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INTERIM ENGINEERING SERVICES BRANCH
SUMMARY OF ACTIVITIES - 1978

Interim Head of Branch - M.G. Allen

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IES BRANCH

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1. SUMMARY

In the 12 months since the formation of the Interim Engineering Services Branch much time has been spent in implementing a matrix system of management and the organisation of work into tasks under task leaders. The changes and new roles expected of staff have created tensions and problems of readjustment, but there have also been successful examples of task team work, and a continued confidence remains that the changes should result in a more satisfying and efficient engineering service in BMR.

Digital acquisition systems continued to be a significant part of the work load. A computer based system installed in the Aero-commander, which makes it compatible with the Twin Otter system, gave very little trouble on commissioning, work on the general purpose marine DAS advanced as far as funds would permit, and new magneto-telluric post-amplifiers gave much improved data quality on the McArthur Basin M.T. survey.

Significant advances have been made in work with Metalliferous Geophysics. I.P. logging probes were built, and a 3 component EM probe looks promising following the most recent down hole tests. The Crustal Group's seismic tape playback system was completed, and much work was done on digitial controllers and other components for the Observatory Group's automatic magnetic observatories, digital F system and vector proton magnetometers.

Work in Rock Measurements included special coring bits, a kerosene coolant system for rock coring, special vices and a specialised Hassler cell for treatment of some palaeomagnetic rock specimens.

A prototype coral coring drill and vibrocorer sediment sample built for Marine Geology's coral reef investigations operated successfully, and a sediment sampling tower is presently being built for further barrier reef work in early 1979.

Preparation of equipment for regional magnetic surveys, engineering geophysics, metalliferous surveys, seismic surveys, airborne surveys, marine geology and geophysics, etc., and providing field technical support in the carrying out of these surveys took much of the capacity of the Branch.

Maintenance and preparation of transceivers for all Branches and mechanical and electronic maintenance of laboratory equipment within BMR also formed a significant part of the work load.

2. BRANCH FORMATION, MANAGEMENT PHILOSOPHY AND EXPERIENCE

In November, 1977, a new branch was formed in response to the Director's decision to bring together all mechanical and electronic discipline-based staff in BMR under the one management. The core of the new branch comes from the mechanical and electronic groups in the old Geophysical Services Section of the Geophysical Branch but includes technical staff from other branches as well as from other sections of the Geophysical Branch. Mr M.G. Allen Geophysicist Class 5, previously OIC Geophysical Services became acting head of the new branch.

The new branch, which has been called the Interim Engineering Services Branch (I.E.S.) comprises four discipline pools (1) Mechanical Professional Group (2) Mechanical Technical Group (3) Electronic Professional Group (4) Electronic Technical Group. This grouping into discipline pools follows the philosophy outlined in the BMR Technical and Drafting Grades Review Team reports and the proposal to introduce a matrix form a management in the new branch, the expectation being that this will provide a better means of bringing together the most appropriate engineering expertise to all BMR projects, while at the same time providing advantages for the technical and career development of all engineering staff. Matrix organisation also works in well with the concept of project management being tried within BMR.

Mr P.A. Smith, a former member of the BMR Technical and Drafting Grades Review Team was seconded to the branch for the first 6 months of 1978. He provided much-needed counselling to staff and assistance in the implementation of the management system being tried.

This is primarily a technical report; but during 1978 so much time and energy have been expended within the branch in resolving problems of organisation under such a totally different system that some account of this is unavoidable in the first annual summary of the new branch.

BRANCH ORGANISATION — COMMENCED IN 1978

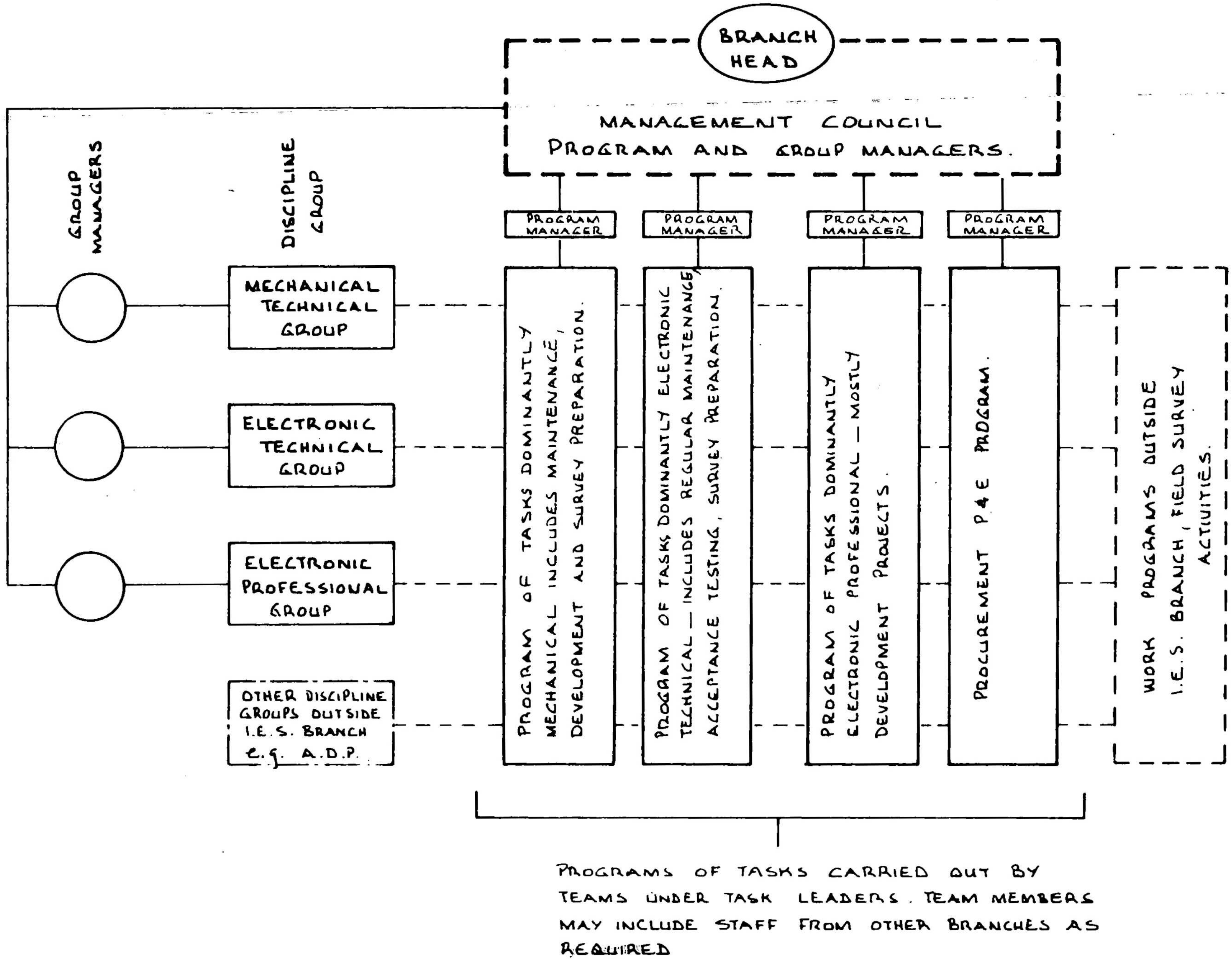


Fig. 2

The basic organisational chart is shown in Fig. 2 and the principal difference from the recommended structure in the Technical and Drafting Grades Review Team Third Report is the inclusion of a "Management Council" comprising the discipline group pool managers and the managers of the major work blocks (Electronic Technical, Electronics Professional, Mechanical Technical and Procurement) who have been called program managers within the branch, since almost all of the branch's activities are included in one or other of their programs of tasks. Many of these tasks are carried out by teams comprising all IES Branch members but equally many involve team members or task leaders from customer branches.

Matrix organisation assumes that the management of people (discipline pools) and the management of the work program will be vested in separate people. This is a fundamental criterion that the branch has not been able to implement effectively in 1978. Another basic management premise is that people at all levels have a lot more talent and organising ability than the specialists skills for which they were employed, and that it is to the advantage of both themselves and the organisation employing them to use these resources to the full. This implies maximum delegation of authority and responsibility. Management's task is then to ensure that task teams get all the information and support required to achieve objectives, and control is achieved principally by monitoring achievement of objectives. During the evolutionary phase in 1978 this aspect of management's function tended to be overridden by more immediate organisation problems, and control was not as effective as it should have been.

Working in teams under Task Leaders produced some successes which would have been difficult to achieve under the old system e.g. the production of a marine under water drill and vibrocorer for barrier reef studies by March 1978. However the additional responsibilities and changing roles of most team members have produced tensions and difficulties in knowing what is expected of each and in developing the confidence and understanding between team members that is required to ensure a smooth working team. This applies equally to both in-branch teams and teams including customer branch members, and applies to both technical and professional staff at all levels. While there is a continuing confidence in the branch that this is a more efficient and satisfying system under which to work, there is also a general realisation that problems of readjustment will continue to occur, and that many more months will elapse before the new working roles are generally understood and accepted.

3. GROUP ADMINISTRATION REPORTS

3.1 Mechanical Section

Dr D.B. Stewart, Mechanical Engineer, Grade 2, resigned in January, 1978. He was BMR's only professionally qualified mechanical engineer and his departure left a gap in mechanical engineering competence and capacity that cannot be filled under present staffing constraints. Some projects had therefore to be abandoned.

Mr D. Hartas, commenced with the section in June 1978 as STO-2 in charge of the Mechanical Technical Group which now comprises the complete section. Prior to this the duties of Program Manager and Group Manager had been shared by G. Thom and D. Stevens respectively.

In November the structure and classifications recommended for this group received formal approval but at time of writing the changes which might result from the approach had not been implemented. Experience to date has been that it will be difficult to realise the full advantages of a matrix structure in this relatively small section. Some progress towards diversification of duties and multiskilling has been made, and the advantages and disadvantages of working in multidisciplinary teams experienced.

The following staff were outposted for the full year:

M. Tratt	TO-1	Marine Geology
D. Foulstone	TA-2	" "
*R. Eaton	TA-2	Rock Measurements Group, Geophysical Branch
J. McIntyre	Main Mech.	Seismic Group, Geophysical Branch

In addition S. D'Arcy (TA2) was assigned to the magneto-telluric party, McArthur Basin Project for 6 months in 1978.

*Mr Eaton resigned in July leaving a gap that could not be filled from the Mechanical Technical Pool.

3.2 Electronics Technical Group

Mr A. Zeitlhofer acted as pool and program manager for this group from the inception of the new branch, and as a member of the management council he has represented the group in decisions on the form and implementation of management changes.

The planning involved in formulating the detailed programme and deployment of staff for the year's activities took a great deal of time. Another time consuming task shared with the Electronics Professional Group was the preparation of detailed work load statistics and information on classification levels required to carry out the tasks. This was needed not only for work planning but as background material for the department's investigations of the reorganisation of both the Electronics Technical and Electronics Professional Groups. At time of writing the proposed structure of these groups has not been finalised. The workload was well in excess of capacity necessitating the deferment or abandonment of lower priority tasks. Allocations to field survey activities took highest priority and accounted for approximately 20% of capacity.

Mr Zeitlhofer was involved in three committees external to the branch:

BMR Accommodation Standards Committee
TTO Training Committee
TAFE College Course Advisory Committee on Electrical/Electronic Engineering.

A small number of staff passed through the group's "Quality Assurance Training Program" which is aimed at retraining in the manual skills required to handle todays printed circuits and microcircuits and associated wiring technology. The aim is to ensure maximum reliability of equipment maintained, repaired or built within BMR.

Various local equipment seminars held by companies were attended during the year but the major event was the ANZAAS Technological Congress which was held in Canberra in May, and proved a stimulating experience for those attending. Details of all conferences attended are given in section 4.

Hugh Kirk, on aboriginal training for 12 months under the NEAT scheme commenced work with the group in September.

The following staff were outposted for the full year.

J. Grace P. Fowler	STO-2) TA2)	Seismic and marine geophysics
R. Dulski	TO-2	Marine geophysics and marine geology
J. Williams	TO-2	Crustal seismic geophysics group
L. Winters G. Green J. Eurell	STO-1) TO-2) TO-2)	Airborne geophysics
G. Woad B. Page	TO-2) TO-1)	Permanent Mundaring Observatory staff
D. Francis	TA2	Engineering Geophysics

In addition other staff were seconded to metalliferous (G. Jennings TO-2, R. Curtis TO-2) and seismic (D. Gardner TO-2 and G. Jennings TO-2) survey parties for lesser periods.

3.3 <u>Electronics Professional Group</u> (K. Seers, A. Spence, P. Hillman, B. Liu, B. Devenish, M. Gamlen, R. Cobcroft)

<u>Programme Management and General Administration</u> (K. Seers). These duties accounted for most of the programme manager's work. The Branch's electronic submission and consequent related work proved to be a very time consuming process throughout the year. The implementation and organisation of the electronic group's programme under the new management style was still an experimental learning process.

K. Seers commenced secondment on special duties for six months from October. B. Liu will act as programme manager during this period, and has prepared the electronic group's programme for 1979.

<u>Group Management</u> (A. Spence, P. Hillman)

A. Spence carried out the group manager's role until July when he departed for the McArthur Basin MT survey. K. Seers and P. Hillman carried out duties of group management for the rest of the year.

Recommendations were made for the purchasing of audio/visual training courses from the University of New South Wales. K. Seers represented BMR on the Bruce TAFE Course Advisory Committee for Electronic and Communication Certificate.

3.4 Procurement Group (P.E. Mann, S. Waterlander, W.E. Gunner)

The Procurement Group within the Geophysical Services Subsection became part of the structure of the Interim Engineering Services Branch when it was formed in November 1977. For the balance of the 77/78 financial year the group continued to handle technical investigations, specification writing and tender assessment on a wide range of equipment approved in the Geophysical Branch plant and equipment buying programme. Placement of a contract for computing equipment for on line digital processing of seismic records was markedly delayed because of the need to investigate the validity of the tender restriction to Hewlett Packard Australia Pty Ltd after the purchase of a larger computer by another Department became a political issue. Some items of plant and equipment approved in the 78/79 draft estimates were advanced to take up the short fall in commitment. In addition because of a delay in the delivery of a La Coste and Romberg gravity meter some plant and equipment items of high priority in the 78/79 draft estimates were advanced to meet the short-fall in cash.

Government policy of preference to goods of Australian manufacture has affected the award of a contract for crystal detectors for airborne radiometric surveys. BMR favours overseas equipment and the matter is still to be resolved. The influence of this factor may be more pronounced for plant and equipment purchases set down for 1978/79.

Under the new structure the workload will still primarily be for the Geophysical Branch although the IES Branch has its own equipment buying program.

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 groups for which the work was done.

4.1 Airborne Geophysics

4.1.1 Airborne Surveys (J. Burell, L. Winters, E. Chudyk and S. Wilcox)

McArthur Basin Survey

The McArthur Basin Survey was carried out between June and September from the airstrip at Gove using both the Aero-commander and the Twin Otter.

The equipment in the Twin Otter operated satisfactorily except for minor faults with the computer and cassette recorder. Early in the survey, an old DANA digital voltmeter was replaced with the more modern DANA 5800/A. (See para. 4.1.3).

The system in the Aero-commander was upgraded, the digital scanner being replaced with a computerised system. (See para. 4.1.2). Faulty triggering of the G803 magnetometer and camera control unit occurred on the survey. These faults were corrected on the survey and further investigated when the aircraft returned after the survey. The Aero-commander was taken out of service at the completion of this survey due to lack of operational funds, and the survey equipment was removed for maintenance.

Murray Basin Survey (G. Green, S. Wilcox and E. Chudyk)

The Murray Basin Survey being flown from Renmark using the Twin Otter started in October and is expected to finish in December. The equipment has operated well except for minor problems with the cassette recorder.

4.1.2 VH-BMR Aircraft installation (L. Winters, B. Devenish, M. Gamlen, G. Green, J. Eurell)

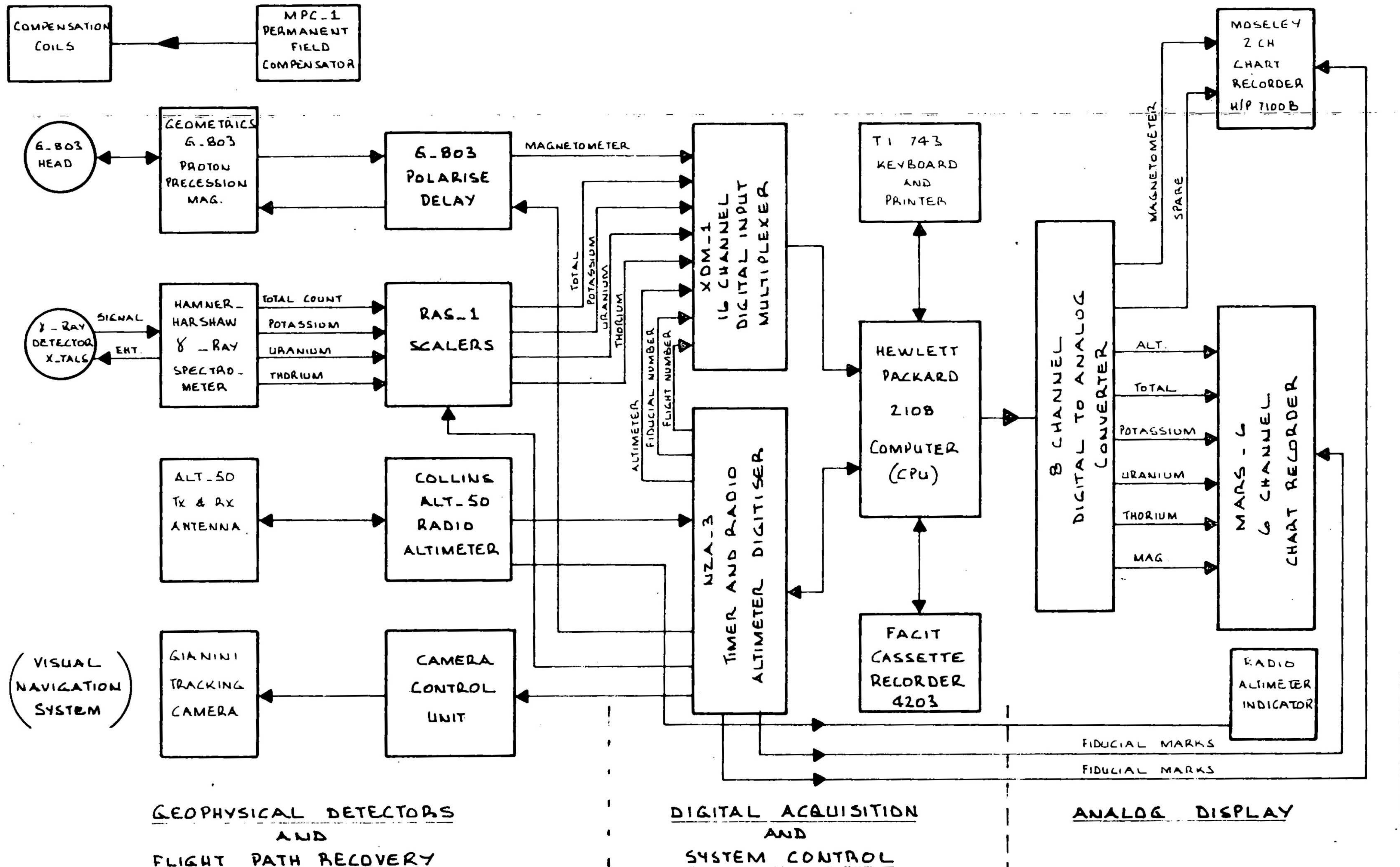
During the year, the system in the Aero-commander was upgraded, the Datamatic data scanner being replaced with a HP2100 MX Computer. A block diagram of the new system is given in Fig. 4.1.2. Other additions to the system were a NZA-3 timer and radio altimeter digitizer, keyboard and printer, Facit cassette recorder, 16 channel digital multiplexer and 8 channel D/A card. (Many of these facilities were originally provided by extra cards added to the data scanner). All other blocks were part of the original Datamatic based system. This upgrading made the system analogous to the system in the Twin-Otter aircraft.

The function of the timer NZA-3 in the system is to provide the basic timing signals. These signals are used by the CPU, the radiometric scalers, camera and magnetometer cycle start. The CPU co-ordinates the gathering of all the data and its recording on magnetic tape. The program is loaded into the CPU by means of the Facit cassette recorder which is also used for the recording of data. Communication with the CPU is by means of a keyboard and printer. The digital multiplexer enables up to 16 inputs to

FIG. 4.1.2

AERO COMMANDER VH-BMR

AIRBORNE GEOPHYSICAL DATA ACQUISITION SYSTEM OVERVIEW



be accepted using one I/O card. In this system, 9 inputs are used, two being required for the magnetometer. The 8 channel D/A card converts the digital data to analogue for chart recorders.

During the Gove Survey, some minor faults occurred which had not shown up during test flights around Canberra. These faults were corrected in the field so that the survey could continue.

4.1.3 VH-BMG Installation (Twin-Otter) (B. Devenish, J. Eurell, M. Gamlen, G. Green, S. Wilcox, L. Winters, R. Gan, K. Mort)

Few changes were made to the data acquisition system for this survey year, and it worked satisfactorily despite some trouble with computers and cassette recorders. Failing data output relays on the older digital voltmeter (used as the flux-gate magnetometer digitizer) were replaced with opto-isolators. This unit was replaced early in the survey by the more modern DANA 5000/A D.V.M. after it had been successfully modified. This unit was used successfully for the rest of the survey.

4.1.4. Airborne Instrument Development

Doppler digitizer (T. Dalziell, M. Gamlen, K. Mort)

A second Doppler digitizer, with added data latch for 'ground speed', was built to allow this information to be sampled by the data acquisition system multiplexer over a wider time range. An extra light emitting diode array to display 'track angle' was also included. This unit was installed in the Twin-Otter whilst serial no. 1 was upgraded to the newer specification. A single handbook covering both digitizers was written.

Airborne Timer (G. Green, M. Gamlen, K. Mort)

Construction of a third NZA-3 timer was commenced to provide a spare unit for either aircraft. Although some extra outputs were added to drive the new camera interface, the design changed very little. The timer handbook was amended and completed accordingly.

1000 cubic inch of Crystal for VH-BMR radiometric system (B. Devenish)

The radiometric system in the Aero-commander is to be upgraded to 1000 cubic inches of crystal volume. This system would send pulse heights in digital form straight to the CPU for analysis. To do this a peak detector and analogue to digital converter are required. Computer models of the peak detector were made and tested using the SPICE package. The models showed that the circuits operated correctly. However, it was found that a suitable instrument could be purchased to carry out the task so development of the computer models ceased.

8 Channel D/A Cards (B. Devenish, D. Downie, T. Daziell)

These cards are now being used in both aircraft. Small modifications were required to these cards to correct timing faults which occasionally occurred. A total of 10 cards have been made.

Camera Interface (B. Devenish, J. Eurell, M. Gamlen, R. Gan, G. Green, S. Prokin, D. Stevens)

As the BMR aircraft use a variety of cameras, a universal interface for inclusion in either airborne data acquisition system (D.A.S.) was designed and built. For routine geophysical survey work a 35 mm fish-eye camera is generally used in the Aero-commander and a 35 mm continuous strip camera in the Twin Otter; however as BMR owns two 35 mm Giannini frame cameras, and a 70 mm frame camera with remote aperture control mechanism, it was necessary to provide for all with the one interface box. Not only does this increase versatility, but it safeguards against camera breakdowns, preventing aircraft from flying. Computer or hardware control is possible with instant manual override of either control mode. In the camera the mechanical timer receiving pulses from the D.A.S. timer was replaced by a remote light emitting diode display flashing precise system time to the film. Three units were made and a handbook written.

MFS7 Serial No. 4 Fluxgate Magnetometer

Serial No. 3 was the first ruggedised version of the MFS-7 and Serial No. 4 will be the second. A complete set of boards (excluding AM6) has been made and tested, and are at present in use in No. 3 chassis "tuned" to No. 2 head. Another chassis has to be built by the Mechanical Group before Serial No. 4 can be finished as a complete operational spare.

4.2 Metalliferous Geophysics

4.2.1 Development of a Downhole Omnidirectional EM Probe

(R. Cobcroft, T. Dalziell, G. Thom, A. Kores)

The Metalliferous Geophysical Group require a downhole electromagnetic probe which is able to sense an electromagnetic field equally well regardless of direction. To date no commercial equipment available will do this. The Scintrex DHP-4 downhole TURAM system out of which this requirement arose is only capable of sensing that component of the EM field which is co-axial with the drill hole.

An electromagnetic probe was designed which used three sets of coils oriented in mutually orthogonal directions. There were 30 coils in all and 10 special subassemblies were manufactured to hold them at right angles to one another. The probe casing was manufactured from polycarbonate material for impact resistance and special attention had to be given to sealing the probe against water to a depth of 200 metres.

Amplifiers were designed and manufactured for mounting within the probe. They were necessary partly to bring up the signal level to improve signal to noise ratio, and partly to isolate the effect of the large inductance value of the untuned receiver coils. Untuned coils were used so that the system could be operated at a number of different spot frequencies. The downhole amplifiers proved marginally unstable in borehole tests, but the cure is not expected to be difficult.

For the uphole part of the system a large transmit loop excited by a TURAM alternator is laid on the surface of the ground around the site. The frequencies available by using three different alternators is 220 Hz, 440 Hz, 660 Hz, 880 Hz and 2.2 KHz. A reference coil is placed near the drill hole collar. The three components of the EM field measured by the downhole probe at depth are then compared with the signal sensed by the reference coil by means of a Hewlett Packard phase/gain meter.

The frequency response of the Z axis coils and amplifier of the probe was measured using a long solenoid driven by a constant current oscillator into which the probe was fixed. A resonance of the coils measured at 10 KHz agreed with design calculations, and is sufficiently far from the frequencies at which the system is to be used to be satisfactory. The overall measured sensitivity of the system also appeared to be adequate for the expected magnitude of the EM field at depth. The X and Y axis cannot be measured adequately at present until a suitable solenoid big enough to take the probe can be manufactured.

4.2.2 Modifications to Winch KWA-1 (R. Cobcroft, C. Rochford, T. Dalziell, W. Harkness)

The 10 000 foot Birdwell well logging winch proposed for use with the downhole omnidirectional probe project was found to be unsatisfactory because the winch could not be driven in both forward and reverse directions. Modifications were therefore made to the wiring of the present 1 HP electric motor which was connected to a new forward, stop, reverse switch. Also the new thicker cable was connected to the slip rings and wound onto the cable drum of the winch. The forward/reverse switching of the motor worked well, but the starting power requirements of the motor proved to be greater than could be supplied from a $2\frac{1}{2}$ KVA set as originally intended, and a 5 KVA set had to be used.

4.2.3 Receiver Coil Design and Manufacture for SIROTEM Transient Electromagnetic Instrument (M. Gamlen, R. Cobcroft, R. Curtis, S. Ioannou, G. Lockwood)

The Metalliferous Geophysics Group required a multiturn receive coil for the SIROTEM transient electromagnetic instrument which would be small enough to facilitate vector measurements. The calculated dimensions of the coil to give the required sensitivity were 700 turns for a coil diameter of 2 metres with an air core. Calculations of the inductance and capacitance of such a coil showed that there would be a resonant peak within the passband of the SIROTEM instrument. The effect of this resonance would be to distort the shape of the decay transient being measured. It was therefore decided to wind the coil in 100 turn sections so cutting down the self capacitance of the coil.

A non-magnetic coil former was constructed from marine ply and assembled without metal components. Special techniques and spacers were used to wind the coil in sections of 100 turns each. The coil was also fitted with stabilizing legs to help with field testing the system.

Field trials of the coil at Cobar showed that it was possible to connect 300 turns in series out of the 700 without causing problems, but with only 300 turns the sensitivity of the coil was really not enough. It is therefore intended to redesign the coil with a magnetically permeable core to increase the sensitivity.

4.2.4 Development of Tools and Techniques for Logging Deep Holes
(R. Cobcroft, G. Jennings, D. Stevens, P. Swan)

An opportunity was offered by CRAE for the Metalliferous Geophysical Group to log several very deep (to 1400 metres) BQ sized holes on leases to the south of the Broken Hill lode. This was seen as an important opportunity and three techniques were chosen for trial. They were:-

(a) Time-domain induced polarization.
(b) Downhole Turam using the Scintrex DHP-4 probe with the HP phase/gain meter substituting for the Scintrex compensator.
(c) Same as (b) except that the signal source is changed from a TURAM loop to a six phase rotating dipole transmitter galvanically connected to an array of earth stakes.

For the induced polarization logging it was necessary to manufacture three IP probes to suit the cable head of the 3,000 metre logging truck. These probes were set up as pole-dipole array with a brass current electrode at the lower end and two lead covered brass potential electrodes spaced above this. The three dipole spacings chosen were 2 metres, 10 metres and 30 metres. The probes were manufactured from high pressure airhose with clamps fastening the hose on the metal electrodes and the cable connection. The wiring was left slack within the hose.

The 3,000 metre cable on the winch was tested with a high voltage non-destructive tester to establish maximum voltage limits so that the IP transmitter output voltage could be limited to protect the expensive logging cable.

Although the IP probes performed well on survey the holes were slow to log particularly with the short spaced dipole. This was because the equipment available (namely a Huntec time-domain IP transmitter and a Scintrex IPR8 receiver) made it necessary to operate the winch intermittently and the readings were taken with the winch stationary. A worthwhile task would be to automate the process.

Both for the downhole TURAM and the rotating current dipole source downhole EM it was intended to use the Scintrex DHP-4 probe. To do this it was necessary to manufacture an adaptor to make connection between the cable head and the probe. Also in both cases it was intended to use the HP phase/gain meter together with the uphole amplifiers borrowed from the omnidirectional probe project.

The downhole TURAM system was set up with a 1 kilometre by 1 kilometre square loop laid out around the area. The projection of the inclined drill hole on the surface of the ground was 900 metres long. The loop was therefore laid out with the hole collar off centre so that the surface projection of the hole was completely contained within the loop. A 2.2 kHz alternator was used to excite the loop.

Entirely anomalous results were obtained when the hole was logged. As the probe decended deeper the amplitude of the signal steadily increased. By means of a series of experiments this anomalous effect was shown to be due to earth currents in the outer metal sheath of the cable. To effect a cure for the problem it will be necessary to redesign the cable head adaptor using non-conducting material and bringing the signal up in a cable pair isolated from the outer sheath of the cable.

Because of the requirements of the downhole TURAM trial and the rotating current dipole source EM trial for the Scintrex DHP-4 probe both trials had to be abandoned until the required adaptor can be manufactured.

4.2.5 Survey Preparation and Support (A. Zeitlhofer, R. Curtis)

Preparation for the Cobar survey included servicing and check-out of Geometrics 816 magnetometer, Geometrics 803 set up for continuous recording, McPhar fluxgate magnetometer, the high power Geotronics transmitter and Huntec & McPhar I.P. equipment. Recorders and an S.P. backing off facility were provided for some experimental techniques and the support of a technical officer provided in the field.

4.3 Engineering Geophysics

4.3.1 Digital Seismic Data Acquisition System (B. Liu, W. Greenwood)

System debugging was carried out on the DAS prior to the Newcastle coal field high resolution reflection seismic survey. Inteference from a switching regulator power supply was largely reduced by rationalisation of earth loops and common mode rejection.

An external geophone continuity test box was constructed so that some simplification of chassis wiring in the SIE amplifiers could be implemented. Investigations were carried out to find a more permanent solution to eliminate some spurious oscillation on the SIE amplifiers at higher gain settings.

4.3.2 Seismic Energy Sources for High Resolution Digital System

A suitable non-explosive energy source has yet to be obtained for both engineering geophysical surveys and for high resolution reflection seismic surveys such as is required for structural investigations over coal fields.

In January 78 a proposal to build a hydraulically driven frequency controlled source was submitted by the branch's mechanical engineer, Dr D.B. Stewart. In effect this was a low power "vibroseis" operating to frequencies in excess of 200 Hz. This proposal had to be abandoned following Dr Stewart's resignation. Recently there have been indirect reports of a commercial "vibroseis" system being extended in its upper frequency range to meet this need, which makes a revival of the BMR proposal very improbable.

Little was done during the year on the "Whacker" road tamper as an energy source, an approach which has inherent signal/noise problems. Enquiries are being made about a hydraulic hammer recently advertised by Prackla-Seismos. This appears the best prospect as an impulse source for high resolution work.

4.3.3 Design and Construction of a Differential Magnetometer (K. Seers, R. Cobcroft, L. Miller, E. Chudyk, S. Ioannou, A. Kores)

A request came from the Engineering Geophysics Section for the design of a control circuit to enable a Geotronics G803 HP proton precession magnetometer to be used with two head units in a differential mode. The controller had to switch heads at the right time in the magnetometer cycle so that the polarising current was off at the time of changeover in order to avoid arcing at the relay contacts. A reading was to be taken with one head and the value of this reading was to be latched; then another reading taken with the second head and also latched. The two readings together with their difference were to be output as analog voltages to a three pen chart recorder. The chart motor was then to be turned on for two or three seconds drawing three traces on the chart.

The control circuit was designed and built but required two further major design changes before a satisfactory system could be achieved. That system will be field tested as soon as manpower becomes available.

The design concept of a suitable supporting arrangement for the magnetometer heads was completed by the Mechanical Section (A. Kores). This will allow rapid traversing with variable vertical and horizontal spacing between heads. Construction has been deferred until completion of tests for the gradiometer prototype electronics.

4.3.4 Eh - pH Probe

The probe is required for groundwater pollution and mineralisation studies and is intended to operate to a depth of 100 metres. Sensors and up-hole electronics were purchased and design commenced on the down-hole probe.

4.4 Well Logging (G. Jennings)

The main logging activities during the year consisted of a cooperative program with Metalliferous Geophysics, and an account of logging at Broken Hill in early August is covered in part 4.2. No special mention is made however of logging in Cobar in late August where the same system was used.

4.4.1 I.P. Logging Tools (G. Jennings, I. Hone (Metals Group), A. Kores, R. Grigg, S. Prokin, P. Swan)

The task team approach which was used to produce these tools in time for a survey at Broken Hill worked well. See para. 4.2 for technical details.

4.4.2 Adoption of DHP-4 probe to 3.000 metre Logger (G. Jennings, D. Stevens).

An adaptor was constructed to allow the DHP-4 EM probe to be used with the 3.000 metre logger cable head. However the unsheathed cable caused unforeseen earth current return problems necessitating some redesign. See 4.2.

4.4.3 Miscellaneous Tasks - 3.000 metre Logger

Routine maintenance of the logger including stripping down, cleaning, checking and resealing of down-hole tools was carried out. A faulty mechanical depth counter was replaced by an electronic up/down counter designed and built by J. Mangion (TTO). Only minor faults in the power supplies, hydraulics, recorder and down-hole tools occurred during field activities.

A density tool used with the logger in 1977 and borrowed from the Queensland Coal Board was repaired and returned. An investigation was also made of density tools commercially available.

4.4.4 Logging in Queensland (G. Jennings)

The 3.000 metre logger was used to log a Geological Survey of Queensland bore at Beaudesert in September. Gamma-neutron and temperature and differential temperature logs were run to 1204 metres and S.P. and resistivity logs from 701 to 1204 metres. An attempt at a caliper log failed due to clogging and failure of the tool motor. The tool has since been dismantled cleaned and repaired. An attempt to run plastic casing to preserve the hole for heat flow measurements failed.

At time of writing the logger is on site at another GSQ bore being drilled at Port Alma near Rockhampton. The bore is in shales which collapsed before the uncased upper part of the bore could be logged.

4.5 Engineering Geology

4.5.1 Bore Flow Pump Test Unit (G. Thom, E. McIntosh, D. Hartas)

The assembly of this unit consisting of a hydraulically operated crane jib and winch together with a motor generator set and positive displacement pump head - all trailer mounted - was completed in April 1978. Since then the unit has been plagued with operational problems within the hydraulic circuitry.

Hydraulic system modifications have been carried out, these being:

i) elimination of inadvertant operation of the winch or jib directional control valves (D.C.V.) by ensuring hydraulic pressure was not available at these valves when not needed.

ii) rerouting accumulator (reservoir of pressurised oil) charge line to achieve full pressure charge without the necessity to loading the wind hydraulic circuit.

iii) relocating a pressure reducing value (P.R.V.) from downstream of accumulator which was, due to an inherent operational factor of P.R.V.'s, continuously bleeding away accumulator pressure.

There remains one hydraulic difficulty to resolve and this is choosing between:

a) persisting with the existing winch brake philosophy involving the accumulator pressure to operate a disc brake when winch D.C.V. is moved to neutral - there is some doubt regarding its reliability and hence safety.

b) or redesigning and changing the braking philosophy to a spring applied brake when hydraulic pressure is relieved. The main advantage will be a fail safe action.

The project team was diverted onto other urgent projects in November pending further investigation of the braking system. Work is expected to recommence on the unit in January 1979.

4.6 Observatories

4.6.1 Controller for Gnangara Automatic Magnetic Observatory
(B. Liu, G. Russell-Smith, F. Clement)

A controller XMA-3 was designed and constructed for the Gnangara digital AMO. The unit interfaces the Elsec AMO system with the magnetic incremental recorder, with facilities for hard copy printout. Optional facilities include cassette recorder and second incremental recorder for back-up functions.

Construction of 3 printed circuit cards and chassis wirings was completed. As the I/O function of the XMA-3 controller is the same as the earlier XMA-1 controller, it is planned to test the unit in the Kowen Forest AMO, prior to the arrival of the Elsec system towards the end of this year.

4.6.2 Digital F System (B. Liu, K. Jurello, D. Pownall)

Major chassis rewiring was carried out on the S/N1 XMA-2 controller to make it compatible with the S/N2 unit. Extensive system tests on both units were carried out with the borrowed G.E.D. clock and other simulated inputs.

The Antarctic digital stations were again postponed due to lack of digital clocks. The digital F system will be set up in the Toolangi Observatory when the clock and proton magnetometer become available.

Timing diagrams and documentation on the controller were modified and updated.

4.6.3 Canberra Automatic Magnetic Observatory (B. Liu, K. Jurello, A. Zeitlhofer, W. Greenwood, G. Rochford)

A BCD line printer was added to the Kowen Forest AMO to provide in-situ hard copy print out for the XMA-1 controller. An interface circuit was designed and constructed for the printer. The unit with a laboratory power supply was installed in the AMO in October and appeared to be working satisfactorily. Repackaging will be carried out when the printer power supply module is delivered. It is hoped that the printer will eventually replace the paper tape punch unit which has been a source of trouble for quite some time.

The AMO was repaired after developing a sequencing fault. The signal strength of the magnetometer was increased considerably by installing a new sensor fluid container and replacing the old signal cable and returning the pre-amplifier.

A system noise problem was overcome by floating the equipment rack.

Assistance was also provided in the re-location of the CMO from the old Kowen site to the new East Kowen Observatory.

4.6.4 <u>General Observatory Equipment Maintenance</u> (A. Zeitlhofer, W. Greenwood, C. Rochford)

General maintenance in support of the existing seismic and magnetic observatory network was carried out throughout the year. This included repairs and modifications to digital clocks, seismic amplifiers, Sprengnether seismograph, accelerographs and other equipment.

4.6.5 <u>Observatory use of Proton Magnetometers for Vector Measurements</u> (K. Seers, S. Scherl, D. Hartas, S. Prokin, R. Smith)

Three BMR proton magnetometers, type MNS2, were modified and made ready for use in the vector coils at Toolangi, Canberra, and Gnangara observatories. Operation over the range 22nT to 72nT is required with a resolution of 0.1 nT. At the time of writing, a unit had been operating at Toolangi for some weeks with satisfactory results. The construction of the sensor used with these magnetometers is under investigation with the aim of reducing temperature problems and improving signal level. The MNS2 handbook was completed.

Two nylon circle clamps were constructed (non-magnetic clamps) to enable the magnetometer head to be suspended centrally within the vector coil base.

4.6.6 Electronic Variometer (B. Liu, K. Jurello)

The electronic variometer is an alternative to the photographic variometer recorder, and will be used initially with an H La Cour sensor. Its advantages include long term reliable operation without the necessity for photographic processing, digital magnetic recording, and distant telemetry monitoring. The electronic system adopted is one with servo-controlled loop for the Helmholtz coil using negative current feedback principles. Some experiments with incandescent light source and laser source were carried out, using d.c. and modulation techniques. Theoretical loop response was evaluated and mechanical design for the light source photo-cell assembly was carried out.

4.6.7 Mundaring Magnetic Observatory (G. Woad, B. Page)

Activities are reported in Geophysical Branch annual summary.

4.6.8 First Order Magnetics (K. Seers, A. Zeitlhofer, W. Greenwood, C. Rochford)

The Adkin 3 comp. Fluxgate Magnetometer was extensively modified and recalibrated before it went on survey. A temperature probe was installed inside the sensor head which reduces the lag between temperature changes and the actual magnetic changes. Temperature is now continuously recorded on an additional recorder channel, thus providing improved systems accuracy. Twice during the year's field work, the Adkin was returned to Canberra for repairs, mainly due to operational wear and tear, travelling on rough roads, using portable generators and having to connect and disconnect sensor leads etc at each new station.

From the experience gained during the survey further modifications are contemplated for any future usage of the system. The extensive modifications to the instrument paid off and overall the survey progressed well to expectations.

4.6.9 Conversion of Photo-drum Recorders to Heat Write (G. Thom, S. Prokin)

For reasons of economy and convenience the Observatory Group in 1976 commenced a program to convert photographic drum recorders to visual (heat sensitive) writing. A prototype using the principle employed in the Geotech Helicorders was completed in 1978 and is now undergoing tests.

The mechanical conversion involved design, drafting and workshop activities. Construction time in the workshop was considerable due to difficult and intricate machining processes e.g. the machining of a hole the full length of recorder drum to accommodate drum paper tensioning rollers and operating mechanism. Other modifications consisted of alterations to the recorder base frame to enable mounting of drum movement limit switches, control switches, the provision of a box section pedestal to house wiring terminals, galvanometer motor and stylus.

A number of drum recorders for use at Mawson, Macquarie Island and Toolangi remain to be converted, but when and if the conversions go ahead will depend on the outcome of the tests on the prototype, and the economics of conversion costs.

4.7 Regional Surveys Group

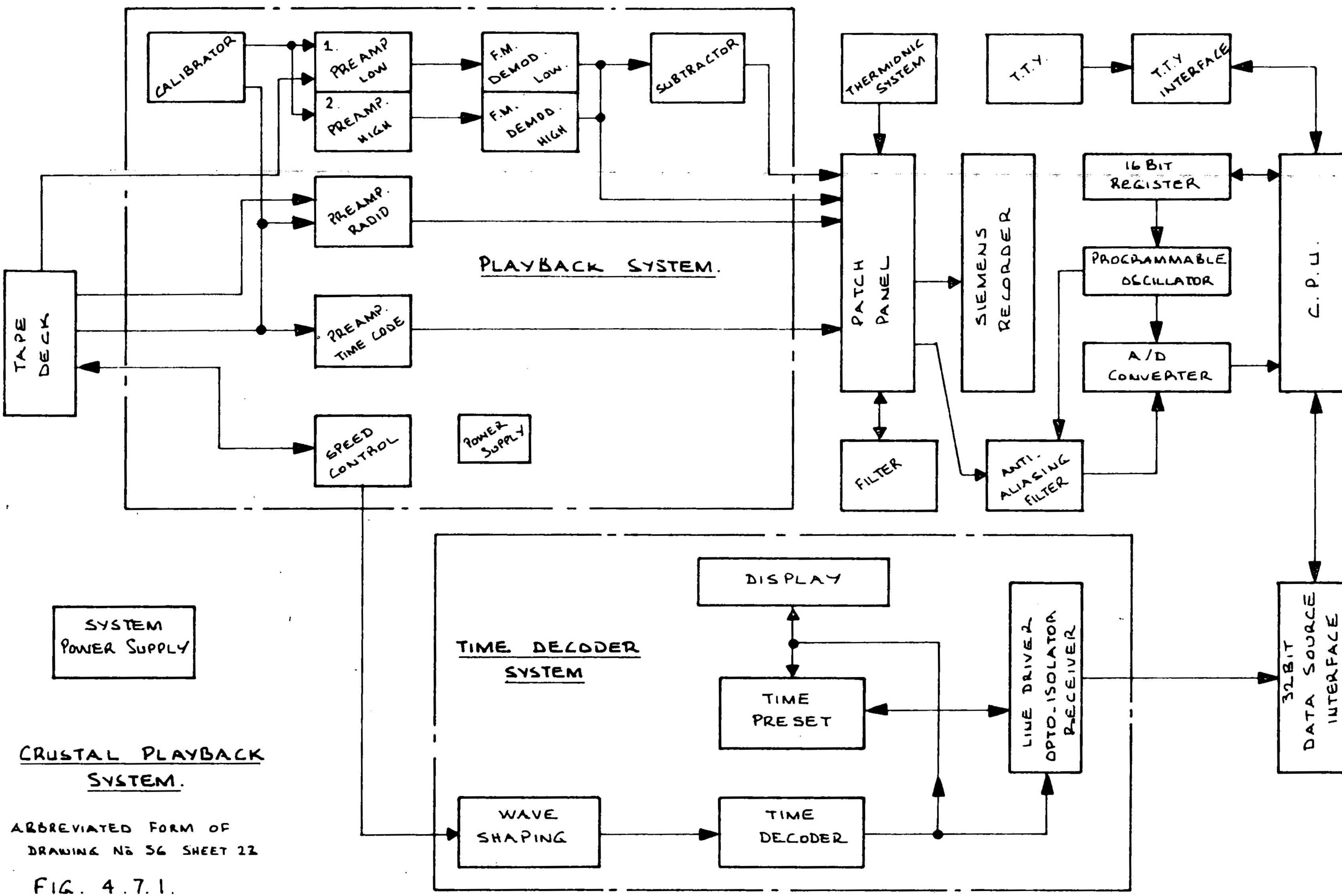
4.7.1 Crustal Seismic Playback System (B. Liu, K. Jurello, D. Gardner, F. Clement, K. Mort)

1978 saw the installation of the BMR designed crustal tape playback system (Fig. 4.7.1). This computerised automatic tape search and playback system has greatly reduced manual labour in processing large quantities of magnetic tapes from the regional crustal surveys, and facilitates digital signal filtering and correlation in the computer.

Major tasks completed during the year for the crustal playback system include:

- a programmable oscillator to provide programmable sampling interval control to the A/D converter.

- an anti-aliasing filter which is programmable by the computer according to the sampling interval.



CRUSTAL PLAYBACK SYSTEM.

ABBREVIATED FORM OF DRAWING No 56 SHEET 22

FIG. 4.7.1.

- upgrading of the IRIC time decoder to correct for time lag.

- upgrading of the tachometer speed control system for the tape drive.

- construction and packaging of a field playback system for the Lachlan Geosyncline crustal survey.

4.7.2 Regional Seismograph Stations (B. Liu, J. Williams, D. Gardner)

Since 1974 the regional seismograph stations have been successfully deployed in several major crustal investigations, including the 1977 Pilbara survey. The current consumption on these recording stations is considered to be too high, judged from the equivalent which could be built using today's available IC technology. It was decided in May that due to resource constraints, the upgrading of these recording stations should be limited to the replacement of the digital clock, tape deck motor and its driving electronics.

After evaluation of several design approaches to the new crystal clock, it was decided to adopt conventional MSI CMO logic. The advantages of this scheme include less current consumption, ease of interface and rationalisation of logic levels. Preliminary circuit design of the clock and IRIC time code generator was completed. Several innovative automatic time correction schemes were evaluated with breadboard construction.

Twelve second-hand Tanberg tape deck units were purchased. Evaluations were carried out on the integration of a low current d.c. tape drive motor and a four channel recording head. Twelve units of light weight seismograph stations based on these tape decks will be packaged in the next two years.

4.7.3 Antarctic Aeromagnetis - Use of Proton Magnetometer (K. Seers, S. Scherl, M. Gamlen, R. Gan)

Some development work was continued to improve performance of the MNS2 magnetometer as an airborne instrument. A narrow-band tracking filter design and the re-design of the input amplifier were postponed when field work for 78/79 was cancelled, but will be resumed in 1979 for the 79/80 season.

4.8 Rock Measurements and Palaeomagnetism

4.8.1 A.F. Demagnetiser (S. Scherl, M. Gamlen, R. Eaton)

The power supply unit for the Helmholtz coils used to back off the earth's field was completed in 1977, and the prototype control unit for the demagnetising system had also been completed and was in use in 1977. Two production models of the control unit for the demagnetising system are required. Production of these new units has been slow mostly due to long delivery of some components. At time of writing a power supply module required to complete the first production unit had just arrived. Completion of the second unit however is dependent on salvaging components from the prototype. Both production units should be complete by the end of 1978. Diagrams for the control unit have been completed and writing up is fairly well advanced. In addition further documentation is required of the Inductrol unit and the Helmholtz coil backing off system.

4.8.2 Palaeomagnetic Data Interface, design and construction (P. Hillman, G. Russell-Smith)

This task is part of a joint project with the A.N.U. which was started in May 1978 and should be completed in December or early 1979.

The interface is needed to match the output of a SQUID magnetometer, which is used by A.N.U. and B.M.R. for measuring palaeomagnetism in rock samples, to the input of a Hewlett Packard 2100 series minicomputer for data storage and processing.

Two independent channels of digital information are obtained from the magnetometer. Each channel provides 5 digits of 4 bits, 4.5v CMOS, in a series/parallel arrangement with coding to correlate digits and bits. The computer card requires a 10 to 15 volt amplitude digital input for reliable operation. Two printed circuit cards which provide complete isolation between their inputs and outputs, using opto-isolators, have been designed and assembled. They are mounted in a small aluminium chassis which also contains the 15 volt power supply needed to drive the minicomputer input board. The input and output plugs and sockets are mounted on the rear panel of the chassis.

The software program for the computer has been written by the A.D.P. section of BMR.

4.8.3 Miscellaneous Mechanical Tasks (R. Eaton et al.)

Apart from preparation of rock samples and other laboratory work R. Eaton completed the following tasks prior to his resignation in July.

(1) construction of a kerosene coolant recirculating system for the rock coring machine for use with specimens friable in water;

(2) a specimen holder for the small diamond saw;

(3) a special Hassler cell for the acid separation of haematite phases from rock specimens.

Six coring drill bits used for palaeomagnetic sampling were repaired and modifications made to 12 new bits. A vice for use in preparation of rock samples was constructed.

4.9 Seismic

4.9.1 Equipment for Bowen Basin Survey (J. Grace, D. Gardner, P. Fowler, J. McIntyre et al.)

Preparation of the recording cab and equipment and other specialist vehicles took place in early 1978 prior to a survey in May at Gundary Plains near Goulburn and in preparation for the Bowen Basin survey. Maintenance of the DFS IV digital system was carried out, and the equipment performed well for both surveys with only minor troubles.

Four National RJ-15A transceivers, 4 Pye FM 10D transceivers and 4 Philips FM 828 transceivers were repaired and tested for use on the survey, and an additional 4 new Philips FM 828/25E transceivers received in June were modified for shot instant transmission.

Geophone strings, and spread and jumper cables required continuous maintenance in the field and replacement of the connectors on the 48 channel spread cables with Amphib 110 connectors has been recommended for greater reliability.

4.10 Marine Geophysics

4.10.1 Marine D.A.S. (Data Acquisition System) (K. Seers, P. Hillman, M. Gamlen, B. Devenish, D. Gardner, D. Pownell, S. Ioannou, J. Watman, G. Russel-Smith, R. Gan) all part-time.

The D.A.S. block diagram produced in 1976 was revised and redrawn to bring it up to date. The major change was the introduction of a 15 volt Interface Unit between the two clocks and the C.P.U. See Fig. 4:10:1.

GED clock Type 105. One of these clocks has been used by the Marine Seismic section for software development, the second has been used by Electronic Development section for equipment development. Both operated satisfactorily throughout the year.

TAM 7 Amplifier/Filters. Sixty-four amplifiers were assembled and aligned by the end of September, the delay in assembly being mainly due to very long delivery times on a few of the components. They are being tested in batches of 8 to check that they meet the specifications of gain, within 6% of nominal value; filter response, pass band frequency within 5% of nominal and ripple less than ± 2% within pass band; and noise in the bandwidth 0.1-10Hz, with gain set to 1000, to be less than 2 micro volts peak to peak.

TAM Amplifier/Filter Test Set. This test set has been assembled and is operating satisfactorily.

Digital Senders and Receivers. Three prototype boards of each type have been completed and fully tested. They operate satisfactorily with three 30 metre cables connecting the senders to the receivers. Production sender boards and receiver boards, 32 of each, have been purchased, the majority of the components have been received and the remainder are on order. Quotations for the contract assembly of the boards have been received and contracts will be placed early in 1979. Eight sender bins and four receiver bins have been purchased and are awaiting labour for assembly and wiring.

4.

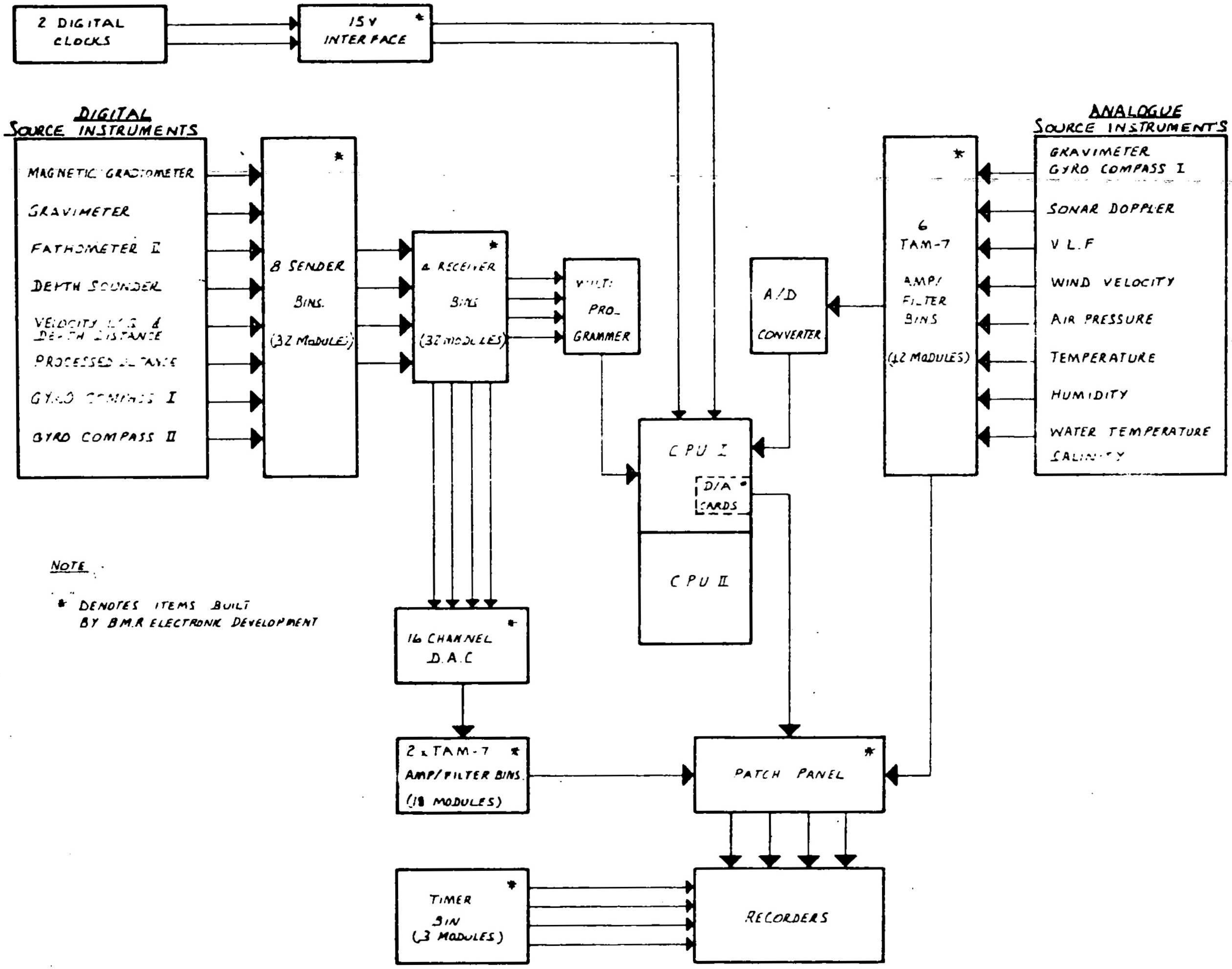

2 DIGITAL CLOCKS
15V INTERFACE *
DIGITAL SOURCE INSTRUMENTS
MAGNETIC GRADIOMETER
GRAVIMETER
FATHOMETER II
DEPTH SOUNDER
GYRO COMPASS II
8 SENDER BINS. (32 MODULES) *
4 RECEIVER BINS (32 MODULES) *
MULTI-PROGRAMMER
A/D CONVERTER
CPU I
D/A CARDS *
CPU II
ANALOGUE SOURCE INSTRUMENTS
GRAVIMETER
GYRO COMPASS I
SONAR DOPPLER
V.L.F
WIND VELOCITY
AIR PRESSURE
TEMPERATURE
HUMIDITY
WATER TEMPERATURE
SALINITY
6 TAM-7 AMP/FILTER BINS (42 MODULES) *
16 CHANNEL D.A.C *
2 x TAM-7 AMP/FILTER BINS. (18 MODULES) *
PATCH PANEL *
TIMER BIN (3 MODULES) *
RECORDERS
NOTE
* DENOTES ITEMS BUILT BY B.M.R ELECTRONIC DEVELOPMENT

Fig. 4·10·1.

Timers. The second prototype timer printed circuit board has been completed and tested. Components for assembly of eight boards have been obtained or ordered and delivery is expected shortly. Eight production printed circuit boards are available and should be assembled early in '79. Four "Elmaset" bins have been purchased and await labour for assembly and wiring.

Stand-along 16 Channel digital to analogue converter. The prototype module has been tested satisfactorily. Components for a further eight modules have been ordered and some delivered. Assembly of the modules and the bin wiring are held up because of lack of labour.

Patch Panel. Two plug in patch panels have been purchased together with connecting pins and patchcords. They have to be assembled into a single rack mounting unit.

Cables and Connectors. The cable for connections between the senders and receivers has been tested and is satisfactory. Three 30 metre cables have been made and used for testing the prototype sending and receiving modules. Two alternative types of cable have been obtained for connection between the TAM 7 outputs and the analogue to digital convertor, either is acceptable electrically but one is thinner, lighter and more flexible than the other.

4.10.2 Marine Tape Transcription (A. Devenish, C. Johnstone, J. Grace)

A request was made from the marine section to construct an interface box which would enable the transcription of analogue marine tapes into digital form. The interface box was constructed; its main functions are:

i) to enable the computer to stop and start the Ampex tape recorder;

ii) to set the flag in the computer when the time break occurs;

iii) to set a bit when the 10 minute mark pulse occurs.

A further approach has been made to develop a system where by the land seismic records may be digitized.

4.10.3 Marine Magnetometers and Shore Stations (J. Grace, R. Dulski et al.)

Equipment was overhauled and prepared for 4 surveys (1) National Mapping survey using the "Cape Don" off NW Australia in July-August; (2) cruise of "Sonne" over the Lord Howe Rise in October-November; (3) the Coral Sea survey of "Sonne" in November, and (4) the cruise of the "Sonne" off NW Australia in late 1978.

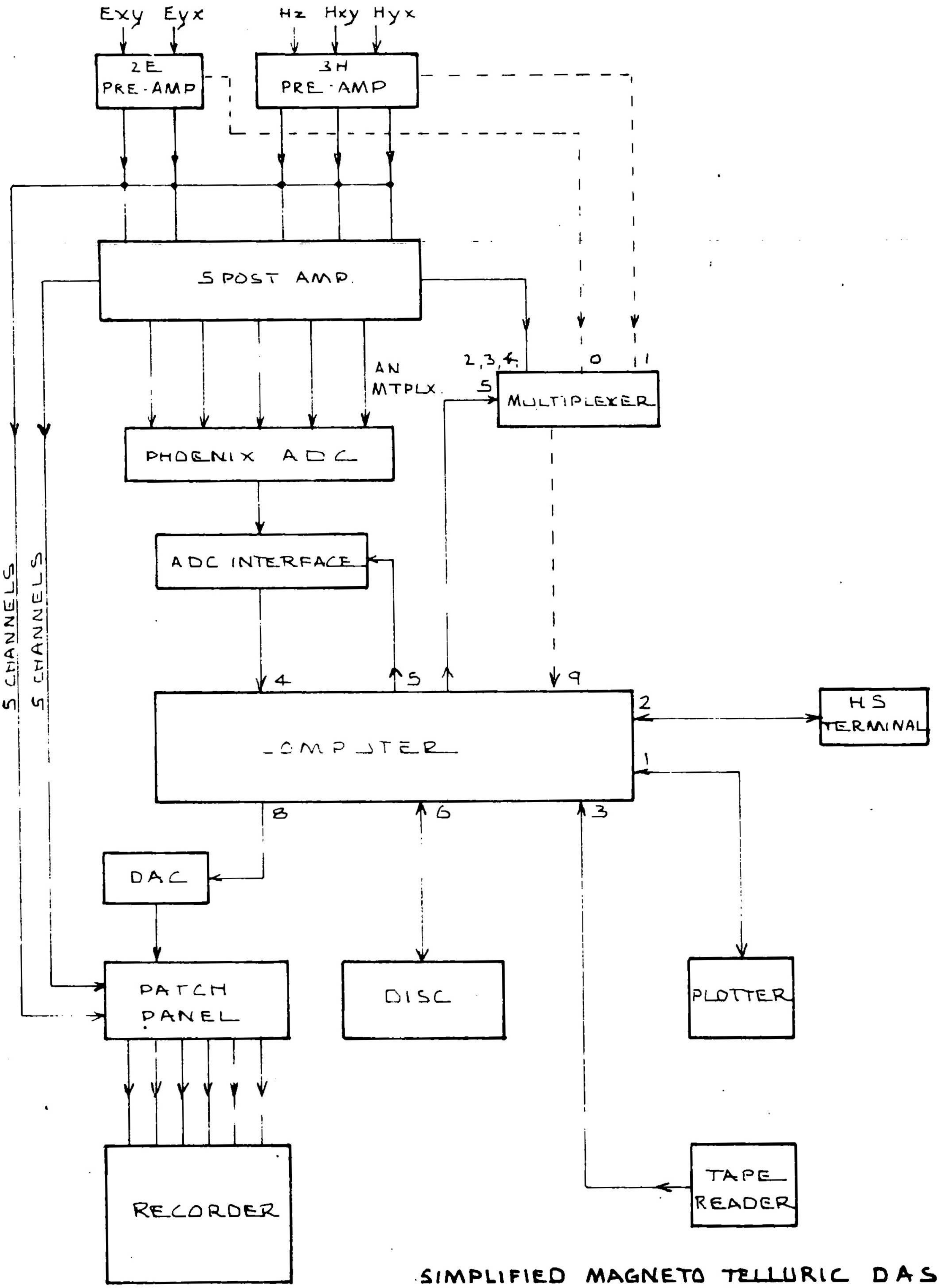
BMR's digital acquisition system, a Geometric marine magnetometer and "Digi-trak" were installed on the "Cape Don", and a shore station using a Geometrics magnetometer was set up at Carnarvon. A Geometrics magnetometer shore station was overhauled and set up on Lord Howe Island, and another Geometrics shore magnetometer (803), was set up at Townsville for the Coral Sea cruise of the "Sonne".

Extensive maintenance was carried out on the marine magnetometer cable winch (R. Dulski, E. McIntosh, W. Harkness and R. Gibb). The 240 V drive motor and electricals, the braking mechanism and drum assembly were overhauled and the total winch assembly protected from corrosion. A Geometrics marine magnetometer was also overhauled and the magnetometer and winch despatched to the "Sonne" in Brisbane in preparation for the cruise off NW Australia.

4.11 Marine Geology

4.11.1 Barrier Reef Drill and Vibrocorer (1978 survey) (E. McIntosh, G. Thom, A. Kores)

A coring drill and vibrocorer were designed for operation on reefs and under sea in shallow water. The rig comprised aluminium tripod with winching mechanism, hydraulically powered vibrocorer which utilised a jack hammer to drive 3" PVC coring tube into the sediments, and a hydraulically powered rotary coring drill. Petrol engines were used to power the hydraulics. Construction including contract work and local field tests was completed in February in time for the 1978 barrier reef survey. The prototype rig worked successfully.



SIMPLIFIED MAGNETO TELLURIC DAS
Fig. 4-12-1

4.11.2 Barrier Reef Drill and Vibrocorer (1979 survey) (E. McIntosh, D. Foulstone, G. Thom, A. Kores)

The rig is being prepared for the next survey in early 1979. Overhaul of the hydraulic power units, drills, jack hammer, winch etc are necessary, together with some modifications to the aluminium tripod and vibrocorer coring tubes.

4.11.3 Barrier Reef Tidal Sediment Sampling Tower (Marine Geology) (G. Thom, A. Kores, D. Stevens, B. Westmore, D. Foulstone)

Investigations, design and construction are underway to complete two towers for a field survey in February, 1979. There will be two, three metre high open frame towers, stabilised to the reef by guys and each tower rigged with sediment collecting bottles at different levels. These bottles will be fitted with sequential opening and closing mechanisms for sediment collection at varying tide levels.

4.12.1 Magneto-telluric System (B. Liu, B. Devenish, K. Jurello, G. Green, K. Mort)

Five new instruments were added to the magneto-telluric system (Fig. 4:12:1) during the first six months of this year and have significantly improved the data quality and system reliability during the 1978 McArthur Basin M.T. survey. All electronic equipment was fully functional upon arrival at the first survey site in McArthur Basin after three weeks journey by road.

The five new instruments were a 5-channel M.T. post-amplifier/filter unit, a digital multiplexer, 8 channel D/A converter, stand-alone power supply and 5 power plug-in modules.

The M.T. postamplifier/filter unit was designed in response to a new set of specifications with different filter bandwidth and gain steps. The use of D/A converter as control element for gain and filter has resulted in improving the accuracy and simplifying the construction of the unit. The output noise of the unit was reduced by 2,000 fold in comparison with the old unit mainly due to the elimination of chopper spike and hum pick up.

The digital multiplexer replaced a multiprogrammer which had been borrowed for the M.T. system. The filter and gain settings of the amplifiers were multiplexed via opto-isolators to the 32 bits data source interface unit of the CPU.

The 8 channel D/A converter provided analogue outputs of the digitized results stored in the DAS.

The power supply unit and modules replaced the older commercial units which were plagued by breakdowns in previous M.T. surveys.

4.12.2 Equipment Performance - McArthur Basin Survey (A. Spence, J. Major, S. D'Arcy)

Figs. 4:12:2 a & b show the rotated tensor plots from "Shanno" site on the McArthur Basin survey. Some appreciation of the very good data quality can be obtained from the smoothness of the plots (triangles) of the processed observed data. The continuous lines are the theoretical curves resulting from the ID earth models derived from the observed curves by ID inversion modelling in the DAS computer. See the McArthur Basin Report Geophysical Branch annual summary for discussion of the full survey results.

The hardware and software "bugs" were removed from the system during a survey at Gundary Plains near Goulburn, prior to the McArthur Basin survey, and only relatively minor equipment problems were experienced during the survey.

Minor faults (e.g. a FET failure and faulty cooling fans) caused failures in the E and H pre-amplifiers. In the postamplifiers an intermittent fault in the logic coding of gain switch positions caused trouble but otherwise they functioned well. The Gould plotter failed and analogue monitoring was carried out with a 4 beam storage CRO and a portable CRO. In fact, acquisition of a suitable CRO is recommended as a better alternative than the Gould plotter for routine monitoring of analogue data.

Heat caused problems in the Phoenix A/D convertor, and power supply troubles caused disc failures on several occasions. Otherwise the 21MX computer and the rest of digital system performed well.

M.T. ROTATED APPARENT RESISTIVITY - ALONG STRIKE

("SHANNO" SITE McARTHUR BASIN SURVEY)

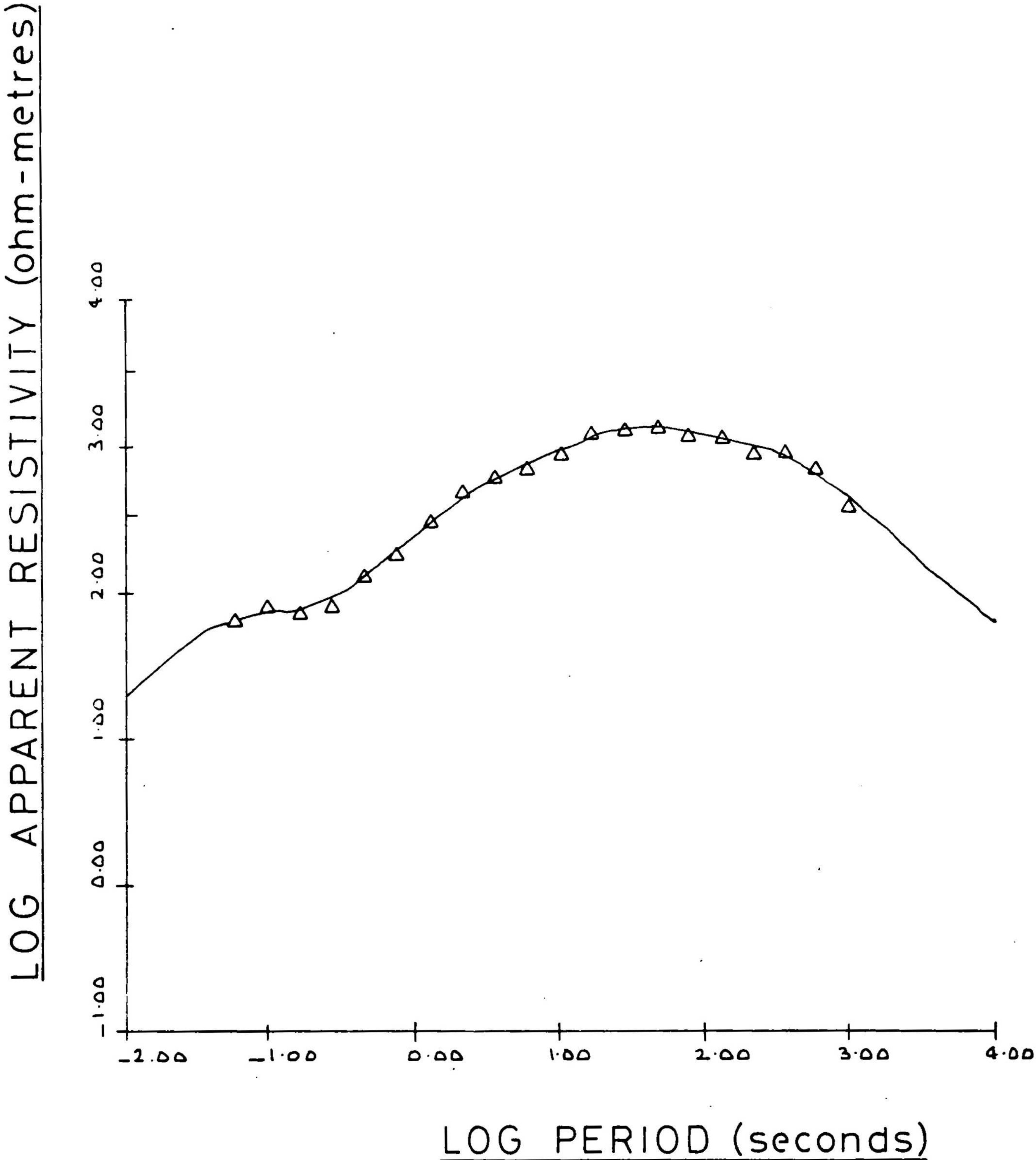


Fig. 4·12·2a

M.T. ROTATED APPARENT RESISTIVITY – ACROSS STRIKE

("SHANNO" SITE MC ARTHUR BASIN SURVEY)

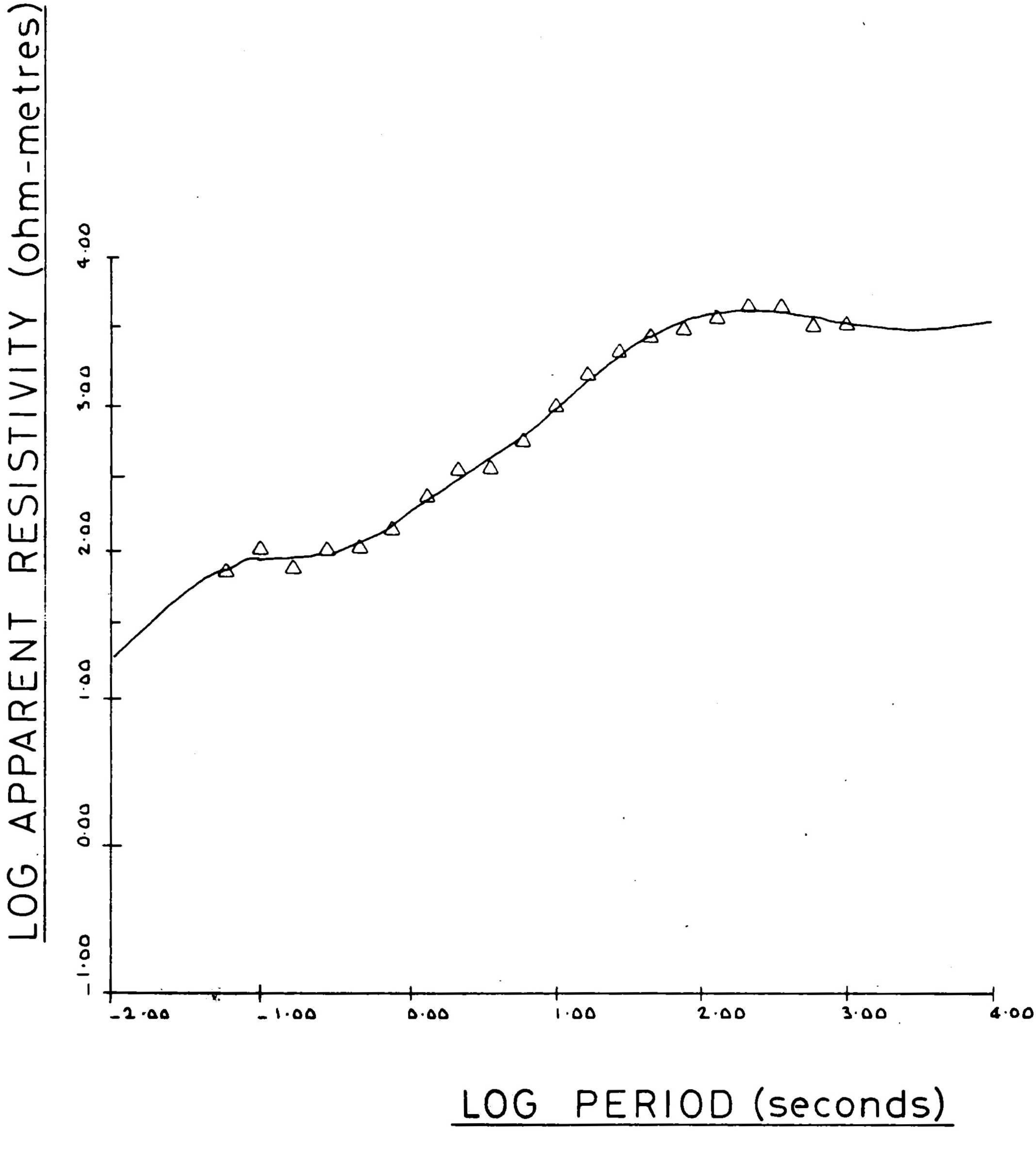


Fig. 4·12·2b

Acquisition and processing software performed well and difficulties encountered were always overcome by halting, purging and restarting. Nevertheless inadequate documentation of much of the software and only limited knowledge of the details of the software operation obtained by the operators programmed to continued M.T. work, must be seen as a weakness in the continued use of this technique.

Vehicles, motor generators etc., suffered in the rough terrain and caused inconveniences and delays, but not sufficient to seriously affect the field program.

4.12.3 <u>Equipment Performance - Gundary Plains M.T. Survey</u> (A. Spence, G. Major)

Two sites were occupied near Canberra and two on Gundary Plains near Goulburn prior to the McArthur Basin survey. On no site was a full good quality data set obtained, but the system problems were all diagnosed and corrected. Many minor instrumental faults were rectified but the two major problems were:-

(1) Noise originating from the "choppers" in the preamplifiers saturating the postamplifiers. This was overcome by incorporating a low pass filter in the front of the post amplifiers.

(2) Noise in the H channel signals. This was traced to galvanic noise in H channel sensor cables caused by ingress of water. New cables overcame the problem.

Another site on Gundary Plains was occupied in November after the McArthur Basin survey and one full data set obtained. However noise on the E channels suspected to be due to man-made inteference downgraded data quality in the upper frequency bands.

4.13 <u>A.D.P. Group</u>

4.13.1 <u>General Installation</u> (C. Rochford, W. Greenwood)

Some time was spent in repairing and calibrating the Gradicon digitizer for the drafting section.

A number of computer terminals were established in various parts of the building. Some of these were connected to the H.P. system and others to the Cyber.

Minor repairs were carried out on the Gould line printer. Various cables were made for the A.D.P. section.

4.13.2 Construction of 16 channel digital multiplexers (B. Devenish, D. Gardner, J. Eurell)

Four multiplexers are to be constructed altogether. So far two units have been constructed and used in the field, one in the magneto-telluric system and the other in the Aero-commander survey aircraft.

Each unit has its own specific power requirements. The unit in the magneto-telluric system runs off 115 volt 400 Hz while the aircraft unit uses 28 volt D.C. Some time was spent in developing a switching regulator for the aircraft unit. This was done to reduce heating. The magneto-telluric system required the multiplexing of non-standard logic levels. To facilitate this requirement, the possibility of using opto-isolated inputs was provided.

Fig. 4:13:2 is a simplified block diagram of the system. A strobe signal from the computer latches all the input data. Three bits from the computer determine which input channel has its data valid on the tri-state bus. This data is then transmitted, via a buffer, to the computer.

The multiplexer units were used in preference to I/O extenders due to their light weight and compact size.

4.14 I.E.S. Branch Projects & General Services

4.14.1 Computer Aided Design - Electronics Design (K. Seers, R. Cobcroft)

During the year an ad-hoc committee of CSIRO Cyber computer users who were interested in computer aided design was convened. The BMR sent representatives to some of the meetings of the committee.

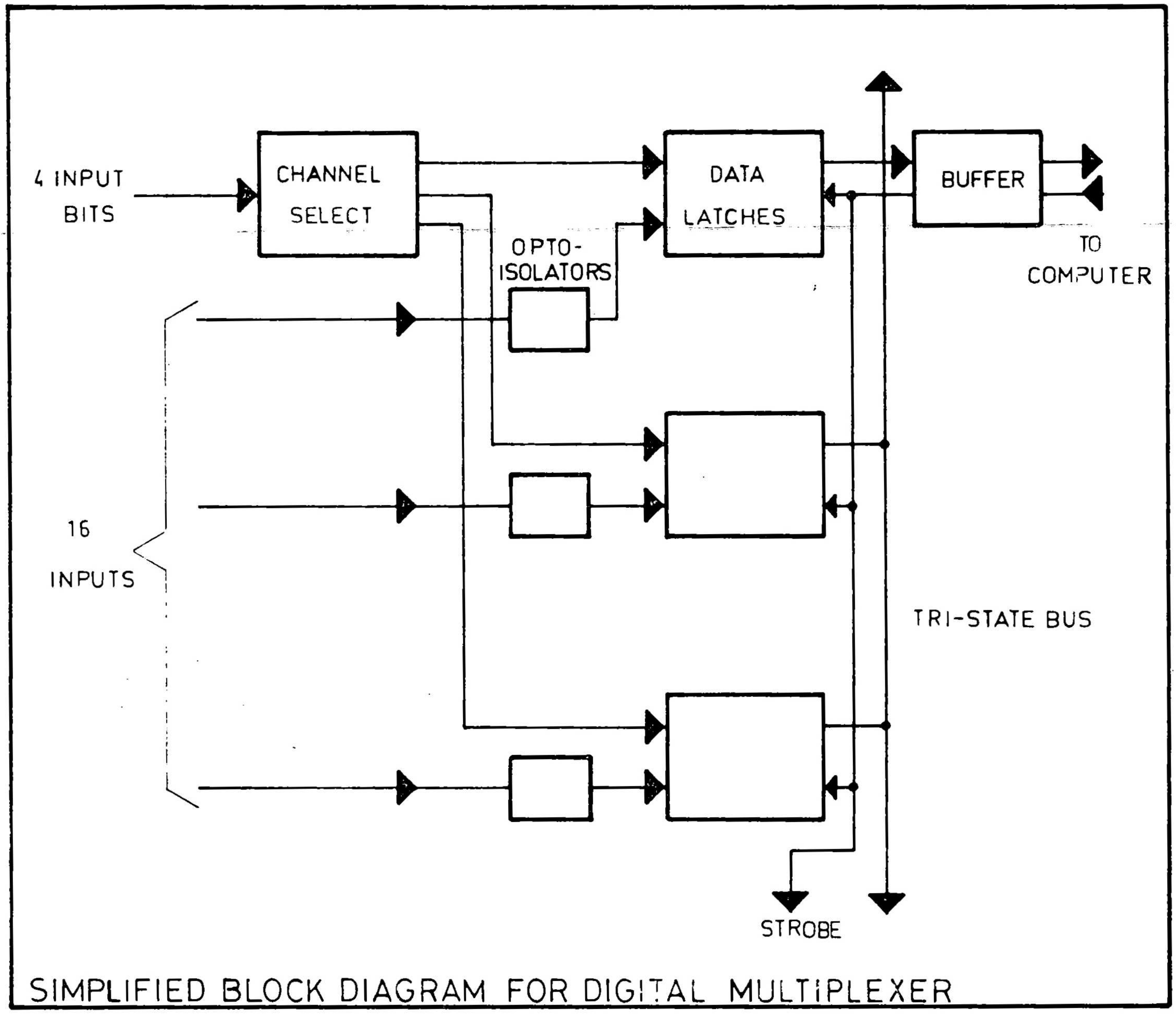

4 INPUT
BITS
CHANNEL
SELECT
DATA
LATCHES
BUFFER
TO
COMPUTER
OPTO-
ISOLATORS
16
INPUTS
TRI-STATE BUS
STROBE
SIMPLIFIED BLOCK DIAGRAM FOR DIGITAL MULTIPLEXER

fig 4.13.2.

Although the topic of computer aided design is a very wide one the immediate interests of the electronic design sub-section of the BMR narrows down to the following:

Network analysis and simulation
Printed circuit board layout design
Drafting layout
Simulation of digital networks

Prior to the formation of the CAD committee the electronic design group in the BMR had been using the electronic circuit analysis program (ECAT) for network simulation. This language, while it is useful and convenient for many purposes has been followed by circuit analysis and simulation languages which are far more powerful.

One of these (SPICE 2) was made available through the committee. We tested this language with a number of problems and found it to be much better than (ECAP). We therefore made a permanent copy of the source language and its compiled relocatable form also on the BMR private disc pack.

A free copy of the language (SCEPTRE) was obtained on tape from the USA. There have been problems in transferring the tape which was written by a CDC6600 computer to the CDC Cyber 7600 computer. These problems will be solved in due course and it is hoped to make the language available to others on the CSIRO Cyber network.

An order was placed for the purchase of (SUPER-SCEPTRE) and the library of device models to go with it. This language is commercially available but at not very great cost ($100) and is said to be able to handle the simulation of digital circuits very well.

A number of other smaller programs were acquired through the committee in the areas of printed circuit board design, wire wrap design and filter design. These will be tested and evaluated when time is available.

Two large programs for linear and non-linear circuit analysis were punched from their listings. The advantage of these programs (LINCAD) and (OSUCAD) is that they can be used interactively. It is intended to use them in this way on the BMR's in-house HP2IMX minicomputer system. Also to make copies available to other members of the ad-hoc CAD committee.

The programs are presently being installed on the HP21MX computer and will be tested when available.

4.14.2 Microprocessor (T. Dalziell, M. Gamlen, B. Devenish, R. Cobcroft, B. Liu)

A power supply and bus system for a Motorola 6800 microprocessor was built into a standard 5¼ in. rack box. This will facilitate interfacing and a little system expansion. Several officers have experimented with the processors and as a result several projects using microprocessors have been suggested for inclusion in the 1979 BMR programme.

The LCDS was interfaced with the RS-232 teleprinter. Some software programs were written and assembled in the Cyber 76 resident assembler. An additional 2 K memory and 1/0 units were delivered.

4.14.3 Sparker Seismic Source Investigations (Dr D.B. Stewart)

Prior to his resignation in January 1978, Dr D.B. Stewart had conducted a series of experiments to investigate the theory of the sparker seismic energy source with a view to developing a better means of controlling their emission spectrum and energy. He is continuing this work at the Duntroon wing of the University of NSW, School of Mechanical Engineering. At time of writing he was still awaiting delivery of test tank facilities and had borrowed sparker equipment and measuring equipment from BMR in preparation for further measurements. Theory and experiment are sufficiently advanced to see the possibility of a better high resolution seismic profiling source.

4.14.4 Instrument Laboratory (W. Burhop)

The only instruments added to the Instrument Laboratory instrument pool have been a logic kit comprising a logic probe, logic clip, logic comparasor, current tracer and logic pulser; and a Hewlett-Packard 97 programmable printing calculator which was obtained to perform calibration calculations simultaneously with calibration measurements. Keeping instruments operational, providing instruments and advice to customers and keeping track of instrument locations took all available time. No programs were written for the calculator and no routine calibrations performed during 1978.

4.14.5 Communications Equipment (W. Harkness)

Repairs and check out of all transceiver and other communications equipment continued throughout the year. Codan transceivers were serviced and channel frequencies changed or added as necessary to meet BMR's programmed activities. Frequencies had to be changed and channels added to 8 Codans obtained from AAEC.

4.14.6 Miscellaneous Activities - Electronic Technical Group

Porta-loggers, magnetometers I.P. equipment and such like used by a number of groups were repaired or maintained. Various other instruments used in the photographic darkroom, drawing office, geological laboratories and ADP were repaired throughout the year.

4.14.7 Miscellaneous Activities - Mechanical Technical Group

In addition to major programmed tasks numerous ad-hoc tasks were completed throughout the year. Most instrument maintenance work (R. Grigg, D. Stevens, S. Prokin) falls into this category and included overhaul and calibration of chart recorders, microbarometers, seismometers, airborne fluxgate magnetometer servo orienting system and similar instrumentation, modifications to geophones, AKAI tape recorder decks, paper tape punches etc. A diamond saw cover was built for the Palaeontology Group and a number of electronic chasses and panels were built in support of electronic development tasks.

In the heavy workshop (R. Westmore, E. McIntosh, S. D'Arcy, R. Gibbs) ad hoc tasks included overhaul and repair of a number of motor generator sets, many smaller jobs in connection with equipment installations in vehicles and throughout BMR.

The model shop (G. Lockwood) designed, constructed, modified instrument boxes and transit cases, show cases, storage racks, light tables, etc. and made and installed fittings in specialised field survey vehicles.

5. TRAINING, COURSES & CONFERENCES

5.1 Training

Two technical training courses recorded on Audio cassettes were purchased from the University of New South Wales. The titles are "Semiconductor Devices" and "Microprocessor Programming". After evaluation they will be used for training in the electronics group and the purchase of additional audio and video courses will be considered. This approach may overcome the problem of training electronics professionals in Canberra isolated as it is from the major engineering centres of Australia.

An in-house electronics quality assurance course is covered in Section 3.3.

K. Seers & A. Zeitlhofer were nominated as departmental representatives on the course advisory committee for the certificate courses within the Bruce College of TAFE School of Electrical Studies. Three committee meetings were attended in 1978.

5.2 Local Conferences

W. BURHOP R. COBCROFT	Measurement & Technological Change, National Measurement Laboratory, Sydney	OCTOBER
R. COBCROFT P. HILLMAN	Computers in Engineering, Institution of Engineers of Australia, Canberra	AUGUST
J. GRACE K. JURELLO S. SCHERL G. THOMAS L. WINTERS	ANZAAS Conference on Science & Technology, Canberra	MAY
D. HARTAS A. KORES G. THOM E. McINTOSH	Australia's International Engineering Exhibition 1978 Sydney	SEPTEMBER
G. RUSSELL-SMITH	8th Australian Computer Conference, Computer Society of Australia, Canberra	SEPTEMBER
A. SPENCE L. WINTERS	Microprocessor Systems, Institution of Engineers of Australia, Sydney	NOVEMBER

5.3 Training Courses

External

M. GAMLEN B. LIU	) Digital Signal Processing, University of Queensland,) Brisbane	MAY
D. HARTAS	) Sperry Vickers Industrial Hydraulics Course,) Sydney	SEPTEMBER
G. JENNINGS	) Introduction to well logging (Schlumberger)) Melbourne	NOVEMBER

Internal

W. BURHOP	) "On the job training"	MAY/JUNE