COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1966/195

ANNUAL SUMMARY OF ACTIVITIES, 1966.

COMMON SERVICES SECTION - GEOLOGICAL BRANCH

15928/65

ANNUAL SUMMARY OF ACTIVITIES, 1966.

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ENGINEERING GEOLOGY AND MISCELLANEOUS INVESTIGATIONS.

INTRODUCTION

Engineering geology, mainly in Commonwealth Territories, continue to form the main field activity of the sub-section. Groundwater investigations including drainage problems, mainly in and around the A.C.T., were maintained during the year. Laboratory work was confined to the testing of building stones and petrographic studies relating to engineering projects and construction materials; some sieve analyses of sand samples were made.

Within the office, compilation of special maps, editing of maps for publication, maintenance of the stratigraphic index and technical files, preparation of stratigraphic lexicons, compilation of a catalogue of building stones, and editing of reports written by staff of the sub-section and of Territory Resident sections, occupied the attention, either full-time or part-time, of nine professional members of the sub-section.

Engineering geology services in Papua - New Guinea, except for the Port Moresby No.2 hydro-electric project at Rouna, were provided by engineering geologists of the P.N.G. Resident Geological Section (J.P. MacGregor and J.R.L. Read). Services for the Port Moresby No.2 hydro-electric project, under construction, were provided by a resident project geologist directed from Canberra. Technical supervision of engineering geology work in P.N.G. was provided by the Supervising Geologist in charge of the Engineering Geology and Miscellaneous Sub-section, in Canberra. Most of the engineering geology services in the Northern Territory were provided from Canberra.

STAFF

E.K. Carter	- Geologist, Class IV, in charge.
D.E. Gardner	- Geologist, Class III, Engineering geology.
G.M. Burton	- Geologist, Class III, Map editing, map compilation and A.C.T. hydrology.
Mrs. F.I. Townsend	- Geologist, Class II, Technical files.
Miss B.K. Graham	- Geologist, Class II, Map compilation (part time only).
I.R. McLeod	- Geologist, Class II, Map compilation (part time only)
I.S. Cumming	- Geologist, Class II, Project geologist, Port Moresby No.2 hydro-electric project, P.N.G. (under construction).
H.F. Doutch	- Geologist, Class II, Map compilation (part of year only).
E.J. Best	- Geologist, Class II, Project geologist, Corin Dam, A.C.T. (under construction. Position created March, 1965) for eighteen months).
W. Oldershaw	- Geologist, Class I, Engineering geology and petrology. (Resigned, 28th January, 1966).
M. Plane	- Geologist, Class I, Map editing (part time only).
Miss C. Mitchell	- Geologist, Class I, Stratigraphic Indexing. (Resigned 21st October, 1966).
Miss L. Yendall	- Geologist, Class I, Stratigraphic indexing, (Part of year only; loaned to N.T.Resident Geological Office, Darwin, for three months).
G.A.M. Henderson	- Geologist, Class I, Engineering geology.
Miss R.G. Warren	- Geologist, Class I, Commenced duty 11th March, 1966; map compilation and catalogue of building stones used in Canberra.
Miss C. Newbigin	- Geologist, Class I, Commenced duty 21st March, 1966; testing of building stones, petrography.
J.C. Braybrooke	- Geologist, Class I, Commenced duty 4th October, 1966; engineering geology, Northern Territory.

Six university students were employed on vacation work during December 1965 - February, 1966. Work performed included collating of data for map compilation, establishment of a catalogue of building stones in use in Canberra, petrography and field mapping of engineering project sites and development areas. The students made an effective contribution to the work of the sub-section; the effectiveness of final year students, however, was somewhat reduced by their early departure, in some cases at short notice, to undertake field work for their honours year.

Three to four field hands were employed on engineering geology and hydrology work during the year. Early in the year the Public Service Board approved the creation of a designation "Field hand, Grade 2" and three field hands are now classified at this grading. Turnover of field hands has been much less rapid than in 1965 but wages employees are still paid much less than their work justifies. The creation of technical assistant positions is still very necessary.

PROGRAMME FULFILMENT.

The programme for 1966 for engineering geology is complete except for the following:

Burbong damsite, A.C.T. - report written but not yet issued.
Gudgenby damsite, A.C.T. - not investigated, to be undertaken in next three months.
Rippability studies by E.J. Polak - assistance not sought.
Building stones - Record on testing of sandstones not written on account of resignation of W. Oldershaw.
A Record has been written on the testing of slates.
Scrivener Dam, A.C.T.Completion Report - not started.
Secretariat Building, A.C.T., foundations report - in progress.
Upper Ramu hydro-electric scheme, T.P.N.G. - design report for underground power station not complete on account of supplementary investigations required. Report on surface power station scheme not started.
Musgrave River hydro-electric development, P.N.G., Aerial investigation of four river systems for possible power development for Port Moresby to be made in November. Field inspections of selected sites probably in January.
Adelaide River damsite, Northern Territory, and Stapleton Creek damsite, N.T. Investigations in progress; should be completed by end of 1966. These exceed our firm programme commitment.

The hydrology programme for 1966 will be completed during the year. The Jervis Bay investigation has been extended to include an engineering geology evaluation and will be completed in 1967.

Map compilation commitments have not been completed owing to considerable extra work that had to be done on Sheets 2, 3, 4 and 5 of the Australia and Oceania 1:5,000,000 geological map,and the experimental nature of the 1:5,000,000 scale metallogenic map of Australia (to which attention was drawn in the programme). Compilation of Australia and Oceania Sheet 10 is complete and Sheet 8 will be completed by the end of the year. A trial compilation of the northern part of Australia and Papua - New Guinea has been completed for the metallogenic map of Australia. The final compilation is not expected to be complete until late 1967. Considerable additional map compilation, particularly contributions to a litho-morphological map of Australia for Land Research Division of C.S.I.R.O. beyond that programmed for, was undertaken during the year. Not all work programmed on account of the Resources Information and Development Branch of the Department was, in fact , requested.

The map editing programme was completed in terms of the number of sheets processed; a number of substitutions of sheets was made by field supervisors.

AUSTRALIA

1966 SUMMARY OF ACTIVITIES ENGINEERING GEOLOGY & MISCELLANEOUS INVESTIGATIONS

Adelaide River Damsite

Stapleton Creek Damsite

Iron Ore Port

Goulburn Slate

Jervis Bay Water Supply & Dune Sand

Burbong Damsite

Canberra Various

Bendora Water Main

Corin Dam

To accompany Record 1966/195

AUS/2/72

Work continued through the year on stratigraphic indexing and the technical files. For half the year only one person was engaged on stratigraphic indexing, but checking current literature was kept up to date and progress was made in other directions.

RESUME OF ACTIVITIES NOVEMBER-DECEMBER, 1965.

In the period November-December 1965 the main new activities initiated were:

Detailed preliminary investigation of the upper Burbong damsite, Molonglo River, A.C.T.
Mapping and seismic testing of the proposed route of a water main from Mount Stromlo to Oakey Hill, Woden district, A.C.T.
Seismic timer investigation of foundation conditions for a possible weir at the Cotter Swimming Pool, A.C.T.
Further mapping on the Belconnen development area, A.C.T.
Setting up a catalogue of building stones used in the A.C.T.
Testing of Goulburn Slate as a high quality paving stone.
On the Upper Ramu hydro-electric scheme drillhole DD.20 was abandoned and DD.20A started.
An inspection was made, and drilling and costeaning designed, for the Adelaide River gorge damsite, Northern Territory.

Several of these projects continued into 1966. Investigation of, and report-writing on, a number of projects continued through November and December and continuing field and office activities were maintained as required.

ENGINEERING GEOLOGY

AUSTRALIAN CAPITAL TERRITORY

Engineering Projects

Corin Dam: Upper Cotter River. Construction of Corin Dam commenced in April. At the end of October the quarry site had been almost completely stripped of soil and siltstone to expose the quartzite which will provide the rock-fill for the 250-foot high earth-cored rock-fill dam. The 1300-foot diversion tunnel had been excavated and lining with concrete was well advanced. The foundations for the earth core had been cleaned down and consolidation grouting was in progress. A few holes for the curtain grouting had been started. A small amount of rock-fill and earth-core had been placed for the coffer dam (which will form the upstream toe of the completed dam) and some rock fill had also been placed for the main dam. Substantial progress had been made with the excavation for the spillway chute.

Geological advice, mapping of exposures and recording of grouting data, were maintained as required through the whole period.

The points of greatest interest about developments to date are: Owing to the presence of clay on joints, shears and bedding a large part of the diversion tunnel was supported by steel sets by the contractor. Rock bolts could probably have been used in some places where steel sets were placed.

Stripping of the quarry site has revealed extensive faulting which has required some modification of quarry design.

Very substantial grout takes have occurred in some of the "B" holes for dam foundation consolidation; use of a sand-cement mix has been recommended in places. Some difficulty has been experienced in stabilizing and supporting the rock wall in places on the left side of the spillway chute cut.

Geological conditions, in general, have so far proved to be in good agreement with interpreted conditions.

Burbong Damsite. Mapping of the upper Burbong Damsite, Molonglo River, was started in November, 1965 and finished in January 1966. A Record has been written and is at present being reproduced. The investigation was for a possible dam about 70 feet high. The site, in highly folded Ordovician metasediments which are fresh and strong at river level, but weathered to shallow depths near proposed top water level, is very satisfactory for a dam of concrete, earth or rock-fill. Suitable rock for concrete aggregate or fill is available nearby and apparently suitable earth materials occur in adequate quantities within four miles of the site.

Bendora Water Main from Bendora Dam, Upper Cotter River, to Cotter pumping station. Excavation for the 5-foot diameter pipe started in September, near Pierce's Creek. Excavation started at chainage 10-mile in Silurian dacite. The Winslade Fault was crossed at 9M 5076 feet; south of the fault the trench at the end of October had been excavated in Ordovician shale, siltstone and sandstone for 2150 feet.

Secretariat Building, Parkes. Foundation conditions for Sections C, D and E of the Secretariat Building were further investigated to determine more precisely the size and distribution of cavities in the limestone beneath the soil and shale. Conditions generally appear to be slightly worse than for Sections A and B; considerable discussion and analysis of results took place between consultants and various authorities before it was decided to found Section C in sound limestone and Sections D and E at the ground surface. Treatment for Section C may be further reviewed.

Bendora Dam, Upper Cotter River. The manuscript of the completion report on the geology of the dam and environs was received from the author (who left the Bureau in May 1965) in November, 1966.

Stromlo-Oakey Hill Water Main Route, Woden district, was mapped and investigated by seismic timer to determine excavation conditions.

Belconnen Reticulation Reservoirs. Foundations and excavation conditions for No. 1 reservoir were determined by mapping, seismic timer work and drilling. A similar investigation is in progress for No. 3 reservoir.

Minor Engineering Structures. Advice was given on numerous minor problems related to engineering structures and buildings, and exposures were mapped as opportunity and resources permitted.

Development Projects

Belconnen District. All, or part, of Areas 10, 11, 13, 14, 15, 16, 17, and 18, were mapped in outcrop detail, together with extensive unnumbered areas along Ginninderra Creek and to the south-west of the Belconnen district.

Mapping of trenches in Areas 6, 7 and 8 is in progress and the excavation for a trunk sewer, which runs west from the proposed District Centre and passes south of Ginninderra Creek, was mapped.

The areas mapped lie entirely to the west of the Deakin Fault and are underlain by Upper Silurian volcanics, metasediments and intrusions.

Woden District. Trenches were mapped as circumstances permitted.

Construction Materials

Construction materials were investigated in connection with several engineering and development projects. In addition the following work was carried out.

Building Stones. Comprehensive tests, including petrographic studies, were carried out on Goulburn Slate to determine its suitability as a high quality paving stone. The stone appears to be a little soft to withstand heavy foot traffic, but otherwise is durable and is attractive in appearance. Extensive quantities of stone are available from an old quarry 16 miles north of Goulburn. Comparative tests were also carried out on Castlemaine Slate from Victoria and on Willunga, Wistow and Mintaro Slate from South Australia to assist in evaluation of the Goulburn Slate. A "slate" (quartz-mica-chlorite schist) from Norway and slate from near Forbes were also tested, and advice given on their properties and suitability as paving stone.

A report on the testing of the slates was written.

A catalogue of building stones used in Canberra buildings and monuments, started in December 1965, was continued. A provisional list has been compiled and work will continue as opportunity presents itself, to complete the catalogue and keep it up to date.

Aggregate The investigation of a possible extension of the Department of Works' Mugga Quarry was completed, but without drilling as the proposal to re-locate the quarry was abandoned. A Record on the investigation was issued.

Sand and Gravel. With the steady depletion of resources of dune sand (used as builder's sand) and river sand and gravel in the A.C.T., numerous requests for assistance were received. In addition to requests by the Department of the Interior to evaluate individual deposits, requests were made by both the Department of the Interior and the Department of Works for an evaluation of known resources and a search for new deposits. Dune sand deposits reported on include deposits in the Pialligo, Coppins Crossing, Oaks Estate, and Majura areas. A report, shortly to be issued as a Record, gives an evaluation of dune sand occurrences in the Molonglo Valley downstream of the Queanbeyan - Sutton Road. Fairly extensive deposits remain on alienated land, but available resources are small.

River sand and gravel deposits at the following localities were investigated: Molonglo River upstream of the Queanbeyan-Sutton Road; Murrumbidgee downstream of Pine Island and near Tuggeranong Creek; and Block 67, Belconnen (Molonglo River near its junction with Murrumbidgee River).

Brick Shale and Clay. Occurrences of brick shale on Gungahlin Block 8, A.C.T., and near Mount Jerrabomberra (south of Queanbeyan) were inspected. Samples of brick clay were collected for A.M.D.L. for determination of properties. Numerous enquiries about the occurrence of brick shale and clay in the district were dealt with.

Drainage.

Areas of poor drainage at the Church of England Boys' Grammar School, the Forrest Primary School and in the suburbs of Campbell, Deakin and Hughes were investigated and remedial measures recommended.

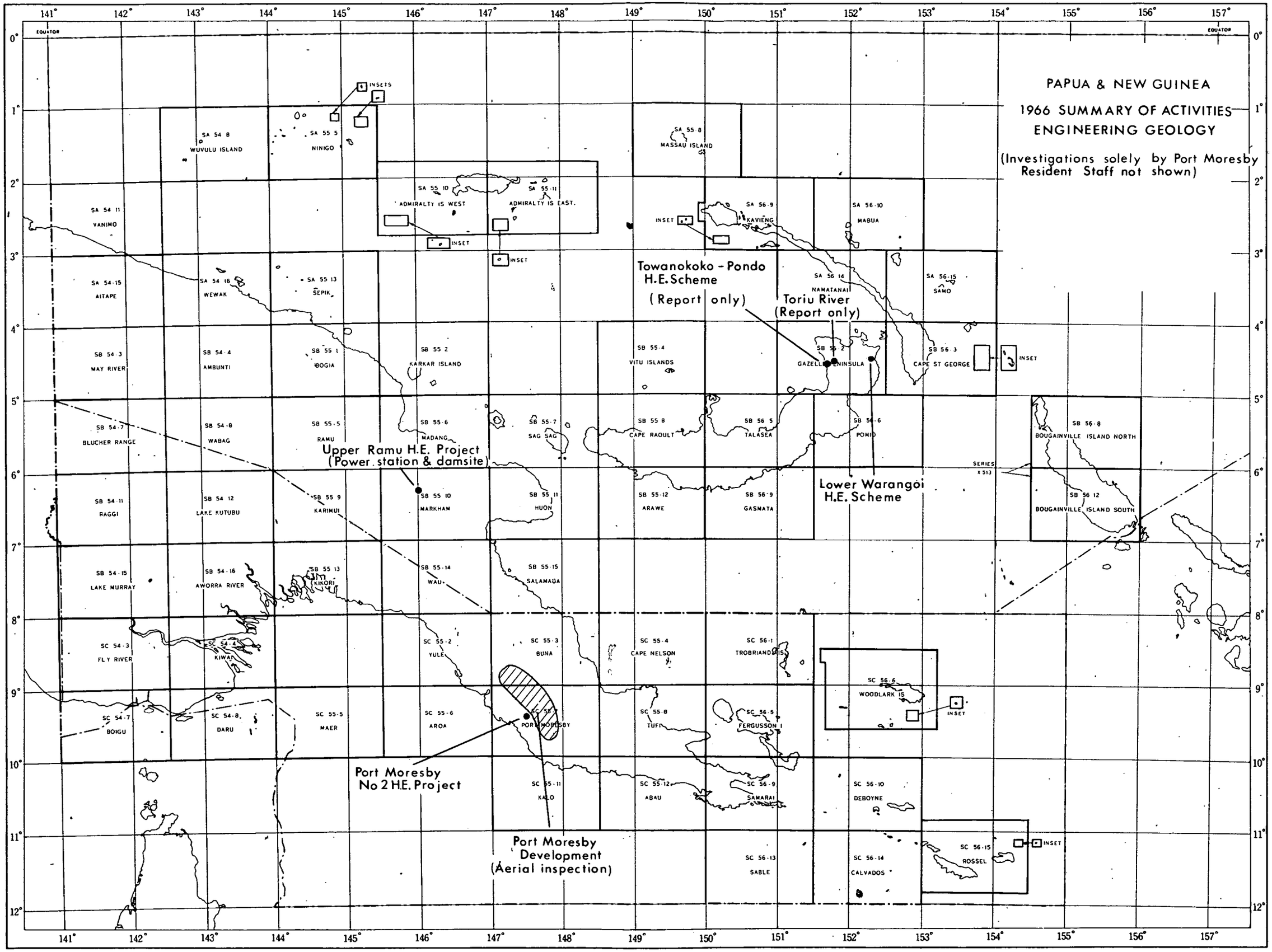
Petrography

Petrographic work was carried out during the year as required in relation to the testing of building stones and the presence of pyrite in aggregate from Blue Metal and Gravel Pty. Limited's Mugga Quarry and the Corin Dam quarry. Petrographic descriptions, including in most cases, reports on engineering properties, were given of specimens from the Belconnen area, Burbong damsite and other minor A.C.T. engineering projects, and from the Upper Ramu, Toriu River and Kassam Pass projects in Papua-New Guinea.

PAPUA & NEW GUINEA

1966 SUMMARY OF ACTIVITIES ENGINEERING GEOLOGY

(Investigations solely by Port Moresby Resident Staff not shown)



NMP/63/02019

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Miscellaneous

Soil and Alluvium. Extensive work was done by field hands on the logging and estimation of resources of soil and alluvium in the Pialligo area. A report on the investigation was written.

Gungahlin Cemetery Site. Further work was done in September on a possible extension to the Gungahlin cemetery site. Auger holes were logged, and a report made on excavation conditions and probable permeability. Further permeability tests were recommended.

PAPUA AND NEW GUINEA

Port Moresby No. 2 Hydro-Electric Power Station, Laloki River.

Construction of the underground station and ancillary structures, to harness the 500-foot head of the Rouna Falls, 18 miles from Port Moresby, continued through the year. Project geologist I.S. Cumming provided geological services throughout the year; he worked as a member of the Commonwealth Department of Works' supervisory team. Except for the first 1100 feet of the tailrace tunnel the whole works are in Astrolabe Agglomerate.

In October 1965 the tailrace tunnel, which provides access during construction, had been excavated to within sixty feet of the start of the machine hall, the design location of the machine hall had been confirmed by exploratory drilling from the tailrace tunnel, and the surge tank rise had been started. The access shaft had been sunk to a depth of 245 feet, leaving 285 feet to be excavated, the intake structure was fully mined and a start had been made on excavations for the diversion weir.

At the end of October 1966 major excavation works had been completed except for the pressure shaft which had to be sunk a further 200 feet to connect with a rise from the machine hall. Minor excavations still to be completed, include excavation and shaping of the sump of the machine hall, excavating without explosives part of the vertical cut-off for the weir, and other minor works.

Lining of the access shaft and rock-bolting of the machine hall are almost complete; draft tubes are being placed and concreted in. The invert of the tailrace tunnel has been concreted, but lining of selected parts of the tunnel and completion of a drainage trench remains to be done. The surface works for the intake structure, other than plant, and the concrete works for the weir are almost complete. The sinking and full-lining of the pressure shaft is the largest single item of geological concern now outstanding. It is expected that, apart from the writing of the geological completion report, geological services will be required for a further five or six months.

Main points of geological interest in the year's activities were: Conditions in the access shaft have proved much as expected - local support only has been found necessary and water flow has presented no serious problems.

The machine hall has opened out very well indeed. There is a striking absence of joints in the agglomerate, no steel or concrete rib supports have proved necessary and water inflow is very slight. Some cracking occurred in part of the roof and required special treatment. Lenticular tuff bands are more numerous than expected; they are generally closely jointed and one tuff band in the machine hall has caused a change in the siting of the crane column footings.

Except for the zone between the Rouna shear and the conglomerate-agglomerate contact referred to last year, only a small proportion of the tailrace tunnel will require lining.

Deeper excavations than planned for the weir have been necessary.

Difficulties have been experienced with stress and strain measuring instruments in the machine hall owing to inaccessibility and damage during blasting. Measurements in the tailrace tunnel have indicated that the primary stress field is hydrostatic, i.e. ratio of vertical stress to mean horizontal stress is unity, but the stress is slightly greater than overburden would impose; the rock generally behaves elastically. Analysis and interpretation of measurements were done by the Snowy Mountains Hydro-Electric Authority.

Upper Ramu Hydro-Electric Scheme, Eastern Highlands of New Guinea.

All field work during the year was done by Port Moresby resident staff and the design report is being written substantially by J.P. MacGregor.

During the year substantial additional field mapping, particularly regional mapping, was carried out to improve knowledge of geological conditions and to establish the availability of construction materials. Field work was supported by petrographic studies in Canberra. Drillhole DD 20A was completed in marble along the tunnel line and DD 22 tested the possible site for an access shaft in the south bank of the river. It revealed marble from a depth of 622 feet and encountered a significant shear. It is apparent that a further, undetected, fault passes between DD 19 and DD 22 and it is not possible to determine the best position, on geological grounds, for the machine hall at present.

Consideration is at present being given by Works Department engineers to a possible re-location of the diversion weir and intake works to improve hydraulic conditions at the weir. Further site investigations will be needed if the change is made.

The design report is substantially written, but cannot be completed until any supplementary investigations needed are carried out. Construction of the underground power station is expected to start in 1968.

Lower Warangoi Hydro-Electric Scheme, New Britain.

Field services for this project were provided by the Port Moresby resident staff. Eight diamond drillholes, of total length about 1600 feet, were drilled during the year. They revealed that: the agglomerate of the proposed dam abutments is moderately to highly permeable and of moderate strength only; gravels in the gorge which forms the damsite are at least 100 feet thick (recent seismic work by the Geophysical Branch indicates a thickness of 150 feet). Some, at least, of the sediments in the southern ridge are highly permeable.

These factors have rendered the scheme uneconomic, and technically difficult, and the investigation will not be proceeded with.

Miscellaneous:

Further details of the investigation of the Upper Ramu and Lower Warangoi hydro-electric schemes are given in the report of the P.N.G. Resident Geological Section for 1966. Accounts are also given of other investigations by the Resident staff.

Four reports by Resident staff on engineering geology investigations were processed during the year for issue as Bureau Records.

Reports, for issue as Records, were written by E.J. Best on investigations of the Towanokoko-Pondo and Toriu hydro-electric schemes, New Britain.

An aerial inspection of the headwaters of three or four rivers near Port Moresby is to be made in November to select possible sites for further major hydro-electric development for Port Moresby.

NORTHERN TERRITORY

Adelaide River Gorge Damsite. Four possible damsites in the Adelaide River gorge were inspected in December 1965 in the company of Water Resources Branch, N.T.A. engineers. The upper site was selected and a programme of drilling and costeaning was designed. The investigation is for a dam roughly 100 feet high and of crest length 700 feet. Detailed regional mapping around the damsite was carried out in July - August and further mapping, and logging of drill core, was resumed in October. At the end of September about 600 feet of drilling involving five holes, had been carried out. Work is continuing.

The damsite is in westerly-dipping quartz greywacke and siltstone of the Lower Proterozoic Noltenius Formation; structure appears to be simple. River alluvium and gravel is at least 45 feet thick along the river. The storage area is bounded in part by Upper Proterozoic Depot Creek Sandstone Member which is gently dipping, well-jointed, and is the source of several large perennial springs. The investigation of the scheme will require a thorough evaluation of the likelihood of leakage from the storage through the Depot Creek Sandstone, particularly along the Adelaide River Fault.

Stapleton Creek Damsite. An inspection was made in October of the site for a low dam, possibly 40 feet high. The dam, together with a levee bank which would involve diversion of the Stuart Highway, would have a total crest length approaching 2000 feet in length. It would be founded in Lower Proterozoic siltstone and sandstone of the Burrell Creek Formation. Geological mapping will be undertaken by the end of the year.

Darwin River Damsite A report on the feasibility investigation, which included drilling and costeaning, was edited and processed for issue in the Record series.

OTHER PLACES.

Nuclear Excavation of Iron Ore Port. An inspection was made, data collected and a brief report written on geological aspects of the feasibility of producing by nuclear means a harbour on the Western Australian coast between Onslow and Cape Preston. The inspection was made in the company of officers of the Australian Atomic Energy Commission, the Western Australian Works Department and Broken Hill Proprietary Company Limited.

Commonwealth Centre, Melbourne. E.K. Carter continues to act as a consultant in the investigation of the site for this Centre in the City of Melbourne.

HYDROLOGY

Australian Capital Territory and Environs.

Considerable progress was made during the year in developing automatic data processing capability, to permit a wider variety of data on groundwater in the A.C.T., and also on Lake George, to be printed out automatically. The programme developed can be used for data from other places.

Rainfall in the first half of the year was below normal and resulted in a general decline in water levels. Lake George depth dropped to 9.45 feet at the beginning of June - the lowest level since January 1959; by early November the lake level had risen only 0.15 feet, reflecting the low run-off from the dried-out catchment area, despite good rains. During the year groundwater levels fell to the lowest since systematic records were started a few years ago. Belconnen 5 bore, which is on a divide and is a sensitive indicator of trends in groundwater levels, started to rise slowly late in August (several weeks later than is normal) and by early November had reached the same level as in early July 1965, (1½ feet higher than in November 1965). The general rise in groundwater level for the region since August has been slight.

During the year information on groundwater levels was supplied to the Commonwealth Department of Works and to the Australian Broadcasting Commission.

Five groundwater observation bores were selected , and logged and tested after drilling by the Petroleum Exploration Branch drillers. Nine other bores were sited, two were tested and advice was given on nine water supply problems. In addition, routine measurements of levels and other data for the various observation bores and Lake George were maintained. A visit was made to Jervis Bay to examine water supply problems.

The group also studies and advised on drainage problems, as reported above.

Mr. Burton was a member of a technical committee on representative drainage basins, established by the Australian Water Resources Council, and helped prepare the report of an advisory panel.

Papua - New Guinea.

Two reports were processed for the Record Series and one other was returned to the author pending further field work.

Northern Territory

Two groundwater reports were processed for the Record series and work was done on two others.

Opinions on bore sites and bore logs were indexed and filed as received.

MAP EDITING

The map editing group serves as a link between map compiler, draftsman, and colour designers; they edit all coloured geological and specialist maps (e.g. geohydrology and metallogenic maps) published by, or with the co-operation of, the Geological Branch. By editing, training of field geologists, advice on the techniques of map production, and co-ordination of the many phases of map production, they help ensure that Bureau maps conform to a uniform standard and are available for fair drawing and printing as required by programme and contractual commitments. Mr. Burton acted as organizer and recorder for the Map Committee.

During the year, editing was carried out as follows:

Sheets	Preliminary edit		Final edit	
	Completed	In progress 31.10.66.	Completed	In progress 31.10.66.
1:250,000 Sheets	20	-	14	2
1:500,000 Sheets	-	-	8	-
1:1,000,000 Sheets	1	-	1	-
Australia & Oceania 1:5,000,000	-	-	5	-
Litho-morphological map of Australia 1:5,000,000	1	-	-	-

MAP COMPILATION

Geological Map of Australia and Oceania 1:5,000,000

Sheets 6, 7, 11 and 12, covering Australia and the Island of New Guinea, were printed and distributed.

Sheets 3, 4, and 5 have been with the printer for some time; Sheet 2, which is to be printed with Sheets 3, 4, and 5, is ready for fair-drawing.

Sheet 10 is ready for fair-drawing and Sheet 8 has been compiled but is awaiting additional information from the British Solomon Islands Protectorate.

Compilation of Sheets 9 and 13 by the New Zealand Geological Survey is reported to be in progress.

Metallogenic Map of Australia and New Guinea, 1:5,000,000

Trial compilations have been made, at final scale, of the two sheets covering northern Australia and Papua-New Guinea, including insets for the most highly mineralized regions. The map will consist of four sheets.

Geological Map of Papua-New Guinea 1:2,500,000

This map has been in the hands of the Printer the whole year. Dye proofs were received some time ago.

Litho-morphological Map of Australia 1:5,000,000.

This map is being produced by Land Research Division, C.S.I.R.O. Substantial contributions to the map have been made by the map compilation group and other Bureau geologists.

Information on production and reserves of major mineral deposits in north-western Australia was compiled for use in the compilation, by the Bureau des Recherches geologique et minieres, Paris, of a preliminary mineral map of the World.

STRATIGRAPHIC INDEXING

Indexing of current literature, checking and reserving of proposed stratigraphic names, and preparation of bi-monthly lists of variations were maintained during the year. Some progress was made in compiling Volume 5h - Australia, General - of the International Stratigraphic Lexicon.

The final page proofs for the Victorian Stratigraphic Lexicon were checked and returned to the Commission in Paris in July, 1966.

Some fieldwork was done by stratigraphic indexers.

TECHNICAL FILES

The systematic recording of office data and references to literature on technical files, which are based on the 1:250,000 map Sheets, continued throughout the year.

RECORDS OF INVESTIGATIONS

The following Records emanating from the sub-section were issued, or allotted numbers, during the year. Those marked with an asterisk have not yet been issued; that prefixed by * were produced by Port Moresby resident staff as part of an investigation under the direction of the Canberra engineering geology group.

1964/140 : Foundation grouting and joint permeability measurements at Bendora dam A.C.T., by J.K. Hill.

1965/200 : Geological report on the feasibility and design investigation of Corin damsite, Cotter River, A.C.T., 1964-1965, by E.J. Best.

* 1965/155 : Preliminary geological investigation of No.1 damsite, Ramu River, Upper Ramu hydro-electric scheme, T.P.N.G., by J.P.MacGregor.

1966/67 : Preliminary geological investigation of Belconnen Areas, 5, 6, 7, 8 and 9, Australian Capital Territory, by E.G. Wilson.

1966/76 : Geological investigation of Mugga quarry, A.C.T., 1965, by W. Oldershaw.

1966/77 : Inspection of Jervis Bay, A.C.T., dune sand deposits, October, 1965, by G.A.M. Henderson.

1966/124 : Engineering geology in Australia, 1966, by E.K. Carter.

* 1966/133 : Geological feasibility investigation of the Towanokoko-Pondo hydro-electric scheme, New Britain, T.P.N.G., 1962, by E.J.Best.

* 1966/138 : Investigation of soil thickness along the route of the Woden - Stromlo water main, A.C.T., 1966, by D.E. Gardner and P.A. Lang.

* 1966/152 : Darwin River water storage scheme, N.T. Geological investigation 1963-1964, by D.F. Maggs and J. Barclay.

* 1966/156 : Dune sand in the Molonglo River Valley, A.C.T., by D.E. Gardner.

Four other reports have been written by members of the sub-section and are being processed for issue in the Records Series.

Reports of engineering geology and groundwater investigations, by Northern Territory and Papua-New Guinea staff, were processed by the sub-section as required through the year. The position is as follows:

Papua-New Guinea engineering geology - 2 Records issued, 1 allotted number and 2 being processed.
Northern Territory engineering geology - 3 Records issued.
Papua-New Guinea groundwater - 2 Records issued, 1 allotted number.
Northern Territory groundwater - 5 Records issued, 1 allotted number, and 2 being processed.

ATTENDANCE AT CONFERENCES, ETC.

G.M. Burton is a member of an advisory panel on drainage basins, of the Standing Committee of the Australian Water Resources Council. He attended three meetings of the panel. He also attended, and displayed groundwater measuring instruments used by the A.C.T. Hydrology Group, at an International Water Resources Conference held in Canberra in September. From 17th October to 8th November, Mr. Burton was overseas; he attended an E.C.A.F.E. Seminar on the Development of Groundwater Resources, held in Teheran, and also visited bodies engaged in groundwater and water conservation projects in Bangkok and Hong Kong.

E.J. Best and G.A.M. Henderson visited the Snowy Mountains Scheme for three days in May.

In August, D.E. Gardner attended a two-day site investigation symposium in Sydney, organized by the Institution of Engineers, Australia.

THE SEARCH FOR PHOSPHATES

INTRODUCTION

The high level of activity in exploration for phosphate by mining companies in Australia was maintained during the year. Inceasing interest is being shown in the possibility of off-shore deposits also; the importance to the economy of the country of phosphate, which is second to oil in mineral insufficiency in Australia, was highlighted by the increase in the basic cost of superphosphate announced about the middle of the year.

On the 20th July, 1965, Cabinet authorized an increase in staff in the Geological Branch of the B.M.R. of up to fifteen positions, to enable the Bureau to expand its contribution to the search for phosphate. Final approval for these extra positions was given in September, 1966, and it is hoped that some of them will be filled before the end of the year under review.

Staff available during the year were:-

H.A. Jones, Geologist Class 2

J. Barrie, Acting Geologist Class 2

J.A. Kaulback, Geologist Class 1

The group was supervised by L.C. Noakes, Assistant Chief Geologist, who also undertook some independent field investigations. Two field hands were employed for most of the year.

SUMMARY OF ACTIVITIES

The following were the main fields of activity of the phosphate group during the year:

1. Dissemination of information to companies interested in phosphate search.
2. Review of the phosphate potential of the Lower Palaeozoic rocks of part of the Tasman Geosyncline.
3. Survey of the phosphate deposits of Christmas Island.
4. Marine geological survey of the upper slopes of the Christmas Island rise.
5. Chemical and sedimentological study of samples from the Gulf of Carpentaria.
6. Visit of Dr R.P. Sheldon of the U.S.G.S.
7. Quantitative and semi-quantitative testing of bore samples and of samples sent in from the field.
8. Reconnaissance of Proterozoic sediments of the Roper-MacArthur River area.

COLLABORATION WITH MINING COMPANIES

Company geologists and consultants engaged in the search for phosphate continued to make use of the facilities of the Bureau and discussions useful to both parties formed an important part of the work of the Bureau Officers. A number of companies, particularly I.M.C. and Mines Exploration, spent some time testing core and cuttings from the Fyshwick core store for phosphate.

TASMAN GEOSYNCLINE

The Lower Palaeozoic rocks of eastern Australia include minor occurrences of phosphate and for a number of other reasons this province deserves attention from the point of view of phosphate search. Accordingly a general appraisal of part of the Tasman Geosyncline was undertaken by Jones and a Record on this work is now in preparation. The area concerned is that underlain by Middle Devonian and older Palaeozoic rocks to the west and south of the Sydney Basin from Tasmania to Bourke. The appraisal is mainly based on a review of the published data, but unpublished work including University theses have been searched and a minor amount of field work carried out. The complexity of the structures and fact that many of the descriptions were written a long time ago and are confusing and contradictory, combined with the fact that very large areas have never been described in any detail, make an appraisal of this sort highly speculative. None the less it is hoped that this work will be of some value to the companies particularly in so far as it gathers information from a wide range of sources into an easily assimilable form.

CHRISTMAS ISLAND

The geological survey of Christmas Island, started by J. Barrie in 1965, was rounded off in August 1966 when Barrie and Jones spent two further weeks on the Island. The drilling programme, which Barrie designed in 1965, has proceeded satisfactorily although problems of sample contamination and unfinished holes have been encountered. A new drilling contractor with a more powerful rig is being engaged. Reserves of at least 200 million tons of phosphate are indicated. Much of this consists of "C" grade material and plans are well advanced to produce a marketable product from the "C" grade phosphate by calcining. Temperature of calcination has to be controlled within close limits and AMDEL have designed for B.P.C. a fluid bed vertical kiln with submerged burners which achieves this control while being unusually economical with fuel.

A pilot plant for the treatment of "B" grade phosphate is now in operation. This separates the fines by washing, screening and cyclones leaving an "A" grade product. The "C" grade fines will eventually be recovered also.

Barrie's Record on the geology of Christmas Island is almost completed and will be available about the end of the year. In addition to the geological mapping and the economic aspects of the phosphate deposits, this account provides a comprehensive review of the geological history of the deposits and includes a body of significant chemical data.

MARINE GEOLOGY OF CHRISTMAS ISLAND

An investigation of the bathymetry and bottom sediments around Christmas Island was carried out in August and September and a Record by Kaulback on this work is in preparation. There is good evidence that some of the phosphate deposits are of considerable age and have an erosional history extending back to early Pliocene times. It is likely that large volumes of phosphate have found their way into the sea surrounding the Island and therefore the possibility of concentrations of detrital phosphate on the sea bed required investigation. The chance that nodules of authigenic phosphate occur in the superficial sediment also needed looking into, while more bathymetric detail was required to investigate submerged terraces and to throw more light on some of the Island structures.

Some 200 miles of continuous sounding lines were run in H.M.A.S. "Diamantina" and about 20 dredging stations occupied during August. Echo-sounding and sediment sampling, both by dredge and by divers, was carried out by Kaulback from B.P.C. barges during August-September.

The bathymetric detail obtained has established that no extensive submerged platform exists close to the Island. No concentration of detrital phosphate was found during Diamantina's survey and a preliminary examination has not revealed any authigenic phosphate. The inshore samples have not yet been examined.

GULF OF CARPENTARIA

Samples from the Gulf of Carpentaria collected by a joint B.M.R. - Sydney University party in H.M.A.S. "Gascoigne" during 1965 were studied by Kaulback. The results of this work will be published in a joint paper by Dr Phipps of Sydney University and Kaulback.

VISIT OF DR SHELDON, U.S.G.S.

Dr Sheldon left Australia in late January on completion of his assignment as consultant to the B.M.R. on phosphate search on the continent. During his 4 months stay Dr Sheldon saw all the major occurrences of phosphate in Australia and held discussions with mining companies and the State Surveys interested in phosphate search. In his report, which appeared as Records 1966/16, he gives a general appraisal of the phosphate potential of the main sedimentary basins and suggests that the Lower Palaeozoic rocks of the Tasman Geosyncline hold the best prospects of large phosphorite deposits. An area in north-western Queensland, where Dr Sheldon noted rocks of promising lithology from the point of view of phosphate potential, is now being actively prospected by two large mining companies.

PHOSPHATE ASSAYS

Testing of bore hole cores and cuttings, and of hand specimens sent in from the field, for P_2O_5 continued during the year.

PROTEROZOIC SEDIMENTS OF THE MACARTHUR RIVER AREA, N.T.

Interest is rising in possible phosphate potential in Precambrian rocks and particularly in the little deformed and metamorphosed sediments of the Proterozoic successions. There seems little reason why phosphorites should not have formed in Proterozoic times and published reports on late Precambrian phosphorites in China provide some encouragement.

L.C. Noakes made a brief reconnaissance of Adelaidean and Carpentarian rocks in the Roper/MacArthur River area bordering the Gulf of Carpentaria as a contribution to the examination of Precambrian sediments for phosphate. The region has been regionally mapped by members of the Metalliferous Section, principally by P.R. Dunn, H.G. Roberts and K.A. Plumb, and the company of one of these officers, H.G. Roberts, made the traverse particularly useful.

No direct evidence of phosphatic beds emerged from the regional mapping but a number of nodule-bearing sediments were examined and confirmed as cherty and non-phosphatic. Although sections of Adelaidean sequences and Carpentarian sediment in the area provided no encouragement in the search for phosphate, the traverse achieved another object in

collecting data on the distribution and quantity of phosphorus deposited in the finer grained of these successions; such characteristics are in part known for Phanerozoic sediments but are virtually unknown for Precambrian terrains.

Chip samples and scintollometer measurements were taken over 35 exposures of fine grained formations within the Proterozoic successions, including samples across the Carpentarian barrier reef complex from O.T. Downs eastward to Top Springs - progressing from back reef beds to reef, fore reef and basin facies. Although only a small number of samples could be collected in the time available, their analysis for phosphorus, and for a wide range of elements across the reef complex, should make some initial contribution to knowledge of phosphorus abundance in these Precambrian rocks. The results of these analyses will be compiled and discussed in a Bureau record.

RECORDS

The following Records were issued or in preparation at the end of the year.

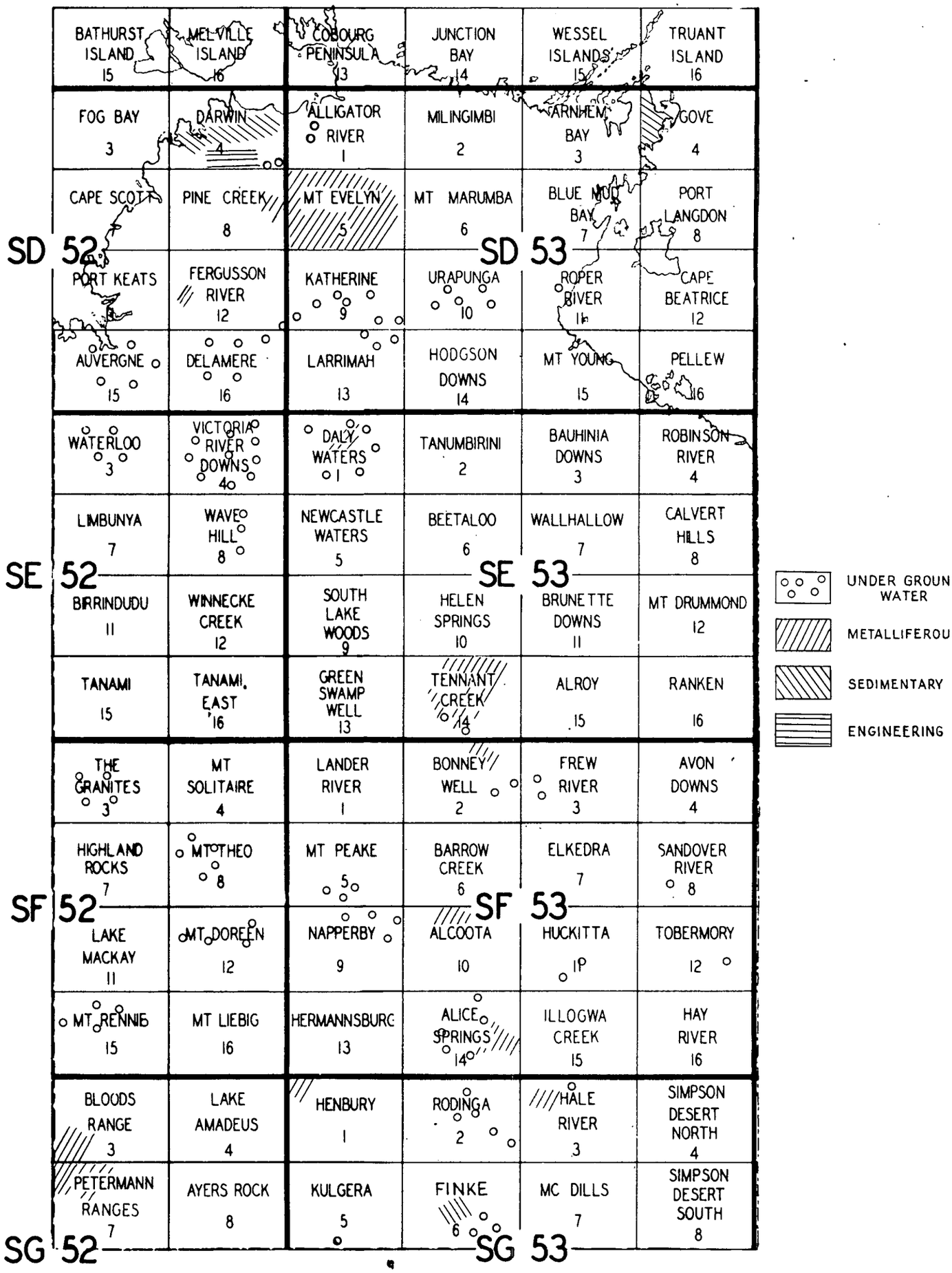
1966/16 - Preliminary appraisal of the Australian continent for sedimentary phosphorite occurrences; by R.P. Sheldon.

1966/ - The geology of Christmas Island; by J. Barrie.

1966/ - An appraisal of part of the Tasman Geosyncline for phosphorite; by H.A. Jones.

1966/ - Recent marine sediments and bathymetry around Christmas Island, Indian Ocean; by J.A. Kaulback.

1966/ - Notes on the distribution of Phosphorus in Proterozoic sediments of the MacArthur River Basin, N.T.; by L.C. Noakes.



To accompany Record 1966/195

RESIDENT GEOLOGICAL SECTION, NORTHERN TERRITORY.

The Resident Geological Section consists of officers of the Bureau of Mineral Resources seconded to the Northern Territory Administration in order to supply geological advice and service to Government Departments, the mining industry and the general public. Offices are maintained at Darwin, Alice Springs and Tennant Creek.

STAFF

Senior Resident Geologist, Darwin.	: R.G. Dodson.
Resident Geologists, Darwin	: J.W.Shields, Geologist Class II. A. Taube, Geologist, Class I. V.J.Kemzeys, Geologist Class I, (resigned). A. Vanderplank, Geologist Class I. (resigned)
Resident Geologist , Tennant Creek	: B. Tapp, Geologist Class I.
Resident Geologists, Alice Springs	: D.R. Woolley, Geologist Class II, (resigned July 1966). I.C.Faulks, Actg.Geologist Class II. I. Youles, Geologist Class I. (resigned July 1966). K.J.Edworthy, Geologist Class I. W.J. Grainger, Geologist Class I. (from October).

Ancillary staff are provided by the Northern Territory Administration.

WATER SUPPLY INVESTIGATIONS

Water supply investigations make up a considerable proportion of the work done by the Resident Geological Section. The investigations consist of hydro-electric surveys of sedimentary basins, appraisals of dam sites and the selection of bore sites. During the past year, investigations were carried out on town water supplies for Alice Springs, Tennant Creek, Adelaide River and two future mining townships, at Frances Creek and Mount Bundy.

The bulk of the water supply investigations were undertaken at the request of the Director, Water Resources Branch.

SELECTION OF BORE SITES.

A total of 133 bore sites were selected. The bore sites are described in minor reports which are made available to the Director of Water Resources Branch for use in the issue of bore construction advice to pastoral and agricultural lease holders, and the planning of government bore holes.

The following is a list of localities for which bore hole sites were selected.

Elsey Station	3	Rose River Mission	1
Mataranka	6	Indiana Creek	1
Frances Creek (Mining township)	3	Jervois	4
Katherine-Willeroo Road	1	Umbeara	1
		Tobermory	1

Moroak Pastoral Lease	3	Mongrel Downs	1
Legune Station	13	Maryvale	6
Daly Waters Pastoral Lease	2	Mt. Doreen	5
Animal Industry Branch Reserve	2	Kurundi	4
Humbert River Station	2	Corandirk	3
Montejinni Pastoral Lease	4	Philip Creek	4
Roper Valley Station	1	Murray Downs	2
Adelaide River (Town water supply)	1	Phillipson S.R.	1
Allambi	2	Delamere Station	15
Top Springs	2	Tea Tree	1
Humble Creek	1	Renners Rock	6
Wave Hill School	1	Neutral Junction	1
Coolibah Creek	1	Yuendumu	2
Kidman Springs	1	Arapunya	1
Fitzroy Station	2	Farm Area (Alice Springs)	1
Ivanhoe Station	4	Auvergne Station	10
Innesvale Station	1	Camfield-Willeroo Beef road	1
Mt. Bundey	2	Frances Creek Iron Ore (Mine Township)	2
Elcho Island Mission	1		

Samples were logged from 131 bores. Information obtained from the bore hole cuttings is recorded, the data being made available to the Bureau of Mineral Resources, Canberra, the Water Resources Branch, N.T., other government departments and to interested mining company officials.

A report was completed recording the locations (where known), names and reference numbers of all bores in the western half of Central Australia. A second report is being prepared to cover the bore data in the eastern half of Central Australia.

TOWN SUPPLY INVESTIGATIONS

Alice Springs

Town Basin: Routine monthly conductivity measurements were made on water from town production bores when samples were available. Assistance was given in the preparation of a Bulletin on the Alice Springs Town Basin, in preparation at Bureau of Mineral Resources headquarters, Canberra. Mereenie Sandstone: Two production bores, P5 and P6, were drilled, locating satisfactory aquifers. A comprehensive report was prepared on the hydrology of the Emily Plains area which includes the Outer Farm area. Future requirements for investigation of this area are considered to be: a test for distribution of permeability, salinity pattern and shape of the piezometric surface west of the production area and secondly, to test for a shallow piezometric surface in the Mereenie Sandstone in the Todd River floodout area near Junction bore.

Tennant Creek

During the second stage of the Kelly Well investigation, 40 bore holes were drilled, totalling 7,072 feet. A report on the investigation was nearing completion at the end of the year. Lack of complete information, particularly salinity data, precludes a reliable interpretation of the underground water reserves of the area. It is obvious, however, that a considerable quantity of good quality water can be pumped from the superficial sediments in the Kelly Well Basin. One bore within the basin yielded 15,000 g.p.h. during pumping tests over a week. Water in the Kelly Well Basin is contained in a succession of unconsolidated to moderately lithified siltstones, sandstones and fine conglomerates. In the lower portion of the basin, a vuggy, a silicified claystone aquifer forms a persistent marker horizon identifiable in each bore hole. From data analysed to date, bores in this aquifer are capable of producing up to 15,000 g.p.h.

An attempt was made to re-interpret data from the Cabbage Gum Basin, which appears to be a small extension of the Kelly Well Basin. Unfortunately, lack of precise data, the loss of bore cuttings and the subjective nature of logs of bore holes prevented an objective conclusion regarding the underground water potential of the basin.

Adelaide River

Advice was provided for the siting of a bore hole planned to increase the Adelaide River township water supply. The bore hole drilled by Water Resources Branch has yielded 1,800 g.p.h.

Frances Creek

Two water bores were sited for a water supply for the Frances Creek iron ore mining township. The two bores yielded approximately 1,200 g.p.h., a quantity of water sufficient for the immediate needs of the township.

Mt Bundey

Two water bores were sited for the proposed Mount Bundey iron ore township. The bores will be put down during the next year.

OTHER INVESTIGATIONS

Papunya

A Water Resources Branch programme consisting of test drilling of twenty seven holes with a total footage of 5,300 feet was based on the recommendations contained in a geological report on the Papunya area. Groundwater suitable for domestic use occurs in Quaternary and Tertiary deposits of fluvial, deltaic and lacustrine origin. Existing production bores have access to sufficient water to meet the forseeable needs of the settlement. Sites for two further production bores have been selected, should they be required in the future.

Warrabri

A geological report on Warrabri Settlement and the surrounding area was prepared. Groundwater is available in large quantities from the shallow Quaternary and Tertiary sediments of the area. A limited drilling programme was carried out by Water Resources Branch within the immediate vicinity of the settlement to establish water level measuring points and to select a site for one further production bore.

Tea Tree

A geological report was prepared on the Tea Tree area. A programme of drilling was recommended to test the extent and nature of the sedimentary basin. Drilling by Water Resources Branch commenced during June 1966.

Amadeus Basin

Bore data from the Amadeus Basin area were compiled for inclusion in the section describing the hydrology in the Amadeus Basin bulletin. The first draft of the text of the section was completed by the end of the year.

Lander River Area

A report on groundwater prospects in the upper parts of the Lander River catchment was prepared and a programme of investigation drilling recommended.

Joseph Bonaparte Gulf Area

A hydro-geological survey was made of the saline coastal alluvial deposits in the north-western portion of the Northern Territory. To provide much needed fresh water for stock on the two stations in this area, Legune and Munmarlary, a series of medium to shallow bores were recommended to draw water at points of discharge along the borders of the saline coastal plains before incoming fresh water mixed with the saline groundwater.

ENGINEERING GEOLOGY

Todd River Damsite

A report on a proposed damsite on the Todd River, Alice Springs, in preparation at the time of the last annual report, was completed.

Adelaide River Damsite

At the request of the Director, Water Resources Branch, a survey was made of two proposed damsites on the Adelaide River. The investigation was carried out by a member of the Bureau of Mineral Resources Engineering Section, temporarily attached to the Resident Geological Section, Darwin. The damsite considered most favourable is situated about three miles south-west of the Adelaide River township. A report on the investigation is in preparation.

MINES AND MINERAL DEPOSITS

Interest in prospecting increased significantly in the Northern Territory during the year. Several mining companies are actively engaged in mineral exploration using geological, geochemical and geophysical methods of prospecting. Small mining companies and individual prospectors continue to prospect both areas of known mineral occurrences and less explored areas. In the light of experience gained in various parts of the Northern Territory, prospecting methods are constantly being revised and improved. Exploratory work has continued at important mineral occurrences such as the manganese ore at Groote Eylandt, the bauxite deposits of Gove Peninsula and the lead-zinc mineralization in the McArthur River area.

IRON ORE

Pritchard's Lode, Mt Bundey

Under agreement with Morgan Mining Co. Limited, four diamond drill holes were put down by the Mines Branch drilling section to test the sulphur and phosphorus content of the Mt. Bundey iron ore at depth. Data obtained from analyses of the cores will be used for blending ore for export shipments.

Frances Creek

Limited exploration continued on the Frances Creek iron ore deposits to confirm inferred extensions of the iron ore lode. Throughout the year, liaison has been maintained and advice given to officials of MacDonald Construction Co. Limited.

Other areas

Several new occurrences of iron ore were reported during the year. Disconnected lensoid bodies reported north of the Frances Creek ore were mapped in detail and four diamond drill holes put down to test their extent and grade at depth. Preliminary results of the drilling indicate that the ore bodies are discontinuous and of lower grade than the Frances Creek ore. At the close of the year, newly discovered iron ore deposits to the east of Frances Creek were being investigated.

MANGANESE

A lensoid band of manganese/iron ore in the Frances Creek North area was mapped in detail. Two exploratory drill holes proved that the ore consists of low grade manganese ore patchily replaced by limonite. Assay results had not been received at the close of the year.

TIN

At the request of the leaseholder, a survey was made of colluvial tin deposits near Collia Waterhole, Daly River district. Minor surveys were also made of alluvial deposits in the Mount Fitch area, west of Darwin River. Advice was given to numerous prospectors regarding the known occurrences of tin ores in the Northern Territory.

COPPER AND GOLD

Little prospecting for gold was attempted outside the Tennant Creek area. By contrast, numerous copper occurrences, particularly in the Alice Springs area, received attention. New copper finds have been recorded and known occurrences were prospected in detail.

TENNANT CREEK FIELD

Bishop Creek

A Government Reserve was placed over the area surrounding the Bishop Creek bore for the purpose of future detailed geochemical investigation. An area one and a half miles square is due to be surveyed on a 600 feet by 300 feet grid.

Previous work at Bishop Creek included the drilling of a diamond drill hole on a magnetic anomaly known as Area One West, bordering the eastern edge of the present area. The drill hole failed to intersect ore.

Black Eye

A Government Reserve about one and a half miles square was placed over the Black Eye area. Preliminary survey work has been completed. The Black Eye areas will be geochemically surveyed in detail.

Blue Moon

An investigation of the Blue Moon mine was made. The area was geologically mapped on a 1" - 100' scale and an underground survey completed around the No. 6 shaft. Only trace gold values were obtained from a newly discovered hematite body.

Five shallow drill holes totalling 386 feet were planned to test the No. 2 lode at the Blue Moon prospect. Results indicated that there was insufficient mineralization in the lode to warrant further investigation.

A structural study of the area led to the conclusion that an ore body might occur at depth. The prospect is therefore considered worthy of a detailed magnetic survey.

Bull Pup

At the request of the lease holder, an underground survey of the prospect was made and samples submitted for analysis. A detailed magnetic survey of the area is considered desirable.

Copper Head

All previous work done on the Copper Head prospect has been compiled and a preliminary survey of the area made.

Explorer 15

A drill hole was sited on a strong magnetic anomaly at Explorer 15. The drill hole was originally sited for a depth of 600 feet, but was stopped at 487 feet. The predominant rock type intersected was a lamprophyre which, it is believed, caused the magnetic anomaly.

Explorer 17

An investigation was made of the copper/vanadium relationship across known copper sulphide mineralisation at Explorer 17 prospect. A vanadium negative anomaly coincides with the copper anomaly. Further research is required in the Tennant Creek area before full assessment of the interelationships between vanadium and copper can be made.

Explorer 27

A diamond drill hole planned to explore the sub-surface geology below a gossan with high copper and molybdenum content, was terminated at a depth of 601 feet. Stringers of quartz with feldspar and chlorite containing minor amounts of chalcopyrite, pyrite and molybdenite were intersected but no major zone of mineralization was proved. In a report, recommendations were made for further geochemical and geophysical work to be followed by confirmatory diamond drilling.

Gigantic

The prospect was mapped and a drilling programme planned to test three anomalies revealed in a ground magnetic survey. The area falls within a Government Reserve.

The first of three drill holes was terminated at 250 feet after passing through 100 feet of ironstone. Assays for gold and copper in the ironstone proved negative. At the close of the year, the second drill hole was down to a depth of 148 feet. The programmed depth is 500 feet, the estimated depth of intersection of the lode being 300 feet.

Great Western

This prospect is covered by a Government Reserve. A preliminary survey of the area has been made preparatory to a detailed geochemical survey.

Hopeful Star

A detailed planetable map was made of the lease. Two drill holes were planned to explore at depth a possible extension of the ore body exposed in the surface workings. In the first drill hole, put down to a depth of 474 feet, only sparsely mineralized sections were intersected, assay results revealing the presence of low grade gold values. The second drill hole was planned to test the possibility of a northerly pitching extension of the ore body. The hole was terminated at a depth of 346 feet after intersecting minor patchy mineralization.

Hopeful Star Extended

At the request of the lease holder, the area was mapped and samples collected for assay. A small copper anomaly was indicated by the distribution of assay values. A systematic waggon drilling programme is considered to be the ideal 'follow up' for the lease.

Lone Star

Under an agreement between the lease holder and Mines Branch, N.T. Administration, a drill hole was put down on the Lone Star lease. The drill hole was stopped at a depth of 656 feet, having intersected minor patches of copper mineralization at a depth of 464 feet.

Recommendations have been made for detailed magnetometer surveys over three magnetic anomalies south-east of the old workings.

Mammoth

A drill hole was sited to test at depth the extension of an exposure of copper mineralization in quartz hematite outcropping south-west of the Mammoth mine. The hole was terminated at 601 feet. No intersections of mineralisation were made.

A magnetic anomaly situated to the west of the drill target is considered worthy of further investigation.

Mem Sahib

A diamond drill hole was sited to explore at depth a geochemical anomaly obtained from analysis results of samples collected from waggon drill cuttings in 1962. No significant mineralization was intersected in the hole drilled to a depth of 403 feet.

Further investigation of the prospect is dependent on the results of a future aeromagnetic survey.

Peter Pan

A geochemical survey of this prospect conducted in early 1965 revealed two minor copper anomalies on the eastern and western edges of the map covering the surveyed grid. A tentative drilling programme has been planned but a confirmatory magnetic survey is considered desirable before the drilling targets are finalised.

Red Bluff

Under an agreement with Australian Development N.L., the Mines Branch N.T. drilling section commenced drilling one of three anomalies in the Red Bluff area, numbered 7a, 7b and 7c. By the end of the year, the drill hole at anomaly 7c had reached a depth of 522 feet, passing through a geological succession similar to that intersected by a previous drill hole, B.M.R. 3. Analysis of the core revealed anomalous copper in certain intervals to a maximum content of 0.5 per cent at 385 feet.

Mosquito Creek

A brief visit was paid to a gold prospect at Mosquito Creek, Tennant Creek district. As values from a representative sample were generally low, no further work has been attempted.

KATHERINE-DARWIN AREA

Mt Diamond Copper Lease

Advice and assistance was given to company officials of F. Price Limited, Canada, in making a plane-table map of the Mt. Diamond copper lease. A drill hole was planned to test at depth the lode which is exposed on the surface. The drill hole was completed but no further work was undertaken by that company.

Daly Waters Copper Prospect

A brief survey was made of a reported copper prospect in the Daly Waters area. The occurrence is not considered worth detailed investigation.

Frances Creek Gold Mine

Following a detailed investigation of the Frances Creek Gold Mine, a report was written.

CENTRAL AUSTRALIA

Ringwood Copper Prospect

Two diamond drill holes were put down on a copper prospect on Ringwood Station to test an occurrence of finely disseminated sulphide minerals in a 60 feet sequence of black siltstone of the Areyonga Formation. A report on the drilling results was in preparation at the end of the year.

Undoolya Copper Prospect

One diamond drill hole was sited at Undoolya Gap to test an occurrence of copper mineralization within the Bitter Springs limestone. The mineralized zone extends over about two feet and values of 0.2% to 0.5% copper were recorded. Some pyritic black shale was intersected. The sequence drilled was part of the Gillen member and included a substantial proportion of tuffaceous material.

Pinnacles Area

Several visits were made to the Pinnacles area to study patchy copper mineralization. Sites for diamond drill holes have been selected to test the copper mineralization at depth at two localities.

Areyonga Settlement

In the vicinity of the Areyonga Settlement, copper as azurite and malachite occurs in a five feet thick siltstone interbedded with limestone in the Areyonga Formation. Mineralization has been traced for approximately half a mile along the strike.

It is planned to map the locality in detail during the coming year.

Lalgra Yard (Henbury)

A diamond drill hole was sited to test the mineralization in cupriferous shales of the Larapinta Group sediments. Drilling was due to start early in 1967.

Dnieper Granite, Huckitta

A low grade occurrence of chalcopyrite and galena was investigated 10 miles north of Red Tank (Huckitta 1:250,000 sheet). The minerals occur in a breccia about 300 feet long and 20 feet wide. Although the prospect is too low grade to warrant further investigation, the area underlain by the Dnieper Granite is considered worth examination.

LEAD-ZINC

Katherine-Darwin area

Assistance was given to the leaseholders of the Evelyn mine. The lease was mapped and a series of drill holes planned to locate known ore bodies at depth. A report on the investigation is in preparation.

Central Australia

As a study of base metal mineralization in the Alice Springs district, about 900 samples from oil well cuttings were collected for analysis. Samples were collected where possible at 10 feet intervals from the following wells:-

Ooraminna No. 1

Waterhouse No. 1

Alice No. 1

Spectrographic analyses figures for the samples from Ooraminna No. 1 revealed consistent high lead and zinc values in the 450 feet of shales near the top of the Pertataka Formation. Maximum values were: lead 2,000 parts per million; zinc 800 parts per million. The lead apparently occurs as oxide, zinc as carbonate; no zinc or lead sulphides were identified. In the samples from Waterhouse No. 1, sporadic high lead values occur near the base of the Jay Creek limestone. No associated high zinc values were recorded. In the Alice No. 1 cuttings, the entire interval of Goyder Formation contains high lead (400 - 800 ppm) and zinc (up to 400 ppm) values.

The results obtained from the study to date indicate that the sedimentary succession of Central Australia warrants a detailed appraisal of base metal mineralization.

PHOSPHATE

Darwin Area

A detailed investigation was made of the sediments of Cretaceous age in the Darwin area. Diamond drill holes were put down at Gunn Point, Lee Point and in the Shell Bay area. Examination of the diamond drill cores resulted in the identification of phosphorite occurring as narrow seams of nodules within an interval roughly ten feet thick. In the Nightcliff area, the phosphatic horizon occurs approximately 20 to 30 feet above the bottom of the Cretaceous sediments. Seams of phosphorite nodules were identified in cuttings from two exploratory drill holes put down on Bathurst Island.

A report on the occurrence of phosphorite in the Cretaceous sediments of the Darwin area has been prepared.

Mud Tank

A brief visit was made to an occurrence of apatite known as the Mud Tank or Jenkins Hut prospect. The visit was made as a ground investigation related to a Bureau of Mineral Resources aeromagnetic survey. The prospect is held under an Authority to Prospect agreement.

LIGNITE

Gove

During an investigation of the underground water resources of the Gove Peninsula, conducted by Water Resources Branch, Northern Territory, a series of water bores were drilled on a surveyed grid. Several bores intersected narrow seams of lignite within the Cretaceous sediments overlying a foundation of granite. The largest intersection was originally reported as ten feet thick, the estimated thickness being based on the fact that a loss of water during the drilling of a ten feet interval coincided with the lift of some coal cuttings.

During an investigation of the reported occurrence of coal, three vertical diamond drill holes were planned to pass through the succession of Cretaceous sediments at sites near where coal had been intersected. The proven succession consists predominantly of coarse, loosely consolidated arkosic sandstone with intercalations of fine textured claystones, some of which contain narrow carbonaceous partings. The sediments are capped by bauxite about 30 feet thick. In two of the diamond drill holes, intersections were made of minor seams of lignite, varying in thickness from less than one inch to a maximum of three inches. The lignite seams occurred at depths greater than four hundred and two hundred feet respectively. In the first drill hole, the total thickness of lignite intersected was approximately three inches, in the second a total of about four and a half inches of coal was measured in the core. No lignite was intersected in the third drill hole. During drilling by Water Resources Branch it was found that seams of lignite intersected in bores sited twenty yards apart were not traceable from one site to another, indicating that the lignite occurs as impersistent lenses rather than layers.

Examination of the cores revealed that the argillaceous horizons and in particular the lignite lenses, contain an anomalous zinc content. In the first drill hole put down, lumps of sphalerite up to half an inch long were identified in the lignite.

Detailed study by P.R. Evans, Bureau of Mineral Resources, of the fossil spore content in the lignite confirmed the age of the sediments as Mid-Cretaceous. The following are the results of an analysis made on the Gove lignite by the Australian Mineral Development Laboratories, S.A.:-

Moisture 30.7%; Volatile 36.7%; Fixed Carbon 22.3%;
Ash 10.3%; BThU/lb. 6550.

From the data obtained from the Mines Branch diamond drill holes and the bore holes drilled by Water Resources Branch, it is concluded that the lignite occurs as narrow lenses formed from isolated accumulations of vegetable matter. In view of the thinness and lensoid nature of the lignite, the great depth at which it occurs, and its low grade, the occurrence has no economic potential.

Alice Springs

A diamond drill hole was put down to test a reported coal occurrence in the Alice Springs Farm Area. A dark grey deposit reported as the coal was found to be a manganese-impregnated clay.

GEOLOGICAL MAPPING

In the Tennant Creek area, the Resident Geologist commenced geological mapping of the Red Bluff area.

SEARCH FOR OIL

Close liaison was maintained with personnel of petroleum exploration companies working in the Northern Territory. Visits were made to drilling operations when possible and discussions held on geological problems faced during oil exploration. Samples of cuttings from drill holes provided by companies engaged in oil exploration were examined and certain samples submitted for spectrographic analysis. The data so obtained was recorded. Further details of the progress of the search for oil is given under the oil search section.

GENERAL

Throughout the year an increasing number of mineral and rock identifications were made for members of the public. Advice and technical information was given to prospectors and company officials engaged in mineral exploration. When possible, research has been carried out on geochemical methods of exploration in the three main areas.

During the year the indexing and filing systems were revised to provide better retrieval and interchangeability between the regional offices.

REPORTS

A large number of reports was prepared by officers of the Resident Geological Section during the year. The most important of these are listed below; those processed as B.M.R. Records are marked by asterisks.

Minglo Lead Prospect	A. Vanderplank.
Investigation of a Magnetic Anomaly over Jessop's and Mount Masson Tinfields.	A. Vanderplank.
Explorer 27 (Last Hope Limonites) Geochemical Prospecting and Diamond Drilling.	W.S. Yeaman.
The Frances Creek Gold Mine, Agicondi Field.	J.W. Shields.
Report on Diamond Drilling at Kohinoor and Eleanor Lease, Pine Creek, Agicondi Field.	J.W. Shields.
Cretaceous Phosphorites of the Darwin Region.	K.J. Kemezys.
Groundwater Bore Sites for Legune Station.	K.J. Kemezys.
Inspection of Cracks in the Daly Waters - Borooloola Road.	A. Taube.
Report on Geological Investigations at the Hopeful Star Gold Mine.	B. Tapp.
Report on Investigations on the Blue Moon Gold Mine, No. 2 Lode.	B. Tapp.
Preliminary Investigations of Proposed Damsite near Old Telegraph Station, Alice Springs.	I.G. Faulks.
Progress Report on Investigation of Groundwater in Kelly Well Area.	I.G. Faulks.
Availability of Groundwater for Papunya Settlement Outstation.	K.J. Edworthy.
Notes on the Petermann Range Survey, 1965.	I. Youles.
Copper Mineralization in the Central Mount Stuart Beds at Mt. Skinner, N.T.	I. Youles.
* The Geology and Hydrology of the Alice Springs Town and Inner Farm Basin. (will be published as Bulletin 89).	T. Quinlan & D. Woolley.
* Proposals for Testing of Groundwater at Warrabri Native Settlement.	D. Woolley.
* Groundwater Investigation at Papunya Settlement.	D. Woolley.
Layman's Guide to the Geology of Central Australia.	D. Woolley.
Geohydrology of the Emily and Brewer Plains Area.	D. Woolley.

Preliminary Appraisal of the Tea Tree Groundwater Basin.	K.J. Edworthy.
Appraisal of the Groundwater Resources of the Lander River Area.	K.J. Edworthy.
Results of Analysis for Trace Elements on Samples from Ooraminna No. 1 Well.	I. Youles.
Diamond Drill Report, Undoolya Gap Prospect.	I. Youles.
Proposed Diamond Drilling, Pinnacles Copper Mine.	I. Youles.

PAPUA & NEW GUINEA

SUMMARY OF ACTIVITIES 1966

- ○ *Regional Mapping and Mineral Investigations*
- □ *Engineering Geology Investigations*
- △ *Vulcanological Investigations*

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
INSET
INSET
SA 56-9 KAVIENG
SA 56-10 MABUA
SA 54-11 VANIMO
SA 54-15 AITAPE
SA 54-16 WEWAK
65406
66405
SEPIK
SA 55-13
Sepik Field
66503
SA 56-14 NAMATANAI
SA 56-15 SAMO
66502 65508 66502 66510
66505 66504
66506
65411
SB 56-2
SB 56-3
INSET
SB 54-3 MAY RIVER
SB 54-4 AMBUNTI
Party
SB 55-1 BOGIA
SB 55-2 KARKAR ISLAND
SB 55-4 VITU ISLANDS
GAZELLE PENINSULA
CAPE ST GEORGE
65409
66201
65415
65302
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
66403
65309
66404
64302
65403
66401
66406
SB 54-11 RAGGI
SB 54-12 LAKE KUTUBU
SB 55-9 KARIMUI
SB 55-10 MARKHAM
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SB 55-11 HUON
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BOUGAINVILLE ISLAND SOUTH
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SB 54-15 LAKE MURRAY
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SB 54-16 AWORRA RIVER
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SB 55-14 WAU
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SB 55-15 SALAMAUA
65106
65211
SC 55-2 YULE
SC 55-3 BUNA
SC 55-4 CAPE NELSON
SC 56-1 TROBRIAND ISLANDS
SC 56-6 WOODLARK ISLANDS
INSET
65404
65425
66402
SC 54-3 FLY RIVER
SC 54-4 KIWAI
65423
65107
65414
SC 54-7 BOIGU
SC 54-8 DARU
SC 55-5 MAER
SC 55-6 AROA
65422
SC 55-7 PORT MORESBY
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SC 56-5 FERGUSSON ISLAND
66504
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66202
65412
65426
SC 55-11 KALO
SC 55-12 ABAU
SC 56-9 SAMARAI
65424
SC 56-10 DEBOYNE
65206
65209
SC 56-13 SABLE
SC 56-14 CALVADOS
SC 56-15 ROSSEL
INSET
65108

TERRITORY OF PAPUA AND NEW GUINEA

RESIDENT GEOLOGICAL SECTION

INTRODUCTION

This is the second year in which the Section has attempted to implement a programme formulated at a local programme conference.

Although various factors have again necessitated some changes in the work programme during the year, the advantages of a general plan have been obvious and it is reasonable to expect that, with further experience, the planned programme will be more nearly fulfilled in succeeding years. However, it will always be necessary to allow for ad hoc requests from other departments, and for the unpredictable demands of the Territory's active volcanoes.

Several new approaches to geological problems have been introduced or considered during the year. Notable amongst these have been the systematic appraisal of areas of potential mineralization; the fuller participation of resident staff in Bureau of Mineral Resources Field Parties working in the Territory; the inter-departmental surveys of village water supplies; and planning for the introduction of new surveillance and prediction techniques in vulcanology.

Apart from routine activities, all work done by the resident staff is now formalised into Investigations or Projects; the latter normally comprising two or more investigations and frequently involving more than one geologist. Each is numbered in accordance with a simple system indicating the year of origin, the unit responsible, and the serial number. These numbers are shown in parentheses adjacent to the Investigation and Project titles throughout this Summary. There are many advantages in this system, the principal being that each investigation has a clear object and defined limits. Each Investigation is written up in the form of a Note on completion of the work.

The Summary is based upon work completed up to the end of September and on a projection for the last quarter of the year. It has been prepared by the officers of the various Units and compiled and edited at Headquarters.

STAFF

Senior Resident Geologist: A. Renwick

Senior Field Assistant: B.J. Humphreys

Secretary: Miss C. Dexter

REGIONAL MAPPING AND MINERAL INVESTIGATION UNITS

	Port Moresby	Wau
Geologists:	D.J. French R.P. Mcnab	R.G. Horne J.A.J. Smit
Field Assistants:	H. Kapu P. Leo	T.S. Tasong B. Maduru

ENGINEERING GEOLOGY UNIT

Engineering Geologists: J.P. MacGregor
J.R.L. Read

Assistant: T. Lavako

VULCANOLOGICAL UNIT

Central Observatory, Rabaul

Vulcanologist-in-Charge	G.W. D'Addario
Vulcanologists	D.D. Middleton (to 7th March). R.R. Harding (1st July to 14th Sept.) R.F. Heming (from 4th October).
Senior Technical Officer	N.O. Myers
Technical Officer	M.F. Gill
Vulcanological Assistants	L. Topue, M. Gaiam, and E. Ravian
Technical Assistant	P. Daimbari
Secretary	R. Chang

Manam Volcano

Tabele Observatory - Observer	V. Kaita
Waris Station - Observer (part-time)	N.W. Paulias (till 11th February) H.S. Tade (from 11th February)

Bagana Volcano

Piva Field Station - Observer	E. Ravian (from 1st June to 4th July)
Observer (part-time)	Fr. Rouhan (from 4th July)

Lamington Volcano

Agenahambo Station - Observer (part-time)	Rev. A.R. Morris (from 7th January to end of February) Br. B. Hughes (from the beginning of March)

Esa'Ala Observatory -

Observer	F. Dira (on leave from 6th October to 20th November). L. Topue (from 6th October to 20th November)

HEADQUARTERS

The Senior Resident Geologist devoted much time during the year to administration, planning, and organization, but also travelled extensively to visit outstations, volcanic and thermal areas, and places where geological investigations were in hand.

Many representatives of the petroleum and mining industries visited headquarters for discussions on exploration programmes, and a large number of enquiries were answered on mineral occurrences and raw material resources. Opinions were given to other Government departments on a variety of subjects, and the Press was kept informed of important developments through the Department of Information and Extension Services.

The Senior Resident Geologist attended all meetings of the Petroleum and Mining Advisory Boards held during the year, and was elected Chairman of the newly formed Advisory Committee on Seismology and Earthquake Engineering. He attended the Conference of Government Geologists in Hobart and subsequently spent some days at the Bureau of Mineral Resources in Canberra.

Talks were given to the Papua and New Guinea Scientific Society and to the Papua New Guinea Group of the Institution of Engineers, Australia. The first annual Stanley Memorial Lecture, sponsored by the Scientific Society, was given by Professor S.W. Carey. The lectures commemorate both E.R. Stanley and G.A.V. Stanley, and a short introduction was given in the form of a biographical note on E.R. Stanley.

A small museum was constructed and a preliminary collection was prepared for exhibition.

REGIONAL MAPPING AND MINERAL INVESTIGATION

PORT MORESBY UNIT

INTRODUCTION

Regional mapping was carried out in Sudest Island and begun in the Goilala Sub-District.

The likelihood of the Territory being a zone of phosphate deposition was assessed by reference to published and unpublished material, and some of the more likely areas were investigated.

Several mining and potentially mineralized areas were examined. Many specimens were identified for the public, and progress was made with the distribution of material for secondary schools in the Territory.

R.P. Macnab was attached to the B.M.R. Sepik River Field Party for six weeks.

PROGRESS ON PROJECTS AND INVESTIGATIONS

Goilala Sub District Project (65106)

The project is designed to determine the likelihood of mineralization in various parts of the area, as an incentive to more detailed exploration by the Mining Industry.

This project was initiated in 1965 with an investigation of the Kaiva Prospect. This is a previously known zinc deposit which shows predominantly zinc-pyrite mineralization, but gold, silver and lead was present in small quantities. A few short drill holes may be warranted to test the thickness and grade of the ore horizon.

Further work on the project was suspended till 1967 following the discovery of more interesting copper prospects elsewhere in the Territories. A known gold - copper occurrence with associated silver, lead and zinc and abundant pyrite remained to be examined near Mount Yule.

Phosphate Deposits in T.P. & N.G. (65107)

This project, comprising several investigations, is aimed at selecting areas favourable for phosphate deposition, and at examining these for phosphate occurrences.

Exploration for phosphate was undertaken by International Minerals and Chemicals Corporation in New Britain, with no success, and in the Pio-Pumari area of Papua where again, although the report has not yet been received, it is understood that no economic deposits have been found.

Phosphate Investigation Milne Bay District (65209)

From March 4th to 7th was spent on board the M.V. Wallach, carrying out an investigation of the Duchateau Islands (Lat. 11° 17' S, Long. 152° 21' E). Specimens were collected from each Island, and subsequently forwarded to Canberra for examination and phosphate analysis. A quantitative analysis of a specimen of beach rock from Duperic Island showed a P_2O_5 content of 13.2%.

Gaiva Prospect Area (65211)

Specimens of Eocene - Mafula Group sediments collected showed no reaction to the ammonium molybdate test.

Sudest Island Project (65108)

Sudest Island, situated at the eastern end of the Calvados chain off the south-eastern tip of Papua, was formerly an area of extensive alluvial and eluvial gold workings. Some unsuccessful attempts were also made at lode mining.

A map on a scale of 1:36,000 was constructed from vertical and oblique aerial photographs and used as a base map for the geological field mapping and geochemical sampling programme carried out early in 1966.

The island is composed of schists (extensively intruded by quartz veins) which appear to be largely of igneous origin with a limited development of sediments on the north-west coast. Shearing has all but obscured the original nature of the rock types and lithological boundaries cannot be located with any certainty.

Syn-tectonic and post-tectonic intrusives are easily recognised and mapped, but are of very limited extent. The auriferous quartz veining is believed to be related to the syn-tectonic intrusions.

The economic possibilities of the island do not seem to be great.

Misima Island (65206)

Misima Island was visited from the 5th to the 8th January, and core from drill hole DD/T17 was logged. This completed the present stage of the drilling programme.

There was little mining activity in the first half of the year but in the latter half a start was made on driving of the intermediate level adit.

Upper Warangoi Copper Deposits (66201)

This investigation was instigated in January following the receipt of specimens containing copper mineralization which had been collected by indigenous peoples in the area.

A Government Reserve was declared over the area and subsequently a series of visits was made to the area in order to do geochemical orientation sampling, geological mapping and auger drilling.

The mineralization in the area consists of chalcopyrite, molybdenite, tetrahedrite, bornite, malachite and chalcocite, and is apparently directly related to a quartz-diorite intrusion in the Baining Series schists.

The stream sediment samples showed a number of small peaks a mile or less in diameter. Augering was undertaken to a depth of 2 feet along the ridge spurs in the area of highest anomaly. The results of this will be used to site proposed diamond drill holes.

Keveri Investigation (66202)

A survey of the Upper Domara River - Keveri Valley - Cloudy Bay area was undertaken in late April and May in conjunction with H.L. Davies' work on the Papuan Basic Belt.

Outcrops of Domara River Beds were found to be less extensive than expected.

"Hornfelsed" basic volcanics and fine-grained marine sediments, occasionally poorly foliated, and occasional areas of bedded calcareous metasediments are widespread.

These rocks are commonly intruded by andesitic and more basic porphyritic rocks, and are correlated with the Urere metamorphics.

To the south, more recent extrusive volcanic rocks continue to the coast - the contact is apparently along a system of faults.

A small area of massive limestone, similar to the Eocene or Miocene limestones occurring elsewhere in Papua, outcrops on the Adau River. Copper mineralization was found at two localities on the Upper Domara River, and some evidence of copper mineralization was found in the area east of the Keveri Valley.

Highly pyritic, generally epidotised porphyritic intrusions and fine-grained "hornfelsed" volcanics or sediments shed into creeks of the old Keveri gold workings, and also occur extensively in the headwaters of the Godaguina River.

An Exclusive Prospecting Licence and two Special Prospecting Authorities have been applied for in the area and a field party has been sent in to investigate the prospect.

WAU UNIT

INTRODUCTION

Regional mapping activity was concentrated in the area of the Wau 1:250,000 sheet.

Mineral investigations were carried out in various parts of the New Guinea mainland.

J.A.J. Smit was attached to the B.M.R. Sepik River Field Party throughout its fieldwork and is taking a part in the compilation of its results.

PROGRESS ON PROJECTS AND INVESTIGATIONS

Wau-Nauti East One Mile Sheet (65103)

The geology of the Wau-Nauti East Sheet has gone through the various stages of editing during the year. A final draft has been submitted to the Bureau of Mineral Resources for publication.

Wau 1:250,000 Sheet (65104)

The progress on the project of the Wau 1:250,000 Sheet is shown in the completion of the following investigations.

Serpentinite Menyamya Area (64303)

A draft of the Investigation Note and the accompanying map were completed. Assay values for nickel and chromium show that the serpentinite bodies are not of economic interest.

The Tertiary sequence has been divided into:

> Menyamya Beds, which consist of steeply dipping sediments and which are unconformably overlain by basalts, the Yagobei Volcanics. These are overlain by the sediments of the Langimar Beds. The ultrabasic bodies, which have been serpentinized, have intruded along probable deep fracture zones. The small basic intrusives which occur in the area appear to be related to the basic volcanics.

Eloa and Biaru Rivers Traverse (65301)

The Investigation Note, which covers the S.E. corner of the Wau 1:250,000 Sheet has been edited and the investigation has been completed.

The area consists of Kaindi Metamorphics, which have been intruded by granodiorite and andesitic porphyries. Near the Papuan Plain the Kaindi Metamorphics are partly overlain by basic volcanics, which are of Miocene or Pliocene age.

Kapau-Baum Traverse (66301)

During the beginning of the year a seven week traverse was made to map the central part of the Wau 1:250,000 Sheet.

The Kaindi Metamorphics form the basement rocks of the area and have been intruded by granodiorite and porphyry bodies. Minor gold was observed in alluvial deposits and it appears to be that the gold has been introduced by the granodiorite in the contact zone with the Kaindi Metamorphics. Structural deformation suggests that the Kaindi Metamorphics in the area were located on the western edge of an area of major tectonic movements, which caused the general slaty cleavage of the Kaindi Metamorphics farther to the east. The boundary was mapped between the Kaindi Metamorphics and the Tertiary sequence, which was divided into Menyamya Beds, Yagobei Volcanics and Langimar Beds. The reconnaissance mapping connects with the more detailed geological mapping of the oil companies in the Gulf District of Papua.

The Investigation Note has been edited and is near completion.

Geochemical Orientation Survey - Wau (65105)

The samples have been collected and despatched for analysis in Australia, and part of the report has been completed. A detailed geological map of the area has been prepared. The portrayal of the drainage pattern on the existing map has been considerably improved with the help of recent aerial photographs.

Analytical results of a first batch of samples confirm a generally accepted relationship between spectrochemically determined arsenic and assayed gold and silver. However, there is poor correspondence between spectrochemically determined gold and gold assays, although the corresponding silver determinations check reasonably well.

Drilling, New Guinea 1964 (64301)

The Investigation Note on percussion and diamond core drilling in New Guinea 1964 was completed.

Porgera River Goldfield (65302)

In the beginning of the year, work continued on examining the core of a diamond drilling programme carried out in the area by Bulolo Gold Dredging Ltd.

A record describing previous geological work was rewritten and has been submitted to Canberra to be produced as a Bureau of Mineral Resources Record.

During October the goldfield was visited to survey a topographical map, to collect geochemical samples and to start a programme of detailed geological mapping.

Kathnel Gold Mine, Kainantu (65309)

The Kathnel Gold Mine at Kainantu was visited twice during the year. The mine workings were surveyed, and geology of the direct surroundings examined and some large scale maps of the mine were prepared.

The main ore occurs as an oxidized, quartz - pyrite-limonite leader along a contact between a small porphyry body and the surrounding schists. Beyond this contact the main leader continues within the schists, but branches into several thin stringers. Some gold occurs in the host rock along the main leader and in between the stringers, which is associated with disseminated pyrite . The overall grade of the host rock is low and it appears to be uneconomical to open out all of the mineralized area.

The mine produced 507 oz. Au fine from September 1965 to 1st July, 1966; according to the owner this production comes from 3,450 tons of ore, which indicates a general recovery of around 3.3 dwts/ton Au fine.

B.M.R. Sepik River Field Party

From June to early August field work was carried out in connection with the Bureau of Mineral Resources Sepik River Party in the Ambunti 1:250,000 Sheet. During August and September field data were studied and a preliminary geological report was completed.

Projected work programme for last quarter

During the remainder of the year it is intended to complete the following Projects and Investigations:

Geochemical Orientation Survey - Wau (65105)
Mount Victor Mine (64302)
Snake River Area (B.M.R. Record)
Kathnel Gold Mine, Kainantu (65309)
Kapau-Baum Traverse (66301)
Porgera River Goldfield (65302).

ENGINEERING GEOLOGY UNIT

INTRODUCTION

The addition of Mr. Read to the Engineering Geology Unit has considerably increased the service which can be provided to Commonwealth and Administration Departments in the Territory. During 1966 a total of 27 investigations were undertaken which included the supervision of geological aspects of investigation of two major hydro-electric schemes (services at Rouna No. 2 are provided directly by the Bureau of Mineral Resources); detailed village water supply surveys of two districts; and the geological investigation of two major sections of the Highlands Highway. Field-work and the preparation of reports on these large investigations restricted the amount of time which could be spent on other work, especially the water supply for towns and a regional appraisal of groundwater problems. A submission was prepared for the creation of an additional post to be filled by a hydrogeologist.

The work carried out by the Unit can be divided under three main headings (a) major hydro-electric schemes, (b) water supplies and (c) miscellaneous engineering investigations. During 1966 about 45% of the work time was spent on (a); 30% on (b); and 25% on (c).

MAJOR HYDRO-ELECTRIC SCHEMES

Upper Ramu Hydro-electric Scheme (65403, 65402)

A visit early in the year to the site of the proposed reservoir dam at the Upper Ramu with representatives from the Commonwealth Department of Works and the Snowy Mountains Hydro-electric Authority resulted in the choice of a new site for the dam some 1,000 feet down-stream from the site investigated earlier. Foundation conditions at both sites are similar.

The drilling investigation for the underground scheme was completed by June. DD 20A on the tunnel line and DD 22 on a revised access shaft position on the right bank of the Ramu river showed that the mechine hall and most of the tailrace tunnel will be in strong marble. There is evidence of some faulting in the machine hall area.

Additional field mapping down the Ramu river and to the west of the tunnel line located marble outcrops in Yonki Creek underlain by siliceous schists of the Bena Bena Formation. As a result, some re-interpretation of the general geology of the area was necessary. The stability of the surface works sites and the access road was investigated.

The preparation of the design report for the scheme occupied most of the second half of the year. A visit was made to Canberra for discussion on layout and content of the report which should be completed by the end of the year.

Lower Warangoi Hydro-electric Scheme (65409)

The drilling programme on the Lower Warangoi continued with the completion of WD 2, and the drilling of WD 8, and WD 8A on the left abutment of the damsite; WD 3, WD 4A and WD 9 on the right abutment and WD 6 and WD 10 on the southern watershed of the reservoir. All cores were logged and photographed and water pressure test results computed. A costean and pit dug close to WD 6 on the watershed was mapped and geological control given for undisturbed sampling by Central Testing and Research Laboratory, Commonwealth Department of Works. A geophysical survey of the damsite and watershed was carried out by a party from the Engineering Geophysical Group of the Bureau of Mineral Resources.

The core recovered from the drilling at the damsite was of low strength and extremely broken. Water losses were high. The drilling of WD 4A and preliminary results of the geophysical investigation indicate a depth of about 150 feet of river gravel at the damsite. Investigation of the watershed has revealed a thick band of permeable gravel. As a result the investigation has been curtailed pending the results of the soils testing, the geophysical investigation and an economic appraisal of the scheme. A geological report on the investigation will be prepared early in 1967.

WATER SUPPLIES

Village Water Supply - Milne Bay District (65424)

A District-wide survey of village water supply problems was carried out with officers of the Department of Public Works and the Department of Public Health between February and May 1966. During the survey a total of 144 villages were visited and recommendations for the construction of a properly protected supply of drinking water made for each place. The villages were mainly located on islands, commonly of coral origin, and in most cases shallow concrete-lined wells were recommended. However, where suitable, surface gravity schemes were proposed, and in some cases rainwater catchment in tanks was found to be the most economical solution to the

drinking water problem. A note on the investigation was prepared and submitted to the various departments concerned.

Village Water Supply - Sepik District (66405)

The second District village water supply survey commenced on the 1st October and will continue till the second week in December. The survey covers both the East and West Sepik Districts in two sections - along the coast and Prince Alexander Ranges, and along the Sepik river.

Once again the survey is in conjunction with officers of the Department of Public Works and the Department of Public Health. The transport and other services are provided by the Department of District Administration and the jetboat to be used on the Sepik River section has been loaned by the Bureau of Mineral Resources.

Village Water Supply - Western District (65420)

The chance of spread of disease from West Irian has placed a high priority on the quality of drinking water in the Western District and as an interim measure a short survey of the water supplies of the stations along the border will be carried out in the first week of November. It is hoped to carry out a full scale District Village Water Supply Survey in the second half of 1967.

Village Water Supply - Rigo Council Villages (65421)

Geological supervision of the drilling recommended for these villages continued through the year. Successful results were obtained from all villages with the exception of Saroa where another bore in a more favourable site will be drilled.

Village Water Supply - Markham Valley (65417)

Percussion drilling by the Mines Division continued in the Markham Valley and several bore sites were examined. Data on other bores were received. No major problems were encountered in the location of ample supplies of good quality water.

Town Water Supply - Rabaul (65411)

Percussion drilling based on the preliminary geological report of the area was continued by the Commonwealth Department of Works. This report was revised and submitted to Canberra. Several bores were sited. Detailed control of investigation was prevented by other commitments.

Town Water Supply - Lae (65416)

The drilling for water at the Army Camp was completed successfully and further drilling for the Lae Town Supply was carried out near the police barracks. Little time was available for supervision.

Town Water Supply - Madang (65415)

Some investigation of the groundwater resources near the town was carried out in 1966. The results were inconclusive and more work is necessary.

Town Water Supply - Daru (65414)

The results of water level and salinity measurements taken in late 1965 were plotted and revision of the note commenced, but the work was interrupted and is not yet complete.

Town Water Supply - Kwikila (65412)

Further drilling in the Kwikila area has confirmed that water supplies are related to the creeks and that nc good aquifer exists. Moderate supplies can be obtained from wells sunk in the gravel in the bed of Kwikila Creek.

Town Water Supply - Marshall Lagoon (Kupiano) (65426)

Two bores were sunk in the centre of Kupiano township and produce moderate supplies of water from a silt-limestone horizon. However, a well sunk close to the bores failed to encounter this aquifer. Investigation of possible water sources farther from the station is continuing.

Water Supply - Boroko Valley (66402)

All information on bores drilled in the Boroko district of Port Moresby was collected and examined. A provisional programme of exploratory holes was drawn up to confirm the groundwater resources.

Water Supply - Administrative College and University (65423)

Two successful bores were sited and drilled at the Administrative College in June Valley, Port Moresby. A drilling programme of 6 bores to supply water for the grounds of the University of Papua and New Guinea was drawn up and it is hoped that this drilling will commence shortly.

Water Supply - Miscellaneous

Advice on water supply problems was given on several occasions to villages, missions and other departments. Sites for bores were selected at the Port Moresby Golf Club, Bautama Mission, and Merigatta Gardens plantation. Problems of pumping, developing and screening bores were discussed with representatives of the Administration Departments dealing with groundwater.

Visit to Adelaide

A note was prepared on the visit in December 1965 to the hydrology and engineering geology sections of the South Australian Department of Mines. This Note was subsequently produced by the Bureau as a Record.

Water Bore Record Cards

All data on groundwater were transferred to Bureau of Mineral Resources Water Bore Record Cards which were indexed. Samples of cuttings from percussion bores were logged.

Water Analyses

Complete analyses of water samples collected in the Territory are carried out by the Laboratory of the Department of Agriculture, Stock and Fisheries and also by the Queensland Government Laboratory. It was found that the use of a Tectron Salinity Bridge gave a useful indication of the total soluble salt content and reduced the number of samples which were sent for complete anslysis.

Mechanical Analysis of Sand Samples

The systematic mechanical analysis of all samples of sand received from water bores was commenced during the year. This gives valuable information on the quality of the aquifer and the size of screen necessary.

MISCELLANEOUS ENGINEERING INVESTIGATIONS

Kainantu-Goroka Road (66403)

A geological survey of the proposed alignment for the reconstructed section of the Highlands Highway between Kainantu and Goroka showed that in many places the weathered nature of the bedrock and great depth of overburden has resulted in slope instability. Careful control of excavation, fill and drainage with a detailed programme of soils testing was recommended. A Note was prepared and later re-issued by the Bureau as a Record.

Lufa-Chuave Road (66404)

The alignment of the proposed section of the Highlands Highway between the Kainantu-Goroka road and Chuave via Lufa was examined. It was found that side-slopes and grades are such that apart from one or two areas the construction of a permanent road should present few major problems. There is slope instability which can be controlled by careful excavation and drainage. Construction of the section immediately west of the Tua river was found to be critical and a detailed investigation recommended. A Note was prepared and later re-issued by the Bureau as a Record.

Daulo Pass Road (66406)

A brief examination of the existing section of the Highlands Highway between Goroka and Chuave via the Daula Pass revealed that the deeply dissected topography has resulted in a narrow road with steep grades and tight-radius curves. In many places cutting to form the pavement has resulted in the slipping of the overburden over weathered shale and volcanics and often there is movement in the bedrock. The improvement of the grade and increase of the radii of the curves would require deep cuts and fills which would lead to more instability. It was considered that the economical improvement of this road was not feasible. A Note is in preparation.

Aggregate - Boram Airstrip (65406)

The drilling at Dabiap Point proved a considerable depth of weathered rock and investigation and drilling of another area on the Letak river was carried out. Drilling was also carried out at Wom Point for coral aggregate. A Note on the Investigation was prepared.

Cement Industry - Port Moresby (65422)

Various possible sources of limestone in the Port Moresby area were examined with an official of Associated Portland Cement. Testing of the quality and quantity of the rock will indicate whether a local industry is feasible.

Drilling - Nine Mile Quarry (65404)

Geological supervision of the drilling programme for extension of the Nine Mile Quarry near Port Moresby included the selection of drill sites and the logging of core. The results of this drilling were not promising as a considerable depth of overburden was located above the workable rock.

Army Small Ships Wharf (65425)

Advice was given to the Commonwealth Department of Works on the quality of the fill used in the construction of the Small Ships Wharf in Port Moresby. Results of test probings were interpreted and depth of penetration for the sheet piling advised. It was found that although several small bands of coral were present no satisfactory set was obtained before 45 feet. A saving of steel was achieved by the driving of every third pile to this depth and the intermediate piles to 30 feet.

Concrete Aggregate - Mendi (66401)

Two samples of concrete which had failed were received from the District Commissioner Southern Highlands, at Mendi. Examination showed that the weakness of the concrete was due to the use of dirty river gravel aggregate. There was no evidence of reaction between the aggregate and the cement. A Note was prepared.

A.N.G. House, Port Moresby

Advice was given to the consulting architect on the foundations for the building. The bedrock is folded and sheared calcareous and siliceous siltstone and in some cases deep excavation was required before material was exposed capable of supporting the 15 tons per square foot load expected from the 12 storey building.

Aggregate Quarry - Goldie River

A possible quarry in fresh gabbro near the Goldie river was briefly examined. Samples of the rock were taken by the Soils Laboratory, Commonwealth Department of Works and submitted for strength testing.

Drainage Wahgi Swamp

Meetings of the Standing Committee on the Drainage of the Wahgi Swamp were attended in Port Moresby and Mount Hagen. These meetings produced definite proposals and a programme of design for drainage of approximately half the swamp. It is hoped to present details to the Land Development Board in early 1967.

Advisory Committee on Seismology and Earthquake Engineering

Quarterly meetings of the above committee were attended and also meetings of the sub-committee on Seismology and the sub-committee on earthquake engineering. A network of voluntary seismological reporters has been set up and the preparation of a Building Code for the Territory which incorporates earthquake provision has been commenced.

Soils Testing

Some simple soils testing apparatus was ordered to aid classification and determination of some of the properties of soils encountered in engineering geological investigation. Unfortunately half the order was mislaid during shipment and had to be written off. It is hoped to start testing with new equipment before the end of 1966.

VULCANOLOGICAL UNIT

INTRODUCTION

Shortage of professional and supporting staff has restricted the amount of non-routine work which could be carried out this year. Proposals have been made to ease the situation, which is critical, but consideration of these by the Office of the Public Service Commissioner has had to be postponed owing to the pressure of salary reviews and other commitments. Even routine essential services could be dangerously curtailed by any further reduction resulting from serious illness or resignations among the existing trained staff. Routine field work has included surveillance of active volcanoes and thermal areas and the investigation of reported volcanic activity. At the Central Observatory seismograph and tiltmeter records have been analysed and interpreted.

Progress has been made with the Rabaul Vulcanological Warning Network, and with the instrumentation of Manam and Esa'Ala Observatories. Sub-stations and Field Stations have been maintained.

The Technical Staff has been actively engaged in maintaining existing equipment and in developing instrumentation for the new stations.

PROGRESS OF PROJECTS AND INVESTIGATIONS

Design and Construction of a Recording Tiltmeter (65508)

This project has been postponed.

Mechanism of Epicentral Location Using only Rabaul Seismological Data (66501)

1531 earthquakes (up to the end of September) have been analysed and entered in the index cards. A new and more comprehensive index card has been designed to include also Rabaul seismological data computed by the International Seismological Research Centre of Edinburgh.

Revision of New Guinea Earthquake Epicentres (66502)

Final analysis of earthquakes which occurred in the Territory during the period January/March 1966 and which were recorded at Rabaul was completed in March. No further final analysis was possible since that date owing to lack of staff.

Epicentre determinations received from U.S.C.G.S. during the year and classified under recognised trends have been listed every month. (Lists are attached to monthly supplements).

Manam Volcano Activity, 1965-1966 (66503)

A draft of investigation carried out between 25th and 28th January and note were sent to the Senior Resident Geologist together with a sketch from Tabele of the upper 1000 feet of the volcano, including part of the southwest valley. (This investigation forms part of the routine surveillance of volcanic areas referred to below).

An Investigation into the Design and Development of Power and Timing Equipment for Seismic Installation (66504)

A major portion of the design work has been completed and a model has been installed at the Esa'ala Observatory in September. (This is further described below under 'Technical Developments').

A Suggested Crustal Study of Blanche Bay Caldera (66505)

The note was completed in March and the preliminary survey, in co-ordination with a Geophysical Party from the B.M.R., was carried out in August.

A High Speed Recorder Trigger Unit (66506)

The investigation has been completed. (This is further described below under 'Technical Developments').

Volcano-Seismic Study of Mt. Bagana, Bougainville Island (66507)

The Willmore seismograph was installed on 1st July at Piva. A field investigation was carried out on 7th July. The area devastated by the pyroclastic flow was inspected, samples collected at the snout of the flow and temperatures measured. Two portable tiltmeters were installed on the concrete floor of the Mission store at Piva.

Structure and Geology of Blanche Bay and Adjacent Areas (66504)

Watom Island, coastal and cliff sections were examined and specimens collected for microscopic examination. Various levels, which may indicate previous sea levels, have been recognised both within the caldera wall and outside it. Mapping of the north wall of the Blanche Bay Caldera has been commenced.

Analysis of Seismogram Records of Rabaul Observatory in Conjunction with the Preliminary Geophysical Survey of Blanche Bay. (66510)

Shot points have been plotted on a map 1:25,000 and analysis of arrival time, period and amplitude of body and shear waves commenced.

ROUTINE OBSERVATIONS

INTERNATIONAL COMMITMENTS

World Wide Standard System - Regular seismogram records were obtained at Rabaul Central Observatory and preliminary analysis carried out. Weekly bulletins were despatched to international centres and relevant data cabled to the U.S.C.G.S. for preliminary computation.

International Seismological Research Centre - Mark Sense Cards covering earthquake phases recorded at Rabaul from January till March have been despatched to Edinburgh for final computation.

OBSERVATORIES

Rabaul Central Observatory - Seismic, tilt, temperature, strand line and tidal recordings were maintained throughout the year.

Tabele Observatory - Vulcanological and seismological observations and tiltmeter readings were carried out regularly. A vertical Benioff seismometer has been coupled to a Willmore recorder, magnification 860. The permanent installation will be carried out in 1967.

Waris Station - Tiltmeter readings and Main Vent observation were carried out regularly by the teacher at Abaria Primary School from February with a small interruption during June. A Crammond transceiver was installed permanently at the station and a new aerial erected by the A.D.C. Bogia to facilitate communication between Tabele and Waris observers.

Esa'Ala Observatory - Tiltmeter readings were maintained and weekly temperature runs carried out regularly across the Oiau Peninsula, Fergusson Island, and Dobu Island. The permanent instrumentation was installed in September.

Agenahambo Station - Tiltmeter readings have been carried out regularly. The Willmore seismograph was removed for repairs on 22nd February and it was again operational on 17th September.

Piva Station (Bougainville Island) - A small shed has been constructed at Piva Hansenide Colony in August. It will accommodate permanently the 2 portable tiltmeters and readings will be carried out by the manager of Piva Station.

ROUTINE SURVEILLANCE OF VOLCANIC AREAS

Aerial inspections of vulcanological centres were carried out in New Guinea including Bougainville Island. The focus of activity in the Territory has been on Manam Island, Bagana and Langila Volcanoes.

Manam Volcano

The permanent evacuation of Bodua Village close to the southwest avalanche valley has been carried out because of the strong activity which persisted throughout the first part of the year at the head of the south-western valley.

Bagana Volcano

Increased gas emission with boulder flow culminated with major explosions at the end of May. Explosions have taken place at the base of the dome blocking the vent. An overflowing glowing cloud followed the course of the southern valley and overturned trees, converted them to charcoal and deposited about 10,000,000 cubic yards of partly-welded ashy material in the Saua River. Temperature measurements after a few days were 180°C at the surface of the pyroclastic flow and 320°C below the welded thin cover. The summit area shows now a steep sided breach approximately 2000 feet long, 600 feet across and 500 feet deep. Electrical storms accompanied the eruption. No evacuation was necessary in conjunction with this phase of volcanic activity because there are no villages within a 4-mile radius of the volcano.

Langila Volcano

The Patrol Officer at Cape Gloucester and the Father from Kalingi Mission reported intermittent activity from the parasitic cone on the northwestern flank of No.1 Crater (Surumei); activity consisted of steam explosions with clouds heavily laden with pulverised old rocks.

Reported Activity

The D.C., Eastern Highlands District, and others reported unusual smoke from the top of Mt Helwig. During the aerial inspection it was ascertained that the smoke was not of volcanic origin.

SEISMOLOGY

Seismic activity has been high throughout the year, though intensities of felt shocks have been extremely low throughout the whole region. An average of 18 tectonic shocks and 40 emergent shocks of short duration per day has been recorded and analysed. Special study has been made of the variation of period and trace amplitude of emergent shocks during the Manam Volcano activity. An average number of 50 volcanic shocks have been recorded daily at Tabele Observatory.

TECHNICAL DEVELOPMENTS

Technical development maintained during this year will eventually allow expansion of research in the vulcanological and seismological fields.

Investigations include:

(66504)

The design and development of power and timing equipment suitable for controlling seismic equipment at new observatories at Tabele, Manam Island, and Esa'ala on Normanby Island is complete. Facilities provided by this equipment include automatic switch-over from primary to secondary time sources in the event of a catastrophic failure of the primary timing system, protection against over-discharge of the nickel-cadmium batteries, and means of recording radio time signals on all records.

(66506)

A high speed recorder trigger unit has been designed and constructed and is operating at the Central Observatory. This unit is basically a switch which comes into operation and switches on a high speed recorder immediately upon the occurrence of a seismic event, should its amplitude exceed a predetermined value. The recorder is automatically switched off by the occurrence of the first hour time signal following the event.

Time Signals

The secondary time source for the Central Observatory is a crystal clock capable of accurate time (approx. 20 ms. per day). It is hoped to use these signals for recording on seismic records at stations remote from Rabaul such as at Esa'ala and Manam Island. An investigation into this will be carried out in 1967.

On 11th August at 1600 hours, A.B.C. 9RB Station started the transmission of time signals from the Rabaul Observatory. Each set of time signals consists of six dots, the first five one-tenth of a second long spaced one second apart, and the sixth one second long. The audio note which forms the dots is generated and maintained at 1000 $\pm$ 1 c/s and controlled directly by the Observatory electronic clock. The signals are being transmitted every hour and acknowledgment of the source of the signals is broadcast every day at 12 noon.

OBSERVATORY BUILDINGS AND INSTALLATIONS

Rabaul Seismic Network - Progress was made on the construction of the stations for the telemetered network around Rabaul. Construction of the stations will be completed in December. Instrumentation for the stations is gradually being assembled and tested and it is hoped that Sulphur Creek, Rabalanakaia, Wanliss Street and Tavurvur "B" Stations will be operational at the end of March 1967, and Taviliu Station by the end of May 1967.

Esa'Ala Observatory - The Esa'Ala Observatory was brought into full operation on 23rd September. This station comprises three short and three long period seismographs operating at moderately high magnifications, and two components of water tube tiltmeters, each component of which is five metres long.

Manam Observatory - Power and timing equipment for Manam Island is now in the course of construction, and it is anticipated that installation will take place about mid-1967. In the interim a seismograph comprising a vertical Benioff seismometer and Willmore recorder is in operation. Power for this is derived from a 12V/240V AC converter supplied by float charged lead-acid batteries. Use of the Willmore vibrator supply is not now used where battery supplies are available.

Keravat Outstation - An additional outstation at the Keravat High School was operational in early November. This station consists of a 3-component short period seismograph recording on 35 mm. film. During 1967 it is hoped to establish a high frequency radio channel between the Central Observatory and this station for the transmission of programmed time signals for recording directly on the seismic records. A field chronometer at Keravat will then be used as the secondary source. Facilities for automatic and manual switching of this chronometer will be included to safeguard breaks in timing caused by bearer circuit failure.

GENERAL

Administrative reports have been issued on 27th of every month and incorporated in the Geological Section Monthly Reports.

Progress reports on Projects and Investigations, together with Vulcanological Reports, Seismological and related data have been issued later every month as a supplement to the Geological Section Monthly Report.

The Vulcanologist-in-Charge devoted a considerable part of his time to matters of instrumentation and civil works for the Rabaul network of seismological stations and other projects. Enquiries have been made overseas regarding slow motion tape recorder seismographs, distance thermographs and pyrometers, and also for techniques for determining earthquake foci. Descriptive data on analytical equipment for a vulcanological laboratory was received from Dr. Green, Research Scientist, Advanced Research Laboratory, U.S.A.

Operational instructions concerning seismogram interpretation, time correction and new tiltmeter operational logs have been forwarded to the outstation observers.

A new index system was compiled in connection with the project of preparation of definitive notes on centres of volcanology, and some progress has been made on the notes regarding Manam, Balbi, Bagana, Langila and Tuluman Volcanoes. It is hoped to resume this investigation now that a second Vulcanologist has again been appointed. A note on additional information, corrections and changes to be introduced in the Handbook of the worldwide standard network has been forwarded on request to the Institute of Science and Technology, University of Michigan.

There were a large number of visitors to the Central Observatory during the year.

RESIDENT GEOLOGISTS - ANTARCTICA

Specimens were collected early in the year from previously unvisited massifs on either side of the Lambert Glacier. This was done in conjunction with a field party of the Soviet Antarctic Expedition.

Preparation of reports on work in earlier years continued as opportunity allowed, and petrographic study of thin sections by AMDEL also continued. Isotopic age determinations on a suite of specimens are in progress.

A report on glaciological work by Bureau geologists was sent to the Antarctic Division for publication, and the MS of Report 118, an account of mapping in early 1965, was submitted for editing.

Liaison with other departments, organisations, and individuals interested in Antarctica was continued.

EDITING AND PUBLICATIONS

The editing section has consisted throughout the year of

K.A. Townley, Geologist Class 4
R.R.E. Jacobson, Geologist Class 2

Map editing personnel belong to another section, though the publication of maps is the responsibility of the Drawing Office, which is under the direction of Mr. Townley's section.

A tabulated summary of throughput during the calendar year 1966 is given below -

TABLE 1 : THROUGHPUT, EDITING, GEOLOGICAL BRANCH

	In press 1. 1.66.	MSS Recd during 1966	To Press 1966	In hand 31.12.66.
Bulletins	6	13	12	5
Reports	10	14	9	10
Maps	23	22	25	19

Explanatory Notes have not been listed; they are issued with each 1:250,000 map sheet, and are almost invariably printed and ready for issue when the maps are printed, because they do not take as long to process.

During the year a pamphlet on Canberra geology for school-children was written and published, and proved a considerable success, not only with children, but also with local and visiting adults; there appears to be a need for simply-written handbooks to satisfy the curiosity of untrained people about the geology of the country they live in.

BULLETINS AND REPORTS NOW BEING PRINTED ARE:

BULLETINS

83 - ANDEL, Tj. H. van, and VEEVERS, J.J., 1967 - Morphology and sediments of the Timor Sea.

93 - BLAKE, D.H., 1967 - Geology of Bougainville Island.

76 - BRANCH, C.D., 1966 - The volcanic cauldrons, ring complexes, and associated granites of the Georgetown Inlier, Queensland.

58 - BRUNNSCHWEILER, R.O., 1966 - Cretaceous ammonites of Western Australia:

1. The heteromorph Lytoceratina

77/2 - CONDON, M.A., 1967 - Geology of the Carnarvon Basin, Western Australia:

2. Permian stratigraphy.

74 - OPIK, A.A., 1966 - The Mindyallan fauna of North-western Queensland. (Vol. 1-Text; Vol. 2-Plates & Appendices).

86 - PLANE, M.D., 1967 - Stratigraphy and vertebrate palaeontology of the Otibanda Formation, Morobe District, New Guinea.

89 - QUINLAN, T., 1967 - Geology and hydrology of the Alice Springs town and inner farm basins, Northern Territory.

91 - RANDAL, M.A., 1967 - Groundwater in the Barkly Tableland.

88 - RICHARDS, J.R., WHITE, D.A., WEBB, A.W., and BRANCH, C.D., 1966 - Isotopic ages of acid igneous rocks in the Cairns hinterland, north Queensland.

73 - SKWARKO, S.K., 1966 - Cretaceous stratigraphy and palaeontology of the Northern Territory.

75 - SKWARKO, S.K., 1967 - Mesozoic fossils from Central Australia and New Guinea (3 papers).

85 - STIRTON, R.A., WOODBURNE, M.O., and PLANE, M.D., 1966 - Tertiary Diprotodontidae from Australia and New Guinea.

82 - WALPOLE, B.P., DUNN, P.R., and RANDAL, M.A., 1967 - Geology of the Katherine-Darwin region, Northern Territory.

87 - WOODBURNE, M.O., 1967 - The Alcoota fauna, Northern Territory.

80 - Palaeontological Papers, 1965.

REPORTS

106 - BEEVERS, J.R., 1967 - A chemical investigation of the potential role of sorption in ore genesis.

114 - DUNNET, D., & HARDING, R.R., 1967 - Geology of the Mount Woodcock One-mile Sheet, Northern Territory.

103 - FORMAN, D.J., MILLIGAN, E.N., and McCARTHY, R.C., 1967 - Structure of the north-eastern margin of the Amadeus Basin, Northern Territory.

117 - HARDING, R.R., 1967 - Catalogue of isotopic age determinations of Australian rocks.

104 - JENSEN, A.R., GREGORY, C.M., and FORBES, V.G., 1966 - Geology of the Mackay 1:250,000 Sheet area, Queensland.

78 - McLEOD, I.R., and GREGORY, C.M., 1966(?7) - Geological investigations along the Antarctic coast between longitudes 108°E and 166°E.

108 - MERCER, C.R., 1967 - Completion reports, BMR stratigraphic wells 8 and 9.

45 - SHIELDS, J., WHITE, D.A., and IVANAC, J.F., 1967 - The Union Reefs Goldfield, N.T.

124 - SMITH, K.G., et al. - Stratigraphic drilling in the Georgina Basin.

115 - TRAIL, D.S., 1967 - Geology of Woodlark Island, New Guinea.

118 - TRAIL, D.S., McLEOD, I.R., COOK, P.J., and WALLIS, G.R., 1967 - Geological investigations by the Australian National Antarctic Research Expeditions, 1965.

113 - WELLS, A.T., et al., 1967 - Geology of the north-east Amadeus Basin, Northern Territory.

105 - YATES, K., and de FERRANTI, R., 1966 - The Astrolabe Mineral Field, Papua.

MINERAL RESOURCES

A simple index to literature on Australian mineral deposits was maintained during the year, so that, in conjunction with the material in Bulletin 72, up-to-date information on Australia's mineral resources was available. Numerous enquiries on this subject were attended to during the year.

The Resources, Information, and Development Branch of the Department was helped with the preparation of a mineral deposits map for the Fitzroy Basin series. The Australian part of a mineral map of the world was checked for the Bureau de Recherches Geologiques et Minieres of France, and data on Australian deposits were compiled for their use in revising the map.

Compilation of a metallogenic map of Australia was supervised. (See report of Engineering Geology and Miscellaneous Investigations Group).