COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD NO. 1967/157

RECOLLECTIONS ON GROWTH OF COMMONWEALTH INTEREST IN GEOLOGICAL SCIENCES

by

IRENE CRESPIN

RECORD 1967/157

RECOLLECTIONS ON GROWTH OF COMMONWEALTH INTEREST IN GEOLOGICAL SCIENCES

by

Irene Crespin

This Record was prepared by Dr. Irene Crespin who retired from the Bureau of Mineral Resources after 34 years of continuous service as a palaeontologist. She has a well deserved world-wide reputation as a micropalaeontologist, and those of us who have been associated with her over the years are pleased to record that her contribution to the geological sciences has been recognised by various learned societies.

Having been for so long a part of the Bureau of Mineral Resources, Dr. Crespin offered to write her recollections of the growth of this organisation from its small beginnings to the large body it is to-day, flavouring it with personal reminisences of events and people.

THE COMMONWEALTH GOVERNMENT'S INTEREST IN GEOLOGICAL INVESTIGATIONS FROM 1910 to 1953

by Irene Crespin, B.A., D.Sc., Hon, F.R.M.S., Hon. Mem. G.S.A.

CONTENTS

SUMMARY OF EVENTS

Commonwealth Government's interest in geological investigations from 1910 to 1953

A. From 1910 to 1926

1910 J.E. Carne appointed to investigate coal deposits at Purari, Papua.

1911 E.R. Stanley appointed Government Geologist in Papua.

1914 Dr. Arthur Wade appointed as Consultant in the search for petroleum in Papua.

1923 Pan-Pacific Science Congress in Sydney and Melbourne, August-September.

1923-24 Dr. Arthur Wade appointed as Consultant in the search for petroleum in Western Australia and Northern Territory.

1925 Dr. Arthur Wade appointed as Consultant in the search for petroleum in Queensland and New South Wales.

1926 Petroleum Prospecting Act passed.
Precious Metals Act passed.

B. From 1927 to 1935

1927 Geological Branch, Department of Home and Territories, created in June- W.G. Woolnough, Commonwealth Geological Adviser, with P.S. Hossfeld as Assistant Geological Adviser. Headquarters in Canberra.

Mr. Frederick Chapman, Commonwealth Palaeontologist, October, with Miss Irene Crespin as Assistant Palaeontologist, December. Headquarters in Melbourne. All appointments temporary.

Palaeontological work intensified.

1928 Geophysical Survey Act passed. Imperial Geophysical Experimental Survey under Professor Broughton Edge set up; J.M. Rayner and R.F. Thyer, members of staff.

1928-29 Palaeontological examination of A.P.O.C. collection of fossils and fossiliferous rocks from Papua and New Guinea.

1930 Dr. Woolnough visited United States and Argentina in connection with the search for oil in Australia.

1932 Dr. Woolnough commenced an aerial photographic survey of Australia. Palaeontological Bulletin No. 1 (now B.M.R. Aust. Bull. No. 1) by Chapman and Crespin issued by Department of Home Affairs.

1934 North Australia Survey Act passed, setting up Aerial, Geological and Geophysical Survey of Northern Australia. Mr. P.B. Nye appointed Executive Officer of the Survey; Mr. J.M. Rayner, Consultant Geophysicist. Mr. N.H. Fisher appointed Government Geologist of New Guinea.

1935 Mr. H.B. Owen seconded from Northern Territory Administration to Geological Branch.

Mr. F. Chapman retired as Commonwealth Palaeontologist in December.

C. From 1936 to 1940

1936 Irene Crespin succeeded Mr. Chapman as Commonwealth Palaeontologist, January 1st. Transfer of Palaeontological Section from Melbourne to Census Building, Canberra, February 10th.

Petroleum Oil Search Acts passed, May and December.

Oil Advisory Committee established, May - Dr. Woolnough, Chairman, Dr. L. Keith Ward and Dr. Arthur Wade, members.

1937 Miss Joyce Gilbert-Tomlinson appointed Assistant Palaeontologist in May. Mr. L.C. Noakes appointed Assistant Geologist, New Guinea.

1938 Vulcanological Observatory commenced in Rabaul, New Britain - N.H. Fisher in charge.

Embargo placed on export of iron ore to Japan from Australia in July.

1939 Irene Crespin visited palaeontological laboratories and oilfields in Java and Sumatra in April.

N.H. Fisher visited vulcanological observatories in Java and Sumatra.

1940 Dr. H.G. Raggatt appointed Assistant Geological Adviser.

D. From 1941 to 1945 (Second World War)

1941 Dr. Woolnough retired and Dr. H.G. Raggatt was appointed Commonwealth Geological Adviser in January. Permanent appointment.

Copper and Bauxite Committee formed.

Mr. Nye appointed Assistant Geological Adviser in November.

1942 Northern Australian Survey disbanded.

Work on Lakes Entrance Oil Shaft commenced.

Geological Branch re-organized as Mineral Resources Survey in June;

Dr. Raggatt, Director; Mr. Nye, Assistant Director; Dr. N.H. Fisher, acting Chief Geologist; Mr. J.M. Rayner, Chief Geophysicist.

Minerals Production Directorate formed, with Mr. J. Malcolm Newman as Controller. Mr. H. Temple-Watts joined Directorate.

1944 Search for Uranium commenced. First use of Geiger-Muller counter in search for uranium ores.

1945 Dr. Raggatt and Mr. Rayner visited United States and Canada.

Australian Aluminium Production Commission established.

First Summary Reports printed.

Mineral Resources Survey transferred from Census Building to Melbourne Buildings, Civic Centre.

E. From 1946 to 1951

1946 First regional geological work in Canberra area early in year.

Toolangi Observatory near Melbourne transferred from Commonwealth Astronomer to Mineral Resources Survey, May 3rd.

Headquarters of Mineral Resources Survey transferred to Melbourne; Geological Section remained in Canberra.

Bureau of Mineral Resources, Geology and Geophysics created, June 11th ? May 11th.

Dr. Raggatt, Director: Mr. Nye, Deputy Director.

Applications for positions of geologists, geophysicists, petroleum technologist, and Mining engineer called for in June and December;

Dr. Fisher appointed Chief Geologist and Mr. Rayner, Chief Geophysicist.

Mr. R.F. Thyer visited United States to study geophysical equipment.

1947 Mr. H. Temple-Watts appointed Petroleum Technologist.

Dr. J.A. Dunn appointed Mineral Economist in July.

First interest of the Bureau in Antarctic when J. Ivanac, geologist, and N. Chamberlain, geophysicist, visited Heard and Macquarie Islands.

Geologists commenced detailed investigations in Fitzroy Basin, Western Australia.

Watheroo Observatory, Western Australia, transferred from Carnegie Institution, Washington, D.C. to the Bureau in July.

1948 Dr. Raggatt and Dr. Fisher attended International Geological Congress in Great Britain.

Geologists began detailed investigations in the Carnarvon Basin.

Mr. Rayner visited Europe to buy geophysical equipment.

Beach sand heavy-mineral investigation, southern Queensland and northern New South Wales coasts commenced.

First Report and the first of the Australian Mineral Industry Reviews published.

1949 Use of reflection seismograph in Oaklands-Coorabin Coalfield Survey.

Mr. R.F. Thyer and Irene Crespin delegates to 7th Pacific Science Congress in New Zealand in January.

Bureau acquired a DC.3 Aircraft for geophysical work.

1950 Site at Acton allocated to Bureau for permanent headquarters in March.

Geophysicists commenced survey in Carnarvon Basin.

Seismic and magnetic observatory set up on Macquarie Island, Antarctica

First bore-logging based on geophysical methods carried out at Roma, Queensland.

Cloncurry - Mt. Isa survey commenced.

1951 Katherine - Darwin survey commenced.

Mt. Lamington eruption. G.A. Taylor awarded George Cross for work.

Wessell Islands and Gove, Northern Territory, bauxite deposits discovered by H.B. Owen.

First aero-magnetic survey in Australia.

Dr. Raggatt a delegate to International Raw Materials Conference in Washington.

Irene Crespin visited United States.

Mr. Rayner attended meeting of International Union of Geodesy and Geophysics in Brussels.

Dr. Raggatt appointed Secretary, Department of National Development, at end of year, and Mr. Nye appointed Director of the Bureau.

F. From 1952 to 1953

1952 Geological map of Australia, Papua and New Guinea issued.

Field work on bauxite in Wessell Island group commenced.

Operations at Rum Jungle, Northern Territory, commenced.

Bauxite deposits discovered on Manus Island by J.E. Thompson.

C.J. Sullivan attended International Geological Congress in Algiers, North Africa.

First of the Bureau Bulletins published.

1953 Fire in Melbourne Buildings, Civic Centre, April 10th.

Transfer of Geological Section to Turner Hostel, Turner, in August.

J.E. Thompson and Irene Crespin attended 8th Pacific Science Congress in the Philippines in November.

Discovery of oil at Rough Range, Carnarvon Basin, Western Australia, in November.

1. INTRODUCTION

The Commonwealth Government has been associated with the search for, and the geological and geophysical investigation of, mineral deposits for more than fifty years.

The ultimate result of this prolonged interest was the establishment, in May 1946, of the present Bureau of Mineral Resources, Geology and Geophysics within the Department of National Development. This organization was preceded by others, the first being the Geological Branch, Department of Home and Territories, which was formed in June 1927. During that long period, no permanent home was available to those engaged in geological work for the Commonwealth Government, until the completion, in 1965, of a building on an imposing site on the northern shores of Lake Burley Griffin in Canberra. It seems appropriate, therefore, to place on record a short history of the Commonwealth Government's early interest in geological investigation, and to give an outline of events leading up to the establishment of the present organization and some of the early years of its existence. I am attempting this story, flavouring it with some personal reminiscences, as I was a member of the original professional staff of the Geological Branch (Department of Home and Territories) appointed in 1927, and had continuous service with the Commonwealth Government until my retirement in November, 1961. The beginning of the story actually goes back to the year 1910, and in this historical review it is carried up to 1953. The Bureau of Mineral Resources, Geology and Geophysics, will, for convenience, be referred to throughout as the Bureau.

In 1956, Dr. H.G. Raggatt (now Sir Harold Raggatt), the first Director of the Bureau, under whose wise guidance this organization has reached its present status of importance in the Australian community, and with whom I have the honour to have been associated for more than thirty years, prepared a summary (unpublished) of the history and organization of the Bureau. With his kind permission and co-operation, certain statements made in that summary are incorporated in the present story.

Mr. P.B. Nye, O.B.E., the second Director of the Bureau, who retired in 1958, has also given me considerable help on certain matters, especially relating to the early attempts to form a Commonwealth (or Federal) Geological Survey. Grateful thanks are given to the present Director, Mr. J.M. Rayner, and to present and past members of the staff of the Bureau for their assistance and comments. At the same time, I have drawn on my own reminiscences of little-known incidents occurring during my long association with the Commonwealth Government. In this contribution, the early history of the Bureau and its predecessors, and their activities, are divided into different periods, each of which was marked by outstanding events. The problems of accommodation, growth of staff, publications, and rock and fossil collections are also described.

In the early days, investigations were devoted almost entirely to the search for oil, and the work of the palaeontologists formed the basis of all activities. In 1956, I placed on record the activities of the Micropalaeontological Section from 1927 to 1952 (Crespin, 1956) listing departmental reports as well as relevant publications.

2. EARLY ATTEMPTS TO FORM A COMMONWEALTH GEOLOGICAL SURVEY

From 1910 onwards, several representations were made to the Commonwealth Government to establish a Commonwealth (or Federal, the term then in current use) Geological Survey. Some of these representations were the results of conferences called by organizations such as the Council for Science and Industry (afterwards the Council for Scientific and Industrial Research and now the Commonwealth Scientific and Industrial Research Organization) and the Australian Institute of Mining and Metallurgy. These conferences were held in 1925, 1935 and 1936 and were attended by representatives from one or both of the above organizations, and from the States and the Universities.

The 1925 conference outlined an organization to conduct geological surveys in Commonwealth Territories as part of the search for oil. The conference in 1935 drew up detailed plans for geological field parties as part of a Commonwealth Geological Survey.

Among the reasons suggested by Raggatt (1956), for the failure of these conferences were the lack of appreciation of the magnitude of the problems of geologically surveying Australia, and the fear on the part of the States that their own surveys would languish. It was also thoughtthat their revenues from royalties would be adversely affected.

3. COMMONWEALTH GOVERNMENT'S INTEREST IN GEOLOGICAL INVESTIGATIONS FROM 1910 TO 1953

A. From 1910 to 1926

The Commonwealth Government became associated with geological investigations as far back as 1910, when it became interested in the search for oil, coal, gold and other minerals in Australia and its Territories.

Early in 1910 coal was discovered by the Mackay-Little Expedition in the Purari area of Western Papua. On September 1910, the Prime Minister of Australia made a request to the Premier of New South Wales for the services of a geologist from the staff of the Department of Mines to examine and report on the coal-field. J.E. Carne was chosen to take charge of this work. In 1913, Bulletin No. 1 of the Territory of Papua, by Carne on oil, coal, and copper in the Territory, was issued by the Department of External Affairs. Carne dealt with oil and coal from the Purari area, and with copper from the Astrolabes. During these investigations he made an extensive collection of fossils and fossiliferous rocks from many localities which were sent to the Australian Museum, Sydney. In 1928, this collection became the property of the Geological Branch at the request of the Commonwealth Geological Adviser, Dr. W.G. Woolnough, and is now housed in the Museum at the Bureau (Crespin, 1956).

On January 9th 1911, Evan R. Stanley was appointed Government Geologist in Papua by the Department of Home and Territories. His headquarters were at Port Moresby. He did tremendous pioneering work on the geology of the Territories of Papua and New Guinea. He published three bulletins under the aegis of the Department of Home and Territories and wrote many scientific papers. His investigations included that on

osmiridium in New Guinea and on gold at Misima and Woodlark Islands. In a paper he presented at the Pan-Pacific Science Congress in Melbourne in 1923, Stanley suggested that "the Commonwealth should seriously consider the establishment of a geological survey in these parts". He died on December 27th 1924.

Towards the end of 1912, the Commonwealth Government became seriously interested in the search for oil on the Australian mainland and in Papua. It decided to appoint a consultant from overseas, and Dr. Arthur Wade of London received this appointment. He studied the oil possibilities of the Gulf Division of Papua and during his investigations nine bores were put down in the region. With the permission of the Director of the National Museum, Melbourne, the palaeontologist to the Museum, Mr. Frederick Chapman, undertook the examination of all fossiliferous material collected during these investigations. (Wade, 1914; Chapman, 1918). Some of this material is in the present Commonwealth palaeontological collection at the Bureau (Crespin, 1956).

In 1919, the Commonwealth Government became associated with the Anglo-Persian Oil Company as part of an agreement with the British Government to search for oil in Papua. Field work began in March 1920, but ceased at the end of 1921. Bores were drilled in the Popo area and samples from these are in the Bureau Collection.

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

Dr. Wade was subsequently engaged to investigate oil possibilities in various Australian States. He submitted reports on the Kimberley District, Western Australia, and on the Northern Territory (Wade, 1923, 1924), on New South Wales (Wade, 1925), and on Queensland (Wade, 1925). Chapman examined the fossils from the Kimberley District, and was the first to record a fossil jelly-fish in the Cambrian rocks of Australia, - at Mt. St. John, Osmond Range (in Wade, 1924, P.47, Pl.9). This early collection of fossils from the Kimberley District also forms part of the Commonwealth collection in the Bureau.

The Commonwealth Government financially assisted the Australian National Research Council to hold the Pan-Pacific Science Congress in Sydney and Melbourne in August and September, 1923. Many noted overseas geologists attended the meeting. I was a member and formed friendships there which have lasted many years. Included amongst these were Dr. T. Wayland Vaughan of Washington, D.C., an authority on the larger foraminifera, whom I met again in his home city in 1951, and Professor H.A. Brouwer of the Netherlands whom I met again in Manila in 1953, and in Copenhagen in 1960. H.G. Raggatt, then of the Department of Mines, Sydney, was also a member.

In 1926, the Federal Precious Metals Act was passed, making £10,000 available for prospecting. £3000 was allotted to Victoria to assist in prospecting for gold.

Then followed important legislation to encourage prospecting for petroleum, and the passing of the Petroleum Prospecting Act of 1926, sowed the first seeds of the organization now known as the Bureau of Mineral Resources, Geology and Geophysics. An amount of £60,000 was provided for the purpose of advances to persons and companies in the search for oil. 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.

B. <u>From 1927 to 1935</u>

The immediate result of the passing of the Petroleum Prospecting Act of 1926 was the appointment, in June 1927, of Professor W.G. Woolnough from the University of Western Australia, and formerly lecturer in Geology at the University of Sydney, to advise the Commonwealth Government on geological problems relating to the search for oil in Australia, Papua and New Guinea. He was referred to as the Commonwealth Geological Adviser, and the Geological Branch of the Department of Home and Territories (later, Department of Home Affairs, and ultimately the Department of the Interior) came into being. Mr. P.S. Hossfeld of Adelaide was appointed Assistant Geological Adviser, a post he held until his resignation in 1935. Mr. H.B. Hawkins was draughtsman-clerk. The first headquarters for these early geologists was in a room in West Block, Canberra.

In 1932 it was transferred to Civic Centre, to the rear portion of the Census Building (which old timers will recall was the old Jolimont Building from Melbourne), where it remained for thirteen years.

On October 17th 1927, Mr. Frederick Chapman, Palaeontologist to the National Museum, Melbourne, and one of the pioneer authorities on foraminifera, was seconded from the State Government of Victoria to the Federal Government for twelve months, accommodation and facilities being provided by the National Museum. At the end of this period the Federal Government requested that they be allowed to retain Mr. Chapman's services until February 13th 1929, the date on which he was due to retire from the Victorian Public Service. The request was agreed to by the Trustees of the Public Library and National Gallery of Victoria, and Mr. Chapman continued as Commonwealth Palaeontologist until his retirement in December, 1935. He died in December 1943.

December 1st 1927 was a ~~memorial~~ memorable day for me, for it was then I was appointed Assistant Palaeontologist, commencing duty on December 29th, thus beginning my long association of 34 years with the Commonwealth Government and the search for oil in Australia, Papua and New Guinea.

The palaeontologists had to be conversant with many groups of fossils of all ages. Consequently the magnificent scientific libraries at the National Museum and the National Library, together with the extensive fossil collections at the Museum, were invaluable. It was also the beginning of the era when micropalaeontology, especially the group of microfossils known as the foraminifera, was becoming important in oil-field work. Mr. Chapman was recognised as a pioneer in this work. He was the first to use the foraminifera as criteria for correlation and age, when, in 1900, he examined Tertiary sediments from an oil well in the Santa Clara County, California. His results were published by the Californian Academy of Sciences (Chapman, 1900). His world-wide knowledge of foraminiferal assemblages was illustrated during the Second World War when his son, Brigadier Wilfred Chapman, who was in the North Africa campaign, would send him small pieces of rock to give him some indication as to where he, (Brigadier Chapman), was at the time. Unfortunately, many of Mr. Chapman's

historic slides were destroyed during the fire at the Bureau offices in Canberra in 1953.

Equipment and facilities made available to the palaeontologists by the authorities in Canberra were very limited. Amongst the small quantity of equipment was a monocular microscope, and this is now an historic piece in the Bureau Museum. In 1929, the Anglo-Persian Oil Company having ceased operations in Papua and New Guinea, a Baker Binocular used by the Company in Port Moresby was passed on to the Palaeontological Section. It was used by the section until 1945, when a modern ~~Bosch~~ Bausch and Lomb was obtained. This beautiful instrument was lost in the Bureau fire of 1953. The old binocular has not been discarded altogether, but was used in the field by different geologists. Facilities for washing samples and making thin sections at the National Museum where we were still working were primitive, and because of the very temporary nature of the Geological Branch the authorities in Canberra were not very sympathetic towards making conditions any easier at the Museum.

Mr. Chapman always had the building up of the Commonwealth Palaeontological Collection as his aim. He secured some original collections of fossils, the most important one being the Mahony Collection of fossils from the Canberra area, made by D.J. Mahony in 1912 during the Survey for the Federal Capital with Professor Griffith Taylor. The National Museum, where the Collection was housed, agreed to hand it over to the Commonwealth in 1928. The Carne Collection of Papuan fossils was handed over to the Commonwealth Government by the Australian Museum, Sydney, on February 8th, 1929, and the Griffith Taylor Collection of thin sections of all genera and species of Archaeocythaninae, described by Griffith Taylor in 1910, became the property of the Commonwealth in 1928 (Crespin, 1956).

On December 6th 1929, and interesting press statement appeared. It said that "the creation of a highly skilled field corps of geologists led by Dr. Woolnough, and the institution of a Commonwealth Oil Library containing all the latest facts concerning the search for oil in Australia, are the chief points in the new policy of the Minister for Home Affairs". At this time, the Geological Branch consisted of Dr. Woolnough and Mr. Hossfeld in Canberra, and Mr. Chapman and myself in Melbourne! No additions to the staff were made for some years.

Despite the insecurity of appointment the years from 1927 to 1935 were exciting ones for the staff of the Geological Branch. Investigations were not confined to the search for oil, as legislation was passed to include other minerals and water.

The Commonwealth Government put the services of its palaeontologists at the disposal of all those engaged in the search for oil. Consequently, extensive collections of fossiliferous rocks and individual fossils, both micro- and macro-specimens, from bore samples and outcrop material, were submitted for examination. This material formed the basis of the now comprehensive reference collection available in the Bureau Museum and in the Core and Cuttings Laboratory at Fyshwick.

The first report made by Mr. Chapman after his appointment as Commonwealth Palaeontologist was on October 7th 1927, on a series of samples from the Freney Kimberley Oil Company Bore at Poole Range, Western Australia. The second one was made on November 15th 1927, on cores from No. 1 Structure Bore, Belford Dome, New South Wales.

The Commonwealth Government was interested in three major areas in the search for oil - Papua and New Guinea, Gippsland in Victoria, and Wooramel River area in North-West Australia.

The Anglo-Persian Oil Company, in which the Commonwealth was financially interested, began operations in Papua and New Guinea in 1919, but discontinued them shortly afterwards, commencing again in early 1927. In December 1927, Dr. R.K. Richardson, principal geologist of the A.P.O.C., arrived in Australia to make plans for carrying out a survey for petroleum in Papua and New Guinea. "The personnel of the expedition, in addition to Dr. Richardson, included Dr. S. Papp, Mr. William Gray and Mr. J. Nason-Jones, all of the staff of A.P.O.C., a party of four expert surveyors, and a detachment of the Royal Australian Air Force with two seaplanes. Two Australian geologists, who have not yet been named, will assist the expedition. .....An examination of the fossils discovered during the survey will be made by Mr. Frederick Chapman, palaeontologist to the National Museum, Melbourne, who has been retained by the Commonwealth Government for this work" ("Argus", December 19th, 1927).

J. Nason-Jones and W. Gray were already in the area, having been transported there by Seagull Amphibians under Flight-Lieut. E.C. Wackett, and between October and December, an "area of approximately 30,000 square miles was observed" ..... ("Argus" 24/1/28).

All palaeontological work on the fossil collections made during investigations from 1927 to 1929 was undertaken by Chapman and myself, the results being incorporated in the four volume report issued by the Company (A.P.O.C. Reports, 1920-1929, published, 1930). Hundreds of specimens were examined. Thin sections of rocks were prepared manually at the Museum; later, arrangements were made with the Director of the Geological Survey of Victoria for its technician to prepare slides of the hard rocks in the Mines Department Laboratory. Some sections were prepared in Port Moresby itself and these are in the Commonwealth Collection at the Bureau. Duplicates of many slides were returned to the A.P.O.C. headquarters in London at the request of the Company. From time to time consultations were held at the Museum with well-known A.P.O.C. geologists including R.K. Richardson, B.K.N. Wyllie, J.N. Montgomery, J. Nason-Jones, Simon Papp, G.M. Lees and K. Washington Gray.

The Geological Survey of Victoria and several private companies including Oil Search Limited were engaged in geological investigations in the search for oil in East Gippsland, especially in the Lakes Entrance area and westward to Bairnsdale and Sale. The Commonwealth Government was assisting financially in some of the operations with the Geological Survey of Victoria. Hundreds of feet of bore cores and many surface samples were submitted for palaeontological examination. Duplicates of all cores (for all bores drilled by the Survey at this time were cored), taken during that period, including the unique ten inch cores from Kalimna Oil Company No. 1 Bore, Rigby Island, Gippsland Lakes, are in the Commonwealth Collection. Further samples were collected by Chapman or myself on frequent visits to the area in company with the Director of the Geological Survey, Mr. W.J. Baragawanath, or one of his geologists. It may be of interest to mention here that Professor Sir Edgeworth David, who was a constant visitor at the National Museum, was insistent that if oil were to be found in the Gippsland area in commercial quantities, it would be off-shore near Lakes Entrance.

Recent under-water drilling operations, 28 miles south-east of Lakes Entrance, have proved this forecast of more than 30 years ago to be correct.

To indicate to the authorities in Canberra the importance of the work being carried out by the Palaeontological Section (for the chances of survival of the Geological Branch at this time were not very promising), Dr. Woolnough urged the preparation of the results of the investigations in Gippsland for publication. He had previously given publicity to the work being carried out by Chapman and myself. So, early in 1932, Palaeontological Bulletin (Bulletin No. 1, Department of Home Affairs), by Frederick Chapman and Irene Crespin, was issued. Five hundred copies were printed and the cost per copy to the public was one shilling and sixpence. This Bulletin is now Bulletin No. 1, Bureau of Mineral Resources. It aroused considerable interest in oil circles in Victoria and one geologist-critic referred to it as "a unique and remarkable publication" (Melbourne Age, 19/3/32). He discussed it at some length and summed up his criticism with the following suggestion: "that future bulletins in this series should contain graphic logs, with ground elevation and all marker beds encountered, correlation diagrams and last but not least, figures of all fossils serving as criteria".

Descriptions of fossil foraminifera and mollusca discovered during these investigations were published in the Proceedings of the Royal Society of Victoria (Chapman and Crespin, 1930, 1930b, 1932, 1933), and the described specimens formed the nucleus of the type collection of fossils in the Commonwealth Palaeontological Collection which now (1966), includes nearly 7,000 type and figured specimens.

From 1932 Oil Search Limited and its subsidiary companies were carrying out geological surveys and some drilling in Papua and New Guinea, in the Longreach area, Queensland, in Gippsland, Victoria, at Mt. Gambier, South Australia, and in the Wooramel River area, North West Division, Western Australia. Amongst the well-known geologists originally attached to Oil Search Limited were H.G.Raggatt, E.A. Rudd, D. Dale Condit, F. Reeves, T.H.W. Dee and G.A.V. Stanley. Cores and cuttings from bores and surface samples from all areas were forwarded for palaeontological examination. In 1933 Mr. Chapman and

I experienced the thrill of discovering the first rocks of Eocene age in Australia, in material collected by D. Dale Condit from the Carnarvon Basin (Chapman and Crespin 1935).

Vacuum Oil Company geologists, C.J. Brenner and E. Jablonski, carried out a reconnaissance survey in Northern Territory and North-West Australia during 1930. Fossiliferous material collected by them was submitted for examination and is now in the Bureau Collection. Transport for the greater part of this survey was undertaken in a hired car, the cost being £425.

With all this activity the very limited storage space at the National Museum soon became severely over-taxed, and additional space was acquired in the basement. At last, too, the authorities in Canberra gave permission for the improvement of facilities for washing samples but all residues had to be taken up three flights of stairs or in the first hydraulic lift in Melbourne, to be dried over a small methylated spirits lamp.

On February 20th 1930, Dr. Woolnough visited the United States and Argentina to inquire into methods employed in those countries in the search for oil. He returned on December 6th. In those days all travelling had to be by ship. Mr. Hossfeld acted as Commonwealth Geological Adviser during his absence. A lengthy departmental report was published later (Woolnough, 1931).

In July 1932, Dr. Woolnough commenced an aerial photographic survey of Australia in search of possible regions for oil development. This was carried out with the co-operation of the Royal Australian Air Force. The flights were made in Wapiti Aircraft, piloted by Flight Lieut. Charlesworth and Flying Officer Miles. A detailed account of these operations was published in 1933 (Woolnough, 1933) Dr. Woolnough was a pioneer in the use of aerial photographs in geological survey work in Australia. Many of the negatives of photographs taken during these operations are to be found in the Bureau Collection.

During one of his visits to Northern Territory between 1932 and 1934, Dr. Woolnough was flying with the Northern Territory Flying Doctor, Dr. Clyde Fenton, when their plane made a forced landing somewhere near Victoria River. The plane was without wireless and they had to walk to Victoria River Downs Homestead for assistance.

In September, 1934, Dr. Woolnough, accompanied by L.C. Ball, Director of the Geological Survey of Queensland, F.G. Forman of the Western Australian Survey and P.B. Nye, Executive Officer of the North Australia Survey, went on a reconnaissance flight in the Southern Cross to select areas for geological investigations and aerial photography for the North Australia Survey. This was the last long flight of the Southern Cross, its next and final one being an unsuccessful attempt to cross the Tasman Sea to New Zealand.

In 1928, the Geophysical Survey Act was passed and authorized the carrying out of geophysical surveys for oil, minerals, and water in Australia. This Act gave effect to a recommendation by Mr. H.W. Gepp (later Sir Herbert Gepp), Chairman of the Commonwealth Development and Migration Commission, that the Commonwealth Government and the Empire Marketing Board would co-operate and share the expenditure of a geophysical survey on a £1 for £1 basis.

Professor Broughton Edge of London University was appointed leader of the Survey and Dr. Bieller, Deputy Director. The present Director of the Bureau, Mr. J.M. Rayner, was seconded from the Geological Survey of New South Wales to be a party leader, and later he was part author of the final report of the activities of the Survey. R.F. Thyer and L.A. Richardson were field assistants and N.H. Fisher was a temporary assistant "engaged for one month or less". The investigation, which was known as the Imperial Geophysical Experimental Survey, was restricted to two years, but in that time it had laid the foundation of applied geophysics in Australia.

The equipment used was for gravity work and was first applied in a survey of the brown coal deposits at Gelliondale, South Gippsland. (A few molluscan fossils of Lower Pliocene (Kalimnan) age collected during this survey are in the Commonwealth Palaeontological Collection). It was later transferred to Lakes Entrance, where an area of 12 square miles north of Lakes Entrance was examined.

Later in 1931, Mr. Rayner carried out a magnetometer survey of a large part of the Gippsland Tertiary Basin and of the Mt. Gambier area, South Australia, on behalf of Oil Search Limited.

In December, 1934, the North Australia Survey Act was passed, setting up the Aerial, Geological and Geophysical Survey of Northern Australia, the group being formed by agreement between the Commonwealth, and Western Australian and Queensland Governments. The formation of the Survey was recommended by Sir Herbert Gepp, Consultant on Development to the Commonwealth Government. Mr. P.B. Nye (later Director of the Bureau from 1951 to 1958), was given leave of absence from the Tasmanian Geological Survey to become Executive Officer of the Survey. Mr. J.M. Rayner was Consultant Geophysicist to the Survey, and Mr. R.F. Thyer, was a geophysical party leader, Mr. Carl Zelman was a trainee geophysicist, Mr. E.H. Morgan, present Chief Draughtsman of the Geological Branch of the Bureau, was assistant draughtsman, and Mr. F.C. Fuller, later of the Bureau, was clerk and later accountant with the Northern Australia Survey. Cloncurry, Central Western Queensland, described by someone as the home of heat, flies, goats and dust, was the headquarters and an office was opened there on April 5th 1935, by five members of the staff including Eric Morgan. Few facilities were available in the field in those days, and anecdotes of happenings make interesting telling. The Survey placed on record more than 100 valuable reports and maps of mineral fields. Field work ceased after the 1940 season and the Survey disbanded early in 1942. The equipment and some of the officers were transferred to the Mineral Resources Survey.

Mr. Nye had two forced landings whilst attached to the North Australia Survey. On each occasion he was accompanied by Sir Herbert Gepp. The first one was in June 1937, when the plane, a RAAF Rapide piloted by Flight Lieut. Tony Carr, got off course on a flight from Tennant Creek to The Granites. They landed near a small lake, about half a mile from Lake Mackay, which they named Lake Rapide. They missed The Granites because of heavy smoke near the ground, the absence of land marks, and a small but persistent drift to the south. The party was lost for 10 days and became short of water and food. Some water was secured by means of collecting it through condensation in an apparatus devised by the party on the plane and using two-gallon petrol tins as a boiler.

The second forced landing was in 1938. The party flew in a RAAF Gannett from The Granites westward to the Western Australian

border, then south to the latitude of Alice Springs and eastward towards Alice Springs. Mechanical trouble began when the plane was 50 to 60 miles from Alice Springs and one engine ceased to function. A forced landing was made 20 miles from Alice Springs. Wireless contact was made with an Oodnadatta wireless station, which notified the Administrator at Alice Springs, and cars were sent to the scene of the damaged plane.

N.H. Fisher was appointed Government Geologist of New Guinea under the New Guinea Administration, in September 1934, with headquarters at Wau in the Central Highlands. Mr. L.C. Noakes joined him as Assistant Geologist in 1937. The headquarters was moved to Rabaul, New Britain in 1940. These two geologist did extensive surveys in the Highlands of New Guinea and in New Britain until operations ceased with the arrival of the Japanese in New Guinea in 1940 and in New Britain in 1941.

Mr. H.B. Owen of the Northern Territory Administration at Alice Springs, was seconded to the Geological Branch in November, 1935, when he was transferred to Tennant Creek. He remained an officer of the Administration but worked under the technical guidance of the Geological Branch, Canberra, until he joined the Mineral Resources Survey in March 1942.

C. From 1936 to 1940

On January 1st 1936, I had the honour to succeed Mr. Chapman as Commonwealth Palaeontologist and became the only professional micropalaeontologist in the Australian mainland for some years. Our peace of mind, I might mention in passing, was perpetually unsettled by the fact that all appointments to the Geological Branch, made under the Petroleum Prospecting Act, were temporary, and subject to revision by the Public Service Board every three to six months.

With the transference from Melbourne on February 10th 1936, of the Palaeontological Section under the supervision of the new Commonwealth Palaeontologist, to the headquarters of the Geological Branch in the Census Building, Civic Centre, Canberra, another era began. All collections of rocks, bore cores, fossils, both macro- and micro-, and the small palaeontological library acquired during the nine

years tenancy at the National Museum, Melbourne, were transported by road to the rear portion of the Census Buildings, which was to be our home for another nine years. The preparation for the transfer took nearly six weeks and the consignment consisted of 100 boxes, cases and cabinets.

How well I remember my arrival in Canberra - a depressing welcome if ever there were one! February 11th 1936 was a hot dusty morning and when I alighted from the old steam train at Canberra Railway Station there was no one to meet me. Telephone calls to the Secretary of the Department of the Interior (Mr. J.A. Carrodus), revealed that they had forgotten about my arrival. Dr. Woolnough was hastily on the scene, but he had even forgotten about accommodation for me. Fortunately, Mrs.N.H. Ludbrook, who lived in Canberra at that time, booked me in at a hotel which said they could only accommodate me for one week. I stayed there for fifteen years!

The welcome at the headquarters of the Geological Branch was even more depressing. No preparations had been made for the arrival of the Palaeontological Section, apart from acquiring a large room which was utterly devoid of furniture, except for a wooden case, and with a floor covered with sticky black malthoid. A personal appeal was later made to the Secretary for assistance, and within a few days some furniture was acquired and linoleum was laid on the floor. Later even a small carpet arrived. All shelving in the other part of the building, used for rock specimens and literature, had been made and erected by Dr. Woolnough himself.

I was relieved to find that provision for the cutting of thin sections was slightly better than that at the National Museum. The machine available for use had been designed and built by Dr. Woolnough and had to be operated manually. Later an assistant was obtained for this strenuous work; and joy of joys, a typist was also appointed!

The transfer to Canberra involved hardships, especially with regard to the necessity for a reference library and reference fossil collections which had been so readily available at the National Museum. The absence of literature relating to fossils and especially on the foraminifera, was a tremendous blow, for not only did the

National Museum have an excellent library but Mr. Chapman himself had a magnificient one which later, fortunately, became the property of the Bureau. The National Library in Canberra had little or no scientific literature and, I am afraid, was not very co-operative. It would not permit the purchase of essential works which were available at second-hand shops in Melbourne. However, Dr. Woolnough pressed the acquisition of certain publications through the Secretary of the Department of the Interior.

In May 1937, Miss Joyce Gilbert-Tomlinson was appointed Assistant Palaeontologist.

In 1938, another large room adjoining the Palaeontological Section was acquired by the Geological Branch; this room was previously occupied by the Advisory Council. An attempt was made to have a small museum. Several beautiful mineral specimens presented by the Broken Hill Propriety Company were placed on exhibition in a large glass-topped show-case loaned by the Australian War Memorial. A display of larger fossils was shown in glass-topped cabinets around the walls of this room. Again, storage space became a problem and gradually garages at the rear of the Census Building were acquired for the purpose.

In 1935, Sir Herbert Gepp, in his capacity as Consultant on Development, and advised by Mr. P.B. Nye (under instructions from the Minister in charge of the North Australia Survey), had carried out investigations into the search for oil. In May and December, 1936, the Petroleum Oil Search Acts were passed. Under the May Act, £250,000 was appropriated to encourage drilling operations connected with the search for oil in Australia and the Territories of Papua and New Guinea. This was based on a recommendation by Sir Herbert Gepp, who had suggested a much larger sum to assist the search. Particular attention was to be paid to the supply of suitable drilling machinery. Part of the appropriation was to be made available for advances by way of loans to approved companies or persons on a £1 or £1 basis. The December Act gave permission for the Minister to buy drilling equipment.

To deal with the applications for assistance, the Commonwealth Government was advised by a technical committee known as the Oil Advisory Committee, which was appointed in mid-1936. The Committee consisted of the Commonwealth Geological Adviser, Dr. W.G. Woolnough, as Chairman, the Director of Mines, South Australia, Dr. L. Keith Ward, and an overseas expert, Dr. Arthur Wade. Mr. H.A. Barrenger of the Department of the Interior was appointed secretary to the Committee. Dr. Wade took up his headquarters at the Geological Branch. Later, an American driller, Earl Koyden, was engaged to supervise the drilling machinery purchased under the Act of December 1936. An especially equipped motor truck was obtained for transport of this machinery, most of which went to Queensland. The Oil Advisory Committee, as originally constituted, was disbanded in 1939.

Shortly after the appointment of the Committee, in September 1936, I accompanied the members of the Committee to Perth, so that I could study the Permian fossiliferous material collected by Dr. Wade during the time when he was attached to the Freney Kimberley Oil Company, and which was housed in the Geology Department, University of Western Australia. It was hoped to discover foraminifera in the material. The search was successful. I was able to have consultations with the Geological Survey of Western Australia as I was at that time engaged in the micropalaeontological investigation of samples from water bores in the vicinity of Perth for the Survey.

Between 1936 and 1940, extensive drilling operations were undertaken in the Lakes Entrance - Sale district of Victoria, under the joint co-operation of the Geological Branch and the Geological Survey of Victoria. I was able to visit all bore sites, usually with an officer of the Geological Survey of Victoria. At times I made the long drive from Canberra in my own car, bringing back extra bore material.

In 1936, leases of the iron-ore deposits on Koolan Island, Yampi Sound, Western Australia, had been granted to H.A. Brassert and Company. By 1937 the company planned to work the deposits and to export the iron-ore to Japan. The Commonwealth Government became disturbed about this and started investigations. It was decided to undertake a survey of iron-ore resources and to obtain technical advice. The Minister in charge of the Development Branch of the

Prime Minister's Department and also of the North Australia Survey, instructed the Survey's Executive Officer, Mr. P.B. Nye, to report on the position regarding iron-ore resources in Australia. The Development Branch collected information from the States, and Mr. Nye reported on the position of iron-ore resources and the effect of export on the future outlook. His report indicated that prevention of exports would be an effective method of conserving what were then thought to be Australia's limited reserves. Dr. Woolnough was relieved of his other duties in April, 1938, so that he could make a complete investigation of the iron-ore reserves in Australia. Later, he reported on Australia's resources. On May 19th 1938, the Prime Minister, Mr. J.A. Lyons, stated that 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". This embargo took effect on July 1st, 1938.

The first Bulletin from the Geological Branch to be issued under the authority of the Department of the Interior was in 1936 (Crespin, 1936), and the second one in 1938 (Crespin, 1938). They were referred to as Palaeontological Bulletins Nos. 2 and 3 respectively. (Bulletin No. 1 was published by the former Department of Home Affairs in 1932). The next Bulletins to be issued were No. 9 in 1943 and No. 11 in 1944, both appearing in roneoed form. The first Bulletin in approximately the present format appeared in 1945. This was No. 14 by H.G. Raggatt, H.B. Owen and E.S. Hills, on the Bauxite Deposits in South Gippsland, Victoria. By 1966, Bulletin No. 93 and Report No. 117, have been issued.

A Vulcanological Observatory was erected in Rabaul, New Britain, in 1938. The following statement appeared in the Territory of New Guinea Annual Report for 1938-1939. "A site for a vulcanological Observatory at Rabaul was selected and a contract let for the construction of a building in 1938. The Administration Geologist (Dr. N.H. Fisher) who will take charge of the Observatory proceeded to Java in March 1939 to study vulcanology methods under Dr. C.H. Stehn, vulcanologist of the Geological Survey of the Netherlands East Indies Government". Dr. Stehn had spent a few months in New Guinea and New Britain prior to the construction of the Observatory.

The site of the Observatory is a picturesque one, which overlooks the town of Rabaul and Blanche Bay. After their occupation of New Britain in 1941 the Japanese made use of the observatory. They tunnelled the area extensively and the locality is now known as Tunnel Hill. Later, when the Observatory staff returned to the site, some of the tunnels were used for storing equipment.

I recall the first meeting in Canberra of the Australian and New Zealand Association for the Advancement of Science. It was in January 1939 and was held in the midst of intense heat and bushfires. The temperature rose to 113 degrees. Many people slept out of doors and in those days, refrigeration was very limited. At the weekend, many delegates were fighting bushfires near the Cotter Dam instead of going on excursions. However, the geologists proceeded on their excursion to Captain's Flat on the Saturday. Boiling radiators were the order of the day. The small Geological Branch, consisting of Dr. Woolnough, Miss Gilbert-Tomlinson and myself, was host to Section C, which included several overseas delegates. It was a tremendous effort. I was Secretary of Section C and all meetings were held at Telopea Park School.

Early in 1939, an event of some importance affected the Palaeontological Section, especially in the micropalaeontological approach to oil-field investigation. Approval was given by the Minister of the Interior for me to visit the Netherlands East Indies, to discuss Tertiary foraminiferal problems relating to Papua and New Guinea and the Netherlands East Indies, with Dr. Tan Sin Hok, micropalaeontologist to the Netherlands East Indies Geological Survey in Bandoeng, Java, and with Dr. Hans E. Thalmann, micropalaeontologist to the Nederlandsche Koninklijke Petroleum Maatschappij, at Palembang, Sumatra. I flew to Java on April 10th 1939, returning to Canberra on June 1st. The trip, which took two days from Sydney to Batavia (now Djakarta), was made in a KNILM Lockheed Hudson Aircraft, and I was the only passenger from Sydney to Sourabaya, east Java. The night was spent at Darwin. The Dutch crew flew the plane low over the islands of Soemba, Sumbawa, Lompok and Flores on the way to Bali, for their lone passenger to see as much as she could from the air. Several days were spent at Palembang, where discussions were had with Dr. Thalmann in the heat of the N.K.P.M.

laboratories across the Moesi River at Serigerong. The oilfields of Pendopo and Selo in southeastern Sumatra were visited and the sight of the bringing in of an oil well on the Djark field out in the midday sun in the midst of the jungle, was an event not to be forgotten. The late G.A.V. Stanley, who was visiting the oil-fields of Java and Sumatra on behalf of the Australasian Petroleum Company at Port Moresby, was on this part of the trip. Some time was spent with Dr. Tan Sin Hok in the palaeontological laboratories at the N.E.I. Geological Survey at Bandoeng, and excursions were made to well-known Tertiary localities in West Java. One soon realized the inadequacy of the equipment available in Canberra. The magnificient camera for taking photographs of thin sections of rocks and foraminifera had been presented by a grateful mining company!

Also in Bandoeng at that time was Dr. N.H. Fisher, then Government Geologist of New Guinea, who was inspecting mineral resources and vulcanological methods in Java and Sumatra. I was fortunate enough to accompany him and Mrs. Fisher, together with Dr. Stehn, vulcanologist to the N.E.I. Geological Survey, on trips to two well-known volcanoes, the Papandajan, south-east of Bandoeng, and the Tangkoeban Prahoe, north of Bandoeng.

In April, 1940, Dr. H.G. Raggatt was appointed Assistant Commonwealth Geological Adviser.

D. From 1941 to 1945

This period was dominated by the Second World War.

In January 1941, Dr. Woolnough retired from his position as Commonwealth Geological Adviser and Dr. H.G. Raggatt was appointed his successor. At the same time, the position of Commonwealth Geological Adviser was made a permanent one. The Geological Branch then consisted of the Commonwealth Geological Adviser (Dr. H.G. Raggatt), the Commonwealth Palaeontologist (Miss Irene Crespin), and an Assistant Palaeontologist (Miss Joyce Gilbert-Tomlinson), together with a draughtsman-clerk (Mr. H.B. Hawkins) and a typist (Miss R. Johnson).

With the outbreak of war in August 1939, the interest of the Commonwealth turned from the search for oil to that of mineral

resources of more immediate defence significance, and this was reflected in the growth of a Commonwealth organization for carrying out surveys and advising the Government on mineral matters.

Field work of the Aerial, Geological and Geophysical Survey of North Australia ceased after the 1940 season, and the Survey was disbanded in 1942. It was necessary, therefore, for the Commonwealth Government to decide what to do with some of the staff and equipment of the Survey. The geophysical equipment was transferred to the Geological Branch under the Commonwealth Geological Adviser. The geophysical staff transferred were R.F. Thyer, L.A. Richardson and C.H. Zelman.

In July 1941, the office of the Commonwealth Geological Adviser, together with the Geological Branch, was transferred to the Department of Supply and Development from the Department of the Interior. This transfer was made because a project for the search for oil in Victoria was placed under the Minister of Supply. The Commonwealth had decided to accept the advice of an American oil engineer, Leo Ranney, and his associate, Charles Fairbanks, to sink a shaft to develop the oil sands at Lakes Entrance, Victoria, by means of horizontal drilling from the bottom of the shaft. A comprehensive report on the geology of the Lakes Entrance area was prepared for them by Dr. Raggatt, myself, I.C.H. Croll, geologist of the Victorian Geological Survey, and J. Binney, boring engineer of the Survey.

The time seemed opportune to set up an organization to co-ordinate and direct geological surveys in Commonwealth Territories and if required, in the States. Staff was necessary for such a project, and in April 1941, it was decided to provide a few new geological positions under the direction of the Commonwealth Geological Adviser. These positions included an Assistant Geological Adviser, and in November, 1941, Mr. P.B. Nye, Executive Officer of the North Australia Survey, was chosen to fill this position.

Amongst newspaper cuttings collected by the writer over a period of years was the following (Melbourne Age, 18/9/1941):

"Geologists (2 positions). £568-640 ..... Applicants should possess a science degree, have had experience in the investigation of ore deposits and sub-surface water supply, preferably in Northern Australia and be able to read technical reports in a foreign language. The successful applicants will be required to undertake duty in Northern Territory, one with headquarters at Darwin and the other at Alice Springs" ..... These positions were filled by H.B. Owen and C.J. Sullivan.

In 1941, a Copper and Bauxite Committee was formed under the Chairmanship of Sir Colin Fraser to advise the Minister of Supply and Development on all matters connected with mineral production. This was replaced later in 1941 by a Commonwealth Minerals Committee under the same Chairman.

In 1941, the Commonwealth Geological Adviser suggested to the Commonwealth Government that it was almost impossible for geologists attached to the Territory of New Guinea Survey to carry out their field work in safety, especially as the Japanese were in the New Guinea area, and that they be temporarily absorbed within the Geological Branch at Canberra. These geologists included N.H. Fisher, L.C. Noakes and C.L.Knight. Early in 1942, the Japanese overran New Britain and Dr. Fisher and Mr. Noakes had considerable difficulty in escaping from the island. Dr. Fisher had an exhausting trip down through the Troubriand Group and ultimately reached Brisbane where he was ill for some time. Mr. Noakes remained in Papua and New Guinea for some time and was decorated by the United States Army for his magnificient work with the Coast Watchers. He eventually joined the Mineral Resources Survey in 1944.

In June 1942, approval was given for the enlarged Geological Branch to be re-organized as the Mineral Resources Survey with a Director and Assistant Director. The Commonwealth Geological Adviser, Dr. H.G. Raggatt, became Director and Mr. P.B. Nye the Assistant Director. Dr. N.H. Fisher acted as Chief Geologist from 1942 and Mr. J.M. Rayner as Chief Geophysicist. These two appointments were made permanent in 1946.

Dr. Raggatt had suggested that a systematic summary of information about mineral resources of Australia should be made. So, at the request of the Commonwealth Minerals Committee, this work was commenced.

Investigations were made by the Mineral Resources Survey in connection with supplies of strategically important minerals, and examinations were carried out on deposits of minerals such as tungsten (King Island scheelite), tin, copper, mica, quartz crystals, beryl, zircon, rutile, ilmenite, antimony, lead and zinc.

In 1942, a Mineral Production Directorate was formed in the Department of Supply and Development, and the Minerals Committee was disbanded. A Controller of Mineral Production was appointed to assist in the production of strategic metals and minerals. Mr. J. Malcolm Newman was nominated to the position and made his headquarters with the Mineral Resources Survey in the Census Building. At this time additional rooms in the Census Building were acquired as office space for the increasing staff. Mr. F.G. Fuller of the North Australia Survey became secretary to the Controller. Mr. H. Temple-Watts, formerly of the Australasian Petroleum Company, also joined the Directorate. The Directorate assisted in obtaining finance, supplies and manpower, took over some mines, and started others.

During investigations on behalf of the Minerals Production Directorate in September 1942, H.B. Owen was in a plane crash at Musgrave, north Queensland. He and his fellow passenger, W. Turnbull, were in a D.H. Dragonfly, which he described as "a miserable, underpowered thing of string and canvas". When taking off the plane hit a sapling. They did a tight spiral over some timber and came down in a clearing full of tree stumps and ant-hills. According to Mr. Owen, the plane was badly smashed, but no one was hurt. However, one onlooker fainted!

In 1942 work on the Lakes Entrance Shaft project was commenced under the Controller of Minerals Production. Mr. H. Temple-Watts was supervisor and technical consultant of the project, and the difficult engineering job was under the supervision of Mr. H.J. Cook, who had had considerable civil and mining engineering experience in Burma. The object of the undertaking was to prove oil supplies in the underlying glauconitic sandstone by means of horizontal drilling. The Shaft was circular in shape, 10 feet in diameter and concrete lined. It was sunk to a depth of 1,156 feet and concreted down to approximately 40 feet above the top of the oil-bearing glauconitic sandstone. It was

estimated that 12,000 tons of Tertiary sediments were mined during operations. In June 1945, a diamond drill hole was drilled from the bottom of the shaft to 1,120 feet. Tests showed that the production of oil from the glauconitic sandstone would not be commercial, and the project was abandoned on May 9th 1946.

From immediately below the fossiliferous sediments of the Kalimnan Stage (Lower Pliocene) of these Lakes Entrance workings, the miners were persuaded to keep a complete section of samples from each kibble brought to the surface. I collected representative samples from this material which was laid out in stratigraphic sequence when, with Mr. Noakes, I visited the project about every four to six weeks between 1942 and 1945. The journey from Canberra to Lakes Entrance, a distance of 275 miles, was in those days a tedious one. The road was unsealed from Canberra to Orbost and the vehicle used to convey us there was one of the original trucks used by the North Australia Survey. It had recently been converted to use producer-gas as petrol was scarce in those war days. The truck was affectionately known as "Leaping Lena". It misbehaved one Sunday evening when returning to Canberra. The hub axle broke several miles south of Michalego, in the midst of a terrific duststorm. Mr. and Mrs. Noakes and the writer spent the night sitting in the truck as the duststorm raged. When help arrived the next morning, the duststorm had abated but the temperature was up to the century mark.

On all visits to the shaft Mr. Noakes and I descended into it in a kibble or, if available, a cage. A unique study of the sub-surface sequence of the Tertiary beds in the Lakes Entrance area, with all the lithological and palaeontological changes, was made possible to the two of us. This study of the glauconitic sandstone <u>in situ</u>, and the sediments immediately overlying it, was of considerable interest, because nowhere in the Lakes Entrance area is this sequence exposed at the surface. (Crespin, 1950; Thyer and Noakes, 1955).

During 1942 and 1943, the Mineral Resources Survey supervised the geological work during the drilling of eight bores by the Water Conservation and Irrigation Commission of New South Wales in the Coorabin area. Seven of the bores were drilled for the Commonwealth Coal Commission and one for the Department of Supply and Shipping.

In 1943, Dr. Raggatt and I issued a report (unpublished, Records 1943/63) on the "Summary of Oil Drilling Activities in Australia and New Guinea" which was based on all available records of bores drilled for oil up to 1943. This work formed a basis for the early part of the Report by Condon, Fisher and Terpstra published in 1958.

After a Commonwealth Prime Ministers' meeting in England in 1944, the Australian Prime Minister, Mr. John Curtin, sent a personal message to Dr. A.C. Rivett, Chief Executive Officer of the Council for Scientific and Industrial Research, that the Mineral Resources Survey was to devote its attention to the search for uranium deposits. The Mineral Resources Survey complied, and from 1944 onwards most of its geological and geophysical staff became engaged in surveys and investigations of all areas in Australia from which uranium minerals had been reported, or in which they were likely to occur. The mineral collections in most, if not all, of the museums in Australia were examined and localities of all radioactive specimens listed. The first use by the geophysicists of the Geiger-Muller counter in the search for uranium minerals was made in 1944. The investigation was continued by the Bureau when it was created in 1946.

With this concentrated effort on strategic minerals, the issue of Summary Reports on individual minerals was commenced. The first report to appear was on zirconium, which was issued in roneoed form; it did not appear in printed form until 1951, when it was listed as Summary Report No. 1. The first Summary Reports in printed form appeared in 1945 - these were on antimony (Summary Report No. 3) and on arsenic (Summary Report No. 22).

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

As a result of this request, and on the recommendation of the Mining Industry Advisory Panel, Dr. Raggatt and Mr. Rayner made a visit to the United States and Canada in May 1945 to study the organization of the Geological and Geophysical Surveys in those two countries. They flew across the Pacific in a Liberator Aircraft under

very uncomfortable conditions.

The specific points to be studied were:

(a) The relationship between Federal and State (or Provincial) Geological Surveys and the Bureau of Mines in the United States and Canada.

(b) The relationship between the Federal Geological Surveys and the administration 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.

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

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

In the same year the Australian Aluminium Production Commission was established under the terms of the Aluminium Industry Act to implement an agreement with the Commonwealth and Tasmanian Governments to set up an aluminium plant in Australia. Officers of the Mineral Resources Survey, either directly or under secondment to the Commission, conducted all the geological work and much of the testing of bauxite deposits for the Commission. Mr. H.B. Owen was engaged continuously on this project for a few years (Owen, 1954). While examining small occurrences of bauxite north of Darwin, he was informed that similar material occurred in the Wessel Islands. A visit in October 1951 confirmed the existence of good deposits there. Investigations by him on the mainland of Northern Territory near these islands following the handing in of a sample with high alumina content resulted in the discovery of the Gove deposits. During his searches through the various islands, Mr. Owen was shipwrecked in the New Hebrides which he said was a close call with rough seas on a pitch black night.

In August 1945, the headquarters of the Mineral Resources Survey was transferred from the Census Building to Melbourne Buildings, Civic Centre.

In late 1945, Mr. L.A. Richardson went to Japan in connection with the search by the United States and Australian Army authorities for Japanese scientific papers and equipment that might be available. He was given the rank of Colonel for this assignment. Whilst at Tohoku University, Sendai, he spoke with a Japanese geologist who asked him where he came from. When Mr. Richardson said "Canberra," he was asked did he know "Dr. Clespin". It was Professor Hanzawa with whom I had corresponded for some years prior to the war regarding the larger Tertiary foraminifera of the Indo-Pacific region, and with whom I was glad to re-establish connections.

E. From 1946 to 1951

Early in 1946, the first regional investigations were undertaken by the Mineral Resources Survey in the Australian Capital Territory. Mr. Nye and Mr. Owen sited water bores on Gunghalin property. Extensive regional mapping of the area followed from 1947 onwards, when L.C. Noakes and C.J. Sullivan supervised student field parties during University vacations. Later Dr. Opik carried out considerable detailed geological work in the region.

On May 3rd, 1946, control of the Toolangi Magnetic Observatory in Victoria, originally part of the Melbourne Observatory, was transferred to the Mineral Resources Survey from the Commonwealth Astronomer.

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

(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.

On March 27th 1946, the Mining Industry Advisory Panel, which included heads of Mines Departments, agreed that the Commonwealth should assist in meeting the requirements for geophysical surveys, because of their cost and highly specialized nature.

Immediately before the establishment of the Bureau as such, the headquarters of the Mineral Resources Survey was transferred to Melbourne. The Geophysical Section also went to Melbourne but the Geological Section remained in Canberra. Sections which were formed later, i.e. Petroleum Technology, Mining Engineering and Mineral Economics, were also housed in Melbourne.

The Bureau in its present form dates from May 11th 1946, It was at first called Bureau of Geology, Geophysics and Mineral Resources, but the title was later changed to the Commonwealth Bureau of Mineral Resources, Geology and Geophysics. Dr. Raggatt was the first Director of the Bureau and Mr. Nye, Deputy Director. Geological and geophysical investigations increased immensely, and more staff was necessary. The fields of activity also expanded. Many of these are indicated in subsequent comments.

On June 11th 1946 and December 18th 1946, the Public Service Board agreed to the appointment of additional staff:

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

(b) 7 positions, including a mining engineer.

A Mining Engineering Group, under H.J. Cook, was formed in 1946. This was the direct result of a policy recommended by the Mining Industry Advisory Panel of rehabilitating mines closed down during the war, and of assistance to companies in the exploration and development of mineral deposits in Australia.

A Petroleum Technology Section was also formed with H. Temple-Watts as Petroleum Technologist.

As a result of a British Commonwealth Official Conference in July 1946 a Mineral Economist was appointed on July 24th, 1947. The first appointee was Dr. J.A. Dunn. The Mineral Economics Section

of the Bureau was established in 1952.

With the increased staff of geologists, which included specialist palaeontologists, I was relieved of having to be conversant with many groups of fossils, and my work was devoted entirely to micropalaeontology. Amongst those recruited to the staff from overseas was Dr. A.A. Opik, whose knowledge of the Lower Palaeozoic faunas is well-known. He joined the Bureau in 1948. Other overseas recruits included Dr. R.O. Brunnschweiler in 1949, and Dr. W.F. Schneeberger and Mr. K.A. Townley in 1950.

As a result of the visit to the United States and Canada by Dr. Raggatt and Mr. Rayner in 1945, an impetus was given to geophysical investigations. In 1946, Mr. R.F. Thyer went to the United States to study techniques relating to the reflection seismograph. This method of geophysical exploration was first carried out in Australia during the Oaklands-Coorabin coalfields survey in New South Wales from July to September, 1949. The party consisted of four geophysicists, a surveyor, a driller and six field assistants (Thyer and Vale, 1952). The method was later used in the Roma area, Queensland. The first bore-logging based on geophysical methods was carried out by Bureau geophysicists at Roma Block 16, in 1950.

Between June, 1946 and April 1947, a comprehensive geological and geophysical survey of the Collie Coalfield in Western Australia was carried out jointly by the Commonwealth and State Governments. The geological work was undertaken by the Geological Survey of Western Australia and the geophysical work by the Bureau. The gravity method was employed in the survey (Chamberlain, 1952).

In July 1947, Watheroo Magnetic Observatory, Western Australia, was transferred to the Bureau from the Carnegie Institution, Washington, W.C., thus showing the increasing importance of the Bureau in the geophysical field.

In 1947, the Bureau commenced investigations into the beach sand heavy-mineral deposits along the southern Queensland and northern New South Wales coastlines, between Southport in Queensland and Woody Head near the mouth of the Clarence River in northern New South Wales. The object of the survey was to determine the reserves

of monazite and consequently of thorium, as well as zircon, rutile and ilmenite. Systematic work began in January 1948 and finished in December 1950. Mr. D.E. Gardner was in charge of investigations, and Mr. J. Ward was responsible for the laboratory which was set up at Southport (Gardner, 1955).

In 1947 and 1948, I visited Roma, Queensland, to collect sediments from all available outcrops in the district, going as far east as Wollumbilla. It was hoped to discover a characteristic Lower Cretaceous foraminiferal assemblage in the beds for correlation purposes with other parts of the Great Artesian Basin. Prior to this all correlations within the Lower Cretaceous in the region had been based on larger fossils. (Crespin, 1953).

Regional geological surveys were undertaken by geologists of the Bureau in North-West Australia from 1947 onwards. Field parties commenced operations in the Fitzroy Basin in 1947 (Guppy, Lindner, Rattigan and Casey, 1958) and in the Carnarvon Basin to the south in 1948 (Condon, Johnstone, Perry and Crespin, 1953; Condon, Johnstone, Prichard, and Johnstone, 1956). Work was also commenced in Dampier Peninsula, in 1948 (Brunnschweiler, 1957). Prior to this most geological work in the region had been undertaken by private companies in their search for oil. The work carried out by the Bureau in the search for oil in these remote parts of Western Australia cannot be underestimated. When oil was discovered in Rough Range, Carnarvon Basin, in 1953, the 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."

Geophysical investigation in the Carnarvon Basin commenced in 1950.

In 1947, the Bureau extended its activities to the Sub-Antarctic Islands, and later to the Antarctic Continent itself. During December 1947 and January 1948, John Ivanac, geologist, and Noel Chamberlain, geophysicist, accompanied the Australian National Antarctic Research Expedition of the Antarctic Division of the Department of External Affairs, on its trip to Heard and Macquarie Islands. It was

hoped to reach the Antarctic Continent but the ship was not suitable for the conditions in that region. The object of the visit of the Bureau officers was to make a geological reconnaissance survey and to set up magnetic observation stations on the islands (Chamberlain, 1952).

W.A. Flower

~~G. Schaefer~~ was the first resident geophysicist on Macquarie Island where he was stationed from 1950 to 1951. Both seismic and magnetic observations were made. H.A. Doyle was the first resident geophysicist on Heard Island, where he was stationed from 1951 to 1952, setting up the observatory on the island and commencing some recordings.

Also from December 1947 to March 1948, E. McCarthy was the geophysicist accompanying the "Wyatt Earp" in its unsuccessful attempt to reach the Antarctic Continent and set up a base there.

In 1948, a Geophysical Laboratory was established at Footscray, Melbourne.

In 1948, Mr. Rayner made a trip to the United Kingdom, France and Sweden for the purpose of buying geophysical equipment, little of which was available after the war. From the British Navy, he bought certain equipment which had been used against submarines, and which then had to be adapted to geophysical needs.

The Bureau acquired a D.C.3 Aircraft in 1949 and adapted it for the use of aero-magnetic survey work. The first aero-magnetic survey was made in 1951. The Bureau was amongst the first to use this equipment in Australia.

Dr. Raggatt and Dr. Fisher were Bureau delegates to the 18th International Geological Congress held in Great Britain in 1948. Dr. Raggatt presented a paper on "Foraminifera in Australian Stratigraphy" (Crespin, 1950) on my behalf, as approval was not given for me to make the trip with them.

In January 1949, I was fortunate to be chosen, together with Mr. R.F. Thyer, as Bureau delegate to the 7th Pacific Science Congress. Meetings were held at Auckland, Wellington and Christchurch in New Zealand. This was the first meeting of the Congress since the

6th Session was held in San Francisco in 1939.

On March 16th, 1950 a site was allotted for a permanent building for the Bureau in Canberra; this site was in Acton near the Institute of Anatomy and the Canberra High School. A temporary laboratory for chemistry and petrology was erected on the site in June, 1953, and placed so as to fit in with the permanent structure when built. However, the site was abandoned in 1961 as unsuitable and plans for the present new building were commenced.

In 1950, two Bureau geologists, J.F. Ivanac and D.M. Traves, went to Pakistan under the auspices of the Colombo Plan. The object of their visit was to assist the Pakistan Government with its search for mineral resources in that country.

In January 1951 a supposedly extinct volcano, Mt. Lamington, in Papua, erupted violently, with disastrous results. Mr. G.A. Taylor, Commonwealth vulcanologist in Papua and New Guinea, carried out magnificent work during this distressing time, for which he was awarded the George Cross. Dr. Fisher also did some outstanding work in connection with the eruption. (Taylor, 1958).

Between 1951 and 1954, the Bureau co-operated with the Joint Coal Board and the New South Wales Department of Mines in conducting an investigation into the reserves of open cut coal. Considerable drilling was undertaken to determine the extent of these reserves.

In March 1951, the Director, Dr. Raggatt, left for Washington D.C., where he spent a few months as a member of the Australian delegation to the International Raw Materials Conference. Also in 1951 Mr. Rayner attended the meeting of the International Union of Geodesy and Geophysics in Brussels.

In April 1951, approval was given for me to visit the United States to study the micropalaeontological collections at the United States National Museum and the Geological Survey in Washington, at the American Museum of Natural History, New York, and at the Bureau of Economic Geology at Austin, Texas. Several universities were visited, as well as oil-fields and oil-field laboratories in Texas and California. I attended the Annual Meeting of the American Association of Petroleum Geologists and Society of Economic Paleontologists held at St. Louis

at the end of April. I also addressed the eastern Division of the A.A.P.G. in New York and the western Division in Los Angeles. Considerable interest was shown in a coloured 35mm movie film of the Carnarvon Basin, Western Australia, which had been loaned to me by Mr. Murray Johnstone, formerly of the Bureau and now with West Australian Petroleum Company. The presence of Dr. Raggatt at the New York Meeting greatly helped me to get through the evening successfully. This meeting was postponed on two occasions because of the indecision of the authorities in Canberra to grant approval for the trip!

Shortly after his return from the United States, Dr. Raggatt was appointed Secretary of the Department of National Development (formed a few years earlier), of which the Bureau forms an integral part. This appointment necessitated his return to Canberra from Melbourne late in 1951. Mr. Nye, the former Deputy Director of the Bureau, became Director with his headquarters still in Melbourne.

F. From 1952 to 1953

It is not intended to pursue the story of the Commonwealth Government's interest in geological investigations beyond the year 1953, as all those interested in the organization of the Bureau are conversant with its growth from that time. However, several notable events occurred in the short period from 1952 to 1953.

An event of considerable importance took place in October, 1952, when the Bureau issued a geological map of Australia, Papua and New Guinea. This map was on the scale of 1 inch to 100 miles and was printed in the standard geological colours. However, there were many large areas in Central Australia that had not been geologically investigated up to that date, and consequently much of that region remained uncoloured. When I attended the Eighth Pacific Science Congress in the Philippines at the invitation of the National Research Council of the Philippines in November 1953, I took with me a Kodachrome slide of this map. It was greeted with great enthusiasm and Australia was congratulated on her great effort.

In 1952, micropalaeontology played an important part in the detection of crime. At the request of the Chief Geologist, Dr. Fisher, I co-operated with the Police Department in investigations connected with the blowing open of a safe at the Royal Canberra Golf Club. As the safe was insulated with diatomite, I was asked to use my knowledge of this material as I had made a specialized study of Australian diatomites during the war, for this mineral was used in the filtration of water for the troops in Northern Australia, Papua and New Guinea. The accused man was unfortunate in having diatomite in the cuffs of his trousers similar to that which was used in insulating the safe: it was an overseas variety. The case received a certain amount of publicity and is still quoted by the C.I.B. in Sydney.

Two other important events occurred in 1952. One was the beginning of mining operations on the uranium fields at Rum Jungle, Northern Territory, and the other was the discovery of bauxite deposits on Manus Island by J.E. Thompson.

C.J. Sullivan attended the International Geological Congress at Algiers, North Africa, in 1952. Prior to the meeting he visited the Belgian Congo to study mineral deposits in that country. He returned to Australia through North America.

On April 10th 1953, a serious fire in Melbourne Buildings, Civic Centre, set back investigations in the Bureau for some time. It apparently started in one of the rooms of the Canberra University College which occupied the floor above the Bureau. The rooms occupied by Dr. Opik, Miss Gilbert-Tomlinson, some of the other geologists and myself received full blast of the fire. Dr. Opik, amongst other things, lost valuable manuscripts and type specimens of fossils. In my room were three thousand micro-slides, including all the diatomite ones, and part of the Chapman Collection of historic slides of foraminifera, as well as more than half of the Chapman Library of Foraminifera, which had been purchased in 1949, and had just been catalogued by me for publication in America. The manuscript was on my table which was completely destroyed. My personal losses were considerable. Amongst those of sentimental value was a framed card inscribed "Label today, tomorrow you will have forgotten."

This card had had pride of place in Mr. Chapman's office at the National Museum, Melbourne, and later in my room in Melbourne Buildings. The attention of many young geologists was called to these wise words. The magnificient collection of Tertiary fossils of New Guinea and Papua, possibly the most comprehensive in the world, which was housed in my room, was saved only by the amazing work of Dr. Fisher, who defied the fireman and removed the drawers from the burning cabinets. Many specimens of larger fossils, collected from different parts of Australia by geologists such as Dr. Opik, G.A. Thomas, J.M. Dickins and R.O. Brunnschweiler, were unrecognizable and had to be replaced by further visits to the field. The main library and most of the rest of the building were completely flooded. Many books which escaped the fire were irreparably damaged by water.

As much salvaging as possible was done, and the Geological Section was subsequently transferred to another temporary home in what was known as the Turner Hostel in Childers Street, Turner. The Section remained there until the recent transfer in 1965 to the new Bureau building in Parkes Way in the suburb of Parkes.

An event of great importance to the Bureau and also to Australia was the discovery of oil, in November 1953, in Rough Range No. 1 Well, Carnarvon Basin, Western Australia. The location of this well followed geological and gravity surveys by the Bureau of Mineral Resources, and seismic surveys by West Australian Petroleum Company Pty. Ltd. The interest in this discovery went far beyond the limits of the Australian Continent. Mr. J.E. Thompson and I, who were attending the Eighth Pacific Congress in Manila, heard of it in that city, and on the following day, when returning to Australia, the Captain of the DC4 aircraft told the writer that he had heard the news in Tokyo.

A happening of a more personal nature was the awarding of the Coronation Medal to me in 1953 in recognition of my work in the geological sciences over a period of many years.

Since 1953, the importance of the Bureau in the mineral industry in Australia has steadily increased. Mr. P.B. Nye retired as Director on March 20th 1958, and Mr. J.M. Rayner succeeded him,

with Mr. H. Temple-Watts as Deputy Director. The headquarters of the Bureau together with the Petroleum Technology, Mining Engineering and Mineral Economics Sections were transferred from Melbourne to accommodation in the M.L.C. Building in Civic Centre, Canberra. The Geological Section remained in the Turner Hostel and, with increasing staff, temporary accommodation had to be found in different buildings in Canberra. The transfer of the Geophysical Section to Canberra was completed in 1965 after the finishing of the Bureau's first permanent home. And now, almost all sections of this large organization are gathered under the one roof. The tremendous growth from four professional officers in 1927 to the present number of approximately 290 in 1966, overwhelms me who was one of these four.

In conclusion, a few of Sir Harold Raggatt's comments (Raggatt, 1956), on the activities of theBureau might be appropriately quoted. He stated that "a large part of the Bureau is engaged in investigation and research. The value of research is notoriously difficult to measure; in fact, it cannot be measured with any degree of accuracy ..... 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. So it is with the Bureau ....." He quoted several instances such as the setting up of the aluminium industry in Australia, resulting from the testing and proving by the Bureau of adequate reserves of bauxite; the discovery of bauxite in the Wessel Islands Group and at Gove, in Arnhem Land; the beach sand and mineral industry and the realization of the large resources through Bureau investigations; and last, but not least, the pioneer geological surveys in Western Australia and their part in the discovery of oil at Rough Range in 1953.

4. REFERENCES

A.P.O.C. 1930 - The oil exploration work in Papua and New Guinea conducted by the Anglo-Persian Oil Company on behalf of the Commonwealth of Australia, 1920-1929. 4 vols. LONDON

BRUNNSCHWEILER, R.O., 1957 - The geology of Dampier Peninsula, Western Australia. Bur.Min.Resour.Aust.Rept. No. 13

CARNE, J.E. 1913 - Notes of the occurrence of coal, petroleum and copper in Papua. Bull. Territ. Papua. No.1.

CHAMBERLAIN, N.G., 1948 - Preliminary report on the geophysical survey of the Collie Coal Basin. Bur.Min.Resour.Aust.Rept.No.1

CHAMBERLAIN, N.G., 1952 - Observations of terrestrial magnetism at Heard, Kerguelen and Macquarie Islands, 1947-1948. (Carried out in co-operation with the Australian National Antarctic Research Expedition, 1947-8).
Ibid. No.5

CHAPMAN, F., 1900 - Foraminifera from the Tertiary of California. Proc Calif. Acad. Sci. 3rd ser. 1 (8), 241-260

CHAPMAN, F., 1918 - Report on a collection of Cainozoic fossils from the oil-fields of Papua. Bull. Terr. Papua 5

CHAPMAN, F., and CRESPIN, I., 1930 Rare foraminifera from deep borings in the Victorian Tertiaries, Victoriella gen nov., Cycloclypeus communis Martin and Lepidocyclina borneensis Provale. Proc. Roy. Soc. Vict., n.s. 42 (2), 110-115

CHAPMAN, F. and CRESPIN, I., 1930a - Rare foraminifera from deep borings in the Victorian Tertiaries, Part II. Ibid. 43 (1), 96-100

CHAPMAN, F., and CRESPIN, I., 1932 Rare foraminifera from deep borings. Part III. Ibid n.s. 44 (1), 92-99

CHAPMAN, F., and CRESPIN, I., 1932a. The Tertiary geology of East Gippsland, Victoria as shown in borings and quarry sections. Bur.Min.Resour. Bull. 1 (Pal.Bull. 1), Dept. of Home Affairs.

CHAPMAN, F., and CRESPIN, I., 1933 - New and rare Tertiary mollusca from deep borings in Victoria. Proc.Roy.Soc.Vict., n.s. 46 (1), 66-77

CHAPMAN, F., and CRESPIN, I., 1935 - Foraminiferal limestones of Eocene age from North-West Division, Western Australia. Ibid n.s. 48 (1) 55-65

CONDON, M.A., JOHNSTONE, D., PERRY, W.J., and CRESPIN, I., 1953 - The Cape Range Structure, Western Australia. Bur.Min.Resour.Aust.Bull. 21.

CONDON, M.A., JOHNSTONE, D., PRICHARD, C.E., and JOHNSTONE, M.A., 1956 The Giralia and Marrilla Anticlines, North West Division, Western Australia. Ibid. Bull. 25

CONDON, M.A., FISHER, N.H., and TERPSTRA, G.R.J., 1958 - Summary of oil-search activities in Australia and New Guinea to the end of 1957. Ibid. Rept. No. 41

CRESPIN, I., 1936 - The larger foraminifera of the Lower Miocene of Victoria. Ibid. Bull. 2

CRESPIN, I., 1938 - The occurrence of Lacazina and Biplanispira in the Mandated Territory of New Guinea and a Lower Miocene limestone from the Ok Ti River, Papua. Ibid. Bull. 3

CRESPIN, I., 1950 - Some Tertiary pelecypoda from the Lakes Entrance Oil Shaft, Gippsland, Victoria. Proc.Roy.Soc.Vict. 60, n.s. 149-156.

CRESPIN, I., 1950 - Foraminifera in Australian stratigraphy. Rept. Intern.Geol.Cong. 18th Sess.Gt.Brit. 1948, pt. 15, 3-8

CRESPIN, I., 1953 - Lower Cretaceous foraminifera from the Great Artesian Basin. Contr.Cush.Fdn., 4 (1), 26-36

CRESPIN, I., 1956 - Micropalaeontological investigations in the Bureau of Mineral Resources, Geology and Geophysics, 1927-52. Bur.Min.Resour.Aust.Rept. No. 20.

GARDNER, D.E., 1955 - Beach-sand heavy-mineral deposits of Eastern Australia. Ibid. Bull. 28

GUPPY, D.J., LINDNER, A.W., RATTIGAN, J.H., and CASEY, J.N., 1958 - Geology of the Fitzroy Basin, Western Australia. Ibid. Bull. 36

OWEN, H.B., 1954 - Bauxite in Australia. Ibid Bull. 24

RAGGATT, H.G., 1956 - Bureau of Mineral Resources, Geology and Geophysics, history and organization. Unpublished.

RAGGATT, H.G., and CRESPIN, I., 1943 - Summary of oil drilling activities in Australia and New Guinea. Bur.Min.Resour.Aust. Records 1943/63, unpublished.

TAYLOR, G.A., 1958 - The 1951 eruption of Mt. Lamington, Papua. Ibid Bull. 38

THYER, R.F., and NOAKES, L.C., 1955 - Oil in glauconitic sandstone at Lakes Entrance, Victoria. Ibid. Rept. No. 22

THYER, R.F. and VALE, K.R. 1952 - Geophysical Surveys, Oaklands-Coorabin Coalfield, New South Wales. Ibid. Bull. 19

WADE, A., 1914 - Report on petroleum in Papua. Melbourne, Commonw. Parl. Rept. 61.

WADE, A., 1924 - Petroleum prospects. Kimberley District of Western Australia and Northern Territory. Commonw. Parl. Rept.

WADE, A., 1925 - The possibility of oil discovery in Queensland. Commonw. Parl. Rept. No.F.4101.

WADE, A., 1925a - Petroleum. Report on investigations made in New South Wales. Commonw. Parl. C. 6468.

WOOLNOUGH, W.G., 1931 - Report on tour of inspection of the oilfields of the United States of America and Argentina, and on oil prospects in Australia. Commonw. Parl. No.161-F.818

WOOLNOUGH, W.G., 1933 - Report on aerial survey operations in Australia during 1932. Commonw. Parl. By Authority.