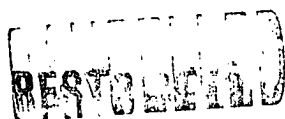


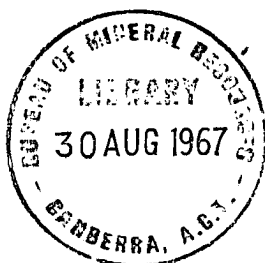
COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS



RECORD No. 1966/211



061269

MINERAL RESOURCES BRANCH,

PETROLEUM TECHNOLOGY SECTION

## REVIEW OF OPERATIONS

1<sup>ST</sup> NOVEMBER 1965TO 31<sup>ST</sup> OCTOBER 1966

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BUREAU OF MINERAL RESOURCES,  
GEOLOGY AND GEOPHYSICS

PETROLEUM TECHNOLOGY SECTION

MINERAL RESOURCES BRANCH

Record. 1966/211

Review of Operations 1st November, 1965

to 31st October, 1966

Contents

I	Staff	1
II	Petroleum Ordinances of the Territories	1
III	Petroleum Ordinances of the Commonwealth	1
IV	Petroleum Policy	2
V	Petroleum Engineering	3
	(A) Drilling	3
	(B) Laboratory	8
VI	Reports, Articles, Statistics, etc.	10
VII	Conferences, Meeting, Courses, etc.	11
VIII	Visitors, Interviews, etc.	12
IX	Visits to Field Operations	12

I      Staff:

Occupied Positions.

- 1 Chief Petroleum Technologist (Class 5)
- 1 Supervising Petroleum Technologist (Class 4)
- 2 Petroleum Technologists Class 3
- 2 Petroleum Technologists Class 2
- 1 Chemist Class 1
- 1 Drilling Superintendent
- 1 Boring Supervisor - This position became vacant on 25th February, 1966 with the resignation of Mr. E.G. Beever. It has now been filled by the appointment of Mr. J. Brennan who is expected to join the Section in December.
- 2 Drillers Grade 2 (Includes one in acting capacity)
- 4 Drillers Grade 1 (Includes one in acting capacity)
- 4 Drilling Assistants
- 1 Technical Assistant Grade 1
- 1 Clerk (Seconded to Section)

Unoccupied Positions. Nil

II      Petroleum Ordinances of the Territories:

During the year the Section dealt with various technical and scientific matters in connection with the administration of the petroleum ordinances of the Northern Territory and the Territory of Papua and New Guinea.

Chief Petroleum Technologist is a member of the Oil Advisory Committee appointed under these Ordinances. He has been acting as a Convenor/Secretary to the Committee since 19th October, 1962.

III      Petroleum Ordinances of the Commonwealth:

Draft of the Off-shore Petroleum Legislation:

During the year Chief Petroleum Technologist attended numerous meetings of State Under Secretaries for Mines, Directors of Mines, Ministers of Commonwealth and State Departments, Commonwealth and State Parliamentary Draftsmen etc. concerned with the drafting of the Bill to cover the Joint Commonwealth/State petroleum legislation dealing with off-shore exploration. These meetings are listed below :-

- |                           |  |
|---------------------------|--|
| 1st - 10th December 1965  | Brisbane. Safety Regulations.  |
| 18th January 1966         | Canberra. Fisheries aspects.   |
| 21st - 22nd February 1966 | Canberra. Representatives of Industry.   |
| 23rd - 25th February 1966 | Hobart. State Mining Engineers. Drafting Regulations.  |
| 2nd - 4th March 1966      | Canberra. State Ministers of Mines and Attorneys General.  |
| 16th - 18th March 1966    | Canberra. Meeting with Messrs. Livermore (Nat. Dev.) and Whiting (Dept. of Mines, Vic.) This constitutes the Drafting Committee. |

22nd - 24th March 1966	Melbourne. Meeting of Mines Ministers.
1st, 18th, 19th, 20th April, 1966	Canberra. Meetings with Mr. Livermore and Mr. R. Whiting.
7th - 9th June, 1966	Melbourne. Under Secretaries of Mines.
15th June, 1966	Canberra. Off-shore legislation Drafting Committee.
21st - 24th June, 1966	Melbourne. Ministers of Mines and State Attorneys General.
5th July, 1966	Canberra. Legislation Drafting Committee, with Mr. K. Cosgrove (Nat. Dev.)
6th - 7th July, 1966	Melbourne. As above.
20th - 22nd July, 1966	Melbourne. Meeting with Captains Pearson and Nicholson of Department of Shipping and Transport concerning marine regulations affecting off-shore operations.
21st - 23rd July, 1966	Melbourne. Legislation Drafting Committee.
24th - 26th July, 1966	Adelaide. Meeting of Commonwealth Parliamentary Draftsmen and State Legal Officers concerning off-shore legislation. Visited Mr. T. Barnes, Director of Mines, South Australia.
3rd - 4th August, 1966	Canberra. Legislation Drafting Committee.
16th August, 1966	Canberra. Meeting with Messrs. Harders and Morrison of Attorney General's Department and Messrs. Norris and Etheridge of Department of Shipping and Transport concerning off-shore legislation.
25th - 26th August, 1966	Sydney. With Mr. Livermore, State Parliamentary Draftsmen and Mr. Ewens, Chief Commonwealth Parliamentary Draftsman.
27th - 29th September, 1966	Melbourne. Legislation Drafting Committee.
5th - 7th October, 1966	Canberra. Meeting of Mines Officers (5th and 6th) and State and Commonwealth Parliamentary Draftsmen (7th).
21st - 24th October, 1966	Canberra. Discussion with Fisheries Division - Dept. of Primary Industries.

IV Petroleum Policy:

Various draft minutes were prepared on Ministerial and Parliamentary questions.

Discussions were held with Department of Customs and Excise concerning possible amendments to By-Laws pertaining to the importation of petroleum exploration and development equipment.

V Petroleum Engineering:(A) Drilling:(i) Seismic Shot-hole Drilling for Geophysical Branch  
1st November, 1965 to 20th November, 1965.

No. 1 Seismic Party completed operations at Gordon Creek, N.T. on 31st October, 1965 and returned to Canberra for the annual overhaul and refit.

No. 2 Seismic Party completed operations in the Gosford area, N.S.W. on 5th November and moved to the Putty area, N.S.W. where operations were completed on 20th November, 1965, and the party returned to Canberra for annual overhaul and refit.

Following are the hole data for the above operations :-

Gosford Area. 1st to 6th November, 1965.

Footage drilled	7088
No. of holes	110
Hours drilling	39
Rate of Penetration (avg.)	181 ft/hour
Number of bits used	17
Average per bit	417 ft.

Putty Area 8th to 20th November, 1965.

Footage drilled	10,718
No. of holes	161
Hours drilling	62
Rate of Penetration (avg.)	173 ft/hour
Number of bits used	15
Average per bit	714 ft.

In both the Gosford and Putty areas, drilling was in the Hawkesbury Sandstone which proved to be very abrasive and resulted in a very short bit life. In the Gosford area bit life was frequently only about  $2\frac{1}{2}$  hours. In the period from 1st to 20th November, the consumption of bits was equal to that normally expected in  $2\frac{1}{2}$  months work in other areas.

19th February 1966 to 31st October, 1966.

No. 2 B.M.R. Seismic Party, Two Mayhew 1000 rigs and one Carey rig operated in the Heywood and Hamilton areas of Victoria and in the Mt. Gambier area, S.A. from 19th February, 1966 to 19th March, 1966. On completion of this operation the party returned to Canberra.

Footage and holes drilled in the Heywood, Hamilton and Mt. Gambier areas were as follows :-

Footage drilled	21,705
No. of holes	289
Hours drilling	127½
Rate of penetration (avg.)	170 ft/hour
No. of bits used	24
Average per bit	904

No. 1 B.M.R. Seismic Party. Two Mayhew "1000" rigs and one Carey rig operated in Queensland (Richmond and Julia Creek areas) from 4th May to 31st October, 1966. The drilling rigs left Canberra on 19th April, 1966.

Operational times were as follows :-

Richmond Area	4th May 1966 to 25th July 1966
Julia Creek Area	26th July 1966 to 31st October 1966

Footage and holes drilled etc. to 26th October 1966, were as follows :-

Richmond Area: 4th May to 25th July 1966

Footage drilled	125,350
No. of holes	1,173
Hours Drilling	758
Rate of Penetration (avg.)	159 ft/hour
No. of bits used	26
Average per bit	7,590 ft.

Julia Creek Area: 26th July to 14th October 1966  
(last date for which reports are available)

Footage drilled	71,990
No. of holes	862
Hours drilling	722
Rate of Penetration (avg.)	99 ft/hour
No. of bits used	Still drilling
Average per bit	Still drilling

It is interesting to compare the average footage per bit of 7590 feet obtained in the Richmond area with the 417 feet per bit obtained in the Gosford area.

Also of interest is the amazing total of 25,795 feet of drilling obtained from one bit in the Richmond/Julia Creek area.

(ii) Shallow Structure Drilling and Coring for Geological Branch.

Owing to the reduction in seismic shot-hole drilling due to only one seismic field party operating, two B.M.R. rigs were able to undertake shallow structure drilling and coring in support of geological mapping by the Geological Branch.

Initially, one party was equipped with a Mayhew "1000" unit and one with a Carey unit. However, after the completion of prolonged vehicle repairs to a Mayhew "1000" rig, lasting until mid-July, it replaced the Carey.

The first geological drilling party left Canberra with a Carey unit in May and was still in the field at 31st October. This party has been operating in Queensland throughout the season.

The following are details of areas of operation, holes drilled, footage etc. :-

<u>Date</u>	<u>Area</u>	<u>No. of Holes</u>	<u>Footage Drilled</u>	<u>Footage Cored</u>
12th - 19th May	Cracow	5	186	36
21st May - 16th June	Blackwater	16	1,145	78
17th - 30th June	Alpha	1	77	15
1st - 14th July	Barcaldine	1	198	101
16th July - 1st Aug.	Tambo	6	749	203
5th Aug. - 27th Aug.	Windorah	7	796	438
Changed from Carey to Mayhew "1000" unit				
27th Aug. - 10th Sept.	Windorah	7	1,224	47
16th - 27th Sept.	Tambo	5	778	123
28th Sept. - 1st Oct.	Alpha	5	964	123
4th - 8th Oct.	Blackall	4	627	120
12th - 13th Oct.	Tambo	1	85	20
17th - 22nd Oct.	Mitchell	3	517	156
Total		61	7,346	1,460

The other geological drilling party left Canberra early in May, 1966 and started operations in the Lilla Creek area, southwest of Finke, Northern Territory. This party continued operations in the Northern Territory until 16th September when it moved from the Gordon Creek area to Hughenden, Queensland where it was still drilling at 31st October, 1966.

The areas of operations, footage drilled and cored etc. for the above party are listed below :-

<u>Date</u>	<u>Area</u>	<u>No. of Holes</u>	<u>Footage Drilled</u>	<u>Footage Cored</u>
18th - 24th May	Lilla Creek (Finke)	1	415	7
5th - 14th June	Sixteen Mile Bore (Alice Springs)	1	634	18
7th - 23rd July	Gosses Bluff	8	606	94
5th - 12th Aug.	Hidden Valley	3	665	32
15th - 20th Aug.	Gloria's Strip	1	86	12
21st - 30th Aug.	Brolga Water Hole	2	242	20
1st Sept.	Larrimah	1	140	10
7th - 16th sept.	Gordon Creek	1	404	26
29th Sept. - 26th Oct.	Hughenden	6	1,168	145 (still drilling)
Total		24	4,360	364

(iii) Drilling for Geological Engineering Services and B.M.R. Test Well

Four observation holes were drilled in the A.C.T. for the Geological Engineering Section. These holes were located one each at Honeysuckle Space Tracking Station, Corin Dam, Black Mountain catchment area and near the B.M.R. Building. A test hole was commenced in the yard at the Fyshwick Store for the testing of geophysical and geological down-hole equipment. This hole was not completed as the drilling unit was required for field operations.

The total footage drilled in these five operations was 585.

(iv) General Comments on Drilling and Associated Activities

B. Findlay, Driller Grade 2 supervised drilling undertaken for No. 2 Seismic Party and by the two units drilling for the Geological Branch.

K. Suehle returned to duty early in June following periods of hospitalisation and convalescence after his accident at Mt. Gambier in July 1965, and has been assisting in checking drilling equipment stores records, in placing orders and in establishing the Section's workshop at Fyshwick.

J. Keunen, Acting Driller Grade 2 supervised the shot-hole drilling operations for the No. 1 Seismic Party.

A considerable amount of investigation and design work and visits to Government Departments and equipment supply companies has been undertaken in connection with the replacement of vehicles and of the Carey rigs, and the purchase of new drilling equipment. This work is summarised below :-

- (a) Vehicles now being used are reaching the end of their economic life. The imported International R190's are becoming increasingly difficult to service due to lack of spares and their replacement by Australian-built or assembled vehicles is imperative. The Vehicles officer has been assisting in the selection of a suitable vehicle.
- (b) The Carey rigs are reaching the end of their service life and spares for these American-built rigs (the only ones of their kind in Australia) are becoming increasingly difficult to obtain. The availability of locally manufactured rigs or of readily available rigs of overseas manufacture, was investigated. Quotations were obtained and an order has been placed for a Mobile B40L unit; this unit is made under licence in Australia. Tender specifications have been prepared for pumps, compressors and other ancilliary equipment for these units. One of the new Mobile B40L units will be specifically for drilling and coring to be undertaken for the Geological Branch.



- (c) As mentioned above, this year shallow drilling and coring was undertaken on behalf of the Geological Branch, which involved extra administrative work, the formation of field parties and the purchasing of coring equipment. The available coring equipment was found to be inadequate for our requirements. A suitable corebarrel was specially designed in conjunction with Triefus Industries and the results obtained, averaging 85% recovery, have been encouraging. The drilling staff also required training in this type of operation.

The amount of work that could be done by the parties was limited by the necessity to work a five-day week and only a limited amount of overtime. Even so, the figures of footage achieved were average and those of core recovery excellent. The amount of actual drilling time that could be done in this period would not compare favourably with that of a contractor who can work 12 hours or more a day, 7 days a week. Problems of logistics were also greater than those of a contractor; for instance, the obtaining of supplies is more involved. The use of the Carey rig also slowed progress and as soon as a Mayhew rig was available it was sent as a replacement. The drilling programmed for Queensland was completed, but that for the Northern Territory had to be reduced due to a delayed start through vehicle repairs and the difficulty of obtaining casing. The use of our own drills for stratigraphic drilling has given flexibility to the programme and valuable experience has been gained in the constitution of the parties, and in the training of the drilling staff. It is felt that with increased supervisory staff and increased overtime, better footage can be obtained in the future. Delays due to lack of supplies of equipment have also been overcome as stocks of the necessary spares are now being carried. Delays were also experienced due to the Stores having moved from Melbourne. Now they are established in Canberra, a complete revision of the Petroleum Technology Stores is being undertaken.

(v) Summary of Drilling Activity

The following tabulation summarises the drilling activity undertaken by the Petroleum Technology Section during the period under review :-

(1st November, 1965 to 31st October, 1966)

<u>Operation</u>	<u>No. of Holes</u>	<u>Footage Drilled</u>	<u>Footage Cored</u>
Seismic Shot-holes	2,595	236,851	nil
Shallow Structure Holes	85	11,906 ?	1,824
Geological Engineering etc.	5	585	13
Totals	2,685	249,341	1,837

Total footage drilled and cored	<u>251,178</u>
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(vi) U.S.A.F. Project F/5112 and F/5113 - Alice Springs

The Section is taking part in the preparation of tender schedules and associated documents for the calling of tenders for the following phases of the above project.

- (i) Tender schedules for Engineering and Geological Services.
- ((ii) Tender schedules for Electrical and other Bore-Hole Surveys.
- (iii) Tenders for the drilling of one 10,000 ft. hole and 13 shallow holes.

This project is being undertaken by the Department of Supply on behalf of the United States Air Force. Officers of this Section have attended preliminary meetings in August, prepared the tender schedules and will be assisting with the examination of tenders when these are received. Tenders closed at 2.00 p.m. on 10th November, 1966.

(B) Laboratory. (1st Nov. 1965 to 31st Oct. 1966)(i) Core Analysis

Conventional core analysis work continued throughout the past twelve months. The analyses consisted of the determination of fluid saturation, formation water salinity, acid solubility, permeability, porosity and density.

Wettability, capillary pressure and pore size distribution were determined on cores selected from reservoir sands.

During the period under review, 1759 individual core pieces were examined, an increase of 227 on the number examined during the preceding twelve months.

A liquid permeameter was used to test the rate of flow of water through 111 samples from the Great Artesian Basin. This work was carried out for the Geological Branch.

Plugs of cores from 340 wells are now stored in easily accessible drawers in the Petroleum Technology Laboratory together with the results of tests.

(ii) Solubility Determination

Acid solubilities for limestone evaluation were determined on 320 samples; this work was also for the Geological Branch.

(iii) Formation Water Evaluation

New work introduced to aid electric log interpretation consisted of the rapid evaluation of formation waters with respect to pH, salinity and resistivity, the latter being determined on the Fann resistivity meter; 63 water samples were tested during the year.

(iv) Bentonite Investigations

Testing and evaluation of untreated and treated bentonites for possible use in drilling muds and iron ore pelletising was carried out as and when required. Subsequent to the discovery and testing of the Black Alley Shale, bentonite clays from north of Roma, Queensland and bentonites drilled by Uranium Consolidated in conjunction with Tennant Minerals, were tested. Uranium Consolidated announced recently that 16 million tons of commercial bentonite had been proved in the Black Alley Shale near Springsure, Queensland.

A report on bentonite from the Black Alley Shale may be found in Record No. 1965/171 "Bentonite in the Upper Permian Black Alley Shale, Bowen Basin, Queensland" by J.E. Thompson and P.G. Duff.

The C.S.I.R.O. report on Yarraman, Queensland bentonite was received and indicated that this bentonite was of an inferior quality.

Further samples of the Mozambique and Japanese bentonites sold in Australia were tested for their suitability for drilling muds.

The number of bentonite slurries mixed and tested during the year amounted to 235.

(v) Gas Analysis

Altogether 13 natural gas samples were analysed. Using new techniques and modified equipment it was possible for the first time, to determine the argon content of most of these gases. No significant quantities of helium have been discovered to date.

(vi) Water Analysis

Partial analysis of eight formation water samples was made.

(vii) Oil Analysis

Semi-detailed chemical and physico-chemical analysis of two crude oil samples from Esso Marlin A-1 was made. Detailed study and analysis of experimental results together with additional testing and study of physical/physico-chemical properties of formations (permeabilities), were submitted in a report.

Semi-detailed chemical analysis, physical testing and study was made on two multiphase, complex seepage samples.

(viii) Miscellaneous

(a) Assembling, testing, calibration and maintenance were carried out on apparatus and reagents used for :-

Gas and liquid chromatography, spectrophotometry, fractional distillation, electro-chemistry, physical and physico-chemical testing, analytical chemistry. (Variability in the supply of compressed air and thermal instability of air conditioning system have caused a considerable loss of time.)

(b) Design and/or selection and adjustment and/or modification of the following apparatus was made:-

- (1) temperature - programmed gas chromatography unit;
- (2) an attachment unit for spectrophotometric reflectance/absorption;
- (3) drawings were prepared for local manufacture of glassware replacement parts for fractional distillation apparatus;
- (4) specifications were prepared for a low-temperature cooling and recirculating plant.

(c) General remarks

The range of analytical tests and results therefrom was increased for all samples and it is intended to extend these ranges further as additional instruments become available.

University student L. Tan was employed in the laboratory from 6th January, 1966 to 25th February, 1966.

VI (A) Reports, Articles, Statistics, etc.

The Section collects, prepares and collates for publication and distribution, the following :-

- (i) Petroleum Exploration and Development Titles Map and Key - twice yearly.
- (ii) The Petroleum Newsletter - quarterly.
- (iii) Rig Activity - fortnightly.
- (iv) Wells and Footage Drilled - monthly and quarterly.
- (v) Breakdown of Exploration Activity and Expenditure - annually.
- (vi) List of Petroleum Exploration Companies (addresses) - twice yearly.
- (vii) List of Petroleum Exploration Contractors, Service Companies and Consultants in Australia - as required, usually two or three times per year.
- (viii) Articles on petroleum exploration in Australia for various publications in Australia and overseas such as "Australian Mineral Industry Review", Australia in Facts and Figures, Department of Trade pamphlet, Encyclopaedia Britannica Year Book, etc. Officers of the Section either jointly or individually prepare papers for presentation at various conferences and symposia e.g. E.C.A.F.E., World Petroleum Congress etc. etc.

- (ix) Special projects. Officers of the Section are undertaking two special projects to improve the petroleum exploration data within the Bureau; these are :-
- (a) preparation of a list and map showing all wells drilled for petroleum (exploratory and development) in Australia and Papua and New Guinea over the last 73 years, to the end of 1965. This work has reached the stage where provisional lists are being checked by State Departments of Mines. The list will show the operator, name of the well, area, 1:250,000 sheet, geographic co-ordinates, elevations, dates spudded and reach final depth, status, final depth and a map reference number. The map will indicate the location with the relevant reference number alongside. This project is being undertaken in conjunction with the Sedimentary Basin Study Group. Annual supplements will be issued to cover future years.
  - (b) the preparation of a Record to present in a single publication, for the first time, comprehensive details of expenditure on petroleum exploration and development in Australia and Papua and New Guinea by Governments and private enterprise to the end of 1965.

## VII Conferences, Meetings Courses, etc.

In addition to the various conferences listed under Petroleum Ordinances of the Commonwealth the following conferences, meetings and courses were attended by officers of the Section:-

### Chief Petroleum Technologist - H. S. Taylor-Rogers

8th to 24th November, 1965 attended the 3rd E.C.A.F.E. Symposium on Petroleum in Tokyo.

From 22nd December to 10th January 1966, he was Acting/Assistant Director (Operations).

22nd August, attended a meeting at Department of Customs and Excise on possible amendments to By-Laws concerning the importation of petroleum equipment.

21st and 22nd September, 1966 attended meetings at the Department of Territories with the Directors of Oil Search Ltd. concerning the future programme of Oil Search Ltd.

### Supervising Petroleum Technologist - M. C. Konecki

8th to 24th November, 1965 and from 22nd December to 10th January, 1966 acted as Chief Petroleum Technologist during the absence of Mr. Taylor-Rogers at the E.C.A.F.E. symposium, Tokyo and while he was Acting/Assistant Director (Operations).

2nd March 1966 was Bureau representative at an inter-Departmental meeting concerning the extension of By-Laws concerning petroleum exploration equipment.

Drilling Superintendent - A. T. Churchill

7th and 8th December, 1965 visited Department of Supply, Stores and Transport and Fox Engineering Ltd. in Sydney for discussions concerning replacement vehicles and Carey rig replacements.

17th March, 1966 visited Triefus Ltd., Sydney with regard to the purchase of new core barrels, also Gardner Denver Ltd., Sydney concerning compressors and mud pumps.

In connection with the purchase of new equipment and with new vehicles for the drilling rigs he visited the Department of Supply and various suppliers on the following dates: Melbourne, 16th June, Sydney 12th July and 3rd August, Melbourne 15th August.

Petroleum Technologist Class 3 - J. M. Henry

29th November 1965, together with representatives from the Departments of Treasury and Customs and Excise visited the American Embassy for discussions with Mr. J. Lawrence, President of Dresser Industries, U.S.A.

4th to 5th August, 1966 visited Department of Supply, Melbourne for discussions with representatives from the United States Air Force concerning U.S.A.F. Project F/5112 - the drilling of a 10,000 ft. hole at C.R.S., Alice Springs.

4th September, 1966 visited Melbourne for final discussions concerning the tender schedules for U.S.A.F. Project F/5112.

Petroleum Technologist Class 3 - P. Duff

18th and 19th July 1966, visited Tennant Minerals Ltd., and the University of Queensland, Brisbane for discussions connected with methods and techniques used in testing of bentonites.

Petroleum Technologist Class 2 - B. McKay

7th to 14th February 1966 visited Woodside (Lakes Entrance) Oil Co. and Esso Exploration Inc. operations in the Gippsland area, Victoria.

Boring Supervisor - E. G. Beaver

Mr. E. G. Beaver resigned on the 25th February, 1966.

VIII Visitors, Interviews, etc.

From the 1st November 1965, to 31st October, 1966 some 150 to 155 visitors representing local and overseas companies interested in or participating in petroleum exploration were interviewed by officers of the Section. It is estimated that some 165 to 180 professional man-hours were involved in these visits and discussions.

IX Visits to Field Operations

Officers of the Section made the following visits to field operations:

M. C. Konecki, Supervising Petroleum Technologist

24th July to 1st August, 1966 visited Moomba S.A., gas field at the invitation of the South Australian Mines Department and together with an officer of that Department witnessed and participated in production testing of Moomba No. 1 and No. 2 wells.

A. T. Churchill, Drilling Superintendent

30th May to 9th June 1966, visited No. B.M.R. Seismic Party and drilling operations for the Geological Branch in the Rockhampton, Emerald and Richmond areas, Queensland.

26th September, he left Canberra to visit drilling operations in the Blackall and Tambo areas, Queensland.

11th to 16th October, Hughenden area Queensland to visit structure drilling and coring operations and to supervise fishing operations to recover a stuck core barrel.

J. M. Henry, Petroleum Technologist Class 3

28th June to 3rd July 1966 visited B.M.R. structure drilling and coring operations in the Gosses Bluff area, Northern Territory.