SURVEILLANCE 1975

METHODOLOGY

P.R. YOUAKIM
Technical Operations Section
Scientific Support Division

SURVEILLANCE 1975

METHODOLOGY

P.R. YOUAKIM
TECHNICAL OPERATIONS SECTION
Scientific Support Division
Canada Centre for Inland Waters

March 1976

INTRODUCTION

1975 Lower Lakes Surveillance

The surveillance cruises, implemented at the Canada Centre for Inland Waters (CCIW) in 1975, were carried out to meet the requirements of the International Joint Commission (IJC). The IJC requirements called for information on areas of improving or deteriorating water quality, general lakewide conditions and responses to the impact of management procedures.

Sampling and analytical methods used in surveillance work were basically the same as those employed in survey or monitor work (see Annex K, IFYGL Technical Plan, Volume 3). Whereas the 1974 surveillance program included only those key parameters reflecting the impact of eutrophication, the present 1975 program was expanded to include more intensive microbiological and water quality parameters for a broader scientific understanding of the lakes' ecological conditions. Equipment and procedures described below pertain to surveillance cruises on both Lakes Ontario and Erie in 1975, carried out aboard the chartered vessel MV NORTHERN SEAL.

MEASUREMENT OF WATER TEMPERATURE

Several methods are available for the measurement of water temperature. Four of these methods, namely the reversing thermometers, the mechanical bathythermograph 1 (MBT), the electronic bathythermograph (EBT) and the bucket thermometer were in use. A minimum of two methods were usually used on every sampling station occupied.

The Reversing Thermometers. Figure 1.

Deep sea, protected-type reversing thermometers measure water temperature at a predetermined depth. The thermometers were fitted to Knudsen water sampling bottles in such a manner that as the bottle reverses on the wire, they are also inverted. The bottles were lowered to the desired depth, left in the water for 6 minutes; a metal messenger was sent down the wire, the bottles were thus inverted and brought up to the deck lab and the thermometers read. The reversing thermometers were used on a minimum of 2 stations per cruise for calibration checks of the EBT temperature traces. They were more frequently used to support mechanical BT traces. The main thermometer can be read to the nearest 0.01°C and the expected error lies within ± 0.03°C. The reading was usually obtained from a stable isothermal layer over a relatively great depth (i.e. the hypolimnion).

The Mechanical Bathythermograph (MBT). Figure 2.

The MBT provides a temperature-depth measurement. In 1975 it was used as a back-up system for the EBT whenever the latter failed. The temperature-depth profile is recorded on a gold-coated slide as the instrument is lowered through the water column. Four depth ranges were available - 30, 60, 140 and 275 m. Approximate depth was obtained from the chart or the echo sounder, the BT of the corresponding depth range was selected, the BT secured to the wire and loaded with a slide, lowered to just below the surface for 30 seconds. Then the BT was lowered at a speed of 2 metres per second till it reached bottom and hoisted up more quickly to the sampling platform.

The Electronic Bathythermograph (EBT). Figure 3.

The EBT provides a direct instantaneous read-out and graphical record of the temperature-depth profile. The EBT system consists of a light weight probe sensor lowered over the side with a winch and cable, and transmits continuous analog data from two transducers (temperature and depth) to an X-Y recorder on board.

The recorder was mounted amidship and the winch port side, upper level. The EBT head (sensor) was mounted in conjuction with a crane on the ship's main deck. On station the EBT head was lowered till its sensor was fully immersed in surface water for one minute. The EBT was then lowered with the EBT recorder switched to read, recording the down trace to the bottom. The EBT sheet is marked by the operator as required. (See Appendix 1 - Data Sheets).

Three depth ranges of 50, 100 and 400 metres were used as appropriate to produce a full scale recorder display of the temperature profile. Accuracy of the system is ± 0.01°C for temperature and ± 1% of full scale for depth (CCIW Engineering Specifications).

The zero check facility provides shorted input to the X-Y recorder for zero check and adjustment of recorder.

The Bucket Thermometer. Figure 4.

Used to obtain surface water temperature. The bucket consists of a laminated rubber cylinder with a wooden bottom. Inside this cylinder there is a second rubber sheath that contains a brass shield encasing the thermometer. The bucket reading is always obtained from the same side of the ship as the EBT, and as close to the "down time" of the EBT as possible. The temperature reading to the nearest 0.1°C is compared each time with that obtained by the EBT (or MBT) at the surface.

The bucket is also read for the synoptic meteorological observations. Here care should be exercised when lowering the bucket while the ship is underway so that the thermometer does not get damaged. Also it can be lowered in such a way as to minimize the entrapment of air bubbles.

MEASUREMENT OF WATER TRANSPARENCY AND COLOUR

The Transmissometer. Figure 5.

The beam transmissometer (model XMS, manufactured by Martek Instruments) which came into prominent use at CCIW in 1973, is a rugged, portable instrument specifically designed for in situ measurements of "turbidity" by determining the per cent transmission of a light beam through a known path length in the water. The sensor head has a collimated detector positioned in the beam of a self-contained collimated light source. The optics are arranged so that the light transmission path between source and detector can be set from one quarter to several metres distance through the underwater body. At CCIW the one-quarter metre and one-metre path length are the only lengths in use. The optical band width of the instrument is defined by a Wratten 45 filter which has a peak transmission at 486 nm.

A pressure transducer (Martek model DM3) which can be fastened to the main body of the transmissometer permits coincident measurement of % transmission vs. depth. The entire in situ sensor package was connected by electrical cable to readout modules in the NORTHERN SEAL wet lab.

Overall system accuracy is approximately ± 1.0% full scale calibration.

Measurement:

1. Set: Power Supply "ON"
   Recorder "ON"
   Depth Function "ON"
   Transmissometer Function "OPERATE"
2. Allow 2-5 minutes for bulb to warm up.
3. Lower transmissometer slowly at first so that accurate surface reading is made.
4. Record down trace.
5. Lift recorder pen.
   Raise transmissometer.
   Set: a) Depth Function "OFF"
   b) Transmissometer Function Zero.
6. Power supply can be set to charge between stations.
7. Record on sheet: a) Date
   b) Monitor Station
   c) Sheet No.
   d) Cable length (30 m or 100 m)
   e) Sea state

Transmissometer readings will not be taken when the conditions are such that the instrument may receive a heavy blow on the side of the ship.

Readings for the manual lab chemistry sheets will be taken at the same depths at which water samples are taken.

The Secchi Disc. Figure 6.

The Secchi disc was lowered into the water on the shaded side of the ship until it just disappeared and then brought up to a depth at which it was just visible again. The colour of the water against the white background was compared to the colour of the solutions in the Forel-Ule scale vials. The Forel-Ule scale is a series of 22 vials with gradations in colour from dark blue (No. 1) to brown (No. 22). The vials are produced by mixing different proportions of ammoniacal copper sulphate and neutral potassium chromate.

A 30 cm diameter white Secchi disc was used in 1975. The depth was obtained to the nearest 0.1 - 0.2 metres and the data-gathering was limited to daylight hours. Readings cannot accurately be taken in extremely rough weather.

COLLECTION OF WATER SAMPLES

Van Dorn Bottles. Figure 7 and 8.

Van Dorn bottles were of PVC material with soft rubber caps at each end pulled together by a length of strong, flexible rubber tubing.

About 3 litres of samples were normally collected. However this amount varied depending on how much was required. 3 litre, 5 litre or 6 litre capacity bottles were available on board.

The Van Dorn bottles have been used extensively and were particularly recommended for trace metals and other water quality parameters.

Knudsen Bottles. Figure 9.

Knudsen bottles are constructed from nickel plated materials and were used for the collection of water samples and precise water temperature from discrete depths. Capacity is 1.2 litres. Manual chemistry samples were obtained either from the Van Dorn or the Knudsen bottles. The bottles are open and thus flushed as they are lowered to the desired depths.

The Integrator. Figure 10.

The integrating sampler (built by Engineering Services Section, CCIW) is designed to collect gradually a representative sample of the water column. Two depths were available; the 10 metre integrator and the 20 metre integrator. Both were is use in 1975.

The heavy integrator (average weight 56 kgms) is lowered at a steady speed of 1 m/sec through the water column. The water enters the cylinder and interior cone through a one way valve. The trapped air is compressed in relation to the depth or the prevailing ambient pressure. The height of the air column changes in accordance with the equation:

$$h = \frac{hz}{d+1}$$

hz: the overall cylinder height
d: the hydrostatic pressure

As the cylinder is returned to the surface, the water inside the cone remains trapped by the one-way valve (Schroder, 1969).

CCIW Pumped Water Sampler. Figure 11.

This system consists of flexible, integrated hose and cable wound on a winch. On the operating end of the hose there is an EBT (to indicate water depth) and submersible pump; at the laboratory end is an XY recorder for the EBT and a hose outlet for water samples.

The pump and EBT are lowered to the desired depth; the pump turned on and, after two minutes flushing period, water samples were obtained. In 1975 the pump sampler was used only in Lake Erie.

Niskin Sampling Bottle. Figure 12.

These are general purpose, non-metalic water samplers available in standard sizes from 1.7 litres to 50 litres capacity. The 30 litre Niskin bottle was used on certain cruises to obtain large samples for chlorophyll, asbestos, radioactivity and phytoplankton studies.

Water may be drained from the bottles by loosening a thumbscrew air vent valve and opening an O-ring sealed stopcock.

CHEMICAL & BIOLOGICAL METHODS AND ANALYSES

1. Dissolved Oxygen. Figure 13.

Samples from each station were drawn off from either Van Dorn or Knudsen bottles into 300 ml B.O.D. bottles and analysed using the Winkler titration method.

Operationally, the Winkler procedure consists of three independent steps - - sample taking, treatment of the sample and standardization. The procedure is based on a set of chemical reactions which convert the dissolved oxygen in a water sample to a chemically equivalent amount of iodine, followed by the measurement of the liberated iodine by titration with sodium thiosulphate. (For detailed procedure consult IFYGL Technical Plan or books on Water Chemistry).

D.O. readings obtained were converted to % saturation using the *in situ* temperature recorded by the EBT and a program for this conversion is available on the Hewlett-Packard calculators, Models 9810 and 9820.

The Orbisphere Dissolved Oxygen probe was used on Lake Erie in 1975 and comparisons of values obtained by this method against the Winkler titration method were made. While this new oxygen probe proves to be very promising, a few modifications will be required before it becomes operational on board ship.

Short description of how to make a D.O. Orbisphere probe measurement:

1. Plug in the oxygen sensor and place in a stirred standard sample.
2. Switch to "batt". Check the batteries and replace them if necessary.
3. Select "temp". Read the temperature when steady.
4. Switch to "set zero" and adjust, if necessary, with the adjacent control.
5. Switch to "20 ppm". Wait for the reading to reach a steady value.
6. Switch to the appropriate concentration range.
7. Set the meter reading to the known standard concentration with the adjacent control "cal".
8. Transfer the sensor to the unknown sample and repeat steps 3 through 6.
9. Read the oxygen concentration of the sample.
10. Switch to "off" at the end of the measurement.

On the MV NORTHERN SEAL the probe was lowered attached to the pump sampler and either a D.O. profile or D.O. measurement at specific depth was made. Most measurements were obtained at 1 m below the surface or 1 m off the bottom.

2. Conductivity Measurement. Figure 14.
(Radiometer Type CDM2 Conductivity Meter)

The "conductivity" of a solution refers to the ability of the solution to carry an electric current.

Apparatus:

a) Radiometer Type CDM2 Conductivity Meter or equivalent.

b) Conductivity cell, Radiometer Type CDC104 or CDC114.

Reagents: standard potassium chloride, 0.01 m. This is a standard reference solution which, at 25°C, has a specific conductance of 1,413 micromhos/cm.

Measurement of samples:

1. Switch on power and allow the instrument to warm up for 5 minutes.

2. Mount and connect either of the two conductivity cells described above.

3. Rinse the cell three times with the sample to be tested and then fill the cell with the sample.

4. Set the Measure-Calibrate switch to Calibrate and rotate the calibrate knob until the needle rests at the triangular mark on the face of the meter.

5. Set the Measure-Calibrate switch to Measure and record the reading indicated by the indicator needle. Record the temperature of the sample at the same time.

Readings were converted to specific conductance @ 25°C using the measured value, sample temperature, calculated cell constant, and conversion factors calculated by Rodgers (1962) for the Great Lakes.

In a single laboratory, the coefficient of variation at a level of 520 micromhos/cm was ± 0.5%.

3. Chlorophyll a. Figure 15.

A surface sample and/or integrated sample was drawn off into a 1 litre graduated cylinder and filtered through a Whatman GF/C glass filter paper at a suction of 7 inches of mercury. When 100 ml of water are left, add about (10) drops of saturated $MgCo_3$ suspension, fold and trim the filter paper and store frozen.

In the shore lab the chlorophyll pigments were extracted in 90% acetone, analysed in a Unicam Model SP 1800 UV Spectrophotometer and concentration values were recorded.

In addition, chlorophyll a samples were collected from stations at which the transmissometer showed a high or low peak.

4. Particulate Organic Carbon. (and Total Particulate Nitrogen) Figure 16.

Procedure:

1. Place a GFC filter on filtration holder.

2. Put the rectangular base cup on the filter.

3. Filter 500, 250 or 100 ml, depending on sample turbidity.

4. Rinse the cup wall after filtration, using 2-3 ml double distilled water, rinse the precipitate with 2-3 ml acidified water and rinse again with 2-3 ml double distilled water.

5. Place the filter in a labeled petri dish, and put it uncovered in a vacuum dessicator maintained at 20 inches of mercury.

Samples were drawn from the integrator into 1 litre graduated cylinder and analysed by combustion in a Hewlett-Packard 185-B CHN analyzer.

Precision values were ± 5 ppb for carbon and ± 2 ppb for N.

5. Suspended Minerals.

I. Filter Preparation.

Glass fibre filters are initially combusted at 500°C for one hour. After cooling in a dessicator the filters are weighed to ± 0.1 mg then placed in numbered petri dishes.

II. Sample Collection.

Samples are collected from the integrator on stations where the transmission is less than 50%. Filtration is carried out at 7 inches Hg and as much water as possible (200 ml, 500 ml, 1 litre or 2 litres) is filtered. The filter is dried for about 3 minutes while maintaining the vacuum, then removed to its petri dish after releasing the vacuum.

III. Laboratory Analysis.

The filters are placed in specially designed stainless steel trays covered with aluminum foil. The trays are then placed in a muffle furnace for one hour at 550°C to volatilize organic matter.

After combustion the trays are put in a dessicator, weighed and the results reported in mg/litre (ppm).

IV. Quality Control.

During the 1975 field season 1050 suspended mineral samples were collected on Lakes Erie and Ontario. Approximately 15% of these samples were collected as duplicates and blanks (known volume of deionized water filtered) for quality control purposes.

The standard deviation for duplicate samples was ± 0.2 @ 1.8 ppm level. The blank values averaged -0.5 ppm.

6. Total Phosphorus. Figure 16.

Samples were drawn from either the integrator or the Van Dorn bottles, as specified in the cruise plan, into 300 ml B.O.D. bottles to which had been added 3 mls of concentrated $H_2 SO_4$.

The samples were returned to CCIW (Ship's Support Laboratory) for colourmetric analysis by the molybdenum blue method using a Technicon Auto Analyzer. Detection limit of the analysis is 0.5 µg P/L.

7. Microbiology. Figure 17.

Samples were obtained from 2, 3 and 4 depths (depending on station depth and thermal conditions) by Bacti Bulbs, Figure 17, according to:

1. Unstratified conditions: 1, 10, 50 and 2 metres off the bottom.
2. Stratified conditions: 1 metre, mid-thermocline, mid-hypolimnion.

Approximately 5-10 minutes before reaching the station, glass sterilized Bacti Bulbs were vacuumed. On station the bulbs were attached to the wire and lowered to the desired depth, a messenger was sent and 2 minutes were allowed so as the bulbs draw enough water from the specified depth so as the bulbs draw enough water from the specified depth replacing all the vacuum. Then the bulbs were hauled up, capped and kept refrigerated prior to analysis.

Parameters analysed were:

a) Total coliform
   Fecal coliform
   Fecal streptococcus: from all microbiology stations, (35 stations on Lake Ontario, 32 stations on Lake Erie).
   Aerobic heterotrophs

b) Pseudomonas aeruginosa: on selected stations.

c) Total counts: on selected stations.

d) Fecal sterols: on selected stations.

For items a, b, c, samples were drawn from the Bacti Bulbs and for d, one 10 metre integrated sample was obtained. Fecal sterol water samples (2 litres) were preserved with 1 ml mercuric chloride solution and delivered to Water Quality Division for analysis.

Extreme care was exercised in handling the microbiological samples so that these did not get contaminated. Within 5 minutes of sampling the bulbs were placed in the refrigerator (at 4°C). The bulbs were refrigerated for a maximum of 24 hours prior to analysis.

In addition at all microbiology stations, integrated samples were collected, treated and tested for:

a) Particulate organic carbon.

b) Total phosphorus, filtered and unfiltered.

c) Total nitrogen, filtered.

(For details of microbiological procedures see CCIW Methods for Microbiological Analysis of Waters, Wastewaters and Sediments).

d) pH measurement:

pH measurements were made by either the Corning digital 109 general purpose pH meter or by the Radiometer general purpose pH meter, Model 28.

This measurement was required only on Microbiology and Water Quality cruises.

Sampling depths were: integrator, one metre below thermocline and 1 metre above the bottom.

Procedure:

1. Closely follow the procedure for setting up the instrument and preparing electrodes provided by the manufacturer.
2. Set temperature compensator to the temperature of the sample being measured. Buffers should also be at the same temperature as sample.
3. For standardizing, select two different buffer solutions in the approximate pH range of the sample to be measured.
4. Place a buffer solution into a beaker and while gently stirring, place electrodes in the solution; wait until meter needle stabilizes and set calibration control to the correct value of the buffer.
5. Repeat (4) above with the other buffer. The reading should be within 0.1 pH units.
6. Electrodes should be rinsed with distilled water and dried gently with soft wipers.
7. To determine pH of sample, place electrodes into a beaker containing sample while sample is being gently stirred. Wait until the meter needle stabilizes and record pH.

8. Water Quality Parameters.

Other specialized water quality parameters were investigated on selected cruises. Samples for Water Quality Laboratory, CCIW, were collected from the same depths as those for dissolved oxygen as follows:

1. <u>Unstratified conditions</u>: 1 metre below the surface and 1 metre above the bottom.
2. <u>Stratified conditions</u>: 1 metre below the surface, 1 metre below the thermocline and 1 metre above the bottom.

Usually the following parameters were analysed:

a) Nutrients: These included phosphorus, nitrates and nitrites, and total nitrogen.

b) Major Ions: These included chlorides, calcium, silica and total alkalinity.

c) Trace Metals: These included mercury, arsenic, selenium, beryllium, silver, aluminum, zinc, cadmium, copper and iron.

Items a) and b) above were analysed on board.

Apparatus

Technicon Auto Analyzer unit consisting of: sampler, manifold, proportioning pump, colourimeter equipped with 50 mm flow cell and filters, range expander, recorder and digital printer.

For other chemical elements, particularly trace metals, different specialized techniques and apparatus such as Atomic absorption, NMR and other spectroscopic and chromatographic techniques were employed. For this reason samples for trace metals, toxic substances or pesticides were brought back to CCIW for shore lab analyses.

(For detailed procedures consult Analytical Methods Manual, IWD, Ottawa)

9. Phytoplankton.

Phytoplankton samples were obtained with an integrator (10 or 20 m) at three stations in Lake Ontario and in Lake Erie. From one nearshore and one offshore station, per lake, a series of vertical samples were obtained with Van Dorn bottles. The number of samples taken was dependent on the depth of the station. This sampling frequency was adhered to on each of the surveillance cruises. The 300 ml samples were preserved with 1.5 ml Lugol's iodine solution and returned to Great Lakes Biolimnology Laboratory at CCIW. There the phytoplankton was gravity concentrated and identification and enumeration was performed, following a standard procedure, on an inverted microscope.

The values obtained will be used in a trend in time data set to evaluate community structure changes with time. The data will yield information on any changes in the balanced community, introduction of pollution tolerant indicators, exclusion of sensitive species and specific make-up of blooms, as these affect aesthetics.

10. Weather Reports.

Standard marine weather observations were made on the synoptic hours and transmitted to Meteo Malton (Toronto weather office) or Meteo Cleveland (Cleveland weather office). In addition to applying the observations for forecasting purposes these had other scientific applications, e.g. satisfying the need for a weather record associated with the bathythermograph casts.

All meteorological instruments were installed on board by the Port Meteorological Officer, Atmospheric Environment Service, and procedures were obtained from the AES publication MANMAR.

ADDITIONAL OBSERVATIONS

1. Solar Radiation.

Solar radiation data were collected on all cruises with a precision Eppley Solarimeter and a Hewlett-Packard strip chart recorder using a fixed paper speed of 1 in/hr. The unit of measurement is the Langley.

2. ATP. Figure 18.

Lakewide samples for Adenosine Triphosphate analysis were collected during the December surveillance cruise on Lake Ontario. At each of the chosen stations, a one litre integrated (0-20 m) sample and a one litre Van Dorn bottom sample were taken. In addition a mid-depth sample was collected at 13 offshore stations.

The preparation of ATP samples (by Dr. M.L. MacKinnon), was composed of filtration and extraction on board ship.

From this first ATP survey, the winter distribution of the total microbial biomass of Lake Ontario will be determined and the relationships between ATP and other parameters (chlorophyll, POC, particulate phosphorus, etc.) will be established.

3. Polychlorinated Biphenyls (PCB's).

A special cruise was initiated covering selected surveillance stations on Lake Ontario for PCB analyses.

4. Remote Sensing.

Sampling, specialized measurements and overflights were carried out in support of the remote sensing projects at CCIW.

On selected cruises the operation of the Quanta Spectrometer (Incentive Research Model QSM 2400) and a modified version of the Colour Index Meter were made. Field trials of the new multifilter transmissometer system (CCIW Engineering, 1975) were obtained on two special cruises.

5. Radioactivity, Asbestos and Plankton Samples for Physical Sciences Section, CCIW.

Collected on selected cruises for radioactivity and asbestos fibre studies.

6. Other Agencies.

Specialized sampling for other agencies, e.g. McMaster University was performed on a few cruises. A special meteorological cruise for the Atmospheric Environment Service was carried out in September, 1975.

STATION KEEPING AND SAMPLING. Figure 19.

The sampling arrangement and procedures have been adopted to minimize the collection of disturbed water, as follows:

1. The ship's officers approach the station position in such a manner that the ship on station does not cross its own wake.
2. The EBT observation helps to determine if the water column is undisturbed.
3. This procedure has been set up for light to moderate winds. In case of high winds, sampling may be curtailed or reduced at the discretion of the Senior Marine Technologist-in-Charge.

DATA QUALITY ASSURANCE. Figure 20.

All members of the surveillance team were responsible for the production of a correct and accurate report, on the completion of each cruise. Descriptive limnological reports were generally produced within 2 weeks. Data handling and data quality assurance were basically those specified in the relevant report by Macdonald, 1974.

Data quality assurance begins with the exact completion of work forms on board. Duplicate and replicate samples and blanks were regularly collected and treated on every cruise. For instance, duplicates for chlorophyll a, POC, suspended minerals and D.O. were collected as per instructions in the corresponding cruise plan. Instrument calibration was performed regularly and any abnormalities reported in the debriefing meeting following the completion of the cruise at CCIW.

An intercomparison study, with U.S. Agencies, was carried out on Lake Erie in June, 1975. The three ships involved were: the MV NORTHERN SEAL (CCIW), the HYDRA (Ohio State University) and the DAMBACH (Great Lakes Laboratory, Buffalo, N.Y.)

BIBLIOGRAPHY

A.P.H.A.	Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., Inc., 13th edition, Washington, 1971.
Carew, T.J. and Williams, D.J.	Methodology Report, Surveillance 1974, Technical Operations Section, CCIW, 1975.
Environment Canada	Analytical Methods Manual, IWD, Water Quality Branch, Ottawa, 1974.
Environment Canada	Methods for Microbiological Analysis of Waters, Wastewaters and Sediments, CCIW, 1975.
Environment Canada (AES)	MANMAR, 4th edition, Toronto, 1971.
Hem, J.D.	Study and Interpretation of the Chemical Characteristics of Natural Waters, Geological Survey Water Supply Paper No. 1473, U.S. Government Printing Office, Washington, 1965.
Hutchinson, G.E.	A Treatise on Limnology, John Wiley and Sons Inc., N.Y., 1955.
IFYGL Technical Plan	Volume 3, 1972
Instruction Manual	Orbisphere Oxygen Probe, Switzerland, 1975.
Macdonald, H.B.	Shipboard Data Quality Assurance, Technical Operations, CCIW, Internal Report, 1974.
Nagel, W.	Manual of Procedures for Processing CCIW Survey Data, CCIW, 1974.
Neumann, G. and Pierson, W.J.	Principles of Physical Oceanography, Prentice-Hall, N.J., 1966.
Philbert, F.J. and Traversy, W.J.	Methods of Sample Treatment and Analyses of Great Lakes Water and Precipitation Samples, Proc. 16th Conf. G.L.R., 1973.
Proceedings	Vol. 19, International Association of Theoretical and Applied Limnology, Part 1 & 2, Congress in Canada 1974, Stuttgart 1975.
Radiometer	Conductivity Meter (Type CDM2d) Instruction and Operating Manual, Radiometer A/S.72 Emdrupvej, Copenhagen, Denmark, 1967.
Rodgers, G.K.	Great Lakes Institute Data Catalogue and Methods for 1960 to 1970, University of Toronto, 1972.

Schröder, R.	Ein Summierender Wasserschöpfer, Archiv. für Hydrobiologie, Stuttgart, 1969.
Surveillance Cruise Reports	Technical Operations, CCIW, 1975.
Sverdrup, H.U. et al	The Oceans, Prentice Hall, 1942.
Vollenweider, R.A.	A Manual on Methods for Measuring Primary Production in Aquatic Environments, 2nd ed., IBP Handbook No. 12, Blackwell Scientific Publications, London, 1974.
Williams, D.J.	Manual of Methods for Limnological Observations of the Great Lakes, CCIW, 1971.

CHLOROPHYLL DATA SHEET

CRUISE NUMBER 75-00-107

DATE	~~LOCAL~~ GMT TIME	SAMPLE NO.	SAMPLE DEPTH	STN. NO.	VOLUME	By	REMARKS
SEPT 22	1350	1	0-20	92	1 L	EW	
22	1445	2	0-20	1	1 L	EW	
22	1550	3	0-20	3	"	D.M.	
22	1550	4	14	3	"	D.M.	XMS
22	1645	5	0-20	2	1l.	RM	
22	1724	6	0-20	4	1l.	RM	
22	1812	7	0-20	5	1l.	RM	
22	1900	8	0-20	6	1l.	RM.	
22	1948	9	0-20	14	1l.	RM	
22	2047	10	0-20	15	1l.	RM	
22	2145	11	0-20	16	1l	EW	
22	2240	12	0-17	17	1l	EW.	
22	2340	13	0-20	18	1L	EW	
SEPT 23	0035	14	0-20	19	1L	EW.	
23	0130	15	0-20	13	1L	EW	
23	0220	16	0-20	12	1L	EW	
23	0325	17	0-20	7	1L	EW.	
23	0413	18	0-18	8	1l.	RM	
23	0445	19	0-20	9	1l.	RM	
23	0528	20	0-20	11	1l.	RM	
23	0625	21	0-20	10	1l.	RM	
23	0625	22	8	10	1l.	RM	xmS
23	740	23	0-20	85	1l.	RM	
23	843	24	0-20	27	1l.	RM	
23	936	25	0-20	28	1l.	RM	
23	1020	26	0-20	29	1l	EW	
23	1130	27	0-20	30	1l	EW	
23	1310	28	0-20	32	1l	EW	
23	1310	29	0-20	32	1l	EW.	Duplicate
23	1400	30	0-20	31	1l	EW	
23	1445	31	0-20	91	1l	EW	
23	1600	32	0-20	43	1l.	RM	

CRUISE NO. 75-00-107.

					POC/TPN					SUSPENDED MINERAL					
Stn no.	Con Stn no.	Depth 0–	Tot. Phos.	POC/TPN	Volume Filtered ml.	Petri Dish no.	Total P ppb.	Part. Org. C ppb.	Total Part. N ppb.	Paper no.	Volume Filtered ml.	Wt. of Paper mg.	Wt. of Paper & Mineral mg.	Wt. of Mineral mg.	Susp. Mineral ppb.
79	47	20	✓	✓	500	79.									
79	47	20	✓	✓	500	79-D									
79	47	20	✓	✓	20	79-B									
77	49	20		✓	500	77									
76	50	10	✓	✓	500	76									
75	51	20		✓	500	75									
74	52	20	✓	✓	500	74									
89	53	20		✓	500	89									
89	53	20		✓	500	89 DUP.									
89	53	20		✓	500	89 Blank									
73	54	20	✓	✓	500	73									
71	55	11.5		✓	250	71									
69	58	20		✓						735	1000				
67	60	20	✓	✓	500	67									
65	62	20		✓	500	65									

Oxygen Standardization Sheet

Reference #: 3

Vessel: NORTHERN SEAL

Cruise: 75-00-107

Date: SEPT 24, 1975

Analyst: R.C.
watch: 12-6

Reagent Stocks:
Date & Initial

$MnSO_4$: ✓

NaOH/KI: ✓

H_2SO_4: ✓

$Na_2S_2O_3$: ✓

$KH(IO_3)_2$: ✓

blanks at least three	standards at least five	
0.00	5.26	223
0.00	5.26	172
0.00	5.27	107
	5.26	428
	5.26	3

average

0.00	5.26

Remarks:

STANDARD: 5.26

checked by:

75/73

CANADA CENTRE FOR INLAND WATERS

TRANSMITTAL AND RECEIPT FORM

☐ COPY FOR SENDER'S FILE ☑ COPY FOR RECEIVER TO SIGN AND RETURN TO SENDER

TO (Postal Address) Mr. W. NAGEL Data Management, CCIW	FROM (Postal Address) P. R. YOUAKIM Technical Operations, CCIW SURVEILLANCE 75-01-101

MEANS OF TRANSMITTAL ☐ Ord. Mail ☐ Reg'd Mail ☐ Air Mail ☐ Express ☐ Gov't Truck ☐ By Hand ☑ Other (Specify)

RECEIVED BY (Signature) W. Nagel	DATE REC'D 27/5/75	SENT BY (Signature) P. Youakim	DATE SENT 27/5/75

ITEMS SENT

QUANTITY	DESCRIPTION 75-01-101
108 ✓	E B T SHEETS
0	M B T SLIDES
0	M B T DATA SUMMARY FORMS
108 ✓	TRANSMISSOMETER SHEETS
108 ✓	DECK LOG SHEETS AND COPY
14 ✓	BRIDGE LOG SHEETS
5 ✓	MET. OBSERVATION SHEETS
6 ✓	9 PT. BT DIGITIZATION SHEETS
26 ✓	MANUAL CHEMISTRY SHEETS
3 ✓	OXYGEN STANDARDIZATION SHEETS
1 ✓	ROLL SOLAR RADIATION RECORD
1 ✓	TRACK PLOT

07 OCT 7]

124

STAR FORMAT CODING SHEET

entered by__________

AUTO ANALYZER

date ____ pg__ of___

Cruise Ref. No.__________

INST	cruise ref. no.	consec. stn. no.	DEPTH metres 1/10		Soluble Reactive Phosphate mg PO4/L		Silica Reactive mg SIO2/L		Ammonia Nitrogen (soluble) mg N/L		Total Nitrate & Nitrite Nitrogen mg N/L		Total Phosphates mg PO4/L		Total Alkalinity mg CaCo3/L		Nitrite mg N/L.			
			CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE	CODE	VALUE
1 2	3 4 5	6 7 8	9 10 11	12 13 14 15 16	17 18 19	20 21 22 23 24	25 26 27	28 29 30 31 32	33 34 35	36 37 38 39 40	41 42 43	44 45 46 47 48	49 50 51	52 53 54 55 56	57 58 59	60 61 62 63 64	65 66 67	68 69 70 71 72	73 74 75	76 77 78 79 80
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				
2 2			0 0 1	0	2 6 3	0	2 9 5	0	2 7 0	0	2 7 6	0	2 6 0	0	2 2 0	0				

verified by__________

C.C.I.W. 1970

WATER QUALITY DIVISION

CCIW BURLINGTON

WATER ANALYSIS REPORT

4/71

REFERENCE:		PROJECT:					COLLECTION DATE:				
LABORATORY NO:											
LOCATION:		MON.	CON.	MON.	CON.	MON.	CON.	MON.	CON.	MON.	CON.
DEPTH (M):											
FIELD OBSERVATION:											
NUTRIENTS		N FIL.	N UNFIL.	N FIL.	N UNFIL.	N FIL.	N UNFIL.	N FIL.	N UNFIL.	N FIL.	N UNFIL.
AMMONIA - N	PPb										
NITRATE + NITRITE - N	"										
NITRITE - N	"										
ORGANIC NITROGEN - N	"										
TOTAL NITROGEN - N	"										
SOLUBLE PHOSPHATE - PO_4	"										
ORGANIC PHOSPHATE - PO_4	"										
TOTAL PHOSPHATE - PO_4	"										
SOLUBLE SILICA - SiO_2	"										
TOTAL CARBON - C	PPm										
INORGANIC CARBON - C	"										
ORGANIC CARBON - C	"										
TRACE ELEMENTS		T	T	T	T	T	T	T	T	T	T
BORON - B	PPb										
CADMIUM - Cd	"										
CHROMIUM - Cr	"										
COBALT - Co	"										
COPPER - Cu	"										
IRON - Fe	"										
LEAD - Pb	"										
LITHIUM - Li	"										
MANGANESE - Mn	"										
MERCURY - Hg	"										
MOLYBDENUM - Mo	"										
NICKEL - Ni	"										
VANADIUM - V	"										
ZINC - Zn	"										
STRONTIUM - Sr	"										
MAJOR IONS		M	M	M	M	M	M	M	M	M	M
CALCIUM - Ca	PPm										
MAGNESIUM - Mg	"										
SODIUM - Na	"										
POTASSIUM - K	"										
SULFATE - SO_4	"										
CHLORIDE - Cl	"										
BICARBONATE - HCO_3	"										
TOTAL ALK. AS - $CaCO_3$	"										
TOTAL HARDNESS - $CaCO_3$	"										
FLUORIDE - F	"										
pH											
SP. COND. @ 25°C	(micro-mhos)										
TURBIDITY	(J.T.U.)										
C.O.D.	PPm										
B.O.D.	"										
ION	FACTOR										
CALCIUM	.04990										
MAGNESIUM	.08224										
SODIUM	.04348										
POTASSIUM	.02558										
CATIONS SUM											
CARBONATE	.03333										
BICARBONATE	.01639										
SULFATE	.02082										
CHLORIDE	.02820										
ANIONS SUM											
PERCENT ERROR											
REMARKS											

NAME OF VESSEL ________ CAPTAIN ________ PRINCIPAL OBSERVING OFFICER ________

YEAR 19			POSITION OF SHIP								APPARENT WIND			WIND			WEATHER		PRESSURE				TEMPERATURE		CLOUDS							† 3-HR PRESSURE CHANGE		‡ SIGNIFICANT CLOUD GROUP(S)			
MONTH (G.M.T.)	DAY OF MONTH (G.M.T.)	Message Identifier	LATITUDE (Degrees and Tenths)	Quadrant of Globe	LONGITUDE Degrees and Tenths, Hundreds (0 or 1) Included.	Day of Month (G.M.T.)	Time of Observation Nearest hour 00 - 23 (G.M.T.)	Wind Indicator (0-4)	Ship's Course at time of Obs. • (°True)	Ship speed • ☐ mph kts. ☐	Direction Relative to Ship • (010°-360°)	Speed • ☐ mph kts ☐	Total Cloud Amount (0-9)	TRUE DIRECTION (00-36)	TRUE SPEED (Knots)	VISIBILITY (Coded 90-99)	PRESENT (Coded 00-99)	PAST (0-9)	BAROMETER AS READ	CORRECTIONS	SEA LEVEL PRESSURE Millibars and Tenths 09 or 10		DRY BULB °C	WET BULB • °C	Amt. of C_L (or C_M) Cloud	Type of Low Cloud	Height of Lowest Cloud	Type of Middle Cloud	Type of High Cloud	Ship's Course Made Good (3 Hrs.)	Ship's Av. Speed - Past 3 Hrs.	Characteristic (0-8)	Amount (Mbs. & Tenths)	Group Indicator	Amount (Coded 1-9)	Type (Coded 0-9)	Height (Coded 00-2
		GROUP 1		GROUP 2		GROUP 3			These columns to be completed ONLY when wind is measured by means of an anemometer.					GROUP 4		GROUP 5						GROUP 6			GROUP 7					GROUP 8				GROUP 9			
		99	$L_aL_aL_a$	Q_c	$L_oL_oL_oL_o$	YY	GG	i_w					N	dd	ff	VV	ww	W				PPP	TT		N_h	C_L	h	C_M	C_H	D_s	v_s	a	pp	8	N_s	C	h_sh_s
		99					00																											8 8			
		99					06																											8 8			
		99					12																											8 8			
		99					18																											8 8			
		99					00																											8 8			
		99					06																											8 8			
		99					12																											8 8			
		99					18																											8 8			
		99					00																											8 8			
		99					06																											8 8			
		99					12																											8 8			
		99					18																											8 8			
		99					00																											8 8			
		99					06																											8 8			
		99					12																											8 8			
		99					18																											8 8			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38

Supplementary Ships report only the data in columns indicated by this hatching ▨

Shaded columns indicate data which do not form part of the transmitted weather message.

*Data in columns 10 to 13 required only from ships equipped with an anemometer.

† Provision is made in columns 31 to 34 for entering the extra group 99ppp when the 3-hour pressure change is 9.9mbs. or more.

‡ The groups $8N_sCh_sh_s$ and $1T_wT_wT_wt_T$ are optional for Selected Ships, but mandatory for Ocean Weather Ships.

VOYAGE FROM ______________________ TO ______________________

Height of barometer above sea level: ____________ ft.

Method of taking sea temps.: ☐ Rubber Bucket ☐ Cond. Intake
Other ______

	SPECIAL PHENOMENA**		SEA TEMPERATURE								ICE ACCRETION				WAVES						ICE						REMARKS			
	General	Detail	Actual Temperature of sea water °C	Difference Dry Bulb minus sea temperature °C	Group Indicator	AIR-SEA TEMP. DIFF. IN HALF DEGREES CELSIUS (Coded)	DEW POINT TEMP. °C	Group Indicator	SEA TEMPERATURE Degrees and Tenths °C	Tenths Figure Of Air Temperature	Group Indicator	Cause of Ice Acc.	THICKNESS OF ICE ACC. (Cm.)	Rate of Ice Acc.		SEA WAVES		SWELL WAVES			INDICATOR FOR ICE GROUP	Kind of Ice	Effect on Navigation	Bearing of Ice Limit	Distance from Ship	Orientation of Ice Edge	Enter times of beginning and ending of precipitation of any kind, fog (visibility less than 1100 yds.), and thunder; and times of windshifts. Enter details of special or unusual phenomena in the space provided at the end of the logbook.	Address to which sent, if transmitted by radio	Call sign of station to which sent, and time sent, G.M.T.	Initials of officer who made observation
															Group Indicator	PERIOD Seconds	MEAN MAX. HEIGHT (Coded)	DIRECTION FROM (True 00-36)	PERIOD (Coded)	MEAN MAX. HEIGHT (Coded)										
	GROUP 10 S_pS_p	s_ps_p			0	GROUP 11 T_sT_s	T_dT_d	1	GROUP 12 $T_wT_wT_w$	t_T	2	GROUP 13 I_s	E_sE_s	R_s	3	GROUP 14 P_wP_w	H_wH_w	GROUP 15 d_wd_w	P_w	H_wH_w	ICE GROUP ICE	c_2	K	D_i	r	e				
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
					0			1			2				3						ICE									
	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69

** For use by Ocean Weather Ships only.

If, for any reason, an observation is not to be transmitted, it should nevertheless be taken and logged, as it is required for climatological purposes. If one or more consecutive observations are not taken, leave the appropriate number of lines blank, up to a maximum of eight. Start a new page at the beginning of each month, and a new logbook at the beginning of each year.

9 Pt. Bt. Digitization

Entered by ....

Date Entered ....

Page of

Cruise

Stn.No	Year	Month	Day	Hour (tenths)	Lat.	Long.	Bt Sfc Temp.	Depth Temperature pairs (corrected)																Corrected Stn. Depth	Indicies of Thermocline		Bt Shape Codes	
							t_1	t_2	z_2	t_3	z_3	t_4	z_4	t_5	z_5	t_6	z_6	t_7	z_7	t_8	z_8	t_9	z_9		n	n	k	ka

121

ADIAN OCEANOGRAPHIC
DATA CENTRE

BATHYTHERMOGRAPH DATA SUMMARY

(Provisional)

ENTERED BY

CHECKED BY

№ 10628

TIME – DATE					POSITION				BT INFORMATION										GENERAL					METEOROLOGICAL															
2 GMT		3 DATE			4 LAT. (N= +)		5 LONG. (W= +)		6 BT SERIAL NUMBER	7 GRID	8 SSRT		9 BT TEMP AT SFC		10 BT TEMP AT SET-UP DPTH		11 DPTH BT SET-UP TEMP	12 STA. NO.	13 SHIP'S SPEED (KTS)	14 DEPTH	15 FIX		16 WIND		17 WAVES		18 WAVES		19 BARO.		20 WET BULB		21 DRY BULB		22 ww	23 CLOUDS		24 VIS
HRS	MIN	DAY	MO.	YR	DEG°	MIN'	DEG°	MIN'			DEG°	1/10		1/10		1/10					M	P	DIR.	FCE/SPD	P_w	H_w	P_w	H_w	MB°	1/10	DEG°	1/10	DEG°	1/10	CODE	T	A	
11 12	13 14	15 16	17 18	19 20	21 22	23 24	25 26 27	28 29	30 31 32 33 34	35	36 37	38	39 40	41	42 43	44	45 46 47	48 49 50	51 52	53 54 55 56	57	58	59 60	61 62	63	64	65	66	67 68	69	70 71	72	73 74	75	76 77	78	79	80

STAR FORMAT CODING SHEET

entered by Ships Officers

Cruise Ref. No.__________

BRIDGE LOG

date______pg__of___

INST.	cruise ref. no.	consc. stn. no.	country	octant	LAT.			LONG.				DATE			TIME (GMT) 1st cast	SND DEPTH metres 1/10	no. of (levels) obs'd	consc. bt slide no.	mon stn. no.	ARRIVAL & DEPARTURE		SHIPS COURSE	SHIPS SPEED	MILES steamed	DEPTH (FEET)
					deg.	min.	sec.	deg.	min.	sec.		yr.	mo.	dy.						GMT TIME	LOCAL TIME				
1 2	3 4 5	6 7 8	9 10	11	12 13	14 15	16 17	18 19 20	21 22	23 24	25 26 27 28 29	30 31	32 33	34 35	36 37 38 39	40 41 42 43	44 45	46 47 48	49 50 51	52 53 54 55 56	57 58 59 60 61	62 63 64 65 66	67 68 69 70 71 72	73 74 75 76	77 78 79 80
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													
2 2			1 8	0				0				7													

C.C.I.W. 1970

verified by__________

THERMOCHECK DATA SUMMARY

VESSEL									
STATION N°									
DATE (G M T)									
YR		INST		CRUISE N°		CONSEC			
		2	2						
1	2	3	4	5	6	7	8	9	10

B.T. N°	S.S R.T.	
SLIDE N°	TIME DOWN(GMT)	
SECCHI DISC	DEPTH	COLOUR
SOUNDING	FEET	METRES

CAST	GREENWICH MEAN TIME			WIRE ANGLE
	DOWN	MESSENGER	START UP	
1ST				
2ND				
3RD				

REMARKS

OBSERVERS

CAST		WIRE LENGTH (M)				LEFT THERMOMETER															RIGHT THERMOMETER															CARD TYPE	
						SERIAL						AUX RDG				MAIN RDG					SERIAL						AUX RDG				MAIN RDG						
						P/U	M	LAST FOUR													P/U	M	LAST FOUR														
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	52	33	34	35	36	37	38	39	40	41	42	43	44	45	46
	1																																			1	2
	2																																			2	2
	3																																			1	2
	4																																			2	2
	5																																			1	2
	6																																			2	2
	7																																			1	2
	8																																			2	2
	9																																			1	2
	10																																			2	2
	11																																			1	2
	12																																			2	2
	13																																			1	2
	14																																			2	2
	15																																			1	2
	16																																			2	2
	17																																			1	2
	18																																			2	2
	19																																			1	2
	20																																			2	2

GLD and CODC 1968

DECK LOG SHEET

VESSEL	REMARKS	
CRUISE N°		
STATION N°		
CONSEC. ST N°		
TIME DATE (G M T)	OBSERVERS	

NOM. DEPTH (M)	PARAMETER AND BOTTLE NUMBER											ACC DEPTH

LOCAL CRUISE NO. 72-

CCIW CRUISE REF. NO. 2,2

CCIW DEPT. OF THE ENVIRONMENT
BURLINGTON, ONTARIO
WATER QUALITY DIVISION
MANUAL LAB. RESULTS

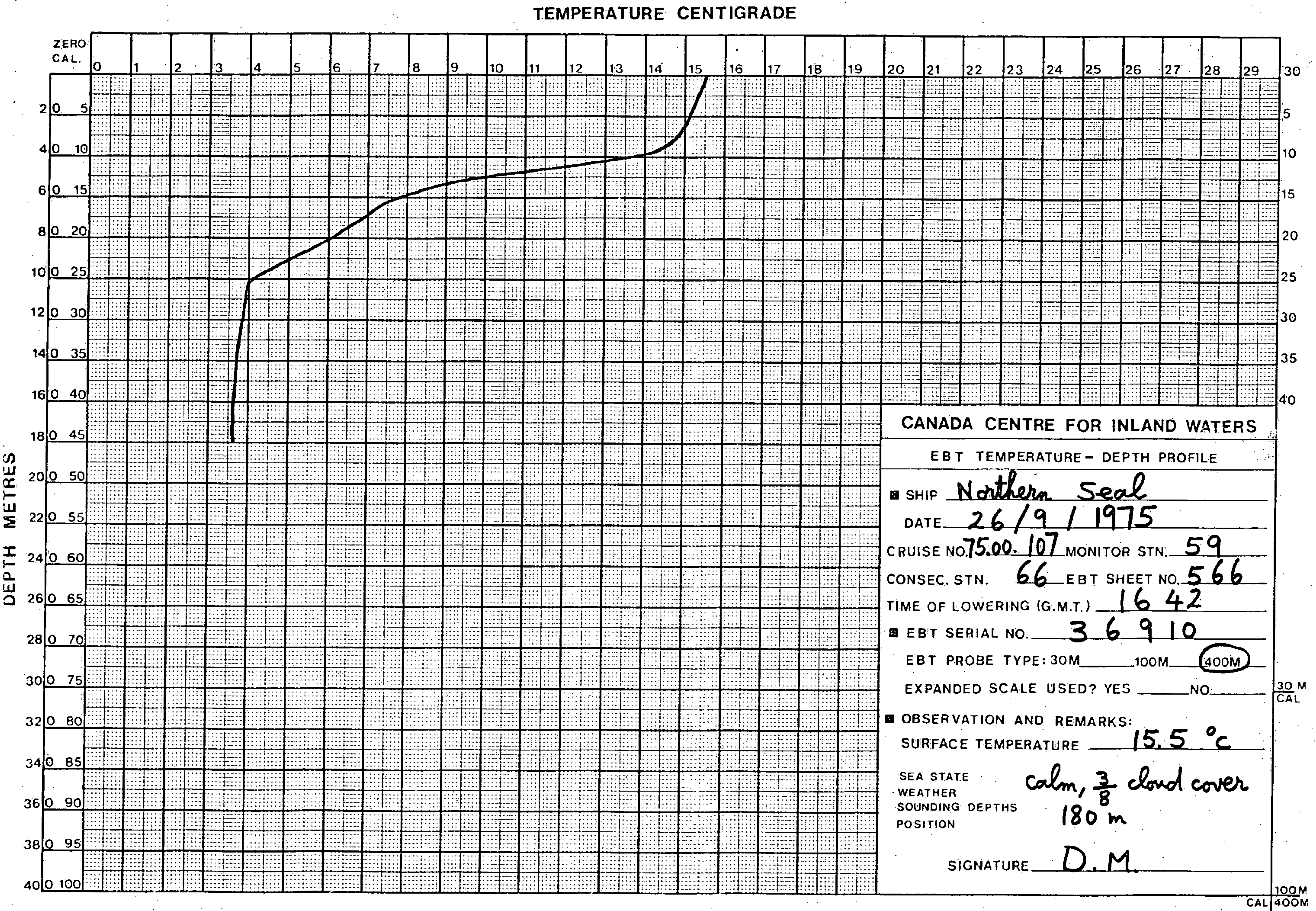
DATE ________

VESSEL ________

PAGE ____ OF ____

MON STN NO	CONS STN. NO.	DEPTH	TEMPERATURE		DISSOLVED OXYGEN				PH in SITU (temp)			TURBIDITY			SPECIFIC CONDUCTANCE 25 °C					% O_2 SAT
		001	100	104	bottle no.	factor and analysts initials	ml. of thio-sulphate	245	bottle no.	213	218	J.T. std.	range	123	bottle no.	micro-mhos	temp. °C	160	cell factor(s) analysts initials	247

C.CIW 1971.



CANADA CENTRE FOR INLAND WATERS

EBT TEMPERATURE - DEPTH PROFILE

■ SHIP Northern Seal

DATE 26/9/1975

CRUISE NO. 75.00.107 MONITOR STN. 59

CONSEC. STN. 66 EBT SHEET NO. 566

TIME OF LOWERING (G.M.T.) 1642

■ EBT SERIAL NO. 36910

EBT PROBE TYPE: 30M ____ 100M ____ [✓ 400M]

EXPANDED SCALE USED? YES ____ NO ____

■ OBSERVATION AND REMARKS:

SURFACE TEMPERATURE 15.5 °c

SEA STATE
WEATHER calm, $\frac{3}{8}$ cloud cover
SOUNDING DEPTHS 180 m
POSITION

SIGNATURE D.M.

RECORDING CHARTS
GRAPHIC CONTROLS CANADA LTD

CHART NO. G10190

PROCES VERBAL

STATION NORTHERN SEAL

TIME	REMARKS	INITIALS
0550 Z	05-09-75. Obs. Meteo Malton VBH Ch.26	JC

OFFICIAL RADIO LOG

FOR SHIP STATIONS

(Radiotelegraph)

PART II

NAME OF SHIP	OFFICIAL NUMBER AND INTERNATIONAL CALL SIGN	PORT OF REGISTRY	GROSS TONNAGE

Serial Number................................ From................................ To................................

NAME OF OPERATING COMPANY..

Issued by

THE DEPARTMENT OF TRANSPORT

Telecommunications Branch

1015.2
9.7
1024.9

METEOROLOGICAL BRANCH - DEPARTMENT OF TRANSPORT - CANADA

Form 63-9452
(Rev. 1967)

OBSERVING SHIPS' CODED WEATHER REPORT BY RADIO

PREFIX	OFFICE OF ORIGIN	NUMBER	NUMBER OF WORDS	DATE FILED	TIME FILED

SENT TO	FREQUENCY	DATE SENT	TIME SENT	TRANSMITTED BY

TO

NOTICE TO RADIO OFFICER:
(1) The printed symbols above each group space are for guidance only and are not to be transmitted.
(2) The message is to be transmitted in a continuous sequence of groups, in the order written.

$99L_aL_aL_a$	$Q_cL_oL_oL_oL_o$	$YYGGi_w$	Nddff	VVwwW	PPPTT	$N_hC_LhC_MC_H$
99434	70769	05064	33504	98030	24918	36400
D_sv_sapp	99ppp	$8N_sCh_sh_s$	$8N_sCh_sh_s$	$8N_sCh_sh_s$	$9S_pS_ps_ps_p$	$9S_pS_ps_ps_p$
11214						
$0T_sT_sT_dT_d$	$1T_wT_wT_wt_T$	$2I_sE_sE_sR_s$	$3P_wP_wH_wH_w$	$d_wd_wP_wH_wH_w$	$d_wd_wP_wH_wH_w$	ICE $c_2KD_ir_e$
0//09	11940		30301			ICE

No Government Administration, or company or person employed in the forwarding and delivery of this message shall be liable for any loss or damage arising from failure to transmit or to deliver the said message or from any neglect, delay, error or omission in the transmission thereof.

Signature of Master, or Officer deputed by Master ______________

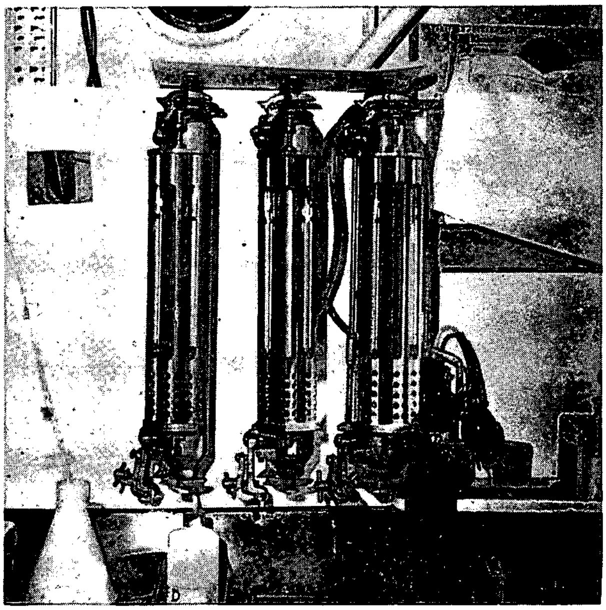
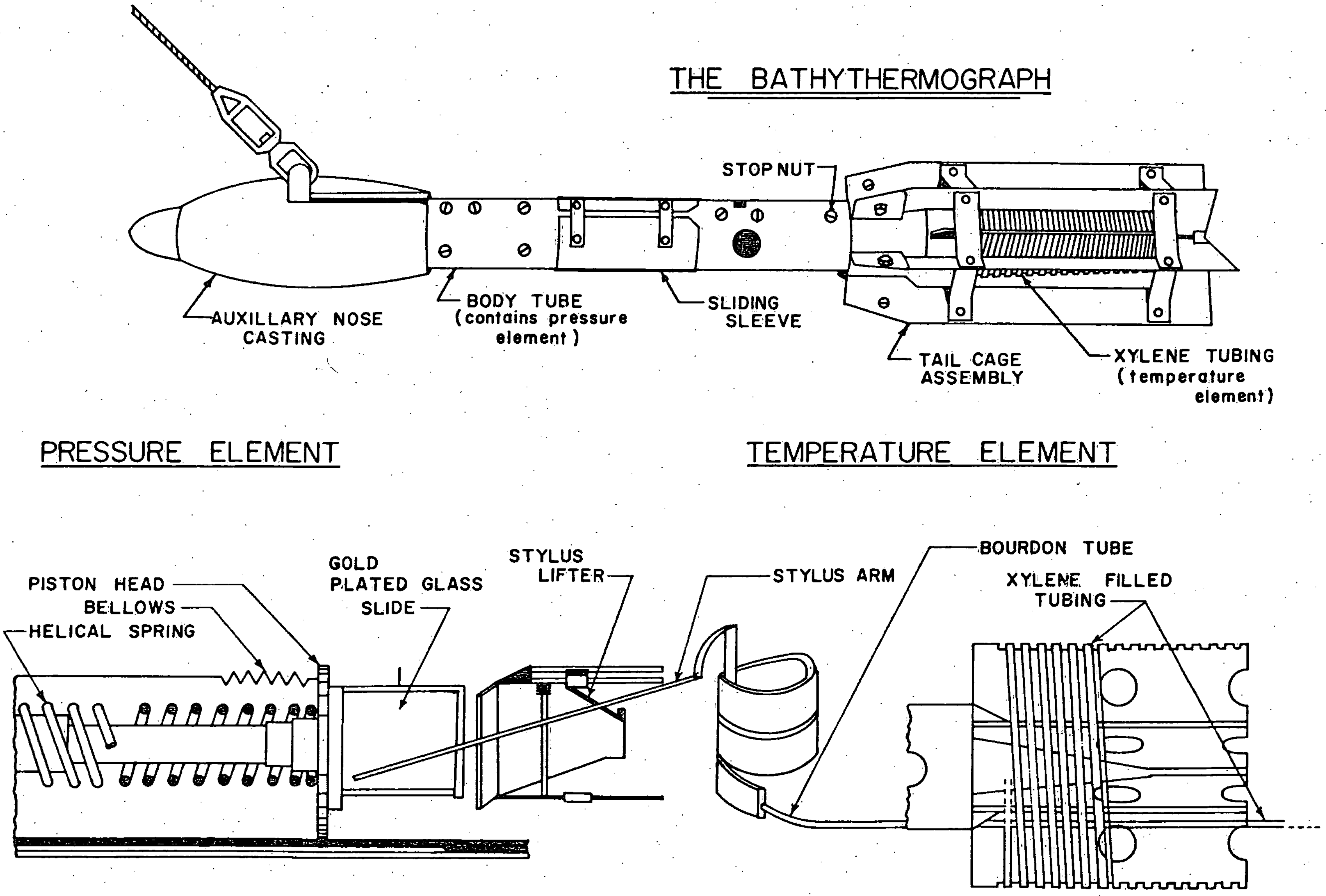


Figure 1

Reversing Thermometers in Knudsen Bottles

Figure 2


THE BATHYTHERMOGRAPH
STOP NUT
AUXILLARY NOSE CASTING
BODY TUBE (contains pressure element)
SLIDING SLEEVE
TAIL CAGE ASSEMBLY
XYLENE TUBING (temperature element)
PRESSURE ELEMENT
TEMPERATURE ELEMENT
PISTON HEAD
BELLOWS
HELICAL SPRING
GOLD PLATED GLASS SLIDE
STYLUS LIFTER
STYLUS ARM
BOURDON TUBE
XYLENE FILLED TUBING

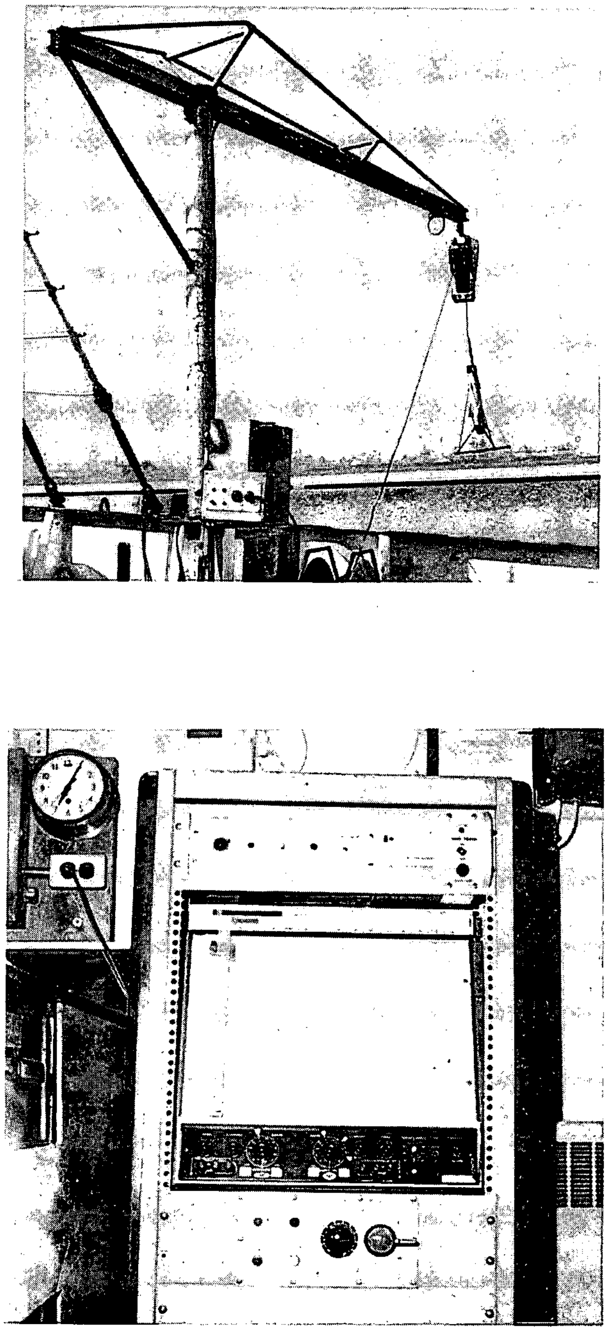


Figure 3

Electronic Bathythermograph: Sensor and Recorder

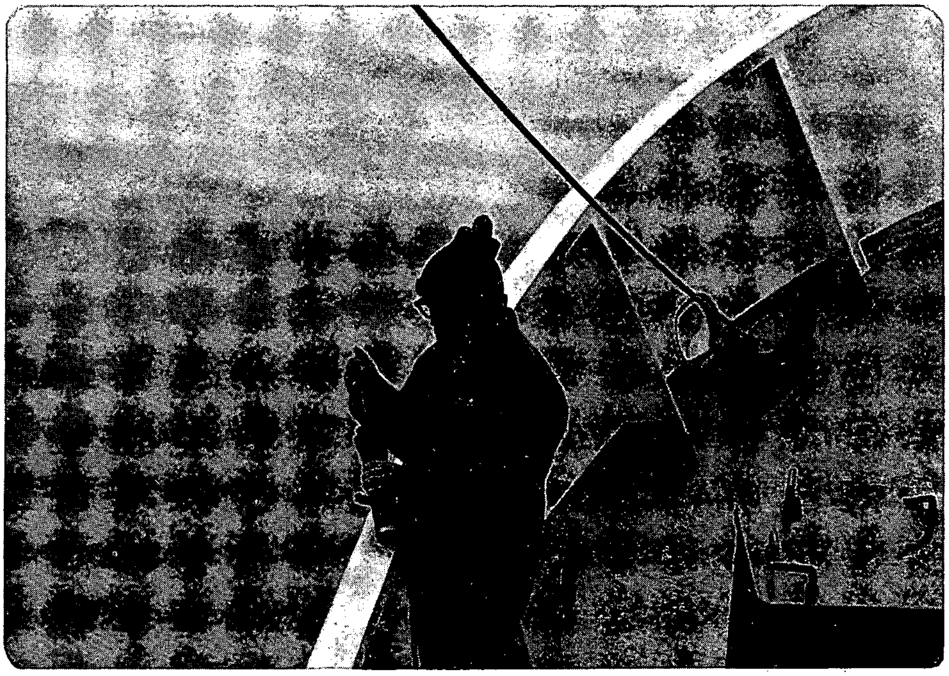


Figure 4

Bucket Thermometer

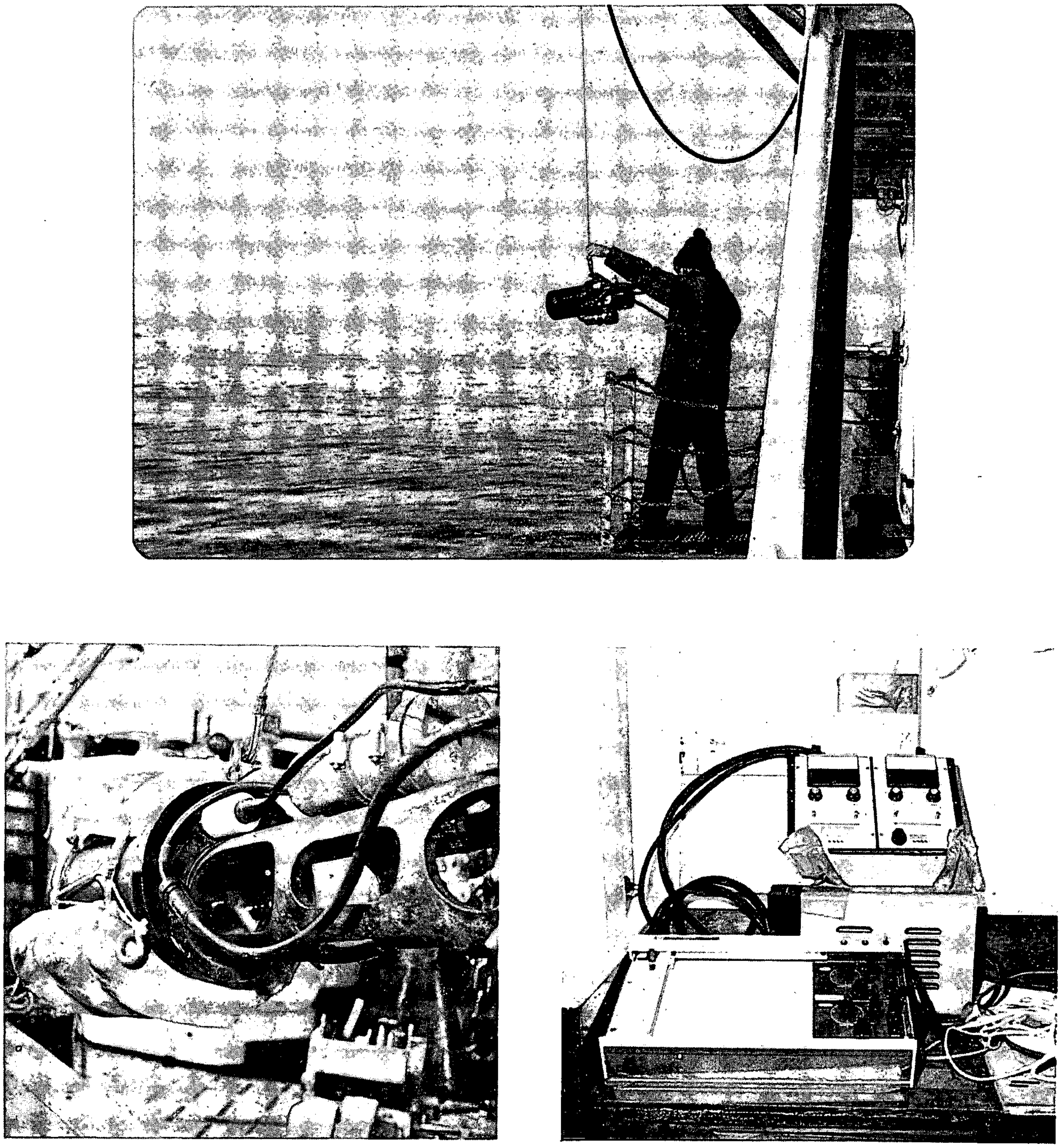


Figure 5

Transmissometer: Sensor, Power Package and Recorder

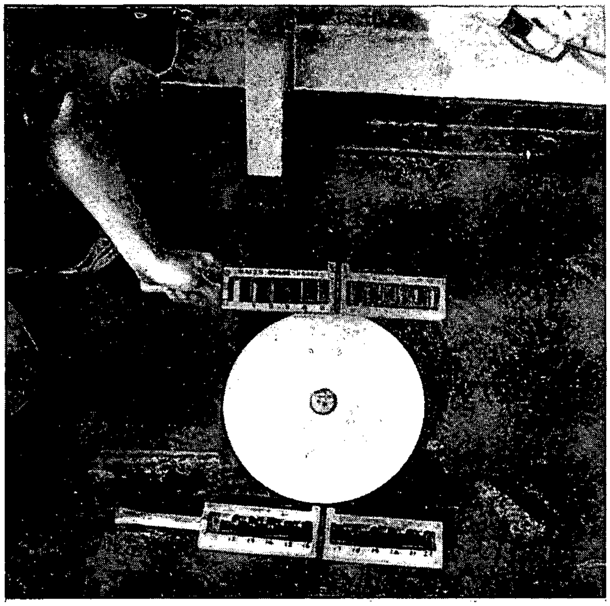


Figure 6

Secchi Disc, Forel and Ule Scales

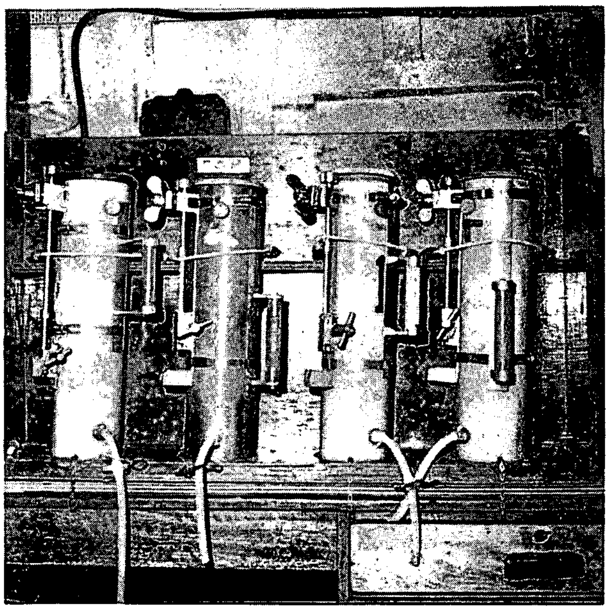


Figure 7

Van Dorn Bottles

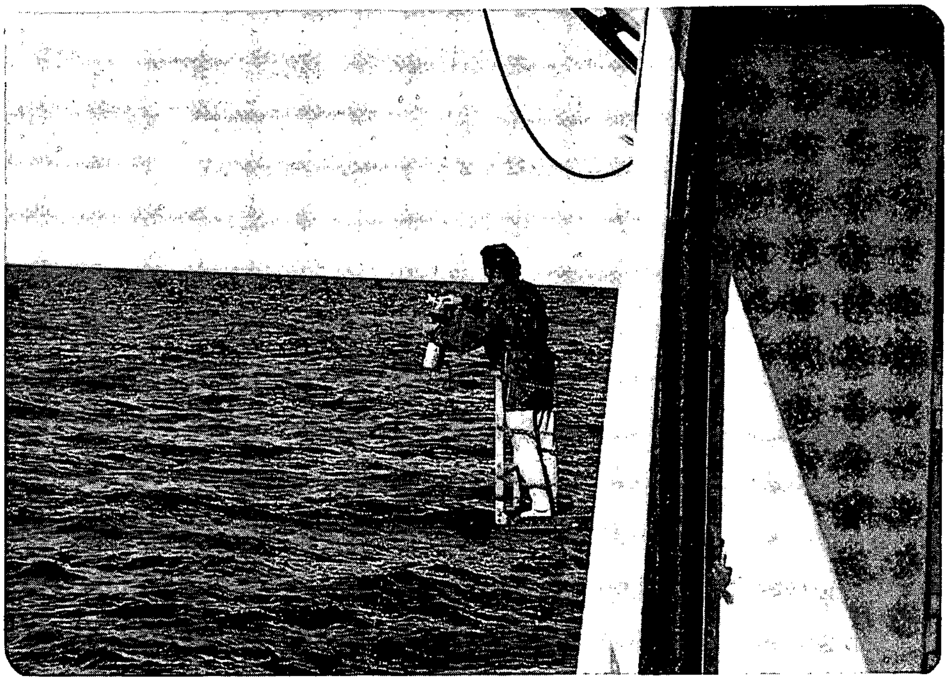


Figure 8

Van Dorn Cast

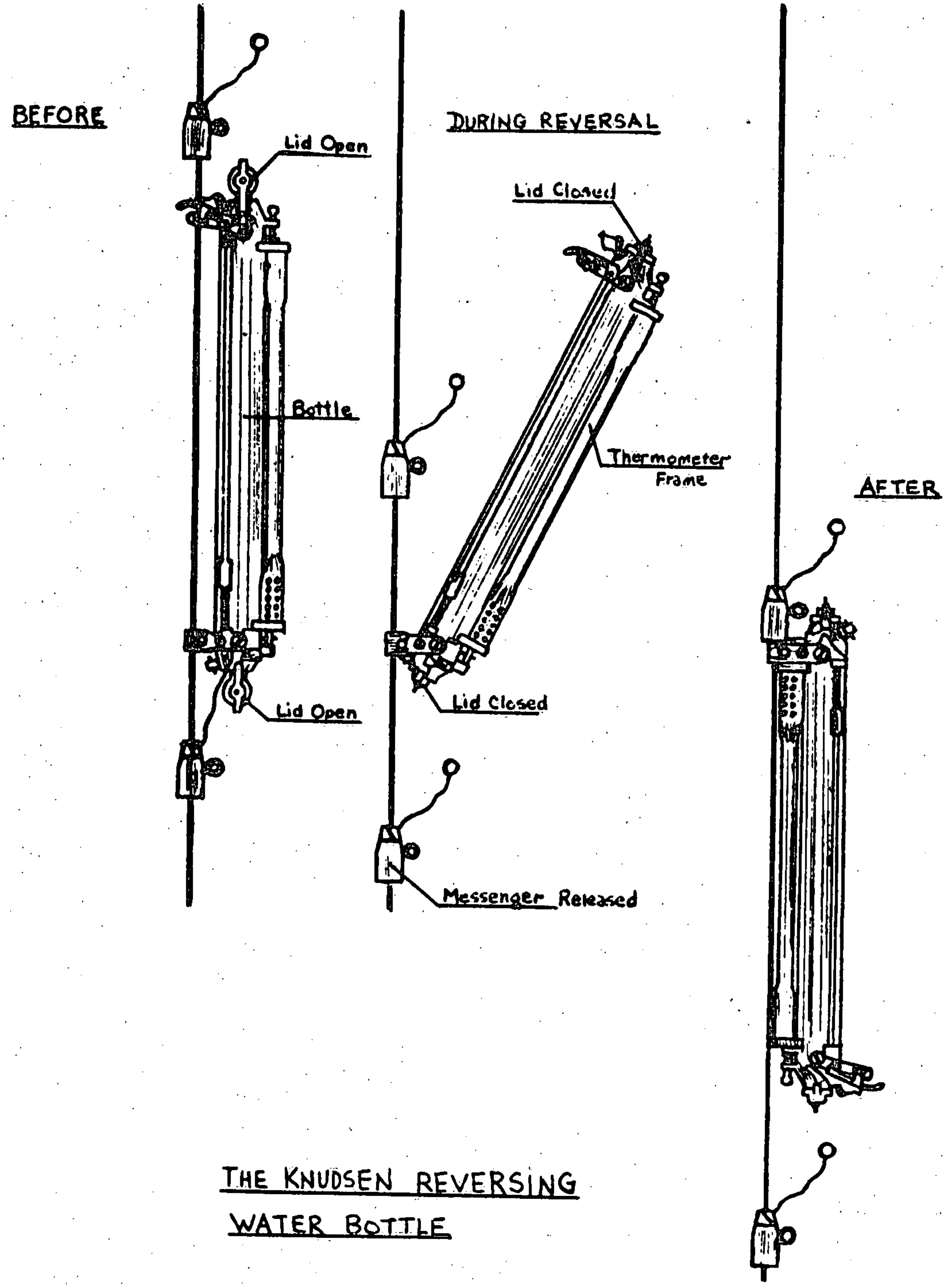

BEFORE
Lid Open
Bottle
Lid Open
DURING REVERSAL
Lid Closed
Thermometer Frame
Lid Closed
Messenger Released
AFTER
THE KNUDSEN REVERSING WATER BOTTLE

Figure 9

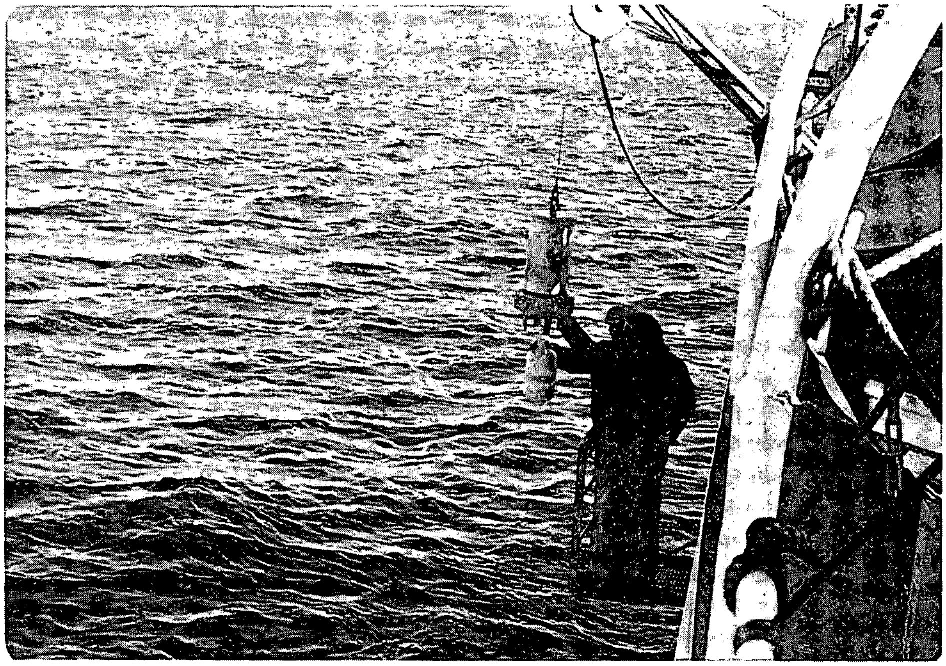
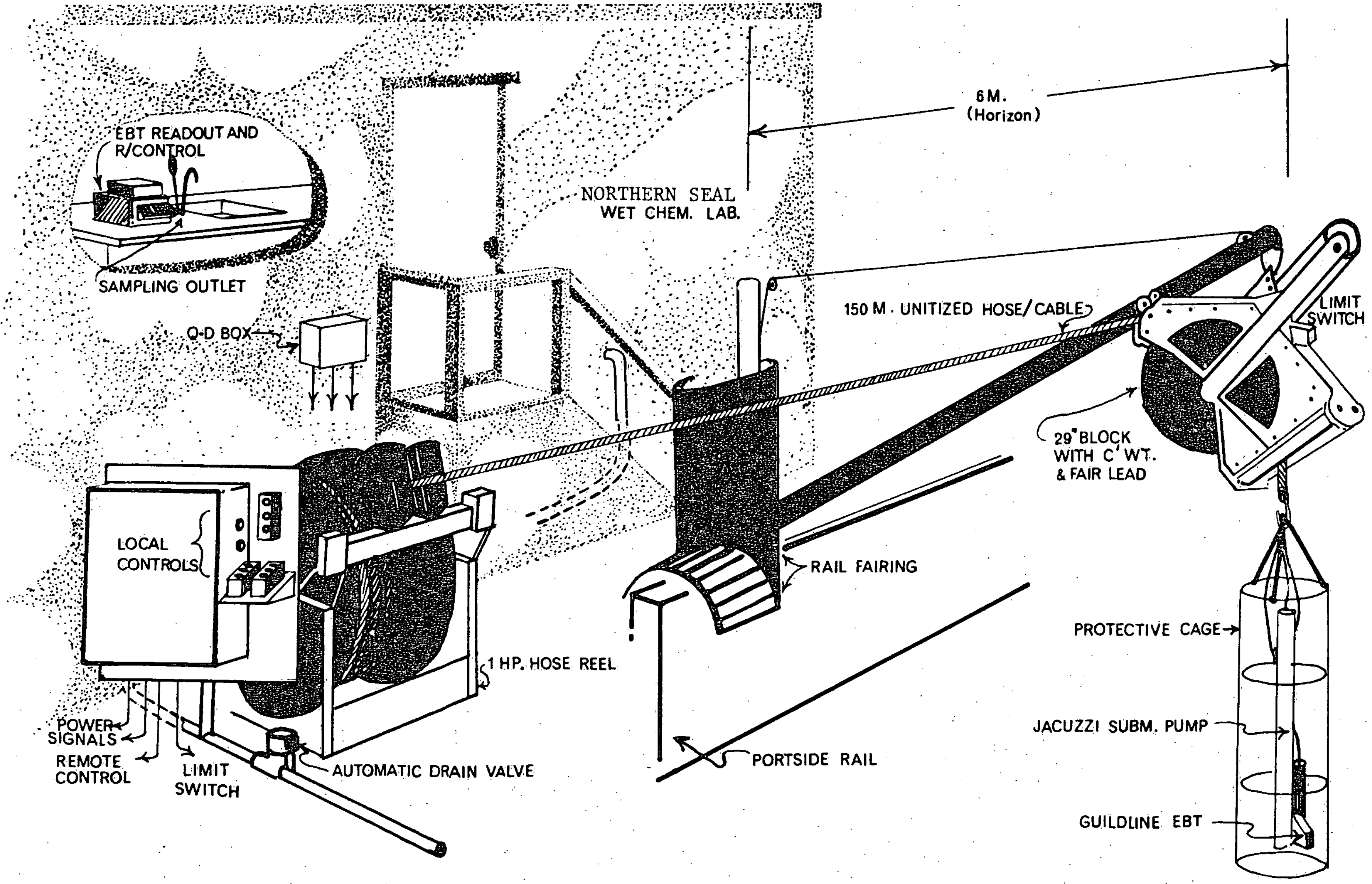


Figure 10

Integrator



100m. PUMPED WATER SAMPLING SYSTEM

Figure 11

NISKIN SAMPLING BOTTLE
Model 1010

Figure 12

Niskin Sampling Bottle

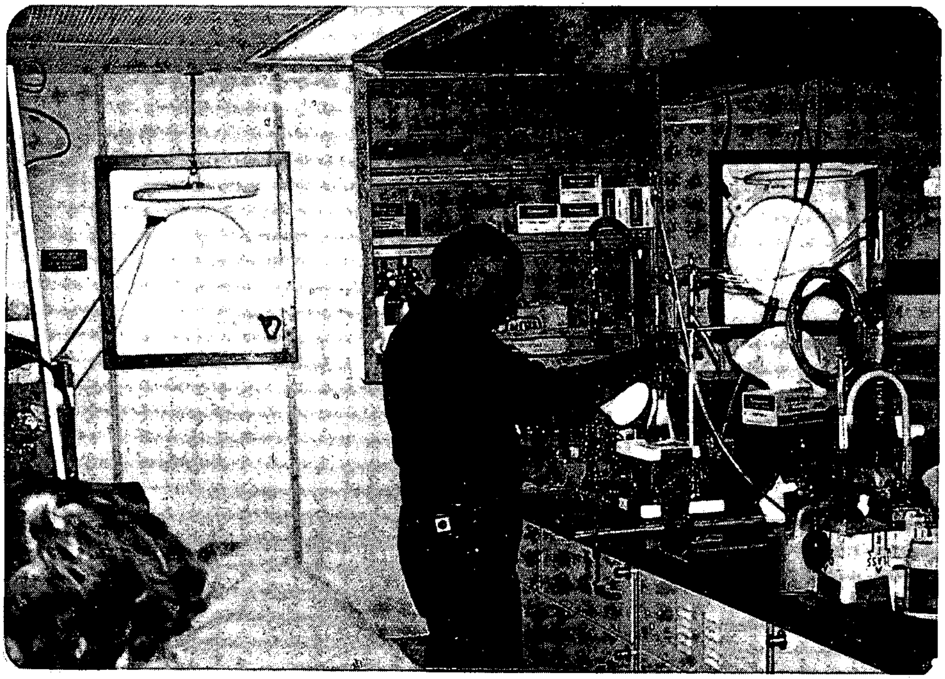


Figure 13

Dissolved Oxygen Apparatus

Figure 14

Radiometer CDM2 Conductivity Meter

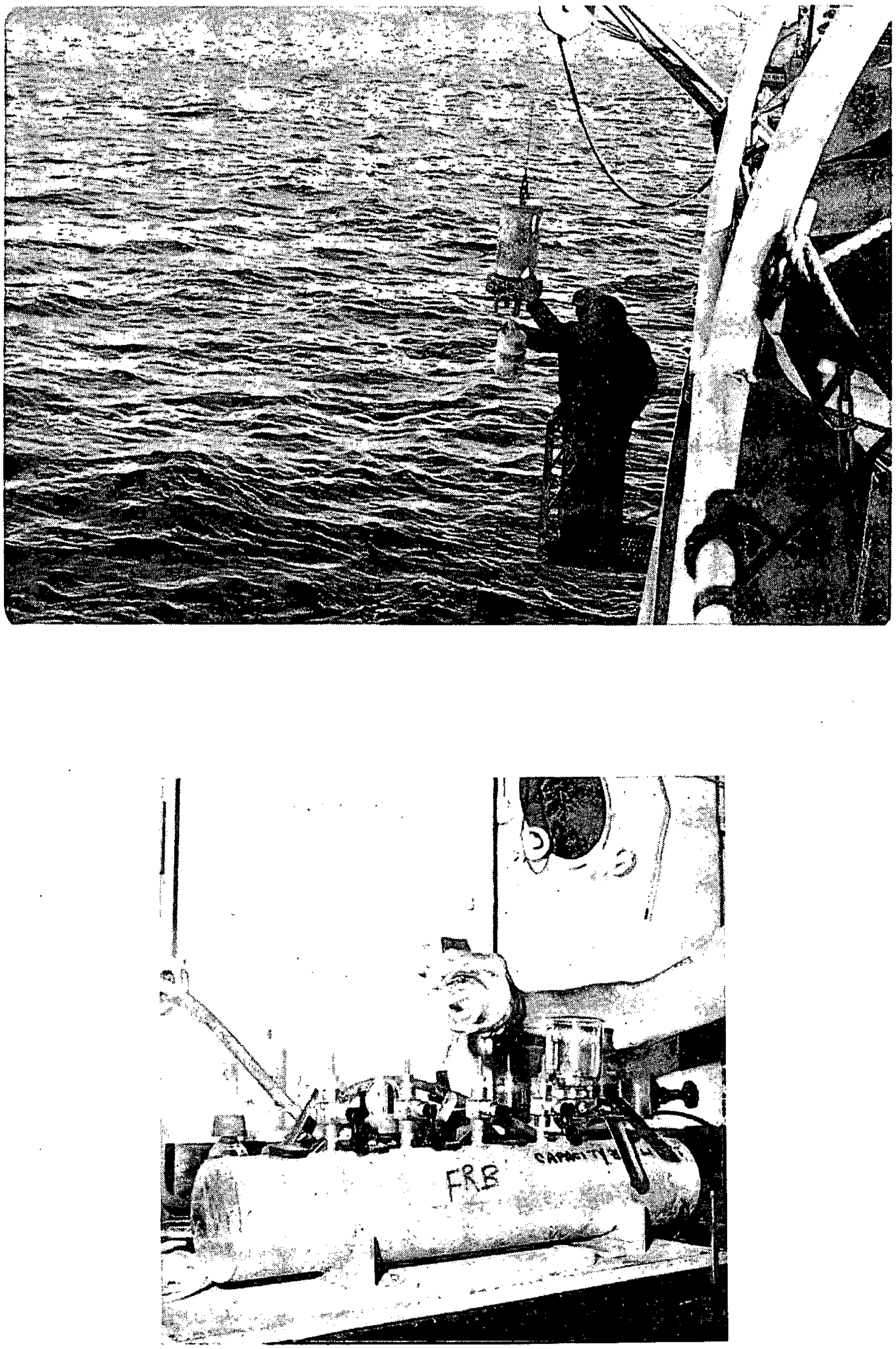
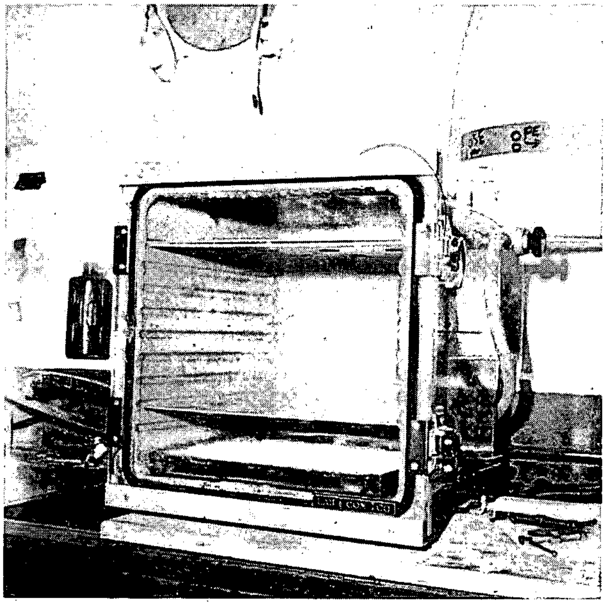


Figure 15

a) Drawing Chlorophyll Sample from the Integrator

b) Filtration Apparatus



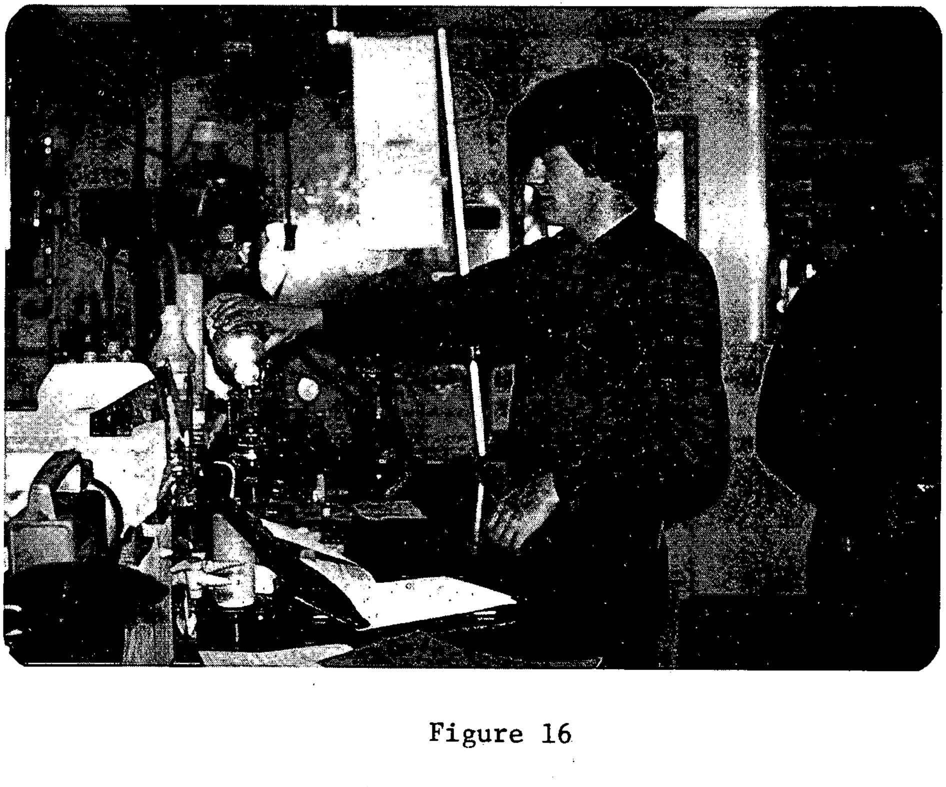


Figure 16

a) Dessicator (POC)

b) Filtration in the Lab.
(Chlorophyll, POC & SM)

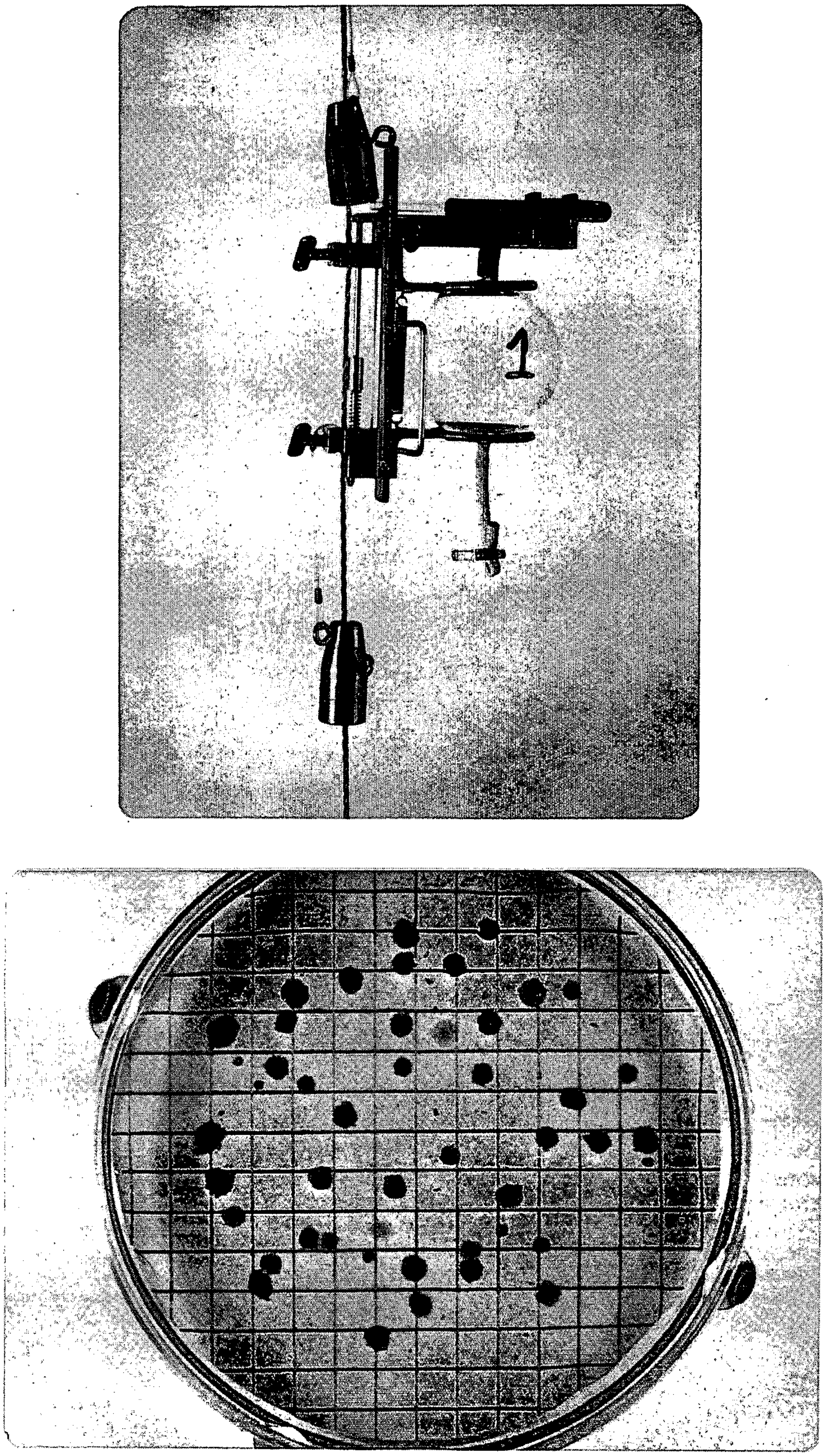


Figure 17

a) Bacti Bulb

b) Culture Plate

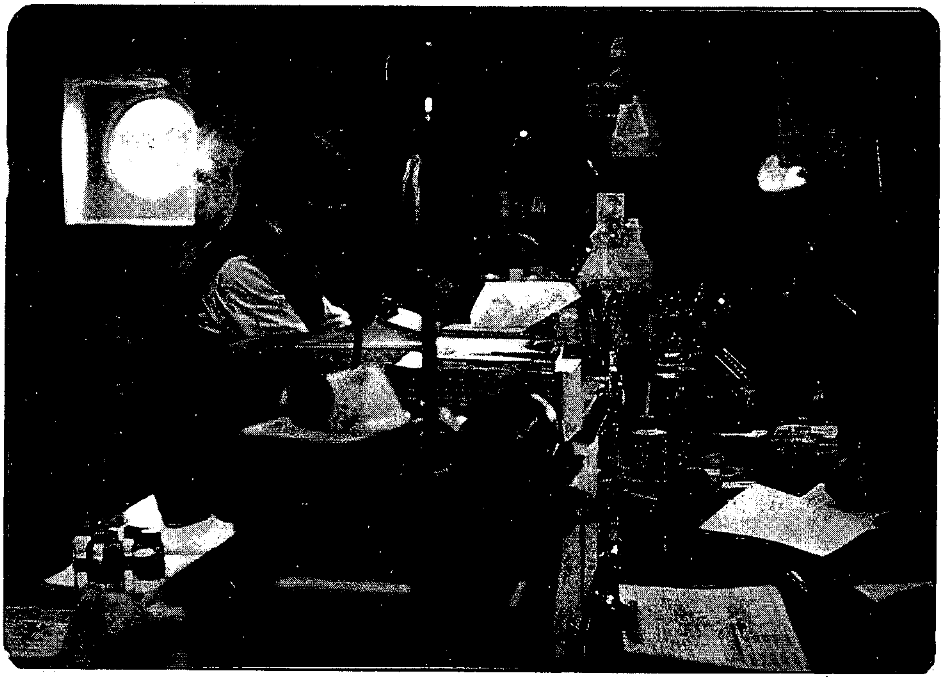


Figure 18

ATP Analysis

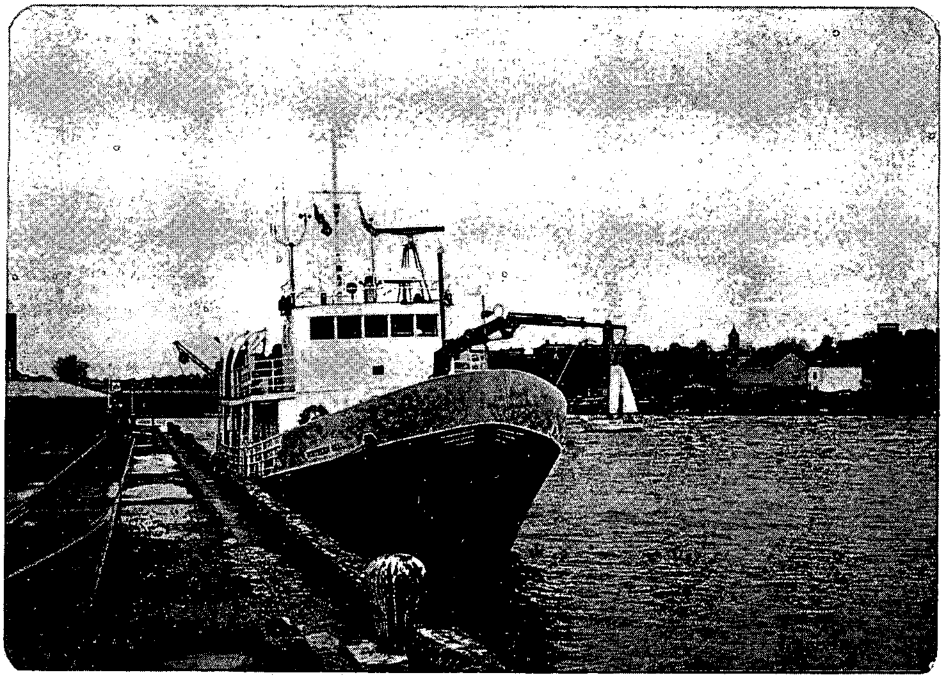


Figure 19

MV NORTHERN SEAL

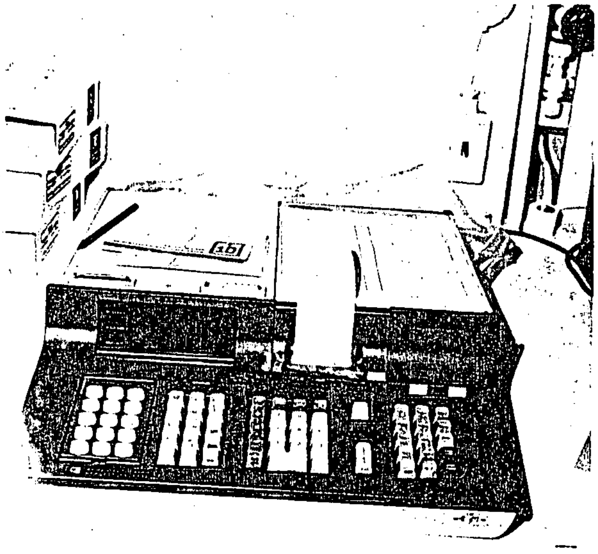


Figure 20

Program Calculator

STATISTICS SUMMARY

Cruise No. ____________ Consec. No. ________ Ship ________________

Dates From ____________ to ____________ Lake ________________

Cruise Type ______________________________ Miles Steamed ____________

Description	Total	Description	Total
Secchi		Moorings Established (CM)	
Stations Occupied		Moorings Retrieved (CM)	
Bathythermograph Casts		Moorings Established (Met.)	
E.B.T. Casts		Moorings Retrieved (Met.)	
Transmissometer Casts		Moorings Established ( )	
Reversing Thermometer Obs.		Moorings Retrieved ( )	
Water Samples Collected (Chemistry)		Moorings Serviced (CM)	
Water Samples Collected (Microbiology)		Moorings Serviced (Met.)	
Water Samples Collected (Biolimnology)		Moorings Serviced ( )	
Water Samples Collected ( )		Cores Taken (Gravity).	
Water Samples Collected ( )		Cores Taken (Piston)	
Water Samples Collected ( )		Grab Samples Taken	
Water Samples Collected ( )		Drogues Tracked	
Water Samples Filtered (Chlorophyll)		Dye Releases	
Water Samples Treated (Phytoplankton)			
Zooplankton Hauls		Observations (Weather)	
Zooplankton Hauls (Mysis)		Observations ( )	
Primary Productivity Moorings			
Bottom Samples (Fauna)		Continuous Observations (Days)	
Integrator (10m)		Air Temperature	
Integrator (20m)		Relative Humidity	
Total Number of Depths Sampled		Water Temperature (In-Hull)	
Total Number of Water Samples Collected		Water Temperature (Towed)	
		Integrated Printout	
ONBOARD ANALYSIS		Solar Radiation	
Geolimnology		Long Wave (IR) Radiation	
Manual Chemistry (Tech. Ops.)			
Nutrients (W.Q.D.)			
Microbiology			

REMARKS