C R U I S E   R E P O R T

Poseidon cruise 22

7 - 11 December 1977

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Poseidon 22: cruise report

7 - 11 December 1977

1. Chief scientist's report

This short cruise was the first of a series of three instrument trials scheduled to precede the international JASIN expedition (August - September 1978). The principal purpose of this first trial was to test the suitability of the towed chemical undulator as a vehicle for surveying temporal changes in three-dimensional temperature salinity structure in relation to the distribution of dye injected at the start of the survey. This test involved injecting a point source dye below the surface and turning a fluorometer mounted in the chemical undulator on a series of tracks through the dye as it spread, the fluorometer output (proportional to the logarithm of the dye concentration) being displayed on chart recorders and input to the ship's NOVA 1200 computer. Secondary objectives involved testing the multisonde and the ship's automatic meteorological recording system.

The site selected for this work was Bornholmbecken, where we expected to find high Richardson numbers in mid water (i.e. above the safety zone that we set to avoid risk of collision with the bottom). However, we abandoned this plan because the seas were too rough and worked instead in the Bornholm gat on the lee-side of Bornholm. This limited the depth of undulator operations to the mixed layer, so the test was less realistic than originally planned. Nevertheless it proved adequate as an instrument trial.

All scheduled tests were completed without incident. The detailed reports on each aspect of the work are attached as appendices.

2. Brief diary

1977 : 12 : 7 :	0800α	Departed IfM pier
		Prepared instruments while on transit
	1504	Multisonde test
	1522	Undulator test
	1550	Continue on course
1977 : 12 : 8 :	0700α	Multisonde station 5 miles W of Bornholm
		(wind Easterly force 7)
	0810	Dye injected on surface
	0823	1st Undulator trial begun
	0954	1st Undulator trial completed
	1000	On course for Bornholmbecken
	1315	Turned back (wind Easterly force 8/9)
	1515	Back in lee of Bornholm
	1535	Drogued buoy in water
	1555	Dye injected at depth of 25 m
	1603	2nd Undulator trial begun
	1750	2nd Undulator trial completed
	1945	Anchored in lee of Bornholm for the night
1977 : 12 : 9 :	0700α	Multisonde station (wind 15 m/s 110°)
	0805	Drogued buoy in water
	0901	Dye injected at 20 m depth
	0909	3rd Undulator trial begun
	1520	3rd Undulator trial completed
	1525	Recover buoy
	1600	Multisonde station
	1700	On course for Kiel
1977 : 12 : 10 :	0800	Start search for Dr. Meincke's lost mooring
		(wind SE force 8/9)
	1000	End search (unsuccessful because echo sounder unusable in such rough seas)
	1005	Continue course to IfM
	1240	Alongside IfM pier.

3. Members of the scientific team

R. Bock	IfM, R.O.
H. P. Hansen	IfM, Mar. Chem.
H. Hundahl	Kobenhavn Univ.
G. Kullenberg	Gothenberg Univ.
H. Leach	IfM, R.O.
M. K. MacVean	IfM, R.O.
P. Minnett	IfM, R.O.
J. D. Woods	IfM, R.O. (Fahrtleiter)

4. Detailed reports

4.1. Chemischer Profiler

Als Vorbereitung des JASIN Experimentes sollte der Profiler zur Verfolgung von Rhodaminmarkierungen in verschiedenen Wasserschichten eingesetzt werden. Hierzu war der Schleppfisch mit einem Fluorometer bestückt worden, dessen Signal über den Sauerstoffdatenkanal zum Bordgerät übertragen wurde.

Die Schnittstelle Fluorometer/Profiler bereitete keinerlei Schwierigkeiten. Die Signale konnten im zulässigen Bereich fehlerfrei übertragen werden.

Die Form der Registrierung der Rhodaminflecken läßt vermuten, daß der Wasseraustausch im Meßbereich des Fluorometers nicht ausreichend war. Hier muß eine Lösung gefunden werden. Bisher wurde lediglich durch den Bypass der Profilerpumpe Wasser in den Meßbereich gedrückt. Diese Wassermenge wurde beim dritten Schleppversuch noch verringert, da der Schlauch des Hauptwasserstromes sich gelöst hatte. Eine vorgeschlagene Lösung besteht darin, den Hauptwasserstrom durch eine geschlossene Meßkammer des Fluorometers zu leiten.

Einige Probleme traten im mechanischen Teil des Profilersystems auf. So führte die starke Zwangsdrehung des Fairingkabels zwischen Führungsrolle und Hauptblock am A-Rahmen dazu, daß zweimal ein bzw. zwei Fairings zerbrachen. Da die Winde ständig beobachtet wurde, konnte dieser Schaden sofort behoben werden.

Als Gesamtergebnis kann festgestellt werden, daß das System mit einer sehr geringen Fehlerquote in der Steuerautomatik gut und zuverlässig arbeitet. Wie sich bei der Demontage des Fisches herausstellte, hat er sich einmal um 360 Grad gedreht. Dennoch bestand keine Gefahr für die Leiterkabel.

Einsatzprotokoll

Stat.Nr.	Datum/Uhrzeit	Tiefen	Bemerkungen
767	08.12.77/08.20	15 m Start	Insges. 8 Registrierungen
	08.41	8 m	
	08.51	10 m	
	09.46	Ende	
769	08.12.77/16.12	16 m Start	Insges. 11 Registrierungen
		Osz. 16 - 28 m	
		Untersch. Pausen	
	17.10	15 - 25 m je 15 sec	
	17.39	Ende	
770	09.12.77/09.41	15 m Start	
	09.55	10 - 25 m Osz.	
		Je 15 sec Pause	Registrierung ca. alle 8 min.
	10.41	10 m	
	11.51	10 - 25 m wie oben	
	14.50	Ende	

4.2. Fluorometer

1. Dye mixing and injection was made from the starboard side and all functioned well. The ship could keep position and the hose was vertical during injection. Three injections were made, at the surface 2 - 4 m, at 20 m and at 25 m.

2. The fluorometer was mounted in the fish in Kiel and during passage to the working area. All seemed to work as planned. The first experiment 8/12 (Station 767), of 2 hours duration, in the surface proved that the dye was titrated in a normal way and that the range and sensitivity of the instrument was ok. The daylight signal was not disturbing although the fish was kept at 4 - 6 m depth.

The subsurface experiments were made in the homogeneous part of the water column since the halocline layer was too close to the bottom west of Bornholm and the weather conditions did not permit us to work east of Bornholm. The second experiment 8/12 (Station 769) - the injection lasting 5 minutes was at 20 - 23 m (1600 CET). First detection of dye layer at 22 m at 1617, and several passages were made until the end of the experiment at 1750. The third experiment (Station 770), started 0906 on 9/12 injection at 25 - 27 m. The fish was launched 0915 but the pump did not start. This was however fixed and 0932 the instrument was working and the fish cycling 10 - 25 m. The first passage was made 0941 and until 1200 navigation was relative to the parachute buoy. After that a Decca navigation pattern was made (Fig. 1) until 1500, making several passages through dye layers. At 1500 the experiment was ended, at 1520 the fish was on board after having passed through clean water in order to check the signal and at 1525 the parachute buoy was recovered.

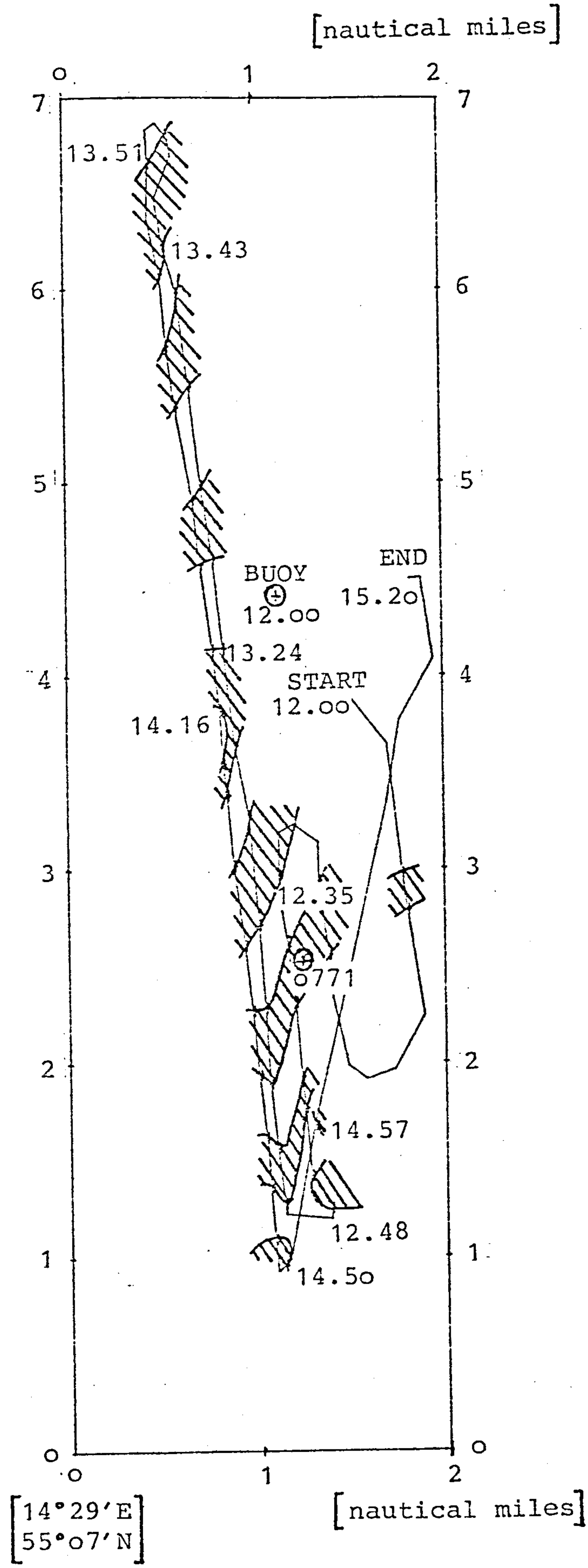
The experiment showed that the dye can be found, navigation relation to the parachute buoy is possible in the early part of the experiment and that Decca navigation following a systematic pattern can be made thereafter. The daylight gave a slight signal at 10 m depth, less than 1 °/oo of the dye signal, but it should be eliminated which can be done by covering the fluorometer volume with a "black box" through which the water is pumped. This will also improve the flushing which is necessary. The typical signal received when passing through the dye is shown in Fig. 2 and the gradual increase as well as the abrupt end are noticeable. This is most likely related to the flushing of water passing the fluorometer, and we plan to have all the water from the pump passing through a "black box" covering the fluorometer volume. The fluorometer signal is log. amplified, which is the only way to cover the 5 - 6 decades required. However, the low concentrations then give an apparently very weak signal. This can be changed by linearizing this part of the signal, which will be attempted. During the experiments the recording was done in the chemical lab and no repeat was available on the bridge. This is however required and a signal line from the lab to the bridge should be arranged.

3. Recommendations/experience

The dye experiments can be made and the fish is working; the tests were very successful. The location of the fluorometer in the fish cannot be changed but in order to improve the flushing a "black box" will be made through which all the pumping will pass.

The daylight signal will be reduced or eliminated by means of the "black box". A linearization of the log amplified signal will be made for the low concentration range. Navigation is crucial and a repeater of the fluorometer signal on the bridge is required.

DISTRIBUTION OF DYE
DURING FRIDAY AFTERNOON
9 - 12 - 77 "STATION" Ø770



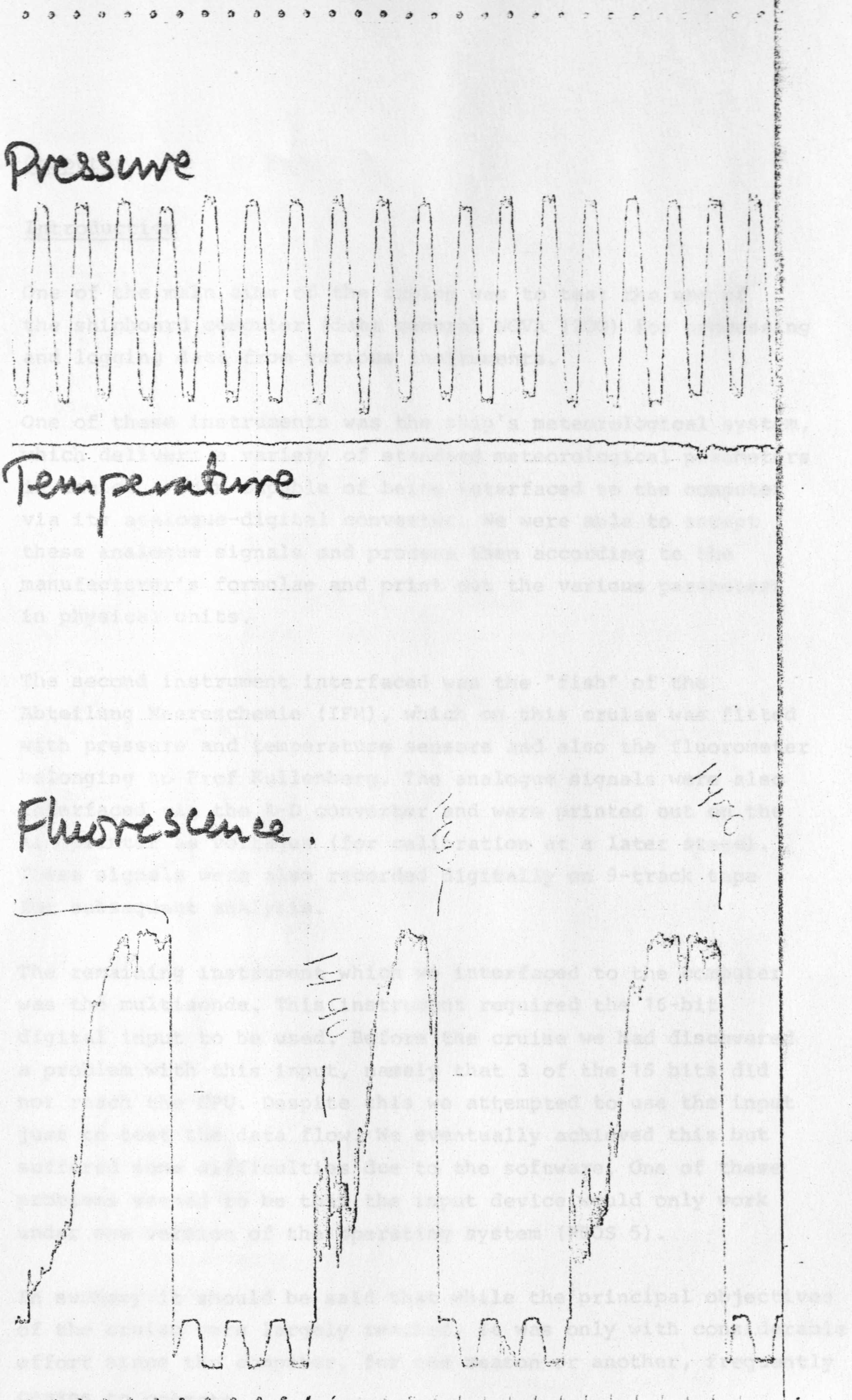


FIGURE 2.

4.3. Computer

Introduction

One of the main aims of the cruise was to test the use of the shipboard computer (data general NOVA 1200) for processing and logging data from various instruments.

One of these instruments was the ship's meteorological system, which delivers a variety of standard meteorological parameters in analogue form capable of being interfaced to the computer via its analogue-digital converter. We were able to accept these analogue signals and process them according to the manufacturer's formulae and print out the various parameters in physical units.

The second instrument interfaced was the "fish" of the Abteilung Meereschemie (IFM), which on this cruise was fitted with pressure and temperature sensors and also the fluorometer belonging to Prof Kullenberg. The analogue signals were also interfaced via the A-D converter and were printed out on the lineprinter as voltages (for calibration at a later stage). These signals were also recorded digitally on 9-track tape for subsequent analysis.

The remaining instrument which we interfaced to the computer was the multisonde. This instrument required the 16-bit digital input to be used. Before the cruise we had discovered a problem with this input, namely that 3 of the 16 bits did not reach the CPU. Despite this we attempted to use the input just to test the data flow. We eventually achieved this but suffered some difficulties due to the software. One of these problems seemed to be that the input device would only work under one version of the operating system (RDOS 5).

In summary it should be said that while the principal objectives of the cruise were largely reached, it was only with considerable effort since the computer, for one reason or another, frequently ceases to operate.

Poseidon Cruise 22 - Programs

1. To log Met. Data onto paper HBWET
2. To log any analogue input voltage onto paper HBAD
3. Logging of Fish Data onto magnetic tape and paper HB4A
4. Logging of Multisonde Data onto paper HBMS. This program not bug free and is only for test purposes.

Poseidon Cruise 22 - Operating Systems

There were 3 operating systems used.

1, RDOS 2 SYS.SV serves
all peripherals except lineprinter and 16-Bit Digital Input (Device 36)

2, RDOS 2 BTØ.. SV serves
all peripherals except magnetic tape units and 16-Bit Digital Input (Device 36)

3, RDOS 5 SYS.SV serves
all peripherals including 16 Bit Digital Input (Device 36).

Poseidon Cruise 22 - Tape Format

9 track 800 bpi.
Standard DG NOVA 257 word Blocks.
(255 words for user).
Data cycles 17 words binary integers

Word 1	ID = 1	
2	day - random number this channel bad	
3	hours (MEZ)	
4	minutes	
5	seconds	
6	Fish pressure	voltages * 2048
7	temperature	voltages * 2048
8	spare	voltages * 2048
9	fluorescence	voltages * 2048
10	spare	voltages * 2048
11	spare	voltages * 2048
12 – 17	empty	

Computer Failures

1. At 1115 on 7/12/77 disk POS2Ø1 became inaccessible and had to have low grade reinitialisation. This however only restored one of the two RDOS 2 operating systems (BTØ)

2. The usual type of computer failure, simply stopping or locking out happened too often to record every instance. As an indication of the frequency of occurance of failures the behaviour during the Station 770 on 9/12/77 is detailed.

0909	Started logging data onto tape RJ9ØØ4
0937	Started logging data onto tape RJ9ØØ5
0951	Failure - start tape RJ9ØØ6
1042	Start tape RJ9ØØ7
1106	Failure - start tape RJ9ØØ8
1130	Failure - start tape RJ9ØØ9
1146	Stop logging

Every time the computer fails the tape onto which it is writing is incorrectly terminated and has to be dismounted and another tape started.

Poseidon 22 - Summary of Data Recorded Tape

Tape No	File No	Date	Start time	Stop time	Instr	St^n	Comment
RJ9ØØ1	Ø	8/12/77	0918	0936	Fish	767	Data useless-software fault
RJ9ØØ2	Ø	8/12/77	1637	1646	Fish	769	Data useless-software fault
	1	8/12/77	1646	1705	Fish	769	Data useless-software fault
RJ9ØØ3	Ø	8/12/77	17Ø7	1721	Fish	769	Data useless-software fault
	1	8/12/77	1725	1737	Fish	769	Data useless-software fault Abnormal end due to computer failure.
RJ9ØØ4	Ø	9/12/77	0909	0936	Fish	770	Data should be good from here onwards Software fault cured.
RJ9ØØ5	Ø	9/12/77	0937	0951	Fish	770	Abnormal end - computer failure
RJ9ØØ6	Ø	9/12/77	0955	1008	Fish	770	
	1	9/12/77	1017	1041	Fish	770	
RJ9ØØ7	Ø	9/12/77	1042	1106	Fish	770	Abnormal end - computer failure
RJ9ØØ8	Ø	9/12/77	1109	1124	Fish	770	
	1	9/12/77	1125	1130	Fish	770	Abnormal end - computer failure
RJ9ØØ9	0	9/12/77	1136	1146	Fish	770	

Poseidon Cruise 22 - Computer Use

Date	Stat^n	Instr	Computer	data on LP	data on MT	
7/12/77	764	MS	No	-	-	
7/12/77	765	Fish	Yes	Yes	No	
8/12/77	766	MS	No	-	-	
8/12/77	767	Fish	Yes	Yes	Yes	Tape RJ9ØØ1 Data useless-software fault
8/12/77	768	MS	No	-	-	
8/12/77	769	Fish	Yes	Yes	Yes	Tapes RJ9ØØ2 and RJ9ØØ3 Data useless-software fault
9/12/77	770	Fish	Yes	Yes	Yes	Tapes RJ9ØØ4 - RJ9ØØ9 Data apparently useful
9/12/77	771	MS	Yes	Yes	No	A small quantity of data was printed onto paper before the dip. This test is only valid for data flow purposes; the numbers are wrong due to hardware fault.

4.4. Multisonde

Largely in support of Professor Kullenberg's dye experiments the Multisonde was used to obtain 18 profiles, from the surface to within about four metres of the bottom, at stations 764, 766, 768 and 771. The lowering rate was generally about 0.5 m/s, (exceptions being the 4th dip of 766, being raised at 0.2 m/s ; 4th dip of 771 being raised at 1.0 m/s) station 768 was abandoned after two profiles because of power loss to the underwater unit. This was thought to have been caused by water leaking into the connector at the top of the telemeter unit. Two further failures just after immersion suggested that the joint between the winch cable and the flying leads might have been leaking, and this joint was remade. However, subsequent failures in the deck unit, (possibly overheating of the microprocessor) characterized by a blank display, which occured when the underwater unit was still on deck indicate a further fault which must be identified and remedied.

An XYY plotter was used to monitor the analogue output from the deck unit. Temperature and conductivity were plotted against pressure for eight profiles and temperature and salinity against pressure for ten profiles. The plotter suffered from poor damping and the resulting "overshorting" renders the plots of very little scientific value. The water column appeared to be well mixed to a depth of 25 to 30 m with higher temperatures and salinities encountered below. Comparison between successive up and down dips show displacements that are unlikely to be environmental. These effects might be caused by the instrument ascending through its own wake, by hysteresis in the pressure cell or by heat flow in the sensors.

With the instrument held just beneath the sea surface the pressure reading was found to vary between -1.8 dbar and +1.0 dbar. How much of the variation was due to surface waves is unknown. Surface salinities given by the Multisonde were compared with 'bucket' samples and were found to require a correction of +0.41 ppt at 7.8 to 9.1 ppt (15 salinometer comparisons). Surface temperatures given by the Multisonde were too high by less than 0.2 ^{o}C at 6.3 to 6.7 ^{o}C. The sound velocity and light attenuation channels were not monitored during this cruise. With so small a range to temperature and salinity it is not possible to attempt a calibration of the instrument, but it is strongly recommended that thorough calibration of the sensors be undertaken before further serious use of the instrument is made.

In addition it is recommended that longer flying leads be connected to the winch cable in such a way that all joints and connectors are free from tension.

Table Multisonde Log.

Station	indicated wire out m	Pressure dbar	Temperature* °C	Conductivity* ms/cm	Salinity* ppt.	Ascent or descent rate m/s	Surface values (bucket) Comments
						Channels plotted against	
764	0	-1.34	6.266	10.414	9.108	0.5 TC	Salinity: (ppt) 9.464 9.464 9.461 9.469 9.469 9.469 9.472
	17	15.34	7.010	11.99u	10.8uu	0.5 TC	
	0	-1.40 -1.34 1.60	6.1uu 6.274 6.27u	10.44u 10.44u	8.9uu 9.1uu	0.5 TC	
	17	15.04 15.20 14.90	6.936	11.75u 12.48	10.46u 10.17u	0.5 TC	Temperature: (°C)
	0	-1.14 -0.92	6.266	10.42u	9.116 9.126	0.5 TC	6.0 6.1 6.1 6.1
	16	14.36 14.28	6.96u	11.69u	10.20u 10.15u	0.5 TC	
	0	-1.34 0.94	6.26u 6.25	10.44u	9.13u		
766	0	-1.58 0.92	6.692	9.288	7.84u	0.5 TC	Salinity (ppt) 8.273 8.274 8.276 8.276
	40	36.10 36.94	8.088 8.036 8.082	12.478 12.668 11.916	10.314 10.778 10.710 10.758 10.896	0.5 TC	
	0	0.98 1.66	6.684	9.292	7.846	0.5 TC	6.7 6.7 6.7
	40	37.40 37.66	9.03u 8.80u	16.57u 16.64u 16.39u	14.366 14.114 14.132	0.2	
	0	-0.76 -1.14	6.694	9.300	7.852		
768	0	-1.44 -1.54	6.686	9.304	7.858	0.5 TS	Salinity: ppt 8.275 8.274 8.275 8.278 8.277
	41	38.76 38.82 39.04	8.552	13.9uu 13.186 13.570 13.080	10.833 11.062 11.100 10.984	0.5 TS	Temperature: 6.7 6.7
	0	-1.24 1.48	6.686 6.674	9.306 9.304	7.860 7.862		Station aborted due to power failure to underwater unit
771	0	-1.28	6.568	9.274	7.860	0.5 TS	Salinities not yet determined.
	40	37.68	9.396	18.978 19.022	16.48u 16.44u	0.5 TS	Temperature: 6.5
	0	-1.38 -1.72	6.574	9.274	7.860	0.5 TS	6.4 6.5
	40	38.02 37.84	9.366 9.332	18.676 18.862	16.28u 16.36u	0.5 TS	
	0	-1.38 -1.14	6.568	9.274	7.85u	0.5 TS	
	40	38.02 37.90	9.398 9.406	18.816	16.350 16.206	1.0 TS	
	0	-1.38	6.574	9.136	7.858		

* The digital display for these parameters is given to 3 decimal places. A "u" in place of a

4.5. Surface Salinity Measurements

Surface salinity samples were obtained on ten occasions, in support of Multisonde stations and as part of the routine sampling scheme.

The Beckmann Salinometer on board proved very difficult to standardize and as a result not all of the bottles have yet been determined. Those that have show satisfactory repeatability; for instance, of the seven samples taken at staition 764, fice were within 0.003 ppt of the mean value of 9.467 ppt.

The first two observations, taken at about 10^{00} and 11^{00} CET on 7.12.77 (just out of Kiel) had salinities of 20.18 ppt and 19.79 ppt while those subsequent had values of between 9.27 ppt 9.93 ppt. (see Table   ).

The failure to obtain repeatable standardization of the Salinometer towards the end of the cruise indicates that the instrument requires an overhaul of the switches in the front panel as well as a thorough cleaning of the specimen chamber.

SURFACE SALINITIES

Station or Time	Bottle number	Surface temperature	Salinity values	mean
10^{00} CET, 7.12.77	561	5.5, 5.4, 5.4	20.181, 20.187	20.184
11^{00} CET, 7.12.77	673	5.5, 5.5, 5.4	19.783, 19.785	19.784
13^{00} CET, 7.12.77	949	6.5, 6.4, 6.3, 6.3	9.930, 9.932	9.931
14^{00} CET, 7.12.77	514	5.8, 5.7, 5.9	9.174, 9.167	9.170
Station 764	663 827 643 840	6.0, 6.1, 6.1, 6.1	9.464, 9.464 9.461 9.469, 9.469 9.472, 9.469	9.467
16^{00} CET 7.12.77	821	5.8, 5.8, 5.8	9.136, 9.135	9.135
Station 766	735 896	6.7, 6.7, 6.7	8.273, 8.274 8.276, 8.274	8.274
Station 768	647 665	6.7, 6.7	8.275, 8.274 8.275, 8.278, 8.277	8.276
10^{00} CET, 8.12.77	663 827	3.3, 3.2, 3.2, 3.1, 3.2, 3.3.	yet to determine	
Station 771	514 494	6.5, 6.4, 6.5	yet to determine	

4.6. Meteorological Instruments

One aim of the cruise was to attempt to calibrate the meteorological instruments; however, meaningful calibrations were not possible because (a) the meteorological parameters, particularly air and sea surface temperature, varied only over a very limited range (less than 3 ^{o}C) and (b) the signal voltages reaching the computer from the sensors were contaminated with a high level of noise. This noise was observed on an oscilloscope and was found to consist mainly of frequencies greater than 10 kHz with amplitudes of typically 20 mV (for all sensors the signal voltage lies between 0 and 1 V).

The ship is fitted with a Memodyne cassette drive which can digitally record the 10 channel data from the meteorological sensors (dry bulb temperature, wet bulb temperature, surface water temperature, dew point, wind speed, wind direction, downward radiation, atmospheric pressure, ship's heading, surface salinity) at selected intervals between 1 and 16 mins. The device was run from about midday on 8th December 1977 until 1200-CET on 10th December 1977 with data being recorded every minute.

Meteorological observations were made at hourly intervals between 1000 CET and 1600 CET on 8th December, once on 9th December and once on 10th December. Computer printouts of the signals reaching the computer were obtained at each of these times. On the 8th December these were in the form of spot values approximately every 0.28 secs ; on the 9th and 10 th December the output was in the form of between 4 and 6 values of each parameter each representing an average of a large number of spot values (4000 on 9th December, giving time intervals of about 35 secs, and 1000 on 10 th December, giving time intervals of about 33 secs.). The meteorological observations are tabulated in the appendix, together with comparison values derived from the computer output. For the 8th December the means and standard deviations of 20 consecutive cycles of spot values are tabulated; for the 9th and 10th December the average of the 4-6 values printed out for each variable, together with the maximum and minimum values, are given.

Wet and Dry Bulb Tnermometers

These are located, together with the downward radiometer and hydrochemical hygrometer, on the Peildeck, level with the after end of the bridge. Here they are relatively exposed but the location is not optimal due to the presence of an exhaust vent about 2 m forward of the position of these instruments. Consideration should be given to the repositioning of these instruments to alleviate this problem. It was noticed that on occasions the wet bulb thermometer was consistently producing higher voltages than the dry bulb thermometer while at other times physically realistic relationships (wet bulb voltage less than that of the dry bulb) were observed at similar voltages. The cause of this problem has not yet been determined, but must be rectified if meaningful results are to be obtained.

In this occasion the signal voltages were compared with the readings of a whirling psychrometer. The observations were made from the Peildeck , the instrument being spun in a position as close as possible to that at which it was to be read. Typically an average of five readings was taken to attempt to remove the variability in the observations, which was at times significant. It was noticed that the instrument took a long time to equilibriate to its surroundings ,after which time it was often doubtful whether sufficient water remained on the wet bulb. Also the readings were sometimes seen to change significantly during the first few minutes after the instrument was brought to range. It is felt than an instrument that can remain semi-permanently on deck in the position in which it is to be read is necessary for calibration purposes.

Hydrochemical Hygrometer

See above for comments on the location of this. Using the manufacturers calibrations the values obtained from this instrument were consistently unrealistic (ranging from about $-15.8^{\circ}C$ to $-17.6^{\circ}C$ when the expected values, determined from wet and dry bulb temperatures, ranged between -2.8 °C and +1.7 °C). The operation of this instrument must be thoroughly checked.

Downward Radiometer

See above for comments on the location of this. No instrument was available against which to check the values obtained from this instrument.

Sea Surface Thermometer

The sea surface temperature is measured by a unit mounted below the water-line on the port side of the ship. It should be withdrawn and thoroughly cleaned before each trip but this was not possible. On this occasion as the electronics engineer was not available to do it. The values obtained were compared with the temperatures measured by a standard Deutscher Wetterdienst sea surface thermometer. The range of sea-surface temperature experienced was only 1 °C; there was a significant amount of scatter in the plot of observed sea surface temperature against signal voltage which was probably due to the noise contamination of the signal.

Sea Surface Salinometer

The sea surface salinity is measured by a unit in the same position as the sea surface thermometer. The manufacturers calibration data are not at present known but according to Dr. Meincke the instrument is suitable only for measuring salinities greater than 28 ‰. During this cruise the salinity of surface water samples was also determined using a bench salinometer and lay in the range 9.1 ‰ - 20.2 ‰. It was noted that high salinities corresponded to low signal voltages from the hull salinometer and vice versa.

Barometer

The atmospheric pressure is measured by an aneroid barometer situated behind the computer. Consideration should be given to whether or not this is the best location for it. The noise in the barometer signal was significantly larger than that in the other signals; this appears to be due to spikes. Comparisons of the signal voltage with values read from the aneroid barometer on the bridge were made but the results were of no significance due to the noise.

Wind Vane and Anemometer

These instruments are situated on top of the mast on the bridge, about 18 m above the water-line. Comparison of the wind direction (relative to the ship's head) from this instrument, as displayed on the bridge, and the signal voltages reaching the computer should be made. On this trip the frequent course alterations and lack of synchronisation between taking measurements and obtaining values from the computer rendered this impossible. A comparison was made between the wind speeds obtained from the Peildeck using a non-averaging, uncalibrated, hand-held anemometer and the computer voltages. The results showed a large degree of scatter and cannot be regarded as significant. It should be noted that wind speed differences of up to 5 m/s could be obtained between various positions on the Peildeck, the wind speed being significantly higher at the windward edge of the deck. Also the 8 m difference in height between the position of the ship's anemometer and the hand-held anemometer should be noted.

Conclusions

High priority must be given to the removal of noise from the signal voltages reaching the computer. The hygrometer, wet and dry thermometers, radiometer and barometer may produce more accurate results if resited. The hygrometer, wet and dry thermometers and possibly also the salinometer should be checked to see that they are functioning correctly. Careful consideration should be given to the choice of the instruments against which to calibrate the ship's sensors and to the choice of the location for these instruments.

APPENDIX

Intercomparison of measured meteorological parameters and signals being logged by the computer

Conversion factor used to convert voltages into physical units (supplied by the manufacturer)

Parameter	Voltage Range (mV)	Physical parameter range
Dry bulb air temperature	0 →1000	$-15^{o}C \rightarrow 35^{o}C$
Wet bulb air temperature	0 →1000	$-15^{o}C \rightarrow 35^{o}C$
Sea surface temperature	0 →1000	$-15^{o}C \rightarrow 35^{o}C$
Dew point	0 →1000	$-30^{o}C \rightarrow 30^{o}C$
Pressure	0 →1000	950mb →1050mb
Wind speed	0 →1000	0m/s →41m/s
Wind direction	0 →1000	$0^{o} \rightarrow 360^{o}$
Ship's head	0 →1000	$0^{o} \rightarrow 360^{o}$
Sea surface salinity	0 →1000	$28^{o}/oo \rightarrow 38^{o}/oo$
Downward radiation	0 →1000	Not known

(a) Dry bulb air temperature (Tdry)

Time (CET)/Date	Measured Tdry (°C)	Means and standard deviations	
		Signal voltage (mV)	Derived Tdry (°C)
1000/7	1.5	323.6 (1.4)	1.2 (0.1)
1100/7	1.5	325.8 (1.0)	1.3 (0.1)
1200/7	1.7	323.2 (1.2)	1.2 (0.1)
1300/7	1.4	311.4 (5.2)	0.6 (0.3)
1400/7	1.4	318.2 (5.0	0.9 (0.3)
1500/7	0.8	310.0 (4.6)	0.5 (0.2)
1600/7	1.2	307.0 (5.4)	0.4 (0.3)
1300/8	3.3	356.2 (2.0*)	2.8 (0.1*)
1000/9	3.2	359.6 (1.4+)	3.0 (0.1*)

+Half-range, not standard deviation

(b) Wet bulb air temperature (Twet)

Time (CET)/Date	Measured Twet	Means and standard deviations	
		Signal voltage (mV)	Derived Twet (°C)
1000/7	0.2	311.6 (1.6)	0.6 (0.1)
1100/7	-0.2	310.8 (0.8)	0.5 (0.0)
1200/7	0.2	310.0 (1.0)	0.5 (0.1)
1300/7	-0.1	299.2 (6.6)	0.0 (0.3)
1400/7	0.0	309.2 (6.2)	0.5 (0.3)
1500/7	-0.1	301.0 (5.6)	0.1 (0.3)
1600/7	0.1	301.4 (6.6)	0.1 (0.3)
1300/8	2.6	358.6 (8.0+)	2.9 (0.4*)
1000/9	2.4	357.8 (1.4+)	2.9 (0.1+)

*Half-range, not standard deviation

(c) Sea surface temperature (SST)

Time(CET)/Date	Measured SST ($^{\circ}$C)	Means and standard deviations: Signal voltage (mV)	Means and standard deviations: Derived SST($^{\circ}$C)
1000/7	5.4	404.8 (1.8)	5.2 (0.1)
1100/7	5.5	407.6 (1.0)	5.4 (0.1)
1200/7	-	-	-
1300/7	6.4	424.4 (5.4)	6.2 (0.3)
1400/7	5.8	419.2 (4.0)	6.0 (0.2)
1500/7	6.1	426.2 (4.4)	6.3 (0.2)
1600/7	5.8	420.8 (5.4)	6.0 (0.3)
1300/8	-	-	-
1000/9	6.4	434.8 (0.8*)	6.7 (0.0*)

*Half-range, not standard deviation

(d) Dew Point (DP)

Time(CET)/Date	Measured** DP$^{\circ}$C	Means and standard deviations: Signal voltage (mV)	Means and standard deviations: Derived DP $^{\circ}$C
1000/7	-2.0	208.8 (6.5)	-17.5 (0.4)
1100/7	-2.8 -2.4	212.7 (6.0)	-17.2 (0.4)
1200/7	-2.2	216.7 (5.8)	-17.0 (0.4)
1300/7	-2.5 -2.2	213.8 (8.0)	-17.2 (0.5)
1400/7	-2.1	214.7 (6.2)	-17.1 (0.4)
1500/7	-1.7 -1.4	210.0 (6.0)	-17.4 (0.4)
1600/7	-1.5	206.7 (7.8)	-17.6 (0.5)
1300/8	1.7	235.7 (0.3*)	-15.9 (0.0*)
1000/7	1.2	236.8 (0.7*)	-15.8 (0.0*)

*Half-range, not standard deviation

**This is actually the dew point calculated from the measurements tabulated in (a) and (b). Where two values are given for one time, the upper is calculated assuming that there was water on the wet bulb and the lower assuming that it was covered with ice.

(e) Pressure (P)

Time(CET)/Date	Measured (P(mb)	Means and standard deviations Signal voltage (mV)	Derived (P(mb)
1000/7	1005.8	596.9 (55.1)	1009.7 (5.5)
1100/7	1005.7	615.1 (19.7)	1011.5 (2.0)
1200/7	1005.5	608.5 (8.7)	1010.9 (4.5)
1300/7	1006.5	619.1 (45.1)	1011.9 (4.5)
1400/7	1006.5	612.9 (5.0)	1011.3 (0.5)
1500/7	1006.9	598.5 (47.4)	1009.9 (4.7)
1600/7	1007.0	626.7 (5.9)	1012.7 (0.6)
1300/8	-	-	-
1000/9	1020.8	752.7 (3.0*)	1025.3 (0.3*)

*Half-range, not deviation

(f) Wind speed (WS)

Time(CET)/Date	Measured** WS (m/s)	Means and standard deviations Signal voltage (mV)	Derived (WS (m/s)
1000/7	20 (25)	480.5 (30.0)	19.7 (1.2)
1100/7	25 (30)	543.7 (10.5)	22.3 (0.4)
1200/7	25 (30)	608.8 (15.4)	25.0 (0.6)
1300/7	22 (25)	554.1 (13.9)	22.7 (0.6)
1400/7	22 (25)	489.3 (17.8)	20.1 (0.7)
1500/7	8 (11)	322.0 (60.7)	13.2 (2.5)
1600/7	18 (20)	534.4 (33.7)	21.9 (1.4)
1300/8	13 (17)	422.2 (24.4*)	17.3 (1.0*)
1000/9	15 (22)	503.4 (14.6*)	20.6 (0.6*)

*Half-range, not standard deviation

**Both mean and gust values given

(g) Wind direction (relative to ship's head) (WD)

Time(CET)/Date	Measured WD	Means and standard deviations Signal voltage (MV)	Derived WD
1000/7	045	63.3 (15.0)	022.8 (5.4)
1100/7	020	55.7 (1.6)	020.1 (0.6)
1200/7	000	55.0 (1.3)	019.8 (0.5)
1300/7	000	977.3 (5.4)	351.8 (1.9)
1400/7	010	0.2 (3.8)	000.1 (1.4)
1500/7	000	895.3 (5.1)	322.3 (1.8)
1600/7	025	57.6 (4.5)	020.8 (1.6)
1300/8	240	691.3 (11.1*)	248.9 (4.0*)
1000/9	-	-	-

*Half-range, not standard deviation

(h) Ship's head (SH)

Time(CET)/Date	Measured SH	Means and standard deviations Signal voltage (mV)	Derived SH
1000/7	070	173.7 (1.9)	062.5 (0.7)
1100/7	090	219.6 (2.1)	079.0 (0.8)
1200/7	120	217.4 (2.2)	078.3 (0.8)
1300/7	125	326.5 (5.5)	117.6 (2.0)
1400/7	110	278.9 (3.1)	100.4 (1.1)
1500/7	117	476.3 (4.7)	171.5 (1.7)
1600/7	090	57.6 (4.5)	020.8 (1.6)
1300/8	237	639.9 (0.6*)	230.4 (0.2*)
1000/9	-	-	-

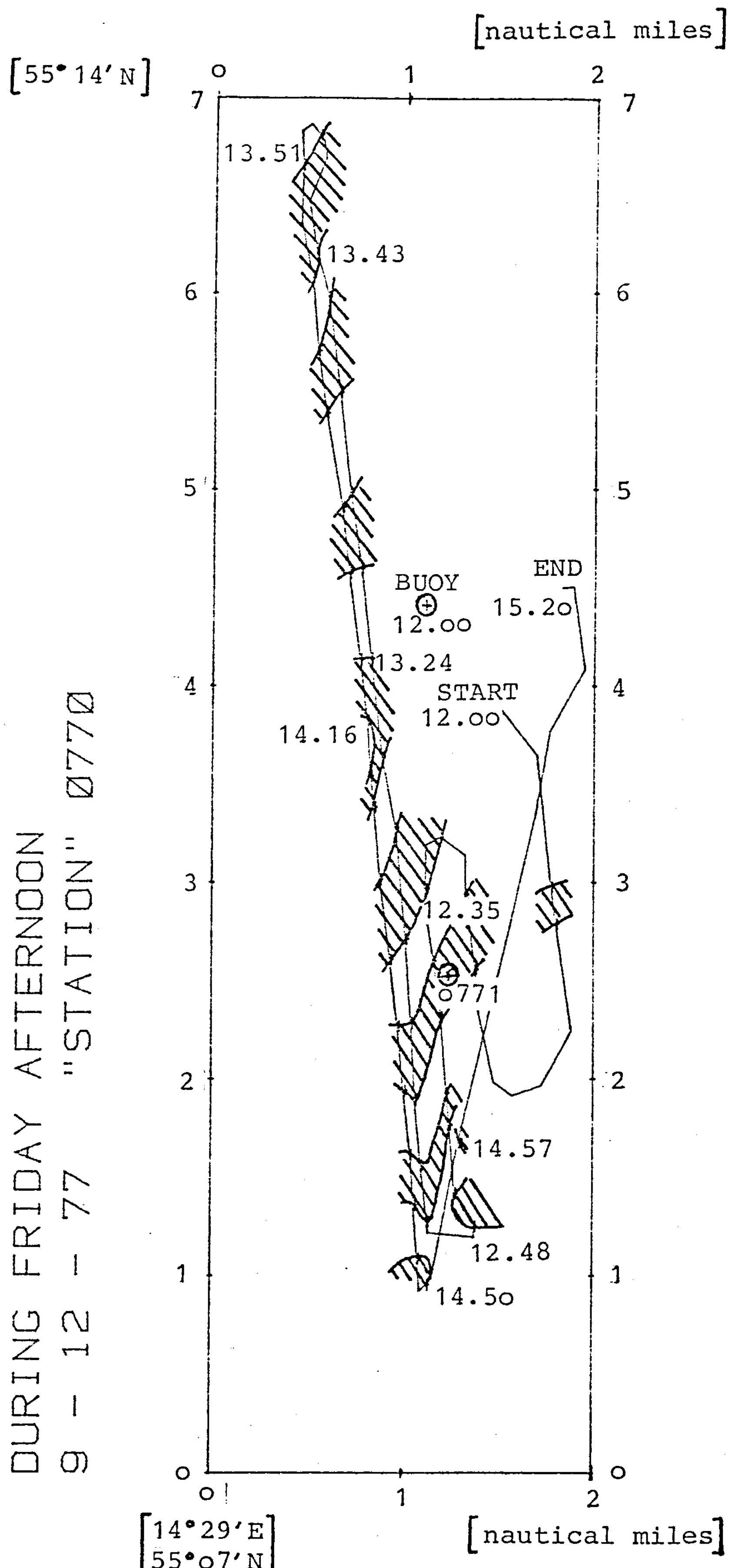
*Half-range, not standard deviation

(i) Sea surface salinity (SSS)

Time(CET)/Date	Measured SSS (^{o}/oo)	Means and standard deviations Signal voltage (mV)	Derived SSS ^{o}/oo
1000/7	20.2	679.1 (3.3)	34.8 (0.0)
1100/7	19.8	705.0 (3.1)	35.1 (0.0)
1200/7	-	-	-
1300/7	9.9	727.4 (4.9)	35.3 (0.1)
1400/7	9.2	727.9 (3.2)	35.3 (0.0)
1500/7	9.5	729.1 (3.9)	35.3 (0.0)
1600/7	9.1	729.0 (4.3)	35.3 (0.0)
1300/8	-	-	-
1000/9	-	-	-

(g) Downward radiation

No intercomparisons possible



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