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REPORT 1944/13

THE ARCADIA BORE, QUEENSLAND.

by

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No. 1 Bore, Arcadia is situated in the parish of Arcadia, county of Westgrove, 85 miles north of Roma and 40 miles north-north-east of Injune, the nearest rail town. It is about 25 miles north of the Hutton Creek bore. Drilling operations extended from 1936 to 1939 and were carried out by Drillers Limited, a subsidiary of Oil Search Limited, with financial assistance from the Commonwealth Government. The bore was drilled in a large dome structure developed in Triassic and Permian sediments. A closure of more than 700 feet was proved. The geological mapping was done under the supervision of Dr. Frank Reeves for Oil Search Limited.

The well was drilled with cable tools to a depth of 4,110 feet and was shut down at that depth for over twelve months, the depth capacity of the plant having been reached. Following the completion of the Hutton Creek bore, the Commonwealth Government plant, which had been used at that site, was transported to Arcadia in 1939. Drilling was concluded in September of that year at the depth of 6,036 feet.

The well was cased with $11\frac{3}{4}$ inch casing to 141 feet, $8\frac{5}{8}$ inch casing to 1,061 feet, and $6\frac{3}{8}$ inch casing to 2,549 feet. On completion of testing, the well was plugged, filled with heavy mud and fitted with a control valve. Unfortunately, the maximum casing head pressure was never determined but records show that it was in excess of 250 lb. per square inch. The drilling indicated that the country was well suited for cable tool plants and that no water troubles were likely to be encountered.

Only small films of oil were met with during drilling, but considerable flows of gas were encountered between the depths of 2,487 feet and 4,110 feet, with small quantities down to 5,940 feet. At 640 feet films of oil were noted and gas was met at 750 feet and 1,187 feet. At the latter depth the gas had the following analysis: Methane - 78.3%; Ethane and higher homologues - 7.0%; Carbon dioxide - 4.9%; Inert gas 9.8%. It was estimated that the flow of gas at 1,187 feet was about 250,000 cubic feet per day.

Between the depths of 2,487 feet and 2,900 feet other horizons were encountered yielding gas of a type different from that obtained at higher levels. The composition of this gas was as follows:- Methane - 22.50%; Ethane and higher homologues - 3.0%; Carbon dioxide - 70.7%; Inert gas - 3.8%. The measured rate of the flow of gas at 2,900 feet over a considerable period of time was 3,000,000 cubic feet per day. Further flows were met with below 2,900 feet, but these were of no economic importance.

The Arcadia bore is the second deep bore in Queensland (the first being Hutton Creek bore) from which a comprehensive series of samples has been examined for their micro-faunal content. This examination was carried out on 1,256 samples consisting of drill cuttings taken over every five feet and of cores taken at numerous depths below 4,112 feet.

Dr. Reeves indicates that the bore started in an horizon in the upper Bowen Series 2,000 feet below the base of the Carnarvon Sandstone (basal Triassic).

The first sample sent in for examination was from the depth of 170 feet. From this depth down to 1,785 feet, the drill cuttings consist of fragments of light to dark grey shale, calcareous sandstone and carbonaceous shale, indicating freshwater conditions. These beds are referred to the lower portion of the

Upper Bowen Series. In this part of the Arcadia structure, therefore, the Upper Bowen has a thickness of about 3,700 feet.

From 1,785 feet down to 5,994 feet, the sediments are referred to the Middle Bowen Series and are comparable with the Hutton Creek bore section. As in that bore three facies are present:-

- (1) A marine one consisting of grey shales containing foraminifera and ostracoda, from 1,785 feet down to 2,390 feet.
- (2) A freshwater one from 2,390 feet down to 4,374 feet, consisting of grey sandstone, grey to dark grey carbonaceous shales with thin bands of coal and plant remains indeterminate.
- (3) A mixed assemblage of marine and freshwater fossils in carbonaceous shale, sandstones, conglomerates, from 4,374 feet down to 5,955 feet with a basal conglomerate from 5,955 feet down to 5,994 feet.

(1) The grey shales which were present in the drill cuttings from 1,785 feet down to 2,390 feet contain an assemblage of marine fossils including foraminifera, spines of brachiopoda and ostracoda. The foraminifera are represented by arenaceous forms such as Ammodiscus multinctus Cressin and Parr, Hyperamminoides acicula Parr, Ammodiscus woolnoughi Cressin and Parr, Haplophragmoides sp. and Trochammina sp. and the ostracoda by one specimen possibly referable to the genus Basslerella. This assemblage of foraminifera is found in the Middle and Lower Bowen Series in the Springsure area, Queensland, and in the Upper and Lower Marine Series in the Hunter River district, New South Wales. Little micro-faunal investigation has been done on the Permian rocks of Queensland and as a result an exact correlation of the sub-surface marine beds with surface exposures is not at present possible. This marine horizon is possibly equivalent to the marine beds which overlie the coal measures at Collinsville. (Reid 1929, 1930).

(2) Sediments of freshwater origin were recognised from 2,390 feet down to 4,374 feet. From 2,390 feet down to 2,585 feet the drill cuttings consist of fine grey sandstone. From 2,585 feet down to 4,374 feet (the first core sample was taken at 4,112 feet) the bore passed through grey to dark grey carbonaceous shales containing plant remains indeterminate and some thin bands of coal. Coal was recorded at 4,110, 4,237, and 4,255 feet.

(3) At 4,374 feet the bore passed into a series of sediments consisting of dark grey to black carbonaceous shales, carbonaceous sandstones, grits, breccias and conglomerates. The greenish grey conglomerates from 5,955 feet down to 5,994 feet are regarded as representing the base of the Middle Bowen Series in the bore section.

Slickensiding and fracturing are noticeable in some of the cores below 4,618 feet, and the company's field geologist, Mr. Peter Dunlop, records various angles of dip ranging from 16 degrees to 51 degrees in the beds between the depths of 4,618 feet and 5,463 feet.

Fragments of Glossopteris were noted by the Writer in cores taken at various depths between 4,251 feet and 5,743 feet. Glossopteris Browniana was recognised at 5,544 and 5,551 feet, cf. Vertebraria at 5,455 feet and cf. Neoggerathiopsis at 5,446 feet. Neoggerathiopsis Hislopi (determined by Dr. Walkom) occurred at 5,553 and 5,746 feet.

Numerous thin sections of cores were examined in this part of the bore. From 4,374 feet down to 5,853 feet radiolaria and some siliceous sponge spicules were present in rocks similar in lithology to those in which they were found in the Hutton Creek bore. Similar genera of radiolaria such as Carposphaera, Cenosphaera and Haliomma were noted, but the tests were

not so well preserved as in the Hutton Creek material.

Green andesites which have suffered intense carbonation (determination by Dr. Germaine Joplin) occur from 5,994 feet down to the bottom of the bore at 6,036 feet, which are probably referable to the Lower Bowen Series. Andesites form the base of the section in the Bowen River coalfield (Reid, 1929).

The following is a tentative interpretation of the sequence proved in the Arcadia Bore, based on the above observations:-

Upper Bowen Series - 170 to 1,785 feet.

Marine zone - 1,785 to 2,390 feet.

Middle Bowen Series - Freshwater zone - 2,390 to 4,374 feet.

Mixed marine and freshwater zone - 4,374 to 5,994 feet.

Lower Bowen Series - 5,994 to 6,036 feet.

The diagrammatic geological section accompanying this paper is based on the company's records and the writer's observations.
