CSIRO
MARINE LABORATORIES

Division of Fisheries Research
Division of Oceanography

Castray Esplanade. Hobart, Tas. 7000

EJL/BB

30 August 1985

Cruise Summary
R.V. FRANKLIN
FR 04/85

Scientific Program

Western Equatorial Pacific Ocean Circulation Study (WEPOCS)
Australian Component Part 1 - July and August 1985

Principal Investigator

Eric Lindstrom, CSIRO Division of Oceanography

Cruise Schedule

Depart Cairns	1500 19 July 1985
Arrive Moen, Truk Islands	1500 8 August 1985
Depart Moen, Truk Islands	0900 11 August 1985
Arrive Dublon, Truk Islands	1030 11 August 1985
Depart Dublon, Truk Islands	1500 11 August 1985
Arrive Cairns	1100 24 August 1985

Scientific Party (all from CSIRO Division of Oceanography unless noted)

Eric Lindstrom (Chief Scientist), Andrew Forbes, Ken Suber, David Terhell, Eric Firing, Len Zedel, Alan Poole, Mark Rayner, Eric Firing (University of Hawaii)

Cairns to Truk only-
Fred Boland, Kevin Miller, Bob Beattie, Daniel McLaughlan

Truk to Cairns only-
Denis Mackey, David Everitt, David Edwards
Brian Griffiths (CSIRO Division of Fisheries Research)

1.0 CRUISE OBJECTIVES:

1) To complete CTD sections along the cruise track for the purpose of geostrophic velocity computation and water mass analysis.

2) To deploy three current meter moorings for direct measurement of velocities over a six month period in the Vitiaz Strait, St. Georges Channel and the Equatorial Undercurrent at 150°E.

3) To obtain surface to bottom velocity profiles at five sites within one degree of the equator along 150°E using the Pegasus profiling system.

4) To obtain acoustic doppler current profiler sections along the cruise track for the purpose of determining relative and absolute flow patterns in the upper 300 m.

5) To measure primary production in relation to phytoplankton size distribution in tropical oligotrophic waters.

6) To study naturally occurring metal-organic compounds and measure the complexing capacity in tropical oligotrophic waters.

7) To determine the lipid content of particulate and dissolved organic fractions in oligotrophic waters and relate them to biological and physical conditions.

2.0 CRUISE NARRATIVE (see also Figure 1):

FRANKLIN departed Cairns on 19 July 1985 at 1500. Departure was delayed awaiting the arrival of the last Pegasus gear via air from Sydney. Proceeding across the Coral Sea for Jomard entrance in the Louisiade Archipelago a CTD station was occupied upon reaching the 4000 m isobath for tests of the equipment. XBTs were dropped in a closely spaced line and ADCP data were collected before entering Jomard entrance for the purpose of determining if a stong eastward flowing boundary current exists on the south side of the Louisiade Archipelago. After clearing Jomard Entrance and entering the Solomon Sea, FRANKLIN made way for Vitiaz Strait via the eastern side of Kiriwina Island. Off the northeast end of this island the first WEPOCS intercalibration CTD station was completed. Enroute to Vitiaz Strait several additional deep stations were occupied as an attempt was made to fix the spooling on the oceanographic winch before the shallower waters of the Bismarck Sea were encountered. FRANKLIN arrived at the mooring site in Vitiaz Strait on the morning of 24 July. A mooring consisting of three Anderaa current meters was successfully deployed at 5° 59.6' S, 147° 45.4' E (see Appendix A for more details on the mooring deployments). A CTD section was then completed across Vitiaz Strait. Another CTD section, consisting of stations to the bottom, was started across the Bismarck Sea and Vitiaz Strait to Cape Matanalem on New Hanover. Station spacing was nominally 30 nm.

From Cape Matanalem a CTD section was continued west to Rambutyo Island (just east of Manus Is.). Upon completion of this section FRANKLIN steamed southeast for St. Georges Channel. Here two CTD stations were occupied northeast of Duke of York Island until daybreak allowing us to enter the Channel for ADCP sections and survey of a mooring site. Large numbers of logs were encountered in the Channel, especially on the eastern side, and work had to be curtailed in this area. The bottom topography was extremely steep, with the Channel being a V-shaped canyon. A suitable place for the current meter mooring was found in 900 m of water on the western side of the Channel, one mile off the east coast of Duke of York Island (4°7.6'S, 152°29.5'E). Following mooring deployment the CTD section was completed between Duke of York Island and the Crater Peninsula of New Britain.

FRANKLIN headed northwest, returning passed Cape Matanalem, to begin work along 150°E. Enroute CTD stations were done at 30 nm intervals. CTD work along 150° E, heading north consisted of 1100 m CTD casts on the half degrees and 4000 m casts on the whole degrees. In addition, Pegasus velociy profiling was begun at 1°S and continued at half degree intervals to 1°30'N. On this northbound leg this involved deployment of the bottom transponders followed by several hours of mapping their locations. This was done by measuring sound travel times between the transponders and a towed transducer called "Pollywog". Once the triangular array of transponders had been mapped, Pegasus, a free falling acoustic dropsonde was deployed in the center of the triangle. It is recovered about four hours later and internally recorded travel time data dumped from its memory to obtain a velocity profile. Pegasus was located at the surface through its radio transmitter and strobe light. Combined Pegasus and CTD profiling between 1°S and 1°30'N occupied about one week.

While at the equator on this northbound leg the surface toroid mooring was deployed at 0°1.9'N, 150°1.8'E (see Appendix 1). Satellite buoy No. 01844 was also deployed approximately 2 miles southeast of the toroid location.

CTD work continued northward to 5° N. On the 7 August work was broken off for the steam to Truk for bunkering and water. Upon arriving in Truk we had to anchor offshore for several hours awaiting the depature of a container ship. Berthing commenced when she departed. The following morning bunkers were taken and it was determined that the water on Moen was unsuitable for our purposes (i.e. dirty). Arrangements were made to take water at Dublon Island, immediately south of Moen. This is standard practice for ships operating in the area.

Steaming from Truk on 11 August FRANKLIN proceeded to 5°N, 150°E to begin an XBT/ADCP run down 150°E to 1° 30'N. At this point we began repeating Pegasus profiles at the six sites. While Pegasus was in the water, 1100 m CTD stations were done at each site. XBTs were also launched to continue the section started at 5°N to 1°S at 30 nm spacing. Pegasus work completed, FRANKLIN returned to the Equator at 149° 30'E to begin a CTD section along the equator to 143°E. Stations were 30 nm intervals and to 1100 m depth, except at 149°E, 147°E, 145°E and 143°E where deep (4000 m or bottom) casts were done.

This section completed, FRANKLIN turned for home. On the return journey to Cairns XBTs were launched at 3 hour intervals. Dawn bio/chem CTD stations, initiated upon leaving Truk, were continued through 23 August. In addition an intense XBT/ADCP section back and forth across Vitiaz Strait was done on 20 August. FRANKLIN reached Cairns on 24 August at 1100.

It is worthwhile noting at this point that the aquisition of data aboard FRANKLIN went very well and that nearly 100% of the planned work was completed. Although many problems were encountered with scientific and ship equipment, none were of such severity as to seriously curtail a major objective of the cruise. The expertise of the technical support and engineering staff on the FRANKLIN was of considerable assistance in maintaining our basic data logging capability.

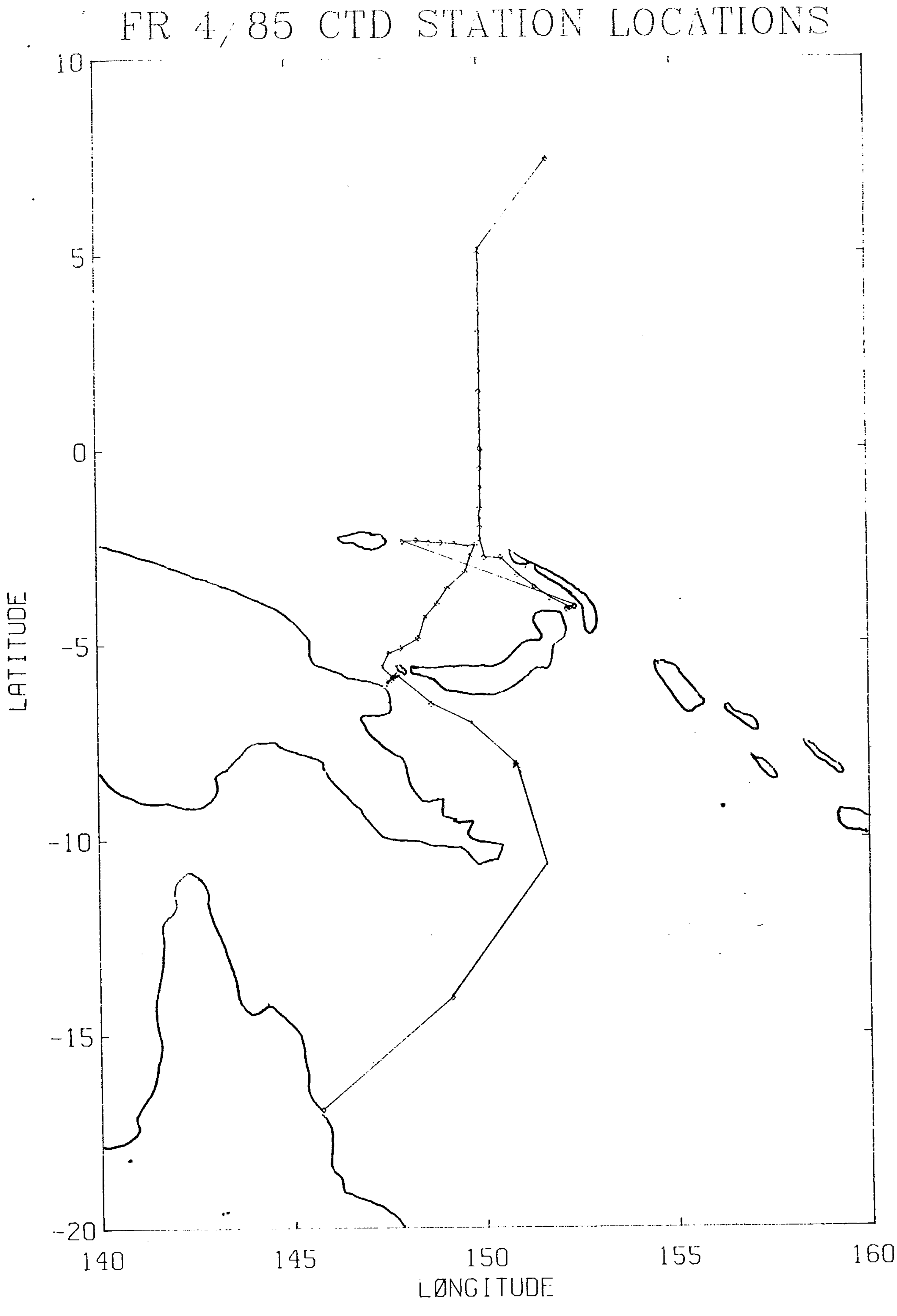

Figure 1a: Northbound leg from Cairns to Truk Islands
19 July - 8 August 1985.

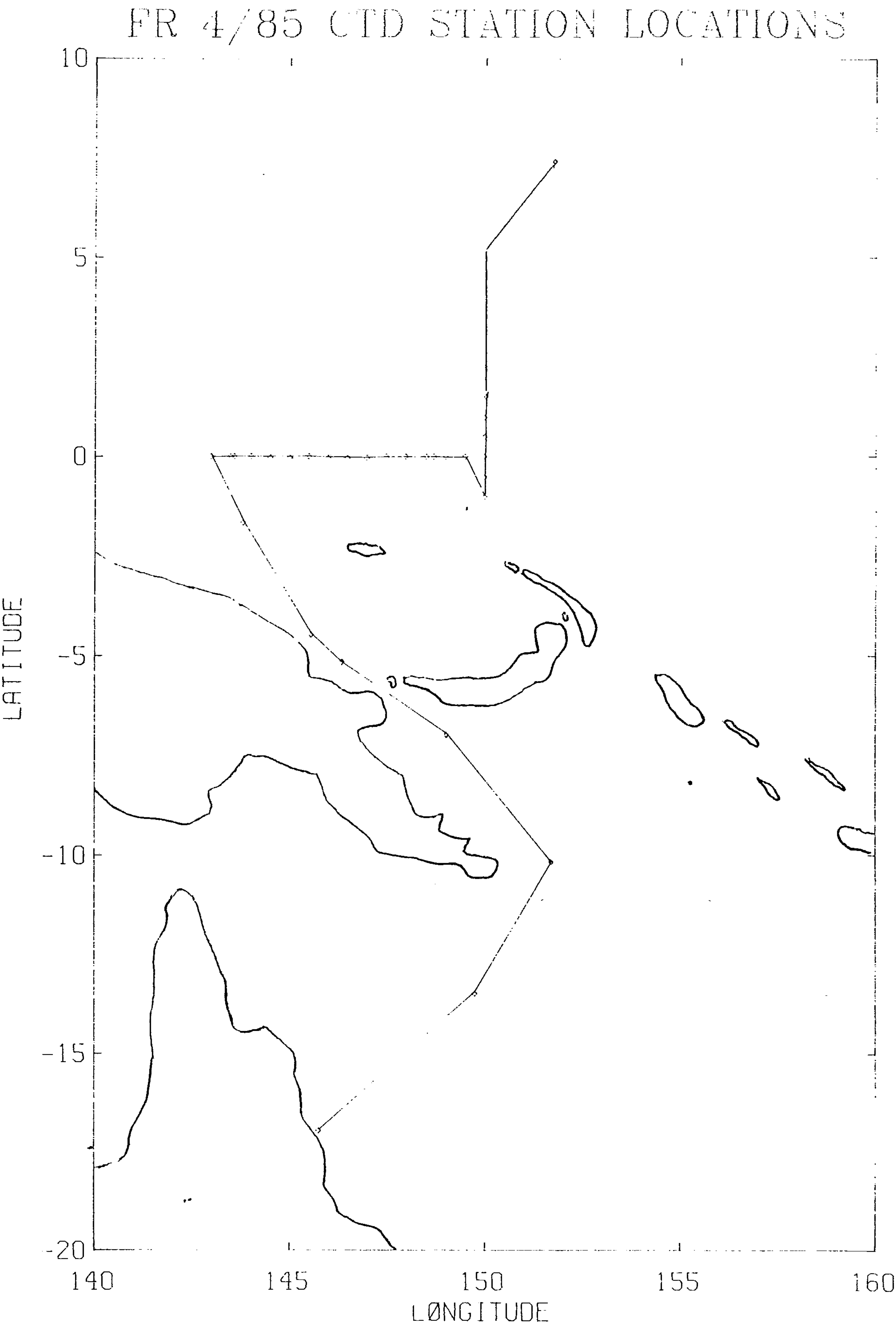

Figure 1b: Southbound leg from Truk Islands to Cairns
11 August - 24 August 1985.

3.0 SUMMARY OF DATA AQUIRED:

1) 95 CTD Stations -6 Stations across Vitiaz Strait (to bottom).
10 Stations across Bismarck Sea (to bottom).
6 Stations New Hanover to Rambutyo Is. (to bottom).
5 Stations across St. Georges Channel (to bottom).
5 Stations St. George to New Hanover (to bottom).
27 Stations along 150°E (alt. to 1100 and 4000 m).
11 Stations for biological/chemical sampling (to 250 m).
15 Stations along the equator (four to 4000 m).
4 Stations for intercalibration with US WEPOCS.
2 Stations numbers aborted and reoccupied.
2 Station numbers allotted for computer testing.
2 Stations to fix winch spooling.

2) 88 XBT profiles logged.

3) Approximately 960 water samples analyzed for dissolved oxygen, phosphate, nitrate, and silicate concentrations.

4) Approximately 300 water samples for analysis of dissolved organic carbon and metal complexing capacity.

5) 24 water samples for analysis of dissolved and particulate organic matter.

6) Productivity measurements were made at six stations using 14 C.

7) 539 hours of meteorological data logged (from 29 July).

8) Approximately 360 hours of thermosalinograph data logged (from 27 July).

9) Approximately 500 hours of acoustic doppler profiler data logged.

10) Approximately 4 weeks of raw navigation data was aquired.

11) 12 current meters deployed on 3 moorings.

12) Pegasus velocity profiles (2 each at 6 sites).

4.0 REPORT ON SCIENTIFIC EQUIPMENT:

4.1 CTD

CTD unit one was used during the entire cruise. There was no trouble with the splice. The pressure sensor appeared to be stable but had a constant -12 db offset on deck. A constant offset of 12.1 db was used in the deck unit scaling during the entire cruise. The rosette for unit one started playing up about two weeks into the cruise and continued to give misfires after being torn down and reassembled. It was decided to switch to the rosette from unit two just before station 57. This unit worked fine for the remainder of the cruise and remains coupled with CTD unit one at cruise end.

Many problems with CTD stations were the result of computer hardware and software problems. For example, the CTD deck unit "locks up" occasionally; is this a software or hardware fault?

The CLEAN task worked, but somewhat erratically, and it generated a variety of errors (see the console log). Files that were open when power failed or the deck unit "locked up" were not handled cleanly as they often lacked end-of-file markers and could not be processed. In addition, there is probably a bug in the processing of the averaged CTD data; the .CAV files consistently have no data at 12 db, which happens to be the pressure offset of CTD unit one.

4.2 XBT

Although the HP-85 system is slow it worked faultlessly logging XBT data during the voyage. The software has a fault such that bathy- messages cannot be produced. Program is secured and the secure code was not known to anyone aboard. There is no manual for the HP-85 on the ship.

4.3 Acoustic Doppler Current Profiler

The ADCP has performed very well during this cruise (since the installation of the new EPROMS sent to Cairns by RDI) and we have succeeded in collecting Doppler data almost continuously during the cruise.

The first week of the cruise was used to improve the Doppler data processing package and to do some testing of the Doppler system. The data acquisition software now allows data acquisition to be suspended at any time for the alteration of operating parameters. A real time display system has also been made possible with the use of one of the new Plotwriter plotters. These new capablilities have made the use of the profiler throughout the cruise much more effective than would have been possible with no real time feedback or convenient means of altering parameters. Tape storage efficiency has also been improved and it is now possible to store about 2 weeks of data on a 2400' tape.

Tests of system performance with and without the rubber acoustic window revealed that the presence of the window did reduce signal levels slightly and decreased the maximum range by about 8 m. The drainage of the thermosalinograph waste into the transducer well was found not to effect system performance. Noise generated by the ships propeller does introduce a significant level of noise compared to background levels. When the ship was stationary with the propeller engaged, but at zero pitch, background signal levels were at 30-35 dB, by reducing the propeller RPM (or declutching) altogether, the noise level was reduced to 4 dB. With reduced noise, the maximum depth was increased by about 45 m. Background noise was not dependent on ship speed.

The transducers were inspected upon our arrival at Truk to check for biological fouling as well as any corrosion problems. There were some goose-neck barnacles growing around the transducers, but none had established themselves on the transducer faces. The zinc anodes were noticeably eroded, but were in good condition at that time.

Based on trials of system performance with a range of transmitted pulse lengths and bin sizes, good ranges were obtained with 16 m pulses and 8 m bins. Longer transmitted pulses did not increase the maximum range more than a few meters and we considered the loss in vertical resolution an unacceptable compromise for the slight gain in maximum range. The system could not be made to operate with bin lengths of greater than 16 m, whenever this was tried, none of the resulting bins were accepted by the ADCP's data rejection criteria. Data in the first and sometimes the second bin (when operating with a 16 m pulse, and 8 m bins) were unreliable and quite often rejected by the processing software. The amount of data lost from the first few bins is definitely correlated with the pulse length used. Limited experimentation with the bottom track system while in Truk lagoon provided no useful bottom track data. When the bottom track option was enabled, the number of bins accepted in the current profile data was greatly reduced (going from 35 bins to 6 bins). It is likely that the new EPROM's have a bug in the bottom tracking algorithm which might account for this behaviour.

Aeration of the water is obviously a very important factor in the performance of the system. Air introduced into the water by the bow and stern thrusters would blank the Doppler profiles completely. We have also hypothesised aeration as a possible contributing factor to the poor maximum depths (200 m in Coral Sea) that we experienced at the start of the cruise; throughout this period, 20 kt winds were blowing and may have been aerating the mixed layer sufficiently to interfere with the Doppler system. Maximum depths were generally about 300 m, 400 m profiles were acquired in St. Georges Channel, and at times on the equator. On the equator the water was exceptionally clear and the biological data collected indicated that there was not much plankton in the water. This suggests very strongly that the source of acoustic backscatter much of the time was provided by temperature microstructure.

Doppler profile sections were collected in Vitiaz Strait, St. Georges Channel, the Bismarck Sea, along 150 degrees east from 1 degree south to 5 degrees north, and along the equator from 150 degrees east to 143 degrees east. For the most part the data collected along these sections is of good quality for the production of relative speed profiles. Radar fixes were made in Vitiaz Strait, some parts of the Bismarck Sea, St. Georges Channel, and at the equator from the meteorological buoy we deployed at 150 degrees east. Good absolute current profiles have been made using the data from these radar fixes. In St. Georges Channel, the mean current at 23:16 GMT 28/7/85 was about 3 kt's in the northward direction. In Vitiaz Strait, the mean current at 5:00 GMT 24/7/85 was about 1.5 kt's in the northward direction. The absolute profiles from the equator clearly show a westward surface current

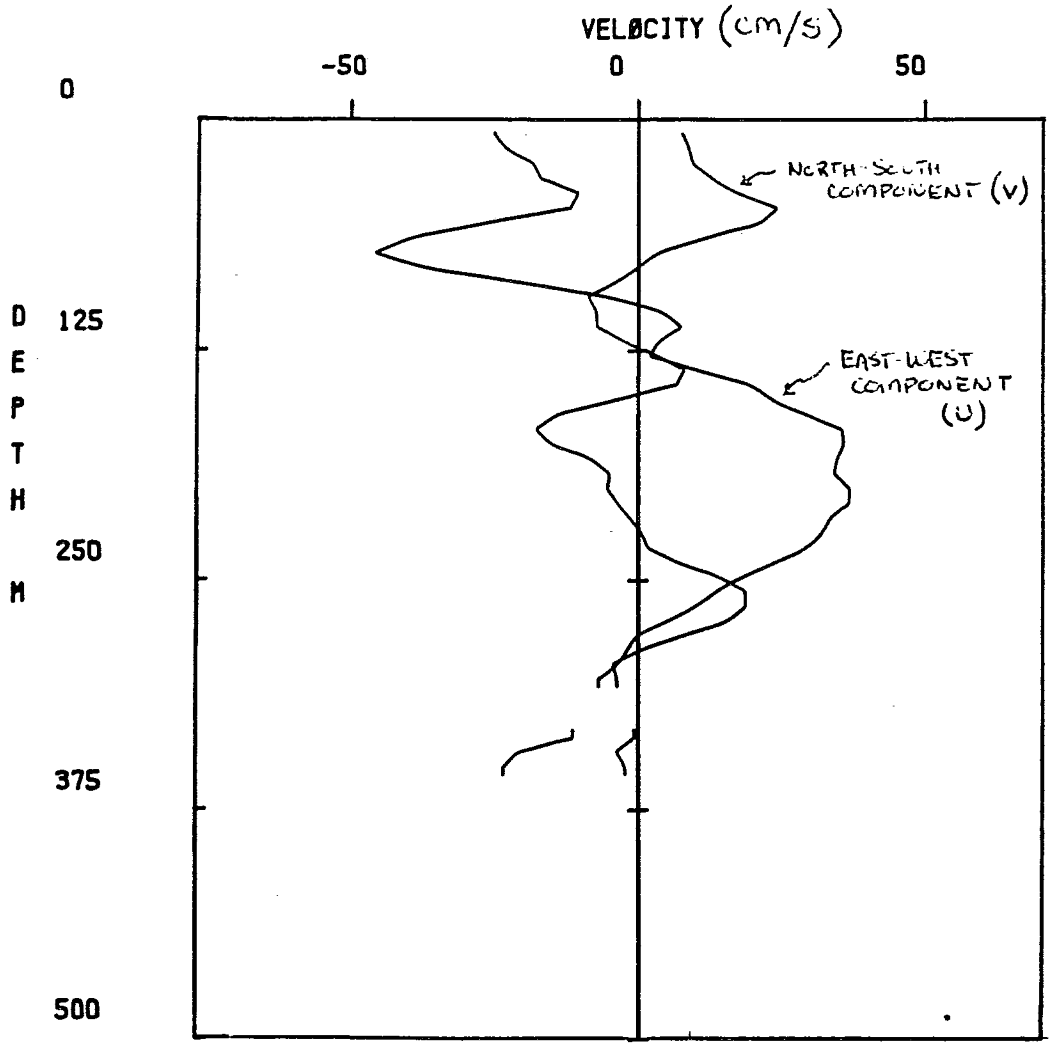

Figure 2: Example of a velocity profile obtained from the Acoustic Doppler Profiler (ADCP) and simultaneous navigation data. This profile was obtained on the equator at 150°E and clearly shows the Equatorial Undercurrent residing between 125 m and 300 m, with a peak speed of about 40 cm/sec.

with an eastward undercurrent. The section made across the equator clearly shows the transition from the equatorial current to the counter current at 2 degrees 30 minutes north. In areas where no radar fixes are available, Sat Nav data can be used to determine the ships true velocity.

4.4 Thermosalinograph

After some software development by Ken suber, computer logging of thermosalinograph day was started on 29/7/85. The digital display worked without fault. The clock is not very accurate (about 5%). The time tags for the data should be obtained from the micro, at least until the clock is fixed. A crystal reference was installed on MICRO 3 about August 12. A file on MICRO 3, DUO:[106,106]TIMES.DAT, gives the correlation between the two clocks (the clock has the Julian day).

The stand-by pump for the thermosalinograph appears to be too small for the job.

4.5 Computers

The Head Disk Assembly (HDA) for the VAX's disk drive was replaced prior to our departure from Cairns. Thereafter it operated faultlessly. The only problem encountered during the cruise was a lack of disk space.

All micro computers have now been put on the UPS system. Adding the crystal reference to the micros' clocks haelped immeasurably.

The major problems with the micros were the chronic, intermittent problems with the tape drives and the 'interference' problems on the bridge micro. These are discussed in more detail in the Computing Section's report.

Some of the user programs on the micros are not sufficiently documented to allow modifications to be made easily. Common and global event flag usage should be especially well documented because they have the potential to cause unrelated tasks to interfere with one another. Also, there is need for a free disk space monitoring routine.

Data entry of hydrology information was hindered by the lack of a terminal in the chemistry or wet labs. VAX terminals had been set up in the GP office but these were most ergonomically inconvenient. The data entry program needs some modification in order to improve efficiency and ergonomic suitability should be taken into account in future terminal installations.

4.6 Satellite Navigation Programs

Initial logging was with the MKII programs, which were to have computed the back-interpolated positions. The programs crashed and could not be re-started, presumably because of errors in DECNET synchronization or with the Master File processing flags.

Ultimately, the MKI programs were resurrected and performed well, except when it was forgotten to activate the Sat Nav 'printer' port after several of the many Sat Nav crashes.

NB: The 'Bridge' frequently put SET and DRIFT to 0 when on station. The programs must be able to accomodate this.

4.7 Sounder

The EK-400 Sounder worked well. It was disabled during Pegasus profiling work because it interfered with 12 khz transponders. During the port call in Truk the controller power supply was blown in an unfortunate accident after plugging an oscilliscope into the rack power points. The power supply was replaced with a unit from the electronics work shop and worked without any problems for the remainder of the voyage.

4.8 Meteorological Instrumentation

The RIMCO met package attempts to measure wind speed and direction, barometric pressure, air temperature and relative humidity. Prior to the cruise, the wind speed sensor was calibrated against a known standard in Hobart and was judged to be operating correctly. At the start of the cruise, neither barometric pressure nor humidity were functioning.

Initially, it was not possible to diagnose the problems of the two faulty sensors because the data display and logging programs were resident on 'Micro 6' on the bridge, which had its own problems. 'Micro 6' worked only sporadically during the first ten days of the cruise, and the met programs suffered corruption a number of times. Due to the pressure of debugging programs to display and record CTD and navigation data, the met data program bugs and 'Micro 6' hardware problems received low priority, but when finally installed on 'Micro 1' in the computer room ('Micro 6' was abandoned altogether), the data logging and display routines worked reasonably well. The display program was modified to show ship's position, speed and heading as well as met data on a VT-220 terminal in the OPs room.

The barometric pressure and humidity sensor problems were investigated and the entire 'Stevenson-screened' unit removed from the mast. Disassembly showed that the humidity sensor could never have worked. It was incorrectly assembled and its humidity-sensing hair component was completely off its mountings. These faults were rectified but there was no such obvious solution to the barometric pressure sensor. The mechanical linkages from the bellows assembly to the potentiometer appeared to be free, so it was merely adjusted as outlined in the RIMCO manual to agree with the pressure indicated by the barometer supplied by the Australian Bureau of Meteorology. The whole assembly was then tested in the lab for a day before remounting on the mast.

Data logging started on 29 July 1985, accumulating 539 hours of met data (at 1 minute intervals) by the end of the cruise. Periodically it is necessary to transfer the hourly data files from the 'Micro 1" disc to the VAX disc, and then copy to tape for archiving.

Calibration of the RIMCO sensors has been attempted by recording their hourly values (from the met display) together with values from comparable sensors on the bridge. The ship's wind speed and direction system and the Met Bureau barometric pressure instrument were used for intercomparison. For humidity comparisons a new AMR temperature and relative humidity sensor was used. A temporary air duct was installed for this, as the instrument must draw its air from outside the bridge. The AMR instrument was in turn spot-checked using an aspirated psychrometer.

Linear regression analysis was performed on the intercomparison data, which showed the following:

Barometric pressure(mb):	Y=126+0.75X	Y=Met Bureau X=RIMCO
Correlation coeff = 0.64	N=99	
Relative humidity(%):	Y=-8.2+0.95X	Y=AMR X=RIMCO
Correlation coeff = 0.55	N=99	

In summary, the RIMCO system appears to have reliable wind speed and direction and air temperature sensors. Barometric pressure is not good, and relative humidity, while adequate now is susceptible to salt accumulation in anything but good weather. For the duration of the intercomparison trials, the weather was unusually fair, so no tests could be made on potential salt encrustation or possible shields. I feel that the AMR humidity sensor should be permanently installed with suitable inlet/outlet air ducts, as it is easier to maintain and appears to be far better constructed than the RIMCO sensor. Of course, the AMR sensor would need to be interfaced to 'Micro 1' for data logging.

The RIMCO barometric pressure sensor should be replaced by a more reliable, preferably solid state (Para-Scientific) sensor, again requiring interfacing.

There is still some work to be done on 'Micro 1' (or on 'Micro 6' if it ever will run on the bridge) to clear up some logging bugs, and to automatically 'clean' the data files to tape.

4.9 Particle Size Analyzer.

The pressure cylinder was broken in transit to Truk, and was temporarily repaired using araldite. Mechanical vibration and apparent electrical noise problems, even though the instruments were plugged into the UPS, were also found. No data were produced from this instrument.

4.10 Scintillation Counter.

New EEPROM boards were brought to Truk and inserted in order to get the instrument electronically functional. Sample counting was very difficult as the code plug indentification seemed to be out of alignment. The alternate counting system, the automatic parameter group counting system did not work.

4.11 Turner Fluorometer.

This instrument appeared to work satisfactorily except that an attenuation plate had to be inserted in the light path in order to obtain a blank using Milli-Q water.

4.12 Variosens.

The Variosens was deployed to 110 m before the dawn CTD stations. It rarely registered any fluoresence and it is suspected that it is not sensitive enough for work in these waters.

4.13 Autoanalyzer.

The instrument worked fine for the entire cruise. A minor problem encountered early on was the constant loss of cadmium columns due to entering air bubbles. The problem was finally tracked down to an incorrectly placed water feed hose to the autosampler.

4.14 Salinometers.

Both salinometers were broken during most of the cruise. Salinities were only analyzed for the first half dozen stations before the temperature compensation probe on the primary salinometer was broken. It was then found that the backup unit was unusable because of broken temperature probes and other ill-defined problems.

An attempt to calibrate the primary unit after spare parts reached us in Truk failed. No stable calibration or result could be obtained in numerous attempts at calibration and analysis. The salinities were later analyzed in Cairns.

4.15 Laboratory Spaces.

There was insufficient table space in the operations room to set up the Pegasus gear and the electronics workshop had to be used as a laboratory space.

The rack setup for CTD work in the operations room is very inconvenient. Workers must suffer neck strain and be constantly jumping up and down during upcasts.

The book shelves over the chart table in the OPs room currently hold computer manuals. The shelves were not designed for this purpose and the manuals are being damaged as a result. The manuals should be stored in the computer room as originally intended. Shelves in the computer room should be amended accordingly.

A tray or hooks need to be installed over the wet lab door for holding the CTD wire overhead. The present situation of looping the cable over the dogs on the wet lab door and over the trolley rail is courting disaster (as we learned early on when the A-frame wa deployed outboard before the wire was freed!).

The landing pad for the CTD in the wet lab should be made non-slip.

Air conditioning in the GP/Drawing office area had trouble keeping the heat down. The problem was partly ameliorated by removing one bank of light from the drawing office.

5.0 REPORT ON SHIPS EQUIPMENT

5.1 Oceanographic Winch

Spooling problems were encountered early in the cruise while trying to complete a deep cast. Approximately 24 hours were lost in trying to correct the miss-lay. The problem originates at the first layer where there is a gap along the aft flange. The gap was filled (packed) lead to facilitate correct winding. The result was significantly better spooling but still faulty. The remaining fault was tolerated as it progressed inward one turn every two layers without getting worse on most occasions.

5.2 Towing Winch.

It had been planned to use the towing winch for towing "Pollywog" used in the Pegasus profiling. The winch could not be made to operate and alternative plans were made to use the mooring winch. The problem with the winch is not exactly known but dirty hydraulics are suspected.

5.3 Satellite Navigator.

The Sat Nav worked well until about 10 days into the cruise when it started "freezing" as many as 20 times a day. This required reinitializing it each time. The problem does not appear to have been solved despite two checks for the boards and connectors, although less frequent failures appear to have resulted.

Another problem cropped up when we were steaming along the equator. The waypoint calculations were seen to be inaccurate (garbage!). Rhumbline navigation was being used at the time. Switching to greatcircle navigation solved the problem, leading one to suspect that there is an error in the software associated with rhumbline navigation along the equator. Rhumbline navigation appeared to work fine for waypoints off the equator.

5.4 Fresh Water Production.

Production of fresh water aboard the FRANKLIN ended approximately one week into the cruise due to a fault in the fresh water maker. Water was obtained at Dublon Island on 11 August. The effective range of the FRANKLIN seems to be about 14 days without fresh water being produced aboard.

Eric J. Lindstrom

Dr Eric J. Lindstrom
Chief Scientist

APPENDIX A

MOORING GROUP REPORT

19 July 1985. Departed Cairns at 1500, 5 hours late after waiting for equipment to arrive. On board Boland, Miller and McLaughlan from the mooring group. Sometime before the cruise we had been promised a long length of dacron for the moorings in Vityaz and St. Georges Straits. This did not arrive and these moorings will be somewhat shorter than planned. The other major omission was the cable to connect the PX-8 to the met station. As a result of this we simply turned the station on on the 17th and waited on a reply from PMEL about the data.

24 July 1985. On station at 2200Z (23 July 1985) for mooring #79 in Vityaz Strait. Aanderaas 7770, 7772 and 7777 started and checked. All rotor counters on 4, sampling interval on 30 minutes and tapes turing. First records were at 0100Z on 23 July 1985. A brief survey showed a fairly gentle bottom slope from 830 to 890 metres on the western side of the strait. Drift was estimated at 3.2 knots and deployment started 5 miles of the intended drop zone.

MOORING #79. From the top: trawl float with 20 m x 12 mm poly rope, 5 x 17" glass floats (in water at 2323Z on 23 July 1985), 19 m x 7 mm wire, RCM5 #7770 (in water at 2329Z), 107 m x 7 mm wire, 3 x 17" glass floats (in water at 2336Z), 19 m x 7 mm wire, RCM5 #7772 (in water at 2342Z), 117 m x 7 mm wire, 3 x 17" glass floats (in water at 2348Z), 19 m x 7 mm wire, RCM5 #7777 (in water 2353Z), 480 m x 7 mm wire, 3 x 17" glass floats (in water at 0019Z on 24 July 1985), 19 m x 7 mm wire, ACR 723 (in water at 0027Z, 10 m x 12mm chain and two wheel anchor (in water at 0034Z). Because of the strong drift we overshot the targeted drop site and the mooring was finally dropped in 882 metres (879 metres on the ship's sounder), giving meter depths of 102, 227 and 367 metres. Position from radar: Sialum Island 11 miles on bearing 241, 5°59.6'S, 147°45.4'E.

Note:
The mooring position is very close to a submarine cable and we will not be able to grapple near the bottom here. On the recovery trip we will have to bring a drop line.

29 July 1985. In St. Georges Channel for mooring #80. From 0600 we were doing ACDP sections across the channel and looking for potential mooring sites on the western side. There are a large number of floating logs in the channel. A site was finally identified and the deployment started at 1050 local time. Meters used were RCM5's 7773, 7154, and 7778. First records were at 2030Z on 28 July 1985, rotor counters on 4, sample intervals at 30 minutes and tapes turning. From the top the mooring was: Trawl float (in water 0052Z on 29 July 1985), 20 m x 12 mm poly rope, 5 x 17' glass floats (in water 0059Z), 19 m x 7 mm wire, RCM5 #7773 (in water 0059Z), 102 m x 7 mm wire, 3 x 17" glass floats (in water 0104Z), 19 m x 7 mm wire, RCM5 #7154 (in water 0113Z), 117 m x 7 mm wire, 3 x 17" glass floats (in water 0121Z), 19 m x 7 mm wire, RCM5 #7778 (in water 0125Z), 480 m x 7 mm wire, 3 x 17" glass floats (in water 0159Z), 19 m x 7 mm wire, ACR723 #105602 (in water 0158Z), 10 m x 12 mm chain and two-wheel anchor (in water 0228Z). Once again we overshot the drop site and we had a thirty minute tow towards the beach to find the right depth. The mooring was dropped in 903 metres (ship's sounder), 1.6 miles from the shore. The bottom looked to have a fairly gentle slope. After the drop we interrogated the release and found it steady on 1.10 kms. Position from

radar: Watara Point (Duke of York Is.) 174 at 1.8 miles, 4°07.6'S, 152°29.5' E. Meter depths: 124, 249 and 389 metres. Release codes: Enable 1567, Diable 1467, Release 0234.

Sometime between the two moorings we had a telex from Mike Reynolds saying that he was receiving data from the met station on the buoy and that the times. After a few hours thinking we managed to make a new connector to communicate with the device. For future reference if we need it again, the met station side is a male DB25 and the PX-8 side is a female with pins 5, 6 and 8 connected to pin 20. After mooring #80 we reset the time and restarted the system. It has apparently no default setting for time and picks something at random - hence the earlier confusion.

Before getting in to the deployment of #81 I had best put in a few words about the mooring calculations. The rope calculations were based on the measured length at 1500 kgms strain which we did at Hobart airport. This length was converted to a T (200 D2) length which was then used in a model to calculate the amount of line needed for the mooring.

We began at about 5 a.m. on the morning of the 2 August 1985 with a bottom survey. The site on 0°N, 150°E was reasonably flat with a depth reading of 5242 metres on the EK400. We surveyed a track 5 miles east and west of the site, five miles south and 5 miles SW and NE. The actual site is flat with a line of small hills running about 2 miles around it on the S, W, and NW sides. On the SE side it is clear and flat. The survey was complicated by the collapse of the Sat Nav and was done by dead reckoning.

The depth at the site was 5242 metres on the EK400 at a sound speed of 1498 m/s. This was converted to a real depth of 5262 metres using a sound speed of 1500 m/s and a correction from Mathew's tables. The model calculations then called for a total mooring length of 5060 metres.

The operation began at 0915 with an abortive attempt to launch the Zodiac - the outboard motor didn't work. First meter in the water was ACM2 #2723-1120 at 0034Z on 2 August 1985. Next was ACM2 #3047-1260 at 0053Z. At this point the buoy was launched. This was done over the starboard side and not very smoothly. Two major mistakes: one, we were moving backwards and two the crane hook was not lowered fast enough to clear the buoy. However no damage was done and the operation proceeded. Next out was ACM2 #3647-1257 at 0140Z, ACM2 #3745-1251 at 0208Z, ACM2 #3122-1196 at 0222Z and the VACM at 0311Z. The line was faired down to the VACM at 350 metres. (Note: something seems to have gone wrong with the VACM mounting since it was first discussed and we now have a piece of chain near the rotor which might require a quick calibration on recovery.) The end of the wire was reached at 0325Z. Next was rope #6, 596 m. (end at 0343Z). Here we switched from the mooring winch to the capstan as a precaution against exceeding the capacity of the winch. This turned out to be unnecessary since the strain on the line was never high after this point. This was rope #4, 608 m. (end at 0436Z). Here we were at the end of reel 3 and we made a drum change to reel 1 and took off rope #3, 607 m and the extra length of 145 m (end at 0510Z). Another drum change put us on reel 2 with #8, 589 m, in at 0532Z, #7, 583 m, in at 0546Z, #2, 605 m, in at 0605Z, and #1, 597 m in at 0633Z. The back-up flotation, 34 x 17" glassfloats followed at 0655Z, then 20 m x 9/16" wire to the releases at 0720Z. At this point we were some distance from the site and the mooring was towed for an hour with the anchors finally being dropped at 0853Z in a depth of 5230 metres (uncorrected from the sounder). The anchor drop was a bit messy with one of the lines breaking prematurely. Following the drop we followed the buoy on radar and it seemed to have settled after about 55 minutes.

The following morning we were able to move near the mooring for an inspection. Because of the chop it was not easy to get an idea of the draft, it looked to be about what was intended. We also took the opportunity to listen to the releases and in the process found that one of the transducers is misbehaving - it transmits properly but is not receiving. The releases are: #401207, Enable 2367, Disable 2346, Release 0134 and #104001, Enable 1256, Disable 1247, Release 0127.

Buoy position 0°01.9'N, 150°01.8'E.

P.S. Just before deployment a telex arrived confirming that the met station was transmitting good data with correct times.

Fred Boland

APPENDIX B

COMPUTING SECTION REPORT

Most programming activity was directed to upgrading the CTD, MET and thermosalinograph program packages and to automating the startup procedures. This has made the programs considerably more friendly for the inexperienced user, but we still have quite a way to go in this regard, judging by some of the comments received.

We now have a preliminary manual covering the over-all computing system. Documentation of the individual program suites ranges from comprehensive, through 'thumbnailed' scraps of paper to almost non-existent.

There is still no software to periodically reset the time on the various computers. This is not such an urgent problem now that the 50 Hz references have been installed.

The new plotters arrived just before our departure from Cairns. One was immediately devoted to real time plotting of ACDP data.

A major activity during the cruise was rectifying, or attempting to rectify, sundry computer hardware malfunctions.

The VAX disk failed to work when it was started up prior to our departure from Cairns. The head disk assembly (HDA) had to be replaced and the disk software restored. Due to a combination of the DEC engineer not arriving until the Wednesday and various minor hassles, this was not completed until 15 minutes prior to the ship's departure. No further problems were experienced with the VAX.

The 'bridge' micro was abandoned, as its main disk was becoming corrupted faster than I could rebuild it. We are not much closer to locating the source of the interference, although the corruption does not appear to correlate with either the radar or the Codan radio. It would certainly be worth trying to resurrect it now that the electronics group has reduced the noise on the Gyro compass.

The cabling from the Met Station and the Sat Nav were re-routed to Micro 1 in the Computer Room. There are now no spare RS232 lines to the Bridge, and terminal space in the Computer room is very cramped.

The continued unreliability of the Micro II tape drives is causing some concern. No faults were found with the CTD tape drive when it was tested by the DEC engineer in Cairns, but it started to give trouble a few days into the cruise. The tape for the general data logging micro also has similar, if not identical, faults. They appear to fall into two classes.

1. The drive becomes set to a state incompatible with the Micro-II computer hardware (corruption of the tape drives memory?). The only way to clear this fault is to reboot the computer and re-start the logging programs.

2. A tape positioning error, which results in 'Fatal Hardware Error' messages. On the CTD tape drive, we seemed to be able to eliminate this fault (temporarily) by jiggling the connectors on the cables to

the tape drive or by re-seating the tape interface card. This suggests a possible mechanical cause for the fault.

Finally, some general comments about improving the overall reliability of the micros:

The micros are not designed for repeated re-configuring of the hardware. Most of the circuit boards have to be removed to make even such simple changes to the system as change the baud rate of a terminal interface. Every time this is done, there is a chance that a board or a cable will be damaged. Repeated insertion and removal also degrades the circuit board and connector contacts. To minimize potential problems, we should do the following:

1. Procure or manufacture several 'full height' bus grant cards for each CPU. This will enable interface cards to be installed or removed without touching the remaining boards.

2. All terminal interface cards should have software-settable baud rates.

3. A faulty unit, eg. tape drive, should not be tested by installing parts from a working unit. If we don't have spares, don't touch it.

Bob Beattie and Ken Suber

APPENDIX C

ELECTRONICS SECTION REPORT

C.1 CTD/ROSETTE SYSTEM.

Several minor problems were encountered with the CTD system. Rosette No. 1 was regularly misfiring on deep stations and occasionally on shallow stations. Problem is believed to be in motor assembly in u/w unit. This rosette was changed with unit 2 and no further problems were encountered. The u/w connector from the sea cable had problems with bad contacts and was replaced. The altimeter cable also had similar problems which were solved by thorough cleaning and retermination altimeter cable. The pressure drift problem did not reoccur although a rather large offset (12.1 m) exists when unit is on deck. Pressure readings on deck varied only slightly and there was no reoccurrence of the rapid changes in pressure readings as occurred on FR 3/85. Both CTD u/w units will have pressure calibration this port period. The salinity output gave a strange step at about 1100 m on a couple of occasions but the problem did not reoccur. Altimeter alarm and remote display problems are believed to be software related. Neil Brown is supplying new software for the 1150 data terminal.

C.2 SIMRAD EK400.

The EK400 suffered damage to one cct. board and a power supply when a problem was encountered with the UPS. The unit was temporarily repaired and spares to complete repair have been ordered. Problem of incorrect "error low transmitter level" errors was solved in Cairns. Performance of EK400 has been very good, the removing of barnacles from the transducers in Truk having a noticeable effect.

C.3 THERMOSALINOGRAPH.

Due to almost perfect weather conditions throughout the cruise very few drop-outs of the pump occurred. Clock function was checked and a 5% error was noted. This also appears to be a software problem. Surface temperature and salinities have been noted from CTD casts to enable calibration of instrument.

C.4 MET. STATION.

Humidity and pressure sensors were disassembled and repaired. Humidity readings now correlate with Gary Meyers' instrument, however pressure is still faulty. See Andrew Forbes' report for more detail.

C.5 INTERCOM/COMMUNICATIONS.

Hand held radios have proved to be a very satisfactory arrangement. A bigger amplifier will be installed in ops. room and microphone relocated.

C.6 CABLE READOUT.

Winch and ops. room cable readouts are now reading the same.

C.7 INMARSAT.

Some problems were encountered but this was believed to be due to congestion of the Inmarsat system. Noise suppressors were installed on the compass repeaters thus enabling the Inmarsat antenna to track the gyro compass successfully.

C.8 VARIOSENS.

Temporary set-up for Variosens was effected and worked reasonably well however due to shortage of plankton overall performance was difficult to determine.

C.9 SATELLITE NAVIGATOR.

The satellite navigator gave continual problems throughout cruise. On some occasions it dropped out several times a day. Removal of boards and connectors and reassembly seems to solve problem temporarily. A software problem was also encountered when doing rhumb line calculations when running along the equator. The waypoint alarm has never worked.

C.10 UPS.

50 hz references were inserted in all Micro-II's and they are now all on UPS. Several power failures occurred during voyage but since Micro-II's are now on UPS stations could be restarted with minimal delay.

C.11 XBT SYSTEM.

XBT system gave no problems.

C.12 PEGASUS.

This was first cruise where a large amount of electronic gear was temporarily mounted on board. The ops. room had obvious shortcomings in this area with no bench space and a lot of cable required to follow the roundabout path from deck. The gp lab has more bench space and is suitable for stand alone instruments but requires even more cabling and is too isolated from the deck. The electronics workshop was the only practical alternative with ease of cabling, bench space (as long as nothing bulky has to be repaired) and access to deck. Regretably (for electronics) the workshop may have to become the sight for more temporary installations. See Appendix 5 for details of pegasus operation.

C.13 COMPUTER HARDWARE.

Due to the large workload of computing section and in the interests of improved service on the FRANKLIN, electronics section would be interested in some involvement in the computer system. Although we have experience within our section in computer maintenance a reasonable level of hardware documentation would be necessary and some formal training in DEC equipment.

C.14 PARTICLE SIZE ANALYSER.

The particle size analyserproved susceptable to mechanical vibrations. Some electrical interference was also noted, and the unit could not be made fully operational.

C.15 LIQUID SCINTILLATION COUNTER.

This unit could not be made operational, due to alignment problems with the rack identification system.

David Edwards
Alan Poole

Electronics Section

APPENDIX D

PRIMARY PRODUCTION IN RELATION TO PARTICLE SIZE.

As the particle size analyzer was U/S, no comparisons could be made whilst we were at sea. Samples were taken for microscopic analysis back in Hobart, so some comparisons may be made. Productivity measurements were done at 30% of surface light and at ambient sea surface temperatures. Samples were measured at 0, 6, and 12 hour intervals to estimate primary production, and after 24 hours to estimate repiratory losses of 14 C. There was no obvious difference in productivity between samples incubated at amient nutrient levels and those that had 1)g at I-1 NO3 added. Primary production was very low, reflecting both the very low chlorophyll levels, and the very low nutrient levels seen. Most sampling was done just at the top of the thermocline, which was usually just at the base of the halocline.

Brian Griffiths

APPENDIX E

PEGASUS VELOCITY PROFILING

The planned Pegasus work for this cruise included deploying transponder arrays at five sites spaced 30 miles apart from 1°S to 1°N on 150°E, surveying these arrays, and making two current profile measurements at each of them. The plan was executed with partial success. Transponder arrays were deployed as intended and an additional one was placed at 1.5°N using spare instruments. All arrays were surveyed satisfactorily, although with some unexpected difficulty. The most serious problems were associated with the profiles themselves. The net result was that the profiles on the northbound leg were moderately impaired by hydrodynamic problems, and the first two extended to only about 3000 m because of instrument failure, while on the southbound leg all profiles have little or no data in the upper 1500 m, for reasons that are still unknown.

The Pegasus current profiling system uses long-baseline acoustic tracking of a freely falling recoverable dropsonde (the Pegasus) to measure absolute ocean currents throughout the water column. Pegasus transmits a 10 ms 10 KHz pulse every 16 sec. and internally records the arrival times of replies from three moored transponders, one each replying at 11.5, 12.0, and 12.5 kHz. The transponder array is ideally an equalateral triangle with dimensions similar to the water depth. In addition to the Pegasus and transponders, the system includes an on-deck acoustic transceiver and towed transducers for interrogating the array from the ship. The primary towed transducer used on this cruise was an Ametek-Straza SP23LT (which has a conical downward-looking beam pattern) housed in a standard pollywog type fish towed with an armored conducting cable.

A primary concern was the degree to which ship's noise would interfere with Pegasus operations. We found that the ship is very noisy at 1 kHz. Noise in the 10 kHz band is less but still a threat to Pegasus work. Noise is correlated primarily with propeller RPMs, and at normal RPMs it was impossible to hear anything from the ship even at zero forward speed. When the shaft was declutched the noise declined to an acceptable level. Chief Engineer Ian Mann took manual control of RPM and pitch, finding that we could go 6 knots with the engine idling (in the ideal weather encountered during Pegasus work), and that reduced the noise very effectively. Since 6 knots was the maximum speed at which the wire angle to the pollywog remined reasonable (around 45 degrees), the situation was quite satisfactory. It might have been less so with stronger winds.

A brief test of a Benthos AQ-21 towed hydrophone array, which stays just below the surface about 50 m behind the ship, suggests that it is superior to the pollywog for listening. The best gear for this type of work on the FRANKLIN might be a small armored cable towing a faired pinger together with a hydrophone wimilar to that in the AQ-21. There seems to be less noise near the surface well behind the ship than 15 m below where the pollywog was towed.

The mooring winch worked very well with the pollywog tow cable, as did the stern A-frame. It was probably better than if we had used the towing winch as originally planned.

The Taiyo VHF ADF provided by Andrew Forbes worked flawlessly and is highly recommended. The antenna location on a short mast fixed to the highest catwalk, above the radar antennas, is ideal and should be used consistently in the future.

The bench space generously provided in the electronics lab was ideal for my purposes, as it would be for any operation requiring a home for electronics with easy access to the deck, both for cables and for personnel.

Pegasus was launched and recovered from the hydrographic platform using a block and tackle to the A-frame. This worked quite adequately, aided by FRANKLIN's lack of roll and by the good weather, but the distance from the water was more than I would have preferred. A long telescoping aluminum pole with a detachable hook on the end was used for pickup. The hook was too heavy, making the rig wobbly and unwieldy. I will try to improve this for next time.

Due to the size of the FRANKLIN, Pegasus pickup times were much slower than I was accustomed to from my previous work with a much smaller and more nimble boat.

Eric Firing