-1}$
Threshold	3 $cm.s^{-1}$, (10 $cm.s^{-1}$ linearity threshold)
Sensitivity	0.4 $V.m.s^{-1}$
Accuracy	±3 $cm.s^{-1}$ ±3% FS
Output Time Constant	1 s
Resolution	0.6 $cm.s^{-1}$
Number Deployed	3 sets of orthogonal pairs (one pair per location)
Placement	jetted structures, 30 cm above bottom in 1.5, 2.5, 4 m depth at 73, 107, 145 m offshore

TEMPERATURE SENSOR

Rosemount Model 171ED	
Sensing Mechanism	Platinum resistance element
Dynamic Range	0 to 25°C (0 to 5V)
Sensitivity	200 mV $°C^{-1}$
Accuracy	±0.04°C
Resolution	±0.013°C
Number Deployed	one

DATA RECORDING SYSTEM

Digital Data Acquisition Subsystem	appended to WAVES minicomputer system
Number of input channels	16 (maximum) configured as 11 channels
Sample Rate	5 $samples.s^{-1}$ each channel
Data Output Format	1/2 inch 7 track magnetic tape 800 BPI in format compatible with CCIW/WAVES data reduction software
Data Display	6 channel analog chart recorder/monitor
Data Acquisition Modes	Mode A:5 Hz scan rate for all sensors plus WAVES turbulence sensors Mode B:5 Hz scan rate for current sensors plus WAVES meteorological sensors Mode C:5 Hz scan rate for all sensors plus WAVES meteorological sensors Mode B switches automatically to Mode C for 20 minutes every 3 hours to collect wave climate data. Waveriders enabled automatically during Mode C.



Sampler head (current meters and submersible pump)
Moveable boom
Compressed air supply
Manifold valve
Solid-state programmable sequencer
Recorders
Control box for manifold and moveable boom
D.C. power supply
Transport sling
Battery vent
Sampling bags

LITTORAL ZONE PROFILER (SLED)

One process being studied in CCIW's research program for littoral-zone processes is littoral-transport of suspended material, and especially the dynamics of this process in the surf-zone. As part of this study a manually-controlled, winch-driven cableway (somewhat similar to a ski tow) has been constructed through the surf-zone. The total system comprises an AC powered winch on the beach, a pair of embedded support piles spanning the surf-zone out to the 4 metre contour supporting a tow cable and an instrumented sled pulled offshore/onshore along this cable. The instrumented sled, shown in the photo, is equipped with 30 collection bags for sampling suspended sediment, an automatic programmer unit, a moveable profiling boom with inlet-port, submersible pump, current sensors, pressure sensor, chart-recorders, event marker and clock. During a single one-hour measurement transect through the surf-zone, there are 3 minute dwells at each of 10 stations, with sediment samples collected at 3 different heights above bottom. Then there is a 2.5 minute period for moving the sled to the next station.

The system is designed to operate in surf conditions up to 2 metre significant wave height, and when in use the sled measurements are enhanced by data gathered by other tower-mounted instrumentation at the experimental site.

SAMPLING, MEASUREMENT AND TRANSITING PERFORMANCE

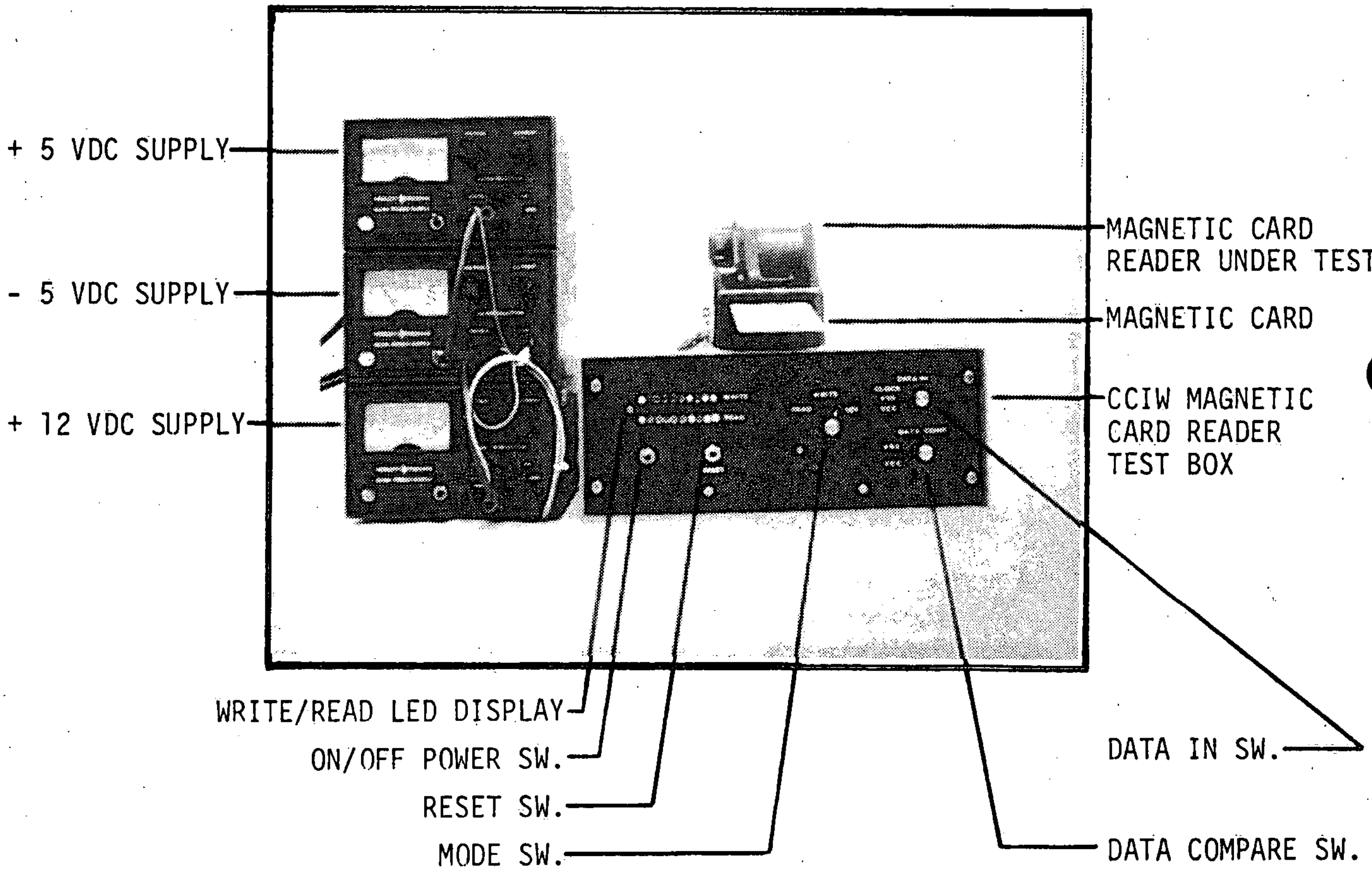
Baseline Distance	125 metres
Horizontal Transiting	One profile per hour, 3 minute dwells at each of 10 stations
Sediment Sampling Sequence	3 samples/station, taken at 10, 30, 100 cm height above bottom
Sled Sampling Capacity	30, 2-litre sample bags (see photo)
Current Sensor Measurement Range	+2.5 to -2.5 m/sec, (±3%)
Current Sensor Type	Ducted impellor, 2-axis (at boom inlet port)
Pressure Sensor Measurement Range	0 to 7 metre (±0.5%) submergence-depth
Chart Recorder	3 channel Y/T, 20 cm/min chart speed
Event Marker Channel	Shows times for boom Lo/Med/Hi positions
Automatic Timing Unit	CCIW's diode programmable sequencer
Power Sources	12VDC lead-acid all instrumentation
	Compressed air scuba tanks for boom motion
	220 VAC 2.5 kW for winch power
Sled Size and Mass	3 by 2 by 1 m; 300 kg

SANKYO SEIKI

MODEL MCP 501-5A-0330

MAGNETIC CARD READER

TEST SET UP



MAGNETIC CARD READER

One interesting recording and play-back device which passed under engineering scrutiny, is a magnetic card reader. This device was used as a subsystem for programming a microprocessor based system to eliminate the need for repeated keyboard entries, where human errors could be serious. A special test box was constructed to ensure correct and repeatable operation of the card reader.

SPECIFICATIONS

Capacity	4280 bits
Channels	5
Life	20,000 card passes
Temperature	+5 to +50°C
Card Size	50 x 100 mm (approx.)


DAY/HR MON/MIN YR/SEC
OXIDE SIDE
READ/WRITE CARD
SEN PWR
BAT
CASSETTE
H.S. PRINT
MTU
L.PRINT
CARD READ
MODEM
K/B ENTRY
DIGITAL
ANALOG
NO DATA
NO DEV
DATA OVFL
AUTO
DISC/COM
TEST
PROC
CONTROL DATA

MULTI-ENVIRONMENT MONITORING SYSTEM-MEMS

To handle the data acquisition task in support of a wide range of CCIW water-science studies, a new functionally-flexible microprocessor-controlled data acquisition system has been designed with a prototype built for evaluation. Modular in system concept, it is available either as a battery operated submersible digitizer (SMD) for data measurement missions in lakes and rivers, or as an AC powered rackmount digitizer and display (RMD) for shipboard use or for laboratory experiments inhouse.

The instrument can accomodate inputs up to a maximum of 32, comprising signals from voltage, resistive, pulse encoded or pulse rate environmental sensors in any reasonable mix, and at presettable sensitivity levels. It features self-test and self-calibrate for reliable and accurate digitizing, and offers a wide range of scan-rates.

Operation commands for this MEMS data-logger is either by manual-entry using the keyboard or by the magcard-reader and a previously written magnetic card. The command and monitor package is normally disconnected from the pressure case of the SMD, but may be left connected if desired (see opposite).

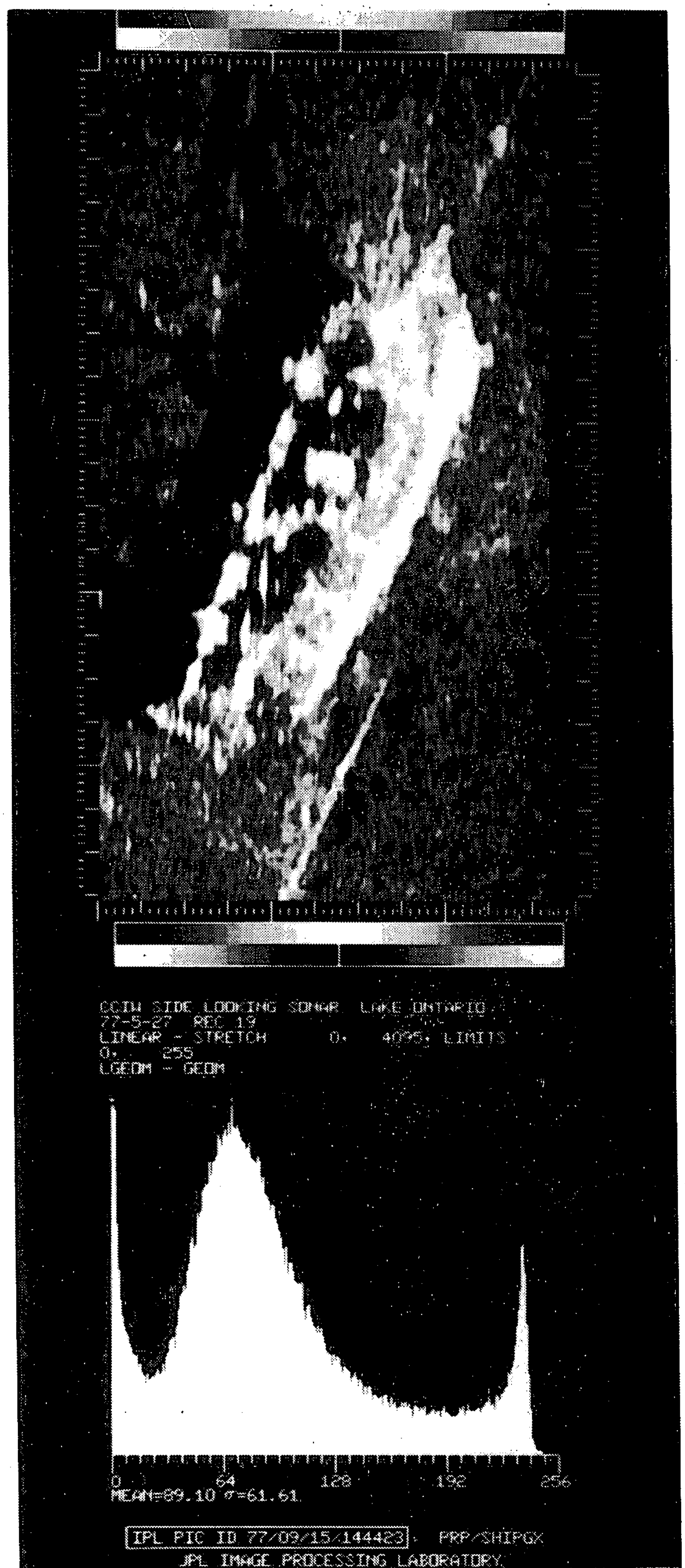
Depending upon the modules selected, one or all of the following outputs are generated. Probably most important is digital data storage on magtape, namely cassette for the SMD, halfinch magtape for the RMD. Digital printout is available directly on the RMD and on the monitor package for the SMD. Several analog outputs are available. Serially-encoded digital data are available in modem compatible format. Output power to external sensors can be timed on and off.

Within the unit, CMOS logic has been extensively used, including the microprocessor and associated memory. Expansion of memory beyond 3 kilobytes presently used is an option for preprocessing data.

To date, effort has been applied to use of the system in a simple auto-timed data acquisition mode, but future applications with increased onboard processing are anticipated and can be implemented. The instrument has been designed and produced in prototype form by Computing Devices Company. Further improvement is anticipated.

PERFORMANCE CHARACTERISTICS

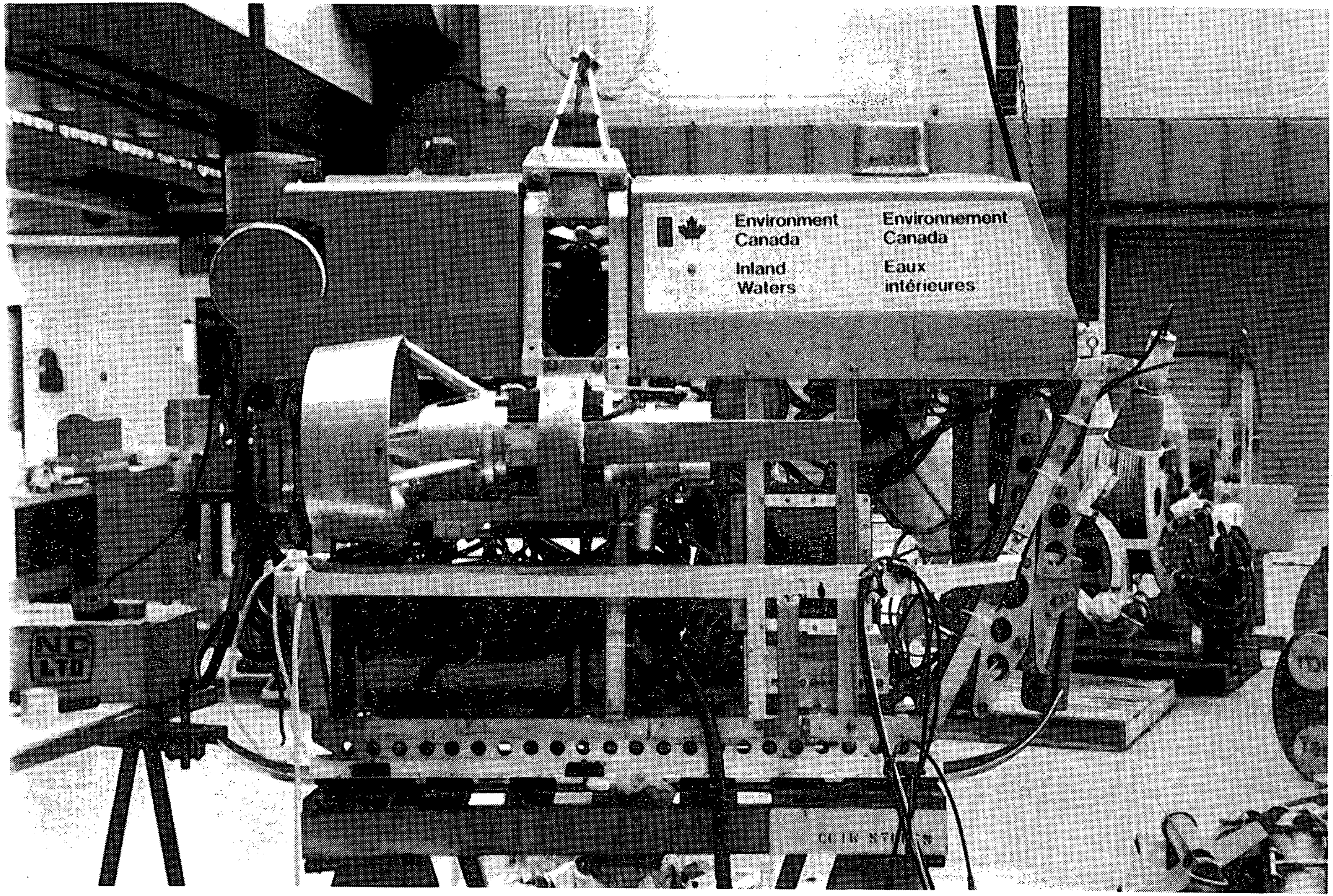
Digitizing Accuracy	12 bit (1 in 4096)
Voltage Inputs (8 ranges)	±5.0/2.5/1.0/0.5/0.25/0.1/.05/.025 Volts FS
Resistive Inputs (8 ranges)	20/10/4/2/1/0.4/0.2/0.1 k Ω FS
Pulse-Count Aperture-Times	0.1/0.5/1/5/10 secs, 1/5/10 mins (4096 count)
Input Channels	Up to 32 maximum
Digital Output to Magtape Storage (SMD)	500,000 16-bit samples on 4-track phase-encoded cassette
Digital Output to Magtape Storage (RMD)	500,000 samples on 7-track 800 BPI halfinch tape (42-bit BCD samples)
Display of Digital (and Status) Data	6 BCD numeric digits + 14 warning indicators
Digital Printout	4 decimal digits per input channel, plus time
D/A Outputs	±5V FS, 10-bit quantization (up to 8 chans)
Serial Digital-Data Output	ASCII-encoded, at 110, 150, 300, 600, 1200, 2400, 4800, 9600 selected baud-rate
Programmed Sensor Power	10W, min, timed ON 10 secs before scan
Supply Voltages	+12V and -12V lines
Operating Temp. Range	-10° to $+40^{\circ}C$
Operating Depth Range (SMD)	0 to 400 m submergence


CCIW SIDE LOOKING SONAR LAKE ONTARIO
77-5-27 REC 19
LINEAR - STRETCH 0. 4095. LIMITS
0. 255
LGEOM - GEOM
0
64
128
192
256
MEAN=89.10 σ=61.61
IPL PIC ID 77/09/15/144423
PRP/SHIPGX
JPL IMAGE PROCESSING LABORATORY

SIDESCAN SONAR IMAGE PROCESSING

Sidescan sonar systems provide a powerful tool for sensing the topography of the lake bed and studying particular features. The application of these systems is limited by the dynamic range of the display recorder and the distortion inherent in the display as they impact on the pattern recognition ability of the interpreter.

Recently, the Jet Propulsion Laboratory (NASA - CALTECH, Pasadena, Ca.) have been applying their image processing expertise to the sidescan sonar problem. Shown at the left are a photographic reproduction of an original CCIW sidescan sonar display and a sample of the application of image processing. The target is of archaeological interest. The processed image is derived from the instrumentation magnetic tape recorder analog recording obtained in the field. The subimage shown has been digitized, extracted from the record, corrected for vessel speed (aspect ratio), and corrected for slant range distortion. Additional techniques for image enhancement are under study at JPL in co-operation with CCIW personnel.


Environment Canada
Environnement Canada
Inland Waters
Eaux intérieures

TETHERED REMOTELY OPERATED VEHICLE (TROV) UPDATE

Engineering Services assisted in the contract management for the upgrading of an existing unmanned, battery driven, underwater vehicle. See Jan. 1976 issue of this unpublished report for further details on the TROV.

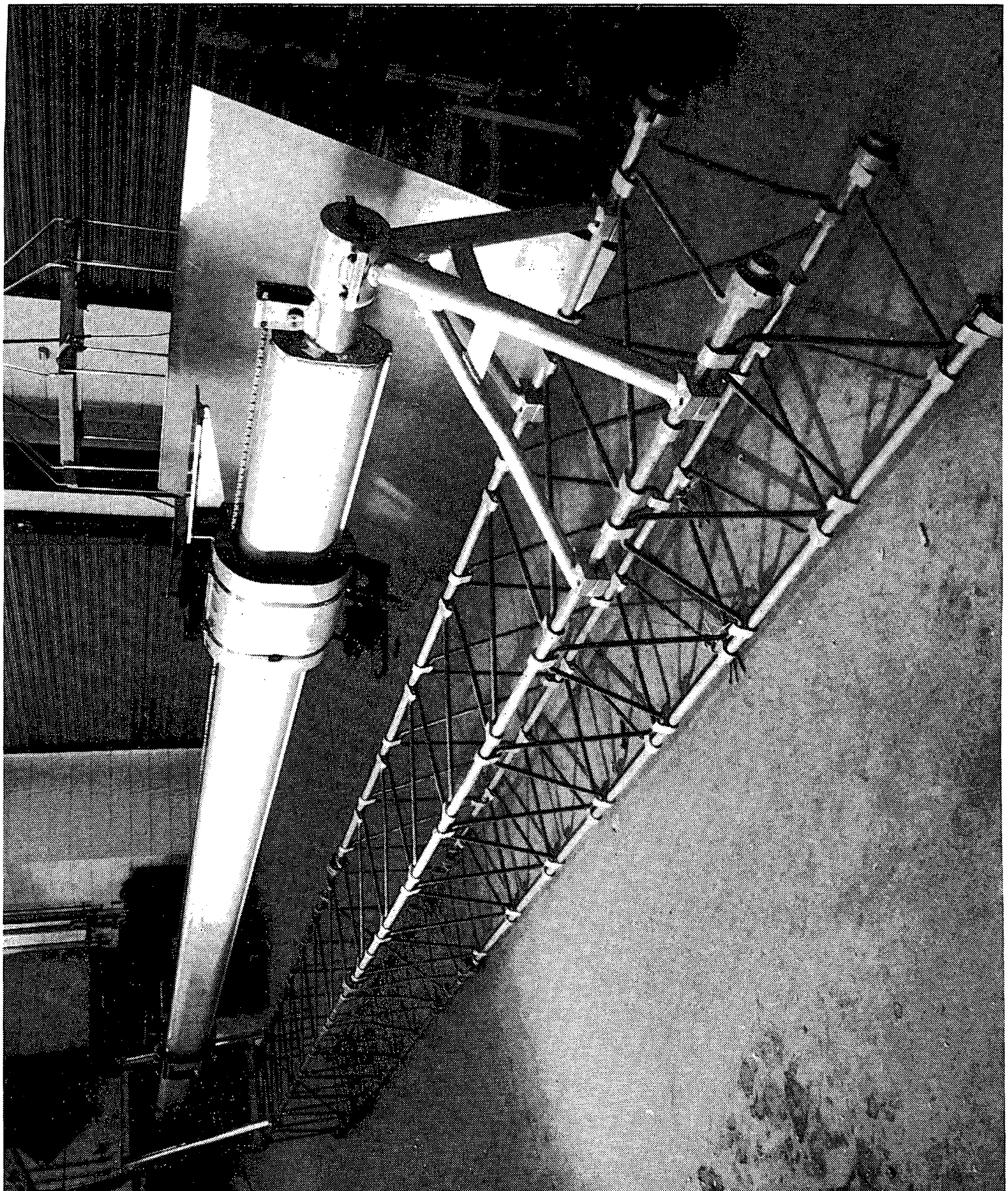
Improvements to the ballasting system were made. The forward ballast tank was changed from a free-flood system to a pressure compensated system and the aft tank was changed to a fixed ballast unit. These changes greatly improved the depth control of the vehicle.

The two fore and aft thrusters were increased in power to 3.5 kW each and the existing 3 small thrusters were combined together to give greater vertical mobility.

The power batteries were replaced by a surface supplied 440 VAC system, and the vehicle electrical system correspondingly changed.

The directional transponders and depth sounding systems were modified to improve their reliability.

A quick firing, 35 millimetre camera triggering system was installed.



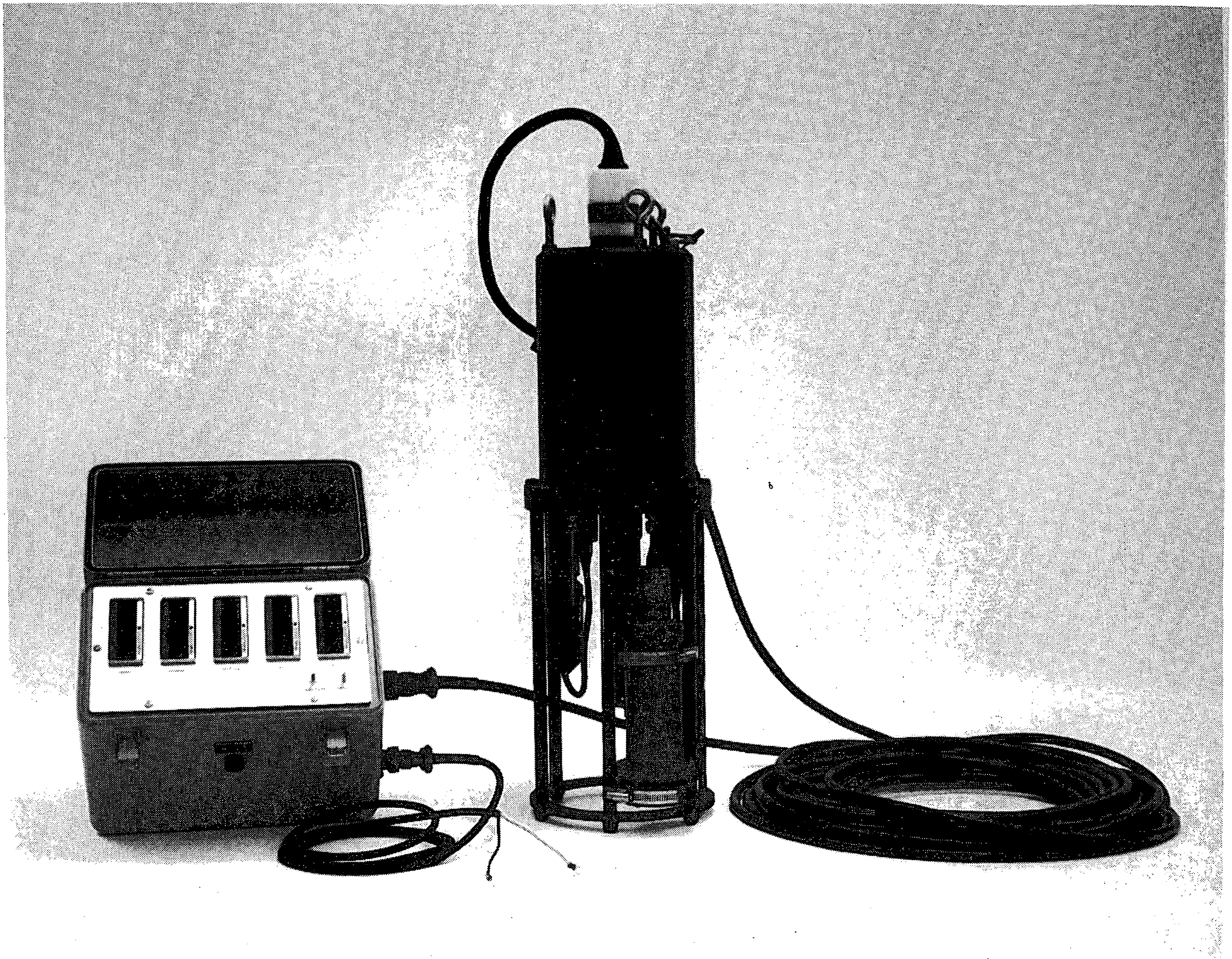
VERTICAL TRAVERSING MECHANISM

This hand-operated profiling unit was designed for use in Lake Manitoba in 4.5 m depth of water. The profiler rigidly attaches to an open structure tower with a clearance from the tower of 45 cm. A pair of lightweight profiling heads carry two current measuring sensors. The distance between the heads is adjustable.

Some remote control features are built into the profiler. The location above the bottom and the heading of the sensors are manually controlled from the top of the tower.

SPECIFICATIONS

Water Depth	4.5 metres
Profiling Range	15 to 500 cm above the lake bottom
Heading Control Range	$\pm 120^{\circ}$
Sensor Spacing	Up to full profiling range
Tower Type	18" Millard



WATER QUALITY PACKAGE (FOR WESTERN/NORTHERN REGION)

On occasion, CCIW carries out lake and river studies where the measurement techniques only need to be basic and simple, perhaps limited to a small boat operation making occasional measurements at points of interest. The total data requirements for the study may not exceed a few hundred measured values, and high density recording may be unnecessary.

The system shown here typifies this type of equipment. A commercial sensing head with 5 standard water quality sensors was available from previous studies. Given suitable battery excitation, the sensor output voltages could be displayed and easily noted using digital panel meters. The complete arrangement (shown opposite) made a portable water quality measurement package suited for small boat operation, intended for the 1977 Qu'Appelle Lakes and River Study in I.W.D.'s Western and Northern Region.

PERFORMANCE SPECIFICATION

D.O. Sensor Measurement Range	0 to 20 ppm (mg/litre)
D.O. Sensor Accuracy	±0.05 ppm (at cal. temp.)
Conductivity Sensor Range	0 to 10 mS/cm
Conductivity Sensor Accuracy	±10 μ S/cm
pH Sensor Range	0 to 14 pH units
pH Sensor Accuracy	±0.01 pH
Temperature Sensor Range	0° to 40°C
Temperature Sensor Accuracy	±0.05°C
Depth Sensor Range	0 to 50 m
Depth Sensor Accuracy	±0.5 m
Digital Displays	3-1/2 digit (0 to 1.999V FS)
Maximum Operating Depth	30 m cable length
Power Supply	12V DC battery

ACKNOWLEDGEMENTS

This year, I acknowledge those who felt the satisfaction and frustrations most of all in producing what is described in this report. They are the engineers and technologists who showed their skill and determination in getting things done under the pressures of time, cost, administration, circumstance, weather, personalities and technical advancement. I believe that a strong Section is built on people such as these:

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