DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 68

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Petrological

dy of Belford (A.O.G.) No. 1 Well, Sydney Basin,

New South Wales

by

S. Ozimic

The information contained in this report has been obtained by the Department of National Development as part of the policy of the Commonwealth Government to assist in the exploration and development of mineral resources. It may not be published in any form or use in a company prospectus or statement without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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PETROLOGICAL STUDY OF BELFORD (A.O.G.) NO. I WELL, SYDNEY
BASIN, NEW SOUTH WALES.

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B.M.R. Records 1968/68

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This petrological study of Belford (A.O.G.) No. 1 was undertaken as part of a review of the Sydney Basin, currently being carried out by the Basin Study Group of the Petroleum Exploration Branch. The principal objective was to establish and define clearly recognizable rock units and to reassess the petroleum possibilities of this part of the basin.

Seven rock units were recognized in Belford (A.O.G.) No. 1 and are set out in summary form in Fig. 1. The section consisted of marine Permian down to 3725 feet, except for an interval of 370 feet represented by coal measures. Altered volcanics tentatively regarded as Permian occur at 3725 feet; the well bottomed in these volcanics at 3854 feet.

Despite numerous gas shows, the hydrogen potential of this sequence is low, due to the high matrix content and extensive cementation of the sands.

BELFORD (A.O.G.) No.1 WELL

Summary of Petrological Results.

		OROSIT		PROVENANCE
BS - B7 B2-8 B,	B ₁ 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1290'- 1426'- 1505'- 1060'- 2250'-	MARINE AGITATED TO QUIET WATER. TRANSITIONAL DELTAIC WITH COAL DEPOSITION. MARINE AGITATED WATER. MARINE QUIET WATER (?)LAVA FLOWS.TUFF	SEDIMENTARY; MINOR GRANITIC AND VOLCANIC. CRANITIC; INCREASING VOLC TOWARDS BASE. GRANITIC AND VOLCANIC; MINOR SEDIMENTARY. GRANITIC AND VOLCANIC; MINOR SEDIMENTARY.
	SCALE 1 inch : 1000 feet.	3854+	To accompany B.M.R. F	2000d 1069/68

WELL DATA

Well Name No.:

Belford (A.O.G.) No. 1.

Operating Co.:

Australian Oil and Gas Corporation Limited.

Location:

Latitude 32°39'23" South

Longitude 151°17'05" East

Sydney Basin, New South Wales. 1:250,000 sheet,

SI 56/1.

Elevation:

Ground Level 244' A.S.L.

Collar Level 248' A.S.L.

Total Depth:

3854' (driller)

Wire Line Logs:

Induction Electric 300' - 1544' Run 1

' 1630**'** - 2380**'** " 2

" 2294' - 3795' " 3

Sonic - Gamma Ray 300' - 1537' Run 1

" 2294' - 3787' " 2

" 1630' - 2400' "

Gamma Ray 1100' - 1536' Run 1

0' - 3765' " 2

' 300' - 496' " 3

Caliper 2294' - 3792' Run 2

1630' - 2400' " 3

Formation Testing:

Attempts were made to test an inflammable gas

show at 826'. Shut-offs could not be obtained,

and the testing was abandoned.

Hydrocarbon Shows:

700', 826', 846', 884', 1295', 1444', 1575',

1697', 1790', 2078', 3180', 3410', 3775'.

Major Reference used in present study.

A.O.G. (1965) - Australian Oil and Gas Corporation

Limited, Belford No. 1 Bore, Sydney

Basin, N.S.W. Well Completion Report,

Summary of Major reference

The drilling operation was carried out from October 21st

1964 to June 24th 1965, as a test of the Belford Dome. The well passed
through rocks of the Permian Maitland Group (Upper Marine Series), Greta

Coal Measures (Lower Coal Measures) and Dalwood Group (Lower Marine Series).

The well was abandoned at 3854' in non-prospective rocks.

Material available for study.

Cuttings:

0' - 3854' (T.D.) at 10' intervals.

Cores:

14 cores, but recoveries were consistently poor;

material available ranged from 4" up to 12"

per core.

Wire Line Logs:

see WELL DATA (Page 2)

Methods used.

All cuttings samples were washed and examined with a low power binocular microscope; thin sections were made from selected intervals and examined under a petrological microscope. The results were plotted on the Petrographic Well Log at a scale of 1":100'. This was subsequently reduced to 1":200' (See Plates 1A & 1B). The interval 1230' - 1730' covering the Coal Measures was plotted in detail at 1":20' and subsequently reduced to 1":50' (see Plate 2).

The cores were examined with the binocular microscope, and thin sections were made from each major lithology. The results were plotted on the Petrographic Core Log (see Plates 3A - C).

Seven units were distinguished on the basis of lithology and wire line log characteristics. These units were numbered from the surface downwards - being prefixed by the letter 'B', to identify the divisions of Belford No. 1. These units have been grouped into three major units on lithogenetic grounds and are shown in summary form in Fig. 1.

The sedimentary rock classification of Pettijohn (1957) was used for specific rock names. However, a modification was introduced to include those quartz rich rocks (<75% quartz) in which detrital matrix is prominent (>15%). "Quartz greywacke" is the term used for rocks in this category. On the logs, the term "volcanic lithic, feldspathic greywacke" is used for greywackes where the proportions of feldspar and volcanic lithics are about equal.

GEOLOGY

UNIT B1

Characteristics: This unit extends from surface to 1290', and consists of a monotonous sequence of pale grey to brown quartz greywacke and lithic greywackes. Core 1 (1064' - 1071') shows laminations. Evenly scattered quartz and chert pebbles occur throughout the interval.

The constituents consist of quartz (20-50%), Chert (5-25%), feldspar (2-10%), volcanic lithics (rock fragments)(1-3%) and some rare sedimentary lithics (1-2%). There is a clayey matrix (15-30%) and sideritic and siliceous cement (3-15%).

No secondary overgrowths have developed on quartz grains - possibly due to the presence of clay coating. Both fresh and altered feldspars are present; the sodic plagioclase is partly or entirely

replaced by calcite. Volcanic rock fragments of basic to intermediate composition occur but are in part replaced by calcite, and rarely by chlorite.

Rare (?) sedimentary lithics have been entirely replaced by chlorite.

Siderite occurs as clasts and as cement, and is uniformly distributed through the unit. Accessory minerals are micas and very finely disseminated pyrite. Traces of lignitic material occur in patches, but a significant amount is found at 1030' - where a lignite bed can be postulated on the basis of sonic and gamma ray logs.

Void filling is predominantly of (?) diagenetic chlorite, undifferentiated clays and silt. Small amounts of siderite and silica cement occur.

Fragments of Bryozoa are found at 290' - 310' and are apparently restricted to this interval.

The low porosity in Unit B1 is attributed to the presence of chlorite and to a much lesser extent to the siderite and silica cement. Numerous gas shows have been recorded from Unit B1 - at 700', 826', 846' and 884'; the two analyses carried out by the N.S.W. Mines Department show that the gas was predominantly nitrogen together with methane and oxygen. The flows were not sustained, and the gas may have been trapped in local porous zones.

No petrophysical analyses have been made, due to insufficient core; very little porosity was seen in thin sections.

The uniform character of the wire line logs reflects the monotonous lithology of Unit B1. However, the gamma ray log shows a marked fall in values from 90' - 300', from which it could be inferred that this interval is more sandy than the remainder of Unit B1; but in thin sections, no lithological difference could be detected. The 16" resistivity log shows a small but steady decrease in values downwards throughout Unit B1. The sonic log is essentially regular, except for a deflection at 1030' due to a band of lignite.

Boundary criteria: The lower boundary of this unit is marked by the change from a very uniform quartz and lithic greywacke sequence to volcanic lithic, feldspathic greywacke rich in chert pebbles, carbonaceous siltstone and coal seams. The change to these varied lithologies is very apparent on the wire line logs (see Plate 2).

Environment and provenance: It is suggested that Unit B1 was deposited in agitated to quiet marine environment where some current action operated. Some laminations and (?) burrow markings are found in cores 1, 2, and 3. The composition of the sediments suggests a predominantly sedimentary provenance, with minor granitic and volcanic sources.

UNITS B2 - B4

This sequence is 370' thick and extends from 1290' to 1660' (see Plate 1A and Plate 2). It consists of interbedded volcanic lithic, feldspathic greywacke with abundant chert pebbles, carbonaceous siltstone and coal seams.

Unit B2.

Characteristics: This unit is 136' thick, extending from 1290' - 1426'. It consists of interbedded sandy carbonaceous siltstone, volcanic lithic feldspathic greywacke, abundant chert pebbles, and thin lignitic to bituminous coal seams.

The greywacke consists of grains of quartz, chert, potash feldspars, sodic plagioclase and intermediate to basic volcanic lithics.

Miscovite and biotite occur as accessory minerals; calcite occurs as a replacement of the volcanic lithics.

Very finely disseminated pyrite is scattered throughout the unit. The void filling consists of chlorite, undifferentiated clay, and in places silt, together with minor amounts of silica, siderite and in places pyrite. The pebbles consist of aggregates of volcanic lithics and loose crystals embedded in a cherty cement, and showing differing degrees of alteration.

The following constituents are found in the pebbles:

- fine grained volcanic lithics of intermediate to basic composition.
- fresh unaltered, unzoned plagioclase and potash feldspars.
- plagioclase replaced by calcite.
- fresh books of strongly pleochroic biotite.
- partly chloritized (?) zoned plagioclase.
- rare corroded quartz.

The carbonaceous sandy siltstone consists of carbonaceous matter, micaceous flakes and rare shale lithics; siderite is common as patches and stringers and some very finely disseminated pyrite is also present. Laminae composed of very fine sand-sized quartz and feldspar occur regularly. The rocks are bonded by chloritic-sericitic clay, and to a lesser extent, siderite. The two coal horizons are dark brown to black and are associated with silt and very fine sand. A minor gas show was recorded at 1295'.

Boundary criteria: The lower boundary of this unit is placed at the top of the youngest semi-anthracitic coal, in Unit B3 - in contrast to the lower rank coals of the overlying Unit B2. This change is shown in the lower gamma ray counts and in the low counts on the conductivity log opposite the coal seams of B3. This combination of readings is indicative of non-porous coals free from impurities. These wire line changes are seen on Plate 2.

Environment and provenance: Unit B2 consists of a mixed lithology: pebbly greywacke, greywacke, siltstone and coal seams. The combination of these lithologies could occur in delta swamps where subsidence was not keeping pace with sedimentation. There are clear indications of a granitic provenance for the sandy siltstone but the source of the composite chert pebbles is not known.

Unit B3.

Characteristics: This unit is 79' thick, extending from 1426' - 1505'.

The lithology is similar to that of unit B2, but is marked by a strong deflection of the gamma ray log, combined with low counts on the conductivity log, opposite the two major coal seams. These characteristics are diagnostic of non-porous, clean coal seams, and are likely to be valuable in correlation. A minor gas show of nitrogen and oxygen with some methane has been recorded at 1444'.

Boundary criteria: The lower boundary of this unit is characterized by the change from pebbly greywacke to a strongly carbonaceous silty sandstone, siltstones and impure coal seams in B4.

Environment and provenance: Unit B3 is similar to that of unit B2. The environment and provenance are essentially the same as for unit B2, but the coals of unit B3 are much purer than those occurring either above or below.

Unit B4.

Characteristics: Unit B4 is 155' thick, extending from 1505' - 1660'. It consists of volcanic lithic, feldspathic greywacke, carbonaceous sandy siltstone, thin seams of coal and scattered chert and quartz pebbles.

These lithologies are essentially the same as in the overlying Units B2 and B3. The coals are again impure as in unit B2. There seems to be a random distribution of both lithologies and grain sizes throughout the sequence. A small gas show of nitrogen, oxygen and some methane has been recorded at 1575.

Boundary criteria: The lower boundary of this unit is marked by a sharp decrease in grain size and outgoing of well sorted greywackes. Also below this point, "siderite rock" with plant fossils occurs, in contrast to the disseminated grains of siderite above. The uppermost foraminifera recognized from the Dalwood Group were recorded at 1681' (A.O.G. 1965). Wire line logs show a very uniform pattern, rather similar to the pattern in the unit B1.

Environment and provenance: The deposition of this unit would be transitional from marine conditions of the Dalwood Group into the terrestrial Greta Coal Measures. Components of the sediments in the unit suggest granitic, volcanic and sedimentary rock source.

UNITS B5 - B7.

This sequence is 2194' thick and extends from 1660' to 3854' (T.D.).

It consists of volcanic lithic greywacke, interbedded carbonaceous siltstone, some lenses of sandy to pure siderite, minor coals and some highly altered volcanics.

Unit B5.

Characteristics: This unit is 590' thick, extending from 1660' - 2250'. It consists of volcanic lithic feldspathic greywacke, sideritic siltstone, sandy and pure siderite rock. Pyritic siltstone is also present. Minor gas shows - nitrogen with lesser oxygen - have been recorded at 1697', 1790' and at 2070'. Below 1681', arenaceous and calcareous foraminifera have been recorded by Crespin (A.O.G. 1965, Appendix A).

The volcanic lithic feldspathic greywacke consists of quartz (15-50), potash and plagioclase (5-20), chert (5-20%) and rhyolitic volcanics (5-15%). Feldspars are partly chloritized and calcified, but the volcanics are strongly silicified. Biotite, muscovite and chlorite occur as accessory minerals. Calcite and siderite occur as grains and as cement. Very finely disseminated pyrite is found in patches and tends to be associated with carbonaceous matter. The cement consists of chloritic clay (15-20%), together with silica and some siderite (5-15%).

Laminae of siderite and pyritic siltstones are irregularly distributed through the unit. Lenses of sandy siderite are common and also contain angular, medium to coarse grained quartz, feldspars and volcanic grains. Some partly carbonized plant fragments also occur within the siderite lenses.

Wire line logs show a uniform pattern, with no significant changes; this pattern is similar to that of unit B1.

Boundary criteria: The lower boundary of this unit has been based primarily on a change in lithology from volcanic lithic greywacke in unit B6 to volcanic lithic, feldspathic greywacke in Unit B5. There is an apparent increase in silt and possibly clay; this is reflected by increased intensity of the gamma ray log. At the actual boundary there is a decrease in grain size from B6 to B5, but this is only a local feature.

Environment and provenance: It is considered that this unit was deposited in intermittently quiet to agitated marine water. This is indicated by the presence of well sorted sandstone interbedded with laminated siltstone containing foraminifera. The composition of the sediments suggests granitic, volcanic and sedimentary sources.

Unit B6.

Characteristics: This unit is 1475' thick, and extends from 2250' to 3725'.

It consists of a monotonous sequence of dark grey, micaceous, volcanic lithic greywacke, thin beds and laminae of siltstone, lenses of pure to sandy siderite, minor coal bands and horizons of quartz and chert pebbles.

The volcanic lithic greywacke is made up of angular to subrounded, well sorted, very fine grained quartz (15-35%), feldspars (3-15%)
and chert (5-20%). Feldspars are mainly microcline and anorthoclase.

Plagioclase is rare, and consists of albite and oligioclase. Chlorite
and calcite are the common replacements of the plagioclase. Silica occurs
as chert and chalcedony. Volcanic lithics (16-35%) are common and consist

mainly of elongated plagioclase laths in a chloritized groundmass. Biotite and muscovite are found as accessory minerals. Siderite and calcite are present as grains and as cement. Shale clasts are rare, and are almost entirely replaced by chlorite. Traces of pyrite and carbonaceous matter are found consistently throughout the interval. The void fillers are chlorite (15-25%), undifferentiated clays and in places silt. Siderite and calcite (2-5%) are subordinate, and silica is rare.

The light grey carbonaceous siltstone occurs as thin beds and as laminae within the volcanic lithic greywacke. Lenses of pure and sandy siderite range from rare to common, and contain angular quartz, feldspars and volcanic lithics.

Rare tests of foraminifera are found together with traces of carbonized plants.

Boundary criteria: The lower boundary of this unit was placed at 3725' where the change from porphyritic volcanics to volcanic lithic greywacke occurs.

Environment and provenance: It is thought that deposition of Unit B6 took place in a marginal marine environment subject to sharp changes in energy conditions. This is indicated by the preservation of coal, the occurrence of siderite and the presence of two major pebble bands. Interlaminations of siltstone and medium grained volcanic lithic greywacke support this conclusion.

b.r

A granitic and volcanic provenance is envisaged for this unit, with a subordinate sedimentary influence.

Unit B7.

Characteristics: This unit extends from 3725' to 3854' (T.D.) It consists of highly altered porphyritic volcanic rock, possibly of intermediate (andesitic) composition. Some flow structures can be seen. Due to extensive alteration only plagioclase phenocrysts are recognizable, but many of these have also been wholly replaced by calcite. Traces of pyrite are concentrated on the borders of some of the plagioclase phenocrysts.

Environment and provenance: In this well there is no way of determining whether this +129° of volcanics was emplaced as a flow or as an intrusion. However, a study of the adjacent Loder No. 1 Well (E. Nicholas 1968) suggests that the equivalent unit there is made up of lava flows and tuffs.

CONCLUSIONS

Agreement with Well Completion Report.

Figure 2 gives a comparison between unit boundaries chosen in this study and stratigraphic subdivisions set out in the Well Completion Report (A.O.G. 1965). Most of the boundaries closely match the formation picks of the Company - except for the upper and lower boundaries of the Greta Coal Measures. The reasons for these differences are discussed below.

The Company picked the upper boundary of the coal measure sequence - between the Maitland Group and Greta Coal Measures - at the first major coal seam, occurring at 1426 feet. The lower boundary - between the Greta Coal Measures and the Dalwood Group was picked at the base of the lowest major coal seam, at 1606 feet.

BELFORD (A.O.G.) No.1

COMPARISON OF B.M.R. UNITS
WITH COMPANY INTERPRETATION

B.M.R.UNITS		BOUNDARY	COMPANY (A.O.G.) 1965					
MAJOR	MINOR	DEPTHS (Ft)	FORMATION	GROUP	AGE			
B1	B1	1290 •	ELDERSLIE FORMATION	MAITLAND CROUP				
	B2	14261 14261			7			
B2-B4	B 3	150 5 ¹		GRETA COAL	M A M			
	B4 16061			MEASURES	Σ			
	B5	1660 ' 2250 ' 2250'	FARLEY FORMATION		\mathbb{C}			
B5-B7	В6	37251 37251	RUTHERFORD FORMATION	DALWOOD	ы Б			
	В7	3854 T.D.	ALLANDALE FORMATION	CROUP				

In the present study, a group of three closely related units was recognized over the interval 1190' - 1660' feet. These units (B2 - B4) contain very similar lithologies, and all contain coal of differing purity; however they represent three distinct phases of sedimentation. The upper two units (B2 and B3) represent "fining upward" sequences, but no regular pattern of grain size variation could be seen in the lowest unit. Also the quality of coals in the middle unit (B3) is far higher than in either adjacent units.

The main effect of the new divisions is to expand the coal measure sequence, both below and above the limits picked by the Company for the Greta Coal Measures.

Summary of New Data.

The 3725' sequence of sediments in Belford (A.O.G.) No. 1 appears to have formed under two sets of very uniform conditions. For the most part the sediments consist of marine greywackes with high component of feldspar and volcanic clasts - that taper off gradually and finally disappear in the lower part of the Unit B1. There has been only one major regression, marked by the development of the coal measure sequence (Units B2, B3 and B4). However, even under these quite different conditions, a very similar provenance operated.

Following the transgression at the end of the coal measure sequence conditions very similar to those operating during the initial transgression again dominated. It is most unlikely that any major breaks in sedimentation occurred in the sequence of sediments in Belford No. 1.

REFERENCES

AUSTRALIAN OIL AND GAS	CORPORATION	1965	Belford No. 1 Bore,
LIMITED			Sydney Basin, N.S.W.
			Well Completion Report by
			Boyd, B.R. (Unpubl.)
			,
AUSTRALIAN OIL AND GAS	CORPORATION	1963	Loder No. 1 Bore,
LIMITED			Sydney Basin, N.S.W.
			Well Completion Report by
			Perry, R.G. and Stuntz, J.
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			Australia. Bur. Min. Resour.
			Aust. Bulletin 48.
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			Hemphills, Austin, Texas.
NICHOLAS, E.		1968	Petrological Study of Loder
			(A.O.G.) No. 1 Well, Sydney
$\mathcal{I}^{\overline{1}} \geq_{\overline{2}}$	·		Basin, N.S.W. Bur. Min. Resour.
•			Aust. Rec. 1968/130. (Unpubl.)
PETTIJOHN, F.J.		1957	Sedimentary Rocks, Harper,
			New York.

O4 0 Preccia to conglomerate LITHOLOGICAL SYMBOLS PETROGRAPHIC WELL LOG WELL NAME, NO BELFORD No.1 ELEVATION (ASL) SAMPLE STORAGE Quartz sand, sandstone Coal OPERATING CO.A.O.G Ground Level 244 ft BMR, Canberra BELFORD (AOG) No.1 MINERAL ABBREVIATIONS Salaca Collar Datum 248 ft WELL LOCATION Siltstone S - Long 151 17 05 E.

HYDROCARBON SYMBOLS

- SECT OF CAS Lat. 32°39'23" Sideville Claystone MISCELLANEOUS Chlorite Bosin SYDNEY - Siderite coment Calcite Interval and Number Sidarite V Volcanie of Formation Test State NSW Limestone Pyrite Micos Altered volcenies Tenement No.PETR.EXPL.LIC. Na103 No sample available 1 250 000 Sheet No. S I 56-1 Feldspar Biol de FOSSILS CARBONATE GRAIN SIZE SONIC COMPANY DESCRIPTION DESCRIPTIONS OF DIR RVAL TRANSF CUTTINGS INTERPRETED UNIT GROUP FORMATION Ores LITHOLOGY Description (3) refers to lithological ncreases pattern 3 at corresponding depth) Rock Name 75 QUARTZ CRITTAGE AND LITTIC CHITTAGE. CONTAINS QUARTZ, CHERT, POTASE WELDEPAR, CREY RED AND BROWN ANGULAR TO PLACIDILASE AND SOME CRAIMS OF STREETS. On SUB-ANGULAR, POOR TO MODERATE SORTED, VER CALCUTE AND MICA. PINE TO MEDIUM CRADNED QUARTZ AND CHERT PATCHES OF PERITS. RICH CRETTACKE AND SHARPZ CRETTACKE. CHLORITE AND MAYNY MATRIX AND MINOR STATOL RARE MULTICOLOURED LITHICS OF SHALE. AND SIDERITE CHARTE. SOME SIDERITE AND CALCITE TOGETHER WITH SANDSTON PYRITE AND CARBONACEOUS MATTER. FRE SCATTERED QUARTZ AND CHERT . . . ർ PERRIES. 윤 PRACTICATES OF BETTOZOA 0 PRACMENTS OF BRYOZOA. Andrew Homen Comments **_0**0 Fia TRACES OF DARK CREY CARBONACEOUS, MICAGEOUS. SLIGHTLY SIDERITIC AND PYRITIC <u>- |~</u> CHLORITIC 0 NACEOU Mi By (2)SILTSTONE WARTZ GRETVACKE AND LITHIC CRETTACES 0 CREY TO BROWN SIDERITIC PURITIC AND IN CONTAINS QUARTS, CHEST AND PELDEPARS. PARTS CARRONACROUS. FELDEPARS ARE CALCTER REPLACED. CRATES OF STREET'S TOCHTON WITH CALCITY. CARBO Σ MICAS AND SOME VERY PIRELY DISSEMENTED) QUARTE CRESTACKE AND LITTIC CRESTACKE PTRITE; TRACES OF CARBONACEOUS MATTER. CREY TO BROWN ARGULAR TO ROUNDED POORLY LANDNAR OF SIDERIFIC, PIRITIC SILESPORE. ORTED, VERY PINE TO COARSE CRAINED QUARTZ AND CHERT RICH CREYWACKE AND ō, MARKE CREYVACER ⋖⊯ SOME SCATTERED CREENISH LITHICS. SIDERITE AND CALCITE OCCUR IN PATCHE RACES OF VERY PIRELY DISSEMINATED <u>~</u> യ PYRITE AND SOME CARBONACEOUS MATTER. ш ___ SCATTERED QUARTE AND CHERT PERBLES. $\bar{\Box}$ ס RACES OF CARBONACEOUS SILESTONE, DARK PROPER STREET LICELYES. S LITHIC CREMINGRE AND QUARTE CRESTACUE. PRACMENTS OF BROWNISH TO BLACK COAL. 100 CONTAINS CHAPTS CHEST POTASS TELDSPAR (LICROCLINE, ANDRINGGASE), PLAGIOGIASE (ALBITE OLIDOGRASE) PARTLY OR ENTIRELY REPLACED BY CALCIFE, INTERNEDIATE TO BASIC VOLCANIC LITHICS SIDERITE AND CALCUTE GRADISPICAS AND PURITE (1) CUARTE CRETTACK: AND LITTLE CRETTACKS. COOKE AS ACCESSORY MINERALS. AS ABOVE SOME PINE TO COARSE CRAINED TRACES OF CARBONACHOUS MATTER. ⋖ WOLCANIC LITHICE. NATRIX AS IN GRETTAGES ABOVE. (2) CARBONACROUS SANDY SILTSTONE. VOLCANTO LIVERTO PELIDSPAURITO CRAST ACCE (3) SIDERITTE MUDERCUE. WITH QUARTE AND CHIEF PRINCES. OVOLCANIC LITHIC, POLDSPATHIC GRETTACE CANDONACHOUS SANDY SYLESTONS. QUARTZ, CHERT, FELDEPARS AND VOLCANIC PROFES TO MIACE COAL. LITHICS WITH SUBORDINATE SILERITE. CALCITE MICAS AND PURITE. CARBONACHOUS BARTIE STIRSTON MILITATIONIONEN CHES PROBLES. BLACE VINESUS COAL. CONTAIN INCLUSIONS OF CRYSTALS AND CHERT PARRILLS CONTAINING IGH DUS DESCRIPTION. : 🗖 (4) MLACK VITE POUR COAL. APPONA CHOUSE SAIDE STREET, a di FOLCANT: LITHER, FRINDSPANIER CREST ACES. BLACK VITHEOUS COAL WITH STAT LAMMATIONS (5) SANDY SUPPLIES WITH PLANT PRACESURE. WOLCANIC LITHIC, PELDSPATHIC CLEY ACTS (1) FOLGALITE PALISPATRIC GETTAGES. TO ACCOMPANY BANAR, EMCORD 1960/61 ¥ AUS - I - 60 A Petroleum Exploration January 1968

FOSSILS CARBONATE GRAIN SIZE (Wentworth Scale) Latim. size (Size) Calche type - Sangs 700 Size	DESCRIPTIONS OF CUTTINGS	SONIC SONIC TIME TIME TO STATE OF STATE	63/ 5 6/	DESCRIPTION BM UNI OF INTERPRETED	OOMPANY INTERPRETATION
(Imm reaction)	Description 3' refers to lithological Nill pattern(3' at corresponding depth)	(2) (2) (2) (2) (2) (2) (2) (2) (2) (2)	Radiation intensity	Formation Rock Name Test Data (after Petitjohn, 1957)	FORMATION GROUPS
Iso.	(5)SANIK SIDERITE WITE PLANT TRACMONTS. (1) VOLCANIC LITHIC FELDSPATHIC CRETTACKS GRET, ARGULAR VISHY FIME TO MEDIUM GRAINED, FOORLY CONSOLIDATED CRETTACKS.		Sid. Ch. 17. 512. 17. 17. 17. 17. 17. 17. 17. 17. 17. 17	COLCATIC LIMITO, FELDEFARRIC GREYWACKE. GUARTZ, FOTASE FELDEFAR, PLAGIOCLASE, CHERT AND VOLCANIC LITHICS. FELDEFARS ARE PARTLY CHLORITIZED AND CALCIFIED. VOLCANIC LITHICS SHOW FLOW TEXTURE	
1300	CONTAINS QUARTZ, POTASH FELDSPAR, FLAGIOCIASH AND INTERNEDIATE VOLCANIC LITHICS, PELDSPARS ARE PARTIX CHIORITIZED AND CALCIFIED, VOLC, LITHICS ARE STRONGLY SILICIPIED.			AND ARE STRONGLY SILICIPIED. BIOTITE, MORCOVITE AND CHICATITE ARE COMMON. PATCHES OF CHIBONA CROUS MATTER OCCUR TOGETHER WITH VERY FIRE DISSEMINATED PIRITE.	ation
1900' 2000' 2100'	GRAINS OF SIMERITE, CALCITE, BIOTITE, MUSCOVITE AND CHLORITE OCCUR AS ACCESSORY MINERALS. SIMERITE LENSES ARE COMMON.	2034	Fld. ch. Py.Mi	CHICATTE NATRIX AND SOME SILICA AND SIDERITE CHICATTE NATRIX AND SIDERITE SIDERITE CHICATTE NATRIX AND SIDERITE SIDERITE SIDERITE CHICATTE SIDERITE	Form P
Stoo,	CEMENTING MEDIA CONSIST OF SILICA AND SIDERITE CHARGE, AND CHLORITE MATRIX. (COAL FRACMENTS ARE RECARDED AS CAVINGS)	21-10	C. sid. To.	FINE GIALL	
2300 × ×	(6) YOLGANIC LITHIC GREYWACKE. DARK GREY TO BROW, ANGULAR TO	2200 22100 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	A STANDARD BY THE STANDARD BY	OF CANIC PLANTS GENERALOGY.	1
2400 x	SUB-ROUNDED, FOOR TO MODERATE SORTED, E VERT FIRE TO MEDIUM GRAINED, SIDERITIC, MICACHOUS, FIRITIC AND CARBONACEOUS GRETWACKE WITH VOLCANIC LITHICS AND			WARTZ, POTASH FELDSPAR, PLAGIOGLASE, MICAS, EMBIT AND VOLCANIC LITHICS. CHAINS OF SIDERITE AND CALCITE ARE COMMON. PYRITE AND CARBOHACEOUS MATTER OCCUR IN	E (0)
2600 P. C.	SOME PINE LANDIAR OF MICAGEOUS SILTETONS	MW/W/Whatman 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		PATCHES. SOME SCATTERED CHARTZ PERBLES. CHICATTIC AND UN-DIPPERBUTIATED CHAY MATRIX; COME SILICA, SIBERITE AND PIRITE CHART.	
2600		244	5i. Py. CA. S		B C C C C C C C C C
2100'		3100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ANT V	ANDY SIDE	
2 too'	(6) VOLCANIC LITHIC CRETWACKE AS ABOVE. SCATTERED QUARTZ AND CHERT FEBLES. FRACEOUNTS OF BLACK VITREOUS COAL.	2000		DICANIC LITTEIC CREYWAGES.	
	(6) VOLCANIC LITHIC GRETWACKS. GRET TO BROWN, WELL SORTED, VERY FIRE GRAINED, SIDERITIC AND CARBONACEOUS	\$ 3000 D 1000 V		ALCARSOUS, SIDERITIC, MICA CEOUS AND PIRITIC JUTH HARE PERRIES OF QUARTZ AND CHERT. LINESS OF SANDY SIDERITE. LACK VITEROUS COAL.	S S S S S S S S S S
) (oo	GREYWACKS WITH SCATTERED QUARTZ AND CHEET PRHELES. LAMINAE OF FIRITIC, SIDERITIC AND MICACEOUS SILASTONE WITH VERY FINE QUARTZ SAND.	bled bled	Fid. Sid. Sid. Sid. Ch. C. Rp. Bi. To	TIC GMINOR	
\$200	<u>s</u>	1200 D	// \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	DICANIC LITHIC CRETWACKE. DEFINITION OF THE SANDY SIDERITE, BLACK THEROUS COAL AND SOME LIGHT CREY MICACEOUS	
3-boo		3300	Fid. Sil. C. Ch. Py. Mi. To.	DIAMONE.	
34eo	(6) VOLCANIC LITHIC GREYWACKE.	3400		DLCANIC LITHIC GESTWACKS. UASTZ, POTASH FELDSPAR, PLAGIOCLASE, CHERT AND DLCANIC LITHICS.	
	DARK GREY, ANGULAR TO SUB-ROUNDED, WELL SORTED, VERY FINE GRAINED, PYRITIC, MICACEOUS AND SIDERITIC GRETWACKE. PATCHES OF CARBONACEOUS MATTER. TRACES OF GREY, MICACEOUS SILTSTONE.	3600 @	////	IDTITE, MUSCOVITE AND CHIORITE OCCUR AS CCESSORY MINERALS, PATCHES OF PYRITE AND ARBONACEOUS MATTER. HIGHITIC MATRIX AND SILICEOUS CEMENT.	
3700	SOME SANDY SIDERITE.	3700		ICACROUS SILITSTONE LANINAE ARE COMMON OGETHER WITH SANUT SIDERITE.	3725'
385470	(7) ALTERED VOLCANIC ROCK. TRACES OF CALCITE AND PYRITE.	385/TD	ed set	INTERNED FOR PHYRITIC VOLCANIC ROCK. RESENTSH CREY, HIGHLY ALTERED, POSSIBLE OF INTERNEDIATE (ANDESITIC) COMPOSITION. INLY PLACIOCIASE PHENOCRYSTS ARE RECOGNIZABLE.	B7

BELFORD (A.O.G.) No.1				Description					
GRAIN-SIZE (Manufacture) Resistivity Conductivity Resistivity Conductivity Resistivity Resis	SONIC DITERVAL TRUMP TIME	GAMMA-RAY RADIATION EVELSIFY ENGLASES APT - UNITS 15	DEPTH	Hydrocarbo	of Interpreted Lithology	Units	Unit Groups	Formation	Group
		Monno	-1250	CAS SEDW	QUARTZ CREYWACKE AND LITHIC CREYWACKE. CREY TO BROWN, ANCULAR TO ROUNDED, FOORLY TO MODERATELY SOFTED, SILTY CREYWACKES. PATCHES AND RHOMES OF CALCITE AND SILERITE; RARE VOLCANIC LITHICS; SOME SCATTERED QUARTZ AND CHERT PERBLES. CHLORITE CLAY MATRIX; SIDERITE CEMENT.	В	В		d
			1300	Þ	INTERBEDDED VOLCANIC LITHIC, FELDSPATHIC GRETWACKE AND CARBONACEOUS SANDY SILTSTONE. CRETWACKES CONSIST OF QUARTZ, FELDSPARS, CHERT, VOLCANIC LITHICS AND MICAS; FIRITE AND CARBONACEOUS MATTER ARE COMMON. CALCITE AND SIDERITE AS RHOMES AND PATCHES; ALSO AS CEMENT WITH SILICA. CHLORITE CLAY AND SILT MATRIX. BROWN SANDY AND SILTY COAL,	2		Formation	GROUP
			1400		SILITSTONE :MICA CROUS WITH VEHT FINE TO MEDIUM QUARTZ SAND, ABUNDANT CAHBONA CROUS MATTER; PATCHES AND RHOMBS OF SIDERITE. SCATTERED CHERT AND QUARTZ PEHBLES.RARE VOLCANIC LITHICS. VOLCANIC LITHIC, FELDSPATHIC CREYWACKE: AS ABOVE, BUT WITH ABUNDANT CHERT PEHBLES. CHERT PEHBLES OF VOLCANIC LITHICS AND LOOSE CHYSTALS WITH	à à	- B4	derslie	AITLAND
			1450	Ór Gas Seed#	VARYING DECREES OF ALTERATION. BLACK SILTY COAL. BLACK VITREOUS COAL. CARBONA CEOUS SANDY SILTSTONE. DARK GREY TO BROWN, SIDERITIC, PYRITIC WITH ABUNDANT CARBONA CEOUS MATTER AND SOME VERY FINE QUARTZ SAND.			E	2
			-1 50 0		BLACK VITREOUS COAL. VOLCANIC LITHIC, FELDSPATHIC CREYWACKE WITH ABUNDANT CHERT PERBLES, AS ABOVE IN UNIT BY. DARK CREY TO BLACK SILTY COAL.	83	2		MEASURES D C
			_12 <u>20</u> ,	OHS SHO	CARBONA CEOUS SANDY SILISTONE. GREY TO BROWN, PYRITIC, SIDERITIC AND IN PARTS CHLORITIC; ABUNDANT CARBONA CEOUS MATTER. LAMINAR OF VERY PINE TO COARSE QUARTZ SAND. VOLCANIC LITRIC, PELDSPATHIC GREYWACKE. AS ABOVE IN UNIT B2 AND UNIT B3, WITH ABUNDANT CHERT PERBLES.		B		COAL
			-1606' -1600'	Þ	DARK BROWN TO BLACK COAL. WITH LAMINAE OF SILT AND VERT FINE SAND. INTERBEDDED VOLCANIC LITHIC, FELDSPATHIC CREYNACHE WITH ABUNDANT CHERT FERRLES	84			a.
	3		1650°	ZEO.W	SANDY SIDERITE. CONTAINS QUARTZ, PELDSPARS, CHERT AND VOLCANIC LITHICS EMBEDDED IN MASSIVE SIDERITE. FRACES OF PLANT FRACMENTS.		В7	Formati	OD GROU
Scale 1":50" To accompany B.M.R.Record 1966	7/60		-1700	\$v∘ X	VOLCANIC LITHIC FELDSPATHIC GREYWACKE. CONTAIN QUARTZ, PELDSPARS, CHERT AND VOLCANIC LITHICS; SOME MICAS, SIDERITE AND CALCITE. PATCHES OF PYRITE AND CARBONACEOUS MATTER. SILICA CEMENT WITH LESSER CHLORITE MATRIX.	B5	B ₅ —		DALWOO

WELL NAME, No. BELFORD (A.O.G.) No.1 Breccia to conglomerate PETROGRAPHIC CORE LOG ELEVATION (ASL) SAMPLE STORAGE Ground Level 244 ft. OPERATING Co Australian Oil & Gas B. M.R., Canberra Silica States Quartz sond sandstone Shale and mudstone Collar Datum 248 ft BELFORD (A.O.G.) No.1 WELL LOCATION =_= Micas Siltstone Geology by: S.Ozimic Lat 32°39'29" S. Long 151°17'5" E. Porosity (estimated) Abundance (estimated) Sadimentary structure Cldystone Basin Sydney State N.5.W. Bedding > 5cm 65403 D Pyrite Limestone P - Pnor 6-12% C - Common 1 - 3% Burrow structure Tenement No Patrol. Expl. Licance No.103 M - Medium 12-12% A - Abundant > 3% Siderite. Position of lost core not known Feldspar G - Good 1.250,000 Sheet No. > 20% DETAILED DESCRIPTION GENERALIZED DESCRIPTION GRAIN - SIZE THIN - SECTION CORRELATION ANALYSIS ACCESSORY MINERALS Estim R-C-Aor Measured %Total Rock Matrix and/or Cement NOTES OF ESSENTIAL Estim % of Total Rock Range B. Mode SPECIFIC ROCK COMPANY COMPONENTS CLAY- UNDIFF × × × × DESCRIPTION SANDS (provenance. environment of deposition , diagenesis, palaeontology etc) NAME CLEARLY PRESENT AS CEMENT AND OR MATRIX UNITS GENERALIZED ROCK NAME (After Pettijohn 1957) 20 40 60 80 100 6 SILAT SANDSTONE STRONGLY LAWINATED; FEW STRINGERS OF SHALE AND PATCHES OF CRANITIC AND SEDIMENTARY 1064'2" MELL JORTED QUARTE GROWLEGEL. GREY~~~~ ROCK SOURCE.
INTER LANDNATED SEDIMENTS CARBONATE: ISOLATED CHERT PERBLES: 1064'4" SOME EUHEDRA OF PYRITE. SUGGEST QUIET WATER DEPOSITIO (1'3") \Box 0 \sim $|\simeq|$ 0 SILTY SANDSTONE; LANDNATED, SHOWING TRACES
OF (?) BURROWS AND SOME SHALY STREAMS. CRANITIC AND SEDIMENTARY ROCK (0) GREY 1264'2" WELL JORT D JED RITTE QUARTZ 12644 9 ---SOURCE. CARBONATE AND SIDLERTE COOR ULT GRALLY THROUGHOUT THE SECRET ALSO CONT. DIE SCATTERED CHERT PERGLES, SOME VERY PINKLY DISSERUMATED PYRITE AND TRACES OF INTER LANDHATED SEDTMENTS ര WITH SCATTERED QUARTZ AND CHERT PERRIES. Ε CARBONACIOUS MATTER. . 2 0 (2'3") Ø Z Z S 12674" SILAY SANDSTONE LAMINATED JITH TRACES
OF (7)BUEROWS, SOME CARBONACEOUS STREAKS,
CARBONATE (SIDERITE) OCCURS UNIFORMLY CRANITIC AND SEDDMENTARY ROCK 1267'2" SIDERITIC QUARTE GRANACE. \times GREY SOURCE 1 AND 2, വ \triangleleft ט THROUGHOUT THE SECRENT FEW ISOLATED CHERT ⋖Ш (1'3") .1268'3" **₹** 155ď SAIDY SIMPSTONE STRONGLY LAMINATED WITH THIS STREAMS OF WEST FIRE QUAPTZ SAED. CARBONATE OCCURS THROUGHOUT WITH VIEW FIRE DISSIBILIZATED PRINTE AND THACES OF S GREY CALCARROUS SILESTONE 1550'2" SEPTIMENTARY ROCK SOURCE WITH MINOR CRANITIC COMPONENTS. XX15504" DETER LAMINATIONS SUCCEST QUIET WATER DEPOSITION. \simeq Ш \supset (1'2") S ⋖ Ш 2554 1554 Σ CHAPTOGE SANDSTORE MASSIVE REDDED, GREEN GREEN GREEN REDWIN CHANTITIC. SEDDENITARY AND PELDSPATHIC LITHIC CRAY ACCE. 1554'3" $\times\!\times$ WOLCANTO SOURCE BOOK. SHALE AND VOLCANIC LITTIES. TRACES OF CARBONALOUS MATTER. ASSOCIATION WITH COAL SEAMS AND GOOD SORTING SUGGEST WEAR SHOW OR CONTINUEDAL 0 8 DEPOSITION IN ACCURATED WATER Ö (1'6") EIA GRI 213574 TO ACCOMPANY B.M.R. Record 1960/68

G E	NERALIZED DESCRIPTION		DETAILED	DESCRIPTION	PLATE 3B
CORRELATION			GRAIN - SIZE/ GRAIN - SIZE/ Wentworth Scole 1 Stim size	% Matrix and/or Cement Est	ACCESSORY MINERALS Im R.CA or Measured % Total Rock Is Minerals Light More NOTES
INTERPRET H B M R	DESCRIPTION S	SPECIFIC ROCK	Q an Q S SANDS CROSS HA	TONENTS . CLAY-UNDIFF OF CONTINUES OF CONTIN	Iprovenance. environment of deposition diagenesis
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	NERALIZED ROCK NAME	(Atter Pettijahn 1957)		45 BLAN / [5 4 / 5 / 5 / 5 / 5 / 5 / 5 / 5 / 5 / 5	polyeoniolog, etc.)
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	DED TO SLICHTLY LANDKATED; WELL	ESLL SOPESD COARTY CRETTAGE.		c R	A C A A PORAMINITYERA RECORDED BY CRESSPOR (A.O.G.1965).
6 SORTED, ARGU	LAR QUARTZ, CHERT, FELDSPARS AND MICS. METES, SIDERIES AND CARBONACEDUS				CRANITIC.SEDDENTANT AND MINOR VOLCANIC ROOK SOURCE.
172737 MATTER.					MASSIVE REDDED AND SLICEFLY LAMINATED SEDIMENTS SUGGEST DEPOSITION IN MODERATELY
PINE GRAINE	TIC SANDSTONE, MASSIVE BEDDED, VEHT O QUARTZ SAND WITH VOLCABIC LITHICS A SILUT MATRIX AND SIDERITS				AGITATED AND QUINT MARINE VATER.
1851 6 3 3 5 7 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	A SILIT MATRIX AND SIDERITE				
O 1854'6	TIC SANDSTONE AS ABOVE.	PELISPATHIC LITHIC CRETIAGE.		HXXXXX ~~~~~	A C A A GRANTFIC, SECONDETTARY AND MINOR VOLCANIO ROOK SOURCE.
E 1951' STLIY SAIDST	ONE.				DEFOSITIONAL ENVIRONMENT AS FOR
O -8 = TRACES OF VE	ED, QUARTZ RICE, LICA CEDUS SANDSTONE GREY RY PINELY DISSEMINATED PYRITE AND				
(1) CARBONA CEOUTS	GREAT 1951 77"	QUARTZ CREYNACKE. QUARTZ, CHERY, FOTASH PELDSPAR.		**************************************	A R A A SEDIMENTARY AND GRANITIC ROCK
O 2196		PLAGIOCIASE AND BIOTITE. CHLORITE MATRIX AND SILICA			SOURCE. MASSIVE BEIDED, WELL SORRED, VERT PINE GRADES SEDIMENS SUGGEST
Z > QUARTZOSE SA	ED, QUARTZ AND CHERT RICH SANDSTONE	CEMERT.		XXXXX///// -~	DEFOSITION IN QUIET MARINE WATER.
(4'6') /// = UNITH PATCHES	nrm /	QUARTZ AND PELDSPATHIC CRETTACKE. QUARTZ, CHERT, FOTASH PELDSPAR. PLAGIOCIASE AND MICAS.		WWW///// ~ ~ 1	AS POR CORE 8.
21991		CHLORITE MATRIX AND SILICA CEARST.			
CARDONA CEOUS	SILTSTOIR. ED TO FREIN LAMINATED SINT TITE				
-(6') SAND AID PAT	CARBONACEOUS MATTER, SOME QUARTZ ORIES OF SIDERITE.	DIDURATED CARBONACEOUS SILASTONE.		**************************************	R A SEDIMENTARY AND GRANTTIC ROOK
Δ c 2645'		PINE SAND,			SOURCE. DEPOSITIONAL ENVIRONMENT AS POR CORE 8 AND CORE 9.
≥ 0 ÷ 3005; 3005	C. SIDERITIC SILTUTORE.				TRACES OF FORALIMITERA TESTS.
OE HASSIVE BEDDO	ED SILTOTORE WITH PIRELY PYRITS, STRINGERS OF SIDERITE AND	CALCARDUS, PYRITIC QUARTZ CRETTACKE AND PYRITIC SILTSTONE.			
TRACES OF CAL	ME TO FIME QUARTZ SAID. RECHACEOUS MATTER.				
A 9 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	DARK 3006'3"	PERITIC, SAIDY SILTSTONE.		XXXX 2222	A SEDDENTARY ROCK SOURCE WITH
3601	DATA CAT CODONE				DEFRUES OF FORMULIPERA TESTS. DEFOSITIONAL ENVIRONMENT NEAR
(1) or 1	PRINTIC SHARTONE. RS OF SIDERITE. DARK GREY	CARBOHACOUS, PYRITIC SILTSTONE.			SHORE. A SEDIMENTARY ROCK SOURCE. DEPOSITIONAL ENVIRONMENT AS FOR
13 OV V VOLCALITE BREE	<u> </u>	WOLCANTE BROOMS		**************************************	CORE 11.
STIONGLY ALTO	ERED VOLCANIC LIVINGS WITH GREY ERRY FRACEINTS, WELL CEMENTED IN D SILLGROUNG COURT.	WOLCANIC BRUCCIA.		**************************************	SERONGLY DISTORTED.
B : 3769'5	DESTS, LARGELY ALTERED TO CALCITE. CREEN				
(18) 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		HIGHLY ALTERED (?) DIFFERMEDIATE VOLCANIC ROCK.		<u> </u>	A SPRONGLY ALTERED TO CALCUTE.
opu 300°2					
TO ACCOMPANY B.M.R.RECORD 1968/68					