COMMONWEALTH OF AUSTRALIA

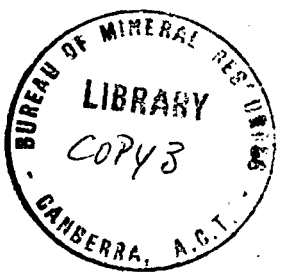
DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS



Record No. 1970 / 81

# Annual Summary of Activities Geological Branch 1970



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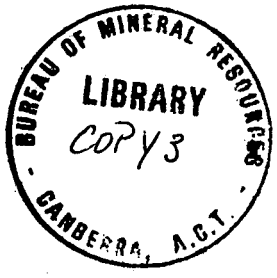

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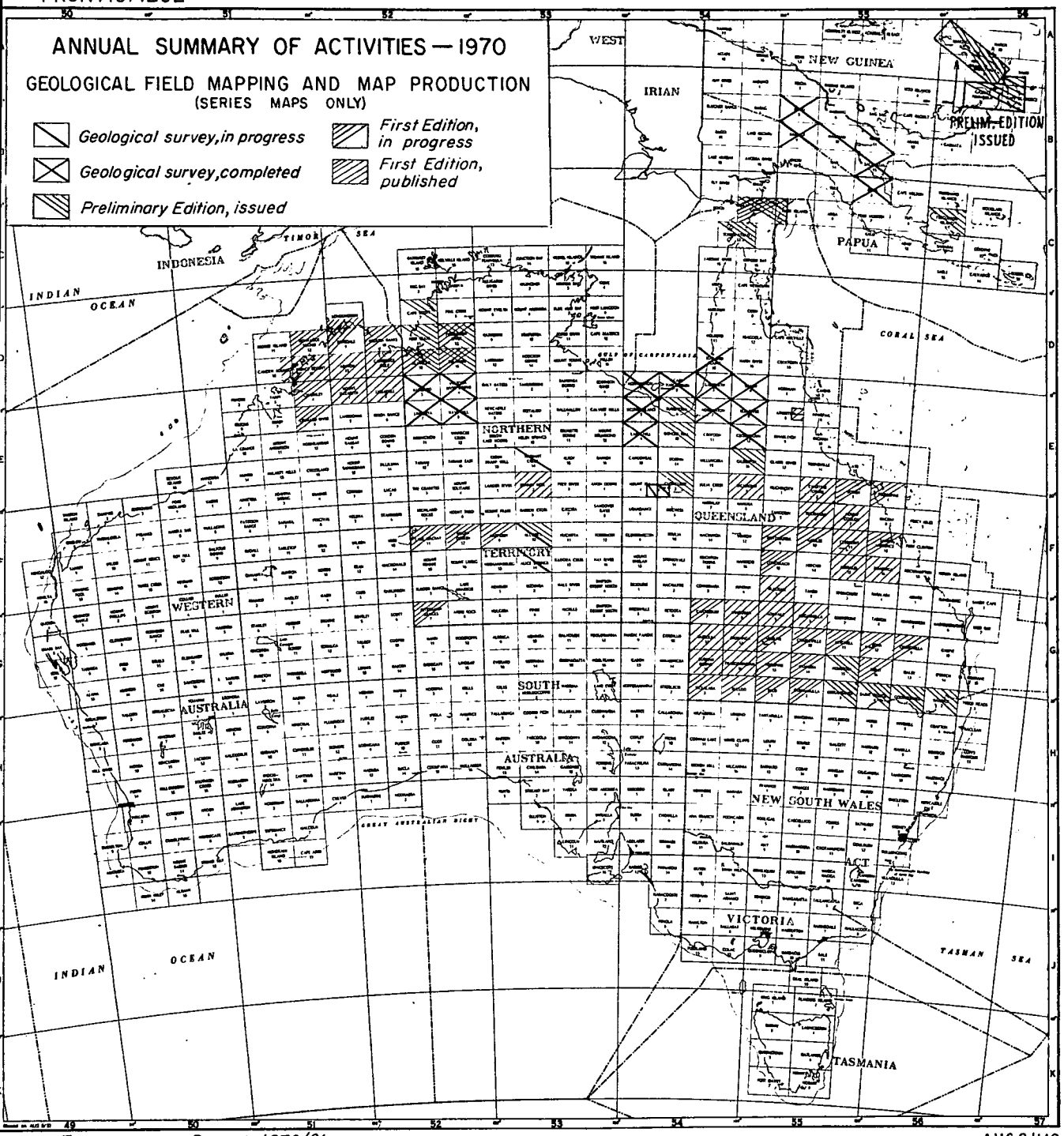


*To accompany Record 1970/81*

AUS 2/142

# ANNUAL SUMMARY OF ACTIVITIES

## GEOLOGICAL BRANCH

RECORD 1970/81


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# SEDIMENTARY SECTION

## SEDIMENTARY SECTION

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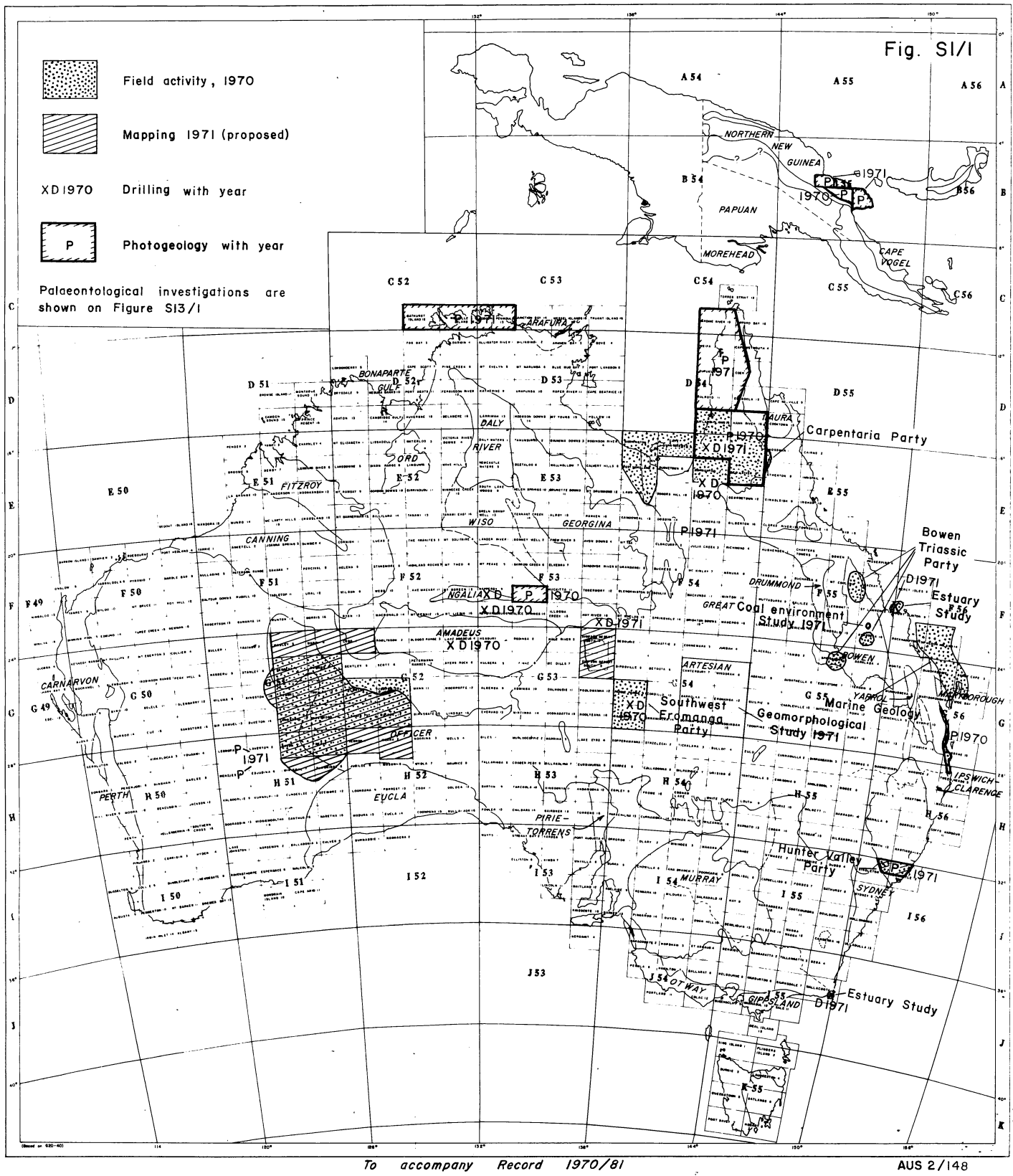
# AUSTRALIA
## AND NEW GUINEA
## FIELD ACTIVITIES – SEDIMENTARY SECTION



## S1 SUMMARY (Fig.S1/1)

During 1970 field mapping at 1:250,000 scale in the Great Artesian Basin was extended north into the Carpentaria Basin and southwest into the South Australian part of the Eromanga Basin. Shallow stratigraphic drilling was used to assist in the interpretation of the stratigraphy. Logging of water bores in the Surat Basin continued during the year. Experimental down-hole gamma-ray spectroscopy logging in a bore near Barcaldine showed that recognizable spectra can be obtained down hole and that high radioactivity in the Toolebuc Limestone, Westbourne Formation and lower Birkhead Formation is due to the presence of uranium. Preparation of maps and reports on the mapped parts of the Great Artesian Basin continued and preparations were made for a hydrogeological study of the basin.

Detailed mapping of part of the Triassic sequence in the Bowen Basin has yielded information on the depositional environments and has enabled the Rewan Formation abd Clematis Sandstone to be subdivided into smaller units. Bedding analysis in the Clematis Sandstone indicates that it was probably deposited in a braided stream environment.

A major project, the 1:250,000 geological mapping of the little known Officer Basin in W.A., was initiated. A brief Landrover reconnaissance was made of twelve sheet areas prior to a major helicopter survey in 1971. Sparse surface outcrops are mainly of Lower Palaeozoic (probably Permian) and Proterozoic rocks.

Shallow drilling was continued in the Ngalia Basin and provided further valuable stratigraphic information in areas with extensive superficial deposits. Four holes were drilled with a total depth of 768 m including 30 m of core.

Four holes were drilled to test evaporite sequences in the Amadeus Basin. Despite mechanical difficulties due to the cavernous nature of some of the evaporites, sections through gypsum and halite beds with interbedded siltstone, claystone and dolomite were cored.

Detailed mapping of the Carboniferous stratigraphy of the Hunter Valley in co-operation with the Universities of Newcastle and New England has yielded new information on the Lower Carboniferous faunal zones of eastern Australia. The complex stratigraphy of the area is being elucidated by a study of brachiopod zones and the mapping of ignimbrite horizons.

Palaeontological investigations continued on material from Australia, Papua-New Guinea and offshore areas. Notable advances were made in studies of Tertiary vertebrates, Mesozoic macrofaunas, Cambrian and Ordovician trilobites, Devonian corals and fishes and Devonian and Carboniferous conodonts.

Studies of Foraminifera continued and the results proved particularly valuable to field parties working in Papua-New Guinea. The first known Australian lower middle Palaeocene to lower Palaeocene (Danian) faunas were recorded from the Sahul Shoals offshore exploration well, W.A. A study of the Cretaceous Foraminifera of Western Australia was started and later in the year extended to include an investigation of the Upper Cretaceous microplankton. Palynological studies mainly of the Upper Mesozoic of the Surat and Eromanga Basins were extended to units of similar age in the Carpentaria Basin. Studies were initiated of the Devonian floras of the Canning Basin and of the Permian floras of Queensland.

In the sedimentological laboratories a computer programme was developed for the analysis of cross-stratification data.

The photogeology group continued routine interpretations for field parties in Australia and New Guinea. Experimental colour and colour infrared photographs flown by BMR over parts of northern Victoria proved valuable for detecting irrigation channel leakages and areas affected by groundwater salinity.

The marine geology survey of the continental shelf was continued in September and an area from Rockhampton to Brisbane covered by sampling and seismic profiles by 31st October. A drowned shallow water reef at 180 m was located in the Capricorn Channel; reefs at a similar depth are present in the Arafura Sea and elsewhere, indicating that no warping of the shelf has occurred since the late Pleistocene.

Compilation of results of fieldwork on the Georgina Basin phosphate deposits has continued and publication is planned for 1971. The deposits, though of many types, appear to be of very shallow water, possibly estuarine origin. To gain more information on estuarine environments, studies of modern estuaries were initiated in the Broad Sound area, Queensland, and at Mallacoota Inlet, in eastern Victoria, the latter in co-operation with the A.N.U.

## S2 - GREAT ARTESIAN BASIN

by

R.R. Vine

Personnel: R.R. Vine (part time), A. Medvecky (part time), N.O. Jones (from August, 1970).

Supervision of the contracts for water bore logging continued. Logging under the 1969 contract continued in November and December, 1969 and, after a break for the wet season, was completed in May 1970. Logging under the 1970 contract started late in September and is continuing. All operations were in the Surat Basin; details are given in Table 1.

TABLE 1 - LOGGING 1969-70

| Month | Logs obtained | | |
|---|---|---|---|
| | Gamma-ray | Temperature | Flowmeter/caliper |
| 1969 | | | |
| November | 3 | 3 | 1 |
| December | 10 | 10 | 10 |
| 1970 | | | |
| January/April | - | - | - |
| May | 3 | 3 | 1 |
| June/August | - | - | - |
| September | 1 | 1 | 1 |
| October | 18 | 16 | 15 |
| Totals | 35 | 33 | 28 |

In November 1969 experimental down-hole gamma-ray spectroscopy logging was carried out in a deep unused bore in Barcaldine. The logging showed that recognizable spectra could be obtained downhole, and that high radioactivity in the Toolebuc Limestone, Westbourne Formation and lower Birkhead Formation is caused by small amounts of uranium.

Preparation of maps and reports on parts of the northern Eromanga Basin and the eastern Surat Basin continued (listed in Section S18).

Preparations for a hydrogeological study of the Great Artesian Basin were started. The main progress so far has been in defining the main programme of study and preparing tender specifications for employment of specialists under contract to assist in the study.

## S3 - CARPENTARIA BASIN PARTY

by

H.F. Doutch

Personnel: BMR - H.F. Doutch (party leader), J. Ingram (until 23/4/70), J. Smart, S. Needham (from 24/4/70), Miss M. McLaren (draftswoman): GSQ - K. Grimes.

Activities: Between the 1969 and 1970 field seasons the party was engaged in report writing (Section S18) and map compilation. Preliminary editions of the 1:250,000 Sheets Burketown, Donors Hill, Gilberton (2nd Edition) have been printed; Dobbyn and Millungera are nearly ready for printing.

Between 8/6/70 and 27/9/70 the party mapped the 1:250,000 Sheet areas of Normanton, Galbraith, Rutland Plains, Red River, Walsh, Mornington and Cape Van Dieman, and the Mesozoic and Cainozoic rocks of Lawn Hill, Westmoreland, Georgetown and parts of Mossman.

Field work in all Sheet areas included 29 hours of reconnaissance flying in a Cessna 177 'Cardinal' and 90 hours during 5 weeks mapping by Bell 47G-3B1 helicopter.

BMR rigs drilled eight shallow stratigraphic holes for the party. Details appear in Table 1.

Visitors to the party in the field were R.R. Vine (party supervisor), B. Williams (Administrative Officer, BMR), B. Mackintosh (Department of National Development), R. Foster (Public Service Board), Dr. K.A.W. Crook (Australian National University), Professor V. Frulof (Moscow State University), and T. Gibson (Mines Administration Pty Ltd).

BMR geologists who worked with the party for short periods were Drs. D. Burger and M. Norvick (palynologists), Dr. S. Skwarko (macropalaeontologist) and C. Simpson (photogeologist).

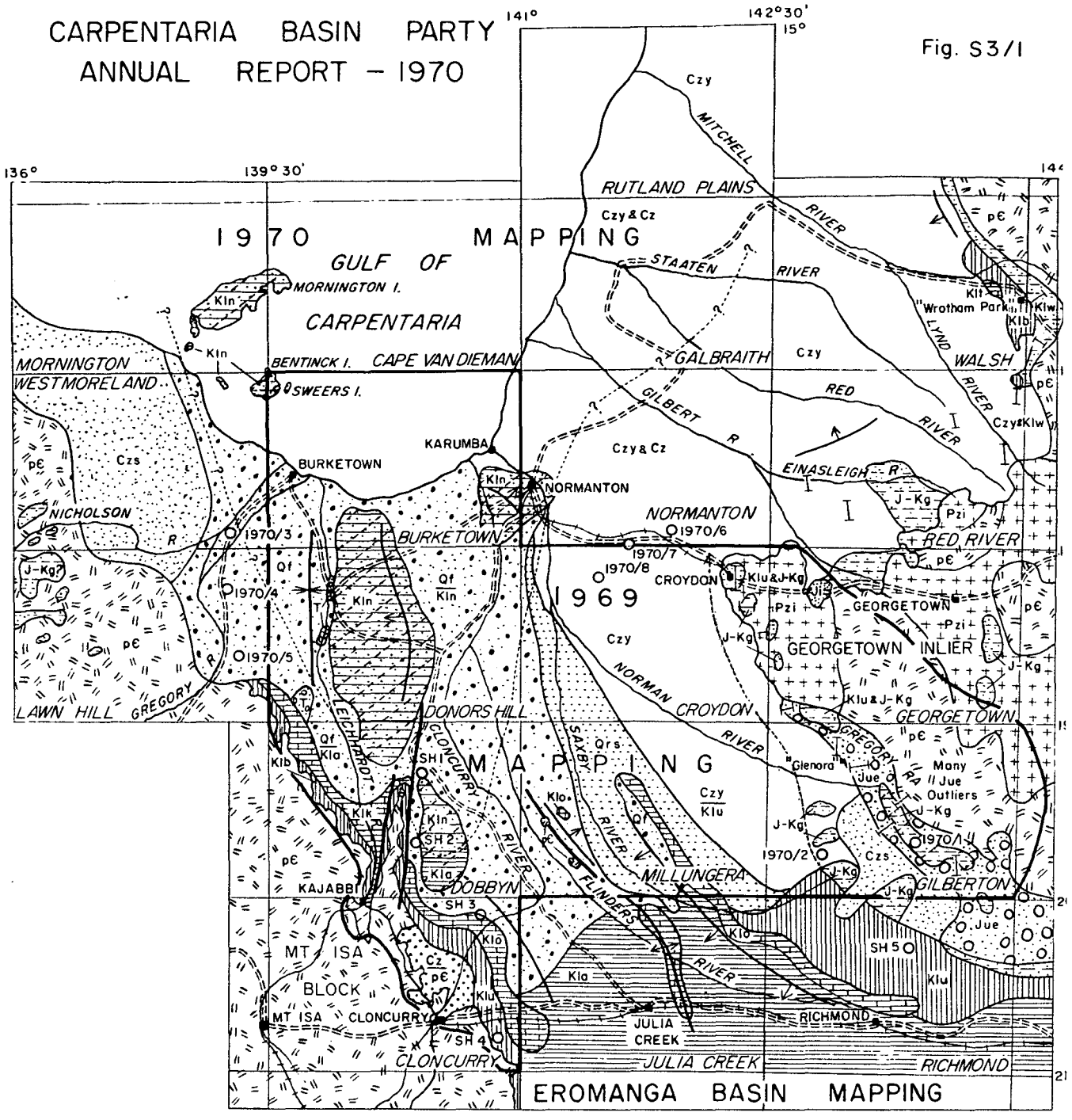
H.F. Doutch attended the ANZAAS Conference in Port Moresby from August 17th to 24th and read a paper "Late Cainozoic tectonics and geomorphology of Cape York Peninsula and the Gulf Country of Queensland".

Geology: Generalized results of 1969 field work are shown on Figure S3/1, which also shows provisional results of 1970 field work.

The sequence in the southern Carpentaria Basin starts with Upper Jurassic Eulo Queen Group quartzose sandstones in depressions in Precambrian basement. Upper Jurassic to Lower Cretaceous Gilbert River Formation quartzose sandstone blankets both the filled depressions and divides between them. The sandstone units are followed conformably by the older mudstone of the Blackdown (Wallumbilla) Formation and the younger Allaru Mudstone, which are separated by limestone and calcareous shale of the thin Toolebuc (Kamileroi) Limestone. The Lower Cretaceous labile sandstone of the Normanton Formation, which is conformable on the Allaru Mudstone, is the youngest Cretaceous unit in the southern Carpentaria Basin.

# CARPENTARIA BASIN PARTY ANNUAL REPORT – 1970

Fig. S3/1




CAINOZOIC

QUATERNARY
- Cz — Undifferentiated
- Qrs — Sand, partly aeolian
- Qf — 'Black soil'-clay and sand
- Czy — 'Lynd Formation'-outwash sand, partly consolidated
- Czs — Sand on ferricrete
- 'Duricrust'

TERTIARY
- T — Floraville Formation-quartzose sandstone and conglomerate

MESOZOIC

LOWER CRETACEOUS
- Kln — Normanton Formation-sandstone and mudstone
- Kla — Allaru Mudstone
- Klk — Kamileroi Limestone
- Klt — Trimble Formation-sandstone, calcilutite
- Klo — Toolebuc Limestone
- Klb — Blackdown Formation
- Klu — Wallumbilla Formation
- } Mudstone, basal sandstone

UPPER JURASSIC - LOWER CRET
- Klw — Wrotham Park Sandstone
- J-Kg — Gilbert River Formation
- } Sandstone, siltstone
- Jue — Eulo Queen Group-conglomerate, sandstone

TRIASSIC (OR JURASSIC ?)
- Ji — Inoruni Sandstone

PERMIAN
- Pzi — Igneous rocks

PRECAMBRIAN
- pε — Undifferentiated

} basement to Carpentaria Basin

- ...?.....?... Inferred, concealed boundary
- Regional dip
- Detailed section
- SH 5 ○ Scout hole, 1969
- 1970/2 ○ Scout hole, 1970
- Fault
- Road
- Railway
- "Glenora" Homestead

0 100 KILOMETRES
0 100 MILES

To Accompany Record 1970/81

Q/A/344

(S3)

TABLE 1 : DRILLING IN CARPENTARIA BASIN, 1970

| Hole/Grid reference/ Rig | Total depth | Cored | Core Recovery | Section penetrated | Results |
|---|---|---|---|---|---|
| Gilberton 1 (1453 app.) | 113.7m(373') | 9 cores, total 24.2m | 82% (20.8m) | 0-10m Red sandy soil<br>10-20m 'duricrust'<br>20-32m Gilbert R.Formation<br>32-62m Loth Formation<br>62-105m Hampstead Sandstone<br>105-113.7m Amphibolite | Drilled to provide comparison of J-K sandstones in Gilberton Sheet area with northern Eromanga sequence. Wireline logging successful, but rocks too weathered for palynological work. |
| Gilberton 2 (605514) Mayhew 1000 | 243.9m(800') | Continuously cored from 18 m (74 cores) | 67% | 0-10m Soil and clay<br>10-30m Wallumbilla Formation<br>30-90m Gilbert R. Formation<br>90-120m Loth Formation<br>120-170m(?) Hampstead Sandstone<br>170(?)-243m Jurassic sandstones | Continuous coring permitting detailed palynology, plus successful wireline logging, allows comparison with northern Eromanga sequence |
| Normanton 1 (487746) Mayhew 1000 | 155m(510') | 1 core 3m (bottom of hole) | 100% (3m) | 0-38m Lynd Formation<br>38-48m Allaru Mudstone?<br>48-55m Toolebuc Limestone?<br>55-155m Blackdown (Wallumbilla)Formation | Showed Gilbert R.Formation not present within 155m (510') of surface. Bottom core taken for palynology |
| Normanton 2 (456742) Mayhew 1000 | 154m(505') | 1 core 3m (bottom of hole) | 93% (2.8m) | 0-52m Lynd Formation<br>52-146m Allaru Mudstone<br>146-154m Toolebuc Limestone | Established depth to Toolebuc Limestone and thickness of Cainozoic Lynd Formation. |
| Croydon 1 (458703 app.) Mayhew 1000 | 154m(505') | 14 cores 32m | 75% (16.5m) | 0-40m Lynd Formation<br>40-94m Allaru Mudstone<br>94-120m Toolebuc Limestone | Established depth and thickness of Toolebuc Limestone; cores of it to be tested for shale oil and trace metals |

(S3) Table 1



| Hole/Grid reference/ Rig | Total depth | Cored | Core Recovery | Section penetrated | Results |
|---|---|---|---|---|---|
| Westmoreland 1 (Grid ref. 208753) Fox Mobile | 152.4m(500') | 4 cores 9m | 91% (8.3m) | 0-36m Alluvium<br>36-61m Weathered Cretaceous mudstone<br>61-152.4m Cretaceous mudstone | Showed Normanton Formation absent, and obtained mudstone cores for palynology |
| Lawn Hill 1 (199698) Fox Mobile | 152.4m(500') | 4 cores 11.6m | 97% (11.3m) | 0-30m Alluvium<br>30-64m Weathered Cretaceous mudstone<br>64-152.4m Cretaceous mudstone | Showed Normanton Formation absent, and obtained mudstone cores for palynology |
| Lawn Hill 2 (205656) Fox Mobile | 152.4m(500') | 6 cores 18.2m | 76% (13.9m) | 0-8m Alluvium<br>8-17m Floraville Formation?<br>17-26m Allaru Mudstone?<br>26-33m Toolebuc (Kamileroi) Limestone<br>23-152.4m Blackdown (Wallumbilla)Formation | Established depth and thickness of Toolebuc (Kamileroi) Limestone, and absence of J-K quartzose sandstone within 500' of surface |

Most of these formations crop out moderately well in the area covered by 1969 field work. Fig S3/1 shows that the area mapped in 1970 is covered almost wholly by Cainozoic deposits except around the margins of the basin, and that other existing formation names are used in the east. At the time of writing we think that the Wrotham Park Sandstone is the northward continuation of the Gilbert River Formation (equivalents of the Eulo Queen Group are probably present only beneath the Gulf of Carpentaria). The Trimble Formation may be a continuation of the Toolebuc Limestone. In 1970 we did not identify any outcrops of the Allaru Mudstone, and recognized Normanton Formation only at Normanton and in the Mornington Island area.

Cainozoic quartzose sand deposits in the east probably all belong to the Lynd Formation, apart from modern alluvia near rivers; in the west grassy clay plains suggest mixed fluvial sediments similar to those of the Flinders River area to the south.

## S4 - SOUTHWEST EROMANGA BASIN

by

A. Medvecky

Personnel: A. Medvecky (BMR)
A. Williams (S.A. Dept. of Mines) from late July.

Duration of field work: July 29th to October 7th.

| Visitors: | | | |
|---|---|---|---|
| B.R. Senior | B.M.R. | 29/7 - 5/8, | 25/8 - 1/9 |
| B.G. Forbes | S.A. Mines Dept. | 29/7 - 5/8, | 25/8 -31/8 |
| M. Plane | B.M.R. | | 29/8 - 1/9 |
| R.H. Tedford | American Museum of Natural History (New York) | | 29/8 - 1/9 |

Drilling: Shallow stratigraphic drilling was carried out in the period September 14th to October 5th using a BMR Fox Mobile rig. The purposes were to determine the thickness of post-Winton Formation deposits and to collect fresh cores from the Winton Formation for palynological and lithological study.

Light Aircraft: A Cessna 171 was used for 15 hours for aerial reconnaissance of the Gason and Pandie Pandie Sheets and the area between Oodnadatta and Clifton Hills Station. The aircraft proved valuable for finding access and locating outcrops.

Geology: The geology of the southwest part of the Eromanga Basin is very similar to that of southwest Queensland. Cretaceous sediments (Winton Formation) are deeply weathered and are overlain by Tertiary? sandstone.

The oldest sediments exposed belong to the Winton Formation. They consist of interbedded sandstone and siltstone overlain by silicified claystone and mudstone, The sandstone is labile, glauconitic?, carbonaceous and has pyrite mineralization in places.

The Winton Formation is unconformably overlain by Tertiary? quartzose sandstone. The top of the Winton Formation is marked by ferruginized breccia and the base of Tertiary? sandstone by thin pebble conglomerate. The sandstone is fine to medium-grained, clean and well sorted. It is overlain by oolitic beds. The top part of the sequence is usually preserved by a silcrete bed, and reworking of silcrete followed by silicification has formed silcrete breccia. Drilling showed the thickness of the Tertiary? sequence, varies from 3 to 40 metres.

The youngest units are gypsum and lacustrine chalcedonic limestone. The gypsum has usually accumulated between sand dunes where it commonly forms crusts up to a metre thick. It is more extensive and thicker, in the southern part of the Gason Sheet area possibly due to accumulation of wind blown gypsum particles against scarps of older sediments. The chalcedonic limestone is only revealed by dam-sinking in alluvial areas, with one exception where it forms a small hill about 3m high.

Extensive Quaternary deposits cover most of the mapped area. They include silcrete gravel (gibbers), dune sand and alluvium. Drilling showed they have an average thickness of 4 m.

The area is dominated by a large surface-expressed structure-the Gason Anticline (Fig.S4/1). Radially dipping cuestas on the flanks of this anticline have outcrops of Winton Formation unconformably overlain by Tertiary? quartzose sandstone. Dips are variable as the Tertiary? quartzose sandstone and Winton Formation have been affected by post-Tertiary block faulting.

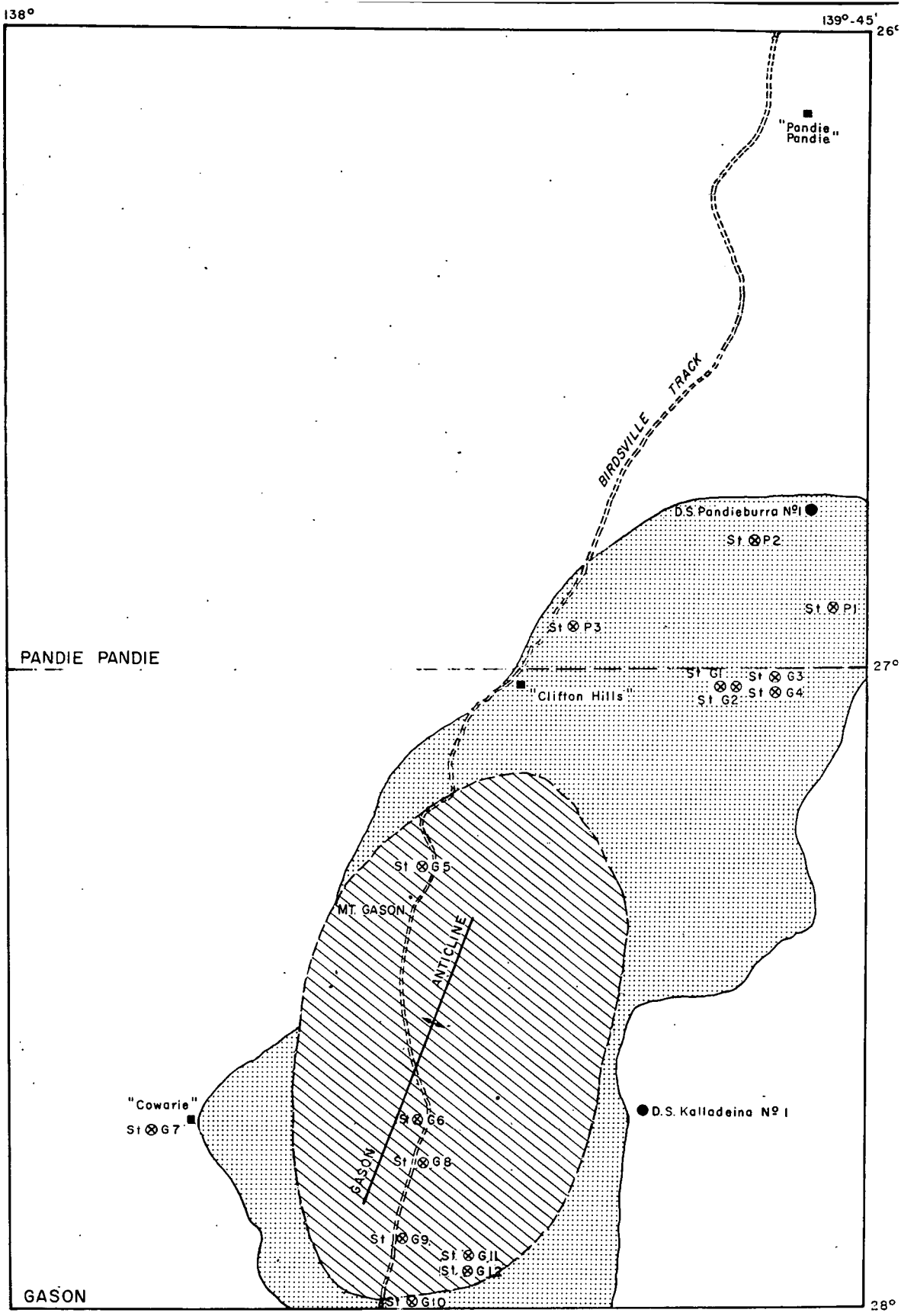



Fig. S4/1 SOUTHWEST EROMANGA BASIN, GEOLOGICAL SKETCH MAP

*To accompany Record 1970/81*

*G54/A/6*

TABLE 1 : SHALLOW STRATIGRAPHIC DRILLING, 1970

GASON AND PANDIE PANDIE 1:250,000 SHEET AREAS, SOUTH AUSTRALIA

(S4)

| Hole | Grid reference | Total Depth (metres) | Drilling (metres) | Coring (metres) | Number of cores | Core recovery Actual (metres) | Core recovery % | Results |
|---|---|---|---|---|---|---|---|---|
| GASON 1 | 209643 | 18.3 | 18.3 | - | - | - | - | 1.5 - 3.0 m gibbers, silcrete, quartzose sand<br>3.0 -18.3 m quartzose sandstone (Tertiary?) |
| GASON 2 | 209643 | 152.4 | 144.7 | 7.72 | 2 | 4.57<br>3.05 | 100<br>100 | 0.0 - 3.0 m silcrete and sand<br>3.0 -32.0 m quartzose sandstone (Tertiary?)<br>32.0 - bottom Winton Formation |
| GASON 3 | 222647 | 24.3 | 24.4 | - | - | - | - | 0.0 - 4.5 m sand, minor gypsum and limestone.<br>4.5 -12.2 m quartzose sandstone (Tertiary?)<br>12.2 - bottom Winton Formation |
| GASON 4 | 222647 | 20.1 | 20.1 | - | - | - | - | 0.0 - 4.5 m sand and silcrete<br>4.5 -17.0 m quartzose sandstone (Tertiary?)<br>17.0 - bottom Winton Formation |
| GASON 5 | 156607 | 47.1 | 42.7 | 4.45 | 1 | 3.11 | 70 | 0.0 - 3.0 m silcrete sand, minor gypsum.<br>3.0 -?6.0 m quartzose sandstone (Tertiary?)<br>6.0 - bottom Winton Formation |
| GASON 6 | 155560 | 152.4 | 143.3 | 9.14 | 3 | 3.05<br>0.32<br>3.05 | 100<br>10<br>100 | 0.0 - 3.0 m sand and clayey sand<br>3.0 - bottom Winton Formation |
| GASON 7 | 643558 | 152.4 | 146.34 | 6.10 | 2 | 1.22<br>2.90 | 40<br>95 | 0.0 - 6.0 m clayey quartzose sand with ironstone<br>6.0 -24.4 m clay and claystone, ironstone<br>24.4 - bottom Winton Formation |

| Hole | Grid reference | Total Depth (metres) | Drilling (metres) | Coring (metres) | Number of cores | Core recovery Actual | Core recovery % | Results |
|---|---|---|---|---|---|---|---|---|
| GASON 8 | 153553 | 12.2 | 12.2 | - | - | - | - | 0.9 - bottom Winton Formation |
| GASON 9 | 150538 | 12.2 | 12.2 | - | - | - | - | 0.0 - 3.0 m gibbers, sand, gypsum<br>3.0 - bottom Winton Formation |
| GASON 10 | 154526 | 9.1 | 9.1 | - | - | - | - | 0.0 - 4.5 m gibbers, clayey sand, gypsum, limestone<br>4.5 - bottom Winton Formation |
| GASON 11 | 165532 | 12.2 | 12.2 | - | - | - | - | 0.0 - 4.5 m gibbers, clayey sand, gypsum<br>4.5 - bottom Winton Formation |
| GASON 12 | 165534 | 10.7 | 10.7 | - | - | - | - | 0.0 - 4.5 m gibbers, clayey sand, gypsum<br>4.5 - bottom Winton Formation |
| PANDIE PANDIE 1 | 232659 | 16.8 | 16.8 | - | - | - | - | 0.0 - 4.5 m gibbers, sand<br>4.5 - bottom Winton Formation |
| PANDIE PANDIE 2 | 216672 | 70.1 | 67.0 | 3.05 | 1 | 2.13 | 70 | 0.0 - 6.0 m gibbers, silcrete, clayey sand, minor gypsum<br>6.0 -36.5 m clayey quartzose sandstone (Tertiary?)<br>36.5 - bottom Winton Formation |
| PANDIE PANDIE 3 | 181655 | 70.1 | 70.1 | - | - | - | - | 0.0 - 3.0 m soil and quartzose sand<br>3.0 -27.4 m quartzose sandstone (Tertiary?)<br>27.4 -42.7 m quartzose sandstone and mudstone (Tertiar<br>42.7 - bottom Winton Formation |
| TOTAL | | 780.4 | 750.1 | 30.46 | 9 | 23.30 | (Av.)76 | |

## S5 - WEST SURAT BASIN

by

B.R. Senior

Personnel: B.R. Senior, Daniele Senior (until November 1969), Barbara K. Graham.

General: Mapping of the Surat Basin in Queensland was completed in 1969, and the early part of 1970 was spent compiling Explanatory Notes on the area (see Section S18). Papers were prepared on the Cainozoic sediments and tectonics in the St George area, and the structure of the southern Nebine Ridge.

## S6 - CENTRAL EROMANGA BASIN

by

B.R. Senior

Personnel: B.R. Senior.

A geological map at 1:1,000,000 scale of the twenty 1:250,000 Sheets which comprise the central Eromanga Basin was compiled. The preliminary edition in three colours, including a gravity plate overprint, will be available early in 1971.

Preliminary work for the bulletin describing the geology of the Central Eromanga Basin was started. All the geophysically logged water bore logs were examined and the top of the Hooray Sandstone and Toolebuc Limestone were chosen for structural contouring at 1:1,000,000 scale. Contouring in the problematic Nebine Ridge area on the top of the Hooray Sandstone is complete.

Of special interest in the Central Eromanga Basin area are the widespread Tertiary sediments containing silcrete beds, and a publication giving the distribution, chemical composition, and occurrence of multiple silcretes was written.

Progress on the 1:250,000 Geological Series Explanatory Notes is listed in Section S18.

## S7 - BOWEN TRIASSIC PARTY

by

A.R. Jensen and S.L. Roddick

Personnel: A.R. Jensen, P.J. Alcock (until March 1970), B.G. Jones (March-September, 1970), S.L. Roddick (from September 1970).

Duration of field season: 5/5/70 to 2/7/70.

Rewan-Clematis Study: Over a period of ten weeks from May to July, more stratigraphic sections were measured in the Rewan Formation in the northern part of the basin, and in the lower half of the Clematis Sandstone in the northern and southwestern parts. Apart from providing a description of the sequence, the section measuring revealed a number of fining-upwards cycles in the Rewan Formation, thus providing an important insight into environment of deposition of this unit.

Modal analysis of sandstone from the Triassic sequence has enabled subdivision of the major units in each area. On this basis in the northern part of the basin, the Rewan Formation and the Clematis Sandstone can each be subdivided into three parts, the lowest subdivision of the Clematis Sandstone corresponding to a subunit previously defined on bedding characteristics. In the southeastern part of the basin, the Rewan Formation is composed of two distinct units not previously recognized, the upper unit containing appreciably more quartz and less labile material than the lower. Sandstone of the Rewan Formation in the southwestern area varies little in composition throughout the sequence, and the main change occurs at the boundary with the overlying Clematis Sandstone.

In the early stages of the study an analysis of the bedding at six localities in the Clematis Sandstone of the southwestern area showed that each bed could be placed in one of seven categories based on grainsize, thickness, stratification type, and nature of lower bounding surface. Further work has shown a genetic relationship exists between these units and that their disposition can be related to sedimentary processes such as the formation of transverse bars. A theoretical model for braided stream deposition was evolved from a study of the relevant literature, and this partly fits the model derived from bedding analysis in the Clematis Sandstone. Another twenty-two detailed sections for bedding analysis were measured during the year both in the Rewan Formation and in the lower and upper parts of the Clematis Sandstone. These have not yet been analysed.

While in the field another 1500 measurements of the orientation of cross-stratification were made. These have now been corrected for regional tilt, and grouped with previous measurements to provide palaeocurrent information. The results of this aspect of the study are still tentative, but it appears that early indications that the Rewan Formation and Clematis Sandstone were deposited in the same drainage system are not confirmed by the more recent data.

Moolayember Study: P.J. Alcock continued to process data gathered during the 1969 field season. Results from the 1969 drilling programme support the division of the Moolayember Formation into a lower sandy conglomerate unit, and an upper mudstone and lithic sandstone unit in the southeastern part of the basin. The boundary between the two units is gradational. Petrological studies of sandstone from surface and subsurface by Jones showed that the lower unit is richer in volcanic detritus. Studies of well sections farther south along the eastern margin of the basin did not detect a similar mineralogical change, but potassic feldspar, rock fragments and biotite decrease southwards with a corresponding increase in quartz.

Detailed outcrop studies in the Carnarvon Range area resulted in revision of the 1969 three-fold subdivision to a two-fold subdivision. It is postulated that the lower unit was deposited in a deltaic, estuarine, and lacustrine environment, and the upper unit in a fluvial environment.

S.L. Roddick prepared isopach, structure contour and palaeogeographic maps of the Moolayember Formation, and commenced an analysis of lithofacies from subsurface data in the southeast part of the basin.

## S8 - TEXAS HIGH PARTY

Results of the investigations were written up in Record form and issued as No. 1970/6 "Palaeozoic geology of the Warwick and Goondiwindi 1:250,000 Sheet areas, Queensland and New South Wales".

This will subsequently be published in the Report series. Explanatory notes to accompany the first edition of the Warwick 1:250,000 Sheet were in preparation at 31/10/70.

## S9.- OFFICER BASIN PARTY

by

M.J. Jackson

Personnel: M.J. Jackson, D.C. Lowry (G.S.W.A.)

General:

A BMR-GSWA joint investigation of the Officer Basin in Western Australia was begun in July 1970. Reconnaissance mapping in the Great Victoria and Gibson Deserts, using two landrovers, was carried out between 8th August and 16th September. An evaluation of the existing geological and geophysical information pertinent to the Basin was also commenced.

Field Work. Systematic mapping during the reconnaissance survey was not attempted, but observations on twelve 1:250,000 sheets were recorded (Fig.S9/1). The following is a summary of the more important observations made.

1. Outcrops are generally poor and widely spaced. Much of the Basin is blanketed by a monotonous series of sandhills and flat laterite plains.

2. Gently dipping coarse-grained poorly sorted arenites form small, lightly weathered breakaways in about 5% of the area. Fine-grained sandstones, conglomerates, and thin siltstone beds are commonly present. Invertebrate fossils were not found, but organic burrows and a host of primary mechanical sedimentary structures were seen at most outcrops. One striated boulder and two exposures of tillite were recorded. A glaciofluvial origin for these sediments is suspected, but evidence for a Permian age (except for the presence of glacial deposits) was not found.

3. Several areas containing previously unrecorded outcrops of Proterozoic and possibly Lower Palaeozoic rocks were found close to the edges of the basin. However, because of the isolated nature of the outcrops and the lack of fossils it was not possible in the time available to equate these rocks with previously mapped formations. It is hoped that the full significance of these outcrops will be realised by detailed mapping.

4. The fossiliferous porcellanite (Bejah Beds) recorded by Wells and others on the Madley, Warri, Herbert, and Browne sheets were not found to the south.

# S10 - NGALIA BASIN STRATIGRAPHIC DRILLING PARTY.

by

A.T. Wells

Personnel: A.T. Wells

Duration of drilling: 31st July 1970 to 19th September 1970.

Geological Results.

The major part of field work except for stratigraphic drilling was completed in 1969 and a bulletin incorporating the results of geological seismic, aeromagnetic and gravity work is in progress.

Stratigraphic drilling:

Shallow drilling to obtain a better understanding of the subsurface stratigraphy started in 1969. The contracting firm Intairdrill (Aust.) Pty Ltd drilled eight holes in 1969 and the programme was completed in 1970 by a BMR drilling crew from the Petroleum Technology Section using a Mayhew rig. Four holes were completed during the 1970 programme, giving an aggregate of 768 m of drilling; total core recovery was just over 30 m and cuttings samples were collected at about 1.5 m intervals for the first 60-90 m in each hole and at about 3 m intervals thereafter.

Drilling results:

Napperby (BMR) No.6, was located near the southern margin of the Ngalia Basin about 1.6 km north of the Stuart Bluff Range and about 12.8 km east of Mount Wedge Homestead. It was completed at 112.4 m in the Carboniferous Mount Eclipse Sandstone and as a result it is inferred that the Mount Eclipse Sandstone rests directly on the Adelaidean Vaughan Springs Quartzite at this locality. The Lower Palaeozoic formations have presumably been eroded and transgressed by the sandstone.

Napperby (BMR) No.5 was drilled about 64 km west of Napperby Homestead and completed at 244.7 m in black, bituminous and calcareous siltstone which is tentatively regarded as Lower Cambrian. The silstone resembles the lower part of the Walbiri Dolomite which is exposed in outcrops southwest of Yuendumu Native Settlement. An oriented core was taken at total depth and this showed that the direction of the steep dip was approximately south-southwest, that is basinwards.

Napperby (BMR) No.7 is located about 19.2 km southeast of Napperby Homestead and reached a total depth of 245.9 m in pre-Tertiary rocks which on field evidence alone could not be correlated with formations in the Ngalia Basin sequence.

Mount Doreen (BMR) No.15 is located in the central southern part of the basin 4.8 km southwest of Djabangardi Hill and about 1.6 km from an outcrop of Vaughan Springs Quartzite. The drill reached a total depth of 164.9 m in the Adelaidean Vaughan Springs Quartzite. It was expected that a formation of Palaeozoic age would be encountered but the result suggests that the southern part of the basin is largely underlain by Vaughan Springs Quartzite.

Explanatory Note Series:

Explanatory notes were written for the Mount Doreen, Napperby and Lake Mackay sheets which cover the Ngalia Basin as well as a large area of the surrounding basement rocks. The first drafts of the notes are being edited and the three map sheets are being fairdrawn for first edition.

## S11 - AMADEUS BASIN EVAPORITE DRILLING PARTY

by

A.T. Wells

Personnel: A.T. Wells, S.K. Skwarko, P. Kennewell.

Duration of drilling:

Drilling at the first site near Goyder Pass commenced on 17/7/70, and drilling of the last hole was still in progress on 31/10/70. Two holes to a total depth of 305 m were planned as part of a study of evaporites and sulphur in the sedimentary basins of Australia. One hole has been completed to total depth, three have been abandoned mainly because of mechanical difficulties and the fourth had reached a depth of about 122 m at the end of October.

Logging: Mibolog Pty Limited ran the following wire line logs: spontaneous potential, resistivity, integrated acoustic velocity with caliper, and gamma ray - neutron. Only the first hole has been logged to date.

Drilling results: The first test hole, Hermannsberg (BMR) No.40, was drilled near Goyder Pass about 160 km west of Alice Springs. The hole was abandoned at 91.4 m because of lost circulation and negligible core recovery in the lower 30 m of the hole. About 29 m of core was obtained representing an overall recovery of 43%. The upper 45.7 m of section penetrated consists of poorly consolidated siltstone of probable Tertiary age which overlies grey and black claystone, siltstone and chert, which persisted to total depth. The lower 45.7 m is probably weathered Bitter Springs Formation and large caves were encountered in this sequence.

Mount Liebig (BMR) No.1 on the north side of the Gardiner Range was picked as an alternative site and the section penetrated in this hole from surface to 92 m consists mainly of gypsum and claystone with minor siltstone and dolomite; halite predominates below 92 m to the total depth of just over 305 m.

The Inindia Bore evaporite occurrence was the second and last site to be drilled. The site is about 64 km north of Curtin Springs Homestead in the southern part of the Amadeus Basin. Lake Amadeus (BMR) No.3 was abandoned at about 51.8 m because of mechanical difficulties. Tightly folded gypsum and minor siltstone, claystone and dolomite persisted to total depth. Lake Amadeus (BMR) No.3A, about 400 m east of No.3 was abandoned at about 45 m because of difficult drilling conditions and lack of evaporite in the hole. Lake Amadeus (BMR) No.3B situated near No.3 drill hole had reached a depth of about 122 m at the end of October, and penetrated rocks similar to those encountered in No.3 drill hole. A large supply of slightly brackish water was encountered at about 100 m, possibly emanating from a fault zone, and it was estimated that around 45 kilolitres of water was being pumped from the hole every hour. The water flow was stemmed by cementing and re-drilling the hole.

## S12 - HUNTER VALLEY PARTY

by

J. Roberts & B.S. Oversby

Personnel: J. Roberts, B.S. Oversby.

The Hunter Valley Party is investigating the Carboniferous of the Hunter Valley, particularly the northern part of the Valley east of Scone and Muswellbrook, to elucidate the complex stratigraphy by means of detailed mapping and the recognition of faunal zones. New information from the northern Hunter Valley is leading to a more precise knowledge of the Lower Carboniferous faunal zones of eastern Australia, and this is being applied in a re-interpretation of the stratigraphy of the Gresford-Dungog area in the southern part of the Valley. During this study there has been close co-operation with the University of New England and Newcastle University.

Both Roberts and Oversby have spent each second month, a total of eleven man months in the field, since November, 1969.

Most field work was concentrated in the Rouchel area, which occupies the greater part of the Woolooma 1:63,360 sheet area. The area is structurally complex, and detailed mapping has been required to elucidate the stratigraphy. Important geological results include:

1. The Spirifer sol, Schellienella sp, Orthotetes australis and Delepinea aspinosa zones are recognized in the Rouchel area. A possible new zone, with Pustula gracilis Campbell as index species, occurs between the Schellienella sp. and O. zones. The O. australis Zone is now known to include faunas from Lewinsbrook near Gresford previously referred to the Spirifer sol Zone, and may be divisible into two zones. As a result of this study, the stratigraphic ranges of many species have been modified.

2. In the Rouchel area a complex interfingering between marine and non-marine formations can be demonstrated, using the brachiopod zones in the marine sediments, and mappable ignimbrites in the non-marine sediments.

3. This new interpretation of the stratigraphy, together with detailed mapping which ties in with that of the University of New England in the north, and Newcastle University to the south, has provided the key to understanding the relationships between the Carboniferous in the Western Belt of Folds and Thrusts in northern N.S.W. and the Hunter Valley.

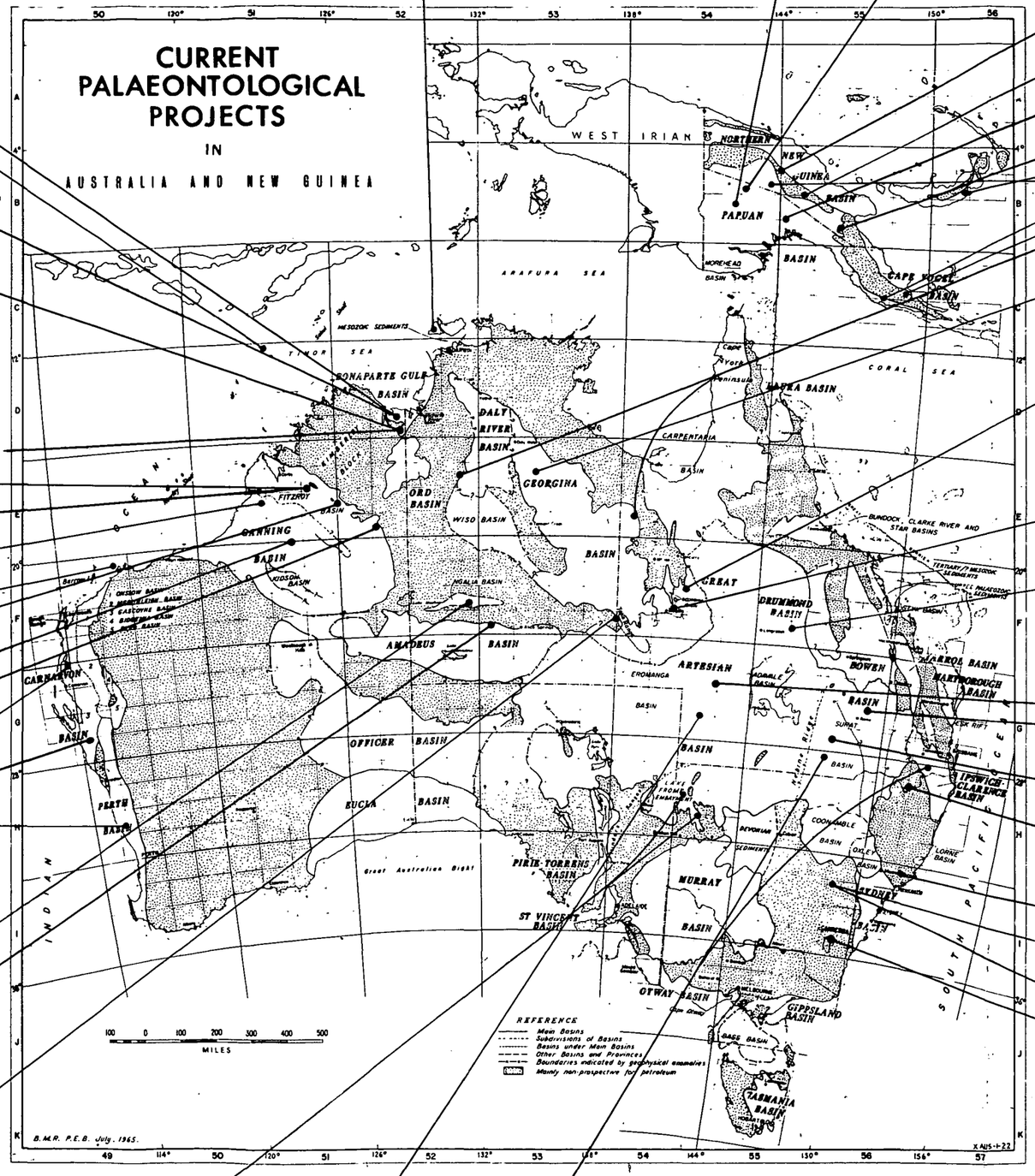
4. Mapping of a number of ignimbrite horizons has helped in understanding the complex structure of the area. To some extent they also provide a means of checking the chronostratigraphic validity of the faunal zones being established. In general all ignimbrite horizons are thicker and more completely welded in the westen part of the area than towards the east. In the marine sections of the eastern part of the area they are represented by shard-rich horizons. Thin-section, age determination, and chemical analyses are being carried out on the ignimbrites.

5. Structurally the Rouchel area consists of two sets of intersecting folds, trending NNW-SSE and NNE-SSW. A large number of high-angle faults cut the area. Relationships among and between folds and faults suggest that many of them were developed synchronously under the influence of a constrictive stress field. It is possible that this stress field developed at a high structural level in response to deformation of basement rocks in and around the Rouchel area.

6. Clastic sedimentary rocks of terrestrial origin are associated with ignimbrites in the western part of the area. Cobble- and boulder-sized clasts of thoroughly-welded ignimbrites and plutonic rocks are common. Secondary zeolites occur in most of the rocks, and are being studied in an attempt to evaluate their significance. These terrestrial rocks seem to have been deposited as gently sloping sheets of debris at the foot of a predominantly volcanic upland region, grading eastwards into a shallow marine environment.

FIG SI3/1

# CURRENT PALAEONTOLOGICAL PROJECTS IN AUSTRALIA AND NEW GUINEA




Cenomarian spores, pollen and microplankton, Bathurst Island

Polynomorphs and microplankton of Jurassic and Cretaceous in the Papuan-Morehead Basins

Land mammals Upper Cretaceous and Tertiary

Lower Jurassic marine fauna

Late Cambrian trilobites

Tertiary larger foraminifera, Papua & New Guinea

Tertiary foraminifera from off-shore wells

Jurassic, Cretaceous and Tertiary palynomorphs from Papua

New Guinea Tertiary rodents

Upper Devonian brachiopods from the Bonaparte Gulf Basin

Tertiary. larger Foraminifera, Papua & New Guinea

Upper Cretaceous foraminifera, Papua-New Guinea

Foraminifera from eastern Papua

Reworked Ordovician conodonts in the Upper Palaeozoic rocks of the Bonaparte Gulf Basin

Lower Carboniferous brachiopods from the Bonaparte Gulf Basin

Tertiary mammals from N.T. and Qld.

Agnostid trilobites from N.T. and N.S.W. Middle Cambrian trilobites of Northern Australia

Late Cambrian trilobites (Chatsworth)

Lower Carboniferous ostracods, Bonaparte Gulf Basin

Lower Carboniferous and Upper Devonian ostracods, Canning Basin

Late Cambrian and early Ordovician trilobites (S. Burke River Structural Belt)

Upper Devonian conodonts from the Canning Basin

Devonian floras of the Canning Basin

Permian spores and pollen, Galilee Basin

Tertiary foraminifera from off-shore wells

Upper Devonian receptaculitids from Fitzroy Basin, W.A.

Jurassic and Cretaceous palynomorphs from the Great Artesian Basin

Ordovician faunas from Canning Basin

Cretaceous ammonites from Australia

Lower Ordovician Dikelokephalinidae from northern Australia

Palaeozoic and Mesozoic plants

Upper Cretaceous foraminifera and nannoplankton, Western Australia

Devonian, Carboniferous and Permian faunas from Warwick, Drake and Texas

Carboniferous brachiopods of the Hunter Valley area

Tertiary pollen grains, Napperby area

Lower Devonian lichid trilobites from Wellington

Lower Devonian brachiopods, south eastern Australia

Lower Ordovician conodonts from the Amadeus Basin, N.T.

Silurian encrinurid trilobites of south-eastern Australia

Ordovician trilobites (Rusophycus)

Late Cambrian and early Ordovician trilobites (Bancannia Trough)

Palynology of the Cretaceous Rolling Downs Group, Eromanga Basin (Qld, N.S.W.)

Neocomian-Aptian-Albian palynological zonations in the Surat Basin (Qld)

*To accompany Record 1970/81*

M(P)213

## S13 - PALAEONTOLOGY (Fig.S13/1)

Dr. G.R.J. Terpstra retired at the end of June. Dr. M.A. Norvick, Dr.M. Owen and Mrs. Judy A Owen joined the Section from the United Kingdom. Mr. G.C. Young joined B.M.R. from the Australian National University. He is working part-time in the Museum and part-time on palaeontological research.

Specialist work under contract has been continued by Dr. Irene Crespin (Catalogue of Australian type specimens), Dr. A.A. Opik (Cambrian trilobites and stratigraphy)and Mrs. Mary E. White (fossil plants).

### MACROPALAEONTOLOGY

by

J.M. Dickins

Work was carried out on the bulletin on the geology of the Bowen Basin and the report on the Eddystone-Taroom-Munduberra area. A joint report with J.J. Veevers and J. Roberts on the Permian and Mesozoic Geology of the Bonaparte Gulf Basin was completed. This report has been edited and sent to the printer as part of the volume of geological papers. A review of activities in Gondwana Stratigraphy and Palaeontology in Australia since 1967 was prepared with J. Roberts for the 2nd Gondwana Symposium. A report was prepared on the Permian fossils from the Eight Mile and Tunnel fault blocks near Warwick.

Dickins attended the 2nd Gondwana Symposium in South Africa in July and visited the offices of the Geological Survey of India at Lucknow and Calcutta and the Geological Survey of Malaysia at Ipoh. He attended the Sydney Basin Symposium at Newcastle in May and the Bowen Basin Symposium at Brisbane in October.

Considerable time was spent on the administration and organization of the Palaeontological Group

# Annual Report

by

M. Plane

The principal work for 1970 was the continuation of the Bullock Creek project. Material obtained in 1969 proved very good and we now have excellent and complete material of a type not previously known. Preparation of this material has been greatly speeded up by the employment, on a part-time basis, of two senior university students. No additional taxa have been added to the fauna.

Comparative work on the Riversleigh macropodid has made it clear that it is one of the earliest, if not the earliest, member of the kangaroo family.

The Protemnodon from the early Pliocene marine sequence in Victoria has proved to be the New Guinea species P. otibandus. A further sample of P. otibandus was found in the Chinchilla collections at the Queensland Museum, and it is now evident that this species ranged from the intermontane valleys of New Guinea through the Darling Downs and to the southern coast of Victoria during early to middle Pliocene time. It is then, the widest ranging kangaroo known, and a paper on this animal is in press.

A field conference of vertebrate palaeontolgists was held in the Tirari Desert, Lake Eyre Basin, during July. The type sections of the middle to late Tertiary non-marine sequence were visited and interesting discussions were held by palaeontologists from Western Australia, South Australia, Victoria, Queensland, BMR, American Museum of Natural History, and Smithsonian Institution.

A contribution was made to a symposium on the evolution of the Kangaroo, and a paper was given to the Geological Society of Australia's symposium on vertebrate palaeontology.

Administrative responsibility for the palaeontological group was assumed during J.M. Dickins visit to the Gondwana Symposium.

## Annual Report

by

S.K. Skwarko

S.K. Skwarko's activities during 1970 can be summarized as follows:

1. Dating, reporting on, and detailed description for publication of collections of fossils submitted from various parts of Australia and eastern New Guinea.

2. Checking final drafts, and proof reading his previously completed manuscripts (viz. three papers in BMR Bull. 126).

3. Maintenance of the Infol Storage System of palaeontological bibliographic references.

4. Supervision of the technical staff in the preparation of fossils, their photography, and duplicating in plaster.

5. Maintenance of correspondence and receiving visitors both from Australia and overseas.

6. Field duties - three months was spent in northern Australia -

   (i) attached to the Carpentaria field party;
   (ii) logging cores of evaporites from Mount Liebig No.1 Bore, 150 miles west of Alice Springs;
   (iii) examining Cretaceous strata in the Tennant Creek - Newcastle Waters area, Groote Eylandt, and Mount Isa area.

## Annual Report

by

Joyce Gilbert-Tomlinson

Description of fossils:

1. Two species of Ordovician fossils from Queensland, the gastropod Teiichispira cornucopiae and the trilobite Warendia bidecorata, were published in the Queensland Palaeontological Society's pamphlet 'Ordovician and Silurian fossils of Queensland' (1969).

2. A paper entitled 'The Lower Ordovician gastropod Teiichispira in northern Australia' was completed and handed to the Editor.

3. A paper on the dikelokephalinid trilobites of northern Australia is expected to be completed by the end of the calendar year.

(Cont.)

Routine examination of fossils:

1. Core 15 of Total Matches Springs No.1 Well (Canning Basin), W.A., on examination proved to contain fossils indicative of Goldwyer Shale (late Lower or early Middle Ordovician).

2. Early Middle Cambrian Mollusca from Queensland and New South Wales were examined and their systematic position and life habit discussed with the collector (P.J. Jell).

Field work:

Four days were spent with the Australian National University's student excursion at Quidong, New South Wales. Fragments of the endemic Silurian cheiruroid trilobite Onycopyge were recovered.

Miscellaneous

1. Various aspects of trilobite organization and distribution were considered at a seminar series held at the Geology School, A.N.U.; the author presented new evidence for the morphology of the ventral surface of trilobites from Ordovician asaphids collected in the Georgina Basin, N.T.

2. Manuscripts of two versions of a paper proposing new Cambrian and Ordovician stages for northern Australia were read and discussed with joint authors (P.J. Jones and J.H. Shergold).

3. Discussions on lower Palaeozoic trilobites were had with Professor H.B. Whittington (Cambridge University).

## Annual Report

by

J.H. Shergold

J.H. Shergold was engaged on the following projects and activities during the year:

1. The greater part of the year was occupied in completing the technical preparation of late Cambrian and early Ordovician trilobite faunas from the southern part of the Burke River Structural Belt, western Queensland, concentrating on the Cambro-Ordovician inliers at Black Mountain, Ninmaroo, Mount Datson and Dribbling Bore. Specimens prepared, illustrated and card-indexed from these localities total 1950. They represent some 44 genera and more than 100 species. Systematic descriptions of this large fauna has been commenced- to date 15 genera and subgenera (eight new) and 41 species and subspecies (27 new) have been described.

(Cont.)

Bulletin 112, describing late Cambrian trilobites from the Gola Beds, western Queensland, submitted for publication in 1968-69 remains in press. Final proofs of Bulletin 104, on Australian Oryctocephalidae, were corrected and this paper is now issued.

2. The card-indexing of Australian Cambrian trilobites continues. A bibliography and index of these trilobites was compiled and published as a BMR record. A second part, primarily a synonymy index, remains in preparation.

3. From 6th July to 12th August, 1970, was spent in the field, collecting Cambrian trilobites from the Bancannia Trough in northwestern New South Wales.

4. Four papers were written during the year, one in collaboration with P.J. Jones and E.C. Druce. Two papers were published; three are in preparation. (See Section S18).

## Annual Report

by

D.L. Strusz

D.L. Strusz continued work on several taxonomic studies: one with Dr. Shergold on the Silurian trilobite Encrinurus and another on Devonian tetracorals from the Texas High are still unfinished. A third with Dr. Chatterton and Mr. Flood, on the Devonian brachiopod "Spirifer" yassensis de Koninck, from Taemas, was completed, and has been accepted for publication probably in December 1970 by the Linnean Society of New South Wales.

The work on Encrinurus was delayed by difficulties in tracing the types of the two commonest species - E. mitchelli and E. bowningi Foerste. Originally these were at Denison, Ohio. Professor H.B. Whittington suggested they may have been lost in floods, or transferred to the U.S. National Museum with the remnants of Denison's type collection. The National Museum cannot find them, so it must be assumed they are lost. The resulting nomenclature problems should be readily overcome, and it is expected to complete this study early in 1971.

The corals from the Silverwood area are being prepared as technical assistance permits, but no completion date can yet be set.

Final work on the text and figures of the Canberra Explanatory Notes was done, and they are now being edited. A bibliography complete to June 1970 is to be added shortly. Work has started on a correlation study of the Australian Lower Devonian, to be presented on behalf of a group of interested workers at a symposium to be held in conjunction with the 1971 ANZAAS Meeting.

(Cont.)

The annual field camp for vacation students was held in the Kiandra - Long Plain area in January and early February, 1970. Four days were then spent by Dr. Strusz and Miss Gilbert-Tomlinson as guests at the annual A.N.U. camp, at Quidong, N.S.W., searching for fresh material of the trilobite Onycopyge liversidgei.

The period from April 17th to June 25th was spent on a visit to Europe, studying the classical areas of the Silurian and Devonian. Reasonable to good collections of comparative fossil material were made.

## Annual Report

by

G.C. Young

During the year preparatory work was carried out on Upper Devonian Bothriolepis material from Australia and Antarctica. In both cases negative preparation and latex casting of the remaining impressions has been the method employed.

The Australian material was collected during the year from Khan Yunis; a locality about sixty miles south of Braidwood, N.S.W., it is in general poorly preserved in a coarse-grained sandstone. The material differs in several respects from the only previously described Australian Bothriolepis species, B. gippslandensis Hills. Phyllolepis - type plates also occur.

The Antarctic material (collected in 1969 by the Victoria University of Wellington Antarctic Party) tends to be fragmentary, but is well-preserved in a red siltstone. Several species of Bothriolepis appear to be represented.

## MICROPALAEONTOLOGY

Two thousand three hundred and twenty-four samples were washed and prepared for examination of their microfaunal content.

Seven hundred and eight-six thin sections were made and nine hundred and seventeen polished rock samples; forty-nine single specimen thin sections were prepared.

Two hundred and sixty-two samples (in weight about 1300 lbs.) were digested in acid in order to extract conodonts.

Thirty-four samples were experimentally treated in an attempt to find new methods of treatment, or improve on established methods.

Eight hundred and thirty-two slides from the foraminiferal collection were cleaned and re-labelled, and the specimens transferred to new slides.

Three hundred samples were processed for spore and microplankton content.

Visitors to the laboratory during the year included -

Mr. S. Keston, Continental Oil Company, and Mr. S. Schuyleman, B.P., to examine foraminiferal collections and discuss work in Papua and New Guinea.

Mr. A.R. Lloyd, consultant micropalaeontologist, for general discussions.

### Annual Report

by

D.J. Belford

D.J. Belford continued study of foraminifera from off-shore wells, Western Australia and from Papua - New Guinea, and illustration of specimens using the scanning electron microscope. Lower middle Palaeocene and possible lower Palaeocene (Danian) foraminifera have been identified from the Sahul Shoals No.1 Well, Western Australia, drilled by B.O.C. of Australia Limited. This is the only known occurrence of beds of this age in the Australian region.

The New Guinea Eastern Highlands field party was visited from the 4th June to 8th July, and the Geological Branch of the Department of Lands, Surveys and Mines, Port Moresby. During the field work a complete section through the Chimbu Limestone (Eocene-Oligocene) was measured and sampled. Samples were also taken through the Mesozoic Chim Group and through a mainly Tertiary section of clastic sediments along the Osaro River.

(Cont.)

A paper entitled "Turonian Foraminifera from the Carnarvon Basin, Western Australia, and their palaeogeographic significance" written in collaboration with Dr. Viero Scheibner of the New South Wales Geological Survey has been accepted for publication in "Micropalaeontology". This paper records the occurrence of several species in this area for the first time, and discusses the similarity of the fauna with those in the Tethyan area.

Age determination of samples submitted by Bureau field parties, mainly in Papua-New Guinea, continued, and a compilation of all palaeontological work carried out on samples from eastern Papua was begun.

Sometime was spent coding foraminiferal references for computer storage and retrieval, using the INFOL programme, and work continued on curating of the foraminiferal collection.

## Annual Report

by

P.J. Jones

A paper in which three stages are proposed for sequences of trilobite and conodont faunas occurring about the Cambrian - Ordovician boundary in the Burke River Structural Belt, western Queensland, was prepared jointly with J.H. Shergold and E.C. Druce for external publication (J. geol. Soc. Aust.); all three stages are recognized in Cambrian and Ordovician sequences extensively exposed in northern and central Australia, and evidence is cited for their recognition in eastern and southeastern Asia, North America and Europe.

The MS of Bull. 117 (Lower Ordovician conodonts from the Bonaparte Gulf Basin and the Daly River Basin, northwestern Australia), submitted to the Editor in August 1969, was updated and virtually rewritten while awaiting tenders for printing.

Study of the Lower Carboniferous ostracods from the Bonaparte Gulf Basin continued; this involved photography using the Scanning Electron Microscope, and computer analysis of species of Rectobairdia by numerical classification.

In collaboration with J. Roberts, a correlation chart of the Upper Devonian rocks of Australia was prepared and circulated for comment (for ANZAAS 1971 Program), and previous palaeontological reports of the Carboniferous subsurface biostratigraphy were evaluated (at the request of the Basins Study Group, Petroleum Exploration Branch).

(Cont.)

Oil company material submitted from the northwestern part of the Lennard Shelf of the Canning Basin, has been examined with the following results:

(i) Lower Carboniferous ostracods from shot-hole samples (Lennard Oil's Alexander Seismic Survey) were used to trace the lateral extent of the Laurel Formation beneath the sand and soil cover.

(ii) Upper Devonian ostracods were found in Napier No2, No.4,and the water bore for Napier No.5; these are being studied.

Examination of samples from BOC Sahul Shoals No.1, drilled offshore Bonaparte Gulf Basin, yielded Upper Triassic ostracods and conodonts in the interval 5960 - 6196 feet.

During the year, one paper was published on Lower Triassic ostracods from the Perth Basin (Bull.108-6), one paper is in press - Upper Cambrian and Lower Ordovician (Tremadocian) conodonts from western Queensland (Bull. 110, with Druce), and one (Bull. 117) awaits publication.

## Annual Report

by

J.G. Binnekamp

J.G. Binnekamp was mainly involved with the study of Foraminifera from New Britain, with emphasis on the larger Foraminifera. Additional samples collected during August and September, 1969, were examined. Selected samples from these and previous collections were examined in detail, and oriented sections of larger Foraminifera prepared and photographed for a reference system and future publication. A record on the results of these studies is almost completed and a publication on the larger Foraminifera is in preparation.

The oldest fauna found in New Britain comprises species belonging to Discocyclina, Pellatispira, Biplanispira, Heterostegina, Nummulites, Spiroclypeus and Halkyardia; this fauna indicates an Upper Eocene age. It occurs in small limestone lenses in indurated volcanogenic sediments called Baining Volcanics.

A younger association of larger Foraminifera comprises species of Lepidocyclina (Eulepidina), Lepidocyclina (Nephrolepidina), Cycloclypeus and Heterostegina. This fauna is thought to indicate Lower Te stage (Oligocene). It occurs in limestones associated with less indurated volcanogenic sediments called Merai Volcanics.

(Cont.)

The overlying lithological unit is an algal - coralline limestone which covers a great part of the island. The base of this unit at its most westerly outcrops in the Whiteman ranges appears to be basal Upper Te stage (lower Miocene), and becomes gradually younger eastwards; in the Gazelle Peninsula, faunas from the base indicate Upper Tf stage (Middle Miocene). Upper Tf faunas have been found over the whole island; genera represented in these faunas include Lepidocyclina (Nephrolepidina), Cycloclypeus, Austrotrillina, Miogypsina, Flosculinella.

Upper Miocene to Pliocene assemblages of planktonic Foraminifera occur in fine-grained limestones which crop out north of the Whiteman ranges and on the north side of the Nakanai Mountains. Similar associations occur in volcanogenic sediments in the Gazelle Peninsula.

Other work included the completion of a record on samples from the Kubor range, in co-operation with D.J. Belford, and a record on samples from the Star Mountains. Some forty samples from the Markham 1:250,000 Sheet area were examined for palaeontological age determination, and another eighty from the same area and from the Huon Sheet area are being examined.

Examination of several small collections of samples from Papua- New Guinea was also carried out.

## Annual Report

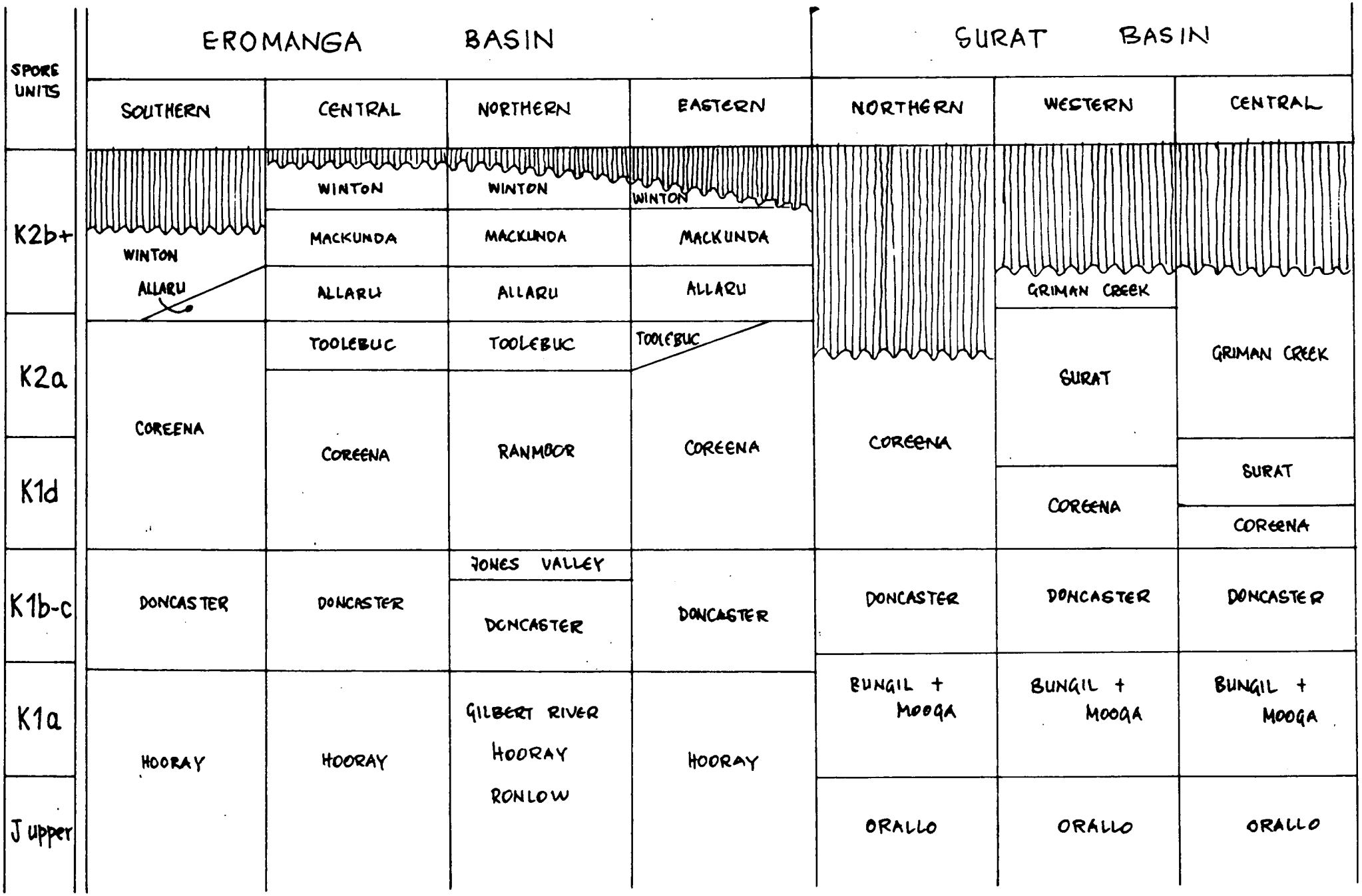
by

M. Owen

M. Owen started work in the Bureau on the 18th December, 1969, with a study of the Cretaceous Foraminifera of Western Australia as the main project. The work is intended to provide a detailed biostratigraphic framework for the Cretaceous in Western Australia and also to provide palaeoecological information on the Cretaceous Foraminifera.

Outcrop formations studied have been the Gingin Chalk, Toolonga Calcilutite, Korojon Calcarenite, and the Miria Marl. In addition, sequences from several boreholes have been examined. These include BMR No.5 (Giralia), Rough Range South No.1, Legendre No.1, Dampier No.1, Ashmore Reef No.1, and Sahul Shoals No.1. All the offshore wells, i.e. the last four named, appear to have almost continuous sections through the Upper Cretaceous, and provide useful information on those intervals of the succession missing in surface outcrops. To complement this study, a systematic programme of photography of specimens from Western Australia using the Scanning Electron Microscope was begun.

(Cont.)




To accompany Record 1970/81

Aus 1/274

FIG S13/2

D. BURGER: ANNUAL REPORT 1970

Work also started during the year on the coding of foraminiferal references for computer retrieval using the INFOL system. This work, being carried out in conjunction with D.J. Belford, has resulted in several hundred references being coded.

Study of the calcareous nannoplankton from the Upper Cretaceous of Western Australia was started during the year. This work is still in an early stage; most of the effort so far has been devoted to developing techniques of sample preparation. However, a study of nannoplankton from the Miria Marl was started, and confirmed the potential usefulness of this group of microfossils, as the Upper Maaestrichtian age indicated by planktonic foraminifera was verified.

## Annual Report

by

D. Burger

The major project was the palynological study of the Lower Cretaceous Rolling Downs Group in the Surat and Eromanga Basins, Queensland. With the progress of regional field mapping and concurrent shallow drilling, sediments from various areas were examined and the results reported in B.M.R. Records. The correlation of sequences belonging to the Group in various areas is based on spore units and is given in Figure S13/2. Reports (published and unpublished) are listed in Section S18.

Extensive study of the Carpentaria Basin was begun later in the year, and mainly Lower Cretaceous (Aptian-Albian) formations in some oil wells were examined. Tertiary sediments from the Ngalia Basin were examined in B.M.R. Napperby No.1. Consultation work for oil companies was relatively minor. Outcrop samples from Cretaceous sediments in Papua were examined at the request of BP Australia. Permian, Triassic and Jurassic samples were investigated in Amoco Towerhill No.A-1 Well, drilled in the Galilee Basin, Queensland.

Research on autofluorescence of pollen grains started in September, 1970. After initial testing of the equipment and autofluorescence properties of various chemicals used for processing of rocks, a beginning was made on a collection of permanent microscope preparations of Recent pollen from Australian and New Guinea trees and shrubs, to serve as a standard for measurements for fossil pollen material.

An edge perforation card system, which stores data on fossil pollen and spores from Australian systematic literature, is being used successfully. A similar system is being designed for fossil dinoflaggellates in the Australian area. A field trip was made together with M.S. Norvick to the Hughenden area, central Queensland, in order to collect outcrop material of Permian and Triassic sediments in the Galilee Basin.

# Annual Report

by

J.A. Owen

J.A. Owen joined the Bureau in December, 1969, and has been doing both editorial and palaeontological work. The following manuscripts have been edited and sent to press:

Bulletin 122 - Brachiopods of the Bonaparte Gulf Basin (in galley proof)
Bulletin 125 - Geological Papers 1969
Report 147 - Catalogue of Fossil Type specimens, Univ. of New England.
Report 148 - Catalogue of Fossil Type specimens, Comm. Pal. Coll.- Protista
Bulletin 126 - Palaeontological Papers, paper by M.E.White edited.

In addition, one Bulletin (134, Yass Conodonts) and two reports (both catalogues of fossil types) are being edited and prepared. Much time was spent in miscellaneous editorial work: checking galley proofs for various Bulletins, advising on editorial matters, checking illustrations and critically reading manuscripts.

Some Cretaceous ostracods from Bathurst Island were examined, but the project was put aside because of insufficient material. A project on Devonian and Lower Carboniferous floras from the Bonaparte Gulf Basin was begun, and assemblages from four wells were examined. Spores from the Devonian horizons were found to be poorly preserved and carbonized, making identification on any meaningful level impossible. The Lower Carboniferous assemblages were varied and diverse and have been previously described.

The current project concerns Devonian floras of the Canning Basin. At present, Upper Devonian (Famennian) assemblages from the Fitzroy Basin (BMR 2 Laurel Downs well) are being examined. The flora is diverse and well-preserved; however, any possible stratigraphic application must await further study.

# Annual Report

by

M. Norvick

M. Norvick joined the Bureau in December 1969. An initial period was spent in familiarisation with Bureau palynological techniques and documentation. A short Department of National Development induction course was attended in February.

The major part of 1970 was allocated to the study of Permian pollen and spore assemblages from Queensland. Stratigraphic and taxonomic problems were investigated in Amerada Thunderbolt No.1 well (Galilee Basin) and outcrop samples from the Hughenden area (N.Queensland).

Mid-Cretaceous microplankton were studied from Oil Development N.L. Bathurst Island Nos.1 and 2 wells (Northern Territory). A stratigraphic and taxonomic paper is in preparation in collaboration with D. Burger.

Microplankton of Upper Jurassic/Lower Cretaceous age were examined in outcrop samples from the Papuan Basin (T.P.N.G.), again in collaboration with D. Burger.

Some time was spent transferring published information on fossil spores and pollen onto edge punched cards, and an edge punched card system was designed for the storage and retrieval of stratigraphic and morphological data on the microplankton.

August 1970 was spent working in the Stratigraphic and Mineral Indexing sections of the Bureau. In January a visit was made to the 1970 student mapping camp at Rules Point (N.S.W.). In June the Hughenden and Gilberton areas (N. Queensland) were visited, Permian and Mesozoic sections examined and sampled.

Visits were made to selected geological institutions for discussions and comparative examination of type specimens, including the Geological Survey of Queensland, and Mines Administration Pty Limited (Brisbane, June), the University of Melbourne and the National Museum (Melbourne, September).

## S14. SEDIMENTOLOGY

by

A.R. Jensen

Personnel: A.R. Jensen, B.G. Jones, T. Zapasnik

Nature of Work:

For much of the year members of the group have been engaged in the study of Triassic rocks in the Bowen Basin (see under Bowen Triassic Party). Some time has also been spent in the development and refinement of techniques used in sedimentological studies, on the development of a computer programme for the analysis of cross-stratification data, and in the routine description and analysis of various samples submitted by other sections.

In preparation for the measurement of the elongation ratios of quartz grains, a method of disaggregation of sandstone and the subsequent mounting of grains on glass slides with arochlor was evolved.

A method of X-ray radiography of thin rock slabs to show internal sedimentary features has been modified from published methods. The method involves the use of a large powder camera fitted with a spring-steel sample holder which can handle samples up to 40 x 25 x 5 mm.

A programme for the correction of cross-stratification measurements for tectonic tilt written by Jones while at the Australian National University was modified and adapted for use on the CSIRO computer. The programme also calculates directional parameters and statistics for data at three levels of grouping.

## S15 - PHOTOGEOLOGY

Personnel: C.J. Simpson, C.E. Maffi (On leave of absence with U.N., Brazil, 23/2/70 to 31/10/70).

Work Completed:

| | |
|---|---|
| Northern Territory | Alcoota 1:250,000 (Southern 60% of Sheet area interpreted). |
| Queensland | Red River, Galbraith, Walsh, Hann River, Rutland Plains 1:250,000 Sheets. |

With the exception of Red River the areas were prepared for field party use only and are not available for issue.

| | |
|---|---|
| T.P.N.G. | Markham - the region north of the Markham Valley was interpreted for field use only. |
| New South Wales | Interpretation was done on problem areas indicated by the Hunter Valley Party. |

Work in Progress at 31st October, 1970

| | |
|---|---|
| T.P.N.G. | Huon Sheet. |
| Western Australia | Air photographs were flown during October by the BMR Airborne Group over areas around Menzies and Leonora. This combined group project has been undertaken to evaluate the potential of colour, infra-red and multispectral photographs, and detailed airborne magnetic observations. |

Special Projects

An air photograph study of coastal erosion in southeast Queensland was made for the BMR Engineering Geophysics Group.

Colour and colour infra-red air photographs were flown by BMR Airborne Group over selected areas in Northern Victoria for the Victorian State Rivers and Water Supply Commission. These photographs have proved useful for the detection of irrigation channel leakage and areas affected by groundwater salinity, and in several aspects of farm management.

The "Provisional list of aerial photographs of Geological and Geomorphological interest from Australia and Australian Territories" was revised and updated.

An instrument was designed to allow stereoscopic viewing of uncut 70 mm strip film. It was constructed by BMR Workshop Section.

Field Work

Evaluation of colour photographs of the Kerang irrigation was carried out in northern Victoria 31/5/70 to 2/6/70.

Field checks of interpreted areas in Queensland and Northern Territory were made from the Carpentaria Basin Party and Arunta Party base camps respectively during the period 25/7/70 to 24/8/70.

Training Courses

Eleven new staff members were instructed in photogeological interpretation techniques.

Displays illustrating photogeology were prepared for the ANU third year geology students in February, and for CSIRO representatives in July.

Group Reclassification

Following discussions with departmental and Public Service Board representatives in July, the Class 1 and 2 Group positions were reclassified to Class 2 and 3 respectively.

## S16 - PHOSPHATE AND MARINE GEOLOGY GROUP

by

H.A. Jones & P.J. Cook

Staff: As at 31st October 1970, professional staff comprised:

H.A. Jones, in charge of group.
P.J. Cook, continental phosphate search and leader of estuary study project.
D. Jongsma, marine geology.
W. Mayo, estuary study project.
J. Marshall, marine geology.

F. de Keyser, D.S. Trail, and R. Geijskes, resigned during the year, and W. Mayo and J. Marshall joined the group on first appointment.

All sub-professional positions, comprising four Technical Officers Grade 1, and three Technical Assistants Grade 2, were filled on 31st October 1970.

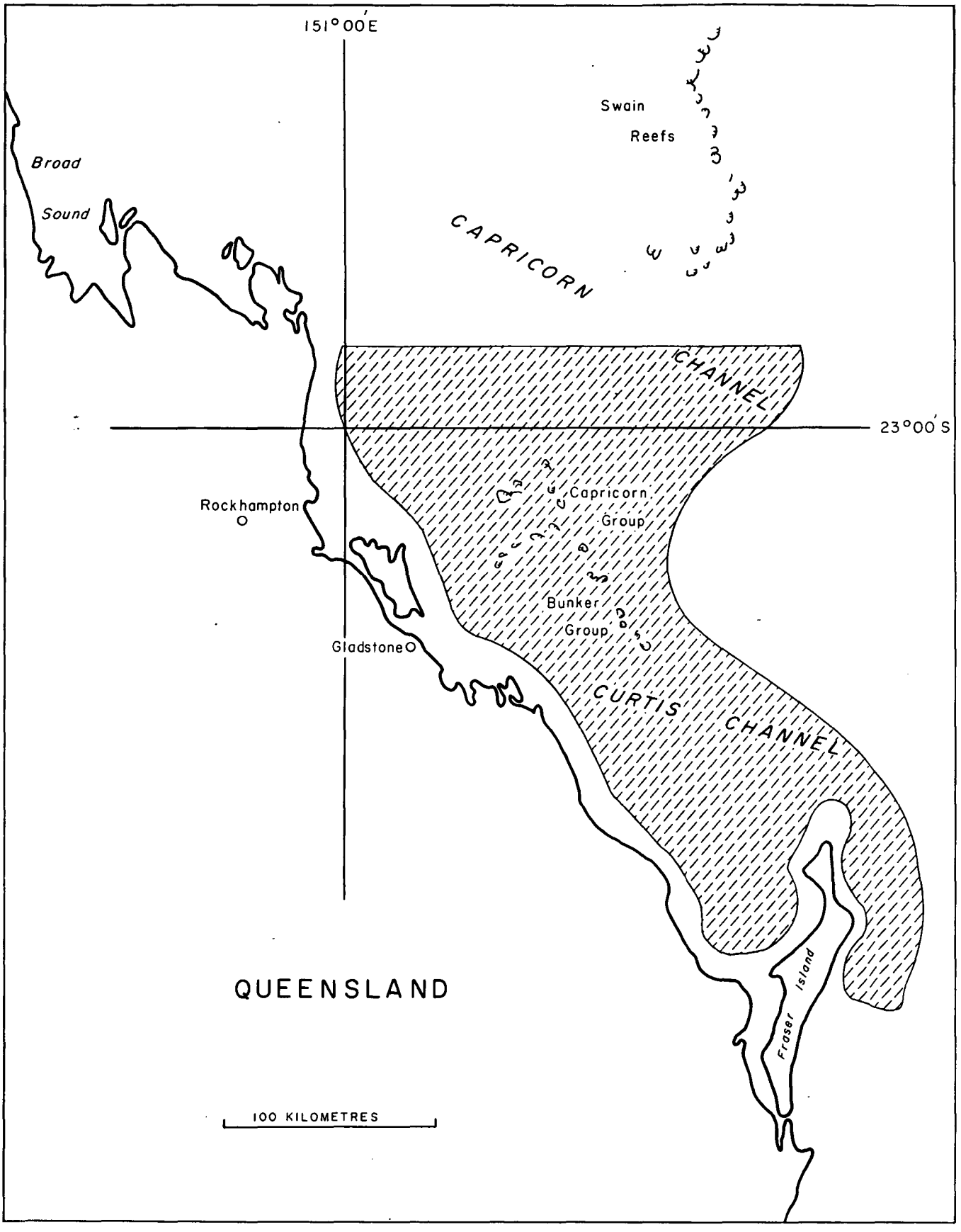



Fig. S16/1 Area covered by Marine Geology Survey 12-9-70 to 20-10-70.
Sample stations on 10 Nautical Mile grid, sparker profiles average 15 Mile spacing.

Marine Geology

The 1970 marine geology survey started on 12th September, and is expected to terminate about 12th December. The area covered by sampling and by seismic profiles up to 1st November is shown in Figure S16/1. It is expected to extend the coverage of the continental shelf as far south as the Cape Byron region by the end of the survey and also to explore some of the northern Tasman Sea seamounts by dredging and seismic profiles.

The vessel used in the survey is the oil rig supply ship M.V. San Pedro Strait, 120 feet overall length, 178 tons net, and 330 tons gross. This ship, which has been working for Esso - B.H.P. in the Bass Strait, was chartered from San Pedro (Offshore) Pty Ltd. She has accommodation for eight in addition to the 8-man crew, and provides a satisfactory platform for marine geological operations, although the violent motion of this particular hull form in moderate seas is a disadvantage.

The results obtained up to 31st October emphasize the sharp contrast between the Capricorn Channel area, which is a depositional zone where there is no well defined distinction between the continental shelf and slope, and the narrow submerged continental margin off Fraser Island which is partially swept clean of sediment by current action and exhibits strong relief. A drowned shallow water reef in 180 m of water was located in the Capricorn Channel; submerged reefs at the same depth were recorded in the Arafura Sea in 1969 by the BMR and have also been noted by other workers in Australian, Californian, and Caribbean waters. The presence of this feature at this depth suggests that no warping of the shelf has occurred since the late Pleistocene in this area.

A number of erosional channels cut into the top of the continental slope in the Curtis Channel have been identified. These probably funnel coarse terrigenous sediment from the coastal Cainozoic deposits to the south, and the biogenic carbonate detritus from the Bunker Group of islands to the north, into the deep basin offshore.

Sparker profiles off Fraser Island have revealed the presence of a strong reflector unconformably overlain by the seaward dipping Recent sediments prograding the present day outer continental shelf margin. This reflector crops out on the upper continental shelf where it forms a sub-horizontal terrace under about 275 m of water. Fossiliferous bedrock was successfully recovered from this surface by dredging.

## PHOSPHATE STUDIES

Field work on the Georgina Basin phosphate deposits was completed in 1969. Since that time, office compilation of mapping, drilling and analytical data has been proceeding. It has become apparent that the present scheme of stratigraphic nomenclature is unsatisfactory and consequently a six-fold scheme of lithostratigraphic units is suggested as a more satisfactory alternative. There would seem to be little doubt that most of the pelletal phosphorites were deposited under very shallow water (possibly estuarine) conditions. There are however, various types of phosphorites, of both primary early diagenetic and late diagenetic origin.

Laboratory work carried out on the phosphorites included major and minor element analyses (at AMDL) petrology, clay mineralogy, and determination of cell dimensions. Investigation of diagenesis which is well developed in the phosphorites was of particular interest. Most of the laboratory work is now completed, with the exception of the cell dimension work which is likely to continue for some time yet. Further publications are contemplated on the laboratory investigations.

Phosphate occurrences in the Sydney Basin were visited with geologists of the Geological Survey of New South Wales.

## ESTUARY STUDY PROJECT

A comprehensive study of the Quaternary geology and geochemistry of the Broad Sound area of Queensland was started in June. This investigation involved both geologists (P.J. Cook, W. Mayo), and chemists (P. Rew, S.E. Smith, and T.G. Powell). Sediments were sampled at approximately 400 localities for sedimentological and geochemical work. $P_2O_5$ analyses were undertaken on these samples in the field, but a variety of analyses remain to be carried out. Water sampling was undertaken throughout Broad Sound and adjacent estuaries; however, due to the extreme drought in this area at present, all samples were found to be normal seawater and it was not possible to investigate mixing phenomena. Some of the mangrove inlets were found to contain seawater of rather low pH; this is being further investigated. The drainage basins adjoining Broad Sound were sampled in some detail in order to ascertain their geochemistry. Echo sounder and sparker traverses were undertaken in the Sound; shallow coring was carried out at a number of localities.

Investigations of Mallacoota Inlet commenced in late October. This is a joint B.M.R. - A.N.U. investigation which is being undertaken for comparison with Broad Sound.

## S17 - OVERSEAS VISIT 18/7/70-28/8/70

Mr. W.J. Perry, in company with Mr. P.J. Hillman of the Geophysical Branch, visited the U.S. National Aeronautics and Space Administration establishments in Washington and Houston as a member of the Departmental team invited by N.A.S.A. to study aspects of their post-Apollo programme. The team was briefed on the Earth Resources Technology Satellite and Skylab programmes, and in the associated supplementary aircraft programmes to evaluate sensor capabilities.

Visits were also made to the U.S. Geological Survey, universities and private companies to investigate work being done in the field of remote sensing applied to earth resources.

Perry also visited the Tektite II operation in the U.S. Virgin Islands for two days. Tektite II refers to a multidisciplinary underwater research project jointly sponsored by several U.S. Government agencies, universities and private companies, which was designed to permit marine scientists to carry out a variety of in situ research missions under saturated diving conditions at a depth of 50 feet.

An account of the visit is being prepared for inclusion in the Records series.

SECTION S18 STATUS OF RECORDS AND PUBLICATIONS ON 31ST OCTOBER, 1970

| PROJECT (chapter) / AUTHOR | TITLE | | FORM OF PUBLICATION | STATUS |
|---|---|---|---|---|
| | | | Bulletin B<br>Report R<br>Explanatory Notes E.N.<br>External Publication E.P.<br>Records C | |
| **GREAT ARTESIAN BASIN** (S2) | | | | |
| EXON, N.F., & VINE, R.R. | Revised nomenclature of the "Blythesdale" sequence | | E.P. | Published |
| CASEY, D.J. | TANGORIN, | SF - 55/5 | E.N. | Published |
| VINE, R.R. | MUTTABURRA | SF - 55/9 | E.N. | In press |
| VINE, R.R. | RICHMOND | SF - 54/4 | E.N. | In press |
| VINE, R.R. | LONGREACH | SF - 55/13 | E.N. | In press |
| EXON, N.F. | ROMA | SG - 55/12 | E.N. | In press |
| REISER, R.F. | SURAT | SG - 55/16 | E.N. | In press |
| REISER, R.F. | CHINCHILLA | SG - 56/9 | E.N. | In press |
| EXON, N.F. | MITCHELL | SG - 55/11 | E.N. | Complete except for drafting of figures |
| VINE, R.R. | GALILEE | SF - 55/10 | E.N. | Complete except for drafting of figures |
| EXON, N.F. & OTHERS | The post-Palaeozoic rocks of the Warwick 1:250,000 Sheet area, Queensland and New South Wales | | C. 1969/80 | Editing |

| | | | | |
|---|---|---|---|---|
| EXON, N.F. | The evolution of the Surat Basin - a summary | | E.P.? | Awaiting editing. |
| MEDVECKY, A. | DALBY | SG - 56/13 | E.N. | In prep. |
| MEDVECKY, A. | GOONDIWINDI | SH - 56/1 | E.N. | In prep. |

CARPENTARIA BASIN

(S3)

| | | | | |
|---|---|---|---|---|
| SMART, J. & OTHERS | Recent geological mapping in the Carpentaria Basin - new stratigraphic names | | E.P. | Complete except for drafting of figures |
| GRIMES, K. & SMART J. | Shallow stratigraphic drilling in the southern Carpentaria Basin, 1969 | | C. 1970/38 | Being collated |
| DOUTCH, H.F. & OTHERS | Progress report on the geology of the southern Carpentaria Basin | | C. 1970/39 | First draft completed |
| SMART, J. & INGRAM J. | GILBERTON | SE - 54/16 | E.N. | First draft completed |
| GRIMES, K. | MILLUNGERA | SE - 54/15 | E.N. | First draft complete |
| SMART, J. | DOBBYN | SE - 54/14 | E.N. | First draft complete |
| INGRAM, J. | DONORS HILL | SE - 54/10 | E.N. | First draft complete |
| INGRAM, J. | BURKETOWN | SE - 54/6 | E.N. | First draft complete |
| DOUTCH, H.F. | Late Cainozoic tectonism of the Trans Australian Platform margin in northern Queensland and New Guinea. | | B.? | In prep. |

WEST SURAT BASIN

(S5)

| | | | | |
|---|---|---|---|---|
| SENIOR, B.R. | Cainozoic textonics and petroleum distribution in the St. George area, Queensland | | E.P. | In press |

| | | | | |
|---|---|---|---|---|
| SENIOR, B.R. | HOMEBOIN | SG - 55/15 | E.N. | Editing |
| SENIOR, B.R. | Structural interpretation of the southern Nebine Ridge area, Queensland | | E.P. | Editing |
| SENIOR, Daniele | ST. GEORGE | SH - 55/4 | E.N. | Editing |
| GRAHAM, Barbara | DIRRINBANDI | SH - 55/3 | E.N. | In prep. |
| MEDVECKY A. & SENIOR, B.R. | Shallow stratigraphic drilling in the Homeboin, Dirranbandi, St. George and Eulo 1:250,000 Sheet areas, Queensland | | C. 1970/82 | In prep. |

CENTRAL EROMANGA BASIN

(S6)

| | | | | |
|---|---|---|---|---|
| EXON, N.F. | TAMBO | SG - 55/2 | E.N. | Published |
| SENIOR, B.R. | CONNEMARA | SG - 54/12 | E.N. | Published |
| SENIOR, B.R. | JUNDAH | SG - 54/4 | E.N. | Published |
| SENIOR, Daniele | DURHAM DOWNS | SE - 54/15 | E.N. | Published |
| GREGORY, C.M. & VINE R.R. | WINDORAH | SG - 54/8 | E.N. | Published |
| GREGORY, C.M. & VINE R.R. | CANTERBURY | SG - 54/7 | E.N. | In press |
| CASEY, D.J. & GALLOWAY, M.C. | BLACKALL | SG - 55/1 | E.N. | In press |
| GALLOWAY, M.C. | ADAVALE | SG - 55/5 | E.N. | In press |
| GALLOWAY, M.C. | AUGATHELLA | SG - 55/6 | E.N. | In press |
| INGRAM, J.A. | EROMANGA | SG - 54/12 | E.N. | In press |
| SENIOR, B.R. | BARROLKA | SG - 54/11 | E.N. | In press |

| | | | | |
|---|---|---|---|---|
| SENIOR, Daniele | THARGOMINDAH | SG - 54/16 | E.N. | In press |
| GALLOWAY, M.C. & SENIOR, Daniele | TICKALARA | SG - 54/3 | E.N. | In press |
| SENIOR, Daniele | CHARLEVILLE | SG - 55/10 | E.N. | In press |
| SENIOR, B.R. | QUILPIE | SG - 55/9 | E.N. | In press |
| THOMAS, B.M. | WYANDRA | SG - 55/14 | E.N. | In press |
| THOMAS, B.M. | CUNNAMULLA | SG - 55/2 | E.N. | In press |
| INGRAM, J.A. | BULLOO | SG - 54/4 | E.N. | In press |
| SENIOR, B.R. & SENIOR, Daniele | Silcrete in southwest Queensland | | B. | In press |
| INGRAM, J.A. | TOOMPINE | SG - 55/13 | E.N. | Complete except for drafting of figures |
| SENIOR, B.R. | EULO | SH - 55/1 | E.N. | Complete except for drafting of figures |
| SENIOR, B.R. | The geology of the central Eromanga Basin | | B. | In prep. |

BOWEN TRIASSIC PARTY

(S7)

| | | | | |
|---|---|---|---|---|
| ALCOCK, P.J. | A report on the sedimentology of the Moolayember Formation, Bowen Basin, Queensland | | C. 1970/25 | Issued |
| JENSEN, A.R. | Regional aspects of the Upper Permian regression in the northern part of the Bowen Basin | | E.P. | In prep. |

TEXAS HIGH PARTY

(S8)

| | | | | |
|---|---|---|---|---|
| OLGERS, F. & FLOOD, P.G. | Palaeozoic geology of the Warwick and Goondiwindi 1:250,000 Sheet areas | | C. 1970/6 | Issued |
| OLGERS, F. | Warwick | SH - 56/2 | E.N. | In prep. |

OFFICER BASIN PARTY

(S9)

| | | | | |
|---|---|---|---|---|
| JACKSON, M.J. | Notes on geological traverses in the Officer Basin, W.A. 1970 | | C. | In prep. |

NGALIA BASIN

(S10)

| | | | | |
|---|---|---|---|---|
| NICHOLAS, T. | LAKE MACKAY | SF - 52/1 | E.N. | Editing completed |
| WELLS, A.T. | MOUNT DOREEN | SF - 52/12 | E.N. | Editing completed |
| EVANS, T.G. | NAPPERBY | SF - 53/9 | E.N. | Editing completed |
| WELLS, A.T. | Stratigraphic drilling in the Ngalia Basin 1970 | | C. | In prep. |

AMADEUS BASIN

(S11)

| | | | | |
|---|---|---|---|---|
| WELLS, A.T. et al. | Geology of the Amadeus Basin | | B100 | In press |
| WELLS, A.T. & KENNEWELL, P. | Evaporite drilling in the Amadeus Basin; Hermannsberg 40, Mount Liebig 1, Lake Amadeus 3, 3A, 3B | | C. | In prep. |

PALAEONTOLOGY

(S13)

| | | | | |
|---|---|---|---|---|
| DICKINS, J.M. | Correlation chart for the Permian System in Australia. In Gondwana stratigraphy. I.U.G.S. Symposium. UNESCO Earth Sciences, 2 | | E.P. | Published |
| MOLLAN, R.G., DICKINS, J.M., EXON, N.F., & KIRKEGAARD, A.G. | The geology of the Springsure 1:250,000 Sheet area, Queensland. | | R123 | Published |

| | | | |
|---|---|---|---|
| DICKINS, J.M., ROBERTS, J., & VEEVERS, J.J. | Permian and Mesozoic Geology of the Bonaparte Gulf Basin. | B125 | In press |
| DICKINS, J.M., & MALONE, E.J. | Geology of the Bowen Basin, Queensland. | B130 | In prep. |
| DICKINS, J.M., & ROBERTS, J. | Progress in Gondwana Stratigraphy and Palaeontology in Australia since 1967. Proc. 2nd Gondwana Symposium | E.P. | In press |
| PLANE, M. | A fossil macropodid from the marine Pliocene of Victoria. Mem. Nat. Mus. Victoria. | E.P. | In press |
| SHERGOLD, J.H., & BASSETT, M.G. | Facies and faunas at the Wenlock/Ludlow boundary of Wenlock Edge, Shropshire. Lethaia 3: 113-142. | E.P. | Published |
| SHERGOLD, J.H. | Oryctocephalidae (Trilobita: Middle Cambrian) of Australia. | B104 | Published |
| SHERGOLD, J.H. | A new conocoryphid trilobite from the Middle Cambrian of Western Queensland. | B126 | In press |
| SHERGOLD, J.H. | Bibliography and Index of Australian Cambrian trilobites, 1. Bibliography and specific index. | C 1970/47 | Prepared |
| SHERGOLD, J.H. | Resume of data on the base of the Ordovician in northern and central Australia. Prepared for the Colloquium on the Ordovician and Silurian Systems, Brest, September 1971 and to be incorporated into the proceedings. | E.P. | In press |
| SHERGOLD, J.H. | In Jones, P.J., Shergold, J.H., & Druce, E. Three late Cambrian and early Ordovician Stages in western Queensland. For submission to the Geological Society of Australia. | E.P. | Prepared |

| | | | |
|---|---|---|---|
| BELFORD, D.J., & SCHEIBNER, Viora. | Turonian Foraminifera of the Carnarvon Basin, Western Australia. Micropalaeontology | E.P. | In press |
| JONES, P.J. | Marine Ostracoda (Palaeocopa, Podocopa) from the Lower Triassic of the Perth Basin, Western Australia | B108 | In press |
| JONES, P.J. | Lower Ordovician conodonts from the Bonaparte Gulf Basin and The Daly River Basin, northwestern Australia. | B117 | with editor |
| DRUCE, E.C., & JONES, P.J. | Cambro-Ordovician conodonts from the Burke River Structural Belt, Queensland | B110 | In press |
| JONES, P.J., SHERGOLD, J.H., & DRUCE, E.C. | Late Cambrian and Early Ordovician stages in Western Queensland (J. geol. Soc. Aust.). | E.P. | In press |
| EVANS, P.R., & BURGER, D. | Palynology of sediments in the Tambo-Augathella area, Queensland. | R | In press |
| KEMP, E.M., & BURGER, D. | Palynology of strata in the northeastern Eromanga and Galilee Basins | C | In prep. |
| BURGER, D. | Palynological observations on Amoco Towerhill No.A-1 Well, Galillee Basin. | C 1970/26 | In press |
| BURGER, D. | Tertiary pollen grains from the Ngalia Basin, Northern Territory. J. Geol. Soc. Aust. | E.P. | In prep. |
| BURGER, D. | Palynology of the Rolling Downs Group, Surat Basin, with reference to G.S.W. Surat Nos 1, 2 and 3 Scout Bores. (To be published by Geol. Survey of Queensland) | E.P. | In press |
| BURGER, D. | Palynology of the Rolling Downs Group in the Surat and southern Eromanga Basins, Queensland. | C | In prep. |

| | | | |
|---|---|---|---|
| SKWARKO, S.K. | Bibliography of the Mesozoic palaeontology of Australia and eastern New Guinea | B108 | Published |
| SKWARKO, S.K. | Aptian (Lower Cretaceous) 'Apiotrigonia' from the Melligo Quartzite, Dampier Peninsula, Western Australia. | B108 | Published |
| SKWARKO, S.K. | On the discovery of Holobiidae (Bivalvia, Triassic) in eastern New Guinea | B126 | In press |
| SKWARKO, S.K. | Middle and Upper Triassic Mollusca from Yuat River, eastern New Guinea | B126 | In press |
| SKWARKO, S.K. | A correlation chart for the Cretaceous system in Australia | B126 | In press |
| SKWARKO, S.K. | Additional Lower Triassic Cephalopods from the Kockatea Shale, Perth Basin, Western Australia | B | Prepared |
| SKWARKO, S.K. | Middle Triassic molluscan fauna from a deep bore in northern Australian continental shelf | B | Prepared |
| SKWARKO, S.K. | Cretaceous stratigraphy of part of the Wiso Basin, N.T. | B | Prepared |
| SKWARKO, S.K. | Some Ordovician graptolites from the Canning Basin, W.A. | B | In prep. |
| SKWARKO, S.K. | Revision of the marine Jurassic faunas of Western Australia | B | In prep. |
| SKWARKO, S.K. | A small Domerian (Lower Jurassic) marine molluscan fauna from eastern New Guinea | B | In prep. |
| SKWARKO, S.K. | Australian Cretaceous Ammonoidea | | In prep. |
| STRUSZ, D. | "Cystiphyllum americanum var. australe Etheridge Jnr. 1892, from North Queensland." 307-319, 22 In Campbell, N.S.W. (Ed.): Stratigraphy and Palaeontology. Essays in honour of Dorothy Hill. ANU Press. Canberra | E.P. | Published |

| | | | |
|---|---|---|---|
| STRUSZ, D. | "Rhizophyllum and Calceola from the Devonian of New South Wales". | B | Published |
| STRUSZ, D. | "A new species of rhynchonellid brachiopod from the Devonian of New South Wales". | B | Published |
| STRUSZ, D., CHATTERTON, B.D.E., & FLOOD, P.G. | "Revision of the New South Wales Devonian brachiopod "Spirifer yassensis". Proc. Linnean Society | E.P. | In press |
| STRUSZ, D. | Explanatory Notes, Canberra Geological Sheet SI-55/16 | E.N. | In press |
| STRUSZ, D. | "Cyathophyllum (Radiophyllum) from the Devonian of eastern Australia. | B116 | In press |
| GILBERT-TOMLINSON, J. | 'Lower Ordovician gastropod Teiichispira in northern Australia' | B | In prep. |

SEDIMENTOLOGY

(S14)

| | | | |
|---|---|---|---|
| JONES, B.G. | A computer programme for analysing directional data designed for use on a CDC3600 | C 1970/67 | Collating |

PHOTOGEOLOGY

(S15)

| | | | |
|---|---|---|---|
| SIMPSON, C.J. | Aireal Estimates of the Limonitic Pisolitic Iron Ore of the Hamersley Iron Province - Western Australia | C 1969/142 | Issued |
| SIMPSON, C.J. | Airphotograph Study of coastal changes - southeast Queensland. | C 1970/55 | Issued |
| SIMPSON, C.J. | Report on Photointerpretation of the Normanton 1:250,000 Scale Sheet - Queensland. | C | Issued |

PHOSPHATE & MARINE GEOLOGY GROUP

(S16)

| | | | | |
|---|---|---|---|---|
| de KEYSER, F. | The phosphate-bearing Cambrian formations in the Lawn Hill and Lady Annie districts, northwestern Queensland | C | 1969/147 | Issued |
| JONGSMA, D. | Marine geology and Recent sediments of Milne Bay, New Guinea | C | 1970/10 | Issued |
| JONES, H.A. | The sediments, structure and morphology of the northeast Australian continental shelf between Rowley Shoals and Monte Bello Islands. | C | 1970/27 | Issued |
| von der BORCH, C.C., & WALRAVEN, F. | Marine geology of the Huon Gulf, New Guinea. | | B127 | In prep. |
| de KEYSER, F. | The occurrence of a late Precambrian tillite in the Georgina Basin | | B | In prep. |
| COOK, P.J., & ARMSTRONG, K.A. | The clay mineralogy of the Middle Cambrian phosphorites of the Georgina Basin | | B | In prep. |
| JONGSMA, D. | The marine geology and Recent sediments of Milne Bay | | B | In prep. |
| COOK, P.J. | Repeated diagenetic calcitization, phosphatization, and silicification in the Phosphoria Formation | | E.P. | Published |
| COOK, P.J. | The Illamurta Diapiric Complex and its position on an important central Australian feature | | E.P. | Published |
| JONGSMA, D. | Eustatic sea level changes in the Arafura Sea | | E.P. | Published |

OVERSEAS VISIT

(S17)

| | | | | |
|---|---|---|---|---|
| PERRY, W.J. | Report of a visit to investigate remote sensing activities in the U.S.A. | | C | In prep. |

# METALLIFEROUS DEPOSITS SECTION

## METALLIFEROUS DEPOSITS SECTION

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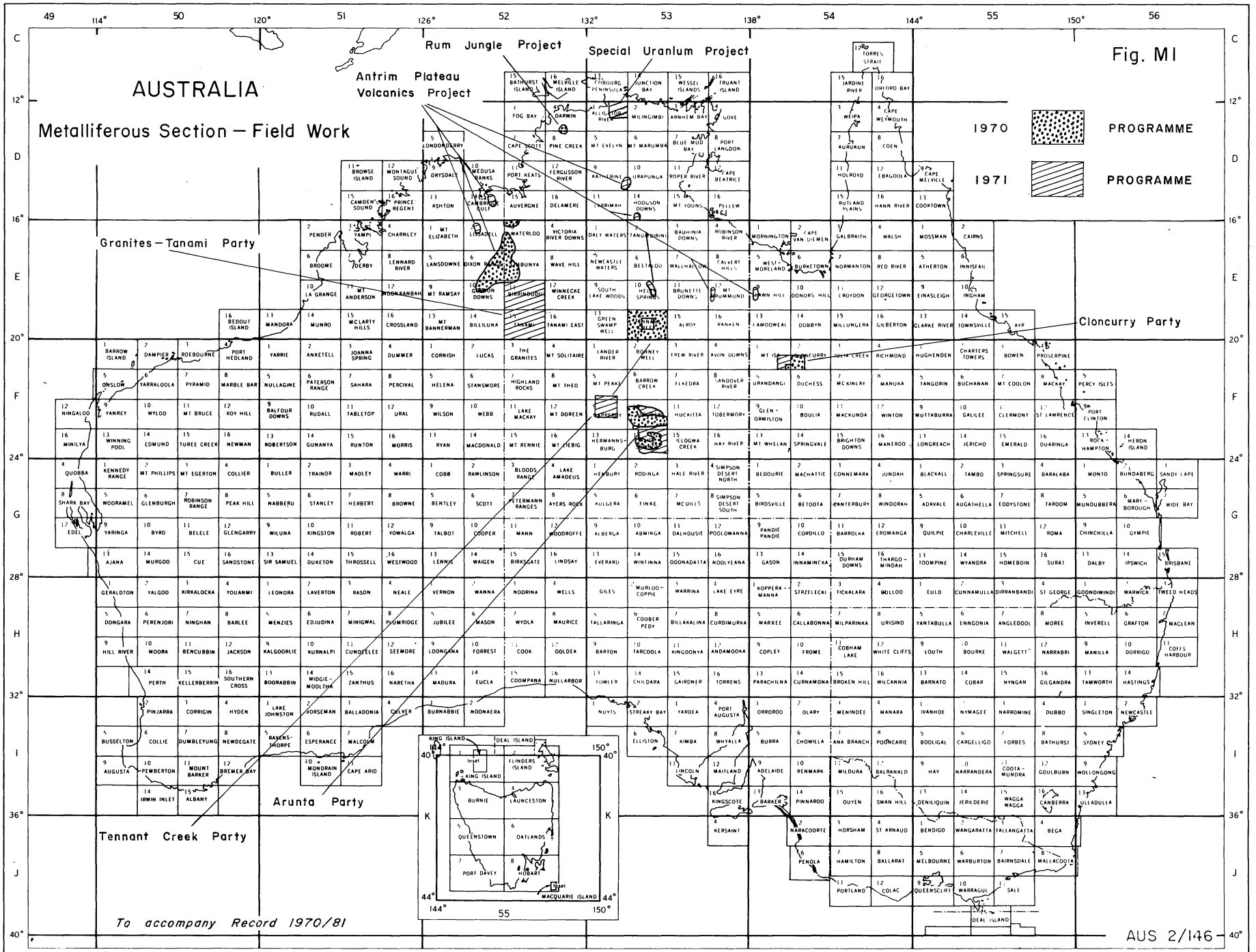
## METALLIFEROUS DEPOSITS SECTION

### SUMMARY

This report summarizes the work of the Metalliferous Deposits Section from November, 1969, to October, 1970. Figures M1 and M2 show the areas where field work was carried out in 1970, and areas which it is proposed to map in 1971. Regional mapping was carried out in the Victoria River, Tennant Creek and Arunta areas, as well as in Territory of Papua and New Guinea and Antarctica. Detailed mapping was concentrated mainly in the Cloncurry - Mount Isa, and the Arunta areas. Work in the laboratories provided support for field investigations and, in addition, involved detailed studies in petrology, geochemistry, isotope geology, and geobiology.

Publications and Records issued, and publications in press or in preparation, are listed in Appendix M1. Following are totals for the period under review.

| | |
|---|---|
| Bulletins | : Issued 1, in press 4, with editor 5, in preparation 6. |
| Reports | : Issued 1, in press 6, with editor 5, in preparation 8. |
| Records | : Issued 22, in preparation 41. |
| Explanatory Notes | : Issued 5, in press 4, with editor 11, in preparation 21. |
| Outside Publications | : Published 16, in press 6, submitted for publication 1, in preparation 19. |


AUSTRALIA
Metalliferous Section — Field Work
Fig. MI
1970 PROGRAMME
1971 PROGRAMME
Rum Jungle Project
Special Uranium Project
Antrim Plateau Volcanics Project
Granites — Tanami Party
Cloncurry Party
Arunta Party
Tennant Creek Party
To accompany Record 1970/81
AUS 2/146

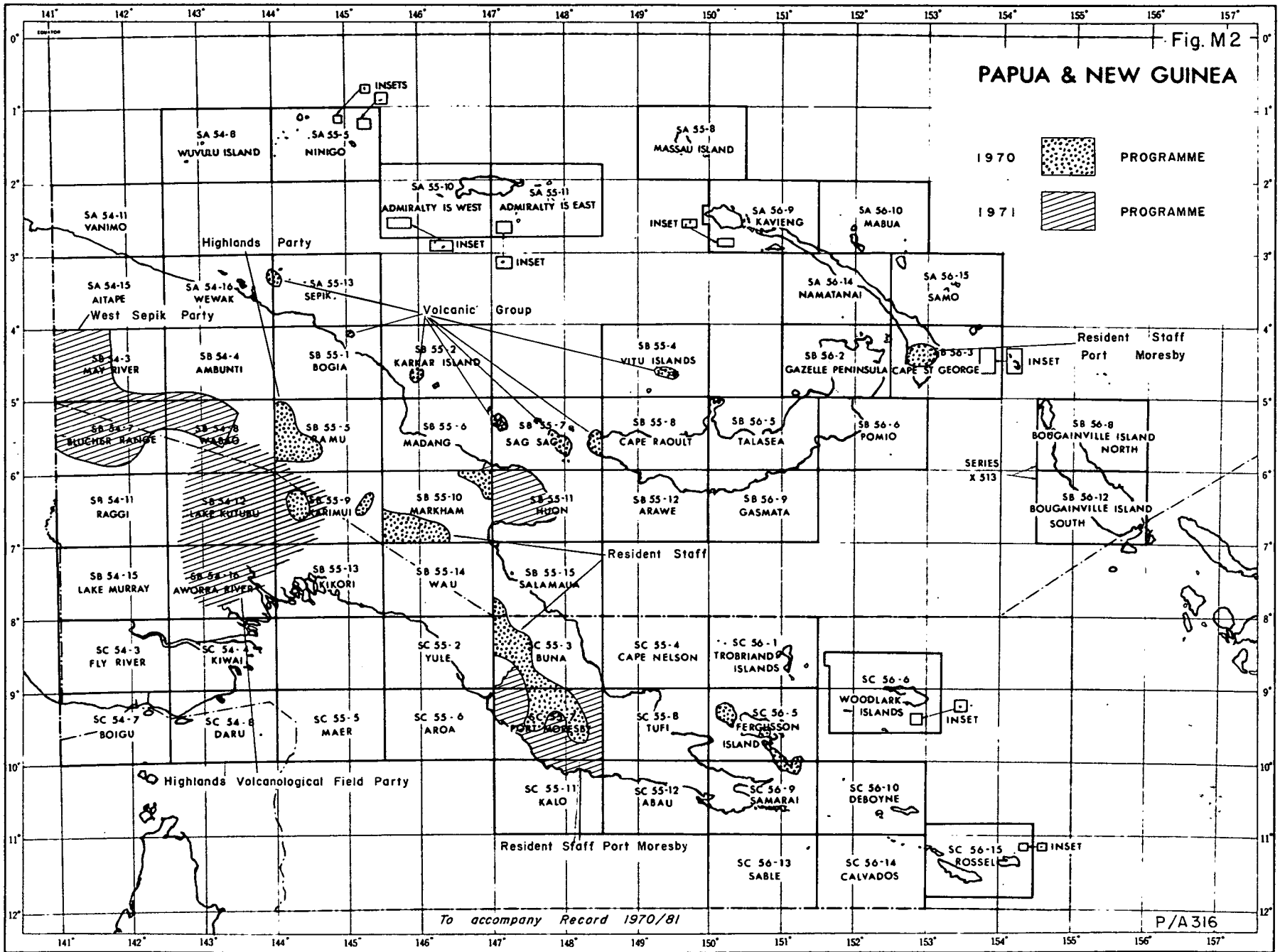


Fig. M2
PAPUA & NEW GUINEA
1970 PROGRAMME
1971 PROGRAMME
INSETS
SA 54-8 WUVULU ISLAND
SA 55-5 NINIGO
SA 55-8 MASSAU ISLAND
SA 55-10 ADMIRALTY IS WEST
SA 55-11 ADMIRALTY IS EAST
INSET
SA 56-9 KAVIENG
SA 56-10 MABUA
SA 54-11 VANIMO
Highlands Party
SA 54-15 AITAPE
SA 54-16 WEWAK
SA 55-13 SEPIK
Volcanic Group
West Sepik Party
SA 56-14 NAMATANAI
SA 56-15 SAMO
Resident Staff Port Moresby
SB 54-3 MAY RIVER
SB 54-4 AMBUNTI
SB 55-1 BOGIA
SB 55-2 KARKAR ISLAND
SB 55-4 VITU ISLANDS
SB 56-2 GAZELLE PENINSULA
SB 56-3 CAPE ST GEORGE
SB 54-7 BLUCHER RANGE
SB 54-8 WABAG
SB 55-5 RAMU
SB 55-6 MADANG
SB 55-7 SAG SAG
SB 55-8 CAPE RAOULT
SB 56-5 TALASEA
SB 56-6 POMIO
SB 56-8 BOUGAINVILLE ISLAND NORTH
SERIES X 513
SB 54-11 RAGGI
SB 54-12 LAKE KUTUBU
SB 55-9 KARIMUI
SB 55-10 MARKHAM
SB 55-11 HUON
SB 55-12 ARAWE
SB 56-9 GASMATA
SB 56-12 BOUGAINVILLE ISLAND SOUTH
Resident Staff
SB 54-15 LAKE MURRAY
SB 54-16 AWORRA RIVER
SB 55-13 KIKORI
SB 55-14 WAU
SB 55-15 SALAMAUA
SC 54-3 FLY RIVER
SC 54-4 KIWAI
SC 55-2 YULE
SC 55-3 BUNA
SC 55-4 CAPE NELSON
SC 56-1 TROBRIAND ISLANDS
SC 56-6 WOODLARK ISLANDS
INSET
SC 54-7 BOIGU
SC 54-8 DARU
SC 55-5 MAER
SC 55-6 AROA
SC 55-7 PORT MORESBY
SC 55-8 TUFI
SC 56-5 FERGUSSON ISLAND
Highlands Volcanological Field Party
SC 55-11 KALO
SC 55-12 ABAU
SC 56-9 SAMARAI
SC 56-10 DEBOYNE
Resident Staff Port Moresby
SC 56-13 SABLE
SC 56-14 CALVADOS
SC 56-15 ROSSEL
INSET
To accompany Record 1970/81
P/A316

## REGIONAL PROJECTS

### FIELDWORK

### VICTORIA RIVER PARTY, N.T.

I.P. Sweet, C.M. Morgan (resigned 10/3/70)
J.R. Mendum (began work in Tennant Creek area May, 1970), R.J. Bultitude

Mapping of the Precambrian rocks in the Victoria River area was completed in 1969, and field work in 1970 consisted of:

1. Collection of samples for age determination, re-examination of glacial rocks and stromatolites, and inter-regional rock correlation - I. Sweet (July and August).

2. Antrim Plateau Volcanics Study. Supervision of stratigraphic drilling, collection of samples from Antrim Plateau Volcanics - R.J. Bultitude (April 20th to mid-October).

In the past three years the Precambrian rocks of the Victoria River district have been subdivided into five major groups and two ungrouped formations. These are the Duerdin Group, the Bullo River Sandstone, the Auvergne Group, the Wondoan Hill Formation, the Bullita Group, the Wattie Group, and the Limbunya Group.

Samples for isotopic dating were collected from rocks of the Limbunya Group, Wondoan Hill Formation, and Angalarri Siltstone (Auvergne Group). A reliable age from the base of the Limbunya Group would be extremely valuable in placing the whole sequence in the geological time scale. Unfortunately suitable material is scarce, and the rocks collected from the Margery Formation are partly weathered silty shales.

Glauconitic sandstones were collected from the base of the Wondoan Hill Formation, and mudstone and claystone from higher in the formation. These should provide useful dates. Three suites of samples were collected from the Angalarri Siltstone in the Auvergne Group.

The second approach to dating the rocks of the Victoria River district was to attempt to correlate the rocks with sequences of known age in other areas. The following rock correlations were made:

| | | | |
|---|---|---|---|
| (a) Angalarri Siltstone | ≡ | Helicopter Siltstone | East Kimberley |
| (b) Limbunya Group | ≡ | Bungle Bungle Dolomite and Mount Parker Sandstone | |
| (c) Kirrkimbie Beds | ≡ | Bungle Bungle Dolomite | |

Following from (a), the Jasper Gorge Sandstone is the equivalent of the Wade Creek Sandstone. A member of the latter, the Mount John Shale Member, has been isotopically dated at 1128 ± 110 m.y. This makes the whole Auvergne Group Adelaidean, and suggests that the remainder of the sequence in the Victoria River district may be Adelaidean, although there is a possibility that the Limbunya Group could be in part Carpentarian.

Re-examination of glacial rocks on the Auvergne and Waterloo 1:250,000 Sheet areas has revealed the presence of the Fargoo Tillite, as well as the Moonlight Valley Tillite. Measurements were taken of long-axis orientations of boulders in three different beds in the Fargoo Tillite at Skinner Point in an attempt to deduce ice-flow directions; the results have not yet been plotted. Another glaciated pavement, formed during deposition of Moonlight Valley Tillite, was found in the East Kimberley area (Fig. M3). It indicates an ice flow from north to south, which conforms with the directions deduced in the East Kimberley.

Antrim Plateau Volcanics Study

A stratigraphic drilling project was completed in August, 1970. Nine holes were drilled (Table 1 and Fig. M 3), but only three reached target-depth (base of volcanics). The drilling rig used (Ingersoll Rand) drilled to a maximum depth of 305 m, but with difficulty. Any future drilling project should be carried out using a diamond drill for continuous coring.

The 3 holes which reached target were all in the eastern sector, at Delamere, Top Springs, and Wave Hill. The first 2 holes bottomed in red and green siltstone, probably Stubb Formation, and the third was drilled 30 metres into probable Jasper Gorge Sandstone. The holes at Inverway, Mistake Creek, Rosewood and Kildurk did not reach the base of the volcanics. Over 1000 m. of volcanics have been measured on the western side of the Hardman Basin, and it was not really expected that bottom would be reached in the Rosewood and Mistake Creek holes.

TABLE 1. Drilling details, Antrim Plateau Volcanics

| Stratigraphic Hole | Depth (Metres) | Thickness of volcanics | |
|---|---|---|---|
| Rosewood No.1 | 270 | 270+ | Collar in Headleys Limestone |
| Rosewood No. 2 | 213.5 | 213.5 | Collar in basalt |
| Mistake Creek No. 1 | 304.8 | 292.7 | Collar in Headleys Limestone |
| Inverway No. 1 | 244 | 244 | Collar in basalt. Struck water: 300 + 1 pm (4000 gph) |
| Wave Hill No. 1 | 164.7 | 120.9 | Collar in Montejinni Limestone |
| Top Springs No. 1 | 244 | 229 | Collar adjacent to Montejinni Lst. Struck water: 530 + 1pm (7000 gph) |
| V.R.D. No. 1 | 91.5 | 91.5+ | Collar in basalt; dry hole. |

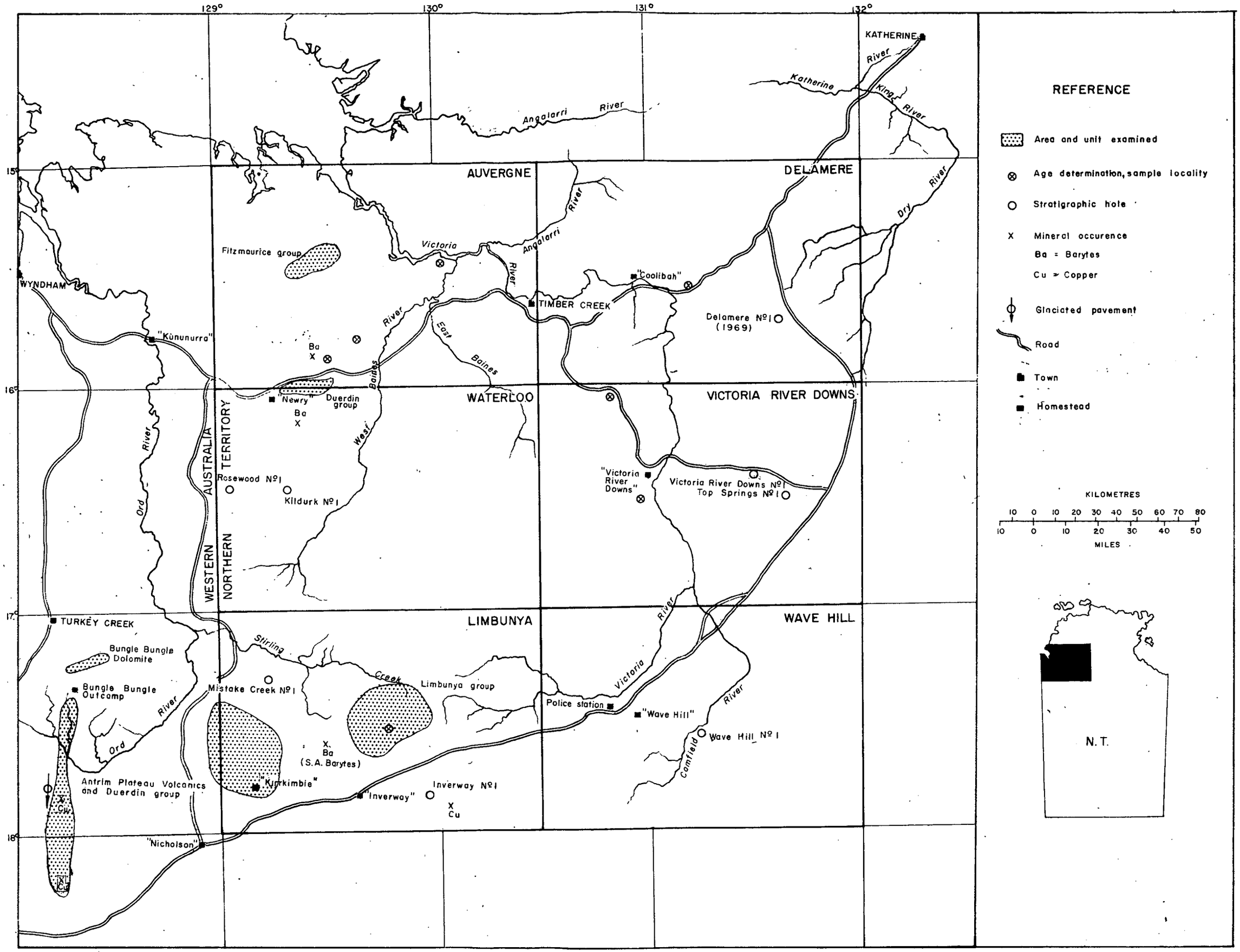



FIG. M3 VICTORIA RIVER, GEOLOGICAL PARTY ACTIVITIES 1969 - 1970

*To accompany Record 1970/81*

*NT/A337*

TABLE 1 (cont.)

*Drilled Oct., 1969

| | | | |
|---|---|---|---|
| *Delamere No. 1 | 149.4 | 137 | Collar in basalt just below Montejinni Lst. contact; dry hole. |
| *Top Springs No. 2 | 76 | 76 | Abandoned at 76 metres. |

The drilling provided cuttings and some core for further geochemical and petrographic work. Minor native copper was encountered in Rosewood No. 1, and possible azurite in a thin limestone interbed in Inverway No. 1. Alteration occurs in basalt in all holes, and is obviously not attributable to present-day weathering.

Petrographic work confirms that the basalts are tholeiites consisting of euhedral and anhedral laths of plagioclase, subhedral and anhedral prisms of clinopyroxene, and small euhedral and anhedral grains and granules of opaque oxides. Phenocrysts of plagioclase, and more rarely, of clinopyroxene, occur in some sections. Chlorite, quartz, chalcedony, carbonate, zeolites, and rare amphibole occur in amygdales. Minor primary hornblende and quartz occur in some rocks.

Economic Geology.

Dykes of vesicular basalt northwest of Kirrkimbie (Fig. M3) probably represent feeders for the flows; these are the only possible feeder dykes so far recognized in the area occupied by the Volcanics.

Barytes: During the year development was begun by S.A. Barytes on a barytes deposit near the Mistake Creek-Inverway road, 32 km. north of Inverway Homestead (Fig. M3). The ore occurs as a sinuous vertical vein over $3\frac{1}{2}$ km. long, and between $\frac{1}{2}$ and 3 metres thick, in Antrim Plateau Volcanics. It is of high grade, and requires only milling without beneficiation. A number of other, but smaller, barytes veins occur within the Volcanics, and two veins were observed farther north in Precambrian rocks (Fig. M3).

Copper: Numerous shows of copper mineralization have been reported from the Antrim Plateau Volcanics and basal Headleys Limestone, but no major deposits have been discovered as yet. Copper minerals include native copper, chalcocite, and malachite.

Metals Exploration have carried out an extensive stream sediment sampling programme, followed up by geophysical work and drilling on the Antrim Plateau Volcanics; they have since relinquished their leases in the area.

## TENNANT CREEK PARTY, N.T.

J.R. Mendum, P.C. Tonkin

Between 1st July and 30th September the party mapped most of the Tennant Creek 1:250,000 Sheet area, apart from the Tennant Creek and Mount Woodcock 1:63,360 Sheet which had been mapped previously by the Bureau. Little work was carried out in these areas.

Geology: (Fig. M4)

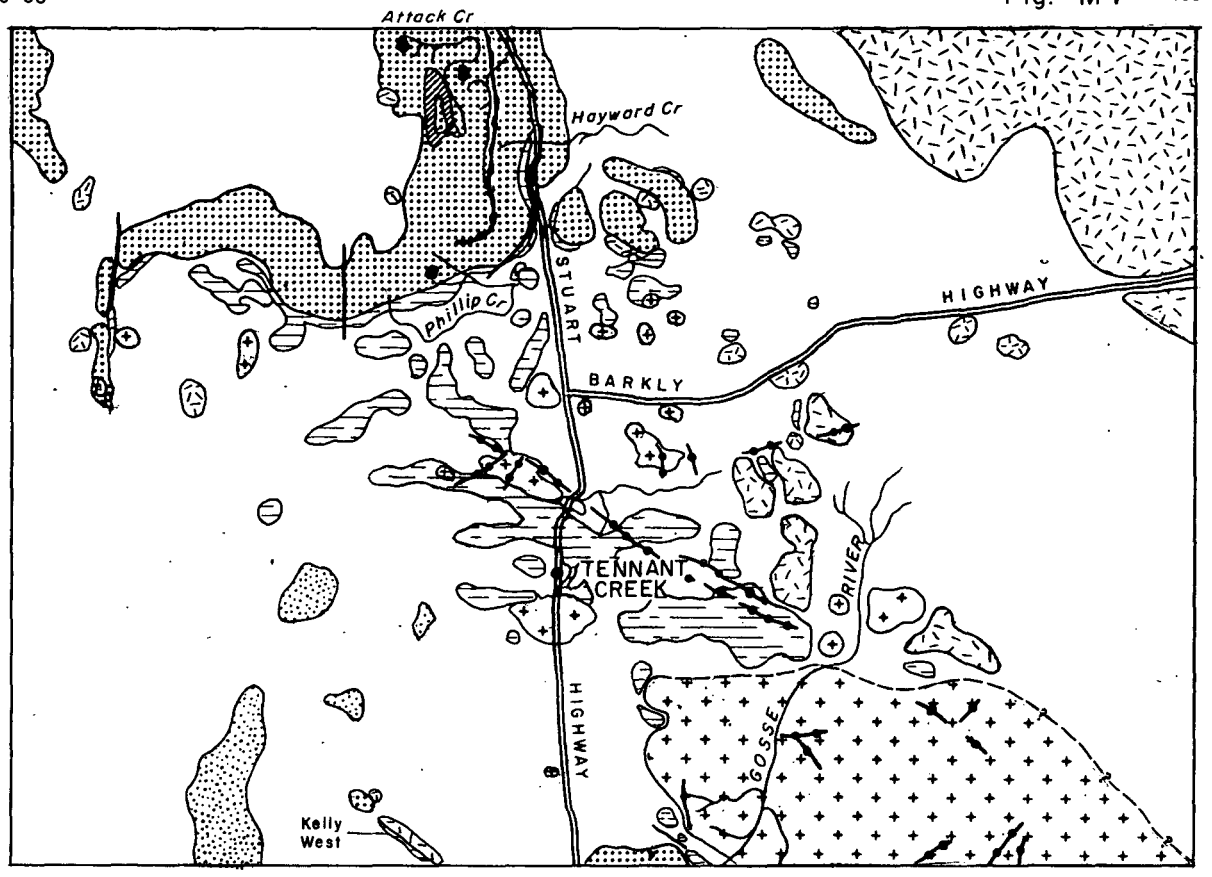
The Precambrian rocks in the area can be divided into two distinct stratigraphic groups - the Warramunga Group and the Tomkinson Creek Group (Fig. M4). The two groups are locally unconformable, but no angular discordance was noted near the northern margin of the 1:250,000 Sheet area. Both groups of rocks have been subjected to polyphase deformation and low grade metamorphism, and the Warramunga Group has been intruded by granite, porphyry, diorite, lamprophyre, and dolerite. Dolerite and (?)gabbro also intrude the Tomkinson Creek Group, but known mineralization is restricted to the Warramunga Group.

The Lower Proterozoic Warramunga Group consists of a deep-water turbidite sequence with two distinctive volcanic horizons and an upper shallow-water sequence. Owing to the paucity of outcrop, deep weathering, facies changes, and the complex structural picture in the area mapped, correlation of lithologies is very difficult.

The oldest known beds are the greywackes and siltstones exposed on the Mount Woodcock 1:63,360 Sheet area, where they are overlain by the 120 metre thick Whippet Sandstone Member. This latter unit is associated with the Bernborough Formation, a sequence of acid volcanics, welded tuffs, and tuffaceous sandstone and siltstone. Above the volcanogenic rocks is a zone of hematite shale, siltstone, and greywacke which is succeeded by a second volcanic group, consisting of thin acid or intermediate flows, ignimbrites, and pink to yellow tuffaceous sediments. A thick shale sequence overlies the volcanics, and this grades upwards into a siltstone-shale and finally a greywacke sequence. This deep-water "flysch type" sequence is overlain by a more shallow-water sandstone-shale sequence with rare cross-bedded orthoquartzite, feldspathic sandstone, and shales. Thin conglomerate lenses also crop out rarely in this sequence.

The base of the Tomkinson Creek Group is marked by a conglomerate which ranges in thickness from 3 metres to about 130 metres. The conglomerate cuts across bedding traces of the Warramunga Group, but because both Groups are folded sympathetically, there appears to be little discordance in outcrop. The conglomerate is overlain by white to pink and purple to brown orthoquartzite which becomes more friable and flaggy in its upper parts. The basal zone of the orthoquartzite is torrentially cross-bedded, and the unit as a whole is overlain by acid and basic volcanics, the latter being highly epidotized. A strongly ferruginous sandstone overlies the volcanics, and this is succeeded by a cross-bedded flaggy, feldspathic sandstone with abundant mud-clasts. Local conglomerates occur near the top of the feldspathic sandstone in some parts of the Sheet area.

Fig. M4




Mainly Czs, Cza cover

10 0 10 20 30 40 Kilometres

10 0 10 20 30 Miles

Tertiary - travertine

Dolomite marker beds

Mesozoic (Cretaceous?); horizontally bedded white claystones, siltstones

Altered basalts - marker beds

Cambrian - chert, chert breccia, minor limestone, siltstone and volcanics.

L Proterozoic - Warramungo Gp greywacke, shale, siltstone, porphyry, minor sandstone volcanics

Proterozoic - granite, some adamellite, fine grained, foliated and porphyritic types

Quartz dyke

U. Proterozoic - Tomkinson Cr beds and Hatches Cr Gp mainly quartz-sandstone, minor siltstone.

Major fault

Map to accompany report on the Tennant Creek 1:250,000 sheet area SE53/14

These are succeeded by micaceous siltstones and flaggy fine-grained sandstones, which are overlain by massive, cross-bedded orthoquartzite which forms a prominent ridge in the Whittington Range. Flaggy partly silicified dolomite and calcareous siltstone overlie the orthoquartzite, and these appear to be represented near the northern margin of the Sheet area by siltstone alone. Flaggy quartz sandstone is the youngest unit exposed in the sequence.

Intrusive Rocks: Numerous biotite granites and adamellites intrude the Warramunga Group, and the granites are intruded by aplitic dykes, quartz veins, and rarely dolerite dykes. The granites contain abundant large rounded microcline phenocrysts, and commonly show a strong foliation. This foliation is also very marked in the quartz and quartz-feldspar porphyries which are very abundant in the Warramunga Group. The porphyries contain rounded feldspar and ovoid quartz phenocrysts.

Dykes and sills of very altered lamprophyre commonly crop out adjacent to the granites.

Dolerite and diorite occur as plugs, sills, and dykes in the Proterozoic sequence, especially near the contact of the Warramunga and Tomkinson Creek Groups, and within the lower sandstones of Tomkinson Creek Group.

Phanerozoic Rocks: The Proterozoic rocks are overlain unconformably by Cambrian basic volcanics, limestone, chert, sandstone, and siltstone. Mesozoic conglomerates and leached claystones form two small outlines in the Whittington Range. Tertiary laterite, silcrete and travertine are common throughout the area.

Structure: The Warramunga Group is folded into major anticlines and synclines along approximately east-west axes. A strong regional cleavage and greenschist grade metamorphism is associated with this phase of deformation. The shales and siltstones within the sequence are more strongly folded and cleaved than the more competent greywackes and sandstones. The Tomkinson Creek Group was folded along with the Warramunga sediments, but shows none of the minor folding which is so common within the older Groups.

Later folding along northeast axes has affected many of the early folds. Several minor subsequent deformations have complicated the picture still further.

Large-scale wrench faulting along north-south fractures has taken place. There is also much normal and reverse faulting throughout the Sheet area. Shear-zones may be traced for 20 kilometres or more in many areas.

Economic Geology

There are six working mines on the Tennant Creek 1:250,000 Sheet area: Peko (Cu), Warrego (Cu), Juno (Au, Bi), Orlando (Cu), Ivanhoe (Cu, Au), and Nobles Nob open cut (Au). Peko Mines N.L. own all the mines except Nobles Nob, which is worked by Australian Development N.L. The Warrego mine is in the initial stages of production, and a further mine, Gecko (Au) is being developed by Peko Mines N.L. Australian Development N.L. are developing a mine at Golden Forty (Au).

The 1:250,000 Sheet area is almost entirely covered by Authorities to Prospect; Peko Mines N.L., Australian Development N.L., Mobile Alluvial Tin, Central Pacific Minerals and Western Nuclear all hold several areas. The Eldorado and Last Hope mines are worked intermittently by prospectors.

The 1970 survey did not reveal any significant prospects. Traces of copper mineralization were found in quartz veins within granite 6 km north-northwest of Red Bluff and 9 km southeast of Nobles Nob. The volcanics within the Tomkinson Creek Group also showed traces of copper mineralization.

## ARUNTA PARTY, N.T.

R.D. Shaw, R.G. Warren, D.J. Forman (part-time).

General

Field-work in the Alice Springs and Alcoota 1:250,000 Sheet areas extended from 12th May to 19th October. Two post-graduate students carried out detailed mapping of parts of the Arltunga Nappe Complex for three months, and an A.N.U. staff member worked in part of the Arunta Complex for three weeks. Five B.M.R. geologists, Drs. B.E. Hobbs and M.S. Paterson (A.N.U.), and Professor J. Sutton (Imperial College, London) visited the party.

Regional Projects

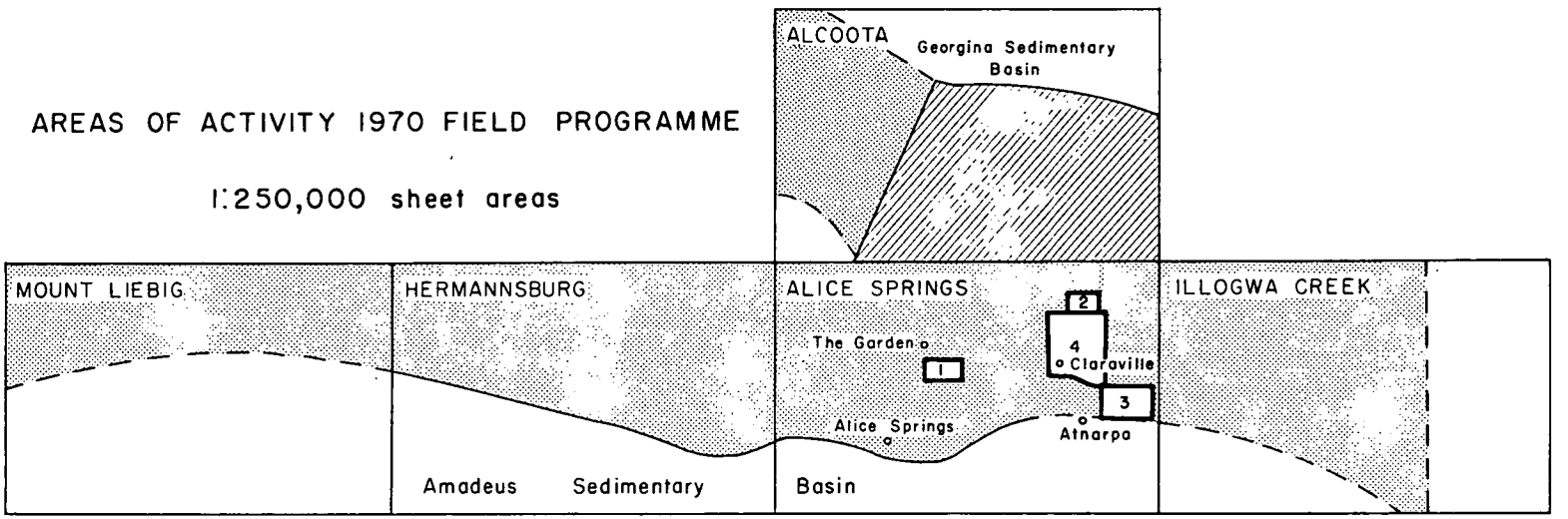
(a) Work continued on compilation of the metamorphic map of central Australia. About 500 specimens were collected during the season from the Mount Liebig, Hermannsburg, Alice Springs, Illogwa Creek, and Alcoota 1:250,000 Sheet areas, and the thin sections were examined by D.J. Forman (see Fig. M5).

(b) Work commenced on a metallogenic map of Central Australia. Information about mineral occurrences in Central Australia was collected from the Northern Territory Mines Branch records for formal indexing. Several prospects in the Alice Springs and Alcoota Sheet areas were examined.

FIGURE M5

# AREAS OF ACTIVITY 1970 FIELD PROGRAMME

## 1:250,000 sheet areas




Broad-scale reconnaissance and collecting for Regional Metamorphic Map.

Detailed reconnaissance using air photographs; 1:250,000 mapping programme.

Detailed mapping; 1:100,000 mapping programme.

1. J. Funk
2. M. Rickard
3. M. Yar Khan
4. R. Shaw

} Australian National University
B.M.R. (Semi-detailed mapping)

To accompany Record 1970/81

N.T./A/339

## Geological mapping at scale of 1:250,000

### Geology (Fig. M5a).

Field-work was concentrated on the exposures of Precambrian metamorphic rocks in the southern part of the Alcoota 1:250,000 Sheet area. Reconnaissance traverses were made of the northern third of the area which is occupied by sediments of Upper Proterozoic age.

B. Senior made a brief survey of the Tertiary deposits in the area.

A summary of the characteristics of the main metamorphic rock types is given in Table 2.

## Detailed Mapping in the Arltunga Nappe Complex

### The Atnarpa area (after M. Yar Khan, A.N.U. student)

In the ranges east of Atnarpa homestead six or seven major thrust slices have been refolded about the complex Atnarpa Antiform. All thrust slices, where evidence is available, young upwards. In several places a series of parallel subordinate thrusts forming an imbricate structure are cut off by a major thrust. The upper slice of Heavitree Quartzite, seen to dip underneath the older Arunta Complex (on both north and south limbs of the Atnarpa Antiform), is not overturned, but probably youngs upwards; the boundary between the Heavitree Quartzite and the Arunta Complex is a folded thrust.

A north to northeast plunging lineation defined by the elongation of quartz grains is developed in the northern and north-eastern parts of the area mapped. At several localities the trend of slickensides agrees with that of the above lineation. The quartz grains have a lattice-preferred orientation as well as a dimensional orientation. The quartz elongation lineation has not been observed to parallel any fold axis, but is refolded by later folds.

The main anticline at the western end of the area mapped plunges at 30° in the direction 300°MN. Associated minor folds have overturned north-dipping middle limbs. High-angle, north-dipping faults parallel the minor folds. A second anticline at the western end of the range generally plunges gently to 50°MN. Middle limbs of small-scale folds associated with this anticline are only slightly overturned.

### Georgina Range - Mount Loughlen area (after J.Funk, A.N.U. student)

The major structure of the area, preserved by the Heavitree Quartzite, is an east-trending syncline whose northern limb is overturned to the south. In the core of the syncline klippen of both Bitter Springs Formation and Arunta Complex are preserved, indicating that east-west folding has followed faulting or thrusting. Minor folds associated with the main east-trending syncline have nearly vertical axial planes and gently plunging axes. The axial plane cleavage to these folds provides a crenulation intersection lineation on the folded schistosity. They refold earlier north-plunging folds.

On the northern limb of the main east-trending syncline, a strongly developed north plunging lineation (defined by an alignment and elongation of quartz grains) approximately parallels near isoclinal, small folds that have a planar schistosity parallel to their axial planes. Elongate grains and pebbles record very large strains.

The Arunta Complex north of the major syncline is similarly deformed. Where the basal Heavitree Quartzite dips underneath the Arunta Complex both units are deformed almost to mylonite. Elsewhere the Bitter Springs Formation dips underneath the Arunta Complex at a thrust-faulted contact. In several places the northern limb of the syncline, klippen of Arunta Complex pass laterally into high-angle faults repeating Heavitree Quartzite on Heavitree Quartzite.

The Arunta Complex north of the major syncline has been retrograded metamorphically to the greenschist facies, but the cover rocks show no sign of new mineral formation except for possible talc formed in siltstone of the Bitter Springs Formation at a thrust contact with the Arunta Complex.

South of the gap between Mount Laughlin and the Georgina Range metamorphically retrogressive gneisses grade sharply into a porphyritic biotite-feldspar-orthogneiss that appears to be largely unaffected by the Alice Springs Orogeny. North of the gap the sequence includes marble, quartzite, calc-silicate rock, amphibolite, knotted schist, and quartzo-feldspathic gneiss.

## Detailed mapping of the Arunta Complex in the Claraville Homestead area Mount Brasse[illegible] Area, Alice Springs 1:250,000 Sheet area.

(R.D. Shaw)

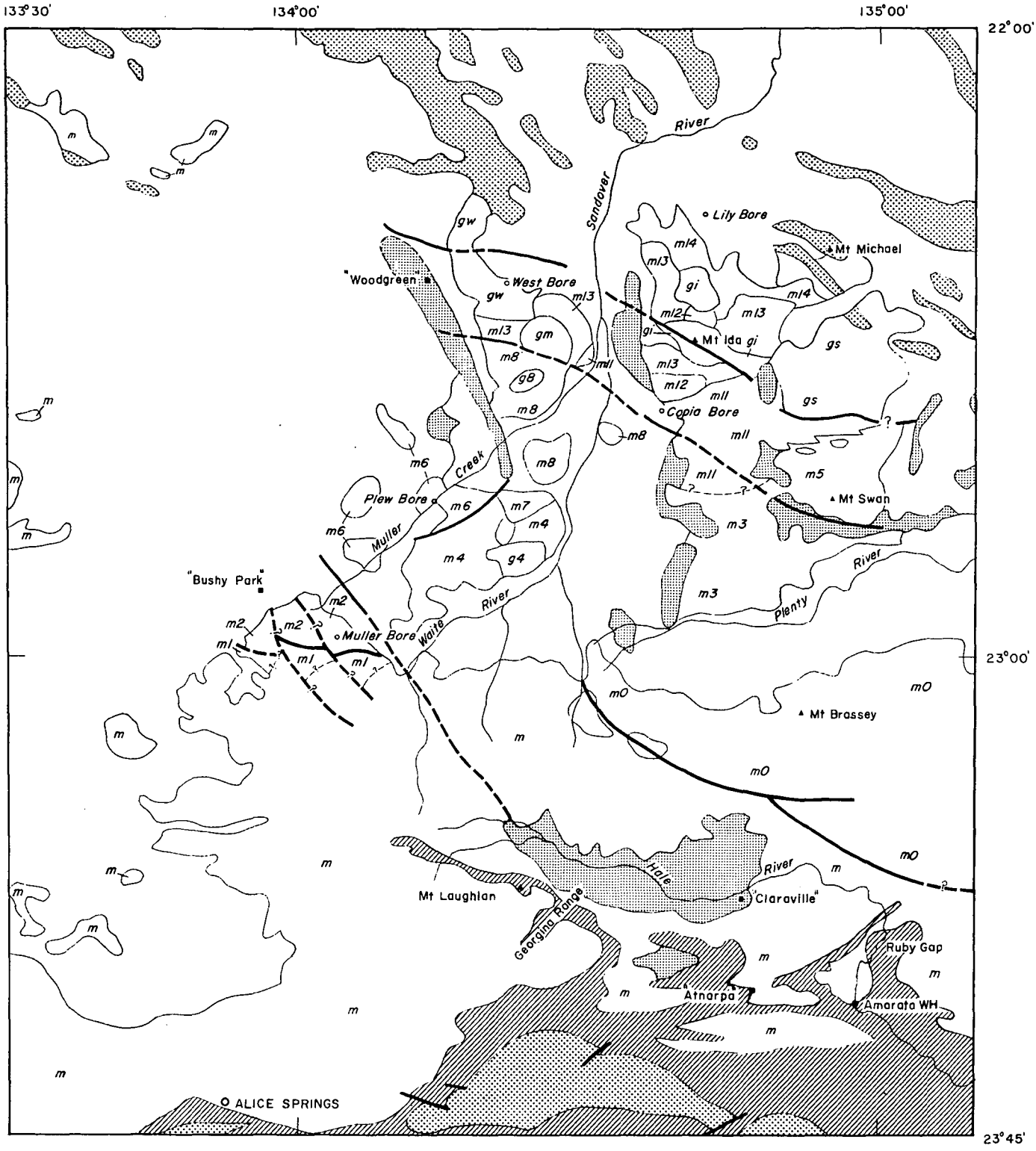
The boundary between retrograde metamorphic rocks associated with the Arltunga Nappe Complex and the high-grade metamorphic rocks to the north was mapped in semi-detailed style.

North of Claraville homestead, high-grade metamorphic rocks are folded in large-scale structures around northerly-aligned axes; secondary or superimposed smaller-scale folds have easterly-aligned axes. The rocks are characterized by the following mineral assemblages: sillimanite-cordierite, sillimanite-corundum, hornblende-biotite-garnet-quartz-plagioclase, clinopyroxene-scapolite, and sillimanite-garnet-plagioclase.

The contact with the retrograde metamorphic rocks is sharp, but there is no evidence of a major thrust at the boundary. The zone of retrograde metamorphic rocks appears to be a broad belt of intense deformation; most of the rocks south of the Hale River appear to have been partly or completely altered by retrogressive metamorphism. South of Claraville homestead the process is completed to the stage where the rocks are locally reduced to mylonite-textured chloritic gneisses. Auriferous quartz veins are believed to have been introduced at the final stages of deformation.

# GEOLOGICAL SKETCH MAP OF THE ALICE SPRINGS AND ALCOOTA SHEET AREAS

FIG. M5A




*Symbolised units described in Table I*

*To accompany Record 1970/81*

F53/A/22

TABLE 2. ROCK TYPES - ALCOOTA SHEET AREA

| Map Symbol | Lithology | Structural Characteristic | Distribution | Comments |
|---|---|---|---|---|
| m1 | Coarse-grained biotite feldspar gneiss with garnet and feldspar porphyroblasts. Fine-grained schistose biotite gneiss. Quartzo-feldspathic gneiss. | Complex plunging folds. | South of Muller Bore. | Granulite to upper amphibolite (Turner & Verhoogen) grade. |
| m2 | Muscovite-bearing gneiss (biotite-rich and leucocratic). | Second generation planar axial plane schistosity. Steep fold axes. | North-north west of Muller Bore. | Evidence of retro-grade metamorphism. |
| m3 | Interlayered mafic gneiss and coarse garnet biotite-feldspar gneiss. Some garnet sillimanite feldspar gneiss. | East-west foliation with steep dip. | North of the Upper Plenty River Valley. | Relationship to Harts Range Group uncertain, but is possibly equivalent to Irindina Gneiss. |
| m4 | Garnet-bearing quartzo-feldspathic gneiss. Sub-ordinate foliated mafic rocks-calc-silicate rocks, sillimanite-biotite-feldspar gneiss. | Northerly strike, folded in steep north-plunging structures. | South and south-east of Plew Bore. | Similar in composition and appearance to m5, locally migmatitic. |
| m5 | Mafic granulites. Leuco-cratic garnet-biotite-feldspar gneiss. | Secondary foliation oblique to primary foliation recog-nizable in veins within the leucocratic gneiss. Mafic rocks are more competent than the leucocratic gneiss. | Around Mount Swan. | Basic granulites of m3 grade westwards into amphibolites of m11. The leucocratic gneiss-es may be parent material for Mount Swan granite. Migmatite in part. |

Table 2. (cont.).

| Map Symbol | Lithology | Structural Characteristic | Distribution | Comments |
|---|---|---|---|---|
| m6 | Biotite-feldspar gneiss. | Strongly foliated; marked compositional banding has north-east strike. | East of Plow Bore. | Possibly overlies m4. |
| m7 | Coarse-grained meta-quartzite (micaceous in part); biotite-feldspar quartz-gneiss, amphibolite, calc-silicate rock. | Quartz has strongly developed down-dip lineation. Second generation folds in biotite-feldspar gneiss plunge to north-east. | North-east of Plow Bore. | Possibly overlies m4. |
| m8 | Biotite-feldspar-quartz gneiss (garnetiferous in southern part). Minor mafic rocks. | Foliation refolded in broad regional pattern. | North-north-east of Plow Bore. | Intruded by g8. Faulted northwards against m13, gm, and subjected to retro-grade metamorphism to south of this fault. |
| g8 | Orthogneiss, biotite-quartz-feldspar (sometimes garnet-iferous). | Foliation parallel to the host rock. | South of Arno Peak. | May be equivalent to gm. |
| m11 | Fine-grained biotite-gneiss minor amphibolite, sillimanite gneiss and biotite schist. | Air photo lineaments indicate superimposed structure | From north-west of Mount Swan to east of Lobia Bore. | Amphibolite occurs only east and west of Waite River. Intruded by gs, gi. |
| m12 | Biotite gneiss. | Broad folding of composi-tional layers with internal ptygmatic folding. | Mainly north and north-east of Copia Bore. | Relationship to m11 not known; only contact obscured by deep weathering. |
| m13 | Fine-grained biotite-feldspar-gneiss, biotite-muscovite schists, mafic gneiss, quartz-ite. | Schistosity parallel to compositional layering. Broad regional warping. | North and south of West Bore. | Junction with m4 mildly sheared. Contact with m12 and m8 faulted. Meta-morphic grade probably upper greenschist (Turner & Verhoogen) Intruded by gi gw, gm. |

Table 2. (cont.).

| Map Symbol | Lithology | Structural Characteristic | Distribution | Comments |
|---|---|---|---|---|
| m14 | Muscovite schist, biotite-muscovite-schist, quartzite. | Well developed planar schistosity. Some second generation folding. | (See map) | Possibly overlies m13 unconformably. |
| m15 | Massive quartzite. | Lacks orientation of m14. | (See map) | Unconformably overlies m14. |
| gm | Orthogneiss (quartz-biotite feldspar). | Foliation parallel to country rock. | South-east of West Bore. | Intrudes m13, possibly m11. |
| gw | Biotite granite (porphyritic). Locally garnetiferous. | Contact crosscuts grain of country rock. Hornfels developed. | North and South of West Bore. | Intrudes m13. |
| gi | Biotite orthogneiss. | Foliated and lineated contact both parallel to and discordant with country rock. | From Mount Ida northwards. | Intrudes m12, m13. |
| gs | Biotite orthogneiss (feldspar porphyroblasts) | Feldspars subparallel to foliation. | Alcoota Sheet area east of the Bundey River. | Intrudes m5, m11. |
| - | Dolerite dykes, fine-grained, zoned. | Dykes 1-2 metres wide. | South-west of Bushy Park homestead. North-west of Mount Swan. | |
| - | Pyroxenites. | Probably pipes, each no more than 10 metres across. | North-east of Copia Bore. | |
| - | Pegmatites and pegmatitic granites. | - | Central one-third of Sheet from north-east of Copia Bore westwards. | |

South-east of Claraville homestead retrograde metamorphism appears to be due to a rise in temperature rather than to dynamic effects. The bulk of the Arunta Formation in the Claraville area is composed of calc-silicate rocks and gneisses of pelitic to psammo-pelitic composition; quartzo-feldspathic gneisses and amphibolites form rare but useful marker beds.

Area South of Mount Brassey: (Dr. M.J. Rickard, A.N.U.).

Detailed mapping of a area south of Mount Brassey outlined three generations of folding in a sequence of amphibolite, calc-silicate rocks, quartzite, and marble.

## CENTRAL HIGHLANDS PROJECT, N.G.

J.H.C. Bain, D.E.Mackenzie; D.J.Belford, R.J.Ryburn (Part-time)

The major part of the field work for this project was done in 1968. In June to August, 1970, detailed mapping and palaeontological collecting were carried out in selected areas, along with helicopter - supported reconnaissance mapping of the lower Jimi valley.

The results of both the 1968 and the 1970 work are presented in Fig. M7, which covers the Ramu and Karimui 1:250,000 Sheet areas. The main feature of economic interest in the map area is the Yanderra copper prospect which is currently being investigated by Kennecott. Other areas have been taken up by oil and mineral exploration companies, but there is little activity at present.

Bain and Mackenzie attended the 42nd Congress of ANZAAS in Port Moresby, where they presented papers on two aspects of regional mapping in the Central Highlands. Bain conducted a post-Congress tour of the Kubor Anticline, and Mackenzie collected material from the Mount Hagen volcano preparatory to commencing a study of Mount Hagen and other Highlands volcanoes in 1971.

## WEST SEPIK RECONNAISSANCE

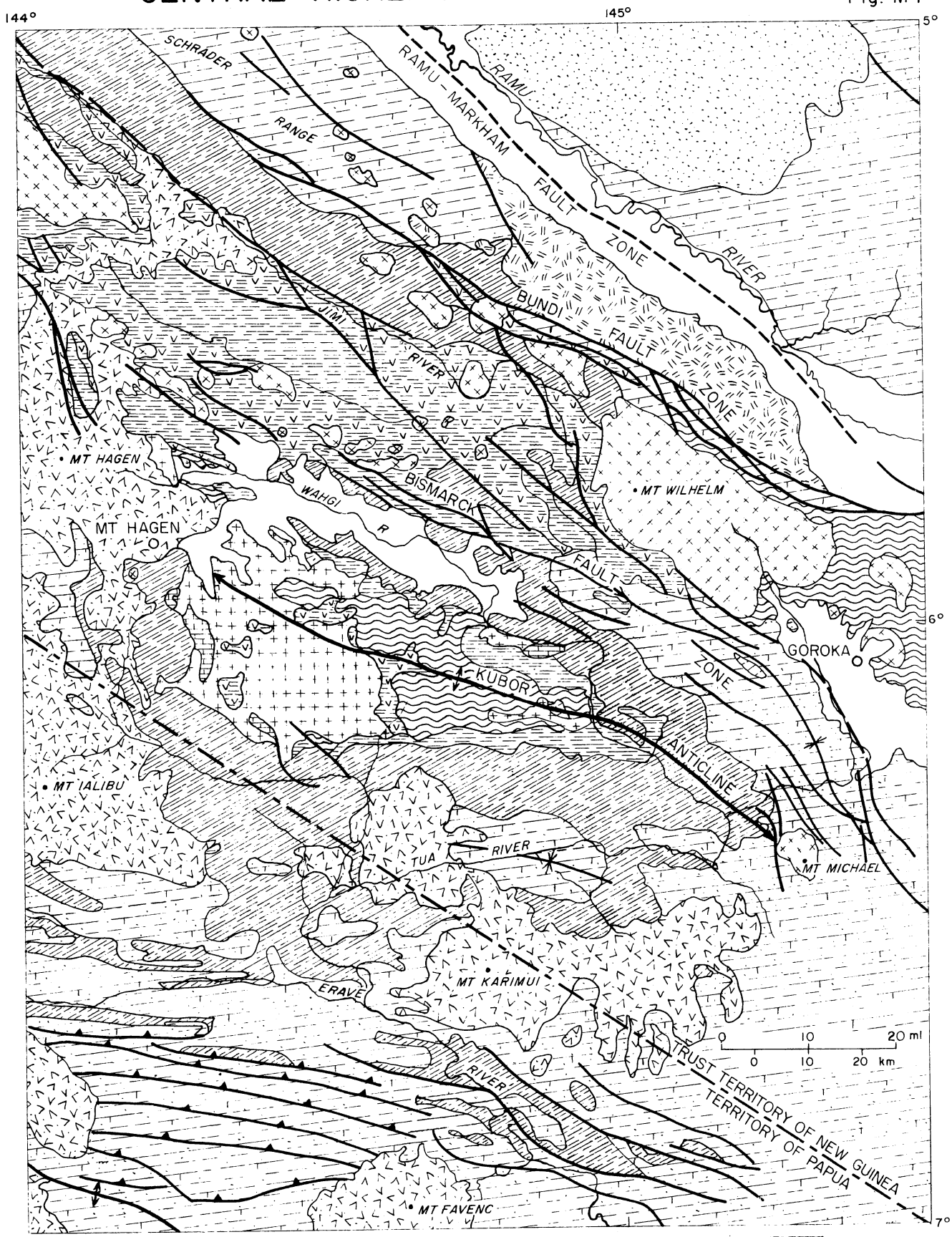
H.L. Davies, J.H.C. Bain

Davies and Bain spent six days in August on a reconnaissance of the area which will be mapped in 1971. The reconnaissance included visits to the Ok Tedi and Frieda porphyry copper prospects. Possible base stations were visited, information was collected from mining company and Administration officers, and sixty rock specimens were collected and described in thin section.

The 1971 survey is planned to cover previously unmapped country between Porgera in the east, the Fly River plains in the south, Sepik plains in the north, and the West Irian border. Army Survey Corps have made available sidelooking radar imagery of areas which are not covered by air-photographs.

# CENTRAL HIGHLANDS OF NEW GUINEA

Fig. M 7




| | | | |
|---|---|---|---|
| RECENT | Alluvium | PERMO-TRIASSIC | Limestone |
| PLEISTOCENE | Volcanics and sediments | PRE-MESOZOIC | Phyllite |
| TERTIARY | Siltstone, shale, limestone and volcanics | INTRUSIVE ROCKS | |
| CRETACEOUS | Siltstone and shale | TERTIARY | acid to basic |
| JURASSIC | Greywacke and other sediments | TERTIARY-CRETACEOUS | ultra basic |
| TRIASSIC | Greywacke and volcanics | PERMIAN | acid to basic |

To Accompany Record 1970/81

B55/A/12

# PRINCE CHARLES MOUNTAINS, ANTARCTICA

I.R. McLeod, J.H.C. Bain, D.J. Grainger, R.J. Tingey

Regional geological mapping, at 1:250,000 scale, of the northern Prince Charles Mountains continued. The party sailed from Melbourne for Antarctica on 19th December. After lengthy delays caused by inclement weather the field base at Moore Pyramid, 350 km south of Mawson, was established by the end of January, and field work began on 1st February. Two parties consisting of a geologist and a field assistant and one party consisting of geologists and a surveyor carried out foot and helicopter traverses in the Porthos and Aramis Ranges. The fourth geologist covered the greater part of the Athos Range by helicopter traverses from the field bases. The work was delayed by adverse weather, and was terminated on 11th February owing to damage to the fixed wing aircraft servicing the base from Mawson. All field personnel were withdrawn to Mawson by 23rd February. Less than 20 percent of the scheduled geological work and none of the survey work was completed.

Pending arrival of the relief ship the Church Mountain-Scullin Monolith area (Gustav Bull Mountains) was mapped in reconnaissance detail.

A further 75 rock samples were collected in the continuing BMR-ANU programme of isotopic dating of the rocks of the Australian Antarctic Territory. Dr. P.Arriens, of the Australian National University, is conducting the laboratory studies. Samples were collected from the Mawson Coast-Framnes Mountains area, and from Moore Pyramid and Martin Massif in the Northern Prince Charles Mountains.

Gravity readings were made where practicable, using a La Coste and Romberg geodetic instrument.

The group sailed from Mawson on 4th March, and arrived in Melbourne on 16th. On returning to Canberra rock specimens were sorted and submitted for petrographic study, notes on specimens collected for age determination were prepared, and work resumed on the Record on the geology of the Prydz Bay - Beaver Lake area mapped in 1969.

During the remainder of the year all personnel worked on other projects, although McLeod attended to all matters of administration and liaison connected with the Antarctic work. He also prepared a paper on the possibility of mineral deposits' occurring in Australian Antarctic Territory, and attended the second Symposium on Antarctic Geology and Geophysics and the eleventh meeting of the Scientific Committee on Antarctic Research and meeting of its Working Group on Geology in Oslo. Medvecky (1969 party) continued work on the Record on the geology of the Permian sediments of the Beaver Lake area; he contributed a paper on these sediments to be symposium.

Geology

Petrographic work on the samples collected is still in progress. In the northern Prince Charles Mountains, extensive areas of outcrop between those examined have still to be visited. Work to date has shown the rocks to be high-grade migmatites, gneisses, and granulites of the amphibolite and granulite facies. Massive porphyritic charnockite occurring around Mount Loewe in the eastern Aramis Range seems to be discordant to the metamorphic rocks. Most of the gneisses and granulites are predominantly quartzo-feldspathic, and are probably metasediments; minor layers which are predominantly pyroxene and plagioclase may represent metamorphosed basic sills or flows. Coarser grained, rather massive, commonly porphyroblastic rocks in the Carter Peak area and Stinear Nunataks may be orthogneiss. Of the parts of the Prince Charles Mountains mapped so far, migmatization is most intense in the eastern Athos Range, although it has affected the rocks of most of the region to different degrees; it seems to be rare or absent in the eastern Porthos Range and eastern Aramis Range.

The geological history of the region is undoubtedly complex. The area has undergone at least two episodes of folding, and at least two of metamorphism.

The reconnaissance work in the Church Mountain-Scullin Monolith area showed that the rocks consist of high-grade gneisses and granulites which are migmatitic in part. Disseminated graphite forms about 10 percent of the rocks at one locality.

REPORT WRITING:

KIMBERLEY PROJECT, W.A.

East Kimberley and Kimberley Basin. K.A. Plumb, D.C. Gellatly, G.M.Derrick

Bulletin 107, "Metamorphism and igneous activity in the Lamboo Complex, East Kimberley area, Western Australia", by Gemuts, is still in press. The Bulletin, "Geochronology of the East Kimberley region, W.A.", by Bofinger, is with the editor. Report 140, "Palaeozoic rocks of the Hardman, Rosewood, and Argyle Basins, East Kimberkey region, Western Australia", by Dow, and the Report "Adelaidean and Cambrian stratigraphy of the Mount Ramsay 1:250,000 Sheet area, Western Australia", by Roberts, Gemuts, and Halligan, are also with the editor.

A paper, "Proterozoic palaeocurrent directions in the Kimberley region, northwestern Australia", by Gellatly, Derrick, and Plumb, accepted for publication by the Geological Magazine in 1969, is still in press.

The following 1:250,000 maps and Explanatory Notes were published during the year: Mount Ramsay, Lansdowne, Mount Elizabeth, and Ashton. The Prince Regent-Camden Sound map is printed, and is awaiting the notes which are in press. Drysdale-Londonderry Explanatory Notes have been printed; machine proofs of the map have been checked, and returned to the printer. Cambridge Gulf, Medusa Banks and Montague Sound Explanatory Notes are with the printer. Machine proofs of the Cambridge Gulf Map are being checked before final printing; fair drawing of Medusa Banks is complete; and fair drawing of Montague Sound is in progress.

Compilation of a 1:500,000 scale map of the Kimberley Basin and West Kimberley regions has commenced.

## CARPENTARIA PROJECT, N.T.

K.A. Plumb, P.R. Dunn, (H.G. Roberts)

Work on the Arnhem Land Bulletin, by Roberts, Plumb, and Dunn, continued during the year. Writing is now almost complete.

No work was done on the Roper River-Queensland Border Bulletin, by Dunn, Roberts, Plumb and Smith, or the Arnhem Land Basement Rocks Report, by Plumb. A brief paper on revisions to the stratigraphy of the McArthur Group, by Plumb and M.C. Brown, is in press; it is one of a collection of geological papers combined in Bulletin 125.

## VICTORIA RIVER PARTY, N.T.

I.P. Sweet, J.R. Mendum, R.J. Bultitude,
C.M.Morgan (resigned February).

The work carried out by the Victoria River Party in 1967 - 1969 has been written-up as Records for each seasons work. The Record for 1967 is issued, that for 1968, is being edited, and that for 1969 is in the final stages of compilation. It is proposed that each of these Records will be produced in the Report series.

The Victoria River area is covered by nine 1:250,000 Sheets. Of these Preliminary Editions have been issued of five - Auvergne, Delamere, Port Keats, Fergusson River and Cape Scott. Explanatory Notes and corrections for first edition have been prepared for all five. The other four Sheet areas are in various stages of compilation, but all are expected to be ready for first edition by March, 1971.

## BURDEKIN REGION, Q.

A.G.L. Paine (resigned June), Miss R. Cameron (part time).

The Record on the Bowen 1:250,000 Sheet area and Explanatory Notes for the Bowen, Proserpine, and Hughenden (N.E. Part) 1:250,000 Sheet areas were completed. The Hughenden and Proserpine Records were modified for the Report series. A 1:1,000,000 map of the Burdekin Region and accompanying notes were completed and forwarded to the Water, Power, and Geographic Branch. A draft 1:500,000 map for the Bulletin was completed, and is being checked by Paine. Writing of the Bulletin was not started, but it may be possible to arrange for D.H. Wyatt (ex-G.S.Q.) to prepare some notes for the map on contract.

## EASTERN PAPUA 148°30'-151°E

T.E. Smith, H.L. Davies, D.J. Belford

Draft text for a Bulletin on the geology of the eastern Papuan mainland was prepared. This will be illustrated by a 1:500,000 scale geological map.

Progress with 1:250,000 scale geological maps was as follows:

| Sheet Name | Preliminary Edition | Explanatory Notes |
|---|---|---|
| Fergusson Island | Published | Draft Text |
| Samarai | In progress | In progress |
| Abau | " | Draft text |
| Tufi | " | In progress |

The following papers were submitted for publication:

Jakes, P., & Smith, I.E. - High-K calc-alkaline rocks from Cape Nelson. Papua. Contr. Miner. Petrol. in press 1970.

Smith, I.E., & Simpson, C.J. - Late Cainozoic uplift in the Milne Bay area, eastern Papua. In B.M.R. Bulletin No.125 (in press)

Smith, I.E. - Late Cainozoic uplift and geomorphology in southeastern Papua given at ANZAAS, 1970.

Smith, I.E. - Late Cainozoic volcanism in eastern Papua, given at ANZAAS 1970.

Hohnen, P.D., & Pieters, P.E., - The Geomorphology of the Dayman Dome, eastern Papua, T.P.N.G., given at ANZAAS, 1970.

Davies and Smith prepared a draft paper summarizing the geology of eastern Papua 147°-154°E for possible outside publication.

## NEW BRITAIN PARTY

R.J. Ryburn, R.W. Johnson, D.E.Mackenzie

New Britain fieldwork was completed in November, 1969. Subsequently work has been in progress on the 1:250,000 geological maps and a Record on the geology.

During the six months' fieldwork in 1969, emphasis was placed on collecting basic field data and samples as quickly as possible. This policy was determined by a number of factors, not the least being the high cost of helicopter and boat support. Map compilation that would normally be carried out in the field was deliberately left until after the field season.

In common with some other areas in New Guinea, there have been many problems associated with the compilation of maps. Inadequate existing base maps have had to be upgraded from all available data. Air photographs provided incomplete coverage at various scales, and the high relief in many areas has prevented direct training of linework from photographs to base maps. Photo-interpretation is heavily dependent on field data, and could be completed only after the field work had been finished. Definition and delineation of some rock units has had to await the outcome of petrographic and palaeontological studies.

(Cont.)

New Britain,(Cont.)

The first editions of the 1:250,000 maps will be published as soon as possible after the completion of the preliminary maps, as good quality base maps will not be available for some years. The Record and preliminary maps are scheduled for completion by June, 1971.

A geological map of New Britain and New Ireland on a scale of 1:1,000,000, together with a summary of the geology, was produced for a Record on the 1969 Rabaul Crustal Study.

## CENTRAL HIGHLANDS PROJECT, N.G.

J.H.C. Bain, D.E. Mackenzie

The eighteen 1:50,000 scale geological compilation sheets produced for this project in 1969 have been modified, and in some cases completely redrawn, as a result of further photogeological interpretation and recently completed field work. The production of further 1:50,000 scale compilations is delayed pending the receipt of adequate topographic bases. A 1:500,000 scale compilation of these geological sheets is being drafted.

More than 400 thin sections have been examined and described. A Record on the geology of the Kubor Anticline ( which occupies an area of 150 x 100 sq. km) is nearly complete.

Two 1:250,000 scale geological sheets (Ramu and Karimui) and Explanatory Notes are in preparation. Complete coverage of these sheet areas has been obtained by inclusion (and consequent re-interpretation) of previously published BMR maps and unpublished oil and mineral exploration company data. Throughout this project compilation of data from published maps and field observations has been severely hampered by the almost complete lack of topographic base maps.

Production of a Bulletin describing the geology of the combined Ramu and Karimui 1:250,000 Sheet areas is planned.

## PAPUAN ULTRAMAFIC BELT

H.L. Davies, R.N. England

Bulletin 128 - "Peridotite-gabbro-basalt complex in eastern Papua: an overthrust plate of oceanic mantle and crust", with a coloured map of the Ultramafic Belt at 1:500,000 scale, was sent for printing in November, 1970.

1:250,000 scale maps (Salamaua, Buna, and Tufi) which cover most of the Ultramafic Belt were prepared for drafting for Preliminary Edition. A paper for outside publication entitled "Mineralogy of two types of ultramafic rock from Papua" by England and Davies was prepared in draft form. Davies presented a paper on the Ultramafic Belt to the 42nd ANZAAS Congress in Port Moresby, and prepared an ANZAAS Excursion Guide for part of the Ultramafic Belt. He also attended the Archaean Symposium in Perth in June to study the association of nickel mineralization with ultramafic rocks in the Western Australian shield.

## OWEN STANLEY METAMORPHICS, T.P.N.G.

H.L. Davies with P.E. Pieters and M. Barsdell-
of New Guinea Resident Staff.

Davies described thin sections of rocks collected earlier in the year, while attached to the resident staff, on traverses from Garaina to Tapini, Woitape, to Kokoda, and in the Kumusi River headwaters. Metamorphic grade between Garaina and Tapini is generally low greenschist facies. Lawsonite occurs in a zone within a few kilometres of the Owen Stanley Fault. A Record on this work should be completed in early 1971.

## DETAILED PROJECTS

### FIELD WORK CLONCURRY - MOUNT ISA PROJECT

G.M.Derrick, A.Y. Glikson, J.E. Mitchell, R.M. Hill,
I.H. Wilson (GSQ), Miss D.M. Pillinger (Draftswoman BMR),
July-October; G.M. Millist (Draftsman, January-June)

Introduction:

During 1970 field work commenced in the Mary Kathleen and Mount Isa 1:100,000 Sheet areas, and map preparation and report-writing continued for the Marraba and Cloncurry 1:100,000 Sheet areas.

Field Work, 1970:

The areas mapped in 1970 are shown in Fig. M8. They include all of the Mary Kathleen Sheet and part of the Mount Isa Sheet; much of the latter has been mapped in detail by Staff of Mount Isa Mines Ltd, by other mining companies, and by research students; mapping on this Sheet will be completed in 1971. Colour aerial photographs (QASCO, 1968) at 1:20,000 (about 1600 feet = 1 inch) were used in the mapping of the Mary Kathleen Sheet area, and at 1:24,000 (QASCO, 1969) for parts of the Mount Isa Sheet area. Compilation has been on bases enlarged from 1:100,000 maps (1969) produced by the Division of National Mapping. Base camp for the season was at Lake Corella, near Mary Kathleen.

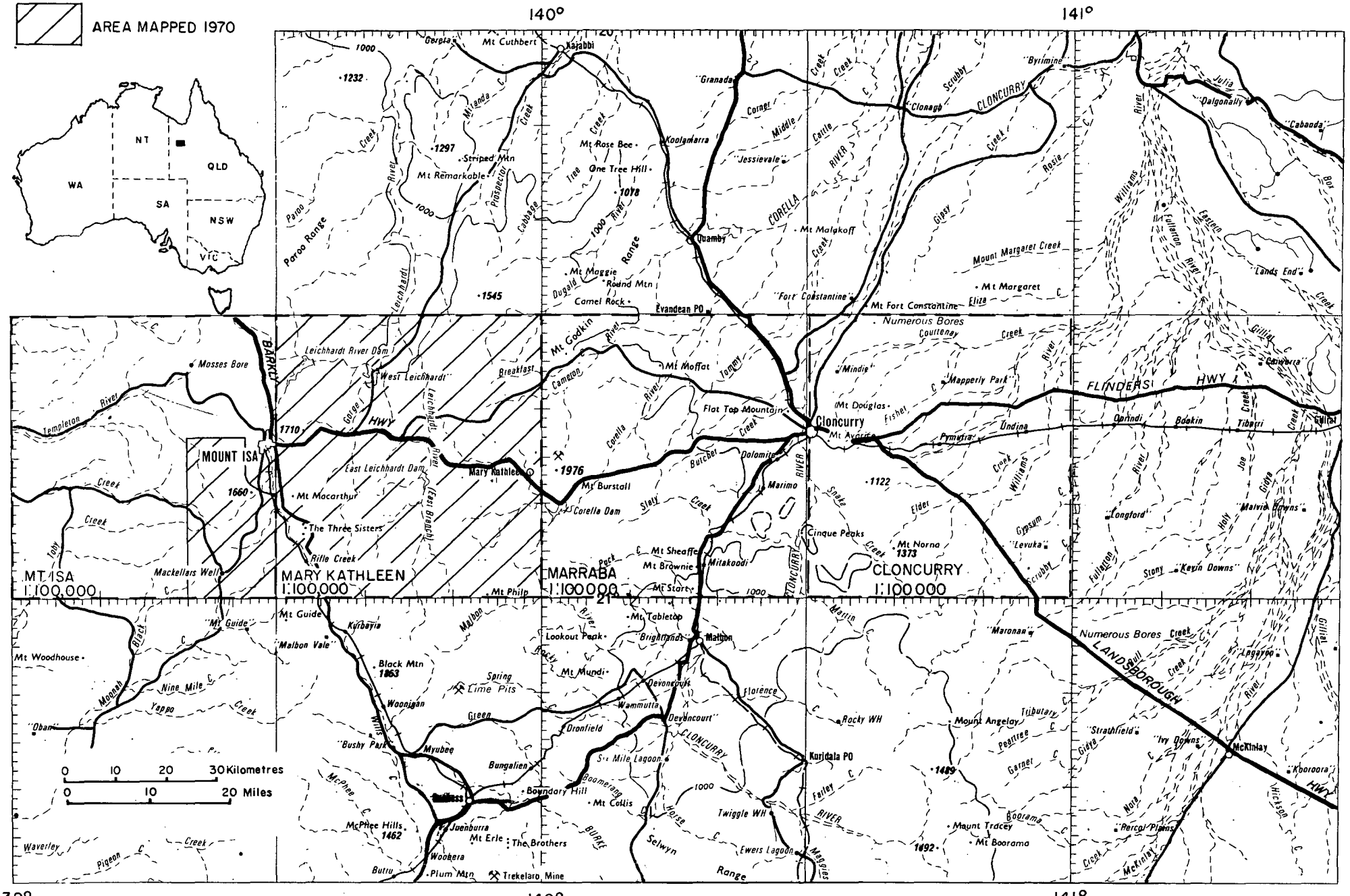
Geology of the Mary Kathleen 1:100,000 Sheet area

This Sheet encompases Precambrian rocks forming part of the eastern and western geosynclines, and the basement rocks which separate these two areas.

Preliminary results, eastern geosyncline: and stratigraphy:

Fig. M9 shows the generalized stratigraphy and structure of this area. Much of the stratigraphy outlined by Carter et al (1961) has required simplification and re-definition. A summary of the stratigraphy, from top to bottom, is given below.

# LOCALITY MAP



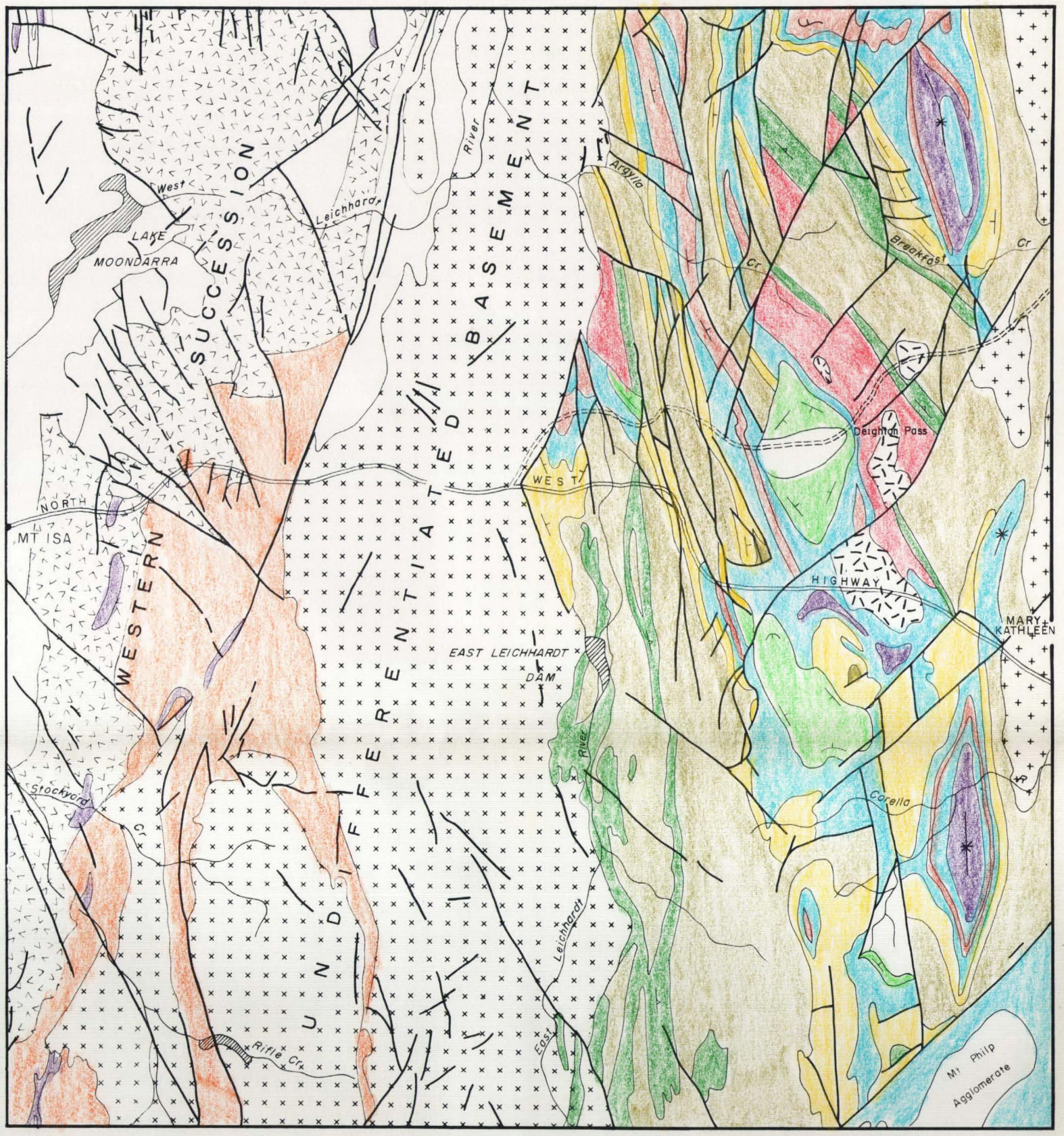

To accompany Record 1970/81

F54/A/19

FIG M8

FIG M9

# PRELIMINARY GEOLOGICAL SKETCH MAP, EASTERN SUCCESSION
# MARY KATHLEEN 1:100,000 SHEET AREA




Geological boundary
Syncline
Fault
Strike and Dip
Foliation

**WESTERN SUCCESSION** ① ②

- Mt Isa Group
- Surprise Creek Beds
- Myally Beds
- Eastern Creek Volcanics
- Mt Guide Quartzite

For lithologies refer to text

**BASEMENT** ②

- Wonga Granite
- Kalkadoon Granite
- Argylla Formation
- Magna Lynn Metabasalt
- Leichhardt Metamorphics
- Undifferentiated

**EASTERN SUCCESSION**

- White Blow Formation
- Deighton Quartzite
- Burstall Granite
- Corella Formation
- Ballara Quartzite
- Dolerite

① Geology taken from Carter et al (1961); subject to revision.

② Mapped in detail, but final results not yet available.

Scale 1" = 4 miles

To accompany Record 1970/81

F54/A2/33

| Thickness Metres | Formation/Member | Lithology |
|---|---|---|
| 400 | White Blow Formation (Informal) | Friable sandstone, silt, schist, black slate, limestone, garnetiferous phyllite, staurolite schist. |
| | ? Unconformity | |
| 2200 | Deighton Quartzite | Massive feldspathic quartzite pebbly quartzite, minor siltstone. |
| | ? Unconformity | |
| 350 | | 3. As for 1. |
| 15 to 630 | Corella Formation | 2. Massive to blocky quartzite, micaceous sandstone, siltstone schist. |
| 370 | | 1. Limestone, laminated calcareous quartzite and siltstone, with scapolite, garnet, cordierite, and andalusite. |
| 380 | Ballara Quartzite | Massive ridge-forming quartzite, minor calcareous quartzite schist; basal arkose and conglomerate locally. |
| | ? Unconformity | |
| ? | Argylla Formation | Laminated feldspathic crystal tuff, porphyritic rhyodacite, rhyolite, quartz feldspar porphyry; minor schist and quartzite. |
| 400 + | Magnalynn Metabasalt (Informal) | Amygdaloidal and massive metabasalt, quartzite, basalt-sandstone mixture, epidosite. |
| ? | Leichhardt Metamorphics | Porphyritic metadacite, rhyolite, biotitic meta-rhyodacite. |
| | GRANITIC ROCKS | |
| | Burstall Granite (Informal) | Coarse-grained porphyritic granite; aplite. |
| | Wonga Granite | Coarse-grained porphyritic granite; biotite granite. |
| | Kalkadoon Granite | 4. Orthogneiss<br>3. Medium - to fine-grained biotite-muscovite granite, aplite, pegmatite<br>2. Coarse-grained granodiorite and tonalite.<br>1. Coarse-grained granite. |

Dolerite of various ages intrudes all units except the Deighton Quartzite and younger rocks.

The major re-definitions, etc. are as follows:

a. The Burstall Granite is separated from the Wonga Granite because it intrudes Corella Formation. The Wonga and Kalkadoon Granites on the Mary Kathleen Sheet appear older than the Ballara Quartzite.

b. A four-fold division of the Kalkadoon Granite; the granodiorite appears to be a marginal hybrid phase; the orthogneiss is a product of intimate veining of Leichhardt Metamorphics by units 2 and 3 of the Kalkadoon Granite.

c. The Magnalynn Metabasalt is a widespread basalt unit intruded by porphyry sheets of the Argylla Formation, and overlies the Leichhardt Metamorphics.

d. The name Argylla Formation has been restricted to mainly acid volcanic material; much of the Ballara Quartzite and Corella Formation was formerly included in it, particularly in the western part of the eastern succession.

e. Charleys Creek Formation is equivalent to the Corella Formation and Deighton Quartzite, and should be discarded.

f. Recognition of a slate-carbonate unit - the White Blow Formation - overlying the Deighton Quartzite.

Structure:

Extensive and fundamental strike faulting occurs throughout the Sheet area. It is best defined by the Argylla Formation-Ballara Quartzite relationship, and up to five repetitions of the sequence (up to the base of the Deighton Quartzite) have been mapped. The faults are normal, in the sense east block up, and movements from 2000 metres to 5000 metres have been determined. In addition, numerous major faults with transcurrent dextral movements of 1 to 2 km trend northeast. The strike faulting is older than the transcurrent faulting, and may be related to basement movements to the west or east.

Economic Geology:

Copper: The basic rock association is dominant throughout. Some copper is associated with intrusive porphyry of the Argylla Formation. A notable stratigraphic correlation has been noted: a number of small producing mines are located where basic dykes intersect the Argylla Formation-Ballara Quartzite boundary. This contact extends north-south for 45 km, and is folded.

Fluorite: A further large body was found in the Burstall Granite in the Marraba Sheet area, and is currently being costeaned by Western Nuclear.

Molybdenite was noted in massive calcite at Lime Creek, also in the Marraba Sheet area.

Barytes has been found in veins in a jaspilite sequence which extends from the Marraba Sheet area into the Mount Philp area. A vein about 450 metres long and 3 metres occurs south of the Marraba Sheet area, near Kuridala.

Preliminary results, Western geosyncline:

The northern half of the western geosyncline was mapped by A.Y. Glikson, and the southern half by the remainder of the party. In the south, stratigraphy is complicated by very major fault-zones (Mount Remarkable and Gorge Creek Faults), and the Leichhardt Metamorhics are more highly re-crystallized than to the east, with orthogneiss and migmatic common. In the Stockyard Creek-Rifle Creek area a quartzite, overlying basalt and defining an anticline, is intruded by Kalkadoon Granite. To the east this quartzite (considered to be Mount Guide Quartzite by Carter et al.) is faulted against (?) Surprise Creek Beds, and to the west it is faulted against basement rocks and lower Mount Guide Quartzite. The sequence overlying the Argylla Formation near Rifle Creek consists of basal conglomerate grading upwards into the lower Mount Guide Quartzite. Large sills of gabbro occur in the Eastern Creek Volcanics.

In the north, the volcanic-sedimentary sequence is strongly faulted into a horst and graben pattern, and is folded on meridional and near vertical north-plunging fold axes. Because of lateral facies variations, as well as thickness variations, the correlation of sequences across fault lines presents many problems. Some of the difficulties, however, can be solved assuming the lensing of units, and differentiation between dyke-intruded pre-volcanic and syn-volcanic sandstones (Mount Guide and Lena units), on the onehand, and post-volcanic sandstones (Myally Beds, Surprise Creek Beds) and shales (Mount Isa Shale and post-Surprise Creek Bed shales) on the other. The post-basement evolution of the sequence is summarized as follows:

1. Deposition of basal pebbly greywacke and arkose beds, representing basement-derived material (lower part of Mount Guide unit).

2. Deposition of feldspathic and quartzose cross-bedded sands, represented by the upper part of the Mount Guide unit.

3. Taphrogenic movements, initiating a rift valley structure between the Gorge Creek Fault and possibly the Mount Isa Fault (the latter is at present a high angle thrust fault, but may have been a normal fault before deformation).

4. Continental volcanism, involving the eruption of basalts (with amygdaloidal flow-tops and flow-top breccias), and contemporaneous deposition of basement-derived quartz sandstones, commonly contaminated by fine to coarse basic debris, resulting in epidote-rich sandstones and in sedimentary-volcanic breccias. The maximum thickness of basalts is recorded from the central zone of the basin, whereas thinner volcanic sequences occur at the flanks of the basin near the Gorge Creek Fault and west of the Mount Isa Fault. Volcanic rocks are missing altogether between the basement and the Surprise Creek Beds - the absence of basic dykes in the latter indicates a post-volcanic time of deposition.

5. Waning of volcanic activity, associated with the eppearance of tuff and agglomerate beds, and the increase in the abundance of feldspathic and quartz sandstones (Lena and Myally units). The scarcity of aqueous sediments (shales and limestones) in the volcanic sequence indicates predominantly continental deposition - a conclusion supported by the absence of pillow lavas.

6. Submergence, giving rise to the deposition of pelitic sediments, represented by the Mount Isa Shale and shale overlying the Surprise Creek Beds.

The commonly limited effect of faulting on the Eastern Creek Volcanics, and the abrupt variations in the thickness of sandstone units, both support the existence of fault-block structures prior to the volcanic episode. The confinement of the basin between two basement blocks (Leichhardt and Sybella), the apparent importance of normal faulting, the continental volcanism, and the subsequent submergence, all suggest a comparison with rift valley structures such as those of the East African-Syrian system. The Mount Isa lead-zinc deposits nowadays considered syngenetic by most geologists, may therefore represent Proterozoic equivalents of the Red Sea syngenetic base metal deposits. Both could have originated through the emanation of ore-bearing solutions percolating along the marginal normal faults. Further deformation of the sequence and associated low-grade metamorphism were probably associated with advanced sinking of the rift structure and with consequent geothermal rise.

Maps, Publications, etc.

a. The Proterozoic metamorphic rocks of the Cloncurry 1:100,000 Sheet area (Soldiers Cap Belt) by A.Y. Glikson and G.M. Derrick (B.M.R. Record 1970/24).

b. In preparation: "The Detailed Geology of the Marraba 1:100,000 Sheet area", by G.M. Derrick, I.H. Wilson (GSQ), R.M. Hill, and J.E. Mitchell. Maps to accompany this Record have been reduced to 1:100,000 scale, and are currently being edited before re-drawing. Field compilation sheets at 1:25,000 scale have been available since May, 1970.

Other Activities:

Derrick assisted with the West Kimberley project, and the writing of the Oscar Range 1:100,000 Record is in progress. Lectures on copper mineralization were given at Queensland and Newcastle Universities during July and August.

Mitchell continued editing of the Ayr geochemical survey Record. Wilson attended the Archaean conference in Perth, and Hill is to take part in the 1970-71 Antarctic expedition. Glikson described 45 thin sections for the Marraba 1:100,000 Sheet area report, and wrote two papers and a note concerned with the Archaean of Western Australia. These were titled as follows: "Structure and Metamorphism of the Kalgoorlie System near Kalgoorlie, Western Australia"; "Archaean geosynclinal sedimentation near Kalgoorlie, Western Australia"; and "Note on the comparison of Early Precambrian Systems". The papers were read in the GSA Archaean Rocks conference in Perth, May. A paper titled "Geosynclinal evolution and geochemical affinities of Early Precambrian Systems" was published in Tectonophysics vol. 9, in August. A paper titlted "Archaean Ophiolites west of Kalgoorlie, Western Australia" was submitted for publication in the BMR special papers Bulletin.

Glikson also submitted about 40 amphibolites and 40 black slates from the Cloncurry and Marraba Sheet areas for major and trace element analyses. Seventeen specimens of sodic porphyry and granite pebbles from the Kurrawang Conglomerate (3 b.y.) were submitted to Dr. Compston (ANU) for further age determinations, and were also submitted for major and trace element analyses. A type section of the Eastern Creek Volcanics was systematically sampled for a geochemical study.

## DARWIN URANIUM GROUP

C.E. Prichard, J.S. Morlock, G.C. Lau, R.S. Needham,
(transferred to Sedimentary Section, April),
D.J. French, (resigned February).

In accordance with a policy decision, active prospecting for uranium in the Rum Jungle District by the Bureau ceased during 1970.

Areas previously under reserve were allotted to companies, a number of whom have called to discuss previous work on their areas.

Three companies made significant finds of uranium ore east of Darwin between the Jim Jim and Oenepelli.

Areas of activity for 1970 are shown in Fig. M10.

### Auger Drilling: (Fig. M10)

To investigate whether subsurface alpha radioactivity would indicate uranium provinces more effectively than surface gamma activity a reconnaissance traverse was carried out from near Darwin to Pine Creek along the Stuart Highway. Surface gamma counts were recorded near each five mile post and alpha activity recorded from an auger drill hole. Both methods indicated increased radioactivity near Adelaide River mine and George Creek prospect and there seems no advantage in using the more time consuming and costly alpha counting method for reconnaissance of an area.

Limited auger drilling which delineated the boundary between the Celia Dolomite and the Crater Formation was carried out in the Shirley West area. Following the policy decision no further work was done here.

### Stapleton Area (Fig. M11).

An auger drill geological, geochemical, and radiometric survey with holes on 1200 feet by 200 feet spacing was conducted over the Stapleton Area. This area was selected because of similarities to the mineralized Castlemaine Hill Area which contained Rum Jungle Creek South uranium orebody. The survey did not disclose radiometric or geochemical anomalies of economic significance. However, the geochemical results assisted in distinguishing between rock units in this area of poor outcrop. A report on the survey is being prepared.

### Rotary Drilling

Over fifty holes have been rotary-drilled in the area this year. Forty-one were drilled by contract; B.M.R. drill crews have completed ten holes, and are presently drilling with two rigs.

Thirty nine holes were to investigate geophysical anomalies and determine their cause. Drilling was supervised, sampled, and lithologically logged by a geologist; geophysical logs were run by the Geophysical Branch, who are preparing a report on the geophysical results obtained.

(Cont.)

Darwin Uranium (Cont.)

One of the rotary holes was on an airborne gamma spectrometer anomaly (No.16) which is co-extensive with an outcrop of leucocratic granite in the Rum Jungle Complex. The drilling showed that anomalous radioactivity persisted in depth (to 50 feet), thus indicating quite a large mass of granite abnormally high in uranium.

Three rotary holes were drilled in the Huandot Magnesite locality (Coomalie Dolomite), and three in the Celia Magnesite locality (Celia Dolomite). In addition to the magnesite which occurs above soil level as upstanding masses, magnesite also occurs beneath soil cover. Argillaceous interbeds and weathered and silicified zones occur irregularly in the subsurface magnesite, and selective mining would be necessary if the deposits were exploited.

Two- five hundred foot holes have been commenced in the Shirley Area. These are designed to check structure and dip of the No.1 Conglomerate of the Crater Formation, and to provide core samples from that conglomerate for mineralogical and radiometric examination. Samples obtained previously by drilling have been leached, and deeper holes may be required to obtain unweathered material.

REPORT WRITING

RUM JUNGLE PROJECT, N.T.

C.E. Prichard, D.J. French, R.S.Needham.

A record on the Crater Formation investigation in the Shirley area is being edited within the Section, and a Record on geochemical and radiometric investigations during 1969 has been issued. A report on a geochemical and radiometric survey in the Stapleton area is in preparation.

McARTHUR RIVER PROJECT, N.T.

Writing of the report is awaiting the completion of chemical analysis of about 400 samples for eleven elements each. For progress on the analytical work, see the section on "Geochemistry of the carbonate rocks of the McArthur River area", under the Geochemistry Group heading.

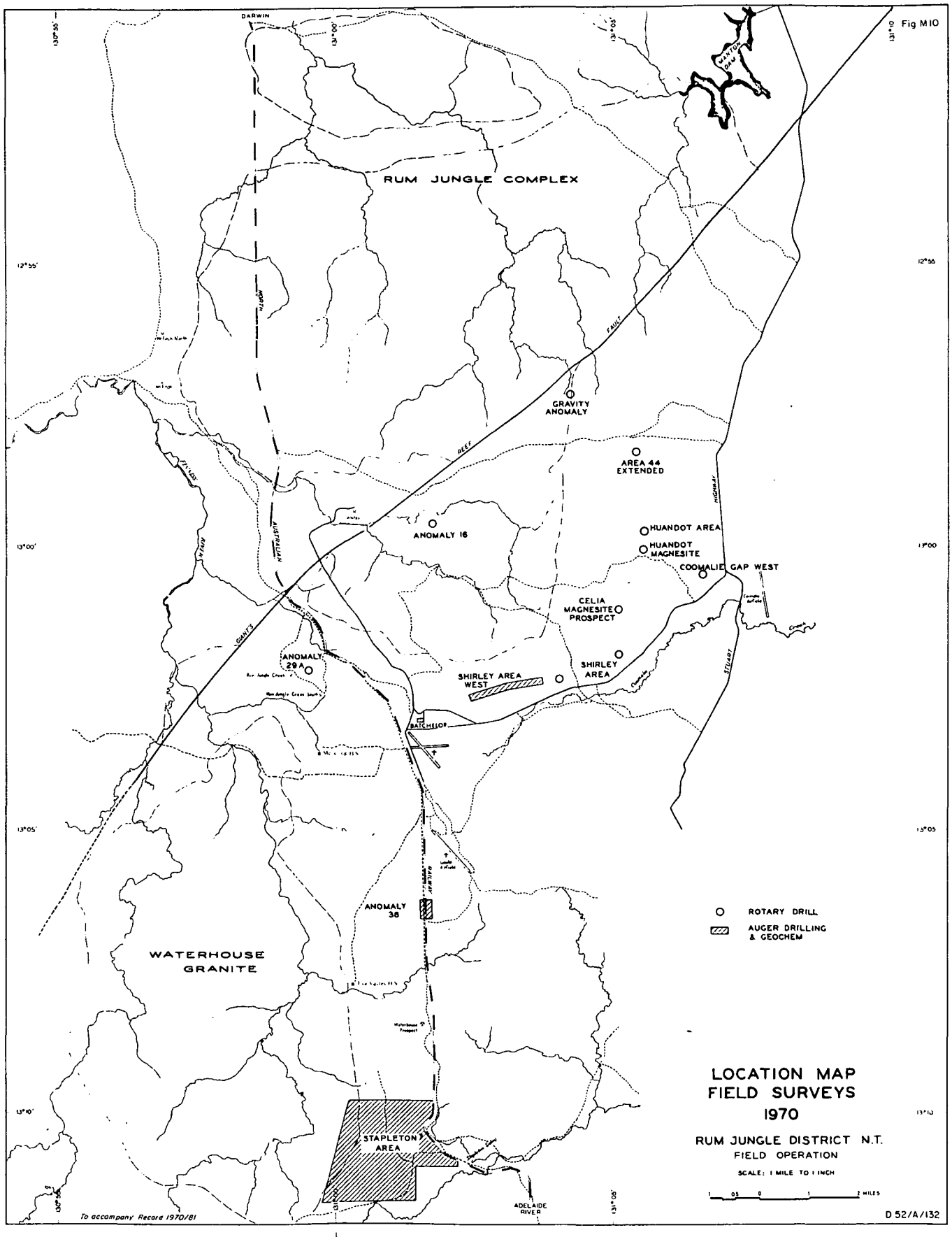
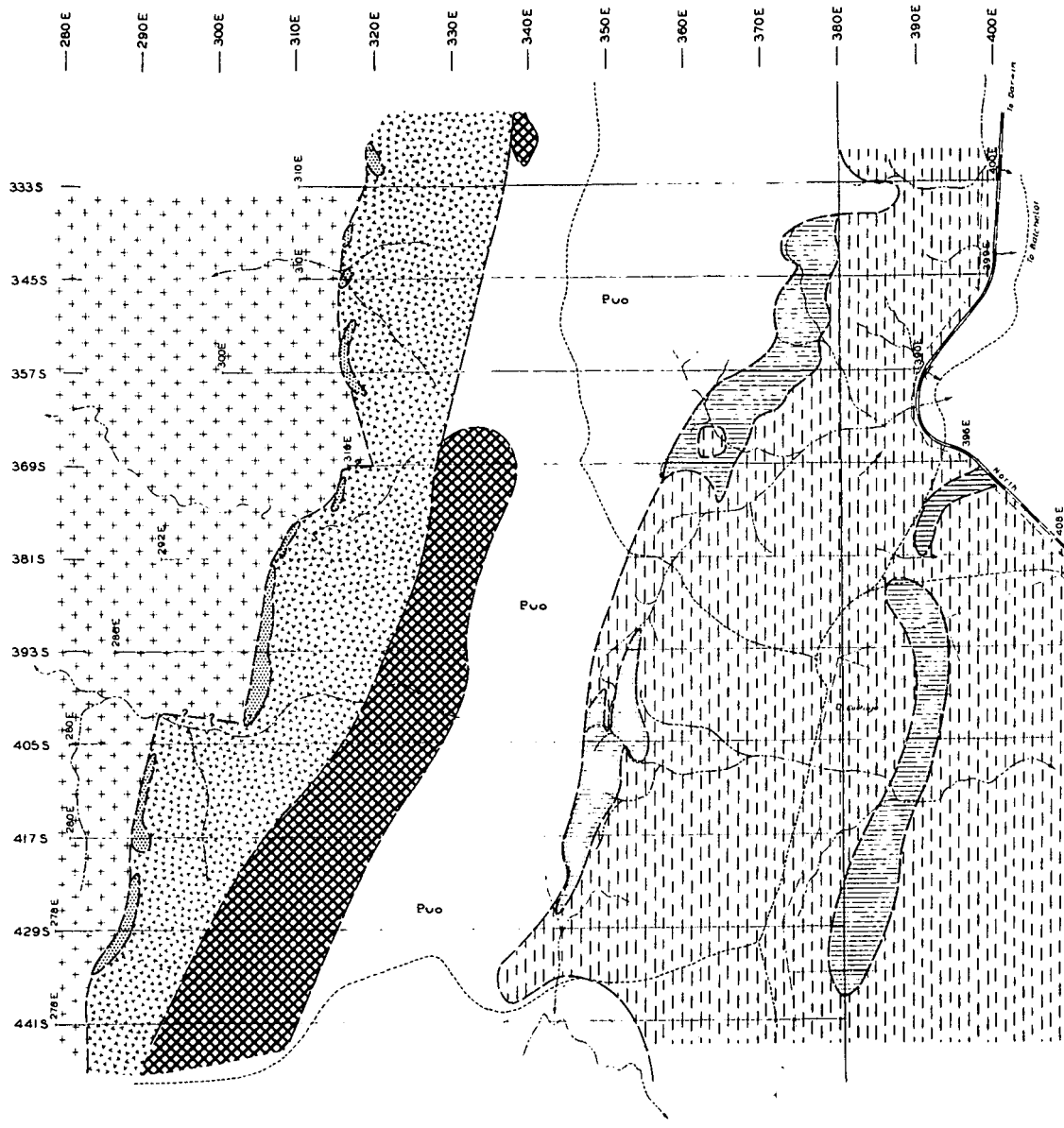


Fig M10
DARWIN
RUM JUNGLE COMPLEX
MANTON DAM
GRAVITY ANOMALY
AREA 44 EXTENDED
ANOMALY 16
HUANDOT AREA
HUANDOT MAGNESITE
COOMALIE GAP WEST
CELIA MAGNESITE PROSPECT
ANOMALY 29A
SHIRLEY AREA WEST
SHIRLEY AREA
BATCHELOR
ANOMALY 38
WATERHOUSE GRANITE
STAPLETON AREA
ADELAIDE RIVER
ROTARY DRILL
AUGER DRILLING & GEOCHEM
LOCATION MAP
FIELD SURVEYS
1970
RUM JUNGLE DISTRICT N.T.
FIELD OPERATION
SCALE: 1 MILE TO 1 INCH
To accompany Record 1970/81
D 52/A/132

Fig. M11




## REFERENCE

| | | |
|---|---|---|
| Puo | Puo | DEPOT CREEK SANDSTONE |
| | Pln | NOLTENIUS FORMATION |
| | Pld | GOLDEN DYKE FORMATION |
| | Plr | CRATER FORMATION |
| | Pll | CELIA DOLOMITE |
| | Ple | BEESTONS FORMATION |
| + + + + | ?Agl | WATERHOUSE GRANITE |

# STAPLETON AREA

## RUM JUNGLE DISTRICT N.T.

## 1970 SURVEY

SCALE

0 500 1000 1500 METRES

0 1000 2000 3000 4000 5000 FEET

T. E.P. MINE GRID

*To accompany Record 1970/81*

D52/48/457

## PETROLOGICAL, GEOCHEMICAL, AND ISOTOPE GEOLOGY LABORATORIES

Professional Staff: K.R. Walker, A.D. Haldane, D.C. Gellatly (transferred to Laboratory in February), J.A. Cooper (commenced January), S.E. Smith, A.Y. Glikson (transferred to Laboratory in December), R.W. Page, R.N. England, C.W. Claxton, J.W. Sheraton (commenced January), and Misses B. Labonne, P.M. Rew (commenced February), and H. Lord (resigned July).

Technical Staff: G.H. Berryman, M. Mahon (commenced July), T.I. Slezák, J. Weekes, A. Maenner, W.C. Whitwell, Miss A. Ahearn (commenced July).

Steady progress was made towards the completion of projects set down for the year. Work benefitted from the contribution made by the Technical Staff most of whom completed their first full year since receiving necessary "in-service" training in the analytical side of operations. However, much inconvenience was experienced during the installation of air conditioning in the building. This resulted in the main instrument laboratories being out of action for periods up to four months.

Some changes were effected in the approach to laboratory work during the year. A feature of this year's work has been the unusually large proportion of field work done in support of laboratory investigations. Nine professional officers visited the field in the course of their project work, and 64 man-weeks' field-work was completed for eight separate projects. Two officers made overseas visits totalling 15 man-weeks. An expanded effort is planned in the investigation of problems related to the application of geochemistry to mineral search under different climatological and geological environments in Australia. This work on exploration geochemistry will be additional to the current regional geochemical work on rock formations.

During the year seven papers were published in outside scientific journals, eight are in press, and another four are in preparation for outside publication. In the Bureau series one Bulletin is in press, and another is in preparation: part 2 of Analyses of Australian Rocks, covering the years 1962 to 69, is being compiled by Dr Germaine A. Joplin. Five papers were contributed to the annual Bulletin of short scientific communications. In addition, seven Records were issued, and another ten are in preparation. Four papers were presented to various scientific symposia, and will appear in the respective Proceedings. A general article on the work of the Laboratory was published in the March, 1970, issue of the Nat/Dev Journal. Eighty reports on minor investigations issued from the various laboratory groups during the year. These will be compiled into the usual annual Record of Miscellaneous Investigations done in the Laboratory.

Assistance with professional and technical training of students was given at various times during the year. A.D. Haldane acted as a Technical Adviser to ECAFE at the 2nd Symposium on Geochemical Prospecting Methods and Techniques, which was held in Ceylon from 10th to 20th September.

K.R. Walker spent ten weeks during April to June in North America, England, France, and southern Africa investigating current developments in the application of geochemistry to mineral search. He also participated in the 3rd International Geochemical Prospecting Symposium held from 16th to 18th April in Toronto, and attended some sessions of the American Geophysical Union Meeting in Washington during the same month.

Various other symposia and conferences were attended by staff members: S.E. Smith, J.W. Sheraton, and G.W. Berryman attended a Symposium on X-ray Spectrometry held at A.N.U. from 9th to 13th February; D.C. Gellatly and A.Y. Glikson presented papers to "The Archaean Rocks" Symposium conducted by the Geological Society of Australia in Perth from 23rd to 26th May; C.W. Claxton went to a Symposium on the Analytical Chemistry of the Uranium and Thorium held at the A.A.E.C., Lucas Heights, from 7th to 8th May; A.D. Haldane attended 5th Australian Clay Mineral Conference held from 18th to 20th August at Monash University; R.W. Page participated in the ANZAAS meeting at Port Moresby from 17th to 21st August, and presented two joint papers incorporating the results of his recent geochronological work in T.P.N.G.; and K.R. Walker and D.C. Gellatly went to the Post IMA-AIGOD Symposium conducted by the Specialist Group in the Genesis of Ore Deposits of the G.S.A. in Sydney from 2nd to 3rd November.

Continuing interest in the work of the laboratories was shown by the numerous visitors and enquiries received from Government agencies, industry, and educational organizations, as well as from overseas.

The results of project activity from the three laboratory groups, (i) petrology and mineralogy, (ii) geochemistry, and (iii) isotope geology, are presented below.

## Petrology, Mineralogy, and Mineragraphy Group

Work in petrology and mineralogy increased progressively during the year as the group re-established itself with appropriate staff. No mineragraphic work was done as it has not been possible to recruit a mineragrapher to date. The group has reviewed arrangements for microscope allocation to staff outside the laboratory. All microscopes and accessories are now on laboratory charge, and are serviced regularly. This is enabling more effective use to be made of the equipment. Some additional microscopes and other equipment are being acquired to meet the growing demand for petrological work by field geologists.

The major projects under way at present in the group include petrological studies of North Queensland granites; Strangways Range carbonatite; basalts, amphibolites, pelites, black slates, and other rocks from the Cloncurry - Mount Isa area; and rocks of the West Kimberley Region. Brief studies are also in progress on the Pb/Zn ores of Narlala, and the chromiferous ultramafic rocks of Eastman Bore in the West Kimberley Region.

The Geochemistry of Australian Granites: (J.W. Sheraton and B. Labonne) For this project 869 North Queensland samples are available. These include samples collected by various B.M.R. field parties from Cape York, the Georgetown Inlier and environs, the Townsville-Charters

Towers area and the Bowen-Rockhampton area, as well as samples collected during this year. About three-quarters of these samples are granitic rocks, most of the remainder being volcanics associated with the granites (see table). Localities for all these samples have been plotted on 1:250,000 maps.

| | Granitic Rocks | Volcanics | Others | Totals |
|---|---|---|---|---|
| Georgetown Inlier and environs | | | | |
| (i) Previously collected samples (C.D. Branch, D.H.Blake, W.B. Dallwitz) | 203 | 75 | 5 | 283 |
| (ii) Collected during 1970 field season (J.W. Sheraton, B. Labonne, W.B. Dallwitz) | 184 | 103 | 4 | 291 |
| Townsville-Rockhampton and adjacent areas. | 244 | 33 | 18 | 295 |
| TOTALS | 631 | 211 | 27 | 869 |

The collecting done during the recent field season was part of a programme to augment the range of samples of Pre-Cambrian to late Palaeozoic granites and volcanic rocks of the Georgetown Inlier and give sufficient coverage for an adequate geochemical investigation of the rocks. Concurrently suites of samples were collected for age determination, especially where this was necessary to resolve inconclusive results obtained previously (e.g., for the Esmeralda Granite and Croydon Volcanics). Altogether 291 samples were collected.

The majority of the samples collected in the past have been prepared for X-ray fluorescence analysis, but the analytical programme has been continually interrupted by break downs in the equipment.

Petrographic examination of samples collected in previous years is now complete. Particular attention is being paid to the variations in accessory mineral content, including fluorite and the other pneumatolytic minerals. A similar study is planned for the samples collected this season when thin sections are available.

A Record reporting progress work on the project will be produced in 1971.

Strangways Range Carbonatite: (D.C. Gellatly and P.W. Crohn). A core-drilling programme by the Northern Territory Mines Branch for this project was completed in December, 1969. Four holes totalling 1740 feet were drilled. Together with a previous hole of 715 feet drilled by Geopeko, the holes now drilled provide an almost complete cross section of this stratiform carbonatite. Logging and sampling of the cores for geochemical and petrological work have been carried out.

Drilling has revealed that the major rock type, rarely exposed at the surface, is a foliated-biotite-calcite rock containing minor amounts of amphibole (?hastingsite), and apatite. Porphyritic dolomite-calcite carbonatite with only minor biotite makes up about 300 feet of a total thickness of about 1600 feet. Subordinate rock types include hastingsite-plagioclase amphibolite, and albite-microcline-aegirine-augite gneiss and pegmatite. Nodular inclusions in the carbonatite comprise apatite, magnetite, ilmenite, dunite, and biotite-hastingsite rock.

Some preliminary geochemical data are available on core scrapings, each sample representing the scrapings from 20 feet of core. Results so far available indicate Nb values up to 120 ppm (average about 40 ppm); Ba up to more than 3000 ppm (average about 1500 ppm); Sr up to more than 1000 ppm (average about 700 ppm); La up to more than 1000 ppm (average about 400 ppm); Y up to 90 ppm (average about 35 ppm). Analytical work is still in progress, and will be reported fully later. A Record is at present being compiled by P.W. Crohn which will summarize the present information, and will probably be available when the present Government Reserve on the area is relinquished. Mineralogical work at present is being carried out on the ilmenite and apatite.

Carbonate veins from Johannsen's phlogopite mine, some 30 km southwest of the carbonatite, have been analyzed to test the suggestion that these veins could be of magmatic (carbonatitic) origin. Although petrographic evidence suggests a moderately high temperature of intrusion for these veins, the extremely low values of Nb, La, Y, Ba, and P indicate that they are not of carbonatite type.

Petrological Investigations associated with the detailed mapping of the Cloncurry-Mount Isa area. (A.Y. Glikson, R.N. England):

Glikson is attached to the Cloncurry-Mount Isa Party helping with the detailed mapping and undertaking various petrographic examinations. The following rock suites are being studied:

(1) The ortho- and para-amphibolites from the Soldiers Cap belt.

(2) The metasediments from the Soldiers Cap Formation. These range in grade of metamorphism from the middle greenschist to the lower amphibolite facies. Staurolite-garnet assemblages are distinct from the garnet-andalusite assemblages in the mica schists. Increasing metamorphic grade goes progressively with increasing grainsize and metamorphic segregation, and sedimentary structures are preserved and even accentuated in the amphibolite facies.

The petrographic studies are being augmented with mineralogical investigations by microprobe. R.N. England proposes to study corresponding mineralogical changes in the pelites and amphibolites with progressive metamorphism.

(3) Calc-silicates (Corella Formation), metasiltstones (Marimo Slate), and basic to intermediate meta-igneous rocks from the Marraba 1:100,000 Sheet area.

Current work involves the study in thin section of a representative selection of basaltic rocks from the type section of the Eastern Creek Volcanics east of Mount Isa. One of the aims is to investigate the processes involved in the silicification and epidotization of the amygdal-

oidal and brecciated flow-tops, but, in addition, a geochemical study will be made of the compositional variations which occurred in the flows with time and according to their structural setting in the volcanic province. Moreover, the sandstones of the Mount Guide Quartzite, Lena Quartzite, and Myally Beds are being studied to elucidate their source. But because of the abundant epidote and potash feldspar in the sandstone intercalations of the Eastern Creek Volcanics it is suspected that the granitic basement as well as the volcanics themselves provided source material for the intercalations.

The black slates in the Marimo Slate and Corella Formation are also being investigated geochemically to compare them with the various formations in the Mount Isa Shale, and to consider their potential for mineralization of the Mount Isa type.

Studies of Archaean Rocks: (A.Y. Glikson)

Work on this topic has received periodic attention for some years and has culminated this year in various papers, three of which (see publication list) will appear in the Proceedings of "The Archaean Rocks" Symposium, held in Perth in May, and another in Tectonophysics, and yet another in the annual Bulletin of short papers. Some further chemical work and isotopic dating are currently in progress on the sodic granite and porphyry pebbles from the Archaean Kurrawang Conglomerate near Kalgoorlie.

In the Electron Probe microanalyser and the Electron Scanning Microscope laboratory, R.N. England has progressed with three major projects: (i) a paper dealing with the occurrence of the assemblage kyanite-pyrophyllite-quartz in the Petermann Ranges, N.T. has been completed for the annual Bulletin of short scientific communications; (ii) a study (with H.L. Davies) of mineral variations in ultramafic and related rocks from eastern Papua is almost complete; and (iii) a study of hornblendes and associated minerals from low to medium grade amphibolites of the Soldiers Cap Formation in N.W. Queensland and the Pottuyu Complex in the Petermann Ranges, N.T. is in progress. Minor investigations included an examination by scanning electron microscope of submicroscopic intergrowths in lunar basalts being studied at the A.N.U.

(i) During electron probe investigations of micas from the Dean Quartzite in the Petermann Ranges the sheet silicate pyrophyllite was found in lamellar intergrowth with phengitic muscovite. Kyanite occurs in the quartzites with pyrophyllite, and continues into higher grade rocks where pyrophyllite disappears. The occurrence of kyanite-pyrophyllite-quartz over at least 20 km along strike is an apparent breach of the Phase Rule. The following explanations are possible, but each has its shortcomings which are discussed in the paper:

  (a) The partial pressure of $H_2O$ is buffered by pyrophyllite decomposition causing the assemblage to become divariant.

  (b) Muscovite-pyrophyllite solid solution has raised the variance.

  (c) The isograd is parallel to the strike of the quartzite.

  (d) Partial retrograde metamorphism with limited availability of water has occurred.

(ii) Microprobe analyses of olivine, orthopyroxene, clinopyroxene,

and chromian spinel from ultramafic and some mafic rocks from eastern Papua revealed differences in mineral composition between ultramafic rocks with cumulus texture and those without recognizable cumulus texture. A further 35 mineral analyses confirmed the difference, and showed that whereas olivine and orthopyroxene from the cumulates ranged in composition from $Fo_{78.5}$ to $Fo_{90.5}$ and $En_{69.5}$ to $En_{91.5}$, respectively, in the ultramafics without cumulus texture they were restricted in composition to $Fo_{91-93}$ and $En_{92.5-94.5}$. It was therefore concluded that the ultramafics without cumulus texture (which make up 90 percent of the ultramafic rocks) could at no stage of their history have been cumulates. It is possible that the non-cumulus ultramafic rocks are the refractory residue of partially melted mantle material which could have been the source for the overlying gabbro and basalt. The results of this work appear in BMR Record 1970/66, and will also be published externally.

(iii) A detailed study of the variation of hornblende composition in the basic rocks from the Soldiers Cap Formation is in progress, and about 40 analyses of hornblende, cummingtonite, and plagioclase have been made. The Soldiers Cap Formation affords an excellent opportunity for the study of changes in amphibole composition with metamorphic grade, because of the association of the basic rocks with pelites where the biotite, garnet, staurolite, and andalusite isograds can be delineated. A similar study is being made of the amphibolites of the higher pressure metamorphism in the Petermann Ranges, and 30 hornblende and cummingtonite analyses have been completed.

In the Thin Section laboratory 1215 thin sections, 120 polished sections, 24 polished thin sections, and about 375 rough and polished rock slabs were prepared. In addition, 30 thin sections were re-polished.

Work in the other Major Instrument laboratories also provided analytical determinations and services required for projects and for the numerous minor investigations of samples submitted throughout the year, including projects being undertaken by other Sections and Branches, some disruption to the analytical services was experienced during the installation of air conditioning in the building.

In the Direct Reading Optical Spectrograph laboratory (T.I. Slezak) 480 samples were quantitatively analysed for various projects, which amounted to 8000 element determinations for the year. In addition, about 200 samples were semi-quantitatively analysed to assist with the identification of minerals by X-ray diffraction. Quantitative analyses made in this laboratory contributed to investigations of the composition of volcanic rocks in T.P.N.G., a variety of rock types collected during the Cloncurry detailed mapping project, and carbonatites from the Strangways Range.

In the X-ray Diffraction laboratory (G.H. Berryman) 939 mineral identifications were made for Metalliferous Section field parties and as part of projects in other Sections, such as the Phosphate Group. Mineralogical studies were carried out on a large selection of "travertine"

material, flow breccia, and shatter-cones from Gosses Bluff. Some assistance was given to the Royal Australian Mint with the problem of detecting sovereign forgeries, using diffraction patterns. Four hundred and fifty Museum specimens were determined to check their identification and, in the case of type minerals, to obtain further diffraction patterns to supplement the A.S.T.M. index. Most of these minerals are true to label, but in a few cases the named mineral is present only in very small amount, and in a couple of cases it could not be detected.

In the X-ray Fluorescence laboratory (J.W. Sheraton) most of the analytical work done has been for the project on the Geochemistry of Australian Granites, but equipment problems limited the number of rock analyses for the year to 400. This resulted from repeated electronic failures, and if these continue to occur, future consideration must be given to replacing the equipment.

The Sample Preparation laboratory (C.R. Whitwell) prepared samples for analysis by the direct reading optical spectrograph and the automatic X-ray fluorescence spectrometer. In all 267 samples were crushed, 578 ground, and 327 powder pellets and 329 fusion discs were made. Some experiments were conducted into improving preparation techniques.

## Geochemistry Group

Geochemistry of the Carbonate Rocks of the MacArthur River area, Northern Australia (C.W. Claxton): This project is part of a study of the depositional environment of the Barney Creek Formation and the Reward and Emmerugga Dolomites. Following an orientation survey in 1967, 450 rock samples were collected from measured sections during the 1968 and 1969 seasons. Analytical work on this collection commenced in May, 1969, and will be completed in December, 1970. The analytical programme included the determination of acid insoluble residue, calcium, magnesium, iron, manganese, potassium, phosphate, and the trace elements copper, lead, zinc, cobalt, and nickel. Preliminary examination of the data obtained indicated a regionally high potassium content in the acid insoluble residues, an anomalously high iron content in dolomite of the H.Y.C. area, and higher than normal phosphate values for the Barney Creek Formation and Reward Dolomite, The Ca/Mg mole ratio is close to unity for most samples. A report on this project is scheduled for completion early in 1971.

Mount Isa Geochemical Project - The general conclusions reached following the completion of the Mount Isa Geochemical Project undertaken by S.E. Smith and K.R. Walker were summarized in last year's report. Since then Bulletin 131 reporting this work has gone to press, and Record 1970/47, which is a compilation of all the analytical data obtained in the investigation, has been issued.

Corin Dam Leakage Investigations (A.D. Haldane, H.R. Lord): Monitoring of the spring water flowing from the toe of the Corin Dam was continued throughout the year. This was supplemented in May by sampling of all outlet tunnel leaks and springs adjacent to the dam.

It was intended to study the effect of summer conditions on the rate of pyrite oxidation; however, this could not be accomplished because rainfall was insufficient to saturate the dam structure and leach out accumulated oxidation-products. Further sampling of spring waters and tunnel leakage was carried out in September following substantial rain. Some of the results of the investigation have been reported in a paper presented to the First International Conference of the International Association of Engineering Geology, Paris, 1970. A Record covering the whole investigation is in preparation. The general pattern of behaviour has now been established, and shows a gradual flushing of acid water from the rock fill and abutment rock upstream of the grout curtain. The composition of water leaking into the outlet tunnel in this section is now approaching that of the impounded dam water. There does not appear to be any replenishment of acid water from pyrite oxidation upstream from the grout curtain. The composition of the leakage water flowing from the toe of the dam has remained substantially constant except during periods of heavy rainfall. Pyrite oxidation is still active in the rock fill on the downstream side, although the results of the September sampling suggest a decrease in the rate of accumulation of oxidation products.

Estuary Study Project, Broad Sound (P.M. Rew, S.E. Smith): The contribution to this joint project comprised a detailed geochemical survey of the catchment of the Styx River, whose estuary forms part of the Broad Sound study area. Field work was carried out during July, August, and September, and covered an area of about 1800 square kilometers. A total of 900 soil and rock samples were collected from 725 sampling sites. Laboratory work on these samples is in progress, and should be completed early in 1971. The programme also included a study of the geochemistry of the river and estuary waters; however, the absence of river water during field work prevented the study of this aspect of the problem.

A field laboratory was set up at Broad Sound for limited water analysis and the determination of phosphate in water and sediment samples. Duplicates of all water samples were returned to Canberra for trace metal analysis.

Lake Burley Griffin Pollution Study (A.D. Haldane, H.R. Lord): Arising from earlier work on the contamination of the Molonglo River by effluent and drainage from the Lake George Mine workings at Captains Flat, the B.M.R. was invited to join an inter-departmental committee to advise the N.C.D.C. on the likelihood of zinc pollution in Lake Burley Griffin; monitoring of the Molonglo River System and the lake will continue. A report was prepared covering the analytical work on the Molonglo River system before filling of the lake began. A Record encompassing the results contained in this report and the results of an intensive monitoring programme suggested by the inter-departmental committee is being prepared. This programme is being carried out jointly by the Department of Works, Department of the Interior, and the B.M.R., and is designed to give a reliable basis for prediction of the behaviour of zinc in Lake Burley Griffin under varying flow conditions in the Queanbeyan and Molonglo Rivers. An interesting feature of this work has been the high levels of copper, lead, and particularly zinc (up to 0.2%) found in sediment currently being deposited on the lake floor.

Minor Investigations: A collection of 18 sediment samples from the floor of the Black Sea was analysed for selected minor and trace elements. A striking feature is the high zinc level (0.2 - 1.0% Zn) in a number of the samples. There does not appear to be any correlation between the high Zn values with any of the other elements determined.

At the request of the Australian Atomic Energy Commission a suite of eleven zircon concentrates was examined chemically for impurities. These concentrates represented the best quality zircon sand from various Australian sources, and are being considered as raw material for the manufacture of zircon metal. All samples showed surprisingly little impurities, and no obvious correlation of purity with source; zircon and hafnium determinations remain to be done by X-ray Fluorescence.

Routine work completed during the year included phosphate samples from the Georgina Basin, analysis of water samples from Jervis Bay and the A.C.T., determinations of copper, lead, zinc, nickel in various mineralized samples from Queensland and the A.C.T., analysis of laterites from Victoria River, W.A., and phosphate determinations on orientation samples from Mallacoota, Victoria.

A number of mortar samples from Commonwealth houses were examined to determine whether the sand/cement and lime ratios met the requirements of the building specification. This work was requested by the Department of Works and the N.C.D.C.

## Isotope Geology Group

This year has been one of consolidation of staff and of good progress on project work. The lack of staff in the sample preparation laboratory is a problem which has been temporarily overcome by entering into an agreement with A.N.U. for their preparation staff to do our work under contract. This arrangement has been convenient, while suitable positions are being sought to staff our own sample preparation laboratory, but changing policies at A.N.U. will probably prevent its continuing much longer.

The Bureau contributed jointly with A.N.U. to the purchase of a Hewlett-Packard computer which is being coupled on-line to the output of the Nuclide and other mass-spectrometers, and will permit the rapid processing of output data.

An initial problem tackled by J.A. Cooper was an examination of available material from the Herberton-Mount Garnet region for an age investigation. He selected the Glen Gordon Volcanics as being suitable for Rb/Sr dating, and the results obtained indicate that good isochron relationships are preserved. The volcanics also provide a satisfactory field control in establishing age relationships between rock units in the region as they represent the oldest igneous activity recognized (D.H. Blake, pers. comm.).

Cooper also investigated a small collection of glauconite samples from the base of the Ngalia Basin. These samples were measured

by both K/Ar and Rb/Sr techniques, and collectively demonstrate an argon and strontium loss pattern. A minimum age of almost 1300 m.y. can be deduced from these measurements.

Early in the year Cooper was invited by the Woods Hole Oceanographic Institute to contribute to a comprehensive study of a new collection of Black Sea sediment cores. He is doing this work in collaboration with other A.N.U. workers, and his analytical contribution of Pb isotope measurements is now complete; only interpretation of the data obtained remains to be done. Additional work for this project was done by C.W. Claxton, of the Geochemistry Group, who made the carbonate and various acid insoluble element determinations. The other A.N.U. contributors to the project are Dr E.J. Dasch, (Sr isotope measurements) and Miss M. Kaye (silicate analyses by X-ray fluorescence). The results of this work will be reported as a chapter in a book comprising all contributions to the investigation.

Cooper led a party to Cape York Peninsula to obtain samples suitable for age determinations needed to augment the previously obtained widespread grab samples, and to help elucidate age relationships between rock units in this region. Preliminary work on sample selection and preparation, and X-ray fluorescence analysis is under way.

Geochronological studies in New Guinea

R.W. Page continued with work along the lines established in last year's Annual Summary. An important part of the New Guinea project, the K/Ar dating of stratigraphically controlled Tertiary volcanic rocks, was completed late in 1969, and this work was written up and submitted for outside publication during the past year.

During the latter part of 1969 and the start of 1970, further Rb/Sr ages and Sr isotopic variations were measured for several of the main intrusive masses and metamorphic rocks of the New Guinea Highlands. This work, coupled with the earlier K/Ar study of the area, has helped to resolve the Mesozoic - Cainozoic tectonic history of New Guinea. In the south, this history can now be clearly and quantitatively related to the Mesozoic development of northeastern Australia, whereas in the northern half of New Guinea, there are cross-cutting active geosynclinal and volcanic belts which parallel the circum-Pacific margin in this region. The geochronological results (on the igneous and metamorphic rocks) in the Highlands region of the island revealed an elongate belt, at least 1000 km long, which was extremely active in Miocene times. Emplacement of granodiorite/diorite batholiths occurred between 10 and 15 m.y. ago, and slightly older ages (about 22 m.y.) were obtained from metamorphic rocks (greenschist to amphibolite facies) in the same belt. These major tectonic processes, which began and finished in the remarkably narrow time-span of less than 10 m.y. occurred during the waning phase of the New Guinea geosynclinal development.

It is possible to relate the "plate tectonic model" to the New Guinea tectonic belt, in that the belt can be considered as the narrow elongate region between moving plates of lithosphere at that time.

Two months have been spent on field work during the last year. This work was related to further sampling some of the porphyry copper deposits in New Guinea and on Bougainville Island. Detailed sampling of the Panguna copper orebody (Bougainville) was undertaken with assistance from geologists of Bougainville Copper Pty Ltd. The earliest granodiorite intrusives are 4 to 5 m.y. old, and the age of subsequent mineralization associated with the diorites that intrude an andesitic pile has been resolved at 3.5 m.y. The Panguna copper deposit is probably the youngest proven orebody in the world.

The geochronological results from several other potentially economic porphyry copper deposits throughout the New Guinea Highlands reveal that many of these are also extremely young. The high-level intrusives and sub-volcanic porphyries of the Wau-Bulolo area may be as young as 3 m.y. In the Ok Tedi area of N.W. Papua, work with Kennecott Copper Pty Ltd strongly suggests that mineralisation of the monzonitic porphyries is as young as 1.1 m.y. The very juvenile setting of some of the porphyry copper deposits is consistent with the overall development of the Highlands, and can be specifically correlated with the late Miocene to Pliocene uplift of the region.

Because of their relative youthfullness, the preservation of potentially economic mineral provinces in New Guinea is likely to be strongly dependent, not only on the geological pre-requisites, but also on the suitable interaction of several geomorphological parameters.

## BAAS BECKING GEOBIOLOGICAL RESEARCH LABORATORY

### BIOLOGICAL GROUP

P.A. Trudinger, B. Bubela, G.W. Skyring, H.E.Jones,
Miss L.A. Chambers.

The biological research programme through 1970 has revolved around the following projects:

1. the physiology and biochemistry of sulphate-reducing bacteria,
2. the concentration of metals by bacteria
3. the toxicity of metals to microorganisms, and
4. the taxonomy and evolutionary status of sulphur-metabolizing organisms.

The programme on the sulphide-oxidation bacteria was phased out with the departure of Dr. D.P. Kelly.

Sulphate reduction by Desulphotomaculum nigrificans.

(P.A. Trudinger, L.A. Chambers).

The work on the pigmented protein which catalyses the last stage of sulphate reduction to hydrogen sulphide in D.nigrificans has continued. The protein has now been purified to homogeneity, and has been positively identified as a sulphate reductase.

Current studies are directed towards achieving better yields of the pigment which, so far, have been poor. Once sufficient material has been obtained, an investigation of the chemical nature and mechanism of action of the pigment will be undertaken.

Concentration of metals by bacteria: (P.A. Trudinger, H.E. Jones).

Studies on the ability of sulphate-reducing bacteria and other organisms to concentrate metals have been extended. Electron microscopy of Desulphovibrio desulphuricans grown in the presence of iron and sulphate, showed the presence of electron-dense granules within the bacterial cell which were absent when either sulphate or iron was omitted from the medium. The implication of these results is that iron sulphide formation may take place intracellularly.

Chemical analyses of Desulphotomaculum nigrificans again indicate that a large proportion of iron is fixed within the bacterial cell. By contrast, copper and zinc appear to be fixed on or within the cell wall-membrane structure.

The results with the sulphate-reducing bacteria suggest that fixation of metal sulphides might be by way of mixed organic-metal-sulphide complexes. This possibility is being examined using synthetic mixtures. Preliminary evidence for the formation of a soluble glutamate-copper-sulphide complex has been obtained.

Comparative biochemistry or organic sulphur metabolism.

(L.A. Chambers, P.A. Trudinger).

This project has been completed.

A survey of cysteine and S-sulphocysteine synthesis by a number of groups of bacteria with different specialized forms of sulphur metabolism was carried out.

In all cases the main mechanism of cysteine biosynthesis appeared to involve an interaction of sulphide with O-acetyl serine. It is possible that such a mechanism arose early in the evolution of sulphur metabolism, and has been conserved during subsequent development of the sulphur metabolic pathways.

Metal toxicity and resistance in bacteria. (B. Bubela)

Work has continued on the mechanism of copper toxicity to bacteria. Particular atention has been paid to the chemical changes in the cell wall which accompany the morphological changes induced in bacteria by copper.

In collaboration with Dr. T. Powell, a gas chromatographic method for the determination of amino acids has been modified and considerably refined. Using this method the amino acid contents of bacteria grown in the presence and absence of copper have been examined.

Considerable changes in cell amino acids have been detected on exposure of growing bacteria to copper. In particular the relative amounts of alanine, glutamic acid, and diamino-pimelic acid are considerably reduced, accompanied by increases in the amounts of other amino acids.

The significance of these changes in relation to toxicity and resistance is being investigated.

Ecology and physiology of sulphate-reducing bacteria. (H.E. Jones).

The characterization of two morphologically distinct non-sporing sulphate-reducing bacteria has been continued. Besides their morphology the two isolates contain pigments which have not been reported in other non-sporulating sulphate-reducing bacteria. Of prime interest are a fluorescent pigment which appears to be a porphyrin with an attched protein, a carbon monoxide reacting pigment and a b-type cytochrome which may be involved in the sulphate-reducing pathway.

Field Studies. (H.E. Jones).

Isolation of sulphate-reducing bacteria from Talasea Bay, New Britain is in progress in combination with a geochemical study on this area by the Mineralogical Group of the Baas Becking Laboratory.

## MINERALOGICAL GROUP

W.M.B. Roberts, C.J. Downes, J. Ferguson, I.B.Lambert,
C.R. Robison (T.O.).

### EXPERIMENTAL INVESTIGATIONS.

Sulphide synthesis and transformation (W.M.B. Roberts, C.R. Robison).

A manuscript dealing with the effects of oxygen, temperature, and pressure on the sulphides of Fe and Cu was completed. It was found that djurleite (Cu 1.96S) could be formed in aqueous solution by the removal of Cu from the chalcocite structure.

A comprehensive literature search into methods of sulphide synthesis in the system Pb-Sb-S was completed by Robison.

Physical Chemistry of Mixed Electrolyte Solutions. (C.J. Downes).

To define the conditions required for the transportation and precipitation of metal ions in a sedimentary environment, it is essential to have a knowledge of their behaviour im brines. The transition metal ions are known to form chloro-complexes in concentrated solutions, but we are particularly interested in the behaviour of trace amounts of transition metal ions in $NaCl-CaCl_2$ brines. A program on the investigation of mixed transition metal chloride and alkali, or alkaline earth, chloride solutions by the isopiestic vapour pressure method is continuing,

Results have been obtained for brines containing manganese. Other evidence suggests that the manganese is present as cationic complexes as distinct from cobalt, nickel, copper, and zinc which form higher (anionic) complexes. In dilute solutions the behaviour of manganese ions is similar to that of the calcium ion, but in more concentrated solutions the activity coefficient is lower for manganous than for calcium ions. This decrease may be equated with complex formation. The effect of acidity has also been studied.

The experimental method being used at present is suitable only for temperatures close to ambient but, as systems at higher temperatures are of interest (c.f. the Red Sea brines), and significant changes with temperature are to be expected, the technique is being modified so that experiments can be carried out on solutions at temperatures of up to 100°C.

Synthesis and Stability of Scapolite. (I.B. Lambert)

Scapolite occurs in many ore deposits and may indicate an original evaporative environment where carbonates, halite, gypsum, etc. were precipitating. In runs of longer than one week at 850°C and 3kb., scapolite and plagioclase have been synthesised from a starting mix of halite, calcium carbonate, illite, and quartz ($\pm$ gypsum).

Future runs will be aimed at synthesizing scapolite at lower temperatures, and monitoring any changes in composition of this mineral with increasing pressure and temperature.

Melting in sulphide-water systems. (I.B. Lambert)

Experiments determing the melting points of various sulphide minerals in the presence of water have just commenced.

Reactions of rocks with aqueous solutions. (J. Ferguson, C.R. Robison).

The metal contents of thermal waters found in volcanic areas and in sub-marine and sub-terranean geothermal environments are thought to result from reactions of the waters with surrounding rocks.

Initial work will be concentrated on the reactions of volcanic rocks with hydrochloric acid solutions at room temperatures and pressures. Preliminary experiments aimed at developing suitable experimental techniques have been completed and further work will be concerned with the reactions of a suite of volcanic rocks collected from near thermal springs at Rabaul and Talasea.

Banded sulphide ores: the experimental production of monomineralic sulphide bands in sediments. (I.B. Lambert, B. Bubela).

A series of test-tube experiments showed that ionic diffusion processes in a wide variety of crushed sedimentary rocks can cause precipitation of monomineralic sulphide bands from homogeneous multi-metallic sources. Analogous processes in natural sedimentary basins could possibly cause some of the monomineralic metal sulphide bands in deposits of the McArthur River and Mount Isa types. The results of this work have been published in Mineralium Deposita.

FIELD STUDIES.

Investigation of ore-deposits: (W.M.B. Roberts)

Core samples were collected from the Woodcutter's deposit, near Rum Jungle, and a detailed mineralogical investigation was begun. The silver-antimony sulphide, pyrangynite, not previously recorded as a constituent of the ore, was identified.

Roberts left for Europe in early March to visit various ore deposits, using Heidelberg as headquarters.

Metal enrichments in the volcano-exhalative-sedimentary environment at Matupi Harbour, New Britain (J. Ferguson, I.B. Lambert).

Geochemical and bacteriological studies of the Matupi area have now been completed with the analysis of a number of additional samples collected en route to Talasea. The data obtained suggest limiting conditions for the generation of economic ore deposits in volcano-exhalative-sedimentary environments. The results of this work have been written up, and will be submitted for publication in the near future.

Geological, mineralogical, and bacteriological investigations of the volcano-exhalative-sedimentary environment at Talasea, New Britain (I.B. Lambert, J. Ferguson, H.E. Jones)

Fieldwork in the Talasea area has been completed, and laboratory investigations of the samples are under way.

Initial work has shown that considerable amounts of pyrite and marcasite are forming within the black sands in areas of colcanic exhalations, and that FeS is precipitating from some thermal springs. Sulphate-reducing bacteria have been detected in most water and sediment samples from this area.

The environment of formation of the iron sulphides differs appreciably from those encountered in other tidal-flat areas in that -

1. the temperature of the area is in the range 60-90°C.
2. the thermal waters are a known, well defined source of iron, and
3. volcanically produced $H_2S$ is the probable source of sulphide, in contrast to the more commonly encountered bacterially produced $H_2S$.

## MISCELLANEOUS

### VULCANOLOGICAL AND CRUSTAL STUDIES

G.A.M. Taylor, R.W. Johnson, I.E. Smith,
T.P.N.G. Resident Staff.

Volcano surveillance, crustal studies, and general vulcanology:

(G.A.M. Taylor).

Field work this year in conjunction with resident staff included study of an eruption of Uluwan volcano in New Britain and investigation of activity of Manam volcano which was showing signs of increased activity.

Uluwan:

The last severe eruption of Uluwan occurred in 1915 when ash and lapilli were widely distributied over the surrounding area. The outstanding feature of the new eruption was the prolonged explosive activity which was maintained almost without cessation from 16th January to 9th February. Consistent jetting and fountaining of incandescent lava was accompanied by fluctuations in intensity during which glowing clouds and lava flows were expelled onto the northern and southern flanks of the volcano.

The explosion of 16th January was preceded by a week of intermittent vapour emission which ended with audible explosions and the appearance of incandescent lava in the crater. During the next few days explosive activity increased in intensity, and new vents opened in the summit area.

At 04.05 hours on 22nd January a strong eruptive pulse expelled a large mass of gas and fragmental material which swept down the north-western valley and adjacent northern slopes, flattening and setting fire to an area of rainforest down to the 500 metre level. Voluminous dust and vapour clouds from this eruption erected above the volcano a huge column outlined by brilliant and noisy electrical phenomena. The area devastated by the nuees ardentes was about one kilometre wide and extended 5 kilometres from the crater.

Lava emission followed this event, and blocky flows of basalt moved down the north-western valley as far as the 800 metre level.

On the night of 26th January lava broke from the south side of the crater, and descended into the escarpment valley which diverted it towards the west. Small nuees ardentes accompanied this new effusive phase. They descended in the same general azimuth as the lava, and were less voluminous and less mobile than the earlier northern event on the 22nd.

During the next two weeks lava poured continuously from the southern side of the crater in two main streams and at the same time vigorous explosive activity went on from the higher vents on the northern side of the crater. The activity gradually waned towards the end of this period and except for very minor vapour emission activity had ceased by 10th February. By this time the thick blocky flow in the western valley had reached a point 500 metres a.s.l. and 5 kilometres from the crater.

Instrumental studies of the eruption indicated an absence of discrete earthquakes and the presence of continuous volcanic tremor during the whole of the eruptive activity. Tiltmeters indicated deflation of the structure as the eruptive activity drew to a close. Analysis of tape recordings of the seismic activity awaits the availability of suitable equipment.

Diagnosis of a volcano without previous instrumental data presented its usual difficulties. However, similarities of the eruption with others that have been studied in the Territory made it possible to recommend limitation to the evacuation of local people, resumption of saw milling operations at the beginning of February and return of the village people before the eruption had ended.

Manam:

During the earlier part of 1969 Manam became unsettled, and produced minor explosive activity from the main crater with indications of deepseated movement manifest in a fluctuating level of seismic activity. Movements in tilt accompanied these developments.

An investigation of the volcano was carried out in February, and a report was prepared for the Chief Resident Geologist recommending precautions to safeguard local population in the event of more vigorous activity.

Crustal Movement: A number of conferences at National Mapping were attended with P.D. Hohnen to discuss investigation of sites for measuring crustal movement in the Territory of Papua and New Guinea. Provisional sites have been selected by Hohnen in the Markham valley below Kasim Pass and in the St. George's channel area. These will be accurately fixed by a National Mapping surveyor who is to accompany the Commonwealth Department of Works party detailed to erect marking pier S.

Petrography: Preliminary examination was completed of lava types from Karkar Island and the volcanic islands off the coast of New Ireland. The Karkar lavas have tholeiitic affinities, and many of the New Ireland lavas contain the unusual feldspathoids, leucite, nosean, and hauyne. Analysis of specimens by Direct Reading Optical Spectrograph indicate high values for strontium and barium, and unusually low values for zirconium.

Crustal Studies: Contributions were made to the joint Record which is being prepared on the New Britain Crustal Study Project of 1969. This Record, which is nearing completion, will contain all the factual material on the organization and results of the investigation.

Seismology: As member of a committee of review of seismological work in the Territory of Papua and New Guinea, Taylor made a visit to the Territory, and contributed to a report covering recommendations on distribution of regional recording stations, interpretation, and submission of information to world data centres, work distribution between the Port Moresby and Rabaul Observatories, staff rotation,and record storage.

International Reports: Further contributions on Post-Miocene volcanoes in Australia and Melanesia were forwarded to the Working Group of the World Volcanological Map. This project is sponsored by the International Association of Volcanology and Chemistry of the Earth's Interior (I.A.V.C.E.I.). The work is now in press.

ANZAAS: Contributions were prepared to the ANZAAS excursion from Port Moresby to Madang via New Britain volcanic areas. The 42nd Congress in Port Moresby was attended, and an excursion group taken to Rabaul where particular interest was expressed by New Zealand visitors in the volcanic surveillance equipment at the Observatory.

Development of Volcanic Surveillance Instrumentation: J.H. Latter of the Global Seismic Research Centre of Edinburgh called to discuss a ten-station radio-telemetred seismic network which is being set up around Rabaul to monitor deep focus earthquakes in the region. This array is being set up with the co-operation of the Vulcanological Observatory, and is designed by Dr. P.H. Willmore. The data from it will be used to determine the focus of deep earthquakes more accurately with the object of correcting current travel-time tables. We are interested in the technical performance of the equipment because our volcano surveillance requirements involve the purchase of telemetred equipment of this type. Initial indications of performance are not encouraging, although this may not be due to design failure.

An approach was made to Professor Newstead of A.N.U. to look at the design problem of telemetering along based water tube tiltmeter data - an outstanding problem of our surveillance instrumentation at Rabaul. Negotiations have been proceeding to obtain the use of old mining tunnel near Murrumbateman as a test station for equipment of this type, The owner of the land and the current holder of the Right of Entry under the Mining Act are both agreeable to our using the tunnel.

Bismarck Volcanic Arc (R.W. Johnson, R.A. Davies, of Rabaul resident staff).

Rock samples from 1969 field work in New Britain were examined petrographically, and 50 were selected for major-element analysis by AMDL. Results of these analyses were received in August, 1970, were presented to the ANZAAS Congress in Port Moresby, and have been included in B.M.R. Record 1970/72 - "Short papers on Quaternary Volcanic areas in Papua-New Guinea".

Three other Records were produced during the year. These were: (1) Ulawun volcano, New Britain: Geology, petrology, and eruptive history between 1915 and 1967 (No. 1970/21); (2) Likuruanga volcano, Lolobau Island, and associated volcanic centres, New Britain (No.1970/42); (3) Seismicity in the Bismarck Volcanic Arc (No. 1970/35).

(Cont.)

Field work recommenced at the end of August. The volcanoes of the Witu Islands and the western part of the Bismarck Volcanic Arc (islands between Umboi and the Schoutens) were examined, and further extensive rock collections were made. In hand specimen, the samples from volcanoes between Umboi Island and the Schouten Islands appear to be similar to those from the eastern part of the Bismarck Volcanic Arc in New Britain; that is, they are silica-saturated basalts, "andesites", and dacites. However, lavas rich in augite phenocrysts appear to be more common from the western part of the arc, whereas plagioclase seems to be the most common phenocryst phase in the lavas of New Britain. Also, rhyolites, which are rare in the New Britain section of the arc, appear to be completely absent in the western section.

During the coming year it is hoped to complete petrographic examination of all samples collected during the two field seasons. R.A. Davies will be involved in the production of reports concerned with the volcanoes of the western part of the Bismarck Volcanic Arc.

Eastern Papuan Volcanoes:(I.E. Smith): Fig. M12.

Volcanic studies in eastern Papua have followed on from systematic regional mapping in the area. It is hoped that petrological and chemical studies on representative samples of the Quarternary volcanics will provide a clue to the genesis of the lavas and their place in the Papua-New Guinea arc system. Specimens from the mainland volcanoes were collected during regional mapping in 1968. The island volcanoes were covered between late August and early October, 1970.

Volcanic rocks of probable Quaternary age crop out in the D'Entrecasteaux. Amphlett, and Lusancay Islands and on Egum Atoll. Their most extensive development is on Goodenough, Fergusson, and Normanby Islands in the D'Entrecasteaux Group. The lavas show a wide range of compositions from olivine basalt, which predominates on Goodenough Island, to obsidian and rhyolite which are widespread on Fergusson, Dobu, and Sonaroa Islands.

The Amphlett Islands are made up of lava and agglomerate of basic to intermediate composition. Some of these rocks are biotite-bearing and are possibly alkaline. To the northwest, Kawa, Nukuana, Simsim, and Wagalasa Islands in the Lusancay Group are composed mainly of volcanic rocks, probably of intermediate composition. The Egum Islands and the Panemote Islands in the central lagoon of Egum Atoll are composed of a porphyritic andesite containing numerous mafic and ultramafic inclusions.

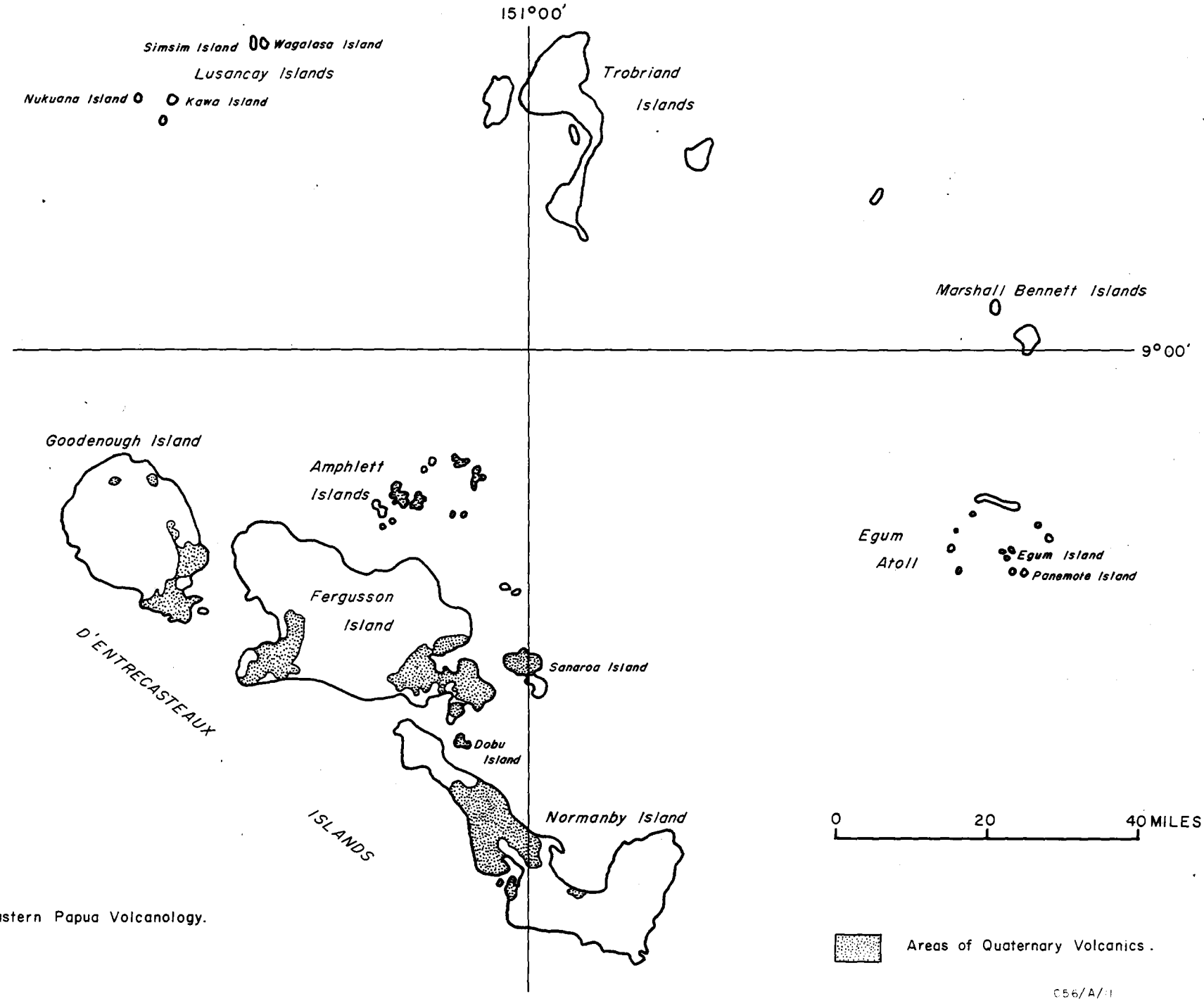



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Fig. M Locality map – Eastern Papua Volcanology.

To accompany Record 1970/81

C56/A/1

## TECTONIC MAP OF AUSTRALIA AND NEW GUINEA

K.A. Plumb, (H.F. Doutch, R.G. Warren)

Plumb is a member of the Commonwealth Territories Divisonal Sub-Committee of the Tectonic Map Committee of the Geological Society of Australia. The committee is preparing a new Tectonic Map of Australia and New Guinea for publication in the near future (see Geological Services Section). The local sub-committee, as well as being responsible for the compilation of material from the Northern Territory, Kimberleys, and New Guinea, is also co-ordinating the other State contributions, and compiling the map of the whole continent. During the past year Plumb has devoted considerable time to editing and revising the first draft, which was compiled during 1969. A meeting of the Tectonic Map Committee was attended in Canberra during March.

## GEOLOGICAL MAP OF PAPUA-NEW GUINEA

P.D. Hohnen, Miss R.G. Warren, H.L. Davies

Information from B.M.R. and oil and mineral exploration companies was plotted at 1:1,000,000 scale. This is the first stage in the preparation of a new geological map of T.P.N.G.

## CONFERENCES, SYMPOSIA, ETC.

"The Archaean Rocks" was the title of an international symposium conducted at Perth and Kalgoorlie from 23rd-30th May, 1970, by the Western Australian Division of the Geological Society of Australia. P.R. Dunn, K.A. Plumb, D.C. Gellatly, A.Y. Glikson, H.L. Davies, D.J. Forman (P.E. Branch), and Miss R.G. Warren (Geological Services Section) were official delegates. The following papers were presented, and subsequently prepared for publication in Special Publication 3, of the Geological Society of Australia.

K.A. Plumb - The Archaean and Australian tectonics.
A.Y. Glikson - Geosynclinal evolution of the Coolgardie-Kurrawang succession near Kalgoorlie
P.R. Dunn - Archaean of Northern Australia
D.C. Gellatly - Archaean(?) rocks of the Kimberley region
P.W. Crohn (read by P.R. Dunn) - Some features of the Precambrian geology and mineral deposits of Australia and Canada.

Geologists of the New Guinea group attended the 42nd Congress of ANZAAS in Port Moresby in August, 1970. Dr N.H. Fisher presented the Presidential Address to Section 3, entitled: Rock weathering, palingenesis and ore deposits. Other papers from B.M.R. were:-

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|---|---|
| Fisher, N.H. | Wau geology reinterpreted |
| Johnson, R.W. | Volcanoes of New Britain |
| Mackenzie, D.E. | Petrology of Pleistocene volcanoes, New Guinea Highlands |
| Smith, I.E. | Evidence of late Cainozoic uplift in southeastern Papua. |
| Heming, R.F. | The volcanic geology of the Rabaul caldera, New Britain. |
| Ryburn, R.J. | Glaucophanic rocks in New Guinea |
| Dow, D.B., and J.H.C. Bain | A Miocene volcanic are in New Guinea |
| Page, R.W., and I. McDougall[a] | Isotopic dating of the igneous and metamorphic rocks of the New Guinea Highlands |
| Page, R.W., and I. McDougall[a] | Potassium-argon dating of the Tertiary f1-2 stage in New Guinea, and its bearing on the geological time scale. |
| Davies, H.L. | Peridotite-gabbro-basalt complex in eastern Papua: an overthrust plate in oceanic mantle and crust. |
| Doutch, H.F. | Late Cainozoic tectonics and geomorphology of Cape York Peninsula and the Gulf Country of Queensland |
| Ferguson, J., and I.B. Lambert, | Geochemical investigations of the thermal area at Matupi Harbour, near Rabaul. |
| Hohnen, P.D., Manser, W.[b] | Epeirogenesis in the Bismarck Archipelago |
| Hohnen, P.D., and P.E. Pieters | The Dayman Dome - A structure in metamorphic rocks caused by Pliocene to Recent uplift |

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| Jongsma, D. | Tectonic evolution and submarine topography of Milne Bay, T.P.N.G. |
| Macnab, R.P.[c] | Geological evolution of the Bismarck Archipelago |
| Ripper, I.D.[d] | New Guinea-Solomon Islands seismicity interpreted in terms of regional tectonics. |

Post-congress excursion notes were prepared by G.A.M. Taylor (volcanoes) H.L. Davies (Papuan Ultramafic Belt), and J.H.C. Bain and D.E. Mackenzie (Kubor Anticline). A party of four took part in the Kubor Anticline excursion, and the other excursions were cancelled because of logistic problems (volcanoes) and lack of applicants (Ultramafic Belt).

a. A.N.U.
b. University of Papua and New Guinea
c. Now with Minjur Mines Pty Ltd
d. Geophysical Branch

## OVERSEAS VISITS

### H.L. Davies

Davies resumed duty in Port Moresby early in January after having completed his Ph.D degree at Stanford University while holding a P.S.B. Postgraduate Scholarship.

### K.R. Walker

Walker was overseas from 1st April to 12th June to attend the 3rd International Geochemical Prospecting Symposium held in Toronto from 16th - 18th April, and to examine recent developments in the application of geochemistry to mineral search with a view to recommending what contribution to this type of geochemical work the Bureau might make in Australia.

The main organizations visited were the United States Geological Survey, the Geological Survey of Canada, the Institute of Geological Sciences and the Royal School of Mines in England, the Bureau de Recherches Geologique et Miniere and the Centre de Recherches Petrographiques et Geochemiques in France and in southern Africa. Subsidiaries of Anglo American Corporation in Zambia, Rhodesia, and South Africa were also visited; these visits involved mainly inspections of the laboratory

activities supporting their geochemical exploration programmes.

The highlight of the visit to Zambia was an inspection of the Nchanga open cut copper mine in the Copper Belt. This mine is the largest in the Belt, where there are 6 mines producing over 300,000 tons of copper a year. Nchanga is in the Katangan System sediments at the northern end of the eroded Kafue anticline. The copper is produced mainly by open cutting a stratiform orebody in the oxidized zone. The minerals of most economic interest are malachite and subsidiary cuprite, chrysocolla, and small amounts of copper phosphates. The sulphide minerals, chalcocite, bornite, and chalcopyrite are obtained mainly from the underground workings. An interesting feature is the presence of copper (about 8%) in the mica vermiculite; this is being stockpiled pending the development of an economic extraction process. Geochemistry has been used widely and successfully for mineral search in southern Africa, in particular, in Zambia and the Copper Belt region.

In summary, it was found that geochemistry forms an integral part of government survey overseas, and that all of the organizations visited maintain large sections, including laboratories, specifically for this type of work. Surveys, as well as overseas mining companies, recognize the important contribution geochemistry can make towards the discovery of a country's mineral resources. Certain new developments in both field and laboratory techniques have been surprisingly successful in mineral search, even in finding new surface deposits in developed countries such as the United States. Moreover, it is recognized that soil exhalation and remote sensing techniques offer good promise for successful use in future geochemical investigations. A Record on the visit and the results of the enquiries is being prepared.

A.D. Haldane

In connection with the 2nd Seminar on Geochemical Prospecting Methods and Techniques jointly organized by UNESCO and ECAFE, the Commonwealth Government was requested by ECAFE to provide the services of two Technical Advisers to assist in the preparation of material for the Seminar, to act as discussion leaders, and to give demonstrations in laboratory techniques. The Seminar was concerned primarily with the training of representatives from member nations in modern methods of geochemical exploration, and relied on informal discussion centred around previously circulated literature appropriate to the various agenda items.

Field activities comprised illustration of soil profile development, and training in heavy mineral panning techniques. In the laboratory, the use of atomic absorption spectrophotometry and selective ion electrodes in the analysis of geochemical exploration samples, and infra-red photography as an aid to geochemical exploration, were demonstrated.

The agenda included a review of the current status of geochemical prospecting in the member countries, regional geochemical exploration, methods of detailed exploration, recent advances in analytical techniques, integrated geochemical/geophysical surveys, geobotanical exploration, and infra-red remote sensing.

Other subjects discussed were the design and use of mobile field laboratories, statistical methods for the evaluation of geochemical data, and the use of non-professional assistance in mineral exploration.

A full report on the Seminar has been prepared.

## R.J. Ryburn

R.J. Ryburn visited Japan from August 19th to September 13th to attend the 1970 meetings of the International Mineralogical Association and the International Association on the Genesis of Ore Deposits (IMA-IAGOD). He also visited some well known Japanese mining areas before and after the meetings.

The meetings were held in Tokyo and Kyoto from August 27th to September 2nd. They were attended by 800 participants from 44 countries. Topics of wider interest included structural and tectonic control of ore bodies, strata-bound ore deposits, physicochemical conditions of ore deposition and recent work on moon rocks. In addition there were specialist symposia and working groups on petrology, mineralogy, crystallography, mineragraphy, inclusion studies, geothermometry, and isotope studies.

During the pre-conference excursion, an area 70 km west of Tokyo was visited where rocks of the Sanbagawa Metamorphic Belt were seen and a pyrometasomatic Cu-Pb-Zn deposit (Chichibu Mine) was examined. On the post-conference excursion a large, low-grade skarn type deposit (Kamioka Mine) and a small bedded manganese deposit (Hamayokokawa Mine) were visited in the central Japanese Alps region. Following the post-conference excursion a privately arranged visit was made to the Hanaoka and Kosaka Mines in Northern Honshu to see some examples of the unique "Black Ore Deposits".

A full report on the visit is being prepared.

PUBLICATIONS*

BULLETINS

| Number | | | |
|---|---|---|---|
| 84 | DeKEYSER, F., LUCAS, K.G. | The geology of the Hodgkinson Basin, Q. | Published |
| 107 | GEMUTS, I.[2] | Metamorphism and igneous activity in the Lamboo Complex, East Kimberley area, W.A. | In press |
| 124 | BLAKE, D.H. | Geology and mineral resources of the Herberton-Mount Garnet area, Herberton Tinfield, North Queensland. | With Editor |
| 125 | ENGLAND, R.N. | Lamellar intergrowths of pyrophyllite and muscovite and the assemblage kyanite-pyrophyllite-quartz from the Petermann Ranges, N.T. | In press |
| | GLIKSON, A.Y. | Metamorphosed Archaean ophiolites near Kalgoorlie, W.A. | |
| | PLUMB, K.A., BROWN, M.C. | Revised correlations and stratigraphic nomenclature in the Proterozoic carbonate McArthur Group, N.T. | |
| | SMITH, I.E., SIMPSON, C.J. | Late Cainozoic uplift in the Milne Bay area, Eastern Papua | |
| | DERRICK, G.M., GELLATLY, D.C. | New leucite lamproites from the West Kimnerley, W.A. | |
| | GELLATLY, D.C. | Problems of provenance of the Yampi Iron Ores, West Kimberley region, W.A. | |
| 128 | DAVIES, H.L., | Peridotite-gabbro-basalt complex in eastern Papua: an overthrust plate of oceanic mantle and crust. | In press |
| 131 | SMITH, S.E., WALKER, K.R. | Primary element dispersions associated with mineralization at Mount Isa, Q. | In press |

(Cont.)

Bulletins (Cont.)

| | | |
|---|---|---|
| DOW, D.B.,<br>SMIT, J.A.J.,<br>BAIN, J.H.C.,<br>RYBURN, R.J. | Geology of the South Sepik Region, T.P.N.G. | With editor |
| ROBERTS, H.G.,<br>PLUMB, K.A.,<br>DUNN, P.R. | Geology of the Carpentaria Proterozoic Province, Arnhem Land, N.T. | With authors |
| DUNN, P.R.,<br>ROBERTS, H.G.,<br>SMITH, J.W.,<br>PLUMB, K.A. | Geology of the Carpentaria Proterozoic Province, N.T.: Roper River to the Queensland border. | In prep. |
| BOFINGER, V.M. | Geochronology of the East Kimberley region, W.A. | With editor |
| WILLMOTT, W.F.,<br>PALFREYMAN, W.D.,<br>WHITAKER, W.G. | Metamorphic and igneous rocks of the Cape York Peninsula and Torres Strait Islands. | " |
| JOPLIN, G.A.[5] | Chemical analyses of Australian rocks: Part II, Igneous and metamorphic, 1962-1969. | In prep. |
| SMITH, I.E.,<br>DAVIES, H.L. | Geology of the South East Papuan Mainland. | " |
| PLUMB, K.A. | Precambrian Geology of the Kimberley Region, W.A. The Kimberley Basin. | " |
| GELLATLY, D.C.,<br>SOFOULIS, J.[2]<br>DERRICK, G.M. | Precambrian Geology of the Kimberley Region, W.A. - The West Kimberley. | " |
| TAYLOR, G.A.M. | Eruption of Manam Volcano | " |

* Many authors left the B.M.R. since their work was carried out; only those employed outside the B.M.R. at the time the work was done are indicated by numbers.

1. Geological Survey of Queensland.
2. Geological Survey of W.A.
3. Geological Survey of N.S.W.
4. C.S.I.R.O. (Baas Becking )
5. A.N.U.
6. Elsewhere.

## REPORTS

| Number | | | |
|---|---|---|---|
| 114 | DUNNETT, D., HARDING, R.R. | Geology of the Mount Woodcock 1-mile Sheet area, N.T. | Published |
| 126 | PAINE, A.G.L., HARDING, R.R.[1], CLARKE, D.E. | The geology of the north-eastern part of Hughenden 1:250,000 Sheet area, N.T. | In press |
| 127 | WYATT, D.H.[1], PAINE, A.G.L., CLARKE, D.E. | The geology of the Townsville 1:250,000 Sheet area, Q. | In press |
| 128 | PAINE, A.G.L., GREGORY, C.M., CLARKE, D.E.[1] | The geology of the Ayr 1:250,000 Sheet area, Q. | " |
| 135 | TRAIL, L.S., | ANARE 1961 Geological traverses on the Mac.Robertson Land and Kemp Land coast. | " |
| 137 | WYATT, D.H.[1], PAINE, A.G.L., CLARKE, D.E.,[1] GREGORY, C.M., HARDING, R.R. | The geology of the Charters Towers 1:250,000 Sheet area, Q. | " |
| 140 | DOW, D.B. | Palaeozoic rocks of the Hardman, Rosewood, and Argyle Basins, East Kimberley Region, W.A. | With editor |
| 144 | CLARKE, D.E.[1] PAINE, A.G.L., JENSEN, A.R. | The geology of the Proserpine 1:250,000 Sheet area, Q. | In press |
| 145 | PAINE, A.G.L., CLARKE, D.E.[1] GREGORY, C.M. | The geology of the northern half of the Bowen 1:250,000 Sheet area, Q. | With editor |
| | ROBERTS, H.G., GEMUTS, I,[2] HALLIGAN, R.[2] | Adelaidean and Cambrian stratigraphy of the Mount Ramsay 1:250,000 Sheet area, W.A. | " |
| | PAGE, R.W. | Catalogue of isotopic age determinations carried out on Australian rocks in 1966. | " |
| | PLUMB, K.A. | Petrography of the igneous and metamorphic rocks of Arnhem Land, N.T. | In prep. |

(Cont.)

Reports (Cont.)

| | | |
|---|---|---|
| MILZITIS, Y., | Compilation of geological and chemical information from the Hundred of Goyder, Rum Jungle district, N.T. | In prep. |
| NO Prog. PRICHARD, C.E., and Geophysicist. | Exploration of the Woodcutters area, near Rum Jungle, N.T. 1964-67. | " |
| BENNETT, R. (Miss) | Catalogue of isotopic age determinations on Australian rocks in 1967-68. | Ready for editor |
| PONTIFEX, I.R., MORGAN, C.M., SWEET, I.P. | The geology of the Auvergne 1:250,00 Sheet area, N.T. | Being edited within Section. |
| MORGAN, C.M., SWEET, I.P., PONTIFEX, I.R., MENDUM, J.R. | The geology of the northern part of the Victoria River Basin, N.T. | Writing complete |
| BAIN, J.H.C., McLEOD, I.R. | Geology of the eastern side of Prydz Bay, Antarctica. | In prep. |
| MACNAB, R.P., | The geology of the Gazelle Peninsula, New Britain. | Being edited in Section. |
| MORGAN, C.M. , SWEET, I.P. , MENDUM, J.R., BULTITUDE, R.J. | The geology of the southern part of the Victoria River Basin, N.T. | In prep. |

## OUTSIDE PUBLICATIONS

| | | |
|---|---|---|
| MEDVECKY, A. | The Permian sediments of the Beaver Lake area, Prince Charles Mountains, Antarctica. SCAR/IUGS Symp. on Antarctic Geology and solid earth Geophysics. | |
| COOPER, J.A. | Dating of glauconite from near-basal sediments of the Ngalia Basin, Central Australia. | In prep. |
| COOPER, J.A. | Rb-Sr dating of the earliest Palaeozoic volcanism in the Herberton-Mount Garnet area, Queensland | In prep. |
| COOPER, J.A.[6]<br>DASCH, E.J.,[6]<br>KAYE, M.[6] | Isotopic and geochemical measurements of some Black Sea sediments - a contribution to Woods Hole marine investigation | In prep. |
| HALDANE, A.D.,<br>LORD, H. | A resume of an investigation into water seepages at Corin Dam. International Congress on Engineering Geology, Paris. 1970. | In press. |
| FISHER, N.H. | Recent Research on Geochemical Prospecting in Australia. Proceedings 3rd International Geochemical Prospecting Symposium Toronto 1970. | In press |
| JAKES, P.,[5]<br>SMITH, I.E. | High potassium calc-alkaline rocks from Cape Nelson Eastern Papua. Contr. Mineral: and Petrol. 259-271. | |
| PAGE, R.W.,<br>McDOUGALL, I. | Tertiary time scale problems K-Ar dating evidence from New Guinea. | |
| PAGE, R.W.,<br>McDOUGALL, I. | Isotopic dating of the igneous and metamorphic rocks of the New Guinea Highlands. | In prep. |
| PAGE, R.W.,<br>McDOUGALL, I. | Ages of emplacement and mineralization of economic mineral deposits in the New Guinea - Solomon Islands region. | In prep. |
| PAGE, R.W.,<br>McDOUGALL, I. | K-Ar dating of the Tertiary $f_{1-2}$ stage in New Guinea and its bearing on the geological time scale. | Am.Jour. Sci. (in press) |
| HOHNEN, P.D.,<br>PIETERS, P.E. | The geomorphology of the Dayman Dome, Eastern Papua. | In prep. |
| HOHNEN, P.D. | The tectonic evolution of New Ireland. | In prep. |

| | | |
|---|---|---|
| RYBURN, F.J. | Glaucophane schist facies metamorphism in New Guinea. | In prep. |
| MACKENZIE, D.E., WHITE, A.J.R. | Phonolite globules in basanite from Kiandra, New South Wales. | Lithos Oct.issue 1970. |
| DOW, D.B., BAIN, J.H.C. | A Miocene volcanic arc in New Guinea. | In prep. |
| McDONALD, J.A.[14] | Some effects of deformation on sulphide-rich bands in lead-zinc ore-bodies, Mount Isa, Queensland. | Econ. Geol. Vol. 65, p. 273 1970 |
| TRUDINGER, P.A.[4] | On the absorbancy of reduced methyl viologen | Anal. Biochem. (submitted) |
| TRUDINGER, P.A.[4] | Carbon monoxide reacting pigment from Desulfotomaculum nigrificans and its possible relevance to sulfite reduction. | J. Bacterial 104, 158 |
| GELLATLY, D.C. | Crossbedded tidal megaripples from King Sound, Western Australia. | Sedimentary Geology, V 4, 185-191 1970 |
| GELLATLY, D.C., DERRICK, G.M., PLUMB, K.A. | Proterozoic palaeocurrent directions in the Kimberley region, north-western Australia. | Geol. Mag. (in press) |
| GELLATLY, D.C. | Possible Archaean Rocks of the Kimberley region, Western Australia. | Geol.Soc. Aust.Spec.publ. 3 (in press) |
| TAYLOR, G.A.M. et al. | Handbook for excursions ANZAAS 42nd Congress | |
| TAYLOR, G.A.M. | Contribution to World Map of Post Miocene volcanoes. | In press |
| DOWNES, C.J.[4] | Activity coefficients of NaCl in the System $NaCl-NaClO_4-H_2O$ at 25°C and the use of Amalgam Electrodes. | J.Chem.Eng. Data 15,444 1970. |
| DOWNES, C.J.[4] | Osmotic and Activity Coefficients for the Sustem $NaCl-MnCl_2-H_2O$ at 25°C. | In prep. |
| DOWNES, C.J.[4] | Thermodynamics of Manganous Chloride Solutions of Varying Acidity. | In prep. |
| DOWNES, C.J.[4] | Comparison of the Behaviour of Ammonium and Potassium Ions in Mixed Electrolyte Solutions. | In prep. |

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|---|---|---|
| DOWNES, C.J.[4] | Activity Coefficients of Hydrochloric Acid in Some Dilute Mixed Electrolyte Solutions. | Jour.Phys. Chem.74, 2153,1970 |
| ROY, A.B.[5] TRUDINGER,P.A.[4] | The Biochemistry of inorganic compounds of sulphur. Cambridge University Press. | 1970 |
| CHAMBERS, L.A.[4] TRUDINGER,P.A.[4] | Cysteine and S-sulphocysteine biosynthesis in bacteria. | In prep. |
| BUBELA, B.[4] | Chemical and morphological changes in Bacillus stearothermophilus induced by copper. | Chem.Biol. Interactions 2,107, 1970. |
| LAMBERT,I.B.,[4] | The composition and Evolution of the Deep Continental Crust, Special Volume, "The Archaean Rock". | Jour.Geol. Soc. Aust. |
| LAMBERT, I.B. | On the definition of granulite. | Neues Jahrbuch für Mineralogie |
| LAMBERT, I.B.,[4] BUBELA, B. | Banded sulphide ores: The experimental production of monomineralic sulphide bands in sediments. | Mineral Deposita 5,97, 1970. |
| LAMBERT,I.B.[4], McANDREW,J.A.[4] JONES,H.E. | Geochemical and Bacteriological Investigations of the Cupriferrous Environment at Pernatty Lagoon, South Australia. | In prep |
| LAMBERT, I.B.[4] WYLLIE, P.J. | Low Velocity Zone in the Earth's Mantle: Incipient Melting Caused by Water. | Science 169,764-766 1970. |
| JONES, H.E. | A hitherto undescribed dissimilatory sulphate-reducing bacterium. | In prep. |
| KELLY, D.P.[4] | Regulation of chemoautotrophic Metabolism: I. Toxicity of Phenylalanine to Thiobacilli. | Arch. Mikrobiol. 69, 330-342. |
| KELLY, D.P.[4] | Regulation of Chemoautotrophic Metabolism: II. Competition between Amino Acids for Incporporation into Thiobacillus. | Arch.Mikrobiol. 69, 343-359. |
| KELLY, D.P.[4] | Regulation of Chemoautotrophic Metabolism: III. DAHP Synthetase in Thiobacillus neapolitanus. | Arch.Mikrobiol. 69, 360-369. |
| FERGUSON, J., LAMBERT, I.B.[4] | Metal Enrichment in the Volcano - Exhalative - Sedimentary Environment at Matupi Harbour, New Britain, T.P.N.G. | In prep. |

## RECORDS

### ISSUED

| | | |
|---|---|---|
| 1968/117 | The geology of the Auvergne 1:250,000 Sheet area (Victoria River Basin), N.T. | I.R.PONTIFEX, C.M.MORGAN, I.P.SWEET |
| 1969/90 | Minor metalliferous investigations, Northern Territory Resident Geological Section: Katherine-Darwin area. | |
| 1969/91 | Minor metalliferous investigations, Northern Territory Resident Geological Section: Iron Ore | |
| 1969/92 | Minor metalliferous investigations, Northern Territory Resident Geological Section: Central Australia | |
| 1969/115 | Notes on the thermal fields at Talasea, Pangalu, and Kasololi, New Britain, T.P.N.G. | R.F.HEMING, I.E. SMITH |
| 1969/117 | Geology of the Ravenswood 1-mile Sheet area, Q. | D.E. CLARKE[1] |
| 1969/119 | The igneous rocks of Torres Strait, Queensland and Papua. | W.F.WILLMOTT, W.D.PALFREYMAN, D.S.TRAIL W.G.WHITAKER |
| 1969/123 | Annual Summary of Activities, Geological Branch, 1969. | |
| 1969/129 | Legend to Metallogenic Map of Australia | R.G.WARREN |
| 1969/133 | The geology of the Charnley 1:250,000 Sheet area, SE51/4. | D.C.GELLATLY, G.M.DERRICK, R. HALLIGAN[2] J. SOFOULIS[2] |
| 1969/144 | An assessment of the possibility of mineral deposits occurring in Australian Antarctic Territory. | I.R.McLEOD |
| 1969/151 | Miscellaneous Investigations carried out in the Geological Laboratory - Part 1: January to June, Part 2: July to December | |
| 1970/13 | The co-precipitation of Fe and trace metals from aqueous solutions | J. FERGUSON |
| 1970/20 | Rb-Sr age determination of some rocks from the West Kimberley region, W.A. | R.BENNETT D.C.GELLATLY |

Records (Cont.)

| | | |
|---|---|---|
| 1970/21 | Ulawan Volcano, New Britain: Geology, Petrology, and eruptive history between 1915 and 1967. | R.W.JOHNSON |
| 1970/24 | Proterozoic metamorphic rocks of the Cloncurry 1:100,000 Sheet area, northwest Queensland. | A.Y.GLIKSON<br>G.M.DERRICK |
| 1970/35 | Seismicity in the Bismarck volcanic arc, T.P.N.G. | R.W.JOHNSON |
| 1970/41 | Geochemical and radiometric investigations, Rum Jungle district, N.T., 1969. | R.S.NEEDHAM |
| 1970/42 | Likuruanga volcano, Lolobau Island, and associated volcanic centres New Britain: Geology and petrology. | R.W.JOHNSON |
| 1970/47 | Mount Isa geochemical project - analyses of core samples | S.E.SMITH<br>K.R.WALKER |
| 1970/50 | Geology of northern half of the Bowen 1:500,000 Sheet area,Q. (with additions to the geology of the southern half). | A.G.L.PAINE,<br>D.E.CLARGE[1]<br>C.M.GREGORY |
| 1970/69 | Catalogue of age determinations on Australian rocks 1967-1968. | R. BENNETT |

IN PREPARATION.

| | | |
|---|---|---|
| 1969/37 | B.M.R. diamond drilling results, Rum Jungle East, N.T., 1966-1968 (Woodcutters L1, 2, 3. and 6 anomalies). | C.E.PRICHARD |
| 1970/3 | Geology of Cape Scott, Port Keats, Fergusson River and Delamere 1:250,000 Sheet areas, Northern Territory. | C.M.MORGAN<br>I.P.SWEET<br>J.R.MENDUM<br>I.R.PONTIFEX |
| 1970/11 | Studies in the cold extraction of copper, lead, and zinc from geological materials. | J.R.BEEVERS |
| 1970/49 | The geology of New Ireland, T.P.N.G. | P.D.HOHNEN |
| 1970/54 | Summary report on overseas study tour, March to May, 1969. | A.G.L.PAINE |
| 1970/63 | Geology of the Gazelle Peninsula,T.P.N.G. | R.P.MACNAB |
| 1970/65 | Crater Formation Investigation, Rum Jungle district, N.T. | D.J.FRENCH |
| 1970/66 | Mineralogy of cumulus and non-cumulus ultramafic rocks from Papua. | R.N.ENGLAND<br>H.L.DAVIES |

Records: (Cont.)

| | | |
|---|---|---|
| 1970/72 | Short papers on Quaternary volcanic areas in Papua - New Guinea | R.W.JOHNSON<br>D.E.MACKENZIE<br>I.E.SMITH |
| | Metamorphic rocks: Garaina-Tapini area, T.P.N.G. | H.L.DAVIES |
| | Volcanoes of the D'Entrecasteaux Islands, T.P.N.G. | I.E.SMITH |
| | Geology of the Tennant Creek 1:250,000 Sheet area, N.T. | J.R.MENDUM<br>P.C.TONKIN |
| | Geology of the Marraba 1:200,000 Sheet area, Q. | G.M.DERRICK,<br>I.H.WILSON[1]<br>R.M.HILL<br>J.E.MITCHELL<br>A.Y.GLIKSON |
| | Geology of the Mary Kathleen 1:100,000 Sheet area, Q. | G.M.DERRICK<br>R.M.HILL<br>I.H.WILSON<br>J.E.MITCHELL<br>A.Y.GLIKSON |
| | Geochemical survey of the Stapleton area, Rum Jungle, N.T. | G.C.LAU |
| | The Precambrian geology of the Oscar Range inlier, Lennard River Sheet area, SE51/8, W.A. | G.M.DERRICK,<br>D.C.GELLATLY |
| | Textures and genesis of the Narloola lead-zinc ores, Kimberley region, W.A. | D.C.GELLATLY |
| | The geology of the Yampi 1:250,000 Sheet area SE51/3, W.A. | J.SOFOULIS[2]<br>D.C.GELLATLY<br>G.M.DERRICK<br>C.M.MORGAN<br>R.A.FARBRIDGE |
| | Notes on the younger Precambrian geology of the Lennard River and Lansdowne 1:250,000 Sheet areas, W.A. | D,C,GELLATLY<br>G.M.DERRICK |
| | Chromiferous ultrabasic rocks near Eastman's Bore, Mount Ramsay 1:250,000 Sheet area, W.A. | D.C.GELLATLY |
| | Geology of the area around the Strangways Range Carbonatite, Alice Springs 1:250,000 Sheet area, SF53/14, N.T. | D.C.GELLATLY |
| | The petrology of the Currambeen Dolerite Wollongong No.2 Stratigraphic Well, N.S.W. | D.C.GELLATLY |

Records (Cont.)

| | |
|---|---|
| Woodcutters geochemical survey, Rum Jungle area, N.T. | W.F.RIDLEY[1] |
| Late Cainozoic uplift and geomorphology in southeastern Papua. | I.E.SMITH |
| Petrology of Pleistocene Volcanics, New Guinea Highlands. | D.E.MACKENZIE |
| Investigation into water seepages at Corin Dam | A.D.HALDANE<br>H.LORD |
| Pollution of the Molonglo River and Lake Burley Griffin - the results of investigations undertaken for Interdepartmental Committee enquiry. | A.D.HALDANE |
| Report on 2nd Seminar on Geochemical Prospecting Methods and Techniques, Ceylon, 1970. | A.D.HALDANE |
| Report on overseas visit April-June 1970. | K.R.WALKER |
| The Papuan Ultramafic Belt - stream sediment geochemical reconnaissance | H.L.DAVIES<br>A.D.HALDANE |
| Progress report on Ruby Gap Thrust Nappe, Amarata Waterhole area, N.T. | R.D.SHAW |
| Geology and copper deposits of the Pinnacles Bore area, Strangways Range, N.T. | R.D.SHAW |
| Progress report on detailed mapping of the Arltunga Nappe Complex, N.T. | D.J.FORMAN<br>R.D.SHAW<br>A.J.STEWART<br>M.YAR KHAN[5]<br>J. FUNK [5] |
| Progress report on the Geology of the Alcoota, 1:250,000 Sheet atea, N.T. | R.D.SHAW<br>R.G.WARREN |
| An eruptive cycle, Manam volcano, Karkar volcano, T.P.N.G. | G.A.M.TAYLOR |
| Doma Peaks Volcano, T.P.N.G. | G.A.M.TAYLOR |
| An anomalous event at Wau, T.P.N.G. | G.A.M.TAYLOR |
| Petrology of the New Ireland volcanoes, T.P.N.G. | G.A.M.TAYLOR |
| Investigation of Crustal structure in the New Britain - New Ireland area, T.P.N.G. | J.A.BROOKS<br>et al. |
| Geology of the eastern aide of Prydz Bay, Antarctica. | J.H.C. BAIN<br>I.R.McLEOD |
| Report on the study of trace element assemblages in carbonate sequences McArthur R.N.T. | C.CLAXTON[6]<br>M.C.BROWN[6] |

## MAPS AND EXPLANATORY NOTES
(1970 progress indicated by underlining)

| | Map | | | Explanatory Notes | |
|---|---|---|---|---|---|
| 1:250,000 Sheet area | Field Work | Prelim. Edit. | Coloured Edit. | Authors | Publication |
| Cambridge Gulf | 1963 | 1966 | In press | Plumb, K.A.. Veevers, J.J.. | In press |
| Lansdowne | 1964 | 1965 | Issued | Gellatly, D.C. Derrick, G.M. | Issued |
| Mt. Elizabeth | 1965 | 1967 | Issued | Roberts, H.G. Perry, W.J.. | Issued |
| Ashton | 1965 | 1967 | Issued | Derrick, G.M.. | Issued |
| Drysdale-Londonderry | 1965 | 1966 | In press | Gellatly, D.C.. Sofoulis, J. | Issued |
| Medusa Banks | 1965 | 1969 | Ready for printer | Plumb, K.A.. Perry, W.J.. | In press |
| Montague Sound | 1965 | 1967 | Being fair drawn | Allen, A.D.[2] | In press |
| Prince Regent Camden Sound | 1965 | 1967 | Printed | Williams, I.[2] | In press |
| Charnley | 1965/67 | 1969 | | Gellatly, D.C. Halligan, R.A. | With editor |
| Lennard River | 1965/67 | 1969 | With editor | Derrick, G.M. Playford, P.E. | With editor |
| Yampi | 1966/67 | Being prepared | | Gellatly, D.C. Sofoulis, J. | In prep |

| | | | | | |
|---|---|---|---|---|---|
| Hughenden | 1963 | 1964 | | Paine, A.G.L.<br>Vine, R.R. | In prep |
| Charters Towers | 1963-64 | 1966 | Issued | Clarke, D.E. | Issued |
| Bowen | 1961 & 1964/5 | 1967 | Being fair drawn | Paine, A.G.L. | With editor |
| Proserpine | 1962 & 1965 | 1968 | Being fair drawn | Paine, A.G.L. | With editor |
| Coen (part) | 1967 | 1969 | To be completed by Sedimentary Section | Whitaker, W.G.<br>Sedimentary Section | Awaiting contributions from Sedimentary Section |
| Cape Weymouth (part) | 1967 | 1969 | | Willmott, W.F.<br>Sedimentary Section | |
| Torres Strait (part) | 1968 | 1970 | | Willmott, W.F.<br>Sedimentary Section | |
| Daru-Maer Island | 1968 | 1970 | Being fair drawn | Willmott, W.F.<br>Whitaker, W.G. | With editor |
| Auvergne, N.T. | 1967 | 1970 | Being fair drawn | Pontifex, I.R.<br>Sweet, I.P. | With editor |
| Port Keats | 1967/8 | 1970 | With editors | Morgan, C.P. | With editor |
| Fergusson River (2nd Ed) | 1957<br>1968 | 1970 | Being fair drawn | Pontifex, I.R.<br>Mendum, J.R. | With editor |
| Cape Scott | 1968 | 1970 | With editor | Mendum, J.R. | With editor |
| Delamere | 1966, 1968 | 1970 | With editor | Sweet, I.P. | With editor |

| | | | | | |
|---|---|---|---|---|---|
| Victoria R. Downs | 1966 1969 | In prep | | Sweet, I.P. | In prep |
| Wave Hill | 1966 1969 | In prep | | Bultitude, R.J. | In prep |
| Waterloo | 1969 | In prep | | Sweet, I.P. | In prep |
| Limbunya | 1969 | In prep | | Mendum, J.R. | In prep |
| Tennant Creek | 1970 | In prep | | Mendum, J.R. Tonkin, P.C. | In prep |
| Wabag, N.G.. (part) | 1963 1966 | 1969 | In prep | | |
| Ramu, N.G.. | 1956, 1962 1967, 1968 1970 | Being compiled | | | |
| Karamui, N.G. | 1968, 1970 | Being compiled | | | |
| Wau, N.G. | to 1968 | Being compiled | | Davies ed. Smit, J.A.J.. | Being edited |
| Tufi | 1968 1969 | Being drafted | | Davies, H. Smith, I. | In prep |
| Abau | 1968 1969 | Being drafted | | Smith, I. | In prep |
| Samarai | 1968 1969 | Being drafted | | Smith, I. | In prep |

| | | | | |
|---|---|---|---|---|
| Salamua | 1965-68, 1970 | Being drafted | Davies, H. | In prep |
| Rossel | 1969 | Being drafted | Smith, I. | In prep |
| Buna | 1965-68, 1970 | Being drafted | Davies, H. | In prep |
| Fergusson Island | 1961, 1968, 1969 | 1970 | Davies, H. | In prep |
| Gazelle Penin. | 1968 | 1970 | Davies, H. (ed.) | In prep |
| Pomio | 1969 | Being compiled | Ryburn, R.J. | In prep |
| Talasea-Gasmata | 1969 | Being compiled | Ryburn, R.J., Johnson, R.W. | In prep |
| Cape Raoult-Arawe | 1969 | Being compiled | Ryburn, R.J. | In prep |

OTHER MAPS

| | |
|---|---|
| **1 inch to 1 mile** | |
| Herberton<br>Mount Garnet | Ready for printer |
| Ravenswood | Withdrawn |
| **1:100,000 Scale** | |
| Yampi Sound<br>Leopold Downs | Being compiled to illustrate Bulletin (with editor) |
| Marraba<br>Cloncurry | Being fair drawn |
| **1:500,000 Scale** | |
| Cape York Area | Fair drawing complete |
| West Kimberley<br>Eastern Papua<br>Louisiade Arch. | Compilation started |
| Papuan Ultramafic Belt | In press |
| Burdekin River Region | Compilation well advanced |
| Kimberley Basin<br>Victoria River<br>New Britain<br>Central Highlands | Programmed |
| **1:1,000,000 Scale** | |
| Geol. map of Papua & New Guinea | Being compiled |
| **1:5,000,000 Scale** | |
| Metallogenic Map of Australia and accompanying notes | In prep |
| **1:1,000,000 Scale** | |
| Metamorphic Map of Central Australia and accompanying notes | In prep |

# GEOLOGICAL SERVICES SECTION

# ANNUAL SUMMARY OF ACTIVITIES, 1970

## GEOLOGICAL SERVICES SECTION


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# ANNUAL SUMMARY OF ACTIVITIES, 1970

## GEOLOGICAL SERVICES SECTION

### INTRODUCTION

The Geological Services Section through most of the year consisted of eight main groups: Engineering Geology and Hydrology; Phosphate and marine Geology; Papua-New Guinea Resident Geologists; Geological Publications and Editing; Map Editing and Compiletion; Mineral Reports, Technical Files and Stratigraphic Indexing; Museum and Transit Room, and Geological Drawing. The Computer Applications group ceased to function with the resignation of T. Quinlan on 20th January. The Northern Territory Resident Geologists group was transferred to the Department of the Interior on 16th September, 1969 and staff transfers became effective in succeeding months.

In October, with the implementation of the new organization of the Operations Branch, the Geological Publications and Editing Group, including the Section Leader, K.A. Townley, was transferred to the Operations Branch; the activities of the group are reported in the summary of activities of the Operations Branch. E.K. Carter was provisionally promoted to the position of Section Leader and some rearrangements of responsibilities was made: the Phosphate and Marine Geology group was transferred to the Sedimentary Section of the Geological Branch (under which section its activities are reported) and Dr. Carter retained technical supervisory responsibility for major engineering geology projects in Papua-New Guinea.

Staff shortages throughout the year have severely restricted the work of the Section - particularly the geological office activities - and recent staff changes have further seriously reduced the activites of the mineral reports, technical files and stratigraphic indexing group.

Staff were employed in the Section in the period November, 1969 - October 1970, as follows:-

Geologist in Charge: K.A. Townley (to September, 1970)

Engineering Geology and Hydrology Group:

Geologist, Class 4: Dr. E.K. Carter
Geologists, Class 3: G.M. Burton (provisionally promoted Geologist, Class 4, in charge of the group, in October, 1970)
D.E. Gardner
Geologist, Class 2: G.A.M. Henderson (promoted from Class 1 September, 1970).
Geologists Class 1: R. Thieme (to March, 1970)
M.J. Jackson (to June, 1970)
Miss E. Rosenberg (part time)
D.C. Purcell
J.A. Saltet
K. Modrak (March-May, 1970)
G.B. Simpson (from September, 1970)
1 Technical Officer, 1 Technical Assistant.

Phosphate & Marine Geology Group

Geologist, Class 4: Dr. H.A. Jones
Geologists, Class 3: F. de Keyser (resigned February, 1970)
D.S. Trail (resigned September, 1970)
P.J. Cook (promoted Class 3 February, 1970)
Geologist, Class 1: R. Geijskes (resigned July, 1970)
D. Jongsma
W. Mayo (from January, 1970)
J. Marshall (from April, 1970)
4 Technical Officers and 3 Technical Assistants.

Papua-New Guinea Resident Geologists

| | |
|---|---|
| Chief Resident Geologist: | A. Renwick |
| Geologists, Class 3: | I.S. Cumming (resigned, December, 1969) |
| | G.W. D'Addario (to December, 1969) |
| | Dr. H.L. Davies (on temporary transfer from Canberra from January to April, 1970) |
| Geologists, Class 2: | D.J. Grainger |
| | D. Palfreyman |
| | G. Jacobson (from March, 1970) |
| Geologists, Class 1: | P.D. Hohnen (to April, 1970) |
| | P.E. Pieters |
| | R.J. Tingey |
| | Dr. R.A. Davies |
| | Dr. G.P. Robinson (from February, 1970) |
| | M. Barsdell (from March; resigned July, 1970) |
| | L.F. Macias (from July, 1970) |
| | J. Harris (from October, 1970) |
| | I.H. Crick (from November, 1970) |
| Geophysicist, Class 1: | I.M. Mancini (to October, 1970) |

Technical Officers, Technical Assistants and Trainee Technical Assistants.

Mineral Reports, Technical Files and Stratigraphic Indexing Group.

Geologist, Class 3 (acting Class 4): I.R. McLeod (Provisionally promoted and transferred October, 1970)

| | |
|---|---|
| Geologists Class 1: | Mrs P. Theime (to end October, 1970) |
| | Miss E. Rosenberg |
| | Mrs J. Smith (from December, 1969) |

Geological Publications and Editing Group.

| | |
|---|---|
| Geologist, Class 5: | K.A. Townley (part time) |
| A/g Geologist Class 4: | I.R. McLeod (part time) |
| Geologist, Class 2: | Dr. R.R.E. Jackson |
| Geologist, Class 1: | Mrs J.A. Owen (from December, 1969) |

Map Editing and Compilation Group

Geologists, Class 3: Dr. G.E. Wilford (promoted Geologist, Class 5, Sedimentary Section, July, 1970)
Miss B.K. Graham (part time)
G.W. D'Addario (from October, 1970)
Geologist, Class 2: Miss R.G. Warren (to June, 1970, part-time thereafter)
Geologist, Class 1: Miss R.L. Cameron

Museum and Transit Room

Geologist, Class 1: Musium Curator: T. Nicholas (resigned May, 1970)
G. Young (from January, 1970, part-time)
P.C. Tonkin (from December, 1969, part-time)
2 Technical Officers.

Computer Applications

Geologist, Class 3: T. Quinlan (resigned, January, 1970).

Geological Drawing Office

Chief Draftsman: H.F. Boltz
Deputy Chief Draftsman: P.A. Boekenstein
Standard Maps (Supervising Draftsman: K. Matveev) - 7 draftsmen, 1 drafting assistant.
Special Maps: (Supervising Draftsman: H. Hennig) - 7 draftsmen, 1 drafting assistant.
Preliminary Compilations (Supervising Draftsman: M.E. Nancarrow)- 6 draftsmen, 4 drafting assistants.
General Drafting (Supervising Draftsman: R. Molloy) - 5 draftsmen, 2 drafting assistants.
Other Draftsmen - 2 draftsmen, 6 trainee draftsmen, attached to various groups.
Photography Group (Photographer-in-Charge: J.E. Zawartko)
3 photographers, 2 photographic assistants.
Other - 2 clerical assistants.

## ENGINEERING GEOLOGY AND HYDROLOGY

The Engineering Geology and Hydrology group continued to conduct field investigations, mainly in and around the A.C.T., as two parties headed by D.E. Gardner and G.M. Burton. The group was supervised by Dr. E.K. Carter who also provided technical supervision of major engineering geology investigations in Papua - New Guinea.

Through most of the year the group was handicapped by the lack of Class 2 engineering geologists; the position will be aggravated by recent staff changes. The work load continued to be heavy and services were maintained only by the use of staff made available from other sections. For part of the year geological design investigation services were provided from Canberra for the Ramu 1 (Stage 1) hydro-electric project, P.N.G.

With the recruitment of a technical officer qualified to conduct soils investigations and testing, the group's ability to map, classify, and evaluate for engineering purposes A.C.T. soils, has been greatly enhanced.

Close co-operation has continued between the Engineering Geology and the Engineering Geophysics groups, both in and around the A.C.T. (including Jervis Bay) and in P.N.G.

The Supervising Geologist's main activities in addition to normal supervisory work in relation to A.C.T. projects (including report editing) and administration were:

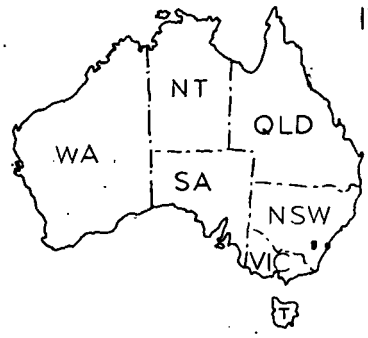
(a) P.N.G. major engineering projects. Four visits were made to the Territory in the period November, 1969, to October, 1970. Projects included Ramu 1 (Stage 1) hydro-electric project-design investigation and report; Sirirumu Dam (2nd Stage) - under construction; Rouna 3 hydro-electric scheme-preliminary investigation; and Musa River hydro-electric scheme-preliminary investigation. Several visits were made to Melbourne and two to Cooma on account of these projects.

(b) Acted as an assessor for the Mining Warden at the enquiry into the landslide on the Port-Panguna road project, Bougainville, which claimed the lives of eight men on 23rd January, 1970.

(c) Contributed to a paper on the production of highly acid water at Corin Dam, A.C.T. (Fig. GS1, locality 22) by the oxidation of pyrite in the rock-fill of the embankment. The paper was presented to an international congress of engineering geologists, and was issued as a Record.

Fig. GSI

# A.C.T. ENGINEERING GEOLOGY AND HYDROLOGY INVESTIGATIONS, 1970









To accompany Record 1970/81

(d) Presented two staff lectures and gave an address of the Royal Society of N.S.W; visited the Melbourne and Metropolitan Board of Works to inspect 2 mechanical tunnel-excavating machines ("moles") and discuss factors affecting infiltration of water into sewers.

(e) Investigated, with others, and wrote a report on, an occurrence of copper-bed-zinc mineralization on the N.S.W.-A.C.T. border, 3 miles north-east of Mount Coree. (Fig. GS1, locality 23).

A.C.T. No. 1 PARTY

Resume of Activities, November-December, 1969

Geological work was carried out concurrently with shallow seismic refraction surveys along part of the route of the proposed Tuggeranong Freeway, at the Molonglo River bridge site where the proposed freeway crosses the river and along the route of the North Molonglo Outfall Sewer and the Molonglo Valley Outfall Sewer. Mapping of urban development areas continued at Belconnen; a compilation of Belconnen geology at a scale of 1 inch to 800 feet was well advanced.

Activities during 1970

The work done during 1970 included site investigations for major engineering projects and for structures such as buildings and water reservoirs, investigation of soil thickness and excavating conditions along proposed route of trenches, tunnels and roadways, continuation of mapping in urban development areas, commencement of soil mapping and testing for engineering purposes, and of an extensive survey of resources of engineering construction materials, mainly aggregate for concrete and for roadmaking.

University students N.R. Baczynski, K. Modrak and P.J. Davoren were employed during the 1969-70 vacation.

Major Engineering Projects.

1. Tennent Damsite, Gudgenby River. (G.A.M. Henderson-Fig. GS1, locality 1*)

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* All numbered localities in the report on engineering geology and hydrology refer to Figure GS1.

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A preliminary investigation of the site in 1967-68 involved geological mapping, supplemented by some seismic work and diamond drilling. A more comprehensive investigation during 1970 included mapping of the storage area, costeaning, and additional seismic work and diamond drilling. A survey of materials resources was carried out by the Central Testing Laboratories, Department of Works, (core material for earth and rock dam) and by the project geologist (rock for rock-fill and aggregate). A report on the investigation was started in October, 1970.

2. Belconnen Lake Dam (G.A.M. Henderson-Locality 2)

Investigation of the sites for dam and spillway was carried out by consulting engineers for the National Capital Development Commission. Geological information was provided by B.M.R. Engineering Geology Group. A specific study was made on the soundness of the bedrock at an alternative spillway site.

Site Investigations

The site investigations were intended either to determine the depths to which excavating could be carried out by earth-moving equipment without the need for explosives, or to gain preliminary information on the suitability of the bedrock, or weathered bedrock, as a foundation material. For both purposes, the investigations involved a geological examination of the site and a shallow seismic refraction survey. The seismic surveys were interpreted on the basis of the geology of the site, as far as it was known, and commonly were checked by diamond drilling. The site investigations provided data for programming effective and economical design investigations.

1. Depth of Excavating Without Blasting (D.C. Purcell, R. Thieme)

A site for a water reservoir (Locality 3) was investigated in Campbell, near the southern slope of Mount Ainslie, also a site for an effluent lagoon (Locality 4) adjacent to the Cotter River, downstream from the Weston Creek sewerage treatment plant.

2. Suitability of Bedrock for Foundations (D.C. Purcell, G.A.M. Henderson)

Two sites for major buildings were investigated, one on Block 4, Barton (Locality 5) and the other on Blocks 43 and 50, Belconnen (Locality 6). A site for a bridge (Locality 7) where the future Tuggeranong Freeway will cross the Molonglo River, was examined late in 1969; early in 1970 the site was tested by diamond drilling. Other sites were inspected; opinions were given on such matters as the strength and hardness of bedrock, and geological observations were recorded.

3. Trenches and Tunnels for Underground Services (G.A.M. Henderson; D.C. Purcell; D.E. Gardner).

For trenching, information was needed on the depths below which drilling and blasting would be required; for tunnelling, information was sought on bedrock conditions such as strength and hardness of the rock, jointing, the type of support which might be needed, and expected inflow of water. The investigations needed ranged from a field inspection to a geological and geophysical (generally seismic) survey, followed by augering and core drilling. Field work on two such projects was completed in 1969. One of them, the North Molonglo Outfall Sewer (Locality 8) was written up as a Record in 1970. The other, the Molonglo Valley Outfall Sewer (Locality 9) is covered in a brief report.

Preliminary work on a Tuggeranong outfall sewer tunnel was outlined; a magnetic survey along part of the route (Locality 10) was completed by the Engineering GeophysicsGroup, and a preliminary geological study was made.

## Proposed Roadways

For efficient design of roadways, information is sought (initially by the National Capital Development Commission) on the thickness of soil and hardness of bedrock at the sites of proposed cuttings, the bearing capacity of soil and weathered rock, on sources of roadmaking material that can be won locally, the drainage of the terrain and on the moisture content of the subsoil. Investigation methods include geological mapping, shallow seismic surveys, and soil sampling and testing.

1. Tuggeranong Freeway (D.E. Gardner). Along the northern part of the Tuggeranong Freeway (Locality 11) geological advice was given to consulting engineers during the preparation of a preliminary design investigation.

2. Acton Saddle Road Link. (G.A.M. Henderson and D.E. Gardner - Locality 12) To carry a major road through Acton to the southern part of Black Mountain, a tunnel will be excavated through the ridge that runs south to the hospital, and a bridge will be constructed across Lake Burley Griffin near the mouth of Sullivans Creek. The Engineering Geology Group provided the consulting engineer with preliminary information on the geology of the route, and diamond drill cores obtained at numerous sites along the route was logged.

## Soil Mapping; Soil Mechanics

1. Equipment and Apparatus (D.E. Gardner; J.R. Kellett) Equipment for conducting basic tests in soil mechanics, such as particle-size analysis and Atterberg limits, was already available. During 1970, more specialized equipment needed for roadway preliminary surveys and for foundation-soil testing, was obtained. A key item of equipment-an auger capable of testing undisturbed samples - was not available until late in the year.

2. Infiltration of Groundwater into Sewers. (J.R. Kellett). The sewerage systems in the A.C.T. are being overloaded during wet weather by seepage into them of large volumes of groundwater. Unless this infiltration can be reduced, the capacity of the present system will need to be increased, at considerable cost; sewer mains in newly developing areas will need to have larger capacities than would otherwise be the case. The seepage occurs through breaks at joints in sewer pipes; these have been attributed to the swelling of clayey soils during wet weather.

The Department of Works requested a soil survey in Watson, A.C.T. (Locality 13) to identify and delineate potential swelling soils in the area. A comprehensive programme of sampling and laboratory testing was carried through; a report on this work was being processed during October as a Record.

3. Soil Mapping for Engineering Purposes (J.R. Kellett; D.C. Purcell) Preparations were made to carry out soil mapping, sampling and testing for engineering purposes, to supplement the geological mapping of urban development areas. A soil survey for roadways, mentioned above, forms part of this programme. A preliminary terrains classification based on topography was prepared to guide sampling.

## Urban Development

Activities entered into in areas that were about to be developed for urban purposes have included detailed outcrop mapping, measurement of soil thickness in such places as erosion gullies delineation of areas of obviously poor drainage, and assessment of resources of construction materials.

1. Belconnen (G.A.M. Henderson) Field mapping was completed by the end of 1969; earlier work was checked at several localities during 1970. A Record on an area covering six map sheets (A.C.T. detail series, 1 inch: 200 feet) was processed, and reports on two other areas, each covering six map sheets, were checked and ready for processing. Reconnaissance mapping was extended north into the Hall District (Locality 14).

2. South and South-West of Canberra (R. Thieme; D.C. Purcell. K. Modrak; E. Rosenberg - Locality 15). Mapping was done within thirteen A.C.T. detail series map sheet areas, as opportunities arose. Two areas were completed and reported on (Modrak). Fair drawing of nine other sheets was well advanced (Thieme). Activities were suspended because of loss of staff and pressure of other work.

3. Developed Areas of Canberra - Capital Hill (G.A.M. Henderson; students employed during vacation - Locality 16).

Excavations mapped on Capital Hill and Camp Hill yielded valuable stratigraphic and structural information.

4. Map of Northern Part of the A.C.T. (G.A.M. Henderson) A map of the northern part of the A.C.T. gives the results of mapping in the urban development areas and of excavations in the established areas during recent years.

Materials Resources

Enquiries were answered principally on aggregate for roads and for concrete, and also on brick shale, sand and building stone. An officer of the Department of the Interior was given some help in developing skills and techniques for testing unconsolidated deposits such as sand deposits.

1. Concrete Aggregate (D.E. Gardner; D.C. Purcell) Enquires were received from several prospective quarry operators, and from the Department of the Interior, regarding possible sources of rock that would be suitable for crushing as aggregate. Field inspections were made near Williamsdale, in the Lanyon area, and in the upper part of Jerrabomberra Creek.

2. Aggregate for Roadmaking (J.R. Kellett; D.C. Purcell; E. Rosenberg) A request was received from the Departments of Interior and of Works for an extensive survey of resources of roadmaking materials for construction and maintenance of country roads at numerous localities in the A.C.T. Reconnaissance investigations and hand augering were carried out in the Paddy's River area (Locality 17) and north of Belconnen (Locality 18). Selected sites were examined in more detail by contract augering.

3. Paddy's River "Gravel" (J.R. Kellett; D.C. Purcell - Locality 19). Weathered granite used for surfacing paths and vehicle parks is quarried at a site along Paddy's River, near Murray's Corner. Resources of suitable material at this locality were determined from the results of a shallow seismic refraction survey, supplemented by auger-sampling.

4. Construction Materials for Earth and Rock Dam (G.A.M. Henderson) Resources of rock for constructing a dam at Tennent Damsite, Gudgenby River (Locality 1) were investigated by the project geologist. Methods used included a seismic refraction survey and diamond drilling (see Tennent Damsite).

## Materials Testing

1. Rock Mechanics (D.E. Gardner). Core samples of rock from drill holes along the route of the proposed North Molonglo Outfall Sewer (Locality 8) were submitted to the Geophysical Rock Testing Laboratory. Results will be available to assist in selecting methods and equipment for tunnelling.

2. Building Stone (D.E. Gardner). A few building-stone samples were tested by petrographic examination, and one by a test for accelerated weathering. In general, building stone samples are submitted to the Australian Mineral Development Laboratories for testing.

3. Concrete Aggregate (D.E. Gardner). Samples were examined petrographically. Arrangements were made with the Australian Mineral Development Laboratories for the testing of samples for expansive reaction with the alkalies in cement.

4. Soil Mechanics (J.R. Kellett). Testing of rocks for engineering purposes is dealt with under "Soil mapping; Soil Mechanics".

## Conferences

D.E. Gardner attended the Symposium on Soils and Earth structures in Arid Climates, held in Adelaide on 21st and 22nd May, 1970.

## A.C.T. No. 2 PARTY

The duties of the party continued to be hydrological investigations in and near the A.C.T.; general enquiries and tasks received from the Australian Water Resources Council (AWRC); and engineering geological investigations, mainly in the southern part of the A.C.T. and at Jervis Bay.

Training of staff was given high priority to partly overcome recruiting difficulties. Saltet and Simonis attended short full-time Fortran courses at C.S.I.R.O., and Saltet spent two weeks on a study visit to the Tasmanian Hydro-Electric Commission. Schuett was sponsored in his private study in the Hydrology course of the Sydney Technical College and Burton attended several conferences partly to assist in general training.

University students I. Gossip and Viejayaratnam were employed during the 1969-70 vacation.

## Late 1969

In October to December, 1969, the party completed several hydrological tasks begun, or planned, and reported in the 1969 report. The new gauging station offshore at Lake George was installed and began supplying very useful results. Data from the lake were synthesized and analysed. Hydrogeological mapping of the forestry catchments at Piccadilly Circus was carried out by Saltet and a vacation student. Jackson compiled and reported on the last section of the Jervis Bay investigation: the Bureau's drilling. Advice was given to the Department of the Interior on a proposed national park at Jervis Bay and general advice was given on the proposed geophysical work at Jervis Bay nuclear power station site for the N.S.W. Electricity Commission (Locality 31). An underground water supply was located for, and developed by, the contractors building the new space facility at Tidbinbilla. General hydrological advice was given to one instrument maker, two manufacturers of desalination plants and one developer of irrigation land. The Scientific Services Branch of the Snowy Mountains Authority was visited in November to see recent developments in materials testing, model-making and field instrumentation.

## Activities in 1970

### Engineering Projects

1. Corin Dam (Locality 22). The investigation into the spring of acid water at Corin Dam was continued and Burton collaborated with the senior authors, Haldane & Carter, on the preparation of a paper on this subject.

2. Googong Dam Site (Locality 21). Saltet co-operated with officers of the Department of Works Central Testing and Research Laboratories, who tested areas of possible material for an earth core for the proposed dam. He undertook mapping of the storage area and designed and supervised the final geophysical, diamond drilling and costeaning programme at the dam site. It is planned to complete and provide a brief preliminary report on the advanced feasibility study by November.

3. Roads J.A. Saltet briefly investigated a major cutting for the Tuggeranong Freeway (Locality 11) for the consulting engineers for the project.

4. Urban Mapping M.J. Jackson completed mapping of the Tuggeranong West Development area (Locality 20) and prepared a report for the Record series.

5. Tuggeranong Sewer Tunnel (Locality 10) Saltet supplied the Geophysical Branch with preliminary information for testing the proposed Tuggeranong sewer tunnel.

A.W.R.C.

Work continued on the compilation of the four groundwater maps of Australia for the Australian Water Resources Council. Burton, as convenor of the Technical Committee on Underground Water's (TCUW) Map Subcommitee, attended the annual TCUW Meeting in Port Lincoln to report on progress and discuss modifications of the maps with State Officers. Meetings with State Officers were also held in Brisbane, Sydney, Melbourne, and Adelaide. The first three maps are now being edited and Map 4 is about two-thirds compiled.

Burton, as a member of the AWRC's Advisory Panel on the Operation of Representative Basins, attended two meetings of the Panel and assisted in the running of the joint excursion to the Yass Representative Basin, for the Panel and the Technical Committee on Surface Water. Burton and Saltet assisted the Department of Works in planning the gauging, and defining the hydrogeology, of the Orroral Basin. (Locality 30). Burton also assisted the CSIRO Land Research Divison's officers who are studying the Yass Representative Basin (Locality 28).

Burton, as a member of the AWRC's Advisory Panel on Research into the Extraction of Water from Unconsolidated Sediments, attended two meetings of the Panel and helped review the two current projects in Sydney and Queensland.

Hydrogeology of the A.C.T. (G.M. Burton; J.A. Saltet; A. Schuett; F. Simonis).

The main network of observation bores in the Canberra Region continued to operate under the direct care of the technical staff. The bores indicated a return to serious drought conditions in late winter and warnings were issued; heavy rains in September, however, led to strong recharge and the situation was remedied.

Saltet, assisted by a student, completed mapping the hydrogeology of the Forestry Research Institute's research drainage basin at Piccadilly Circus (Locality 27). He selected two groundwater observation bores for the basins and supervised the drilling of the bores by the Bureau's Mineral Resources Branch.

Saltet sited another observation bore in the Red Hill catchment as part of an investigation into a drainage problem (Locality, 29). This bore will give useful information on an urban catchment.

The network of shallow observation bores at Jervis Bay (Locality 25) was modified and operated successfully under the supervision of Schuett, who has almost completed the manuscript for a Record on the network.

1. Lake George (G.M. Burton; A. Schuett; F. Simonis-Locality 24). Routine gauging was continued. The off-shore gauge established in late 1969 was operated successfully and the recorders gave valuable records of seiche periods and characteristics, and water temperature changes. Minor operating problems were overcome and a small meteorological station was established nearby, on shore. During the summer of 1970/71 the water balance of the lake will be studied by the bulk aerodynamic method.

The hydrological records of Lake George were processed by computer to study seasonal patterns of run-off and evaporation, and changes in the salt balance.

Burton delivered lectures on the hydrogeology of the lake to the Youth Hostels Association and the Canberra Club.

2. Farm water supplies Saltet sited twelve bores on farms, mainly in the Gundaroo and Hall areas of N.S.W. adjoining the A.C.T. Burton and Saltet answered ten other queries on farm water and similar problems. Burton sited a bore at the El Alamein Army Camp at Sussex Inlet (Locality 26) and selected areas for the installation of experimental infiltration galleries for Army projects.

3. Drainage Problems Saltet completed the investigation, previously undertaken by Burton and Jackson, into serious drainage problems in the Red Hill catchment (Locality 29). A permanent observation bore and several temporary piezometers were installed. A report was completed by Saltet on the hydrogeology and drainage of the catchment.

Burton examined and reported on a groundwater drainage problem in the new N.R.M.A. Building in Northbourne Avenue, Braddon.

Training and External Assistance The party co-operated with the Training Section of the Department of External Affairs in preparing a programme of training in Australia for a Pakistani groundwater engineer, Mr. J. Hannan. Mr Hannan spent about a week of his induction period in the party. Mr B.C. Waterhouse, of the New Zealand Geological Survey, spent several days of his period as an Anzac Fellow, with the field party. Mr Fillipi, of the Water Resources Section of the N.T. Mines and Water Resources Branch, visited the group and studied methods of storage and processing of water data.

## Conferences

Burton attended the Hydrology Symposium of the Institution of Engineers, Australia in Hobart in February and participated in an excursion to the Gordon River Dam and hydro-electric project. In September, he attended the 1st International Congress of the International Association of Engineering Geologists, in Paris, and participated in the pre-sessional excursion in the Paris region and the post-sessional excursion in the Marseilles region. He proceeded from Marseilles to Belgrade and Attended the 2nd International Rock Mechanics Congress and the post-congress excursion to some of the karst regions of the Adriatic.

## General

Burton accompanied Carter in February on a visit to the Ramu and Laloki hydro-electric schemes T.P.N.G. and to the Bougainville landslide enquiry. Burton visited briefly the engineering geologists at Port Moresby while returning from Europe, to pass on information from the two Congresses.

## Records of Investigation

The following Records produced within the sub-section, or involving members of the sub-section, were issued, or allotted numbers during the last twelve months. Records numbered 1969/105, 1969/111 and 1969/127 were allotted numbers before 1st November, 1969 but were issued after that date. A number of other reports for the Records series are either being processed, or awaiting edit.

| Record No. | Author | Title |
|---|---|---|
| 1970/45 | M.J. Jackson | Stratigraphic bores BMR Ulladulla 1 & 2, and implications for engineering geology, Jervis Bay. |
| ø * 1970/53 | G. Jacobson (in 2 parts) | Engineering Geology of Phase 1 of the Ramu 1 Hydro-Electric Project, Eastern Highlands New Guinea. |
| ø 1970/60 | G.A.M. Henderson | Geological investigations, Belconnen sheets F4C, G5B, G5C and G5D, A.C.T. 1965-1967. |
| ø 1970/61 | G.A.M. Henderson | North Molonglo Outfall Sewer, A.C.T. Geological report on detailed investigation 1969. |

* Author is a member of the Papua-New Guinea Resident Geological staff.

ø Record numer allotted but not issued by 31st October, 1970.

| Record No. | Author | Title |
|---|---|---|
| ø 1970/68 | M.J. Jackson | Engineering Geology of Tuggeranong West Urban Development Area, A.C.T. |
| ø 1970/75 | A.D. Haldane, E.K. Carter, G.M. Burton. | The Relationship of pyrite oxidation in rockfill to highly acid water at Corin Dam, A.C.T., Australia. |

## RESIDENT GEOLOGISTS

## TERRITORY OF PAPUA AND NEW GUINEA

There are now 15 Resident Geologist positions in the Territory. However, at no time during the year were all these filled simultaneously, and the shortage, especially of experienced senior officers, has limited the overall achievements of the group.

Services have been provided to the Administration in the fields of Regional Mapping and Mineral Investigations, Engineering Geology, and Volcanology. Information and advisory services have also been extended to Commonwealth Departments and to mineral exploration companies, prospectors and members of the public.

## HEADQUARTERS AND ADMINISTRATION

The Chief Resident Geologist (A. Renwick) visited Bougainville in January following a major landslide and observed the Ulawun eruption en route. He visited Rabaul in March, April, July, September and November; and inspected work on the Ramu Hydro-Electric Scheme in June.

In April and October he visited B.M.R. Headquarters in Canberra for discussions on a wide range of problems. Following the former visit he attended the Chief Government Geologists' biennial conference in Sydney. For this period, Dr. H.L. Davies acted as Chief Resident Geologist. During the latter visit he attended the Supervisors' programme meetings.

Preparations for, and the event of, the 42nd ANZAAS Congress occupied much staff time. The Congress was the first major meeting to be held in Port Moresby and a lot of improvization and experimentation were involved. The Resident Group ran well attended geological excursions from Port Moresby to the Astrolabe Plateau during the Congress.

The extensions and additions to the Central Volcanological Observatory at Rabaul, which were completed at the end of 1969, provided greatly improved working conditions this year although the air-conditioning system is still inadequate.

The new wing at the Group's Port Moresby Headquarters was completed in July and this, together with the alterations to the old wing, provided good working conditions for the first time in some years.

There was a further increase in the number of visitors requiring information and in the number of requests for advice, information, and the identification of material. Most of these visitors and enquiries were connected with mineral exploration, but a number of other matters were also dealt with.

In addition to his duties of supervising activities and administering the Territory's Geological Survey, the Chief Resident Geologist continued membership of the Mining Advisory Board, the Petroleum Advisory Board, the Science Faculty of the University of Papua and New Guinea, the Council of the Scientific Society of Papua and New Guinea; remained Chairman of the Advisory Committee on Seismology and Earthquake Engineering; and was appointed Chairman of the new Scientific Advisory Committee to the National Parks Board.

## REGIONAL MAPPING AND MINERAL INVESTIGATION SECTION

### INTRODUCTION

### STAFF AND MOVEMENTS

D.J. Grainger – Acting Head of Section for most of the year. He was a member of the B.M.R. geological party attached to the Australian National Antarctic Research Expedition for the 1969/70 summer field season. He resumed duty in the Territory on 27th April 1970.

H.L. Davies – On temporary transfer from Canberra from 5th January to 23rd April. He was in charge of the Section during this time.

R.J. Tingey – Was a member of the B.M.R. geological party attached to the Australian National Antarctic Research Expedition for the 1969/70 summer field season. He resumed duty in the Territory on 20th April 1970. He took recreation leave from 26th August and after his return on 11th November he will transfer to a Canberra-based position.

P.D. Hohnen – On recreation leave from 24th April prior to transferring to a Canberra-based position.

P.E. Pieters – Transferred from the Engineering Section in February 1970. He continued with Engineering work until May, and proceeds on leave in December.

M. Barsdell – Assumed duty 6th March, resigned 24th July, to begin post-graduate studies overseas.

I.H. Crick - Due to assume duty in October, but transfer deferred owing to unavailability of suitable housing.

## REGIONAL MAPPING

### PROJECTS AND INVESTIGATIONS (See Fig.GS2)

The most important undertakings were the consolidation of data for the compilation of the Markham (Grainger) and Port Moresby (Pieters) 1:250,000 geological maps. No major field operations are planned for these officers until the projects are completed, sometime in 1971. Davies is compiling the Buna and Salamaua 1:250,000 Sheets in Canberra.

#### Markham 1:250,000 Regional Mapping

Field work in the Markham Sheet area was concerned with filling in gaps in the geological coverage.

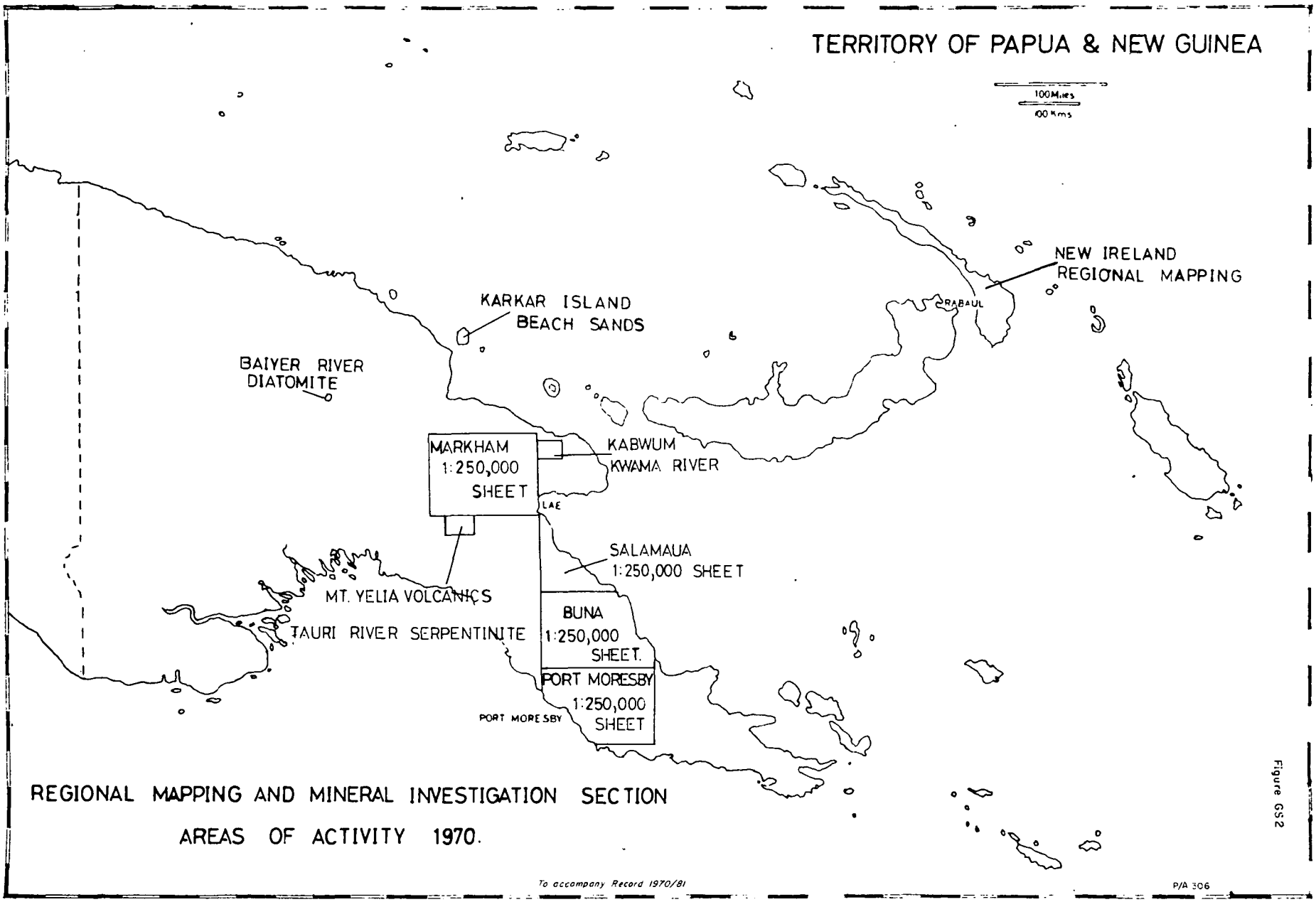
Foot traverses and helicopter traverses were made by Grainger, Pieters and Barsdell in late May and early June from a base camp at Marawaka. The work completed the geological mapping of the south-western part of the Markham Sheet and joined up with previous mapping in the Kratke Range area by Resident Staff and with mapping by the 1968 B.M.R. Kubor Range party.

The main stratigraphic unit is the Omaura Greywacke which consists of massive greywacke and pebbly sandstone; sandstone; moderately to well bedded siltstone and shale, sometimes calcareous; and minor limestone lenses. In the extreme southwest of the Sheet there is a possible unconformity with sediments of the Aure Group overlying the Omaura Greywacke. It is hoped that the dating of micropalaeontological samples will help to resolve the relationship.

Several of the peaks of the Kratke Range are capped with massive limestone, apparently conformably overlying the Omaura Greywacke. Limestone collections were made for micropalaeontological dating.

In the northern part of the adjacent Wau 1:250,000 Sheet investigations were made of the Mount Yelia volcanics, and of a serpentinite body in the upper Tauri River Valley.

On completion of the mapping in the Marawaka area, Grainger and Pieters moved camp to Kabwum in the Huon Peninsula. Helicopter traverses were made in the Uruwa River drainage system to complete the mapping of the northeastern part of the Markham Sheet. A brief reconnaissance had been made in September 1969 during the mapping of the area north of the Markham Valley but bad weather had prevented follow-up work.


TERRITORY OF PAPUA & NEW GUINEA
100 Miles
100 Kms
NEW IRELAND
REGIONAL MAPPING
RABAUL
KARKAR ISLAND
BEACH SANDS
BAIYER RIVER
DIATOMITE
MARKHAM
1:250,000
SHEET
KABWUM
KWAMA RIVER
LAE
SALAMAUA
1:250,000 SHEET
MT. YELIA VOLCANICS
TAURI RIVER SERPENTINITE
BUNA
1:250,000
SHEET.
PORT MORESBY
1:250,000
SHEET
PORT MORESBY
REGIONAL MAPPING AND MINERAL INVESTIGATION SECTION
AREAS OF ACTIVITY 1970.
Figure GS2
To accompany Record 1970/81
P/A 306

The northerly flowing Uruwa River, and its tributaries the Som and Iyut have eroded through the thick sheet of subhorizontal limestone that forms the summits of the Saruwaged Range and have exposed the underlying volcanic rocks. The Saruwaged Range rises to altitudes of more than 13,000 (plus 4,000 m) and shows evidence of glaciation. The volcanic rocks exposed beneath the limestone are olivine basalt, agglomerate and tuff with small limestone lenses. There are minor occurrences of andesite and diorite. Pillow lavas are exposed in the headwaters of the Som River. Limestone samples for micropalaeontological dating were taken throughout the area and other collections were made near Kabwum. The area had been extensively faulted and uplifted and is seismically active.

While Grainger and Pieters were working the Uruwa River area, Barsdell made a road traverse from Lae to Gusap with side traverses up the major rivers to collect material for micropalaeontological dating from the poorly indurated sedimentary rocks which form the foothills flanking the northern side of the Markham Valley.

A photogeological interpretation of the part of the Markham Sheet north of the Markham Valley is being made by B.M.R. Canberra. The interpretation will be extended to cover the Huon Peninsula. A few foot traverses will be required in the Wantoat area to check certain results of the photointerpretation.

Compilation of the geological data is continuing.

Tingey completed an Investigation Note (69202a) on the geology of part of the Kratke Range.

Central District Regional Mapping

(a) Port Moresby 1:250,000 Sheet

Pieters began the compilation of geological data for the Port Moresby Sheet. Several traverses have been made to fill in gaps in the geological coverage.

In March, Pieters made a geological traverse of the Kokoda Trail with side traverses along major creeks. For most of the length of the Trail Owen Stanley Metamorphics of the greenschist facies are exposed. On the northern fall of the Owen Stanley Range between Kokoda and Kagi the rocks are predominantly blue-and green-schists. Southwards from Kagi the schists have a much darker appearance, are often graphitic and quartzose. The compositional change is associated with an important structural break near Kagi. In the Efogi area intermediate extrusive rocks overlie the schist but are usually restricted to topographically low areas. Between Menari and Ua-Ule Creek there is an increase in the occurrence of small intrusions and dykes of intermediate to basic composition. Pyrite mineralization is associated with the intrusive phase. In the Ua-Ule area the country rocks are slates and phyllites of the greenschist facies. To the south are steep cliffs of the ?Pliocene Astrolabe Agglomerate. The contact of the agglomerate with the slates and phyllites is probably faulted.

In early September Pieters took part in a survey of the headwaters of the Musa River in co-operation with Australian Oil and Gas Pty. Ltd.

Barsdell also assisted with field work in the area of the Port Moresby Sheet. He made a week-long traverse in May from Tetebedi through the northwestern headwaters of the Musa River to obtain more information on the contact between peridotite of the Papuan Ultramafic Belt and the Owen Stanley Metamorphics, and on the nature of the metamorphic rocks.

As a result of photointerpretation by Pieters more field work will be required in the Port Moresby area to check certain results of the interpretation and to complete the geological coverage.

(b) Buna 1:250,000 Sheet

Davies, Pieters and Barsdell made traverses in the Buna Sheet area as part of the programme to complete the geological coverage, and traverses were also made in the Garaina area of the adjacent Salamaua 1:250,000 Sheet. Davies is compiling the geology of the Buna Sheet in Canberra.

Pieters made traverses in the Kokoda area in February to examine the greenschists of the Owen Stanley Metamorphics outcropping along the Owen Stanley Fault.

In February, Davies traversed from Garaina to Tapini, and in April Pieters walked between these two points by a different route. They investigated the greenschist metamorphic rocks of the Owen Stanley Metamorphics. Intrusions of diorites and intermediate porphyritic rocks occur but no mineralization other than minor pyrite was observed.

In March, Davies traversed from Woitape to Kokoda and examined the metamorphics which are of higher grade (amphibolite facies) than in the Garaina-Tapini area. ?Plio-Pleistocene volcanics in the Woitape area are mostly of rhyolite and dacite composition. Thick lava flows predominate but agglomerate crops out near Woitape. Barsdell made a more detailed study in May.

Davies and Barsdell worked in the Tetebedi-Ilimo area of the Port Moresby and Buna Sheets during part of March. They ascertained the presence of a narrow belt of amphibolite-granulite facies metamorphism along the fault contact between peridotite of the Papuan Ultramafic Belt and schist of the Owen Stanley Metamorphics. The high grade metamorphics are gabbroic in composition with gneissic and probably cataclastic textures; the original rock may have been basalt or gabbro.

On completion of the traverse Davies and Barsdell visited the Iauga Formation type locality near Cape Ward Hunt. The Formation consists of a predominantly andesitic or dacitic pyroclastic sequence which becomes increasingly calcareous towards the top. A Tertiary $f_{1-2}$ stage has been determined for the calcareous part of the Formation. Davies had mapped part of the same unit further inland in the course of the Papuan Ultramafic Belt surveys.

The work by Davies and Barsdell near Cape Ward Hunt indicated deposition in shallow marine and littoral environments and showed that the limestone member is not a distinct rock unit but is rather a lime-rich horizon deposited during a period of less intense volcanic activity. The degree of faulting within the Iauga Formation leaves doubt as to whether the limestone is the uppermost unit of the Formation, as was earlier assumed. It might equally well be simply a lime-rich lens within the main pyroclastic sequence.

69102 New Ireland Regional Mapping

In January, Hohnen completed the compilation of the 1:50,000 Sheets of New Ireland. A B.M.R. Record is in preparation in Canberra.

At the end of March, Hohnen, Davies and W. Manser (University of Papua-New Guinea) visited New Ireland to collect material for micropalaeontological dating.

## MINERAL INVESTIGATIONS

At this stage in the development of the country an important feature of the work of the Section is the assessment of the Territory's mineral resources. This work has been hindered in the past by staff shortages but it is hoped that mineral assessments will form a considerable part of the future programme of the Section.

The need for Territory-wide mineral assessments is emphasised by the large number of mining company representatives who visit the Section to obtain information on mineral deposits and to consult the Data Files which are the repositories of all unclassified geological information relating to the Territory. Discussions with company personnel are an important, but time-consuming aspect, of the work of the Section.

A number of specific mineral investigations have been made (Fig.GS2).

Karkar Island Beach Sands

Following an application by a mining company for a Prospecting Authority to explore for beach sands on Karkar Island, Madang District, Tingey visited the island in May to assess the beach sand potential.

The island was formed by a Recent volcano which erupted basaltic lava and agglomerates. Ilmenite and magnetite which occur as accessory minerals in the lavas could be expected to form economic beach sand deposits under favourable conditions of concentration.

Tingey investigated beaches and sampled beach sands by pitting and by surface sampling. Mineralogical studies revealed low proportions of heavy minerals in the beach sands, although minor local concentrations

of more magnetite-rich sands did occur. The generally narrow beaches, the absence of dunes backing the beaches, and the presence of deep water close inshore, indicate that conditions for the accumulation of economic beach sand deposits have not operated on Karkar Island.

Baiyer River Diatomite

Tingey made a brief inspection in May of lake-beds near Baiyer River in the Western Highlands District to investigate the occurrence of samples of diatomite which had been sent to the Geological Office.

Reported Copper Occurrence, Kwama River Near Kabwum, Huon Peninsula

Grainger and Pieters visited a reported copper occurrence in the Kwama River while based at Kabwum during the June regional mapping programme. Copper mineralization had been reported in float material in a small tributary of the Kwama River but a study of the float at the locality failed to find mineralization other than very minor amounts of pyrite. The float consists of olivine basalt, agglomerate and tuff, and limestone.

At several localities in the Huon Peninsula native copper and associated secondary copper minerals occur as trace amounts in basaltic rocks, and geochemical stream sediment samples collected on previous surveys in the Saruwaged Range show high background values for copper related to the volcanic rocks.

Although no copper mineralization was evident in hand specimen at the Kwama River locality a collection of float material was made and submitted for assay to determine background metal values. Geochemical stream sediment samples were also taken. The assay and geochemical results have not yet been received.

Geochemical Surveys

It has been the practice to collect stream sediment geochemical samples during the Markham regional mapping surveys. The sample density has not been sufficient for mineral exploration purposes but the results of multi-element determinations will provide information on background values for the major rock types and may help to delineate broad areas worthy of more detailed work. The effectiveness of stream sediment sampling has been shown by the detection of known minor mineralization, and anomalies associated with minor serpentinite bodies.

Panned heavy mineral concentrates have been collected in conjunction with the stream sediment samples and mineralogical and geochemical determinations made on the concentrates. An assessment of the results and comparison with stream sediment geochemical determinations is to be made.

## MISCELLANEOUS

Grainger and Tingey were members of the B.M.R. geological party attached to the Australian National Antarctic Research Expedition for the 1970 summer field season. Tingey resumed duties in the Territory on 20th April and Grainger on 27th April. They both spent some time editing draft reports on the 1970 Antarctic field work.

Pieters was co-author of a paper entitled "The Dayman Dome - A Structure in Metamorphic Rocks caused by Pliocene to Recent Uplift" read at the 42nd ANZAAS Congress in Port Moresby in August. Tingey and Grainger assisted with ANZAAS tours illustrating the geology of the Port Moresby area.

A large number of specimens and samples were identified and submitted, where appropriate, for chemical determinations, for prospectors and members of the general public.

## ENGINEERING GEOLOGY SECTION

### INTRODUCTION

### STAFF AND MOVEMENTS

P.E. Pieters – Until February when transferred to Regional Mapping Section.

G.P. Robinson – Assumed duty 11th February. Is transferring to Regional Mapping Section in November.

G. Jacobson – Assumed duty 23rd March, and was stationed at Arona (Ramu Hydro-Electric Scheme) from 26th March to 12th August. Visited Canberra from 19th to 25th July in connection with the Ramu design report.

L. Macias – Assumed duty 9th July.

J. Harris – Assumed duty 24th October.

In addition, M.J. Jackson, B.M.R., Canberra, worked as Project Geologist on the Ramu Hydro-Electric Project from October, 1969, to 14th April, 1970.

Officers of the section were engaged in 11 projects and investigations. 2 Notes on Investigation and 1 B.M.R. Record were prepared. The scheduled programme had to be curtailed as a result of the lack of staff during most of the year. Some commitments to investigations for water supplies and roads could not be met. Locations of projects and investigations are shown in Figure GS3.

## HYDRO-ELECTRIC SCHEMES

Geological services were provided to the Commonwealth Department of Works for the following hydro-electric schemes:

### Ramu Hydro-Electric Scheme (69412)

Project geologists for the design investigation of Phase 1 of the Ramu 1 Project, Eastern Highlands, were M.J. Jackson (until April) and G. Jacobson (March to October). The investigation included detailed geological mapping of the intake area, costeaning and diamond drilling. Jacobson prepared a B.M.R. Record covering the results of the investigation.

The Ramu 1 Project will involve construction of an underground power station to utilise 700 feet of head at the upper end of the Ramu Gorge. The project is sited in folded and faulted Miocene sedimentary rocks, which have been intruded by dolerite dykes and sills and are overlain by Quaternary sediments. The power station will be 700 feet underground and will be excavated mainly in marble and dolerite. Associated underground works include an access shaft, pressure shaft and a tailrace tunnel, 7000 feet long. Surface works for the project include a diversion weir, control building and transformer yard and will be founded on greywacke, shale and dolerite which are in places weathered to considerable depths. Seismic effects and slope stability are important considerations in design of the project. Construction materials are expected to be available locally.

The Ramu 1 Project will supply power to Lae, Madang and the Highlands. Construction is planned to commence in 1971.

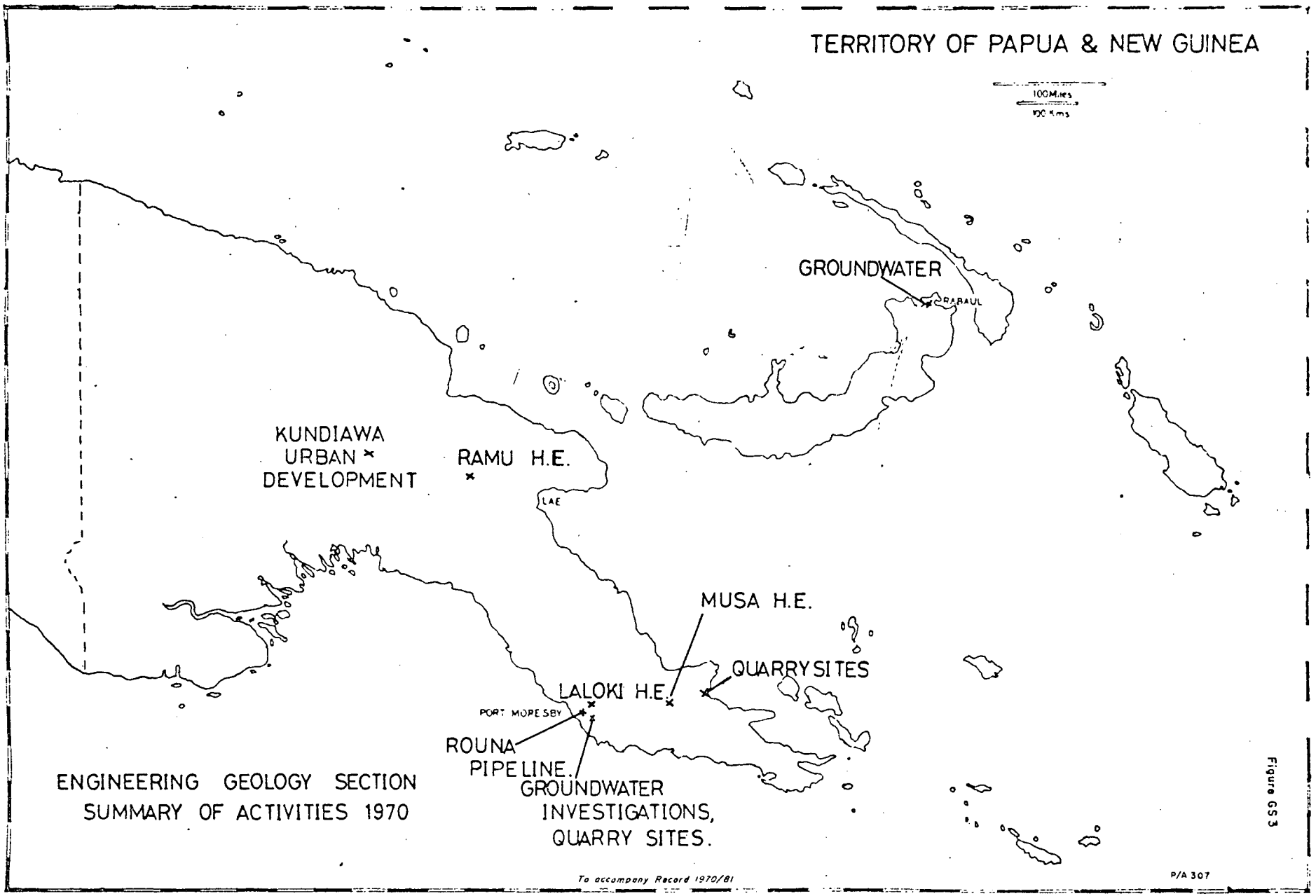
### Musa Gorge Hydro-Electric Scheme (70101)

The proposed hydro-electric scheme in the Musa Gorge, Eastern Papua, was investigated. L. Macias mapped the geology of several alternative damsites in the gorge, and was assisted by a B.M.R. geophysical survey in selection of the most suitable damsite. The dam will be founded on peridotite which is serpentinised in places and is generally closely jointed. Scree and hillwash deposits occur on the abutments.

G.P. Robinson mapped an area of 500 square kilometres surrounding the scheme and including the reservoir basin. Filling of a large reservoir is expected to increase seismicity in this area of active faults. The possibility of leakage from the reservoir was investigated, and a brief survey made of possible sources of construction materials.

### Laloki River Hydro-Electric Scheme

Geological work for the Laloki River Hydro-Electric Scheme, which supplies power to Port Moresby, continued throughout the year.


TERRITORY OF PAPUA & NEW GUINEA
100 Miles
160 Kms
GROUNDWATER
RABAUL
KUNDIAWA
URBAN
DEVELOPMENT
RAMU H.E.
LAE
MUSA H.E.
QUARRY SITES
LALOKI H.E.
PORT MORESBY
ROUNA
PIPELINE.
GROUNDWATER
INVESTIGATIONS,
QUARRY SITES.
ENGINEERING GEOLOGY SECTION
SUMMARY OF ACTIVITIES 1970
To accompany Record 1970/81
P/A 307
Figure GS3

Sirinumu Dam Stage 2 Construction (69401)

Construction work for Sirinumu Dam Stage 2 involved raising the main dam and five saddle dams by 22 feet, and construction of three new saddle dams and a new spillway. Geological supervision throughout the year was by G.P. Robinson who mapped the foundations using enlargements of photographs taken as excavation progressed. The main dam and spillway are founded on fresh agglomerate, the saddle dams are founded on weathered agglomerate. Advice was given concerning possible leakage and slope stability problems.

Rouna 3 Power Station (68422)

The site for the proposed Rouna 3 power station was investigated by G.P. Robinson. The power station will be founded on alluvial gravel. The slopes above are colluvium containing large boulders of agglomerate, and drainage will be necessary to increase slope stability.

Rouna 4 Power Station (70403)

G. Jacobson made a preliminary study of alternative sites for the proposed Rouna 4 power station, and a possible flume or pipeline route. The flume/pipeline route will traverse colluvial deposits containing large boulders of agglomerate. The application of geophysics to this problem is being investigated.

## GROUNDWATER

Groundwater Investigations, Central District

Groundwater investigations were undertaken by G.P. Robinson and P.E. Pieters at several localities near Port Moresby and elsewhere in the Central District. Drilling programmes were recommended at the following localities:

- Ecology Laboratory, Department of Agriculture, near Jackson's Airport;
- Laloki Plant Introduction Centre;
- Laloki Estate, 16 mile;
- near Kapa Kapa;
- Sapphire Small Goods, 16 mile;
- Kuriva River Farm, Kuriva;
- Bautama School, Mt. Diamond.

A water supply investigation was undertaken at Loloata Island but drilling was not recommended.

Investigations for village water supplies continued in the Central District, in collaboration with the Regional Health Office. A drilling programme is being undertaken in the Rigo, Sogeri and Vanapa areas.

Town Water Supply, Kwikila

G.P. Robinson investigated the town water supply of Kwikila, Central District. It is considered unlikely that the water shortage in Kwikila can be alleviated by further utilisation of groundwater, and a supply from the Kemp Welch River is the most practicable solution.

Groundwater Investigation, Tomaringa, New Britain (70401)

P.E. Pieters investigated groundwater conditions for the Police Station at Tomaringa in the Gazelle Peninsula, New Britain. Recommendations were made for drilling, and a Note on Investigation was prepared.

## OTHER INVESTIGATIONS

Rouna-Mt. Eriama Pipeline

G.P. Robinson inspected the geology of the Rouna-Mt. Eriama pipeline, which is under construction for the Port Moresby water supply. Problems were encountered with the foundations for and the stability of anchor blocks. Possible landslides necessitated the re-alignment of part of the pipeline.

Quarry Sites, Oro Bay, Northern District

Possible quarry sites in the vicinity of Oro Bay, 14 miles S.W. of Popondetta, were examined by G.P. Robinson. The most likely source or rockfill for wharf construction is from gravel beds in the Eroro River, 1½ miles from Oro Bay.

Quarry site, Mt. Laws, Goldie Road.

Altered gabbro being quarried at Mt. Laws, Goldie Road, is not satisfactory for some constructional uses. G.P. Robinson inspected the site and recommended a diamond drilling programme at a locality where unaltered dyke rocks could be quarried.

Kundiawa Urban Development (70402)

G.P. Robinson investigated slope stability problems affecting proposed urban development at Kundiawa. Slope characteristics in the area were mapped, actual and potential landslide areas delineated, and recommendations for drainage made in unstable areas. A Note on Investigation was prepared.

## VOLCANOLOGICAL SECTION

### INTRODUCTION

### STAFF AND MOVEMENTS

W.D. Palfreyman - Manam Island was visited between 29th and 31st December, 1969. Several aerial inspections of Ulawun volcano were made during January and one week was spent at the Ulamona field station between 2nd and 8th February during which time the Ulawun eruption was observed and trips made to the devastated area and southwest lava flow. Manam and Boisa Islands were inspected between 18th and 25th March. Aerial inspections were made of Mount Balbi and Mount Bagana on 4th May. Cape Gloucester was visited between 10th and 12th June to observe the renewed activity of Langila volcano. The annual programme conference in Port Moresby was attended in early October.

R.A. Davies - Observations of the Mount Ulawun eruption were made from the field station at Ulamona Mission between 16th January and 2nd February and between 7th and 16th February. Karkar Island was inspected from the air on several occasions between 3rd and 6th May. An aerial inspection was also made of Long Island during this period. A routine visit was made to the Esa'Ala Observatory during June. This was followed by an inspection of Mount Lamington. The ANZAAS Congress was attended between 16th and 21st August. The New Guinea Islands geological survey was begun on 24th August, finishing at Rabaul late in October.

M.G. Mancini - The two field seismograph stations in the Hoskins - Talasea area were inspected between 6th and 9th January. Assistance was given in the Mount Ulawun eruption investigations between 16th and 21st January. A routine visit was made to the Esa'Ala observatory between 4th and 18th March. Two field seismograph stations were operated near Mount Bagana between 3rd and 16th May. He took leave from 18th July and was subsequently transferred to Canberra.

## VOLCANIC ACTIVITY

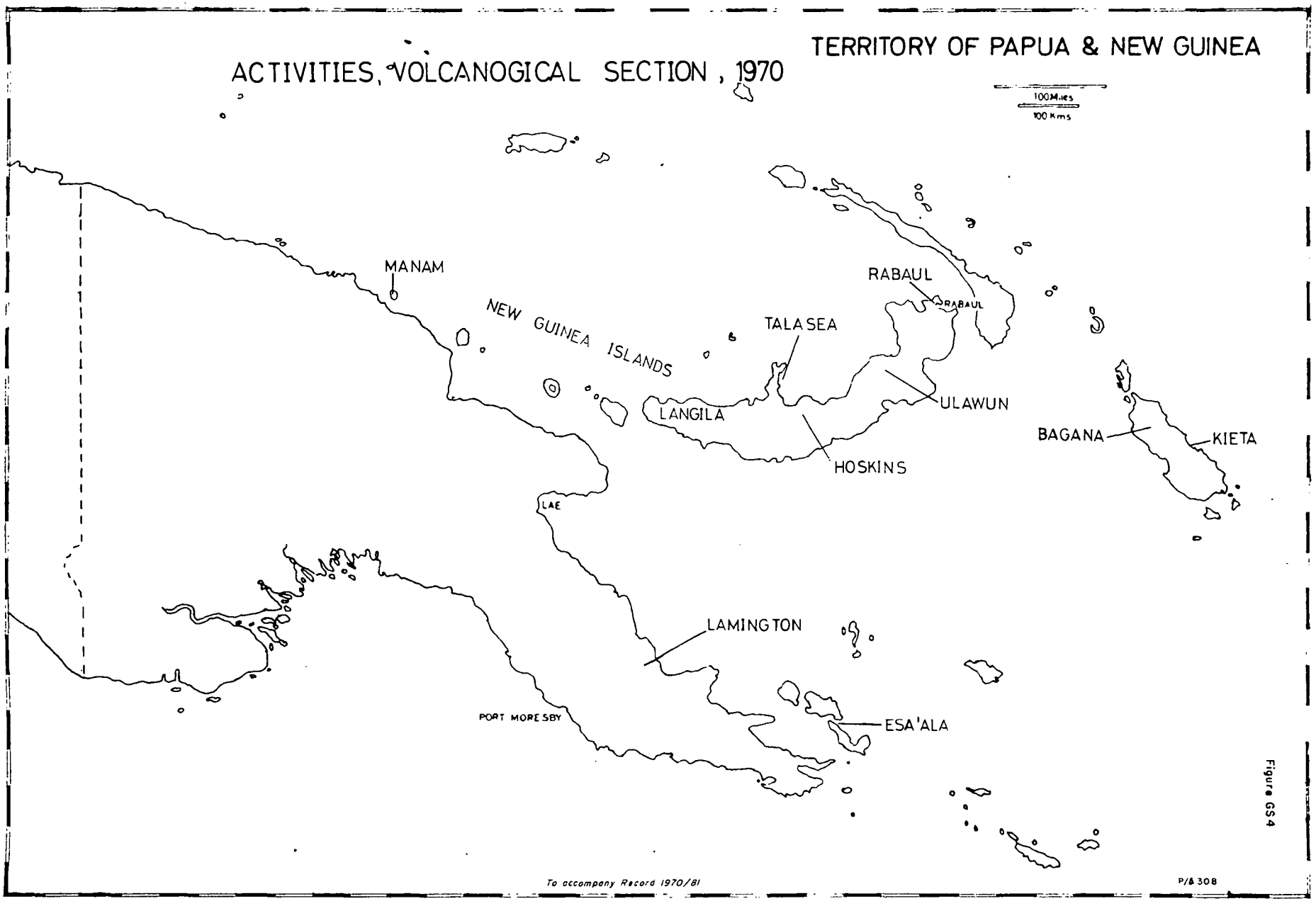
### Manam Volcano

The rhythmic ejection of brown or grey, ash-laden vapour at varying intervals from the main vent of Manam volcano continued, with minor fluctuations, until October. At times, the ejctions were accompanied by rumbling explosions of varying intensity and duration. Light falls of ash were recorded at Tabele and Waris on a number of occasions during the year but were most frequent during the first four months. A fluctuating summit glow was observed from the Tabele observatory on one or more occasions during every month.

Seismic activity, as measured by the daily count and average daily amplitude of the volcanic tremor, fluctuated through the year. From a peak attained on 4th January, this activity declined steadily, except for minor resurgences during February and March, until the end of April. Activity then increased slightly but had declined to its former level by the end of June. A further fairly pronounced resurgence became evident at the end of August and was maintained until the end of September.

### Ulawun Volcano

Ulawun volcano became active on 9th January after a period of inactivity of several years. Between 9th and 15th January, thin columns of grey, ash-laden vapour ascending from the summit crater were observed from the nearby Ulamona Mission. Activity rapidly built up from the 16th onward with an increase in the frequency of ejections and the volume of ejected material, so that by the 21st, dense ash-laden vapour was being ejected continuously from the three summit vents to a height of over 15,000 feet. This was accompanied by deep rumbling explosions and a continuous volcanic tremor of high amplitude. Night time observations revealed the ejection of incandescent material to heights of over 3,000 feet above the crater. At 0405 hours on the 22nd, a nuée ardente descended the northwest flanks of the volcano devastating an area of forest at the foot of the cone, approximately 1½ x 1½ miles. This was followed several hours later by a small lava flow. On the 26th two lava flows were expelled from vents located in the southern sector of the old crater; this activity continued until 9th February. Three small nuées ardentes punctuated this effusive activity on the night of the 26th - 27th. These travelled down the southern flanks of the cone and devastated a small area of forest. The forceful ejection of incandescent blocks and ash-laden vapour continued unabated until 2nd February when a distinct decline in activity was observed. Both the visual and seismic activity continued to decline until the eruption terminated on 9th February. Slight fumerolic activity has been evident from that date.


ACTIVITIES, VOLCANOGICAL SECTION, 1970
TERRITORY OF PAPUA & NEW GUINEA
100 Miles
100 Kms
MANAM
NEW GUINEA ISLANDS
RABAUL
RABAUL
TALASEA
ULAWUN
LANGILA
HOSKINS
BAGANA
KIETA
LAE
LAMINGTON
PORT MORESBY
ESA'ALA
Figure GS4
To accompany Record 1970/81
P/A 308

Bagana Volcano

Dense white vapour emission has been continuous from the summit region of Mount Bagana during the year. A lava protrusion which commenced growth after the 1966 eruption now completely fills the old crater. Small blocky flows periodically issue from this mass and move several hundred yards down the flanks of the cone.

A white mushroom shaped eruption cloud was seen above the summit on the 3rd February and a red summit glow was observed that evening. An explosion was heard from the direction of the volcano on 24th February, and white eruption clouds were again seen on 10th, 18th, and 20th June. Dense, grey, ash-laden vapour emission seen on the morning of 31st July was preceeded by a summit glow.

Langila Volcano

Summit activity at Langila volcano was renewed during late May after a period of repose of seven months. Initially, this consisted of the emission of small quantities of white vapour from the No. 2 crater. More vigorous activity was initiated on 1st June with the ejection of a dark grey, ash-laden vapour cloud accompanied by a loud explosion; similar ejections took place on 6th and 8th June and 4th July. The quiet emission of white vapour was continuous throughout this period. The main phase of the eruption commenced on the morning of 12th July when a further ash ejection was reported. This was followed by several more later in the day. This pattern of periodic ash ejections punctuating continual white vapour emission continued until the middle of August. A peak in activity was reached around the end of July when ash ejections averaged one per hour. The ejection of incandescent boulders was observed on several evenings at this time.

Balbi Volcano

An aerial inspection made on the 4th May showed that activity has not changed since the last inspection in July, 1968. Activity is confined to the western and southeastern walls of crater B and to the sulfatara field to the west.

Karkar Volcano

The summit crater was entered at the beginning of the year by a local resident. He reported some activity from the smaller of the two secondary cones. This was not evident during the last inspection made in 1964.

Aerial inspections carried out in May failed to reveal any new activity.

Long Island Volcano

The small cinder cone which lies within the crater lake was inactive when examined from the air in May.

Mount Lamington Volcano

An inspection carried out in late June showed that there is considerable fumerolic activity at and near the summit of Mount Lamington. Temperature readings were taken of active areas on the floor of the crater, at the base and on the flanks of the dome, and on the summit of the dome. At several places temperatures in excess of 200°C were recorded. Local residents say there is evidence of continuing dome growth.

## SPECIAL PROJECTS AND INVESTIGATIONS

Ulawun Eruption Investigation (70501)

A preliminary report by R.A. Davies, in collaboration with M.G. Mancini, has been published by the Smithsonian Institute. A more detailed final report in the form of a Note on Investigation has been prepared.

Rabaul Caldera Structure Study (70502)

Use was made of seismic data from a number of local explosions, both on land and underwater, in an attempt to elucidate the structure of the Rabaul Caldera. Data from previous Crustal Study Projects were also used. A Note on Investigation has been prepared.

Seismic and Volcanological Investigations - Mount Bagana (70503)

Seismic investigations were conducted in the Mount Bagana area during May. A Note on Investigation has been prepared detailing the methods and equipment used and the results obtained together with an account of recent volcanic activity.

Seismic and Volcanological Investigations - Mount Lamington

An investigation team visited Mount Lamington at the end of June. A site for a telemetry seismograph station was found on the upper flanks of Mount Lamington and installed equipment worked satisfactorily until a technical failure in July. New equipment was installed later in the year. The crater and dome of the volcano were inspected and the temperature of a number of thermal areas recorded.

Analysis of Tabele Seismic Records

A plot of the daily count and average daily amplitude of the continuous volcanic tremor recorded on the Tabele records was commenced as from June, 1969. It is hoped that these plots will prove to be a reliable gauge of volcanic activity.

Temperature Recording - Tavurvur Crater

A continuous recording thermograph was located at the various thermal points in Tavurvur crater during the year. The graphs obtained show that, except for one point, the temperatures of the thermal areas are constant within the range 98° - 100° C. No readings in excess of 100°C were obtained.

Data Extraction from Various Observatory Files

Data cards listing all available references, both published and unpublished, relating to the various volcanic areas have been produced. Work was commenced on extracting various data from these sources as a preliminary to the compilation of definitive files on each area.

## ROUTINE ACTIVITIES

### Volcanological

Rabaul

Weekly temperature recordings were made at the thermal areas at Sulphur Creek, Rapindik, Sulphur Springs, Rabalanakaia, Tavurvur and Vulcan throughout the year. No significant temperature changes were observed.

Manam Island

Routine visual observations of volcanic activity were made from the Tabele Observatory and from Waris throughout the year.

D'Entrecasteaux Islands

Regular weekly temperature recordings at the thermal areas on Normanby and Dobu Islands did not reveal any significant temperature variations during the year.

### Seismological

A total of 27 seismic records per day (excluding records from portable field stations) were obtained from the local and regional stations (the latter includes the Bougainville Copper station at Kobuan). A Preliminary Earthquake Analysis was regularly produced on a weekly basis. Daily telegrams containing data on significant earthquakes were forwarded to the American Embassy, Canberra for transmittal to U.S.C.G.S. Data for I.S.C., Edinburgh, were forwarded on request.

A number of recommendations proposed by the Seismic Review Committee were put into effect during the year and resulted in considerably reducing the routine work load.

The Institute of Geological Science's seismograph station network was established during the year and data obtained was of considerable assistance in the analysis of local shocks.

Seismic Activity During 1970

A total of 2146 earthquakes were recorded at Rabaul between 1st January and 7th September.

The number of regional shocks (less than 10° distant) with computed local magnitude greater than 5 recorded at Rabaul, are as follows:

| | | | |
|---|---|---|---|
| January | 14 | May | Not Computed |
| February | 10 | June | 15 |
| March | 16 | July | 13 |
| April | Not Computed | August | 21 |

There were twenty shocks felt at Rabaul between January and September.

A swarm of sinusoidal tremors was clearly recorded on all Harbour Network stations during April, May and June. A peak of 200 per day was recorded on 14th April. This had decreased to 130 per day by the 16th and the average for May was 40-50 per day. The original epicentre, computed at 04½°S, 152°E, is now under debate and an origin close to, or under Rabaul cannot be excluded.

The periodic seismic storm affected the Normanby Island area again between 7th and 10th May. The four largest shocks were felt with Intensity III-IV at Sehulea and Ganawe on the 8th. Two of these shocks registered a $M_L$ of 5.8 at Rabaul. Approximate epicentre co-ordinates are 10°00'S, 151°00'E.

## STATIONS AND EQUIPMENT

Central Observatory, Rabaul

The construction of the new building was completed in December, 1969 and was occupied towards the end of the month. The technical section stores were completely reorganised and index cards and a stores vocabulary were produced.

W.W.S.S. Equipment

Routine maintenance was carried out and minor faults attended to. Calibration tests were carried out between 3rd and 6th August.

Rabaul Harbour Network

Station RAL was inoperative from 13th-20th February owing to cable damage. Station VUL was rendered inoperative on 2nd March by a lightning strike. Regular maintenance was carried out through the year.

Keravat Station

The station operated satisfactorily apart from a breakdown between 27th-29th March due to a broken drive belt.

Agenahambo Station

Routine inspections were made between 11th and 13th February and 27th and 29th June. The Willmore recorder was replaced in February and July.

Tabele Observatory

Operated satisfactorily throughout the year apart from battery charger failures which closed the station between the 8th and 25th June.

Waris Station

Tiltmeter readings were received for most of the year. Difficulty was encountered on several occasions with the battery charger. The part-time observer proved unreliable and was replaced in October.

Esa'Ala Observatory

An inspection was made between 7th and 13th January when a crystal chronometer was replaced and various minor faults attended to. A further inspection was made between 25th and 30th June and also in November. Drifting, caused by changes in ambient temperature, was reduced somewhat by placing a styrofoam box over the galvanometer control box of the L.P. E.W. component.

Ulamona Field Station

A three component portable Willmore seismograph station and a smoked paper Sprengnether recorder connected to a 6 cycle geophone were installed at Ulamona at the commencement of the Ulawun eruption in January. The station gave satisfactory results and was closed on the 18th June.

Tiltmeter readings were received regularly from the part-time observer.

Garbuna Field Station

Operated satisfactorily until closed down on 8th January.

Pago Field Station

Operated satisfactorily until closed on 11th January owing to lack of transport.

Piva Field Station

A telemetry seismograph station was established on the flanks of Mount Bagana during May. A reference station was operated simultaneously at Piva. Recording time was reduced because of inadequate battery facilities. Radio interference also proved a problem.

Regular tiltmeter readings were received throughout the year from the part-time observer.

Mount Lamington Field Station

A telemetry seismograph station was established on the flanks of Mount Lamington during June. The records were marred somewhat by radio interference and by a technical fault. The unit was replaced by modified equipment later in the year.

Cape Gloucester Field Station

A portable station was established at Cape Gloucester on 25th July. Its operation was hampered by the lack of adequate battery facilities. The station was closed on the 12th August.

Technical Development

A portable smoked paper Sprengnether recorder was successfully put into operation. This involved the building of a preamplifier and a suitable carrying case.

A telemetry system using a modified Pony transceiver as a bearer was successfully developed and field tested around Rabaul and at Mount Bagana and Mount Lamington. A second unit incorporating several modifications was subsequently developed.

Design work and drawings were completed for the new telemetered surveillance equipment.

# MAP EDITING AND COMPILATION

## EDITING

Twenty six final-edition maps and their accompanying explanatory notes were edited during the year (22 standard series, scale 1:250,000; 4 at scale 1:500,000).

## Compilation

Geological Map of Australia and Oceania, Scale 1:500,000 (G.E. Wilford; Miss B.K. Graham).

The first draft of sheet 1 showing the title and general reference was compiled by G.E. Wilford. Drafts of Sheets 9 and 13 were received from the Geological Survey of New Zealand, and suggestions for amendments were sent to G.S.N.Z.

International Geological Atlas: Sheet 15 - Australia and Oceania, Scale 1:10,000,000 (Miss B.K. Graham)

The final compilation at 1:6,000,000 scale, was forwarded to the Commission for the Geological map of the world, Paris, where it will be published at 1:10,000,000 scale.

Groundwater Maps of Australia, Scale 1:5,000,000 (G.M. Burton; T. Plumb; N.O. Jones; G.E. Wilford).

See under "Engineering Geology and Hydrology - A.W.R.C."

Tectonic Map of Australia, Scale 1:5,000,000 (H.F. Doutch, K.A. Plumb; Miss R.G. Warren, M.J. Rickard (A.N.U.))

The new Tectonic Map of Australia and New Guinea, which the Geological Society of Australia is to publish, is nearing completion; publication is hoped for in 1971. The Commonwealth Territories Divisional Sub-Committee of the Tectonic Map Committee (listed above) is responsible for compilation of the Northern Territory, the Kimberley district of Western Australia, Papua-New Guinea, and most of Queensland; it is also responsible for co-ordinating all the other State Sub-Committees' drafts and compiling the final map of the whole continent. It has been mainly responsible for determing the basic concepts of the map and designing the legend and colour schemes. Close liason is being maintained with the compilers of the Metallogenic Map of Australia.

Editing and corrections are in progress. Explanatory Notes will be produced later.

Metallogenic Map of Australia and Papua-New Guinea, Scale 1:5,000,000 (I.R. McLeod, Miss R.G. Warren)

The map is being published on behalf of the Subcommittee for the Metallogenic Map of the World, a subcommittee of the Commission for the Geological Map of the World.

State Geological Surveys, several companies, and interested individuals have commented on the map and notes.

Close co-operation and interchange of ideas with the Tectonic Map Committee of the Geological Society of Australia continued; the tectonofacies base of the metallogenic map is adapted from the draft Tectonic Map of Australia.

Compilation is now completed and the commentary is being written.

Geology of the Northern Territory, Scale 1:2,500,000 (G.E. Wilford)

A draft solid-geology map, and legend, has been compiled; it still has to be checked and have structure, Cainozoic deposits (as an overlay) and age data added to it.

Geology and Minerals Map, Burdekin Queensland, Scale 1:1,000,000 (A.G.L. Paine, Miss R.L. Cameron)

The map and notes have been edited and sent to the Geographic Section of the Water, Power and Geography, Branch Department of National Development, for publication in the "Resources" series.

Geological Map of the Burdekin Area, Queensland, Scale 1:500,000 (A.G.L. Paine; Miss R.L. Cameron).

The first draft has been compiled and drawn; A.G.L. Paine has to make any additions needed and to write accompanying notes.

CONFERENCES

Miss R.G. Warren attended the Archaean Symposium in Perth, 25th-31st May.

## INDEXES AND MINERAL REPORTS

The functions of the group are to compile geological reports on the mineral deposits of Australia, to maintain indexes of mineral deposits and stratigraphic nomenclature, and to keep technical files up-to-date and provide information from them as required.

In addition to their normal duties, members of the group during the year have worked part-time in the map compilation and engineering geology groups. McLeod has also been engaged on Antarctic geology and information, editing and data storage and retrieval matters.

### Stratigraphic Index (Miss E. Rosenberg, Mrs J. Smith - part time)

The Stratigraphic Index reached its full complement of staff for the first time in nearly two years in December, 1969. Two Honours Geology graduates are now employed in the Index with some typing assistance (averaging about 6 hours a week).

Enquiries continued to come in from State Surveys, Universities, and companies regarding availability of stratigraphic names and their priority. An average of four written enquiries and several enquiries by telephone are received each month. In addition, numerous requests for information come from within the Bureau.

The indexing of stratigraphic names in current literature continued; some earlier literature which had not been indexed due to lack of staff was also dealt with. The index now contains some 13,000 published stratigraphic names. About 1240 names are reserved in the index, for publication at a future date.

When possible, newly appointed geologists, class 1, spend a month working on the index. This serves two purposes: it helps new geologists to become familiar with the use of formal stratigraphic names and also helps with the indexing of periodicals.

The bimonthly variations list, containing new proposed names and first publication of stratigraphic names, continued to be sent to State Surveys, Universities, and interested companies.

As can be seen from the table below, the number of invalid names has declined considerably; this is a gratifying result of the increasing knowledge of the existence of the Index. The figures are for 1969 calendar year; those in brackets are for the same period of 1968.

| | Qld. | N.S.W. | Vic. | Tas. | S.A. | W.A. | N.T. | TPNG | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Proposed Names | 26 | 134 | 7 | 5 | 6 | 28 | 26 | 15 | 247 |
| | (36) | (30) | (9) | (25) | (9) | (14) | (17) | (41) | (181) |
| Proposed names | 42 | 66 | - | - | 1 | 1 | 6 | 8 | 124 |
| now published | (30) | (8) | (6) | (-) | (19) | (22) | (8) | (-) | (93) |
| Other new names | | | | | | | | | |
| Formal | 3 | 59 | 1 | - | - | - | - | 3 | 66 |
| | (1) | (-) | (-) | (-) | (-) | (-) | (-) | (1) | (2) |
| Informal | 1 | 9 | - | - | - | - | - | - | 10 |
| | (12) | (7) | (-) | (5) | (4) | (15) | (3) | (2) | (48) |
| Invalid | 1 | 8 | - | - | - | - | - | - | 9 |
| | (5) | (3) | (2) | (4) | (3) | (1) | (-) | (-) | (18) |

Mineral Indexing and Mineral Reports (I.R. McLeod; Mrs P. Thieme)

The index to published literature on Australian mineral deposits was maintained together with the index of reserves of Australian mineral deposits.

Numerous enquiries about Australian mineral resources were attended to. The 'Nickel' and 'Iron Ore' chapters of Bulletin 72 were revised. Publication of these chapters, along with the "Phosphate" and "Aluminium" chapters, was held up by staff shortages in the Drawing Office.

Technical Files

Recording and indexing of unpublished data in the technical file system continued. A large amount of time was spent on the excision and filing of newspaper clippings, the volume of which has increased markedly since the "mining boom". Occasional clerical help was available. Towards the end of the year, several field geologists spent a period of 2 weeks each assisting with filing. Use of the files by staff of the Branch and of other Branches is decreasing: apparently many staff members are unaware of the existence of the Technical Files.

# MUSEUM AND TRANSIT ROOM

## MUSEUM

This report covers the period 1st October, 1969 to 30th September, 1970.

### Registration of rocks, minerals and fossils:

Approximately 9,000 rocks collected by Bureau field parties were registered and placed in storage during the year. This involved the removal of about 450 boxes of samples to the Fyshwick rock store.

A further 40 speciments collected by various Bureau staff members were registered and placed in the museum mineral and fossil collections.

### Commonwealth Palaeontological Collection:

Type fossil numbers from CPC 11314 to CPC 11396 were allotted to various authors during the year, and the following type specimens were placed in storage in the strong room (Room 1):-

| | | | |
|---|---|---|---|
| CPC 8125 - CPC 8324 | Bonaparte Gulf brachiopods | (J. Roberts) |
| CPC 8461 - CPC 8660 | Bonaparte Gulf brachiopods | (J. Roberts) |
| CPC 10423 - CPC 10435 | brachiopod Uncinulus | (P.G. Flood) |
| CPC 10500 - CPC 10650 | Taemas Fauna | (B. Chatterton) |
| CPC 10790 - CPC 11126 | Bonaparte Gulf brachiopods | (J. Roberts) |
| CPC 11323 - CPC 11340 | Antarctic plant fossils | (M.E. White) |

There are now approximately 9,000 type fossils stored in the strong room and occupying about 55% of total drawer space.

A reorganisation and stocktake of the type collection was commenced in February, 1970. Previously, type fossils were either stored according to taxon or grouped together according to author, and these inconsistencies placed heavy reliance on the cataloguing system (which is far from complete) in attempting to locate a particular specimen. The rearrangement now being undertaken involves placing the types in numerical order. This should greatly simplify the location of specimens and facilitate stocktaking. Some 1,500 types have been rearranged so far. In many instaces specimens have had to be numbered, necessitating reference to figures in the relevant publication in each case. In addition an attempt has been made to reduce the proportion of cardboard per unit of storage space, as up to 40% of space may be wasted by using unusally large specimen containers.

Two card systems and a register have been used at various times in the past to catalogue type specimens, but all three are incomplete. Updating the card systems would involve several years time-consuming work and would only achieve a duplication of information already available in the original publications and the catalogues prepared by Dr. I. Crespin. For this reason the register has been used during the year to catalogue new types, and is being progressively brought up to date. This system serves the purpose of providing name, locality, reference and storage location information for each CPC numberand enables the full use of all numbers allocated to a particular author to be determined at a glance.

Campbell Collection

During the year a reorganisation of the Campbell Collection of Broken Hill minerals was undertaken. 670 of the most valuable specimens are now stored in the museum in the following chemical groupings according to Dana's system of mineralogy:-

1. native elements
2. sulphides, arsenides, arsenides, etc.
3. oxides and manganates
4. carbonates
5. silicates
6. phosphates, arsenates and vanadates
7. sulphates
8. tungstates and molybdates.

Each speciment has been numbered and catalogued in an alphabetical cardsystem. These specimens constitute one of the best collections of Broken Hill minerals in Australia.

Plant Fossil Collection

In August and September a reorganisation of the large collection of plant fossils held in the museum was carried out. Thirty-three boxes of material were removed to the Fyshwick store leaving only specimens figured in BMR Records to be accommodated in the museum. Some 2,000 specimens were entered in the fossil register and several crates of plant fossils were unpacked and registered. A number of specimens figured in records had been refigured in BMR Reports and Bulletins and were therefore renumbered and transferred to the Commonwealth Palaeontological Collection.

Rock and mineral sets for educational purposes and displays

A number of requests for rocks and minerals for displays and educational purposes were handled during the year. These included three display collections each of twenty-nine large ore mineral specimens from most of the better known mining areas in Australia

prepared for display in Australian embassies in Geneva, Washington and Brussels, and a collection of eighty-nine common rock, fossil and mineral specimens sent to the Geological Survey of Fiji for teaching purposes in the training of geological assistants. Dr Barabanov, of the University of Leningrad, was given a collection of minerals, and smaller rock and mineral sets were supplied to Lyneham High School and the Bairnsdale Technical School. In addition, groups of rocks and minerals were brought together to illustrate lectures on various geological topics given by several Bureau staff members. Specimens from the museum collections ere exhibited in the display case in the foyer at various times during the year.

## Visitors to the museum

There were on the average about six visitors to the museum per week during the year. Many of these brought in rock, mineral or fossil specimens for identification, and there were a number of more specific enquiries regarding suitability of various rock types for such purposes as blue metal quarrying and use as building stone. Scientists from the C.S.I.R.O. Division of Soil Research brought in a number of bedrock samples for identification in relation to study of toxicity in soils. Student groups from Campbell and Lyneham High Schools were shown through the museum and examined the collections.

## Field work and collecting trips

T. Nicholas acted as geologist-in-charge at the vacation student camp from 1st to 8th February 1970.

P. Tonkin spent 3½ months mapping in the Tennant Creek 1:250,000 Sheet area.

Mineral specimens from Ardlethan, Tilba Tilba, Rockley and Kyogle and fossil specimens from Khan Yunis Wyanbene and Good Hope were collected by museum staff.

## Transit Room

The officer in charge of the transit room sends on to the appropriate contractor, or group in the Bureau, samples submitted for thin-sectioning or detailed laboratory work, and arranges, where necessary, the appropriate financial documentation. An average of about 1,100 samples are handled each month.

He also stores, catalogues, and maintains a loans register of all petrological thin sections.

Plans were made some years ago to store sample information on punch cards, but were only partly implemented. The system proposed was reviewed during the year, with the object of using computer storage and retrieval methods for sample data. The sample submission form has been re-designed and has been in use for the 1970 field season; it has received favourable comment from the users. As time allowed, further work was continued in preparation for the card-punching of data on all samples submitted. The transit room officer will be responsible for this work.

## GEOLOGICAL DRAWING OFFICE

Set out below is a statement of the work in progress at 30th October, 1970 and of work performed in the twelve months preceding that date.

The position with regard to standard map sheets is presented pictorially in the frontispiece to the Record.

### SHEET MAPS

#### 1:250,000 Series

26 sheets published (including 4 sheets compiled by the Geological Survey of Western Australia)

1 " reprinted (compiled by the Geological Survey of Western Australia)

13 " in press

14 " fair drawing in progress

1 Special Map (South Sepik Region) fair drawing in progress

#### 1:500,000 Scale

1 Sheet published (Tambo-Augathella)

5 " reprinted (Georgina Basin, Kimberley East)

3 " in press (Amadeus Basin E & W, Papuan Ultramafic Belt)

1 " fair drawing in progress (Cape York Peninsula)

1 " " " completed, ready for printing (Drummond Basin)

#### 1:63,360 Series

2 Sheets in press

Australia and Oceania, Scale 1:5,000,000

Sheets 6, 7, 11, 12 reprinted

Sheet 1 (Reference Sheet) drawing of final compilation in progress

Metallogenic Map of Australia and New Guinea, drawing of final compilation in progress.

Tectonic Map of Australia and New Guinea, drawing of final compilation in progress.

Geological Atlas of the World, Scale 1:10,000,000 (sheet 15 - Australia and Oceania compilation complete.

PRELIMINARY MAPS (1:250,000,000)

19 sheets published
5 " in press
17 " in progress

1:1,000,000 scale, 2 sheets in progress

PHOTOGEOLOGICAL MAPS (various scales)

9 sheets completed

MISCELLANEOUS MAPS

Bowen Basin 1:1,000,000 3 plates, fair drawing in progress

Yass Basin 1:30,000, fair drawing in progress

Pictorial Index, 27 maps in press

Cloncurry 1:100,000 fair drawing in progress

DRAWING FOR RECORDS, REPORTS, EXPLANATORY NOTES, BULLETINS AND EXTERN. PUBLICATIONS

948 drawings completed
17 " in progress