BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Record 1980/72

INTERIM ENGINEERING SERVICES

SUMMARY OF ACTIVITIES 1980

077808

Record 1980/72

INTERIM ENGINEERING SERVICES

SUMMARY OF ACTIVITIES 1980

IES BRANCH

SUMMARY OF ACTIVITIES 1980

ILLUSTRATIONS

2

1. SUMMARY

A PSB review of the Electronics Professional Sub-section, and some further investigations of positions in the Electronic Technical Sub-section took place in 1980. However the formal structure of Engineering Services remains unfinalised.

In 1980 most tasks were extensions of work initiated in 1979, or earlier, and no major new engineering tasks were undertaken. Survey preparation and field support for survey parties absorbed a major proportion of Electronic Technical Sub-section's capacity. Much of the work undertaken in Mechanical Sub-section was unpredictable and unprogrammed.

In the Twin Otter aircraft the increased spectrometer crystal volume and the C12 compass installation gave greatly improved data. Preparation for recommissioning the Aero-Commander and upgrading of its systems are under way. Considerable support was given to Metals Geophysics in the evaluation and calibration of SIROTEM and in the equipping of a carborne magnetometer and data acquisition system.

Wire line logs were run on 42 bores in 1980 in support of hydrological, oil shale, source rock and other studies. Proposals to digitise BMR's deep logger are well advanced.

A new position of STO-1 (observatory specialist) was filled in mid-1980 and is having the expected impact on advancement of observatory systems. A five component magnetograph completed in time for the MAGSAT survey gave satisfactory results and initial tests of a photo electronic variograph were good. The completion of 36 low power crystal clocks for automatic crustal seismographs is held up by late delivery of liquid crystal displays.

Preparation for marine geophysical surveys and installation of data acquisition systems and magnetometers were major activities. A BMR modified Trisponder navigation system gave better navigation data on the RV Sonne cruise and a Tracor satellite navigation system was interfaced to BMR's data acquisition system on the Nella Dan. Installation of the Raytheon sub-bottom echo sounder on the Cape Pillar, Kalinda and Nella Dan were major tasks. The first digital magnetic shore station was established at Charters Towers. Additional BMR designed multiplexers and digital to analogue convertors are being built for marine systems, National Mapping and on airborne systems.

Two BMR designed underwater digital acquisition systems for recording tidal and wave current flow in Great Barrier Reef studies functioned well. The only problems were with the flow sensors which became unreliable towards the end of the survey. The BMR designed hydraulic powered rotary coring drill operated satisfactorily on a new towing and operating platform built under contract. This is a submersible catamaran type structure which is flooded to sink the platform for operation on the sea bed.

Numerous ad hoc tasks were completed for most sections in BMR.

2. GENERAL ADMINISTRATION

The organisational structure of the Branch is still not finalised. A review of the Electronic Professional Sub-section took place in 1980 and resulted in no changes other than to formalise the existing positions and their revised duty statements. The review of the Electronic Technical Sub-section is still incomplete, and has become dependent on the completion of a review of the marine and seismic geophysical areas in which both engineering and science designated technical officers work. However within BMR the engineering positions are recognised as IES Branch positions, and good formalised working arrangements have been developed between IES Branch and the geoscience areas it serves, including those areas in which staff have been placed on long-term secondment.

3. SUBSECTION ADMINISTRATIVE REPORTS

3.1 Mechanical Sub-section

Mr G. Thom acted as STO2, Group and Program Manager during the year. Maximum use had to be made of contract work to meet the most urgent task deadlines and this was further aggravated by the retirement of A. Kores (TO-1) on medical grounds in May. An increasing proportion of the work of this group has been unpredictable arising from their primarily supportive role to other areas and this makes for planning difficulties. The diversity of tasks also places unusual demands on the versatility of the limited design capacity of the group.

The following staff were outposted for the full year.

D. Foulstone - TA2 Marine Geology.
J. McIntyre - Maintenance Mechanic, Seismic Group, Geophysical Branch.

A position of TO-1 (engineering) outposted to Marine Geology is to be redesignated science as a result of a departmental review of the TO science grades in this area and will be transferred from the Mechanical Technical pool.

3.2 Electronic Technical Sub-section

Although the STO-2 Group Manager position for this Sub-section has been advertised three times in 1980 it remains unfilled, and A. Zeitlhofer continued to carry out both Group and Program Manager functions during the year. The review of the Sub-section is still incomplete and is now dependent on a review of the TO science grades in seismic and marine geophysics. This is about to take place. A new STO-1, observatory specialist position has been created and filled and a redesignated position of STO-1 in the Procurement Group has been filled. A submission concerning the classification of the TO, well logging specialist, has yet to be investigated.

The last of the Trainee Technical Officers graduated in January 1980, and a proposal to revive this scheme was submitted. Three staff were lost by resignation or promotion during the year and to date no new staff have been recruited.

A. Zeitlhofer continued to act on the TAFE College advisory committee concerned with the Electronics and Communications Certificate Course.

The following staff were outposted to other sections:

J. Grace A/g. STO2 Full year	Seismic/Marine Geophysics
R. Dulski A/g. STO1 Half year	
P. Fowler TA2 Full year	
D. Gardner TO2 Part-time	
C. Rochford TO2 A/g. Full time	Regional Geophysics

G. Wood T02) Full time) B. Page T01) Mundaring) W. Greenwood ST01 Part of year)	Observatory Section
G. Green ST01 Full time) J. Eurell T02 Full time) J. Mangion T01 Part of year)	Airborne Geophysics
R. Curtis T02 Full time	Metalliferous Section
G. Jennings T02 Full time	Well Logging
J. Whatman T01 Full time	Magnetotelluric Group

3.3 Electronic Professional Sub-section

Program Management (K. Seers). All crisis tasks deadlines were met despite staffing and budget constraints. However, halfway through the year a thorough program review became necessary owing to the reduction in available technical grades staff to support the work of the group. In consultation with the customer groups some tasks had to be cancelled, others deferred.

Group Management (A. Spence, K. Seers). A. Spence took on this role at the start of the year but following the formal transfer of his position to Geophysical Branch, K. Seers continued on a temporary basis. A vacant Science 3 position was filled by internal promotion (M. Gamlen) towards the end of the year, so for most of 1980 the group had two officers less than for 1979. Other than attendance at courses and conferences, no staff development was attempted.

3.4 Procurement Group (P. Mann, R. Dulski, W. Gunner). Mr A. Waterlander retired in October 1979 being replaced ultimately by Mr R. Dulski in July 1980. Until Mr Dulski joined the group it was difficult to meet the procurement program and assistance was sought from the other groups.

The group handled technical investigations, wrote tender specifications and made purchase recommendations on a wide range of equipment and components approved in the plant and equipment buying program for the Geophysical and Interim Engineering Services Branch.

The main workload for the IES Branch was purchasing, electronic, electrical and mechanical components required to construct specialised equipment unavailable commercially for programmed surveys. The group handled the allocation of radiocommunication facilities for survey parties and loan of equipment to institutions and other government departments.

For the Observatory and Regional Section, specifications were issued for sonic velocity measuring equipment for rock samples, two chart recorders for observatory/regional magnetic measurements, and digital clocks for observatories. By far the greatest expenditure was on components to construct twenty-four BMR designed NCE-3 clocks to be used in automatic crustal seismic survey stations.

For the Airborne and Metalliferous Section a three-component fluxgate magnetometer was purchased and tenders called for a versatile spectrum analyser. Tenders were called for an additional large volume crystal detector for radiometric surveys and a high density magnetic tape cartridge for the computer based data acquisition system on VH BMG. Funds (79/80) were committed for the purchase of a SQUID magnetometer and a gamma density logging tool after tenders had been assessed.

In the first few months of the 1980/81 financial year recommendations were made to purchase a six channel chart recorder, a storage oscilloscope, an analogue to digital multiverter, a nine track magnetic tape recorder and visual display terminals for the Seismic Gravity and Marine Section. Submissions to restrict the tendering to one company in each instance for the supply of additional crystal detectors for gamma ray spectrometry and a Doppler navigation system were prepared. These items are required to recommission the Aero-Commander VH-BMR for which funds have been provided.

4. TECHNICAL REPORTS - EQUIPMENT DEVELOPMENT AND SURVEY PREPARATION

Most of the Branch's activities are for customer groups outside the Branch. The technical reports are therefore presented under headings which indicate the group for which the work was done.

4.1 Airborne Geophysics

The introduction of new equipment in the Twin Otter VH-BMG, the decision to recommission the Aero-Commander and the commencement of the re-equipping of this aircraft were major technical activities of the year.

4.1.1 Airborne Surveys (G. Green, J. Eurell, J. Mangion). Two surveys were completed in Western Australia with a minimum of technical problems. The beginning of the year saw the finish of the Bunbury survey then between May and September VH-BMG surveyed the East Canning Basin from Halls Creek. On-going at present is the Murray Basin survey from a base at Broken Hill.

4.1.2 Completed Projects

4.1.2.1 C12 Compass System. The C12 compass system comprising directional and vertical gyros, remote compensator, power supply-amplifier and flux valve arrived in December 1979. TAA installed the flux valve in the port wing and the labs group mounted and interfaced the rest of the equipment. It is now a fully integrated part of VH-BMG's navigation system. This compass was in use during the East Canning Basin survey between May and September, and proved to be an accurate and reliable instrument.

4.1.2.2 Spectrometer. The INOTEC A-D converter was interfaced to the Geomtrics spectrometer unit, this required some hardware work but mostly it was a software job carried out by D. Downie (ADP Group). We now have an excellent spectrometer system that is both very easy to set up and has displayed a high degree of stability. The system currently provides a periodic printout, while on line, of gain, zero point, and system resolution. This is achieved by monitoring the natural thorium peaks, so it is no longer necessary to carry any radioactive sources in the aircraft.

4.1.2.3 16 Channel Multiplexer. The BMR designed and built MPX replaced the H.P. unit previously used. This new unit has proved to be neat and reliable and, since the introduction of low power I.C.'s, a low power consumption device.

4.1.3 Projects in Progress (G. Green, J. Eurell, J. Mangion).

4.1.3.1 Barometer and Thermometer. The digital barometer and thermometer have arrived and will be mounted and interfaced into the DAS for use in VH-BMR in 1981. It is hoped that by monitoring these additional parameters, the interpretation of the radiometric data can be improved by correcting for atmospheric conditions. The techniques will be evaluated in VH-BMR and a system installed in VH-BMG if results indicate it is worthwhile.

4.1.3.2 MFS7 Fluxgate Magnetometer Ser. No. 4. Circuit boards and most of the components have now arrived for the construction of the fourth MFS7. This construction will take place when staff and time are available.

4.1.3.3 Upgrading MFS7 magnetometers. Most of the PC boards have been completed. Rewiring of drive boards for S/N. 1 & 2 is still required. Testing and debugging of all systems remains to be done.

4.1.3.4 Aircraft Ground Power Unit. A new 28V DC motor driven power source is being made up, the details of design have been finalised and the construction of the mounting frame is in the hands of our workshop.

4.1.3.5 Re-equipping of Aero-Commander. All of the old VH-BMR equipment has been retrieved from the various groups where it has been in use during the aircraft's stand down. This equipment is now being made ready for installation following the aircraft's arrival at the end of October.

4.1.4 New Developments

The return of VH-BMR has initiated a new wave of enthusiasm. Although the aircraft is initially being equipped as it was prior to stand down, many changes are proposed and some new equipment has already been ordered. Some of these new plans include:-

10

- Two 1000 Cu in crystal slabs for the gamma ray spectrometer
- C12 compass system
- DECCA doppler navigation system
- New 3-M cartridge recorders (for both aircraft)
- Digital recording of magnetic ground stations (for both aircraft).

4.2 Metalliferous Geophysics

4.2.1 Development of a down-hole omni-directional EM probe (R. Cobcroft, R. Curtis, J. Major). A 2.4 metre diameter Helmholtz coil had been built for calibrating the probe. A cradle for mounting the probe in the Helmholtz coil was built as a z-axis goniometer. During an attempted calibration in January an intermittent fault occurred which would have been very difficult to demonstrate clearly without the Helmholtz coil and the goniometer mount. The fault was probably present during the previous survey at Cobar and would have contributed to uncertainty in the results obtained.

The fault necessitated a complete disassembly of the probe and the replacement of several coils which had been affected by 'silastic' infiltration. An improved subassembly for holding the coils was manufactured and when the probe was reassembled a satisfactory calibration was obtained.

A repeat survey was made at Elura with the probe in the shaft. Only one week in late April was available for this work and this was to be the last occasion on which the Elura deposit could be used for such a test survey as mining operations were to commence in early May.

Before the survey however, two improvements to the probe technique were made. Firstly, the PAR phaselock analyser, ordered in 1979, gave a significant improvement in data quality when substituted for the HP Phase/Gain meter. Secondly, the data quality was improved by substituting an oscillator and power amplifier for the Turam motor-driven alternator used to excite the transmit loop. This eliminated short term frequency instabilities caused by 'hunting' of the governor in the Turam set.

In order to assess the size of the "zone-of-investigation" of the probe in a practical field situation, a survey was made to Single Tree Hill, Peelwood, NSW, where a diamond-drill hole penetrating a mineralised zone was available. Unfortunately with the length of cable available the probe could only just enter the mineralisation.

Results of logging the hole at several frequencies were encouraging, but completely satisfactory results were not obtained owing to a common-mode interfering signal. This is expected to be solved by a number of circuit changes to ensure a balanced system throughout.

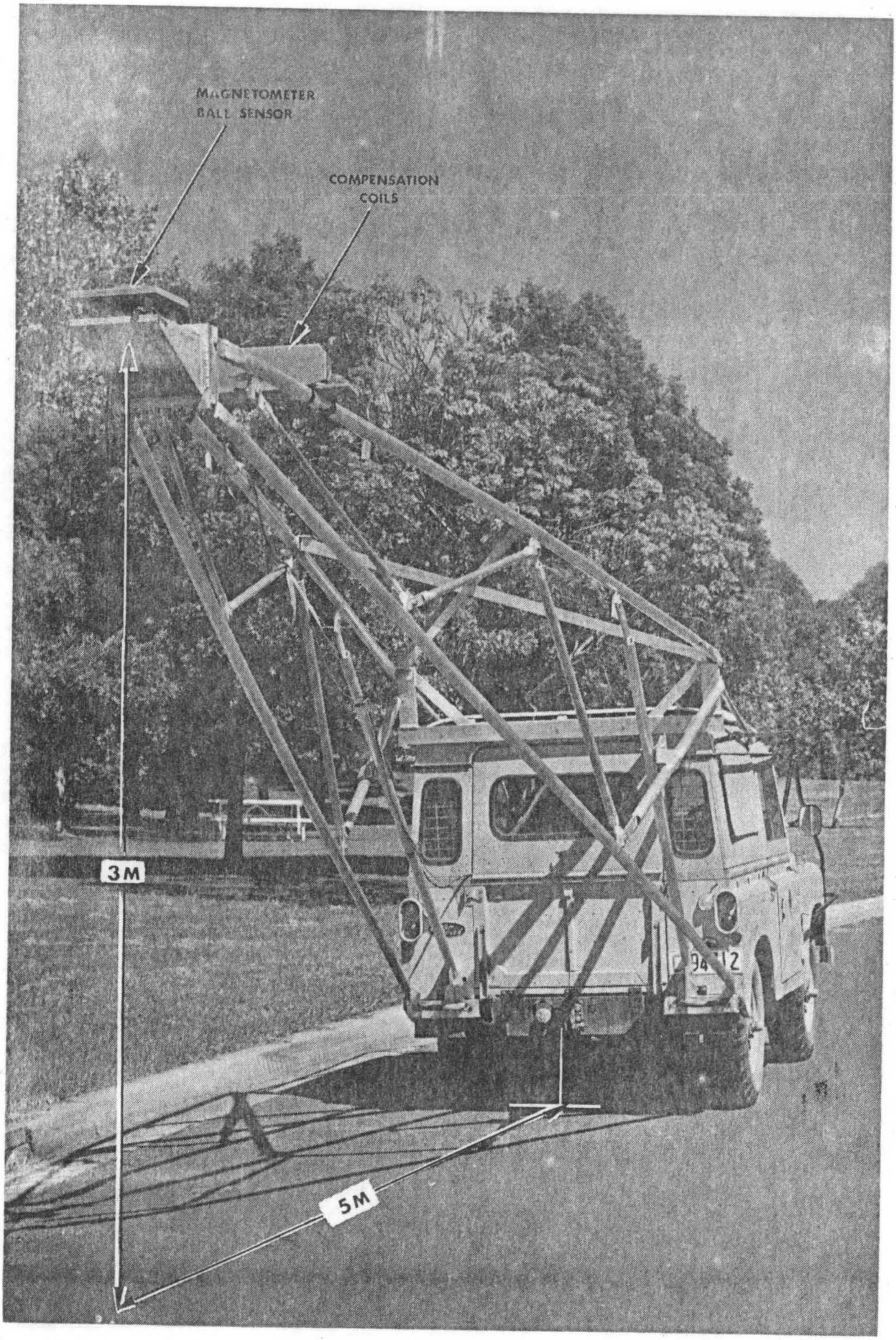
More work was done on a mathematical theory of interpretation and a number of interactive computer programs were written for data reduction.

4.2.2 <u>Vehicle-borne magnetometer system</u> (R. Curtis, E. McIntosh, D. Pownall, W. Harkness, R. Cobcroft). Following the successful use last year of a G803 proton magnetometer in a Landrover for a vehicle-borne-magnetometer survey, further work was done to improve the system. A proposal by the Metalliferous Geophysics Sub-section to traverse hundreds of line-kilometres in the Eromanga Basin meant that the detector had to be attached to the vehicle rather than man-packed behind it. A non-magnetic vehicle-mounted boom was therefore designed (Fig. 4.2.2).

Investigations of the anomalous field around a Landrover showed that at a distance of 5 metres behind the vehicle the field gradient is tolerably small and compensation between 10 and 30 nanoteslas would be required. The boom was made to carry the head 5 metres behind the vehicle and 3 metres above ground. A set of compensation coils from a CAE 9-term compensator was mounted on the boom and an adjustable constant-current supply was built and used to power the coils. These coils are being used to compensate for the permanent component of the field and pieces of magnetically soft ferrite near the head are being used to compensate for the induced component of the field.

A number of faults were repaired in the DATAMATIC data serializer/formatter and also in the G803 magnetometer.

12



Vehicle-borne Magnetometer Boom.

Fig.4.2.2.

13

4.2.3 Development of a Carborne Data Acquisition System (R. Cobcroft, R. Curtis). As originally planned the D.A.S. was to be based on a pair of 6800 microprocessors. It involved the in-house development of software for the operating system with the only major item to be bought being a Texas Instruments 'Silent 700' terminal.

However, because of the decreasing number of technical grades support staff available in 1979 and the primitive microprocessor development facilities available at the time, an acquisition system based on a Hewlett-Packard 9825 desktop calculator was investigated and recommended. Funds could not be obtained for the calculator and the project will be delayed until an enhanced microprocessor facility expected in 1981 is available.

4.2.4 Measurement of complex resistivity (B. Devenish, M. Gamlen). A lock-in analyser was purchased to make the amplitude and phase measurements necessary to characterize the transfer function of the ground (or rock sample). Doubts about the behaviour of the instrument with complex waveforms and its ability to resolve phase to better than 0.03 degrees led to it being sent to the National Measurement Laboratories for calibration and assessment. The results showed the phase resolution to be adequate but a low frequency limit of 0.5 Hz could be a problem in situations when inductive coupling between transmitter and receiver, caused by high surface conductivity is strong.

Some measurements were performed on a rock sample to check waveform distortion.

Preliminary plans for a digital phase measuring system were formulated but this work may not continue into 1981 because of changing priorities in the Metalliferous Geophysics programme.

4.2.5 SIROTEM evaluation and calibration (W. Burhop, S. Scherl, M. Gamlen). S. Scherl and M. Gamlen designed and built a digital signal averager for the MPPO-1 transient electromagnetic (TEM) apparatus. W. Burhop calibrated a SIROTEM (CSIRO's TEM apparatus) and an MPPO-1 in the laboratory. He and M. Gamlen went with B. Spies from the Metalliferous Geophysics Group on two short field trips. They used the augmented MPPO-1 to distinguish between normal conductivity response in SIROTEM, and spurious cable and magnetic mineral effects.

4.2.6 Borehole fluxgate magnetometer feasibility study (M. Gamlen, S. Scherl). A literature study has directed effort towards the construction of a single element prototype magnetometer using a temperature compensated magnetic material for the sensor. It is proposed to use a toroidal and a linear sensor to measure the radial component and the axial vector respectively. As cable twist precludes orientation knowledge, a toroidal sensor, to give resultant radial field, can replace two linear sensors without loss of information. To simplify measurement and digitisation, time shift of the zero crossings of the fluxgate output signal will be measured instead of the more usual second harmonic content of that signal.

4.2.7 Survey preparation and support (R. Curtis). Equipment maintenance continued throughout the year in support of a number of short surveys such as downhole omnidirectional probe exercise and vehicle-borne magnetometer trials. Modifications were made to the G803 magnetometer to make it compatible with the Datamatic and Kennedy digital system. Improvements were made to the vehicle distance measuring system providing a digital readout for the driver. Vehicle installation was improved for the existing Landrover and specifications were provided on the replacement vehicle due for delivery next year.

4.3 Engineering Geophysics (L. Miller). Due to the reduction in workload in this area no permanent outposting of staff occurred during the year. Activities were mostly confined to stocktake of stores and preparation of equipment for loan to ANU, PNG and Victorian Geological Surveys.

4.3.1 Eh/pH Logging System (G. Thom, D. Pownall, L. Miller). Due to the restricted probe diameter of 60 mm it is almost impossible to satisfactorily fit the Leeds & Northrup pre-amplifier into the probe. Modifications to the physical size of the amplifier appear to have introduced drift problems, and it may be necessary to design a special amplifier to overcome the difficulty. This has not been given priority and it was not possible to bring this project to a successful conclusion.

4.4 Well Logging (G. Jennings)

4.4.1 Equipment & survey preparation. Maintenance of equipment and improvements to vehicle installation required a lot of time as did investigations into conversion of the system to digital recording. Other new equipment investigated included a wall lock geophone, twin detector density tool and magnetic susceptibility tool.

In the field faults occurred in power supplies, ratemeters, S-P and resistivity modules, in the Selsyn repeating system and chart recorder. The caliper and neutron gamma tools also developed faults. A large crack has developed in the cab and faults have occurred in the hydraulic system and other mechanical parts. Although the equipment has operated satisfactorily this year, much of it is nearing the end of its economic life.

4.4.2 ACT surveys. A total of twelve holes were logged at Piallago, Long Gully and West Belconnen refuse sites, with a gamma tool to monitor waste pollution of ground water. In the Yass River Basin area logs of two holes were attempted but not completed owing to equipment failure.

4.4.3 NSW surveys. Eight holes in the Bungendore area drilled by W.C. & I.G. of NSW for supply of town water were logged with gamma and neutron gamma tools.

Two holes in the central west of NSW near Lake Cargellico were logged for groundwater studies using gamma and neutron gamma tools.

One oil source-rock study hole near Menindee in the Darling Basin was logged for PE Branch using SP and resistivity.

A hole in the Tibooburra, Wanaaring area for Geological Branch investigation of oil shales was logged using gamma, neutron gamma, caliper, electric logs and a hired density tool.

4.4.4 Queensland surveys. Fourteen holes were logged in the area between Charleville and Barcaldine for the NERDDC oil shale project. Gamma, neutron gamma, density and caliper logs were run in all holes and resistivity and SP logs in two deep holes only.

Four holes were logged for Geological Branch shale investigations in the Mt Isa area. Gamma, neutron gamma, caliper, SP resistivity logs were run.

4.4.5 Portable Loggers (D. Pownall, W. Greenwood). The suitcase logger was prepared for survey work at the Great Barrier Reef.

The Widco 450 SHL logger was prepared and used to log a number of holes in the Bungendore area drilled by the NSW Water Resources Board.

4.4.6 Digitising of BMR well-logging system (R. Cobcroft, G. Jennings). The present BMR logging system produces analog records on paper charts. This form of data is difficult to handle, and any computer processing would require laborious hand-digitising of the analog records.

A brief feasibility study was conducted to consider ways and means of providing a digital acquisition system for the logging truck. The result of the study was to recommend a minicomputer based system which is to be completed in 1981.

4.5 Observatories (L. Zeitlhofer, W. Greenwood, D. Pownall)

4.5.1 Canberra Magnetic Observatory. A number of faults which occurred during the year were repaired. Problems of short intermittent data losses were investigated and at time of writing two months trouble-free operation had been obtained. A temperature monitor was installed to record temperature of EDA fluxgate magnetometer in the analogue hut for comparison of the fluxgate and CMO magnetometer records. An improved version of sensor head purchased from Elsec was also installed. This will eliminate cracking of the head due to overheating.

Equipment was prepared for telemetering single channel magnetic data from Kowen Forest Observatory to BMR Building to provide a visual monitor.

4.5.2 Seismograph station support. Various types of equipment was repaired and calibrated throughout the year. The seismometer and carrier equipment was moved from the old Kowen Forest test site to the new Kowen East Observatory site. a single channel Helicorder was converted to three-channel operation for Alice Springs Observatory. This freed two single-pen Helicorders for use in other observatory applications.

4.5.3 Adkin three-component fluxgate magnetometer. The system was prepared for MAGSAT ground control observations at Charters Tower in January. Various modifications were carried out on the Adkin to improve its reliability, and the drawing office is producing an improved handbook for the Adkin which will include new circuits, parts list and wiring diagram. This should greatly facilitate repairs on the instrument in the future.

4.5.4 Mundaring Geophysical Observatory (G. Woad, B. Page). Activities are reported in Geophysical Branch annual summary. Some support was provided by I.E.S. Branch in the form of equipment repairs, special spares and general administrative matters.

4.5.5 Five components digital magnetograph (B. Liu, K. Jurello). The digital thermometer required to complete this system did not arrive in time for the February survey so a digital voltmeter was used with an anlogue thermistor amplifier to give BCD outputs of the fluxgate sensor head temperature. The digital thermometer was incorporated later in the year.

A BCD line printer was integrated with the system to give on-line monitoring of the components X, Y, Z, F, and T.

The digital controller was continually plagued by intermittent faults which were later traced to interface problems with the Adkin fluxgate magnetometer.

The system was dispatched to Charters Towers for the MAGSAT field survey. Field results throughout February were satisfactory.

Results for the first order survey in WA after the MAGSAT survey were also good, apart from minor problems with the printer and the chart recorder.

A similar digital system using a second controller was set up and tested in the Canberra Magnetic Observatory where it was used to record F from an Elsec proton magnetometer.

4.5.6 Photoelectronic magnetograph (B. Liu, K. Jurello, T. Dalziell, R. Grigg). This project, started in 1978, again progressed slowly because of frequent diversion of staff to higher priority tasks. Debugging was carried out on the servo amplifier which supplied feedback current to the Helmholtz coil to maintain the La Cour variometer magnet in its null position.

With assistance from Observatory staff, a QHM variometer was set up in the Kowen Forest magnetic test hut as a D variometer. Initial problems encountered included noise and drift. Some of the noise problems were traced to poor wiring of the servo amplifier; drift was traced to the constant current generator supplying the Helmholtz coil.

The servo loop gains and compensation were optimised during experiments performed in July by T. Dalziell. Calibration facilities were added to the PEM system and linearity tests gave satisfactory results.

Variographs obtained during July and August showed excellent agreement with the D component output of the digital AMO at the Canberra Magnetic Observatory.

4.5.7 Proton vector magnetometer (K. Seers, W. Burhop). The BMR-designed MNS-2 proton magnetometer is used in a vector coil system to obtain absolute readings at Canberra Magnetic Observatory. Unexplained baseline variations were investigated. Extensive temperature testing of the internal crystal oscillator showed that this could be the cause in part only. New crystals having more stable charactertistics are to be installed and further investigations made.

4.6 Regional Geophysical Surveys

4.6.1 Crustal playback system (B. Liu, C. Rochford). Some minor changes were made to the time code circuit to improve triggering on weak signals, and minor maintenance carried out. Documentation of the system has still to be completed.

4.6.2 Development of lightweight seismographs (K. Seers, B. Liu, C. Rochford, J. Rutledge, S. Prokin). Further investigations into low-power d.c. motors for driving the modified Akai tape recorders produced a commercial motor and generator combination which could reduce current consumption by an order of magnitude (to less than 50 mA). Various prototype items for mounting the motor and generator were made in the mechanical workshops and an electronic speed control circuit was designed and built. Prototype testing will start before the end of 1980.

Extensive tests on a Geotech S500 active seismometer and associated Geotech 42-50 amplifier were satisfactory, and twelve of these amplifiers have been ordered. The design of a low-power modulator will start in 1981.

20

4.6.3 NCE-3 Low Power Digital Clock Production (C. Rochford, F. Clements, J. Rutledge, D. Gardner). Production planning meetings for the construction of 36 clocks were held in December 1979, quotes for components were received by mid-January, and orders were then placed with the individual suppliers. Most items were received by the middle of May allowing the construction by contract of the printed circuit boards. At this stage the only item outstanding is the liquid crystal displays which are holding up the completion of the project. These are expected to arrive before the end of October and will allow the clocks to be completed by the end of the year. See Fig. 4.6.3.

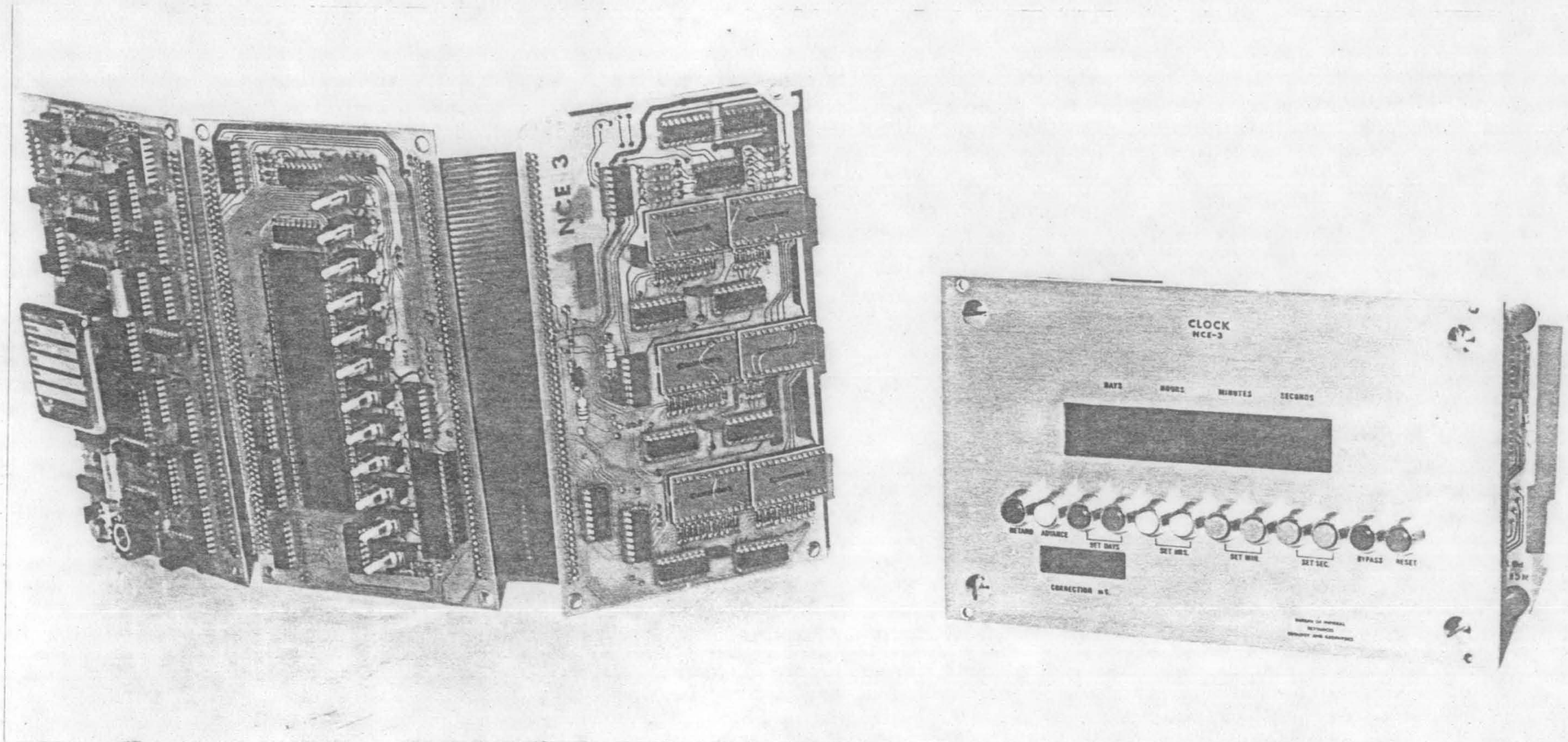
4.6.4 Field work and general maintenance (C. Rochford). Two areas of field work were covered during the year. Six recording sets were serviced and placed in the Dalton-Gunning area for micro-earthquake recording in March and April. Although there were some equipment problems satisfactory results were obtained. All crustal seismographs were serviced for a deep seismic refraction survey carried out in the Eromanga Basin during August/September. Generally equipment performed satisfactorily.

Time was also spent in the preparation of batteries for the remote recorders, preparing vehicles and all miscellaneous items required for surveys.

One heat-flow unit was made serviceable by repairing the sensor probe.

4.7 Rock Measurements & Palaeomagnetism

4.7.1 Sun compasses (S. Prokin). Components for two 75 mm sun compasses have been made except for the protractors. The protractors are being anodised rather than engraved which takes so much time, but it has taken a long time to find a contractor to do the anodising.



NCE-3 DIGITAL CLOCK. 36 are being built for the Regional Seismograph stations.
Note the method of interconnection for ease of servicing.

Fig. 4.6.3.

4.8 Magneto-tellurics

4.8.1 Survey preparation (S.D'Arcy, J. Whatman). Mechanical work on the survey vehicle included provision of additional storage for tools, a rack to hold a spare wheel and modifications to the canopy frame. The equipment racks were rearranged to permit better air circulation and operating convenience. The system was overhauled, assembled, and calibrated. Pre-survey checks also included occupation of a test site at Tuggeranong where satisfactory data was obtained.

Twelve sites were occupied during the Eromanga Basin survey and data quality in all frequency bands was generally good, Equipment problems included a pre-amplifier power supply failure, computer disc memory failure and a fault in a dual channel part controller in the HP computer. This latter fault resulted in the loss of the digital record of 4 sites, a fact which was only discovered after the party returned to Canberra.

4.9 Seismic

4.9.1 Seismic processing system (B. Devenish, M. Gamlen). B. Devenish attended the in-house course given by the suppliers of the macro-arithmetic array processing unit (MAP) purchased for seismic processing. The system failed to work on delivery and the fault was traced to its power supply. A second supply forwarded from the USA was similarly faulty; a third was lost in transit and the fourth worked. The system was successfully interfaced to the HP computer in the processing system.

Some of the MAP floating point data is in IBM format and this is converted by software to HP format. As this is a slow process, a hardware conversion circuit was designed and sent to the manufacturer for evaluation.

4.9.2. Equipment overhaul and survey preparation (J.K. Grace, D. Gardner, P. Fowler, D. McIntyre et al., from Geophysical Branch). All the seismic recording equipment was overhauled and tested between the end of the 1979 field season and the commencement of the Central Eromanga Seismic survey in July 1980. Equipment overhauled and tested included the DFS IV digital recording system, geophone groups, spread cables, radio transceivers, shot-firing equipment, and all associated test equipment.

A new 54-trace electrostatic oscillograph (SIE model ERC 10) was integrated with the recording equipment and modifications to the timing line triggering circuit were made and tested.

A 48-channel set of common-mode filters was installed and tested.

A LWB flat-top Landrover was fitted out as a shooting truck. Explosives and detonator magazines were constructed and fitted. The remote firing equipment was installed and tested.

Design and construction of a new power distribution board for the seismic instrument cab was completed. All instrument power and charging circuit wiring was renewed.

The seismic recording equipment vehicle was overhauled. The instrument cab was made dust-proof and the air-conditioning repaired.

4.9.3 Gundary Plains deep crustal reflection test survey - May 1980 (J.K. Grace et al., from Geophysical Branch). Six shots were recorded along 12 km of the Goulburn-Tarago Road. During this survey field testing of the seismic recording system was carried out prior to the start of the Central Eromanga Basin Seismic Survey. All equipment performed satisfactorily.

4.9.4 Analog/digital tape transcription (J.K. Grace, D. Gardner et al., from Geophysical Branch). The PMR-20 and MS-42 analog tape systems were integrated with the DFS IV so that seismic data from the Eromanga Basin recorded in analog FM and AM formats could be digitised. Tapes from the Thylungra and Welford seismic surveys were digitised.

4.9.5 Central Eromanga Basin seismic survey July 1980 - September 1980 (J.K. Grace, D. Gardner et al., from Geophysical Branch). Field recording commenced on 28 July. Six-fold CDP seismic data is being recorded in SEG B format. 20 seconds of data is recorded from each shot. Minor equipment faults caused the loss of two days recording time.

4.10 Marine Geophysics

4.10.1 Marine seismic analogue-to-digital conversion (B. Devenish, G. Russell-Smith). Using an A-D converter chip, a plug-in card for Hewlett-Packard computers was designed specifically to assist with the digitising of analogue seismic tapes.

4.10.2 Modifications to multiplexers XDM-1 (B. Devenish). The sixteen-channel digital multiplexers designed and constructed in 1979 were becoming excessively hot when operating with all input cards. The problem was solved by replacing standard TTL logic devices with lower-power Schotsky TTL devices.

4.10.3 Marine data acquisition system (K. Seers, S. Iannou, B. Russell-Smith, W. Harkness, R. Ian, F. Clements, K. Mort, D. Stevens, T. Prokin). Higher priorities kept in abeyance much of the production work on the BMR-built items for the marine DAS. The following were achieved towards the end of the year.

4.10.3.1 TAM 7 data amplifiers. Sixty-four units were housed in type SAM-1 bins with power supplies. A BMR Record is in preparation.

4.10.3.2 XDS-1 digital senders. Three four-channel, twelve-bit units were completed in time for the Nella Dan trial cruises. The remaining five units should be finished before the end of the year. The main hold-up is the wiring of the bins by contract.

4.10.3.3 XDR-1 digital receivers. One unit only was completed; contract wiring of the bins for the remaining three eight-channel units must wait until 1981 for funds.

4.10.3.4 NTM-1 marine timers. At the time of writing, two bins are wired, all eight dual-channel timing nodules and all four power supplies are completed. Wiring of the remaining two bins is also scheduled for completion in 1980.

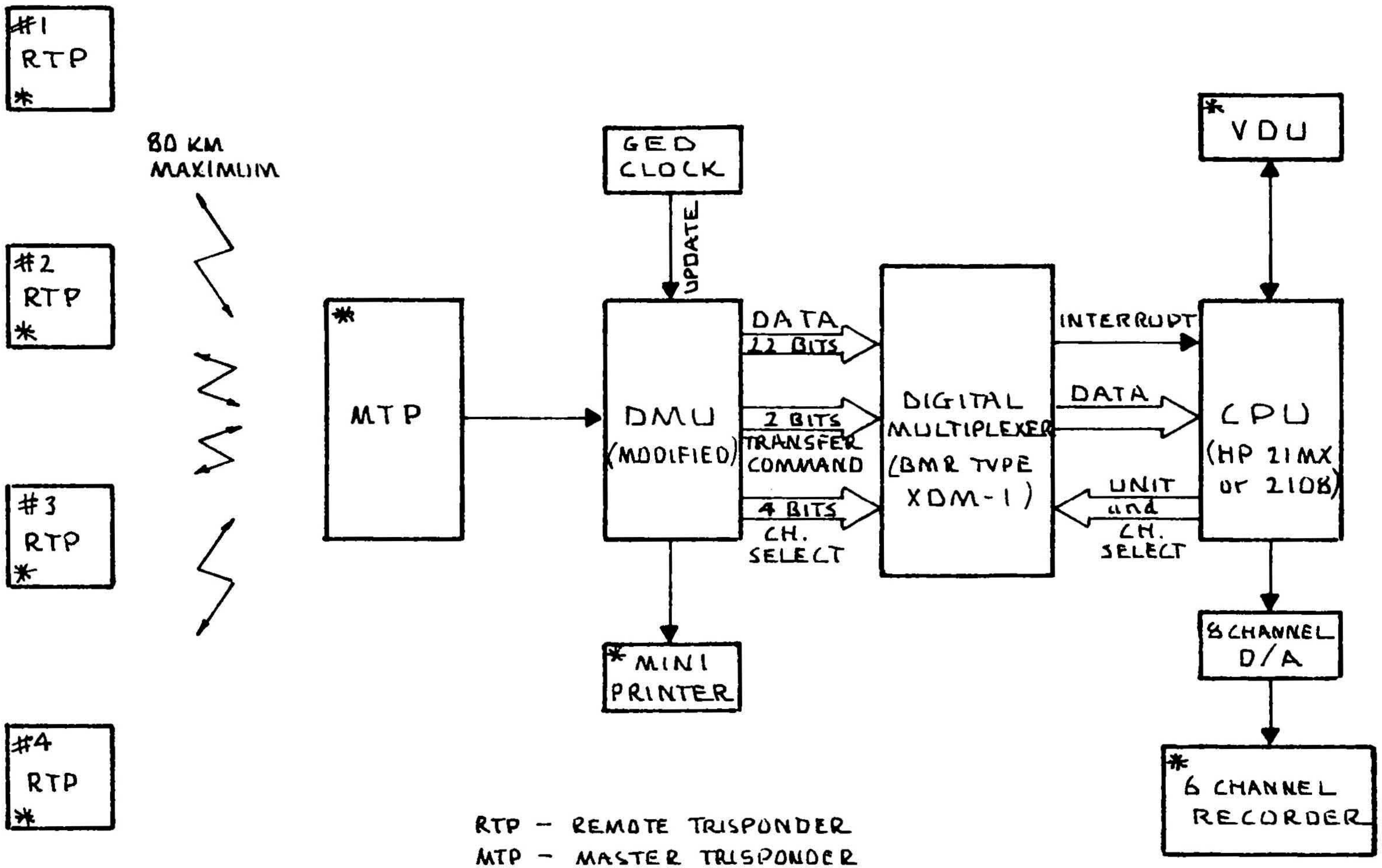
4.10.3.5 Other items. Two items are to be carried forward to 1981: a patch panel for analogue recording and two stand-alone digital-to-analogue converters for monitoring purposes.

4.10.4 Trisponder navigation system modifications (B. Liu, D. Gardner). The 'Decca' Trisponder navigation system is a radio location system which gives the position of a mobile target station (ship) by measuring its distance to two fixed reference stations.

The Australian Survey Office were to use this system in the R.V. Sonne for the Eastern Shelf marine survey in September. To provide the overall accuracy and reliability required, a decision was made to modify the system to measure distances from four reference stations simultaneously instead of two. Modifications to the Distance Measurement Unit and printer were completed in June.

ASO and BMR staff jointly completed successful sea-going system trials in July on the "KARIN", a research vessel of the CSIRO Division of Fisheries. On return to BMR, the navigation system was interfaced to the HP computer via the BMR-designed XDM-1 digital multiplexer. Two data latch cards in the multiplexer were modified to supply four channel interrupts to the computer.

Installation of the navigation system on the R.V. Sonne was carried out in late September. Some troubles during the first week of survey were traced to software timing problems and were rectified.



RTP – REMOTE TRISPONDER
MTP – MASTER TRISPONDER
DMU – DISTANCE MEASURING UNIT
VDU – VIDEO DISPLAY UNIT
CPU – CENTRAL PROCESSING UNIT
D/A – DIGITAL TO ANALOGUE CONVERTER

* UNITS PROVIDED BY AUSTRALIAN SURVEY.

MODIFIED TRISPONDER NAVIGATION SYSTEM and DATA ACQUISITION SYSTEM

FIG. 4-10-4

Documentation on the modified system in the form of a BMR Record was completed. A block diagram of the modified system accompanies this summary (Fig. 4.10.4).

4.10.5 Modifications to TRACOR satellite navigation system (B. Devenish, L. Miller). The Tracor satellite navigation system as used for marine surveys on the Nella Dan did not have an output which could be interfaced to the data acquisition computer. Modifications were installed which permitted the computer to access the satellite navigation data and also to control the operation of the system.

4.10.6 Digital seismic acquisition system. Development of digital seismic processing system (J. Grace, R. Dulski, P. Fowler, L. Miller). Technical services were made available for these two on-going Geophysical Branch projects as required.

4.10.7 Marine seismic streamer cable winch (J. Rutledge). Further investigation showed that a proposal to modify BMR's large seismic cable winch would not produce a winch compact enough to meet current needs. A new winch was designed with a drum 1.37 m long and 0.915 m diameter. It will accommodate 150 m of 37 mm cable. The winch will be powered by a hydraulic motor driven by a hydraulic pump coupled to an AC/DC electric motor. A budgetry quote has been obtained for its construction.

4.10.8 Nella Dan magnetic surveys - October 1979-March 1980 (R. Dulski, P. Fowler, J. Grace, S. Scherl et al., Geophysical Branch). A magnetometer and digital data acquisition system (DAS) were installed on the M.V. Nella Dan for the 1979-1980 season Antarctic cruises. The equipment was assembled and installed between 15-19 October. R. Dulski operated the equipment on the first cruise to Macquarie Island from 19 October to 1 November. The equipment was operated on 3 voyages and serviced during port calls in Melbourne between each voyage. Only minor faults occurred during the voyages.

4.10.9 Nella Dan Surveys (October 1980-1981) (R. Dulski, B. Devenish, L. Miller, J. Rutledge). BMR's digital acquisition system, a marine magnetometer, the Raytheon sub-bottom echo sounder, and a modified Tracor satellite navigator system had to be installed during the M.V. Nella Dan's turn round times prior to the Macquarie Island cruise in October and the Bass Strait test cruise in early November. B. Devenish went on the Macquarie Island cruise primarily to ensure the operation of the modified Tracor system. The installation of the Raytheon echo sounder transducers involved a lot of mechanical work and was completed prior to the Bass Strait test cruise.

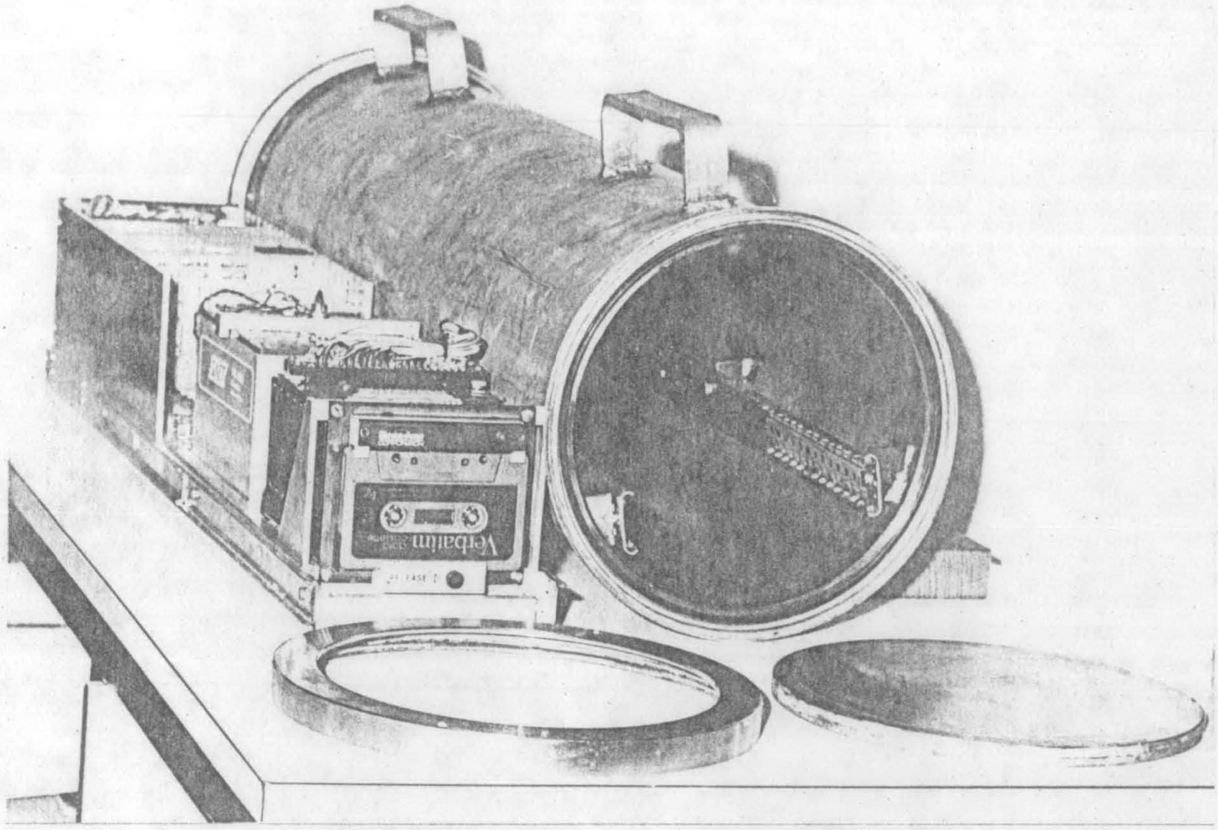
4.10.10 Heard Is. cooperative cruise with National Mapping. M.V. Cape Pillar. January 1980-April 1980 (R. Dulski, P. Fowler et al., Geophysical Branch). Raytheon precision bathymetric equipment, magnetometer and DAS equipment were installed on the Cape Pillar. The cruise commenced on 18 February from Melbourne. Seven thousand nautical miles of magnetic and bathymetric data were collected including about 300 n.m. over the Heard-Kerguelen Ridge and about 1000 n.m. of data during the test cruise from Melbourne to Perth. Only minor faults occurred during the cruise.

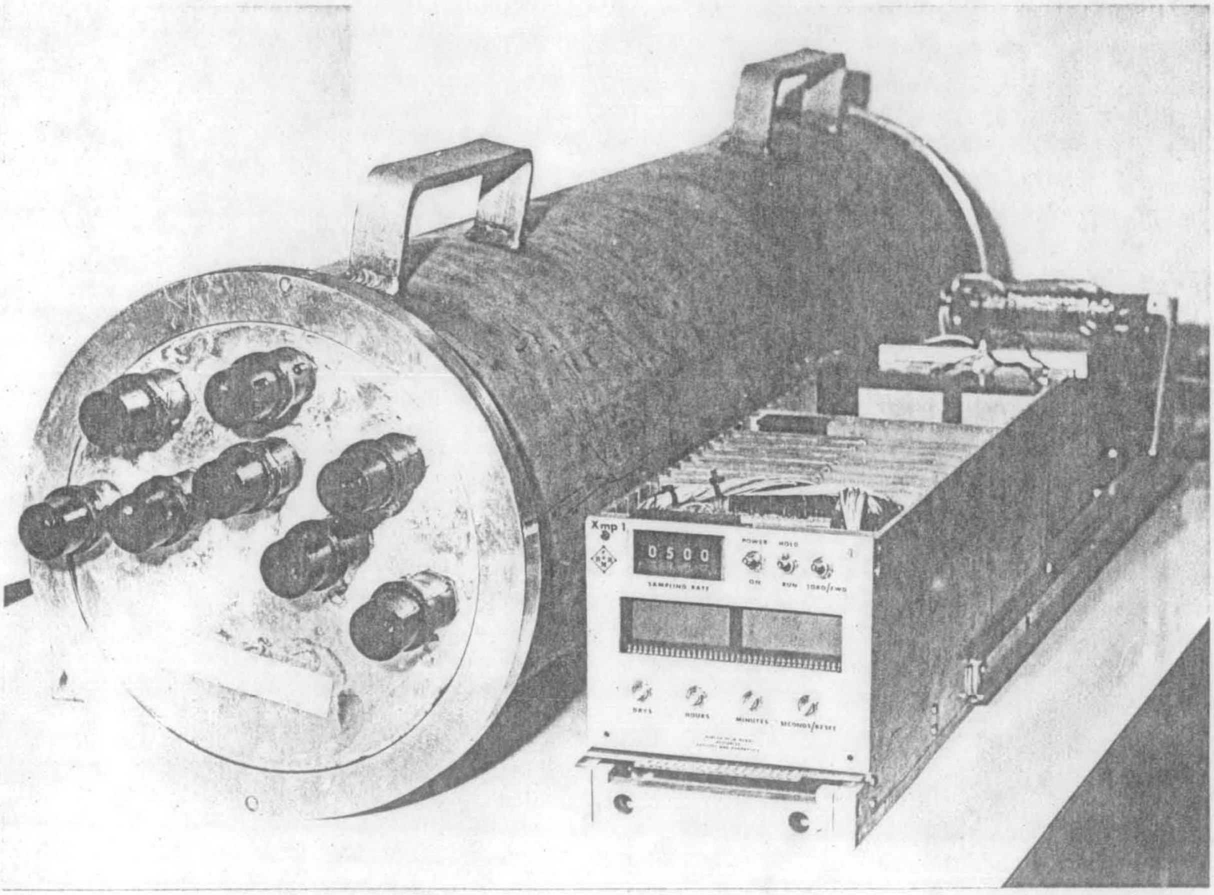
4.10.11 G.B.R. cooperative survey with National Mapping. M.V. Kalinda, April-Sept., 1980 (J. Grace, R. Dulski, L. Miller, P. Fowler, J. Rutledge et al., Geophysical Branch). BMR's data acquisition system (DAS), marine magnetometer and Raytheon sub-bottom echo sounder were installed on the M.V. Kalinda in late April/May 1980. The DAS also received data from NATMAP's Atlas echo sounder and Hi-Fix and Mini Ranger navigation systems.

Installation of the Raytheon echo sounder involved construction of a transducer mounting chamber and its installation on the hull of the vessel. Some sub-bottom data was obtained but a resonance thought to originate in the transducer housing seriously reduced data quality.

A magnetometer shore station was installed at Charters Towers.

Only minor equipment problems occurred during the survey which ran from 6 May to 19 September 1980.





Great Barrier Reef Underwater Data Aquisition System.
The stainless steel container is designed to withstand water depths of 100ft.

Fig. 4.11.1.

4.10.12 General Maintenance (R. Dulski, P. Fowler). Repairs, de-rusting and check out of sparker systems continued. Other equipment such as Raytheon bathymetric system, magnetometers, recorders and winches were prepared for installation on Cape Pillar, Nella Dan and other vessels.

4.11 Marine Geology Projects

4.11.1 Underwater data acquisition system (B. Liu, J. Rutledge, T. Dalziell, R. Gan, A. Kores). Following successful field use of a prototype in 1979, two production data acquisition systems, each consisting of 13 printed circuit boards and digital cassette recorder were completed by the end of February. Calibration of the flowmeter was carried out in the hydraulic laboratory flow tank of Duntroon Military College. At mid-range, nominal speed agreed closely with the flow tank calibration.

Construction of the two stainless steel underwater vessels to house the systems was delayed in the mechanical workshops owing to higher priority tasks. The two vessels were eventually completed by the middle of April after an all-out effort by the workshops staff. With the assistance of the A.C.T. Water Police, the vessels were tested satisfactorily in Lake Burley Griffin at a depth of 15 metres.

T. Dalziell participated in two field surveys with the Great Barrier Reef field party, the first in April and the second in September. All equipment functioned properly on the first survey except the sensors which attracted algal growth quickly and required constant maintenance on the bearings. The algae problem was largely eliminated on the second survey after all the sensors were sprayed with anti-fouling paint. Difficulties were experienced however on the second survey with malfunctions of reed relays within the impeller sensors.

Sometime was spent on data editing and equipment overhaul on return to Canberra. R. Moore of the A.D.P. Section assisted by writing a program for plotting the output data.

4.11.2 Borehole electromagnetic current flow meter (B. Liu, T. Dalziell). The Colnbrook EM Current Flow Meter arrived in August. Acceptance tests and calibration were carried out in BMR and in the hydraulic laboratory of Duntroon Military College. Drift on the offset appeared to be the main problem. One channel of the amplifier also experienced intermittent instability which was rectified.

During the Great Barrier Reef survey in September, the EM Current Meter was used to monitor the water movement within a drillhole. Calibration procedures were derived to enable the system to compensate for offset drift. The EM system worked satisfactorily in monitoring the tidal movement but encountered difficulties in the drillhole due to sensor head movement.

The EM system and recorder sustained considerable damage following an accident at Viper Reef in October when the tripod on which the equipment was mounted was toppled by freak wave conditions. The system was airfreighted to BMR for remedial maintenance and repair.

4.11.3 Vibrocorer (J. Rutledge, A. Kores). A vibrocorer using a 6 metre long disposable aluminium tube as both drill and coring barrel was tried in 1980. It was driven by a concrete vibrator attached by an adaptor to the coring barrel, an arrangement which has been recorded in the literature and used successfully by some authorities. The vibrator was driven by a flexible mechanical drive. Both small and large vibrators were used and several types of adaptors tried. Although some core was obtained the device was not satisfactory, at least in the lagoonal reef environment. The adaptor had to be moved as the tube penetrated, and the higher powered adaptor fractured the aluminium tube before much penetration was obtained. Little or no theoretical data is available on this type of coring device and a better understanding of the physics of the process will be necessary before much more can be done.

32

4.11.4 Hydraulic powered rotary drilling rig (E. McIntosh, A. Kores, D. Foulstone, J. Rutledge). A hydraulic powered underwater rotary drilling rig built in 1978 and designed to drill to 20 metres was overhauled and minor modifications carried out in preparation for the Great Barrier Reef survey. However instead of being operated from a tripod, the drill was mounted on a catamaran-type pontoon assembly on which it was towed. for the pontoon assembly were drawn up in the Mechanical Sub-section, and it was built under contract in Cairns. The pontoons are flooded at the drill site so that the whole assembly sits on the bottom during operation. It worked well but some minor modifications are required before next season's work.

4.11.5 Sediment sampling towers (A. Kores, G. Thom, S. D'Arcy, D. Foulstone). The towers described in the 1979 annual summary were further modified to allow more samples to be collected during a small tide and to improve reliability and convenience of the sampling mechanisms.

4.11.6 Alpha particle spectrometer for uranium series dating (M. Gamlen). The system finally specified comprised off the shelf items, and very little engineering work will be involved. Tender recommendations have been made and the equipment should be delivered and assembled in early 1981.

4.12 Petroleum Technology

4.12.1 Pyrolysis sampling system (B. Devenish, F. Clements). Final tests on the furnace controller for this system showed that the various heating rates specified were met by the unit as designed.

4.12.2 Automated helium porosimeter (B. Devenish). A preliminary design was investigated for automating the readout of a helium porosometer. A SCMP microprocessor is to be used to derive the pressure equilibration versus time curve.

4.13 ADP Projects

4.13.1 Electron microscope interface to HP computer (B. Devenish). On investigation, the necessary outputs were easily obtained on the electron microscope and the job reduced to interconnection only. This was done by staff from the Electronic Technical Group.

4.13.2 X-ray diffraction system interface to HP computer (B. Devenish). After consultation with the ADP Section this task was again deferred for another year.

4.14 Museum

4.14.1 Mineral display cabinet for QUESTACON (G. Lockwood, W. Harkness). A mineral showcase was constructed and electrically wired for short wave and long wave ultra-violet light sources, Selected specimens were installed by the museum staff and the showcase is now permanently installed at the Questacon centre at Ainslie.

4.15 Engineering Services Branch Projects

4.15.1 Domestic statellite applications (K. Seers). After consulting with potential BMR users, a paper outlining BMR's needs was prepared for the Satellite Project Officer, Posts and Telegraph Department. Further talks with officers of the SPO resulted in a possible forward plan for digital data transmission from remote seismological stations.

Mobile receivers or transmitters are unsuitable for use with the satellite because of the high pointing accuracy necessary for antennas in the 12-14 GHz band.

4.15.2 Proton magnetometer development (S. Scherl, K. Seers, G. Russell-Smith, M. Gamlen). In March S. Scherl returned from Antarctica with 8000 km of good aeromagnetic data which completed the Enderby Land survey and gave the improved MNS-2 magnetometer its first field trial.

Further development in the laboratory included a trial of Gamlen's new algorithm for measuring frequency; a microprocessor was used to process the analogue proton precession signal in place of the more usual phase-locked loop. This, and other work, has resulted in the project proposal which should result in a new proton precession magnetometer offering almost two orders of magnitude improvement in resolution over BMR's present instruments. It could make the basis of a gradiometer suitable for vehicle-borne surveying.

4.15.3 Microprocessor systems (R. Cobcroft, B. Liu, T. Dalziell, M. Gamlen, S. Scherl, G. Russell-Smith). After looking at a number of microprocessor chips the electronic design group has settled on two for its immediate requirements. They are the Motorola 6809 and the RCA CMOS 1802: the former chosen as the most generally useful for our purposes, and the latter selected where the low power dissipation of CMOS equipment is important.

A study of available microprocessor development systems has shown that the best solution to the software problem, created by Motorola upgrading their 6800 to the 6809 level, is to purchase a full-scale development system which will solve most of the hardware and hardware/software integration problems as well. It will be readily expandable to support the Motorola 146805 CMOS chip if an alternative to the RCA 1802 is required.

For the 1802, cross-assembler, de-bug, and simulation software has been installed on the BMR computer system. The computer and 1802 communicate via paper tape. With this equipment it is proposed to develop an underwater data acquisition system for marine geology work on the Barrier Reef. The low dissipation of the CMOS devices will enable the equipment to remain unattended and underwater for the maximum time.

4.15.4 Computer-aided design (R. Cobcroft). Work continued on adapting the circuit analysis program, SCEPTRE, to run on the CYBER system. When the library file of transistor, diode and SCR models was used on a routine basis it was found that the format of the file needed to be changed to facilitate reading by the SCEPTRE program. A short FORTRAN program was written to do this and a new file was created containing the reformatted library file. A number of benchmark programs were run successfully using the new library file. Not all features of the model editor within the SCEPTRE program were implemented but a sufficient number to make the program generally useful have been implemented to date.

Some editing of the interactive circuit analysis program LINCAD was undertaken. The program compiles and can be loaded into the in-house HP computing system and some of its circuit simulation features are now working. It will however require more work to make it fully operational, and this can be done only on a relatively low priority basis.

4.15.5 Sparker seismic source investigations. Sparker and current monitoring equipment are on loan to Duntroon School of Mechanical Engineering, where Dr D.B. Stewart is investigating the theory of sparker seismic energy sources with a view to developing a better means of controlling emission spectrum and energy. His work resulted in the presentation of a paper at the Tenth International Congress on Acoustics at Sydney in 1980. A significant finding has been that the initial pressure pulse appears to be due primarily to water expansion and occurs before any detectable bubble has formed.

4.16 General Services

4.16.1 Miscellaneous Activities - Mechanical Sub-section. Two hundred and thirty unprogrammed miscellaneous tasks were carried out during this year by three officers specifically allocated to this type of work.

4.16.1.1 Carpenters shop (G. Lockwood). Tasks included: design and construction of an exhibition display case, transit cases for field equipment, manufacture and installation of special shelves and storage facilities in specialist areas and vehicles and assistance with BMR displays in Canberra and Sydney.

4.16.1.2 Heavy workshop (R. Westmore). Tasks included: on-going maintenance to rock crushing equipment, repairs and maintenance of sundry head office equipment, fitting of a winch to a vehicle, vehicle installation repairs and modifications and construction of a mobile water pump unit.

4.16.1.3 Instrument shop (R. Grigg). Tasks included: consultative and advice services on a wide range of design construction and maintenance proposals, repairs and callibration of instruments including gravity meters, microbarometers, and photographic equipment, etc.

4.16.2 Miscellaneous Activities - Electronic Technical Sub-section (A. Zeitlhofer, W. Greenwood, D. Pownall, W. Harkness).

4.16.2.1 For Geophysical Branch. Activities included construction of a multiple battery charger for the Isogal Network survey, testing of geophones using the shake table, maintenance of magnetometers and acceptance testing of new equipment.

Assistance was provided in the procurement of a range of test equipment required to maintain geophysical equipment in Irian Jaya. A spinner magnetometer (Model SR-4) sent from Irian Jaya required extensive work including replacement of components damaged by corrosion, and installation of a cooling fan to prevent overheating.

In the Laser-scan system a new Vidicon camera tube was fitted, and the TV monitor realigned and re-installed.

4.16.2.2 For Geological Branch. A Varian atomic absorption spectrometer was repaired, Engineering Geology's down-hole bore flow pump was checked out and a new power cable fitted, an ultrasonic cleaner was repaired and a suitcase logger serviced.

4.16.2.3 For Petroleum Exploration Branch. Work included repairs to centrifuge, pump, motor, ultrasonic cleaner, H.P. Varian & Pye gas chromatographs. An external trigger circuit was built and installed in the centrifuge to provide for easier sample readings and more precise speed control.

4.16.2.4 For ADP Section. A number of remote terminals were installed, frequent repairs made on the Gradicon digitiser and maintenance carried out on the Gould Plotter.

4.16.2.5 Communications equipment (W. Harkness). Preparation of transceivers for field surveys including changing of channel frequencies to meet programmed needs continued throughout the year. The AM (double side band) mode is now illegal and is being removed from all Codan transceivers as they are returned. Three Philips FM 25W transceivers used by the seismic party were fitted with a 1W option for operation from trail bikes.

4.16.2.6 Electronic drafting (R. Gan, F. Clements, K. Mort). Projects requiring major electronic drafting input for printed circuit board design, panels, handbook illustrations, etc included Marine Geology's ocean current data acquisition system, NCE-3 low power clocks, Trisponder navigation system modifications, TAM-7 marine data amplifiers, marine digital receivers XDR-1 and digital senders XDS-1, airborne camera interface NCI-1, and ADKIN magnetometer circuits.

A printed edge connector plug was devised for use in prototype printed circuit boards and extender boards and saved considerable time on some tasks. The idea was submitted to the department under the staff suggestion scheme.

Master equipment handbooks were updated as necessary, and the components catalogue system maintained.

4.16.2.7 Electronic Instrument Laboratory (W. Burhop). Supervision of the allocation of pool instruments, maintenance of electrical measurement standards, and provision of advice and service on measurement equipment occupied much of the time. The only instruments added to the pool this year were one 40V 10A DC power supply, one 20V 2A bipolar DC power supply/amplifier, and two universal frequency counters. The laboratory cannot satisfactorily meet many measurement requests which arise from the increasing accuracy and complexity of geophysical equipment.

Much time was spent on tasks arising from the calibration of SIROTEM equipment (see 4.2.5) and this work is still not complete. Other tasks included design and construction of a thermocouple and amplifier, and modifications to a Wheatstone bridge, both for use in heat flow measurements, design and construction of an automatic gravity meter battery charger for vehicle use, and a detailed examination of MNS-2 magnetometer precession signal (see also 4.15.2).

Arrangements were made to include the Electronic Instrument Laboratory in National Mapping's travelling clock itinerary. This is the most economical way of monitoring the laboratory's nubidium frequency standard.

5. TRAINING, COURSES, CONFERENCES, REPORTS

5.1 Local Conferences

R. Cobcroft B. Devenish W. Greenwood K. Jurello	Measurement and Computation in the 80's, Hewlett-Packard Ltd, Sydney, 12 February, 1980.
B. Liu	Conference on Digital Systems Design, 1980, Institution of Engineers, Australia, Sydney, 21-22 May 1980.
R. Cobcroft M. Gamlen R. Curtis T. Dalziell W. Greenwood D. Pownall	Personal Computing for the Eighties (Micro-computer Conference), Aust. Computer Society, Canberra, 9-11 July 1980.
R. Cobcroft	Complex Resistivity Seminar, Macquarie University and Aust. Society of Exploration Geophysicists, Sydney, 12-13 August 1980.
B. Liu W. Burhop W. Greenwood	Precise Time and Frequency Conference, Institution of Radio and Electronic Engineers (Aust.), Canberra, 25-28 August 1980.
M. Gamlen	Transient EM, Surface and Borehole, Aust. Society of Exploration Geophysicists, Sydney, 9 October 1980.
D. Pownall	Soldering Technology Seminar, The Australian Tin Information Centre, Sydney, 30 July 1980.

5.2 Training Courses

External

B. Liu	Assembly Language Course, Hewlett-Packard Ltd, Canberra, 7-11 July 1980.
W. Harkness	Codan Transceiver Servicing Course, Codan Pty Ltd., Adelaide, 18-20 February 1980.
M. Allen	Management by Objectives, Rydges/AMR International, Sydney, 23-25 June, 1980.
E. McIntosh, D. Foulstone	Industry Hydraulics Course, Sperry-Vickers, Melbourne, 21-25 July 1980.
G. Thom	Communications Workshop, ANU, Canberra, 5-6 May, 1980.

Internal

R. Cobcroft	Introductory Course, HP 9825, Hewlett-Packard Ltd, BMR, Canberra, 21-24 July 1980.
B. Devenish	Macro Arithmetic Processor Course, BMR, Canberra, 7-18 July 1980.
G. Green, R. Dulski, D. Pownall	Report Writing, Departmental course, Canberra, 14-15 August 1980.
R. Gan, W. Greenwood, W. Gunner	" " " " " 14-16 October 1980.
R. Curtis, R. Gan, W. Greenwood	Communications Skills, Departmental course, Canberra, 22-23 May 1980.

G. Thom	Session Presentation Workshop, Departmental course, Canberra, 28-30 May 1980.

5.3 Reports and Addresses

BMR Record

1980/62	Liu, Y.S.B. Gardner, D.	Trisponder navigation system modifications.

Addresses

K.J. Seers	Institute of Radio & Electronic Engineers, Canberra. On 19 February and 15 April talks were given to Canberra Branch IREE on "Electronics in Geoscience". The talks were accompanied by demonstrations in BMR's laboratories in which IES staff assisted.

41