Rept. Bk. No. 714
G.S. No. 3089
Pal. Rep. 3/65
S.R. 11/5/170

CONFIDENTIAL

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

PALAEONTOLOGY SECTION

OUTBACK OIL CO. N.L.
COOK NO. 1 WELL
SUBSURFACE STRATIGRAPHY

by

N.H. Ludbrook
Senior Palaeontologist

RB 114

2nd March, 1965

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

OUTBACK OIL CO. N.L.

COOK NO. 1 WELL

SUBSURFACE STRATIGRAPHY

ABSTRACT

Cook No. 1 Well of Outback Oil Co. N.L., drilled on Nullarbor Plain to a total depth of 915 feet intersected approximately 470 feet of Tertiary sediments followed by unfossiliferous sands and then limestones and sands of possibly Lower Cambrian age in which drilling ceased.

INTRODUCTION

Cook No. 1 Well was drilled on Nullarbor Plain 21 miles south east of Cook R.S., latitude 30°50'S, longitude 130°41'E. Drilling commenced on 27th October, 1964, and ceased on 23rd November, 1964. Elevation of ground level was 330 feet and of the rotary table 3 feet above ground level. Depths were measured from the rotary table.

Owing to drilling difficulties some of the upper section was redrilled, and samples were received from holes 1a and 1c.

The present report presents a stratigraphic interpretation based on cuttings and one core from 1a and 1c. Well 1c was completed as a water bore at 900 feet. Only the Tertiary section carried fossils, and these were poorly preserved.

Formation boundaries have been adjusted to the electric logs.

STRATIGRAPHIC SUMMARY

The following stratigraphic units were intersected in the well:

Age	Formation	Depth (feet)	Thickness (feet)
Quaternary	sandy limestone	0 - 25(?)	25
Lower Miocene	Nullarbor Limestone	(?)25 - 175	150
Upper Eocene	Wilson Bluff Limestone	175 - 346	171
Eocene	unnamed clays and sands	346 - 470	124
?	unnamed pyritic sands	470 - 525	55
?Lower Cambrian	not determined	525 - 915	390

QUATERNARY SANDY LIMESTONE

Samples from the well between surface and 25 feet contain fragments of reddish limestone with sandy kunkar, as well as chips of miliolid limestone. The latter are from Nullarbor Limestone, but it is probable that a thin veneer of Quaternary material is present. A specimen of Ammonia beccarii in the cuttings and of two other specimens observed in cuttings towards the bottom of the well would appear to confirm this.

NULLARBOR LIMESTONE
25 - 175 feet, thickness 150 feet

Cream crystalline limestone typical of Nullarbor Limestone was intersected between 25 and 175 feet. Diagenesis had proceeded too far for most of the fauna to be specifically identified, but Operculina, Amphistegina and Elphidium chapmani were present.

The formation is of Lower Miocene age.

WILSON BLUFF LIMESTONE
175 - 346 feet, thickness 171 feet

At 175 feet cream bryozoal limestone, somewhat glauconitic, was entered, This is the Wilson Bluff Limestone of Upper Eocene age, of which Maslinella chapmani and a limited fauna of small foraminifera were recognizable, although most of the foraminifera and bryozoa were recrystallized. The base of the formation is sandy, glauconitic and pyritic.

EOCENE CLAYS AND SANDS
346 - 470 feet, thickness 124 feet

Highly carbonaceous clay and quartz sand with pyrite aggregates were intersected below the Wilson Bluff Limestone. These are as yet unnamed, although they outcrop at Pidinga. The base of the formation is placed at 470 feet where there appears to be a change in accessory mineral composition. A brown mineral with a brilliant lustre (? siderite) characteristic of the interval 365 - 470 has been submitted to Australian Mineral Development Laboratories for identification.

PYRITIC SANDS OF UNCERTAIN AGE
470 - 525 feet, thickness 55 feet.

Unfossiliferous quartz sands with coarse subangular to angular quartz grains, lithic grains, rare garnet, feldspar, muscovite and abundant pyrite.

It is difficult to correlate these sands with any known formation. In some respects they resemble Permian sands of the western margin of the Great Artesian Basin, but they are more angular than usual and lack any identifying foraminifera or carbonaceous material.

No age is therefore assigned to them at present.

LIMESTONE AND SAND OF ?LOWER-CAMBRIAN AGE
525 - 915 feet

At 525 feet hard grey limestone and fine sandstone were entered. The formation appears to be unfossiliferous. It contains oolite bands, represented in cuttings at 610, 640-660, and 750 feet. Both pyrite and calcite veinlets are present. In places the limestone is carbonaceous, but it failed to yield any significant spores. The sandy interbeds are inclined to be silty and micaceous or to consist of coarse to subrounded quartz in a calcareous matrix. Some chert is present. There is occasional red mottling.

These sediments have been compared with cuttings from bores at Maralinga which were regarded as of Proterozoic age

(Marinoan Series). They do not appear to belong to the same series. R.P. Coats of the Geological Survey in discussion with the writer has given the information that oolites and chert occur in association with limestones at the base of the Cambrian in northern South Australia. This evidence would appear to support the writer's view that the section below 525 feet in Cook No. 1 Well is of lower Palaeozoic, ? Lower Cambrian age.

COMPARISON WITH COMMONWEALTH RAILWAYS COOK BORE

A series of samples from the bore put down at Cook by the Commonwealth Railways was taken to Canberra in 1944 for micropalaeontological examination. The sequence in this bore was determined as follows (Crespin , I. 1955. Micropalaeontological examination of samples from the Cook Bore, Nullarbor Plains, South Australia. Bur. Min. Res. Geol. Geophys. Records 1955/100 (unpublished)).

Depth (feet)	
0 - 112	limestone - ? Lower Pliocene
112 - 137	limestone - Miocene
137 - 225	calcarenite - Eocene.
225 - 228	sandstone - Eocene
288 - 346	346 claystone - "probably Lower Cretaceous"
346 - 409	siltstone - Lower Cretaceous
423 - 604	sandstone - Lower Cretaceous
604 - 649	quartz sandstone - no age suggested
684 - 1208	purplish red to green shales and silicoeous rock - "probably Lower Palaeozoic".

Comparing this sequence with Outback Oil Cook No. 1, and taking into account that the claystone from 288 - 346 is more likely to be the Eocene clay intersected in O.O. Cook No. 1 between 346 and 470, the Tertiary sequence is some 124 feet thinner in C.R. Cook bore than in O.O. Cook No. 1. The Cretaceous is missing in Cook No. 1, while the pre-Cretaceous sandstone between 604 and 649 feet in C.R. Cook Bore is that intersected between 470 and 525 feet in O.O. Cook No. 1. Apart from

a record of siliceous rock showing oolitic structure at 731 feet in C.R. Cook Bore, the description of the beds below 684 in C.R. Cook Bore as "purplish red to green shales and siliceous rocks" appears more in keeping with the Marinoan than with the Lower Cambrian.

Correlation of the two wells is shown in Fig. 2.

DESCRIPTION OF THE CUTTINGS

Depth (feet)	
0 - 25	Fragments of reddish limestone and sandy kunkar, together with chips of miliolid crystalline limestone.
25 - 100	Cream crystalline limestone.
100 - 175	Cream crystalline limestone with Operculina, Amphistegina, Marginopora.
175 - 200	Cream bryozoal limestone, somewhat glauconitic, with small foraminifera, mostly Cibicides spp.
200 - 275	As above, with Maslinella chapmani.
275 - 340	Cream crystalline limestone with Maslinella chapmani and small echinoids.
340 - 350	Dark grey carbonaceous sandy clay with subrounded to subangular quartz with polished surfaces, dark green glauconite pellets, pyrite-quartz aggregates.
350 - 360	Carbonaceous sandy clay with abundant plant remains, Globorotalia sp. cf. G. tribulosa, Gyroidina octocamerata.
Core 1	362 feet. Black carbonaceous clay, with fine quartz grains and coaly matter.
365 - 370	Fine angular quartz sand, with carbonaceous matter, pyrite, ? siderite.
370 - 380	Fine to coarse silty sand, with angular quartz.
400 - 470	As above, with small agate grains, abundant grains of ? siderite.
470 - 490	Quartz sand with subrounded and polished to angular quartz grains, lithic grains, rare garnet.
490 - 520	As above, with feldspar, garnet, muscovite, quartz-pyrite and ? siderite in rock fragment.
520 - 525	As above, with pink garnet (rare).
525 - 550	Grey limestone and sandstone with muscovite, green clay, angular quartz, pyrite veins and crystals.
560 - 590	Grey and reddish limestone and mottled grey and red fine sandstone, micaceous, with green clay minerals. Some of the limestone is sandy, with subrounded quartz in a calcareous matrix, chert.

Depth (feet)	
590 - 600	Grey limestone as above, brown siltstone.
600 - 610	Light grey limestone as above, more abundant brown siltstone sometimes in thin bands reminiscent of the stylolites in the Kulpara Limestone.
610 - 620	As above, with oolitic limestone.
620 - 650	Sandstone with thin bands of carbonaceous siltstone, very micaceous; some oolite chips.
650 - 660	Grey limestone, oolite, and chert.
666	Bit sample. Grey very fine pyritic micaceous sandstone with abundant fine muscovite flakes.
670 - 700	Limestone and coarse sandstone, pyritic, with coarse subrounded quartz grains in a silty and finely siliceous matrix.
700 - 720	Dense grey limestone, siliceous limestone, chert, and pyrite.
720 - 735	Grey silty sandstone with some limestone and chert.
735 - 750	Limestone and silty sandstone.
750	Grey limestone, oolitic limestone, angular quartz grains with fractured surfaces.
750	Bit sample. Brownish calcareous siltstone, micaceous.
752 - 754	Limestone and siltstone, micaceous, with quartz veins, quartz sand.
755 - 780	Sandy siltstone with some red siltstone.
780 - 800	Grey limestone.
800 - 835	Grey fine sandstone or siltstone.
835 - 840	As above, with carbonaceous matter and calcite veinlets.
840 - 850	White and dark grey limestone, carbonaceous in places; light grey fine sandstone.
850 - 900	Fairly even grained medium to coarse sandstone with angular quartz grains, some with crystal faces, some slightly rounded; cemented with very little siliceous matrix. Some rounded opaque minerals, fragments of micaceous siltstone and red siltstone.
900 - 915	Mostly fine angular to subrounded quartz grains with some micaceous sandstone.

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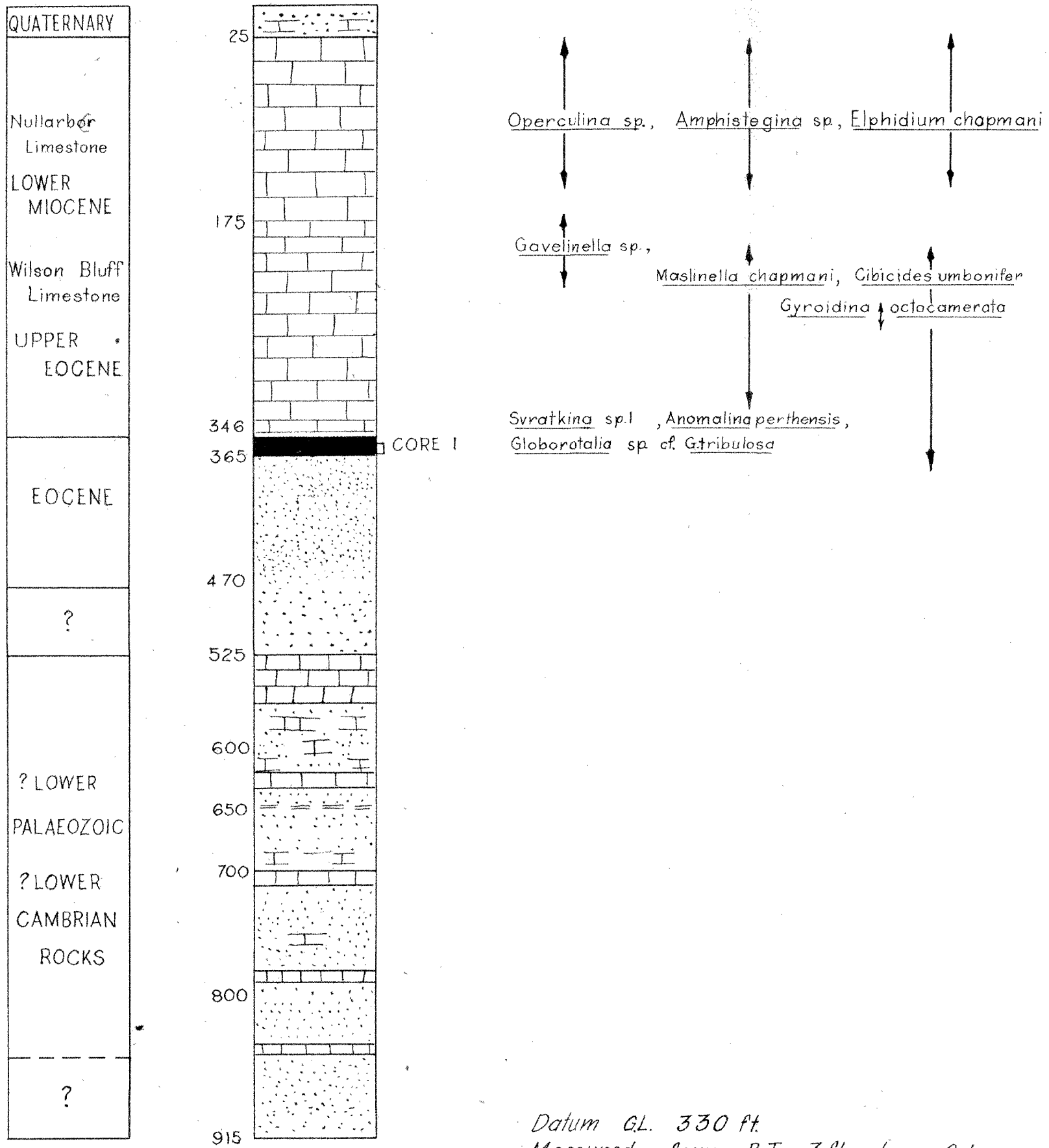


Datum G.L. 330 ft.
Measured from R.T. 3 ft. above G.L.

Fig 1

To accompany report by N.H. Ludbrook.

S.A. DEPARTMENT OF MINES

No.	Amendment	Exd.	Date

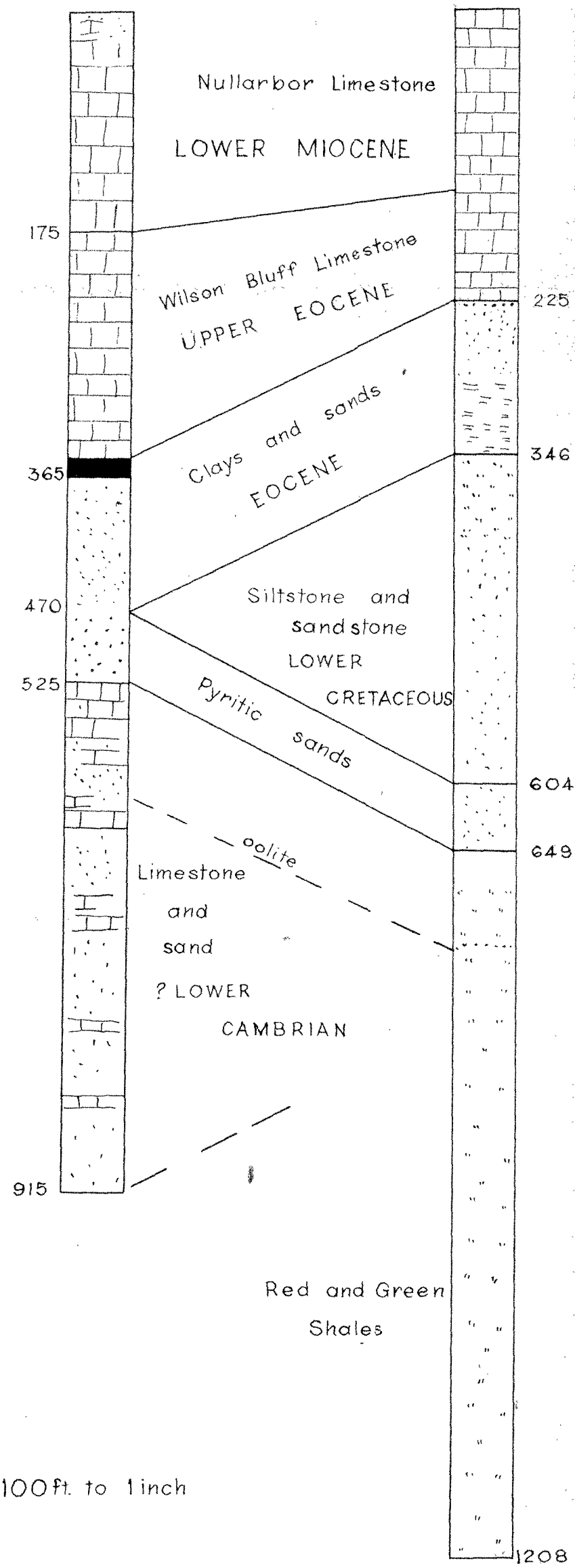
OUTBACK OIL CO. N.L.
COOK N° 1 WELL

Approved	Passed		Scale : 1inch : 100ft.
		Drn.	65-126
		Tcd. P.G.H	Ab
		Ckd.	
Director		Exd.	Date 26-2-1965

200—8.63 1423

OUTBACK OIL Co. NL
COOK Nº1 WELL

COMMONWEALTH RAILWAYS
COOK BORE



Scale: 100ft. to 1inch

Fig 2

S.A. DEPT. OF MINES

CORRELATION OF OUTBACK OIL CO. NL. COOK Nº1 WELL AND COMMONWEALTH RAILWAYS COOK BORE

To accompany report by N.H. Ludbrook.
26-2-65

65-127
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