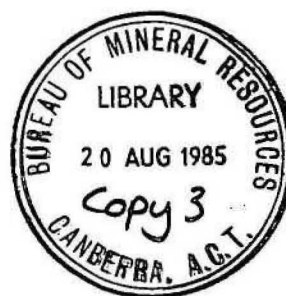


1972/144

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Record 1972/144

BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS
GROWTH AND ACTIVITIES

1946 TO 1972

Compiled by

E.B. Aronsen

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BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS -
GROWTH AND ACTIVITIES
1946 - 1972

BMR became an official organization in March 1946 with a personnel establishment of 55 positions, which included 24 geophysicists, 17 geologists, a mining engineer, and a petroleum technologist; a mineral economist was added in 1947. The functions laid down for the Bureau then have been generally accepted ever since; a copy of the formal statement of BMR's functions as recently restated by the Government is at Annex A.

Between 1946 and 1960, BMR was organized under three Sections: Geological, Geophysical and Administrative. Mining Engineering, Mineral Economics, and Petroleum Technology groups were with the Administrative Section of the Bureau. Between 1960 and 1962, to keep pace with demands, the Geological and Geophysical Sections were designated Branches, and three additional Branches were created: Mineral Resources, Operations, and Petroleum Exploration. The Mineral Resources Branch incorporated the previously established Mining Engineering, Mineral Economics, and Petroleum Technology groups: Operations Branch absorbed the previous Administrative Section and included new Sections to assist in the planning and co-ordination of the Bureau's programme, and the publication and dissemination of information. Petroleum Exploration Branch was established to administer the Petroleum Search Subsidy Act and to gather geoscience information on sedimentary basins. This five-Branch organization is maintained now.

Since 1946, BMR's personnel establishment has increased at an average annual rate of about 23 (see Annex B). Accordingly, from a modest beginning with 55 positions, the Bureau now has a total of 637 established personnel including 141 geologists, 113 geophysicists and 28 other professional officers (engineers, chemists, petroleum technologists, and mineral economists).

Geological Branch Activities

Although geological surveys of potentially economic basins and mineralized zones were undertaken during the early years, BMR's main geological effort has been slanted towards a systematic geological map coverage at 1:250 000 scale of all Australia and its territories (including Antarctica and Papua New Guinea). But, because of base map deficiencies, this particular program did not gain momentum until the mid 1950's.

Since 1955, BMR has geologically surveyed over 200 map areas to 1:250 000 scale, each map covering a standard area enclosed by one degree of latitude and one and a half degrees of longitude; some of the mapping was carried out jointly with the State Geological Surveys. State Surveys also produce geological maps to this scale; now the overall joint effort has progressed to a stage where completion of the initial coverage is in sight. However, some revision mapping will continue well into the future.

Concurrently, BMR channels considerable effort into detailed geological mapping of metalliferous provinces and structurally complex areas; in the earlier years, this mapping was mainly to 1:63 360 scale. In 1963, a decision was made to adopt the 1:100 000 scale for regional detailed mapping because contoured base maps were being produced at this scale, and because this smaller scale proved to be a more logical step from the 1:250 000 mapping. Detailed mapping at 1:100 000 scale will increase as the tempo of mapping at 1:250 000 decreases.

The activities of Geological Branch Engineering and Resident groups should be mentioned at this stage. Engineering geology is a service provided by BMR to various government departments and instrumentalities in support of major projects such as dams, bridges, tunnels, and other engineering installations. This engineering group also conducts hydrogeological investigations in connection with the occurrence, suitability, and quantity of underground water. The group has operated virtually since 1946 and has conducted surveys throughout Australia, particularly in the Australian Capital Territory, Northern Territory, and Papua New Guinea.

Since 1946 and until September 1972, BMR has had resident staff in Papua New Guinea to provide geological and geophysical services to the Government's Administration there. The functions of this staff include geological mapping, assessment of mineral resources, volcanology, engineering geology and hydrogeology; it also participates in regional and engineering surveys conducted within PNG by other Sections of BMR. In September 1972, Papua New Guinea established its own Geological Survey which is staffed mainly by seconded BMR officers.

Extension of the onshore geological activities seaward was initiated in 1961. However, although the Bureau took part in various marine geological investigations as opportunities arose, it was not until 1967 that a program, aimed at systematic geological mapping of the Continental Shelf out to the 500 metre isobath, was launched. About 300 000 square miles of the shelf have been surveyed on a reconnaissance basis (to a 10 mile grid) and, of this, BMR has contributed 172 000 square miles. A 'field' season averages 80 days sea-time (including port supply and repair periods) and produces a coverage of 35 000 to 40 000 square miles. Results are produced as shelf sediment maps at 1:1 000 000 scale.

Geological field activities are supported by a substantial laboratory group comprising of palaeontology, petrology, mineralogy, sedimentary, geochronology, and chemistry. This group also pursues specifically designed projects in the interest of mineral exploration. Further, a drafting office (currently with 49 personnel), a remote sensing/photogeology group, and a map editing service form part of the support for geological field activities.

Worthy of special mention is BMR's use of hired helicopters as a means of transport on geological surveys, particularly in Papua New Guinea and remote areas of mainland of Australia. For the 1972 field season budgeting has provided for up to 200 flight hours in Papua New Guinea, and 360 in central and northern Australia.

Geophysical Branch Activities

The Bureau's early geophysical field work consisted principally of rather small, detailed surveys for minerals using electrical, electromagnetic, magnetic, and radiometric methods. Somewhat more extensive gravity surveys for coal and oil were also undertaken. Seismic exploration equipment was first used by BMR in 1949; airborne magnetic surveys began two years later, and, in 1959, helicopters were introduced as vehicles for gravity surveys. With the advent of 'airborne' equipment, systematic geophysical coverage of the whole of Australia and Papua New Guinea became possible. Extension of geophysical activities to include the continental shelf and outer margin was initiated in about 1958, and expanded considerably in 1965 when continuously recording shipborne equipment was introduced.

BMR began onshore aeromagnetic surveys of selected areas in 1951 using its own DC-3 aircraft. Later, the effort was supplemented by the purchase of a second DC-3, equipped for combined magnetic and scintillometer surveying, and a Cessna aircraft which was equipped for low-level scintillometer work. Subsequently, this fleet was reduced to two aircraft, which have since been replaced by more advanced types (Twin Otter and Aero Commander). Some aeromagnetic surveys for BMR are undertaken by contractors.

A systematic aeromagnetic survey to cover all land areas began in the late 1950's; results are published at the standard 1:250 000 scale. BMR's output (including contractual effort) for this survey during the period 1961 to 1971 may be taken as fairly typical; it amounted to a yearly average of 12.6 (1:250 000) sheet areas and, of this, BMR aircraft covered about 8.3 sheets per year (this equates to approximately 50 000 line-miles). Line spacing, which has not been standardized, varies between a half mile and five miles depending on the detail required.

At the present rate of progress, the aeromagnetic survey of Australia and Papua New Guinea should be finished by about 1986. Radiometric air surveys of selected areas are often carried out in conjunction with aeromagnetic tasks as BMR aircraft are fitted to acquire the relevant data simultaneously.

Associated with BMR's Airborne Section is the Metalliferous group, the prime function of which is to conduct geophysical investigations and surveys to assist in the search for metalliferous mineral deposits. For its task this group, which expanded rapidly in the mid 1950's, now utilizes a wide range of geophysical methods including electrical (conductive, inductive, and self potential), electromagnetic, gamma-ray spectrometry and magneto-telluric. To a lesser extent, gravity methods are used. It is difficult to indicate a growth pattern for these particular activities; however, one of the aims is to apply modern geophysical methods for the surveys and to develop new techniques and equipments.

Activities of the Seismic, Gravity and Marine Geophysical Section include systematic surveys of large regions and detailed investigations of specific areas. A current project is the helicopter gravity survey which began in 1959 and is scheduled to finish in 1974. The aim of this survey is to provide onshore gravity coverage of Australia and Papua New Guinea on a seven mile grid. Since 1963, most of the field work has been done by contract with an average yearly expenditure in excess of \$200 000. BMR's annual rate of progress for the survey steadily increased from an output of five 1:250 000 scale map areas in 1959 to about 46 in 1969; the total coverage for 1972 exceeded 50 map area. Detailed gravity surveys are mounted for specific purposes, e.g. to assist in the search for minerals, and in the interpretation of complex geological structures.

In 1965, BMR began to extend its geophysical surveys and interpretations to offshore areas, with the intention of covering the whole of Australia's continental margin and that of Papua New Guinea. The marine geophysical group is small, and its main objectives are achieved through contract

operations in which ships, personnel, and about half the scientific equipment are provided by the contractor. The group prepares the specifications and provides close supervision and control of data reductions and interpretation. The cost of BMR's marine contracts for normal operations has usually been of the order of \$250 000 a year.

Sea-time has averaged 90 days per normal 'field' year (1965, 1967, 1968, 1970); this excludes positioning time but includes time in ports, delays, break-downs, etc. On the basis of a 10-mile line spacing, the average line mileage achieved has been 15,000 per field year giving an average coverage of 120 000 square miles for each of these years. The data recorded includes sparker seismic, magnetic and marine gravity. Precise navigation and bathymetric control are essential.

BMR's program for 1971 and 1972 should not be regarded as normal because a special effort was made to complete the initial geophysical reconnaissance of the Continental Margin. In 1971 for instance, one vessel, in 218 days sea-time, covered 39 000 line miles giving 750 000 square miles of coverage; the survey, however was opened to a 20-mile line spacing. In 1972, the Bureau achieved a similar coverage; continuous operation with a cruise speed of 10 knots was the norm.

It is important to mention here that most data resulting from the aeromagnetic and marine geophysical surveys are in a form suitable for processing by computer. Without computer assistance BMR could not cope with the large input of field data without increasing the existing establishment of personnel.

Since its beginnings in 1949, BMR's seismic activities onshore have been oriented towards providing information on the structure of sedimentary basins primarily to assist in the search for petroleum. The Bureau can now deploy two seismic teams with associated drilling equipment and personnel; up to 250 000 feet of seismic shot hole drilling is achieved during a field season. Occasionally the seismic group becomes involved in projects outside the sedimentary domain, an example being deep crustal investigation.

The Observatory Section has built up gradually over the years. The Observatory work dates back to 1946, when the Bureau acquired its first geophysical observatory (Toolangi, Victoria); others were added, and by 1958, BMR had observatories at Mundaring (W.A.), Port Moresby (PNG), and Darwin (N.T.), and outpost observatories in Antarctica. A headquarter staff is now located at Canberra and, since 1962, fifteen out-stations (unmanned) have been established throughout Australia and Papua New Guinea for seismic recordings. The programs at the main observatories have been expanded progressively to meet their primary role, that is, collection of geomagnetic, seismological and ionospheric data.

BMR's Regional Geophysics group, which works in conjunction with our observatories, undertakes geophysical investigations of major geological features, their relation to mineral provinces and sedimentary basins and to the occurrence of earthquakes and volcanoes. It is also responsible for the provision of basic regional gravity data, and the establishment of standards for gravity measurement in Australia and their relation to the world network. Another BMR responsibility is the preparation of isogonic charts, covering Australia and its Territories, at five-year intervals. Surveys are carried out periodically to up-date these magnetic charts.

The Geophysical Services Section includes laboratories and workshops, the functions of which embrace design, development, testing and maintenance of instruments, and rock property measurements. This group, which also includes a large drafting office, evolved principally to support the field activities of the Geophysical Branch. Engineering geophysics, which forms yet another element of the Service Section, conducts surveys throughout Australia and PNG; the need for these surveys has expanded gradually to match the demands of increasing population and development.

Petroleum Exploration Branch Activities

The main functions of this Branch are to carry out the technical aspects of the Commonwealth's Petroleum Search Subsidy Act and to review continuously the geology, geophysics, and physical properties of the sedimentary basins, and assess their petroleum prospects.

The Petroleum Search Subsidy Act, which was introduced in 1957 to stimulate the search for oil by private enterprise, has called for an establishment of eleven geoscientists to cope with the administrative task. It is not expected that any increase in establishment will be required.

However, the Basin Study Group, with its current establishment of ten scientists, is likely to increase in view of the very large task ahead of it and its relatively slow rate of progress. To date the group has complete work on a number of important basins; in 1972, work on the Canning Basin in Western Australia continued.

Mineral Resources Branch

This Branch had its beginning in 1946/47, when BMR had one economist, one mining engineer and a petroleum technologist; these three positions are still reflected in the Branch's current organization which calls for 34 established positions including 7 mineral economists, 2 mining engineers, 5 petroleum technologists, 2 petroleum chemists and 13 personnel for drilling engineering.

Functions of the Branch's Mining Engineering and Mineral Economics Sections include the study and investigation of resources, mining, treatment, marketing and utilization of minerals for the purpose of appraising mineral resources world-wide and developing policies thereon.

Drilling, engineering and petroleum technology are organized under one section, the major functions of which are to provide drilling services for BMR and to undertake investigations in petroleum technology, including laboratory work. With regard to drilling, BMR has seven mobile drill plants which are called upon to operate generally anywhere in Australia for seismic surveys, stratigraphic, and engineering drilling.

Operations Branch Activities

The main function of this Branch is to co-ordinate BMR's program and the activities of all Branches; to provide editing,

library, publications, and information services; and to give general administrative support to all of BMR. The Branch has grown progressively with BMR's expansion.

There is scope for some additional effort in the information service section where the increasing volume of geoscience data requires an improved storage and retrieval system (probably computer assisted), the planning for which has started.

Other Activities

BMR officers keep abreast of each other's activities through weekly (summer) seminars at which professional staff members present details on the progress and results of their program activities. Also, symposia are being held by BMR with a view to presenting to the public the scope, progress, and results of surveys and other activities. Some BMR officers lecture on request to Universities and other organizations associated with the mineral industry.

Each year, a number of BMR officers proceed overseas; some to attend conferences, some to take up specific studies for BMR, and some to further studies in fields of value to BMR.

A special activity exists in BMR's Baas Beeking Geobiological Research Laboratory, which was established in 1965 under the sponsorship of BMR, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Mineral Industry Research Association (AMIRA). The broad objective of this joint laboratory is to investigate the biological and chemical processes associated with the formation of stratiform mineral deposits and the subsequent changes that take place in such deposits. BMR is the major contributor to this group insofar as funds and equipment are concerned.

Use of Specialists

Utilization of outside specialists to assist in various projects has long been a practice at BMR. For example, during 1960-63 the Institut Francais du Petrole assisted in a study on petroleum prospects in Australia. In its study on phosphates, BMR called upon

the services of Drs R.P. Sheldon (USGS) in 1965/66 and T.H. Van Andel (Scripps Institute of Oceanography) in 1967. Drs A.A. Opik, I. Crespin, and M.E. White have given valuable assistance in palaeontological projects. During 1971, Dr G. Richter-Bernberg provided specialist advice in connection with a study on evaporites. Currently, the Bureau de Recherches Geologiques et Minieres has been contracted for a period of about 18 months to assist in the hydrogeological study of the Great Artesian Basin.

Education

BMR has offered a number of cadetships each year for pass graduates to complete an honours degree. Additionally, officers who wish to undertake full time post-graduate studies of their own choosing (e.g. degree of Ph.D.) may be granted leave without pay for this purpose; financial assistance may be provided according to circumstances.

BMR also provides support for some of its personnel who are studying part time at universities for additional qualifications, or at vocational colleges for technical training. Financial assistance and some time off the attend lectures may be granted in accordance with Commonwealth Public Service practice.

During the summer vacation period, BMR employs university students (usually undergraduates in geology and geophysics) to undertake tasks associated with their studies. Some of these students are later recruited into BMR.

Budget

BMR's total expenditure for the financial year 1950/51 was about \$900,000. This expenditure increased to nearly \$2,000,000 in 1956/57, over \$3,000,000 for 1960/61, \$5,000,000 for 1963/64 and \$7,500,000 for 1970/1.

Superimposed on this expenditure were the payments to private enterprise to subsidize petroleum exploration activities. First payments, totalling \$527,000 were made in 1957/58. By 1962/63 subsidy payments, increased to \$10,000,000 per year. Since 1962/63 these payments have ranged between \$9,000,000 and \$14,000,000 annually.

Personnel

BMR's present establishment is made up of 282 professionals (geologists and geophysicists etc.), 100 technical officers and their assistants, 93 drafting officers and assistants, plus 162 other personnel (workshop, drilling, administrative, computing, and photographic staffs). This gives the total establishment at BMR of 637. Field parties are supplemented by temporary staff (average 50) to undertake basic tasks.

FUNCTIONS OF THE BUREAU OF MINERAL RESOURCES

The functions of the Bureau are as follows:

1. As a primary function, to obtain, study, publish, and provide basic geological and geophysical information necessary for the exploration and development of the nation's mineral resources; this to be done where appropriate in co-ordination with State and Territorial authorities.
2. In order to support the function of obtaining basic information to undertake experimental studies and research into geology and geophysics.
3. To make basic investigations of the earth's magnetic and gravitational fields and in seismology and vulcanology.
4. To complement the work of the State and Territorial authorities by undertaking geological and geophysical investigations into the occurrence and distribution of underground water.
5. To undertake geological and geophysical investigations on behalf of other Commonwealth Departments and authorities including the provision of resident staff by arrangement with the Territories.
6. To obtain basic information on, and review the mineral resources of the Commonwealth and its Territories; to study the various sectors of the mineral industry both in the national and international spheres; to publish and provide information about the mineral industry.
7. To undertake such investigations to mining engineering and petroleum technology as are relevant to (1) and (6) above.
8. To prepare advice for Government on the mineral industry, including the exploration and development of mineral resources in the national interest.

9. When directed by Government, to administer schemes for the assistance of sectors of the mineral industry and to undertake special mineral projects.

BMR PERSONNEL ESTABLISHMENT
GROWTH AND DISTRIBUTION
OF EFFORT

GROWTH

Year	Professionals	Non Professionals	Total;
1946	55	-	55
1950	102	96	198
1955	196	194	390
1960	242	242	470
1965	282	288	569
1970	272	355	627
1972	282	355	637

DISTRIBUTION OF EFFORT (PROFESSIONALS ONLY) - 1972

Primary Mapping	50	Geology and Geophysics, Land and Marine
Geology of Economic Provinces	64	" " "
Laboratories	34	Geology, Geophysics and Petroleum Technology
Engineering	16	Geology and Geophysics
Papua New Guinea Resident Services	13	" "
Observatories	18	Geophysics
Regional Geophysics	9	Geophysics
Equipment & Techniques (Research and Development)	13	Mainly geophysics
Petroleum Subsidy	11	For administration of the Petroleum Subsidy Act
Resources and Industry Review	13	Mineral Resources Branch positions
Editing and Information	18	Operations Branch positions
Other	17	Includes Planning and Co- ordination and Remote Sensing

REFERENCES

- RAGGATT, H.G., 1956 - Bureau of Mineral Resources, Geology, and Geophysics, History and Organization. Bur. Miner. Resour. Aust. Rec. 1956/150. (unpubl.)
- WHITE, D.A., CLARKE, G.F., & SMITH, K.H., - Review of Activities of the Bureau of Mineral Resources, Geology, and Geophysics (1946-1967). Bur. Miner. Resour. Aust. Rec., 1967/49 (unpubl.).
- CRESPIN, I., - Recollections of the Growth of Commonwealth Interest in Geological Sciences. Bur. Miner. Resour. Aust. Rec. 1967/157 (unpubl.).