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REPORT ON VISIT TO UNITED STATES OF AMERICA.

by

Irene Crespin.

CANBERRA.

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INTRODUCTION.

The object of my trip to the United States of America was to discuss problems of micropalaeontology with various authorities in that country, to visit the palaeontological laboratories of the United States Geological Survey and National Museum, State Universities, Museums and laboratories of oil companies and to enquire into the latest techniques used in oil-field laboratories. I was also to attend the joint Annual Convention of the American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists and Society of Exploratory Geophysicists at St. Louis.

I left Canberra on Thursday April 5th and Sydney on April 6th for San Francisco and New York where I arrived on Saturday April 7th at 11.30 p.m. I left San Francisco on my return to Australia on July 2nd and arrived in Sydney on July 4th and Canberra July 5th.

During that time I visited the Department of Micropalaeontology at the American Museum of Natural History, New York; Princeton University, Princeton, New Jersey; Cornell University, Ithaca, New York State; United States Geological Survey and United States National Museum, Washington, D.C.; Washington University, St. Louis; University of Texas and Bureau of Economic Geology, Austin, Texas; University of Southern California, Los Angeles; Scripps Institute of Oceanography, La Jolla, California; University of California, Berkeley; California Academy of Science, San Francisco and Stanford University; oil company laboratories at Houston and San Antonio, Texas, and at Los Angeles and Bakersfield, California.

I addressed the eastern division of the American Association of Petroleum Geologists in New York and the western division of the same Association and society of Economic Paleontologists at Los Angeles, the Paleontological Society of Washington and the Geological Societies of San Antonio and of San Joaquin, Bakersfield. Talks were also given to the senior geological students at New York State University, Princeton University, Cornell University, and Washington University, St. Louis.

INSTITUTIONS VISITED:

On my arrival in New York on April 7th, I was met by Miss Angelina Messina, of the Department of Micropaleontology, American Museum of Natural History and from April 9th to May 10th this Institution was my headquarters. Dr. Brooks Ellis, Chairman of the Department of Micropaleontology and Miss Messina were most kind and placed all facilities at my disposal whilst in New York. At the Department, I saw the setting up of the famous Catalogue of Foraminifera of which Dr. Ellis and Miss Messina are co-editors. This publication is wholly produced within the Department by Dr. Ellis, and his staff of research personnel typists, photographers and artists. An immense card index arranged according to genera, species and authors is available for use by visiting micropalaeontologists who are constantly arriving from all parts of the world. In regard to this catalogue, Dr. Brooks Ellis requested that I should have a complete catalogue made of the magnificent Chapman Library of foraminiferal literature which was fortunately acquired two years ago by the Bureau of Mineral Resources and which is housed in Canberra. It is already known that this library contains many rare papers on foraminifera. It is Dr. Ellis' plan to publish this catalogue in the journal "The Micropaleontologist", which is also set up at the Department of Micropaleontology.

Two members of Dr. Ellis's staff are at present engaged on the problem of living conditions of foraminifera and the effect of temperature, salinity of the water and food are major considerations in this study. It was a privilege to observe such investigations.

Dr. Ellis hopes to make the Department the centre of distribution of topotype foraminiferal material for workers all over the world. All material received is carefully stored and catalogued. I was fortunate to obtain some of this material. Dr. Ellis had also designed an ingenuous machine for cutting thin sections of foraminifera.

On the evening of April 11th I addressed the senior geology students at New York State University on "Microfossils in Australian Stratigraphy", and on April 12th, I addressed the Eastern Division of the American Association of Petroleum Geologists. Many leading petroleum geologists, micropaleontologists and geophysicists were present. Dr. Bruno Winkler of the Socony-Vacuum Oil Company presided and Dr. Raggatt came from Washington to attend. The address which was illustrated was entitled "Some Features of Tertiary and Cretaceous Stratigraphy in the North-West Basin, Western Australia".

At the suggestion of Dr. Raggatt, I made a short visit to Washington so that I could meet the people with whom I would be associated later and to make plans for a longer visit. Whilst there news arrived of permission to extend my visit to the States to three months, and Dr. Preston Cloud, head of the palaeontological and stratigraphic branch of the United States Geological Survey, whom I had met at the Seventh Pacific Science Congress in New Zealand in 1949, planned my itinerary through Texas and California and communicated with well known palaeontologists advising them of the possible date of my arrival at each city. This schedule was adhered to throughout and at this point I would like to record my thanks to Dr. Cloud for his great kindness to me and for placing all facilities of his branch at my disposal.

On April 22nd I left New York by air for St. Louis to attend the Annual Joint Convention of the American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists (of which I am a member) and the Society of Exploratory Geophysicists. The Convention lasted from April 23rd to 26th, and approximately 3,500 geologists and paleontologists attended. I met many well known geologists and palaeontologists many of whom I had corresponded with for several years. Amongst the palaeontologists were Professor H. Stenzel of the University of Texas, Professor A.K. Miller of the University of Iowa, with whom I had collaborated in a paper in 1939, Mrs. Betty Kellett Nadeau, an authority on Palaeozoic ostracoda from Washington University, St. Louis and Mrs. Esther Aplin of Jackson, Mississippi, with whom talks on her recent investigations into the genus Cyclammina have been of considerable help to Dr. Raggatt and me in our work on the Torquay area, Western Victoria. Many excellent papers on sedimentary and palaeontological subjects were read and of special interest were those on the origin of glauconite, classification of quartz-bearing sediments, reef structures in Palaeozoic formations and their importance in oil geology and the statistical approach to the distribution of foraminifera in sediments.

May 1st and 2nd were spent at Princeton University where I had talks with Professor Howell at the Department of Paleontology and where I was the guest of the Faculty of Science. I also had talks on Palaeocene foraminifera with Dr. Stephen Fox, formerly micropalaeontologist at Princeton, who came from Rutgers University, New Brunswick to see me.

On June 6th I left New York for Ithaca, New York State, for discussions with Professor Storrs Cole at the Department of Paleontology, Cornell University, where I was again the guest of the Faculty of Science. Professor Storrs Cole is the authority in America on Tertiary and Cretaceous larger foraminifera and we had informative discussions on the larger Tertiary foraminifera in the Indo-Pacific area, especially on those found in Japan, Saipan, Guam and other islands in the Pacific and their relationships with assemblages in North-West

Australia. I had the privilege of examining Professor Cole's magnificent collection of larger Tertiary and Cretaceous foraminifera from all parts of the world.

May 11th to 25th was spent in Washington. Dr. G.A. Cooper, Curator of Paleontology, United States National Museum, placed all the facilities of the Museum at my disposal. Much time was spent in comparing my specimens of Australian foraminifera with those in the Cushman Collection which is probably the greatest collection of foraminifera in the world. I received much useful advice from Miss Ruth Todd of the United States Geological Survey who is in charge of the Cushman Collection and from Dr. A.R. Loeblich, micropalaeontologist to the United States National Museum and his wife who is an authority on Lower Cretaceous foraminifera. Some time was also spent with Dr. Lloyd Henbest of the U.S. Geological Survey in his laboratory where he explained techniques he used in cutting sections of the larger foraminifera, and his method of cataloguing and registering specimens. Dr. Henbest is one of the authorities on the family of Palaeozoic foraminifera, the Fusulinidae.

At the request of the officers of the Survey, I examined samples from a bore at Okinawa and I had discussions with Dr. Preston Cloud on the Tertiary stratigraphy of Saipan, which were based partly on my talks with Dr. Storrs Cole at Cornell University and partly on my own investigations on the Indo-Pacific Tertiary foraminifera.

I visited Dr. K. Lohman in his laboratory at the Survey to see the ingenuous techniques he used for the study of Diatomites. Whilst in Washington, Dr. Cloud arranged a geological excursion to Chesapeake Bay, Maryland, so that I could collect Miocene foraminiferal material for comparison with Australian Miocene assemblages.

On May 25th I left Washington by air for Austin, Texas, where I was met by Professor Stenzel of the Bureau of Economic Geology, University of Texas and Mr. W. George of the Ground Water Branch of the U.S. Geological Survey. These two gentlemen were untiring in their efforts to make my visit to Texas a success. Austin is the centre of extensive deposits of Cretaceous and Palaeocene age and I was able to make collections of material from type sections for comparison with foraminiferal material of similar ages in North West Australia. My headquarters was at the Bureau of Economic Geology and my thanks are due to Professor Stenzel for the immense amount of time he gave me not only in discussions on problems vital to Australian Tertiary and Cretaceous stratigraphy but also in the field.

Whilst in Austin, I made two visits to San Antonio, an important oil centre in southern Texas. The first was to visit Dr. John Sandidge, micropalaeontologist to the Magnolia Oil Company, and the second was to address the Geological Society of San Antonio. At this meeting I met Miss Knicker, one of the first micropalaeontologists to use foraminifera in oil-field work in Texas, over twenty years ago. Miss Knicker is now one of the few micropalaeontologists in the United States who works as a consultant.

On June 7th I left Austin by car with officers of the Ground Water Branch for Houston where two strenuous days were spent visiting oilfield laboratories and visiting oil-fields themselves. I first visited the well-equipped micropalaeontological laboratory of the Gulf Oil Corporation, which is housed together with the core testing laboratory, in a delightful new air-conditioned building. Dr. Mark Hanna is in charge and he has three other micropalaeontologists with him and four laboratory assistants. The laboratory of Humble Oil and Refining Company which is in charge of F.W. Rolshausen was visited next. Although a considerable amount of foraminiferal work is done here, this huge company also has laboratories elsewhere in the States. The laboratory of Stanolind Oil and Gas Company is under the care of J.B. Garrett who has ten micropalaeontologists under him as well as a staff of laboratory assistants. Approximately 10,000 samples are sent in from the field each month and have to be dealt with.

On June 11 I took the train to Los Angeles via the Grand Canyon. I arrived in Los Angeles on June 13th where I was met by Dr. Mason Hill of Richfield Oil Corporation. I would like to express my thanks to Mr. Frank Morgan, Vice President of Richfield Oil Corporation

(and 1951 President of A.A.P.G.) and to Dr. Mason Hill for their kindness whilst in Los Angeles and especially to Dr. Hill who arranged my programme in and around Los Angeles. Time was spent in the laboratories of Richfield Oil Corporation at Long Beach where M.L. Natland and Tom Rothwell were in charge; of the Texas Company of California in Los Angeles where I talked with Dr. Boris Laiming, J.M. Hamill and Dr. Louis Simon and of the Union Oil Company on the Dominguez Oilfield where Mr. Crawford was in charge. All these micropalaeontologists spared no effort in explaining the setup of their laboratories and at each place I was able to examine extensive collections of foraminifera which are so vital in oil-field investigations.

Whilst in Los Angeles I had the pleasure of again meeting Dr. Hans Thalmann, a world-wide authority on foraminifera whom I had visited in Palembang, Sumatra in 1939. There were long discussions on the foraminifera at his home with M.C. Isrealsky of the California Institute of Technology, Pasadena and Dr. Goudkoff formerly of the Shell Company and now in private practice. I visited the palaeontological department of the University of Southern California to see Dr. Orville Bandy and the Hancock Museum to see Dr. Irene McCulloch, who is working in Recent foraminifera and who has two artists engaged in drawing species for her forthcoming publication.

I addressed the western division of the American Association of Petroleum Geologists and the Society of Economic Palaeontologists and Mineralogists whilst in Los Angeles.

A short visit was made to Scripps Institute of Oceanography at La Jolla, Southern California where I was the guest of Dr. Francis Shepard who is in charge of investigations relating to the ocean bottom. Dr. Fred Phleger and Miss Francis Parker, micropalaeontologists attached to the Institute, spent some time showing me Recent Foraminifera from the Atlantic and Pacific Oceans. Many of the forms occur as fossils in the Pliocene and Upper Miocene deposits in the Indo-Pacific area. We also discussed their forthcoming work on the off-shore foraminifera in the Gulf of Mexico which they were about to carry out for the Gulf Oil Corporation.

On June 20th I left Los Angeles by car with Dr. Mason Hill for Bakersfield, the rich oilfield centre about 100 miles north of Los Angeles. During my stay there I was the guest of the San Joaquin Geological Society. I visited the Richfield Oil Corporation Laboratory which is in charge of Stanley Carlson, the laboratory of the Superior Oil Company, where R.B. Hutcheson is the micropalaeontologist and the laboratory of Stanley Beck, one of the few consultant micropalaeontologists in the United States. Mr. Beck took me on a tour of the Kern Hill and Round Hill Oil fields.

I arrived in San Francisco on June 21st and there Mr. Henry Hawley of the Standard Oil Company of California arranged my itinerary.

I desire to convey my sincere thanks to Mr. Hawley for his kindness. He arranged for me to meet the Chief Geologist and other senior members of the Staff of the Standard Oil Company and of its subsiduary, Richmond Oil Company, to discuss some of the features of the Tertiary and Cretaceous geology of the North-West Basin, Western Australia, where his company is proposing to undertake a drilling programme in the search for oil. Mr. Hawley also arranged for Mrs. McFarlane, a palaeontologist attached to Richmond Oil Company, to act as a guide for me and put a car at our disposal during my stay in San Francisco. A visit was made to the Californian Academy of Science to meet Dr. Hertland who is in charge of the palaeontological section in that Institution. I attended a short session of a Symposium on Evolution at the University of California, Berkeley, at the invitation of Professor Durham, at which papers were read on subjects relating to certain fossils which are of importance in the Cretaceous stratigraphy of Western Australia. Mr. Zach Arnold showed me over the well-equipped micropalaeontological laboratory. A day was spent at Stanford University where I was entertained by Dr. Myra Keen and Professor Kuller of the Department of Paleontology. Dr. Keen explained the system of cataloguing type specimens, which are closely guarded by her. She also showed me the historic collection

of foraminifera determined by the late Frederick Chapman, the first Commonwealth Palaeontologist, in 1900 from an oil well in the Santa Clara County,. This was the first occasion when foraminifera were used in oilfield investigations in the United States.

I was able to talk with Dr. R.M. Kleinpell who was on sabbatical leave from the Department of Micropalaeontology, Stanford University. Dr. Kleinpell is an authority on the Miocene stratigraphy of California and we had a long discussion on Indo-Pacific Tertiary foraminiferal faunas. I also visited the laboratory of the Tide Water Associated Oil Company in San Francisco to see Dr. C.C. Church.

Mr. Max Steineke, a noted American field geologist who had spent several years in New Zealand in connection with the search for oil there, took me to Monterey and Carmel, important Miocene localities in California where I was able to collect samples of the rich foraminiferal bearing beds known as the Monterey Shale. During this trip I was able to see the shores of Monterey Bay which have been the centre of research regarding a possible origin of glauconite and one which I have quoted from time to time in my publications on Gippsland.

ACKNOWLEDGMENTS;

My visit to the United States was a wonderful experience and I desire to express my grateful thanks to Dr. Raggatt for proposing to the Secretary of the Ministry of National Development that permission be granted me to make the trip. I would also like to express my appreciation to the transportation officers at the Australian Embassy, Washington and at the Australian Consulates in New York and San Francisco for their untiring efforts in making my travelling arrangements run so smoothly.

My appreciation is also extended to the many geologists and palaeontologists I had the privilege to meet for their kindness and courtesy to me. Amongst those are Dr. Brooks Ellis and Miss Angelina Messina of the Department of Micropaleontology, American Museum of Natural History; Professor Howell of Princeton University; Professor Storrs Cole, Cornell University; Dr. Preston Cloud, Miss Ruth Todd, and Dr. Lloyd Henbest United States Geological Survey Washington; Dr. G.A. Cooper and Dr. A.R. Loeblich of the United States National Museum Washington, Professor H. Stenzel, Bureau of Economic Geology, and Mr. W. George Ground Water Survey, U.S. Geological Survey, Austin, Texas; Dr. Mason Hill, Richfield Oil Corporation, Los Angeles and Mr. H. Hawley, Standard Oil Company of California, San Francisco.

PRINCIPAL RESULTS OF VISIT:

The welcome given me by geologists and palaeontologists everywhere was almost embarassing and it was especially pleasing to learn, whilst there, that the results of my investigations relating to Australian Cretaceous and Tertiary stratigraphy which have been published in scientific journals here and overseas during the last fifteen years, have been well received by palaeontologists in the United States.

Many excellent techniques were observed in oil-field laboratories in Texas and California and some of them were part of the general setup in all oil-field work. However some were outstanding and could be successfully used in our laboratory in Canberra. Some of these observations are mentioned here.

1. The foraminifera and to a lesser degree, other microfossils such as the ostracoda, conodonts and fish scales, play a major part in all oilfield investigations. As a result of this large numbers of micropalaeontologists are being trained in universities and in the oil-laboratories themselves for this work. Even the laboratory assistants who prepare the samples for examination by the micropalaeontologist become highly efficient in their work and are continuously devising labour-saving methods.

2. Techniques used in the oil field laboratories are essentially the same in all, but there are differences in the method of preparation of material for micro-examination and in methods used in the examination of the microfossils.

A. Microfossils.

Nearly all drilling is controlled by the foraminifera when the oil sands are being approached. When a well is being drilled in a new area, the foraminifera are studied throughout the entire thickness of sediments until the oil sands are reached. Once control is established by the presence of certain zonal foraminifera or assemblages of species in beds approaching the oil sand in the first well, only these forms are looked for in further drilling in the area. To carry out this work successfully, micropalaeontologists must be thoroughly conversant with the foraminifera of different ages and different formations. The age of the beds is determined primarily by the foraminifera and the importance of these small forms in this work can be realised when it is stated that companies have a field equipment box containing a microscope, lamp, filterpaper, slides and brushes always ready in case the micropalaeontologist should be called urgently (either day or night) to the field of operations.

The methods of using the foraminifera in a known sequence of sediments in the oil-field laboratories differ in Texas and California. In the laboratories in Houston and San Antonio, Texas, the search for the "marker species" is all -important. But in the laboratories in California, in and around Los Angeles, at Bakersfield and San Francisco, the assemblage of species is important. However, during a visit to the laboratory of the consulting micropalaeontologist Stanly Beck, at Bakersfield, I was fortunate to see the "marker species" technique being put into practice. Samples were arriving at regular intervals from a well which was being drilled in the vicinity of Bakersfield and which was approaching a critical depth. Each sample on its arrival was immediately prepared for examination and as soon as it was ready Mr. Beck's two assistant micropalaeontologists searched for the marker species which in this case was Valvulineria californica. Meantime the telephone rang continuously: the drillers were awaiting news that the well had passed through the V.californica zone. It was extremely interesting to observe that drilling operations at this critical stage were controlled by the presence of certain species of foraminifera.

The differences in the methods used in Texas and California are possibly due to the difference in sedimentation in the areas being drilled in each State. In the Houston area, which borders on the northwestern part of the Gulf of Mexico, there is a uniformity of sedimentation over a tremendous area in width and a great thickness in depth and assemblages of foraminiferal species are fairly constant in the beds of certain ages. Therefore the search for one particular species saves much time. In California, in the vicinity of Los Angeles and around Bakersfield, facies changes are common in the sediments and each has its characteristic assemblage of species. It is necessary therefore to study each individual bore sample when the drill reaches the critical depths. This method, I think, keeps a careful check on the possible mixture of samples.

In the Richfield Oil Corporation Laboratory at Long Beach, California, beds in a certain area are zoned by the use of fish scales. The study is a specialized one but is being used successfully by Tom Rothwell.

Ostracoda are being used successfully as marker fossils in areas where drilling is in Palaeozoic rocks. Mrs. Betty Kellett Nadeau of Washington University, St. Louis, is training students to recognise age of the beds and various formations in those beds by the ostracoda and all her students were successfully placed with oil companies during the long mid-summer vacation. The study of Palaeozoic ostracoda is being furthered in the United States Geological Survey by Dr. Gregory Sohn.

B. Techniques. The apparatus used in the washing of samples in oilfield laboratories differs little in different companies. The general technique is similar to that used on a much smaller scale in the laboratory at Canberra but several valuable improvements were noted. Some of the companies in California, especially the Texas Company and the Union Oil Company used a "Roller Mill" for breaking down moderately friable samples. The Bureau fortunately has this machine which was suggested to us by Eric Craig, of Signal Oil and Gas Company, California, when visiting Australia in 1948 and which was ultimately acquired from California.

Most apparatus and especially containers into which samples are placed for washing and drying were made of stainless steel. All samples were washed through 200 mesh sieves and dried in electric ovens. The most compact electric oven was seen at the University of California.

Compact equipment was used at the United States Geological Survey at Washington by Dr. Lloyd Henbest for cutting sections of larger foraminifera and of certain hard limestones. Details of this machine were obtained. A smaller machine on rather similar lines was setup by Dr. Brooks Ellis at the American Museum of Natural History, New York. The methods of mounting rock slides and single specimens of foraminifera was studied at both of the above institutions.

The method of mounting and storing foraminifera was similar in all oilfield laboratories and institutions. All specimens are mounted on specially designed cardboard slides rather similar to those used by the Bureau but all these slides are covered by glass slides which are kept secure by aluminium slide holders. The hope of obtaining sheet aluminium in Australia for such use is not encouraging. By such covering, labelling of slides is perfectly preserved for all time. All slides are stored in either wooden or steel cabinets. The magnificent Cushman Collection at the United States National Museum, Washington, is housed in steel cabinets which are prepared in small units that can be easily added to. In time all slides will be placed in aluminium covers.

Up to date microscopes are used by all workers. These are manufactured chiefly by Bausch and Lomb or by Spencers. Many are equipped with detachable illuminators. Objectives are so arranged in these new microscopes that change in magnification does not necessitate change of focus.

The following points arise from these observations:

1. The importance of foraminifera in oil-field geology and in general stratigraphic work especially for zoning and determination of age of the beds.

2. The similarity of Cretaceous, Palaeocene and Eocene species of foraminifera in Australia with those of the United States and the dissimilarity of the Miocene and Pliocene species.

3. The importance of micropalaeontological work overseas and the large number of micropalaeontologists available for positions, show how necessary it is for more interest to be taken in the training of micropalaeontologists in Australia. This fact is well brought out by the fact that until recently I was the only professional micropalaeontologist in Australia and was responsible (with some untrained assistance) for all micropalaeontological investigation of rocks of all ages for the Commonwealth Government and State Mines Departments and private companies drilling for oil.

4. The laboratory assistants who prepare the samples for the micropalaeontologists are highly efficient in their work and are thoroughly interested in it, so much so that they are continually devising labour-saving gadgets. Similar assistance in the laboratory at the Bureau compares unfavourably with this. I would respectfully suggest that such assistants in future, be drawn from a group of geology students who have

failed to reach the necessary high standard required for those who are admitted as Grade I Geologists. The appointment of men or women of this standing would add to the efficiency of the work and relieve the micropalaeontologist of much unnecessary routine work.

5. The use of stainless steel equipment in oilfield laboratories and electric ovens for drying samples is universal in the United States.

6. The care of type specimens of fossils in palaeontological collections is of paramount importance and investigations at Universities such as Stanford University show that types must be properly housed. There they are kept under lock and key in a special cabinet and supervised by one responsible person in the palaeontological section. At Columbia University, New York, type specimens are kept in a fire-proof room. The increasing number of types in the Commonwealth Palaeontological Collection necessitates similar supervision.

Irene Crespin

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