COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

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HISTORY AND ORGANIZATION

EARLY ATTEMPTS TO FORM A COMMONWEALTH GEOLOGICAL SURVEY

by

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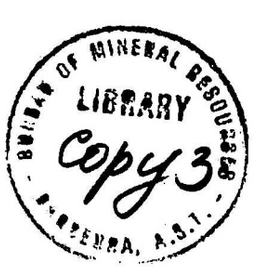

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BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

HISTORY AND ORGANIZATION.

EARLY ATTEMPTS TO FORM A COMMONWEALTH GEOLOGICAL SURVEY

1. Between 1910 and 1935 several attempts were made to establish a Commonwealth Geological Survey. These attempts were made at the request of organisations such as the Council for Scientific and Industrial Research (now Council for Scientific and Industrial Research Organisation) and the Australasian Institute of Mining and Metallurgy. Conferences between representatives of the Commonwealth and States were held in 1925, 1935 and 1936. They failed because of -

(a) lack of appreciation of the magnitude of the problem of geologically surveying Australia;

(b) too narrow a conception of the importance of geological studies in mineral discovery;

(c) fear on the part of some States that their own surveys would languish;

(d) reasons of no real importance such as that given as a result of the representations of the 1925 conference - that the Commonwealth would not establish a Geological Survey until "uniformity in geological cartography" has been agreed to by all States.

2. These early efforts may be considered as an attempt to establish a Commonwealth Geological Survey on a general or philosophical basis as distinct from the demonstrable necessity to establish it for practical or economic reasons.

EARLY COMMONWEALTH INTEREST IN OIL SEARCH

3. The Commonwealth Government was associated with geological work in connection with the search for oil in Papua and New Guinea as far back as 1914, when Dr. Arthur Wade carried out investigations in the Gulf Division of Papua on its behalf. With the permission of the Director of the National Museum, Melbourne, Frederick Chapman undertook the examination of all fossiliferous material collected on these surveys.

4. In January, 1920, the Government announced that a reward of £10,000 would be paid for the discovery of oil in commercial quantities, and the amount was increased to £50,000 in September of that year. After a 5-year trial it was concluded that this method was ineffective, and the offer of a reward was withdrawn.

5. Legislation to encourage prospecting for petroleum was then introduced and under the Petroleum Prospecting Act - 1926, an amount of £60,000 was provided for the purpose of advances to persons and companies engaged in the search for oil in Australia. The Act was extended to Papua and New Guinea in 1927, and the appropriation increased to £160,000; an additional sum of £50,000 was voted in 1928.

6. In June, 1927, Dr. W. G. Woolnough was appointed to advise the Commonwealth Government on the search for oil. He was referred to as the Commonwealth Geological Adviser. He was later assisted by Mr. P. S. Hossfold. On 17th October, 1927, Mr. F. Chapman, A.L.S., Palaeontologist to the National Museum, Melbourne, was appointed Commonwealth Palaeontologist to assist Dr. Woolnough. Miss Irene Crespin, B.A., was appointed Assistant Palaeontologist. The organisation became known as the Geological Branch of the Department of the Interior. On Mr. Chapman's retirement in December, 1935, Miss Crespin succeeded to the position of Commonwealth Palaeontologist, and she is still employed as a specialist in micropalaeontology in the Bureau of Mineral Resources. The headquarters of the Geological Branch was in Canberra, but the Palaeontological Section was housed in the National Museum, Melbourne. When Mr. Chapman retired Miss Crespin was transferred to Canberra. All these appointments were made under the Petroleum - Prospecting - Act - 1926.

GROWTH OF COMMONWEALTH INTEREST IN MINERAL INVESTIGATION BEFORE THE SECOND WORLD WAR

Palaeontological Work in Oil Search (1927-32).

7. The Commonwealth put the services of its palaeontologists at the disposal of all those engaged in the search for oil. Consequently, between 1927 and 1932, extensive collections of fossiliferous material from bores and outcrops were submitted for examination. This material formed the basis of the present Commonwealth Palaeontological Collection.

8. At this time the Commonwealth was interested in three major areas in the search for oil - Papua and New Guinea, Gippsland in Victoria, and Wooramel River in Western Australia.

9. In 1929, the Anglo-Persian Oil Company, in which the Commonwealth was financially interested, ceased the extensive surveys in Papua and New Guinea which it began in 1920. The lengthy four-volume report on the results of the Company's operations between 1920 and 1929, incorporated the palaeontological work of Mr. Chapman and Miss Crespin.

10. Between 1929 and 1938 Oil Search Limited of Sydney, with its subsidiary companies, carried out geological surveys in Papua and New Guinea, Longreach (Queensland), Gippsland (Victoria), Mt. Gambier (South Australia), and the Wooramel River area (Western Australia). It also tested a number of anticlinal structures in Queensland, N.S.W. and South Australia. The cores and cuttings from these orebodies were sent to the Palaeontologist for examination and report.

11. The Mines Department, Victoria, also made use of the palaeontological section and thousands of feet of bore cores from East Gippsland were submitted for micropalaeontological examination.

12. In 1932 the first Palaeontological Bulletin (now Bulletin No. 1 Bureau of Mineral Resources) was issued by the Department of Home Affairs (now Interior). This was a summary of the work carried out by Mr. Chapman and Miss Crespin on the fossiliferous rocks from bores and quarries in East Gippsland.

Geophysical Survey Act, 1928.

13. In June 1928 the Geophysical Survey Act was passed by the Commonwealth Parliament to give effect to a proposal for carrying out geophysical surveys for oil, minerals and water in Australia. The proposal developed from an Imperial Conference decision that experiments in geophysical surveying should be carried out in some portion of the Empire. Provision was made for the surveys to be financed by the Empire Marketing Board and the Commonwealth Government on a £1 for £1 basis.

14. Professor Broughton Edge was appointed leader of the investigation which was known as the Imperial Experimental Geophysical Survey. This Survey laid the foundations of applied geophysics in Australia. The book which was published describing the techniques used and summarising the results obtained, still has an honoured place in geophysical libraries.

15. The present Deputy Director of the Bureau of Mineral Resources, Mr. J. M. Rayner, was a member of the survey.

Northern Australia Survey Act (1934).

16. In December, 1934 the Northern Australia Survey Act was passed setting up the Aerial, Geological and Geophysical Survey of Northern Australia. This Survey group was formed by agreement between the Commonwealth, Western Australia and Queensland governments. It placed on record a considerable number of valuable reports and maps on mineral fields and kept alive applied geophysics. Field work ceased after the 1940 season and the Survey was disbanded early in 1942. Officers and equipment of the Geophysical Section were taken over by the Mineral Resources Survey (see paragraph 28). The present Director of the Bureau, Mr. P. B. Nye, was the Executive Officer of the Survey, the Deputy Director, Mr. J. M. Rayner, was Consultant Geophysicist and the Chief Geophysicist, Mr. R. F. Thyer, was a geophysical party leader.

Petroleum Oil Search Act (1936).

17. In May, 1936 the Petroleum Oil Search Act was passed. The object of the Act was to appropriate £250,000 to encourage, particularly by supplying suitable oil-drilling machinery, drilling operations in connection with the search for petroleum in Australia and the Territories of New Guinea and Papua. Part of the appropriation was to be made available as advances by way of loans to approved companies or persons on a £1 for £1 basis. In dealing with applications for assistance, the Government was advised by a technical committee known as the Oil Advisory Committee, which originally consisted of the Commonwealth Geological Adviser, Dr. W. G. Woolnough, as Chairman, the South Australian Director of Mines, Dr. L. Keith Ward, and an overseas expert, Dr. Arthur Wade.

Unemployment Relief Works Acts (1933-1938)

18. In 1933-1938 advances totalling £493,750 were made to States under the Unemployment Relief Works Acts to provide "for the purpose of relieving unemployment, assistance to the metalliferous mining industry".

Survey of Iron Ore Resources (1938)

19. In 1938 a survey of iron ore resources was undertaken. Dr. Woolnough, Commonwealth Geological Adviser, was relieved of his other duties in April, 1938, so that he could devote the whole of his time to this work.

20. On 19th May, 1938 the Prime Minister (Mr. J. A. Lyons) stated that in the light of a preliminary report by the Commonwealth Geological Adviser, Dr. W. G. Woolnough, the Government was "satisfied that accessible iron ore deposits capable of economic development are so limited as to compel their conservation for Australian industrial requirements." He also announced the Government's "intention to proceed, in collaboration with the technical officers of the States, with a complete detailed survey of Australia's iron ore resources." He added that preliminary work on the survey had already begun.

21. Mr. P. B. Nye, then Executive Officer of the Aerial Geological and Geophysical Survey of Northern Australia, whose advice the Government also sought, had reported that Australian ore reserves were limited and recommended prohibition of export as the most effective method of conserving reserves.

22. The Commonwealth Government sought the advice of these officers because in 1936 leases had been granted to H.A. Brassert & Co. Ltd. of iron ore deposits in Yampi Sound, Western Australia. The Company proposed to work the deposits and export the iron ore to Japan.

SECOND WORLD WAR

23. During the Second World War the Commonwealth's interest in mineral resources was intensified and this was reflected in the growth of the Commonwealth Organisation for carrying out surveys and advising the Government on mineral matters.

24. In April, 1940 the position of Assistant Commonwealth Geological Adviser was created and Dr. H. G. Raggatt was appointed to the position.

25. In January, 1941 the position of Commonwealth Geological Adviser was formally created and Dr. Raggatt was appointed to the position. At that time the Geological Branch consisted of the Commonwealth Geological Adviser, (Dr. Raggatt) the Commonwealth Palaeontologist (Miss Crespin) and an Assistant Palaeontologist (Miss Joyce Gilbert-Tomlinson) together with a draughtsman-clerk (Mr. H. B. Hawkins), and a typist.

26. In April, 1941 Cabinet considered what should be done following the decision to disband the Aerial Geological and Geophysical Survey of Northern Australia. The time seemed opportune to set up an organisation to co-ordinate and direct geological surveys in the Territories and to maintain a geophysical section for use in the Territories, and, if required, by the States. As a result a few geological and geophysical positions were provided for (including an Assistant Commonwealth Geological Adviser) under the direction of the Commonwealth Geological Adviser. Mr. P. B. Nye, Government Geologist of Tasmania and former Executive Officer of the Aerial Geological and Geophysical Survey of Northern Australia, was appointed in November, 1941, to the position of Assistant Commonwealth Geological Adviser.

27. In July, 1941 the office of Commonwealth Geological Adviser was transferred to the Department of Supply and Development from the Department of the Interior. The immediate reason for this was that the Commonwealth had decided to accept the advice of an American oil engineer - Leo Ranney - to sink a shaft to develop the oil sands at Lakes Entrance, Victoria. This project was placed under the Minister for Supply.

28. Geologists from the New Guinea Survey were temporarily absorbed into the Geological Branch in 1942 after the Japanese had over-run New Britain.

29. In June, 1942 the Commonwealth Geological Adviser and his staff became known as the Mineral Resources Survey with a Director and Assistant Director. It commenced a systematic summary of information about the mineral resources of Australia, using two criteria to establish priority:

(a) importance in war;

(b) status and scope of knowledge of resources.

Many people have expressed surprise that the first minerals dealt with were zircon and rutile. The reason is simple. These minerals suddenly assumed importance for war purposes, and almost nothing was known about our resources. On the other hand, though lead and zinc were important, resources were known to be large and there were several well established large mines producing these metals.

30. Investigations were made in connection with supplies of strategically important minerals and examinations were made of deposits of these minerals, for example, tungsten (King Island scheelite), tin, copper, mica, quartz crystals and beryl. One of the "by-product" results of these investigations was that it became apparent that pyrite resources were very large and could, if necessary, be developed to supply Australia's requirements of sulphur.

31. In 1941 a Copper and Bauxite Committee was formed under the chairmanship of Sir Colin Fraser. This was replaced later in 1941 by a Commonwealth Minerals Committee under the same chairmanship. The object of the Committee was to advise the Minister for Supply and Development on all matters connected with mineral production. It virtually lapsed in 1942 when the Controller of Minerals Production was appointed.

32. In 1942, a Controller of Minerals Production, Mr. J. Malcolm Newman, was appointed to assist in the production of strategic metals and minerals. Producing mines were assisted in obtaining finance, supplies and manpower and some mines were taken over and some commenced by the Directorate.

33. In September, 1944 the Mining Industry Advisory Panel of the Secondary Industries Commission was set up with Dr. H. G. Raggatt as Chairman. Other members represented mining employers, trade unions and the Australasian Institute of Mining and Metallurgy. From June, 1945 the Secretary or Director of Mines in each State and the Acting Director of Mines for the Northern Territory became members. Broadly, the function of the Panel was to advise on post-war mining policy. It made reports on such matters as rehabilitation, taxation, health and safety in the mining industry and on geological and geophysical surveys.

34. In October, 1944 a request was made in the form of a printed pamphlet to the Prime Minister by the Australasian Institute of Mining and Metallurgy to establish a Federal Geological Survey.

35. On 19th February, 1945 Cabinet decided on a radical change of policy in connection with the search for oil. It directed that financial advances to companies should cease and that the Commonwealth should appoint staff to carry out geological and geophysical surveys and to do scout and test drilling.

POST WAR

36. Experience during the war - if it had done nothing else - had shown the value of :

(a) gathering together information on an Australia-wide basis;

(b) analysis of that information by one authority. During the war State boundaries had no significance. The criteria that determined where mineral development should take place or be accelerated were -

(i) relative importance - here there could be a difference between the State and Commonwealth viewpoint;

(ii) possibility of speedy development;

(c) having available specialist investigators who could be used solely as the urgency of the situation demanded in any part of Australia.

37. In May - September, 1945 on the recommendation of the Mining Industry Advisory Panel, a visit was made overseas by Dr. H. G. Raggatt and Mr. J. M. Rayner. They examined the organisation of the United States Geological Survey and the Canadian Geological Survey and paid particular attention to :

(a) the relationship between Federal and State (or Provincial) Geological Surveys and Bureaux of Mines in U.S.A. and Canada;

(b) the relationship between Federal Geological Surveys and the administrations of Territories: e.g. Alaska (U.S.A.) and North-West Territories (Canada);

(c) the status and use of geophysical methods in mineral exploration in North America.

38. In U.S.A. the Federal Survey is dominant; in Canada the position is much the same as in Australia. There are some obvious reasons for this. The United States has approximately the same area as Australia and Canada, but is divided into 48 States so that there are many problems requiring study on a Federal basis than in Canada and Australia. The United States Survey was well established early in the history of the United States, with wider functions than most other Geological Surveys, thus giving it many public contacts. It has always maintained a very high standard of performance and conduct.

39. Canada is divided into Provinces which are much the same size as the Australian States. There is a tendency to develop a

pattern of independence by some Provinces, which is accentuated by the racial and language difference in Quebec. There is no opposition in the Provinces to the Federal Survey, but differences of opinion arise as to what the functions of the Federal Survey should be. Provinces have several times asked for the Federal Survey to be enlarged, to concentrate on regional mapping. The Federal answer has been that this is a fine idea but if its Survey does not engage in economic work the taxpayers might not be prepared to support it.

40. Reports were made to the Mining Industry Advisory Panel by Dr. Raggatt and Mr. Rayner on their return.

41. On 20th March, 1946 a Cabinet Committee approved a recommendation arising out of a report by the Mining Industry Advisory Panel for setting up a Commonwealth Bureau of Mines incorporating the Mineral Resources Survey and the Minerals Production Directorate. Eight functions, including the following two, were specified in the approved recommendation :

(a) "To provide technological and technical advice to the (mining) industry and to undertake geological and geophysical and other forms of research";

(b) "To undertake market surveys and other economic investigations in relation to mining and development of the industry."

42. On 27th March, 1946 the Mining Industry Advisory Panel, which then included permanent heads of Mines Departments, agreed that because of their cost and highly specialised nature, the States should rely upon the Commonwealth to meet their requirements for geophysical surveys.

43. On 11th June, 1946 and 18th December, 1946 the Public Service Board issued certificates relating to Cabinet decisions of 19.2.45 and 20.3.46 for -

(a) 48 positions - 17 geologists, 24 geophysicists, 7 others including petroleum technologist.

(b) 7 positions, including a mining engineer.

44. The Public Service Board also approved the use of the name "Bureau of Mineral Resources, Geology and Geophysics." The establishment of Bureau of Mineral Resources, more or less in its present form, therefore dates from this approval.

45. The Mining Industry Advisory Panel (see para. 32) recommended a policy of rehabilitating mines closed down during the war, and of assistance to companies in the exploration and development of the mineral deposits in Australia. The recommendations were approved by Cabinet Sub-Committee on 20th March, 1946 (Agendum No. 14/1946, Supplement No. 1).

46. The administration of this work was to be carried out by the Bureau and in 1946 a Mining Engineering Group was formed in the Administrative Section. In 1947 Cabinet approved the purchase of 4 diamond drilling plants to supplement the Bureau's investigations and for hire to the Mining Industry. Later, additional drilling plants were purchased in connection with the search for uranium deposits, and are in current use.

47. Additional staff (including drillers) were approved and appointed and the group established as a separate Section in January, 1952.

48. One of the officers of the Section acts as Secretary to the Wire Rope Research Committee and to the Conference of Chief Inspectors of Mines of the States. Meetings of the latter are held annually and by this and other means a uniform code of safe working practices and health precautions for mine workers has been agreed upon. Other mining matters, particularly those in which uniformity of practice between the States is desirable, are discussed at the annual conference.

49. As already indicated in paragraph 34, the Commonwealth Government decided in February, 1945, to make a radical change in policy in connection with the search for petroleum throughout Australia and its Territories, and included scout boring and test drilling in the Commonwealth contribution to the search for oil.

50. Drilling was to be carried out by the Mineral Resources Survey, which had taken over the plant purchased under the Petroleum Oil Search Act (1936). This responsibility passed to the Bureau when it was formed in 1946 with a Petroleum Technology Group established in the Administrative Section. This group became a separate Section in 1950.

51. Later, plants for both oil well drilling and scout boring were purchased and drilling staff approved and appointed. Both the scout boring plant and staff were used in the urgent and important drilling for open cut coal in N.S.W. between 1951 and 1954. Shot-hole boring for the Geophysical Section's seismic surveys is also done by the Petroleum Technology Section.

52. On 3rd May, 1946 Toolangi Magnetic Observatory was transferred to the Bureau from the Commonwealth Astronomer.

53. On 1st July, 1947 Watheroo Magnetic Observatory was transferred to the Bureau from the Carnegie Institution of Washington, thus indicating that Australia had "grown up" magnetically.

54. On 24th July, 1947 a Mineral Economist was appointed as a result of a British Commonwealth Official Conference, July, 1946 which called for "Standard methods of recording figures of mineral resources", and for close study of "economic aspects of mineral resources and production". A Mineral Economics Section of the Bureau was established in 1952.

55. It became apparent in the early days of the Second World War that Australian mineral statistics were very poor. In many cases it was not possible to add together statistics published by individual Mines Departments to obtain an Australian total. Since then there has been continuous improvement. Arrangements were completed in 1954 for the Bureau of Census and Statistics and the Bureau of Mineral Resources to co-operate in gathering, compiling and publishing statistics collected through State Mines Departments and Statisticians. Throughout Australia mineral statistics are now collected and published on a uniform basis.

56. The growth of the Bureau since 1947 has been determined by its considerable success and the desire of governments to

concentrate on surveys of those areas which hold out the greatest promise of producing minerals required for :

(a) security and self-sufficiency;

(b) the earning of export income.

Examples of (a) are petroleum, bauxite and ores of uranium, copper and tin.

Examples of (b) are ores of lead, zinc, uranium, and tungsten and the minerals rutile and zircon.

ACCOMMODATION OF BUREAU

57. During its 27 years of existence, the organisation now known as the Bureau of Mineral Resources, Geology & Geophysics, has had no permanent home. The Geological Branch was first accommodated in a room in West Block in 1927. The Branch later transferred to the rear portion of the Census Building in Civic Centre. An extra room was acquired when Miss Crespin, together with the Palaeontological Collection, was transferred from the National Museum, Melbourne, to Canberra in February, 1936. These premises were occupied until August, 1945, when a transfer was made to Melbourne Buildings in Civic Centre. The Geological Section remained in Melbourne Buildings until its offices and much of its material was destroyed by fire on 10th April, 1953. Its present temporary home is in what was formerly known as the Turner Hostel.

58. The headquarters of the Mineral Resources Survey and the Geophysical Section were transferred to Melbourne in 1946. Sections which were formed later - Petroleum Technology, Mining Engineering and Mineral Economics, were also established in Melbourne. Since 1947 the Bureau (except the Geological Section) has been accommodated in Chancery House, Melbourne. A Geophysical Laboratory was established at Footscray in 1948.

59. A site was allotted on 16th March, 1950 for a permanent building for the Bureau in Canberra. A temporary laboratory for chemistry-petrology was erected on the site in June, 1953, and placed so as to fit in with the permanent structure when built.

ARRANGEMENTS IN COMMONWEALTH TERRITORIES

60. The arrangements between the Bureau and the Administrations of Commonwealth Territories have been marked out after examination of similar arrangements in the United States and in Canada and after discussion with the Department of Territories and the Public Service Board.

61. To meet the day to day requirements of the Administrators of the Territory of Papua-New Guinea and of the Northern Territory, the Bureau provides a Resident Staff. The officers on the Resident Staff are completely under the direction of the local Administration, but have the same opportunities for promotion within the Bureau as all its other officers. They are supported by the experience and advice of their seniors in the Bureau and by its library and laboratory facilities. The Bureau believes that this arrangement not only ensures a supply of trained geologists for service in the Territories, but that the Territories thereby get a higher quality staff than could be supplied in any other way.

62. In addition the Bureau provides geological and geophysical parties for special and continuing regional investigations within a programme worked out in consultation with the Administrators.

63. Since 1953 the Bureau has maintained a special group in Darwin to keep in touch with and assist companies, syndicates and individuals engaged in the search for uranium. The group has been provided with a small but well equipped radio-metric laboratory, bore-hole logging equipment and technical facilities for repair of prospectors' geiger and scintillation counters.

RELATIONS WITH STATES.

64. It is sometimes stated that no constitutional basis exists for the Commonwealth to have an organisation interested in mineral development (except in the Territories), because ownership of the minerals is vested in State Governments. However, a former Solicitor-General of the Commonwealth - Sir George Knowles - held the view that the defence power and the overseas trade functions of the Commonwealth provided adequate constitutional authority.

65. In the Supply and Development Act, No. 6, 1939, it is provided that the Department of Supply and Development, subject to the directions of the Governor-General, shall administer matters relating to the arrangement or co-ordination of "the investigation and development of Australian sources of supply of goods which, in the opinion of the Governor-General, are necessary for the economic security of the Commonwealth in time of war and in particular, the investigation and development of additional oil resources, the production of power alcohol from vegetable crops and the production of oil from coal and shale."

66. The Act also states that "where in the opinion of the Governor-General, it is necessary or desirable in the interests of the defence of the Commonwealth that information should be obtained in relation to industrial, commercial or other undertakings, or with respect to any goods, the regulations may require such persons or classes of persons as are prescribed, to furnish, as prescribed, such information and particulars, as are prescribed with respect to those undertakings or goods."

67. "Goods" as defined in the Act include mineral deposits.

68. The Commonwealth's concern with fissionable materials, including uranium and thorium, is indicated quite clearly in the Atomic Energy Act, 1953.

69. The Commonwealth's concern with overseas trade in minerals - both into and out of Australia - becomes more evident every day as the population grows and mineral production increases. Many actions have been taken under the appropriate Commonwealth Acts & Regulations prohibiting, limiting or in some way regulating imports and exports of mineral products.

70. These actions are based on examination of the relevant facts, including in some cases field surveys of the particular resources concerned.

71. Major policy decisions of the Commonwealth Government have been based upon reports by its officers that resources of certain minerals were available in Australia which justified such decisions being taken, e.g. the establishment of the Australian Aluminium Production Commission, the policy of encouraging the use of indigenous pyrite in place of imported sulphur.

72. It would be idle to suggest that these actions and policies could be initiated other than on the basis of a knowledge of Australian resources as a whole. A Prime Minister of Australia, writing to a Premier, has stated :

> "Where Commonwealth policy (on minerals) is involved, specialist officers of the Commonwealth should have the opportunity, if they consider it necessary, to examine the (mineral) deposits for themselves."

73. There is another important point which is commonly overlooked. Geology has many branches and no man can hope to be competent in more than one or two of them. It follows from this that unnecessary duplication would result if every State attempted to have on its own Geological Survey specialists in all branches of geology. Each survey should concentrate rather on recruiting specialists in the particular branches of geology likely to be of most use in its particular State. Likewise, it would be unwise for the Bureau and each of the States to duplicate research facilities if the work to be done justified only one centre. The location of this centre should be a matter for agreement. If the need were a general though limited one, the Commonwealth should provide it, but if the greatest need were in one State the centre should be in that State.

74. The Bureau of Mineral Resources does not desire to use its constitutional position to force itself on the States. It prefers to work on the basis of consultation with States. Much of its work is done at the invitation of States. In fact, two of the most extensive investigations it has undertaken are being made under Agreements set out in letters exchanged between the Prime Minister and the Premiers of Queensland and Western Australia. There are (a) detailed surveys of large sedimentary basins with petroleum possibilities in the north and north-west of Western Australia and (b) metalliferous areas of Northern Queensland.

75. The Bureau has permanent working arrangements with all, or most of the States, for :-

(a) indexing of literature on general geology and economic geology;

(b) compilation and publication of geological maps of Australia - in the first place on the scale of 1 inch equals 4 miles - using standard symbols and colours;

(c) ground and airborne geophysical surveys.

PERFORMANCE OF BUREAU

76. A large part of the Bureau is engaged in investigation and research. The value of research is notoriously difficult to

measure; in fact, cannot be measured with any degree of accura Moreover, despite the pleas of research organisations that their value should not be measured in terms of obvious successes one fears that this is the yardstick the taxpayer tends to use. Every Australian has heard of cactoblastus and myxamatosis and knows something of the benefits that their introduction to Australia has conferred on Australia; but C.S.I.R.O. has made many contributions to fundamental research the benefits of which have or will far outweigh those arising from cactoblastus and myxamatosis.

77. One general comment may be offered here. The investigator and research worker is a pioneer. Rarely is he concerned with commercial exploitation of the results of his work. As a result his contribution to development tends to be forgotten or overlooked.

78. So it is with the Bureau. Few people remember that the decision to set up the aluminium industry in Australia followed directly upon the establishing by the Bureau that reserves of bauxite were adequate to support it. Later the Bureau was responsible for the discovery of bauxite at Wessel Island and itself discovered the still larger deposits at Gove in Arnhem Land.

79. It was the Bureau that first pointed out that Australia had resources of sulphide mineral sufficient to supply our sulphur requirements indefinitely.

80. The beach sand mineral industry was virtually in the back yard class until the Bureau, realising that the resources were large, recommended to the Government that the export of mixed sands should be prohibited, so that companies would be encouraged or obliged to instal separating plants for the production of high-grade clean concentrates of individual minerals. At that time the beach sand industry earned export income to the value of £270,000; now it earns more than £7.5 million.

81. If oil is discovered in commercial quantities in Western Australia, it will be due primarily to the pioneer geological surveys of the Bureau. When oil was found at Rough Range in November, 1953, Mr. Tollis, Vice-President of Standard Oil of California stated: "It was the extensive exploration efforts of Australia's Department of National Development which led to the leasing of widespread acreage now held by Caltex and Ampol. This work was what encouraged Caltex to return to Australia in the hope of bringing in the Commonwealth's first discovery."

CONCLUDING REMARKS.

82. I should like to conclude this talk by repeating some remarks I made in 1947 in my Presidential Address to Section C of A.N.Z.A.A.S.

> "The task before us calls for a concerted effort by State and Commonwealth geological surveys, mining companies and the Universities. There is plenty of room for discussion of our problem but none for dispute about what each of us should do, since the maximum technical resources we can command will fall far short of what is required.

"My plea, therefore, is that we pool our technical resources, intensify investigation of the structural and lithological conditions in which the more important ore masses occur, examine their chemical and physical properties and their susceptibility to detection by geological and geophysical methods. In this way we may have confidence that we will -

(a) find extensions of known ore-bodies;

(b) find new ore-bodies in the vicinity of known ore-bodies where the environment is structurally and lithologically similar to that of the known ore-bodies;

(c) find new ore-bodies in structurally and lithologically favourable environments at some distance and perhaps quite remote from known ore-bodies;

(d) accumulate a mass of data from which new concepts will emerge to assist our attack on the problem of ore-finding generally.

"When one considers the relatively few important known ore-bodies and the complexity of the ore-finding problem, the magnitude of the prospecting task before us will be appreciated. We must face the fact from the beginning that our failures will far outnumber our successes, as indeed they do today, but nevertheless looking to the odd major success for our reward, carry out our exploration with boldness and courage."

SEPTEMBER 1956.

H.G. RAGGATT.