W404

Natural Resources and Environment

AGRICULTURE • RESOURCES • CONSERVATION • LAND MANAGEMENT

DEPT. NAT. RES & ENV
PE904907

IMRAY BORE (G.B)
WELL SUMMARY

ONSHORE

1 Folio No	2 Referred to	3 Date	4 Clearing Officer's Initials	1 Folio No.	2 Referred to	3 Date	4 Clearing Officer's Initials

FILE COVER INSTRUCTIONS FOR ACTION OFFICERS

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(2) REFERRAL TO OTHER OFFICERS: When an Officer completes action on the file and further action is required by some other Officer, please initial Column (4) and on the next vacant line, enter the relevant folio number in Column (1), indicate to whom the file is to be forwarded in Column (2) and record the date in Column (3).

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REGISTRY MUST BE NOTIFIED OF ANY FILE MOVEMENTS BETWEEN OFFICERS

LOCATION

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IMRAY BORE

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PE904137

This is an enclosure indicator page.
The enclosure PE904137 is enclosed within the container PE904907 at this location in this document.

The enclosure PE904137 has the following characteristics:

ITEM_BARCODE	= PE904137
CONTAINER_BARCODE	= PE904907
NAME	= well card
BASIN	= GIPPSLAND
PERMIT	=
TYPE	= WELL
SUBTYPE	= WCR_CARD
DESCRIPTION	= well card Imray Bore
REMARKS	= abandoned 1939.
DATE_CREATED	=
DATE_RECEIVED	=
W_NO	= W404
WELL_NAME	= Imray Bore
CONTRACTOR	= Austral oil Drilling Syndicate NL
CLIENT_OP_CO	= Austral oil Drilling Syndicate NL

(Inserted by DNRE - Vic Govt Mines Dept)

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EXTRACT FROM MINING AND GEOLOGICAL JOURNAL.

(Jany 1939)
Published in Mining & Geological Journal Vol 1 No 4. 1942.

IMRAY OIL BORE, LAKES ENTRANCE.

By I. C. H. Croll, B. Sc.

The Imray bore is the second of a series being drilled by the Austral Oil Drilling Syndicate N.L., as part of a plan of developmental work in the Lakes Entrance district. The following noteswere compiled during several visits to the Imray bore while drilling was in progress. Use was also made of the drillers' log supplied by the syndicate to the Mines Department, and reports of the Commonwealth Palaeontologist.

LOCATION.

The bore is situated in allotment 124A Parish of Colquhoun, County of Tambo, at a point 415 feet north 20° west from the southernmost angle of the allotment. The land is included in lease No. 2 issued under the Mines (Petroleum) Act 1935. Aneroid readings show that the derrick floor is 135 feet above sea level.

DRILLING OPERATIONS.

Drilling was carried out with a steam-driven percussion plant used with a tubular steel derrick. Samples of the strata were taken every 10 feet and sent for examination by the Commonwealth Palaeontologist. A continuous core of the oil-bearing series was taken with a Baker core barrel, and the recovery was satisfactory. Eight-inch casing was set and cemented at 398 feet, shutting off the top water horizon, and 6-inch casing was set and cemented at the top of the oil-bearing stratum at 1,253 feet.

STRATIGRAPHICAL SEQUENCE.

The drillers' log records a succession of marls and limestones from 61 to 1,005 feet, followed by 248 feet of brown micaceous clay, and the green glauconitic sandstone in which the oil is accumulated. The sequence determined by the Commonwealth Palaeontologist is as follows:--

9	to	60½	feet Upper Pliocene and Pleistocene
60½	to	215½	feet Lower Pliocene (Kalimnan)
215½	to	244	feet Transition to Miocene
274	to	630	feet Middle Miocene
630	to	1,005	feet Lower Miocene
1,005	to	1,253	feet Upper Oligocene (Micaceous series)
1,253	to	1,273	feet Upper Oligocene (Glauconite series)

WATER:

Two water horizons were penetrated, one at 500 feet, and another at 580 feet. Partial analyses of these waters indicate a concentration of 897 parts per million, with sulphate and chlorine contents of 10 per cent. and 31 per cent. respectively, closely agreeing with the chemical and other characteristics of the upper water in the No. 1 Lakes Entrance Development Bore.

GAS.

Gas was first recorded at 766 feet, and persisted in moderate quantities throughout the Lower Miocene marl and Upper Oligocene micacious series. It was not possible to obtain a sample for analysis, but as it burned with a pale-blue non-luminous flame suggestive of methane it is probably a "dry" gas identical with that recorded under similar circumstances in other bores.

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OIL.

Traces of oil were evident in the micaceous series and higher, but in no case was there more than a thin film visible. Similar traces were recorded in other bores, and there is nothing abnormal in the occurrence at the Imray bore. The association of gas and oil traces in the Lower Miocene and Upper Oligocene micaceous series suggests that oil-forming conditions were present to a limited extent during the deposition of these strata, but it is not implied that they are the source beds for the oil in the lower (glauconitic)horizon.

Oil in appreciable quantities was present in the Upper Oligocene galuconitic sandstone penetrated at 1,253 feet. The oil is principally accumulated in coarse gravelly lenses within the glauconitic s series, and the production tests showed that the yield improved when these lenses were reached. No water or emulsified oil accompanied the oil, which is not under pressure in the reservoir. The oil is identical with that produced in other bores in the area.

PRODUCTION.

Tests for production were made during and after coring into the oil-bearing stratum, and the maximum rate from 20 feet of open hole (approximately 28.5 square feet surface area) was .29 gallons per hour for 23 hours. It was noted that the oil did not rise in the hole, and it is possible that an improved yield would be obtained by reducing the fluid level from time to time and thus minimizing the small back pressure which would stop the oil flowing into the bore.

SUSPENSION OF OPERATIONS.

Work was suspended and the bore sealed at the request of the Commonwealth Oil Advisory Committee in August, pending the investigation of a scheme for unit development of the area.

CONCLUSIONS:

The following conclusions may be drawn from the work performed at this bore:—

(1) It is possible to obtain "dry" oil from the Upper Oligocene glauconitic sandstone if drilling is stopped before the lower water horizon is penetrated.

(2) The oil is not under natural pressure, and if commercial quantities are present they would have to be lifted by pumping or bailing.

Date of Report

-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-

14/12/38.

See Min geol. J. Vic.
5 (4) 72
Vol No Page
Article by I.C.H. Croll.

DR. F. H. CAMPBELL: 12/7/38.

Imray Well

Depth	Percentage oil by weight	
1259'6"	.17%	
1263'	.53%	
1274'6"	3.3%	) tests dated 14/6/38 by air drying
1253'3"/1254'3"	1.05%	) Petroleum ether from undried sample
1254'	.33%	to be regarded as minimum values
1274'	4.16%	
6)	9.54%	
	1.59%	

Average of averages (Chapman & Campbell):-

8.25
1.59
2)9.84%(4.92%.

F. CHAPMAN'S TESTS: IMRAY WELL:

Depth	Weight of sample.	Tested with	Percentage oil by weight	Remarks
1258'6"	280 grns.	Petroleum ether	1.43%	Residue treated with pure ether gave addln.9.78%.
1260'6"	285 "	pure ether	9.7%	
1262'	283 "	pure ether	2.47%	After removing 19.8% of water by slow drying
1263'	183 "	pure ether	6.01%	After removing 4.37% moisture.
1274'	187 "	pure ether	11.23%	
1274'		pure ether	19.23%	(After making much longer period of digestion)
1274'6"	130 "	pure ether	7.69%	After drying out 10% of water
			57.76%	
		Average -	8.25%	

MR. WATSON: vide Croll's report:

Range from .07% to 1.05% which he (Croll) states to average .39%, which he considers should be brought up to .89% or in round figures 1%.

Average of averages:-

Chapman,	8.25
Campbell,	1.59
Watson (as determined)	.39
3)	10.23
	3.41%

Ex. Cook's Reports (Separation Lab Extension Oil Shaft Project).

MRAY WELL

Bailing started Tuesday 27 Feb 1945 and

days elapsed since last bailing 1100 days.

27-2-45 Fluid 43 ft from surface

column of oil 978 ft.

.. .. water 253 ft.

Total depth 1274

Ratio of water in oil 1 : 3·866

% age of oil 79·45 %

oil in tanks on surface 1042 galls

i.e. 1·065 galls/ft.

water est. = 270 galls.

on 13th July 1944 after standing for 695 days.

was bailed. Fluid from surface 109'

column of oil 992'

Column of water 173'

Total depth of hole. 1274'

Ratio of water to oil 1 : 5·734

% age oil 85·15 %.

17-11-41	177'4"	in 45 days 19 hrs.	
7-3-43	995 ..	375 ..	
29-11-43	~~445'9"~~		
	1128'3"	642 days.	
9-11-44	1217'10"	988 ..	
27-2-45	1231'	1096 ..	

Date 1945	Hours Stand.	Total fluid bailed	water	Bbls oil / 24 hrs.	~~Bbls~~ oil ~~to bbls water~~	% of water in oil / ~~24 hrs.~~	~~Bbls~~ oil / 24 hrs.
3	19½	5½	1½	38·4	40	4	49·2
5	48	100½	21	38·2	80½	5	40·25
6	28½	51½	9½	37·2	48	8	40·4
7	19½	38½	6½	36·6	32	7	39·4
8	24	48	10	35·7	38	6	38·0
9	..	45	8½	34·3	36½	6	36·5
10	..	46½	8½	35·7	38	6	38·0
12	48	89	15	34·8	74 3	6	37
13	24	40¼	9½	28·9	30¼	6	30¾
14	..	39½	7½	30·1	32	6	32
15	..	41½	9½	30·4	32	5	32

Date 1945	Hours Standing	Total Fluid	water	oil	% water in oil	oil / 24 hrs	Adj oil / 24 hrs.
16	24	42 1/2	8 1/2	34	4	34	32.6
17	..	40 3/4	6 3/4	34	8	34	31.3
19	48	85 1/2	18 1/2	67	5	33.5	31.8
20	24	41 3/4	8 1/2	33 1/2	7	33.5	31.2
21	"	41 1/2	8 1/2	33	5	33	31.3
22	..	41 1/2	9	32 1/2	4	32.5	31.2
23	..	41 3/4	8 3/4	33	4 1/2	33	31.5
24	..	41 3/4	8 1/2	33 1/4	5	33.25	31.6
24	48	83	18	65	5	32.5	30.9
27	24	40 1/2	8 1/4	32 1/4	5 1/2	32.25	30.4
28	..	39 1/2	8 1/2	31	4	31	29.8
29	..	42	9	33	4	33	31.7
Apr 3	120	200	41	159	5	31.8	30.2
4	24	41 3/4	8 3/4	33	4	33	31.7
5	24	40 1/2	8	32.5	5 1/2	32.5	30.7
6	24	41	8 3/4	32.25	5 1/2	32.25	30.5
11	120	201 3/4	45	156 1/4	4	31.25	30.1
12	24	43 1/4	8 3/4	35	5	35	33.2
13	..	40 1/4	8	32 1/2	4	32.5	31.2
14	..	40	9	31	5	31	29.5
17	72	121 3/4	27	94 3/4	5	31.6	30
18	24	42 1/2	9	33 1/2	6	33.5	31.5
20	144	141 1/4	48 1/2	191 3/4	6	32.1	30.1
26	48	81	16 1/2	64 1/2	5	32.25	30.6
27	24	40 1/4	8 1/4	32	5	32	30.4
30	72	117 3/4	24 3/4	93	5	31	28.9
May 1	24	39	8 1/4	30 3/4	6	30 3/4	28.9
2	-	38	8	30	6	30	28.2
3	-	33	3	30	5	30	28.5
4	-	39 1/2	7	32 1/2	5	30 1/2	30.9
~~5~~	~~24~~	~~49~~	~~16 1/2~~	~~32 1/2~~	~~10~~	~~32 1/2~~	~~29.2~~
~~7~~	~~48~~	~~98 1/2~~	~~33 1/2~~	~~65~~	~~8~~	~~32 1/2~~	~~29.9~~
~~8~~	~~24~~	~~50 1/4~~	~~16 1/2~~	~~33 3/4~~	~~8~~	~~33 3/4~~	~~31.0~~
10	48	99 3/4	35	64 3/4	10	32.4	29.2
~~11~~	~~24~~	~~47~~	~~16~~	~~30~~	~~8~~	~~30~~	~~27.6~~
7	72	110	13 1/2	96 1/2	5	32	30.4
8	24	42 1/2	8	34 1/2	6	34 1/2	32.4
10	48	71 3/4	13 3/4	58	5	29	27.6
11	24	40	10	30	5	30	28.5

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Austral Oil Syndicate. / Imray Bore

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El. 135. (Lat. 37°52'08"S) PL Colquhoun. PP Lease 2.
1939 T.D. 1274. (Long. 147°39'48"E) (Ludr
1938

I.C.H. Croll

Location allot 124A. PL. Colquhoun Co. Tambo. 415' N 20°W. from southernmost angle of the allot. In P.P. Lease 2.

Elevation: 135' Derrick floor.

Drilling operation with percussion plant. Continuous core of oil bearing strata taken with Baker core barrel, with satisfactory recovery. 8" casing set & cemented at 398' shutting off top water horizon. 6" casing set & cemented at top of oil bearing stratum at 1,253'

Stratigraphic Sequence Drillers log records a succession of marls & limestones from 61' - 1005', followed by 248' of brown micaceous clay, & then the green glauconitic sandstone in which the oil is accumulated. The sequence by Comm. Paleo. is

Upper Pliocene and Pleistocene	9' to 60½'
Lower Pliocene (Kalimnan)	60½' to 215½'
Transition to Miocene	215½' to 244'
Middle Miocene	274' to 630'
Lower Miocene	630' to 1005'
Upper Oligocene (Micaceous Series)	1005' to 1253'
Upper Oligocene (Glauconite Series)	1253' to 1273'

Water Two water horizons penetrated at 300' and 580'. Partial analysis of these gives concentration of 897 ppm with a chlorine content of 31% & sulphate content 10%.

Fmray Bore.

Gas

Gas unit recorded at 766', persisted in moderate quantities throughout the Lower Miocene marl & Upper Oligocene micaceous series. No sample was obtained, but it burnt with a pale blue non-luminous flame suggestive of methane.

Oil

Traces of oil were evident in the micaceous series & higher, but in no case was there more than a thin film visible ~~the~~ oil in appreciable quantities was present in the Upper Oligocene glauconitic sandstone penetrated at 1253'. The oil is principally accumulated in coarse gravelly lenses within the glauconite series, and the production tests showed that the yield improved when these lenses were reached. No water or emulsified oil accompanied the oil, which is not under pressure in the reservoir.

Production. Tests were made during & after coming into the oil bearing stratum, and the max. rate from 20' of open hole (approx 28.5 ft² surface area) was 0.29 g.p.h. for 23 hours. It was noticed the oil did not rise in the hole. ~~This possible that an improved~~

Suspension of operations

Work was suspended & the bore sealed at the request of the Commonwealth Oil Advisory Committee in August pending investigation of a scheme for unit development of the area.

Imray Bore

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3/3.

Raggatt 1940 Drilled to near base of the glauconite & plugged ~~back~~ to hold back water under the direction of the Oil advisory Committee Bailing tests extended over 400 days, gave a production of about 5 gallons per day.

Rising tests were commenced in Sept 1939., the fluid column in the bore being allowed to rise, and the level measured at weekly intervals. The rate of rise at commencement was 4 ft/day but by June 10. 1940 it had gradually decreased to 2½ ft/day, due to approaching equilibrium

Re H.G. Leggett 1940 "Oil Possibilities in the Lake Erie Area"

Imray.

Bailing tests over 400 days gave a production of about 5 galls/day (not completely water-free Oil).

Rising tests commenced in Sept 1939.
Rate at start 4'/per day but by 10-6-40 it had gradually decreased to about 2 ft per day.

2. PRELIMINARY REPORT

20

Parking Report
finished
30/3/39

I M R A Y W E L L.

PRELIMINARY REPORT ON THE IMRAY BORE, EAST GIPPSLAND.
(15 chains N.W. of Foster's Bore).

Sample 1. 9'-60'6".- Ochreous coloured gritty sandrock, with a feeble clay cement.

Washings consist mainly of angular to partially rolled quartz grains and some limonitic particles. Occasional felspathic(saussuritised) fragments and mica flakes present. A few arenaceous foraminifera (Trochammina and Haplophragmoides) occur in the finer siftings.
This sample comes within the Recent to Up.Pliocene.

Sample 2. 60'6" - 61'3".- Hard whitish to fawn-coloured calcareous sandstone, with flakes of dark greenish mica. Matrix containing numerous mollusca, chiefly as casts and impressions, due to partial metasomatic solution.

The mollusca are represented by indeterminate bivalves and Turritella sp.

A thin section shows about 20 % of minute angular quartz grains with a large proportion of calcareous cement, the latter invading the hollow shells and crystallising out as calcite. Embedded in the matrix are remains of polyzoa, indet. ; echinid spines and test fragments; molluscan shelly fragments and numerous foraminifera.

Amongst the Foraminifera identified are,- Eponides repandus(frequent), Anomalina rotula, Globigerina bulloides, Globorotalia sp., Nonion sp., Elphidium macellum and Triloculina trigonula.
This hard band and the succeeding, to Sample 8,are in the Lower Pliocene(Kalimnan)

Sample 3. 61'3"- 90'. - Moderately soft, bluish-grey shelly marl, with ochreous streaks.

Washings contain mollusca(Turritella tristira, Venericardia sp., Clausinella cf. subroborata, some Ostracoda and abundant spicules of the tunicates or Sea-squirts in the finer siftings.

Foraminifera are represented by Nodosaria raphanistrum, Bulimina inflata, B.pupoides, B.polystropha, Bolivina aff. limbata, Rotalia beccarii(very common), R.aff.venusta, Globigerina bulloides, Nonion aff.depressula, N.scapha(v.c.) N. rictaziana Cushman, Elphidium macellum, Quinqueloculina seminu-

61'3" - 90' contd.

lum, Q.agglutinans, Q.ammophila, Q.vulgaris, Triloculina circularis, T.tricarinata and Karreriella siphonella.

Ostracoda present are,- Bairdia amygdaloides, Cythere demissa, C.tetrica, C.scutigera, C.scabrocuneata, C.dictyon.

Typical Kalimnan.

Sample 4. 90'-118'.- Tenacious bluish-grey, sandy and shelly marl.

Washings largely consist of minute green glauconite grains, with some angular quartz. Also occasional arenaceous foraminifera, indet. and many small hyaline forms indicative of shallow water conditions. Ostracoda, and a few molluscan fragments, of which only Eulimella is recognisable.

In the finer washings broken spicules of the freshwater sponge (Spongilla) are fairly abundant. These sponge remains were either washed down by river agency or blown into the shallow Kalimnan sea by strong winds from the north. There are also abundant calcareous spicules of Tunicates present.

Foraminifera.- Bulimina elongata (new var.), Uvigerina pigmea, Nonion aff.depressulus, N.scapha, N.~~stelligera~~ striatulus, Elphidium macellum, E.crispum, E.striatopunctatum, Planispirina sigmoidea, Quinqueloculina oblonga, Q. seminulum, Q. vulgaris, Q.lamarckiana, Q.agglutinans, Spiroloculina cf. arenaria, Sigmoilina bradyi, Triloculina tricarinata,

Gasteropoda.- Eulimella sp.

Ostracoda.- Pontocypris simplex, Cythere acupunctata.

Kalimnan.

Sample 5. 118'-142'.- Tenacious, dark brownish grey, sandy and shelly marl. Sediments and fossils indicate fairly shallow water conditions.

Washings contain numerous molluscan shells, barnacles, echinoid spines, foraminifera (abundant) and ostracoda.

Fine Washings consist of minute angular quartz grains, foraminifera and abundant spicules of Tunicates.

118'-142' contd.

Foraminifera.- Nodosaria scalaris, Lagena orbignyana, Glandulina laevigata, Bulimina aculeata(c.), Rectobolivina striata, R.bifrons var.striatula, Discorbis vesicularis var.dimidiata, Rotalia beccarii(c.), R.howchini, Anomalina nonionoides, Nonion ~~stelligera~~ victoriense, Elphidium crispum, E.striatopunctatum, Rhizammina indivisa, Planispirina sphaera, Quinqueloculina vulgaris, Q.agglutinans, Q. ammophila, Sigmoilina bradyi, Triloculina tricarinata, Pyrgo bulloides.

Ostracoda.- Macrocypris decora, M.tumida, Cythere militaris, C.tetrica, C.dictyon, C.normani, Cytherella punctata.

Pelecypoda.- Venericardia gippslandica.

Scaphopoda.- Dentalium tornatissimum.

Gasteropoda.- Pyramidella deplexa, Turritella tristira, T. conspicabilis.

Crustacea(Cirripedia).- Balanus amphitrite var.acuta.

Kalimnan.

Sample 6. 142'-168'. - Tenacious bluish-grey sandy marl, with greenish tinge in parts.

Washings. Shelly fragments(mollusca), abundant Foraminifera and Ostracoda. Sandy portion consisting of angular grains of quartz, occasional glauconite casts of foraminifera, limonitic particles and mica flakes.

In fine washings Tunicate spicules are abundant.

Foraminifera.- Bulimina elegans, B. aculeata, Bolivina beyrichi, Rotalia howchini, R.beccarii, Anomalina nonionoides, Cibicides ungerianus, Nonion scapha, Elphidium striatopunctatum, E. imperatrix, Quinqueloculina vulgaris, Clavulina cf. parisiensis.

Ostracoda.- Bythocypris tumefacta, Cythere tetrica, C.scabrocuneata, C.scutigera, Cytherideis sp.

Gasteropoda.- Turritella sp.

Crustacea(Cirripedia).- ?Balanus amphitrite var.acuta.

Sample 7. 168'- 188'.- Greenish-grey sandy and shelly marl, with dark greemish nodular lumps containing massive polyzoa.

Washings contain shelly fragments(Turritella), glauconite grains, brown and white mica flakes and abundant Foraminifera, and Ostracoda, and Polyzoa.

In the Fine Washings occur numerous dolomite crystals and also spicules of tunicates and sponges.

Foraminifera.- Lenticulina orbicularis, Bolivina beyrichi, Uvigerina pigmea, Discorbis vesicularis, x var. dimidiata, Rotalia beccarii, R. perlucida, R. howchini, Anomalina nonionoides, Cibicides lobatulus, Nonion depressulus, N. stelligera, N. scapha, Elphidium crispum, Quinqueloculina vulgaris, Q. lamarckiana, Sigmoilina bradyi, Triloculina tricarinata.

Pelecypoda.- Condylocardia sp. Venericardia calva.

Gasteropoda.- Turritella tristira.

Ostracoda.- Macrocypris decora, Bythocypris tumefacta, Cythere demissa, C. militaris, Cytherella lata.

Polyzoa.- Cellaria australis, C. contigua, Melicerita angustiloba, Lunulites canaliculata, Retepora sub immersa.

Kalimnan.

Sample 8. 188'-215' 6".- Greenish-grey, shelly and sandy marl.

Washings contain shell fragments, polyzoa(worn), Foraminifera, echinid spines and a fair amount of glauconite. Also Ostrea and Mopsea.

Fine Washings contain chiefly minute quartz grains, shelly flakes and foraminifera.

Foraminifera.- Lagena favosopunctata, Bulimina aculeata, Rotalia howchini, Siphonina australis, Cibicides ungerianus, C. victoriensis, C. lobatulus, Dyocibicides variabilis, Anomalina nonionoides, Globigerina bulloides, Quinqueloculina vulgaris, Q. vanusta, Triloculina tricarinata.

Polyzoa.- Cellaria rigida, C. contigua.

Ostracoda.- Cythere dictyon.

near base of the Kalimnan.

Sample 9. 215'6"-244'.- Grey, friable, sandy marl.

Washings contain abundant polyzoa and some Mopsea joints. The Foraminifera are scarce and small and there are some glauconite grains present.

Fine Washings chiefly of minute quartz grains and broken sponge spicules; also a few tunicate spicules present.

Foraminifera.- Uvigerina tenuistriata, Discorbis vesicularis, D.margaritifera, Rotalia howchini.

Polyzoa.- Cellaria contigua, Melicerta acutimarginata, Retepora sp.

Upper Miocene.

Sample 10. 274'.- Grey, tenacious, shelly and polyzoal marl.

Washings consist largely of polyzoa, at time slightly encrusted, and numerous joints of Mopsea. Also some shell fragments, probably Ostrea.

Fine washings contain quartz, sponge spicules and abundant crystals of dolomite with an average diameter of 27 mu.

Foraminifera.- Lenticulina orbicularis, Rotalia howchini, ?Pulvinulinella tenuimargo, Cibicides lobatulus, C.ungerianus, Dyocibicides variabilis, Textularia gramen.

Polyzoa.- Cellaria rigida, C.gracilis, Schismopora granum, Idmonea conferta, Hornera tuberculata, H.frondiculata.

Anthozoa.- Mopsea sp.

Middle Miocene. Polyzoal series.

Sample 10 A. 300'-368'.- Whitish-grey, friable polyzoal limestone, with occasional shell-fragments.

Washings consist of abundant polyzoa and joints of Mopsea, with occasional Foraminifera and echinid spines.

Fine Washings contain numerous minute foraminifera.

Foraminifera.- Lenticulina orbicularis, Rotalia howchini, Cibicides lobatulus, Elphidium crispum, Spiroplecta ammina carinata, Textularia sagittula.

Anthozoa.- Mopsea tenisoni.

Polyzoa.- Idmonea hochstetteriana, I. contorta, Hornera involuta.

Mid.Miocene.

Sample 11. 396'-408'.- Pale grey, moderately tenacious, polyzoal marl.

Washings rich in Polyzoa, as Lepralia, Membranipora, Retepora, Hornera, etc. Also occasional Foraminifera and Ostracoda, and moderately abundant Mopsea.

Medium siftings with abundant Foraminifera and Ostracoda.

Fine Washings with abundant rotaline forms and some spicules of calcisponges.

Foraminifera.- Glandulina laevigata, Ramulina sp., Bolivina punctata, B.limbata, B.cf.aenariensis, cf.Baggina, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, Elphidium macellum, E.crispum, Spiroplectammina carinata.

Ostracoda.- Loxoconcha australis, Xestoleberis cf.africana, Cytherella lata.

Anthozoa.- Mopsea sp.

Polyzoa.- Cellaria contigua, Hornera tuberculata.

Middle Miocene.

Sample 12. 408'-490'. Dark-grey, friable polyzoal marl.

Coarse Washings consisting largely of polyzoa (some massive fragments); also numerous joints of Mopsea and Foraminifera.

Medium and Fine Siftings contain Foraminifera, Ostracoda and echinid spines.

Sample 12 continued.
Foraminifera.- Lenticulina orbicularis, L.articulata, N.hispida, Nodosaria raphanistrum, Lagena orbignyana, L.lacunata, L.striata, Bolivina robusta, Heronallenia lingulata, Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, C.victoriensis, Ammosphaeroidina sphaeroidiniformis, Gaudryina rugosa.

Middle Miocene.

Sample 13. 490'-495'. Pale grey sandy marl.
Coarse Washings largely composed of polyzoa, together with shelly fragments, echinid spines and Mopsea joints; also a few Foraminifera.
Finer Washings with abundant Foraminifera and Mopsea.
Foraminifera.- Dentalina fissicostata, Lingulina bartrumi, var.metungensis, Guttulina problema, Bolivina punctata, Gyroidina soldanii, Eponides repandus, ?Pulvinulinella tenuimargo, mata Rotalia howchini, Cibicides victoriensis, Orbulina universa, Textularia sagittula, Ammosphaeroidina sphaerodiniformis.
Polyzoa.- Adeona clavata, Lepralia gippslandica, Menipea uniserialis, Idmonea geminata.

Lower ~~Middle~~ Miocene.

Sample 14. 575'-610'.- Pale grey polyzoal marl, somewhat plastic.
Coarse Washings consisting largely of Polyzoa, with massive pieces of Cellepora. The latest appearance of some of the larger forms of Foraminifera belonging to the Lower Miocene are met with in this sample, as Hofkerina and Operculina.
Finer Washings contain Foraminifera, echinid spines and joints of Mopsea.
Foraminifera.- Lenticulina orbicularis, L. articulata, L.cultrata, Vaginulina legumen, Dentalina fissicostata, ?Pulvinulinella tenuimargo, mata Siphonina australis, Anomalina glabrata, Cibicides ungerianus, C.victoriensis, C. lobatulus, Dyocibicides variabilis, Planorbulinella larvata, Acervulina inhaerens, Gypsina globulus, G.vesicular,

Sample 14 continued.

Foraminifera contd.
Hofkerina semiornata, Sphaeroidina bulloides, Globigerina triloba, G.bulloides, Operculina victoriensis, Textularia sagittula.

Ostracoda.- Loxoconcha alata.

Polyzoa.- Cellaria contigua, Membranipora sp., Idmonea sp.

Lower Miocene.

Sample 15. 610'-630'.- Pale grey polyzoal marl, somewhat plastic; with occasional shell fragments.
Coarse Washings chiefly formed of polyzoa and a few large foraminifera(Lenticulina and Gypsina).
Medium Washings with abundant foraminifera, chiefly rotalines, Mopsea joints, echinoid spines and a few glauconite grains.

Foraminifera.- Lenticulina orbicularis, Cassidulina subglobosa, Eponides repandus, cf.Pulvinulinella tenuimargo, Rotalia howchini, R.beccarii, Siphonina australis, Cibicides victorianus, C.ungerianus, Dyocibicides biserialis, Gypsina vesicularis, Globorotalia truncatulinoides, Textularia sagittula.

Polyzoa.- Bigemmellaria pedunculata, Crisia acropora, Retepora beaniana, R.lineata, Idmonea sp., Hornera tuberculata, Mecynoecia proboscidea.

Lower Miocene.

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Imray Bore.

Sample 16. 630'-654'.- Pale grey polyzoal marl, darker in parts, somewhat friable.

Coarse Washings chiefly consist of cyclostomatous Polyzoa, some joints of Mopsea, ossicles and stem plates of Antedon; also a few Foraminifera.

Medium Washings contain an abundance of minute Foraminifera and echinid spines.

Foraminifera.- Lenticulina orbicularis(common), L.articulata, Lingulina bartrumi,var.metungensis, Cassidulina subglobosa, Anomalima glabrata, Cibicides ungerianus(common), Globorotalia truncatulinoides(frequent), Carpenteria proteiformis, Amphistegina lessonii(frequent), Operculina victoriensis, Textularia sagittula.

Anthozoa.- Mopsea hamiltoni, M.tenisoni(common).

Crinoidea.- Antedon sp.

Polyzoa.- Cellaria rigida, Cellepora fossa, Hiantopora liversidgei, Retepora porcellana, R.subimmersa, Tessarodoma elevata, Idmonea venusta, Hornera prominens, Hornera tuberculata.

Sample 17. 654'-673'. Greenish grey, somewhat plastic, polyzoal marl.

Coarse Washings with abundant Polyzoa, chiefly Cyclostomes, large Foraminifera as Carpenteria and Amphistegina, and numerous echinid spines and joints of Mopsea.

Medium Washings with abundant minute Foraminifera.

Foraminifera.- Lenticulina gyroscalprum, L. orbicularis, L.articulata, Vaginulina legumen, Lagena orbignyana, Eponides repandus, Epistomina elegans, Heronallenia lingulata, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, C.victorianus, Dyocibicides variabilis, Gypsina globulus, Carpenteria proteiformis(frequent), Globigerina conglobata, Dorothia gibbosa.

Addendum to p.9. Sample 16. 630'-654'.

Marginulina costata, Lepidocyclina cf. martini (fragment showing vertical section through centrosphere), L. marginata (rolled fragment showing tangential chambers).

Sample 17 contd.

Polyzoa.- Porina gracilis, Heteropora pisiformis, Crisia macrostoma, Idmonea trigona, I.hochstetteriana, Mecynoecia proboscidea, Retepora fissa, Hornera tuberculat-

Sample 18. 673'-685'. Greenish grey marl with whitish patches. Somewhat plastic. Upon dropping the slowly dried material into water numerous bubbles are liberated. These show under the microscope occluded oily globules. In the finer sediment occur minute dolomite crystals.

Coarser Washings contain fragments of white limestone, shelly particles, joints of Mopsea, abundant Polyzoa and Foraminifera.

Medium Washings with abundant minute Foraminifera, chiefly rotalines.

Foraminifera.- Lenticulina gibba, L.rotulata, L.orbicularis (very common), L.cf.umbonata, Lagena castrensis, Cassidulina subglobosa, Siphonina australis, Cibicides victoriensis, C.lobatulus, Amphistegina lessonii, Operculina victoriensis

Polyzoa.- Cellaria australis, Steganoporella patula, Porina gracilis, Retepora fissa, Filisparsa orakeiensis, Entalophora verticillata.

Sample 19. 685'-690'. Pale greenish-grey tenacious marl, with Polyzoa and Foraminifera; somewhat plastic.

When immersed in water, oily bubbles arise. A film of oil globules produced with the chloroform test.

Coarse Washings show a small residue, chiefly of Polyzoa, echinid spines(Goniocidaris), joints of Mopsea and a few Foraminifera(Lenticulina).

Medium Washings with numerous Foraminifera, chiefly rotalines.

Foraminifera.- Lenticulina orbicularis, L.cultrata, L.rotulata, Dentalina fissicostata, D.consobrina, Nodosaria scalaris, Lagena orbignyana, Guttulina problema, Bolivina limbata, Cassidulina subglobosa, Heronallenia lingulata, H.wilsoni, Anomalina glabrata, Cibicides ungerianus, C.victorianus, C.lobatulus,

Sample 19
Imray Bore, continued.

Echinoderma, Goniocidaris prunispinosa(spines).

Polyzoa.- Porina gracilis, Hornera prominens.

Sample 20. 690'-700'. Pale grey tenacious marl.
Oily bubbles in evidence, as also strong reaction with chloroform.

Coarse Washings showing fragments of white and pale green limestone, abundant polyzoa, joints of Mopsea and some Foraminifera.

Medium Washings rich in smaller Foraminifera; also numerous echinid spines.

Foraminifera.- Lenticulina orbicularis, L.rotulata, L.vortex, L.crepidula, Lagena castrensis, Guttulina lactea, Globulina gibba, Sigmoidella elegantissima, Cassidulina subglobosa, Heronallenia lingulata, Eponides concentricus, E.scabriculus, Epistomina elegans, & Cibicides ungerianus, C.lobatulus, Carpenteria proteiformis, Operculina victoriensis(common), Verneuilina triquetra.

Polyzoa.- Cellaria gracilis, C.australis, Adeona clavata, Porina gracilis, Membranipora sp., Steganoporella patula, Porella baculina, Idmonea incurva, Retepora fissa, Hornera tuberculata, Lichenopora hispida, L.wilsoni.

Ostracoda.- Cythere scabrocuneata.

Lower Miocene.

Sample 21. 700-710'. Pale grey tenacious marl.
Traces of oil by chloroform test.

Coarse Washings contain shell fragments, Polyzoa and many large Foraminifera(Lenticulina, Carpenteria Amphistegina, Operculina); also ossicles of brittle-stars and starfish.

Medium Washings with numerous joints of Mopsea, and small Foraminifera, chiefly rotalines and Cassidulina

Fine Washings contain Bolivina.

Imray Bore.

Sample 21 contd. 700'-710'.

Foraminifera.- Lenticulina cultrata, L.articulata, L. calcar, L.angulata, L.orbicularis, Dentalina obliqua, Sigmoidella elegantissima, S.elegantissima, var.kagaensis, Bolivina limbata, Cassidulina subglobosa, C.calabra, Uvigerina pigmea, Heronallenia lingulata, Eponides concentricus, Siphonina australis, Cibicides lobatulus, C.victoriensis, Carpenteria proteiformis, C.rotaliformis, Amphistegina lessonii, Globorotalia truncatulinoides, Operculina victoriensis, Crithionina sp., Textularia sagittula, var.fistulosa.

Lower Miocene.

Sample 22. 710'-720'. Greenish-grey, rather friable marl. Oil globules showing on water-soaked material. Trace of oil by chloroform test.

Coarse Washings contain fragments of hard limestone, ossicles of Antedon, Polyzoa, Mopsea and a few large Foraminifera.

Medium Washings with broken Polyzoa and rotaline Foraminifera.

Fine Washings with minute rotalines an hyaline Foraminifera.

Foraminifera.- Lenticulina orbicularis, L.cultrata, Dentalina obliqua, Cassidulina subglobosa, Eponides repandus, Cibicides ungerianus, C.lobatulus, C.victoriensi cf.Rectocibicides sp., Carpenteria rotaliformis, Pullenia sphaeroides, Globorotalia truncatulinoides, Verneuilina ensiformis.

Polyzoa.- Cellaria contigua, Porella baculina, Cellepora coronopus, Tessaradoma elevata, Retepora beaniana, Entalophora australis, E.australis, Idmonea milneana, Lichenopora australis.

Ostracoda.- Cythere flexicostata.

Lower Miocene.

Sample 23. 720'-730'. Greenish-grey, friable marl. Traces of oil on water surface in washing. Finest sediment with abundant coccoliths and occasional dolomite crystals.

Coarse Washings consist of Polyzoa, Mopsea joints, ossi ossicles of Crinoids, plates and spines of echinids and Foraminifera.

Medium Washings with Lenticulina, rotalines and Cassidulina.

Foraminifera.- Lenticulina orbicularis, L.rotulata, L.articulata, Cassidulina subglobosa, Discorbis raresc cens, Heronallenia lingulata, Eponides repandus, ?Pulvinulinella tenuimargo~~o~~inata, Anomalina glabrata, Cibicides ungerianus, C. victoriensis, Planorbulinella plana, Carpenteria proteiformis, Amphistegina lessonii, Globorotalia truncatulinoides, Lepidocyclina tournoueri, L.martini, Operculina victoriensis, Verneuilina triquetra.

Polyzoa.- Schizoporella macgillivrayi, Steganoporella patula, Porina vertebralis, Porella baculina, Retepora fissa, Idmonea geminata, Hornera tuberculata.

Sample 24. 730'-735'. Greenish-grey marl, somewhat plastic. Traces of oil bubbles on surface of water in washing. When highly magnified these bubbles are seen to be surrounded by a zone of oily material.

Coarse Washings contain Polyzoa, Antedon ossicles and large Foraminifera(Amphistegina, Carpenteria, Lenticulina and Lepidocyclina); also cidaroid spines.

Medium Washings contain abundant small Foraminifera, chiefly Cassidulina and rotalines, with spines of echinids and Mopsea joints.

Finest Washings chiefly minute Foraminifera(Cibicides and Bolivina).

Foraminifera.- Lenticulina orbicularis, L.rotulata, L. cultrata, Lagena castrensis, Bolivina limbata, Cassidulina subglobosa, Gyroidina soldanii, Eponides

C

Imray Bore.

Sample 24, contd.

karsteni, Mississippina concentrica, Cibicides ungerianus, C.victoriensis, Dyocibicides biserialis, Carpenteria proteiformis, Amphistegina lessonii, Lepidocyclina tournoueri, Textularia rugosa, T. sagittula.

Polyzoa.- Amphiblestrum simplex, Hornera tuberculata, Mecynoecia proboscidea.

Sample 25 735'-738'. Grey, friable, polyzoal and foraminiferal marl. Traces of oil on surface of water during washing. The finest floatings of sediment with abundant coccoliths.

Coarse Washings with a few, somewhat rolled polyzoa. Large Foraminifera fairly abundant (Operculina, Amphistegina and Lepidocyclina).

Medium Washings with polyzoa and smaller Foraminifera, chiefly rotalines; also joints of Mopsea.

Foraminifera.- Lenticulina orbicularis, L.cultrata, Dentalina communis, Trifarina bradyi, Cassidulina subglobosa, Discorbis vesicularis, D.bertheloti, Gyroidina soldanii, ?Pulvinulinella tenuimarginata, Anomalina glabrata, Cibicides lobatulus, Dyocibicides biserialis, Amphistegina lessonii, A.radiata, Operculina victoriensis, Lepidocyclina tournoueri, L.howchini, L.borneensis.

Polyzoa.- Cellepora coronopus, Porina tubulifera, Idmonea hochstetteriana.

Sample 26. 738'-750'. Dark grey, polyzoal, shelly and foraminiferal marl; somewhat plastic.

Numerous bubbles with coating of oily matter arising from the water during washing. Coccoliths abundant in the finest sediment.

Coarse Washings, with Foraminifera (Lenticulina common, Operculina and Amphistegina). Polyzoa abundant and well preserved. Stem fragments and joints of Mopsea.

Fine Washings with pelagic Foraminifera (Globigerina and Pulleniatina; also abundant rotalines.

Imray Bore.

Sample 26 contd.

Foraminifera.- Lenticulina orbicularis, L.gyroscalprum, L.articulata, L.gibba, Lagena castrensis, Sigmoidella elegantissima, Heronallenia lingulata, Gyroidina soldanii, Eponides exiguus, Epistomina elegans, Mississippina concentricus, Cibicides victoriensis, Dyocibicides biserialis, Gypsina vesicularis, Amphistegina radiata, Globigerina triloba, G.bulloides, Pulleniatina obliquiloculata, Operculina victoriensis.

Polyzoa.- Amphiblestrum spathuloides, Steganoporella patula, Porina(Acropora) vertebralis, Tessaradoma elevata, Idmonea hochstetteriana, Mecynoecia proboscidea.

Brachiopoda.- Magellania cf.tateana(T.Woods). juv.

Sample 27. 750'-760'. Dark grey polyzoal and foraminiferal marl, somewhat plastic. Oily globules liberated in water. Abundant coccoliths in the finest sediment.

Coarse Washings, with abundant and well preserved Polyzoa, echinoid spines and Foraminifera(Amphistegina, Operculina and Lenticulina).

Medium Washings contain fragmentary polyzoa, Globigerina and rotalines.

Foraminifera.- Lenticulina orbicularis, L.cultrata, L.rotulata, Dentalina consobrina, D.retrorsa, D. roemeri, Reussella spinulosa, Heronallenia lingulata(c.), Eponides karsteni, E.repandus, Siphonina australis, Anomalina glabrata, Cibicides lobatulus, C.ungerianus, C.victoriensis, Amphistegina lessonii, A.radiata, Globigerina triloba, Globigerina bulloides, Pulleniatina obliquiloculata, Operculina victoriensis, Discammina emaciatum, Trochammina sp.

Polyzoa.- Porina(Acropora) gracilis, Retepora subimmersa, R.rimata.

Ostracoda.- Bairdia amygdaloides, Cytheropteron batesfordiense.

Sample 28. 760'-770'. Dark grey polyzoal marl, somewhat plastic.

Coarse Washings, roch in Polyzoa; also a few worn Foraminifera(Lenticulina and Amphistegina)

Medium Washings contain numerous small Foraminifera, chiefly rotalines; also broken polyzoa and joints of Mopsea.

Fine Washings with ascidian spicules, small rotalines, Bolivinae and Cassidulinae.

Foraminifera.- Lenticulina orbicularis, L.convergens, L.crepidula, Dentalina consobrina, Lagena marginata, Guttulina silvestrii, Bolivina limbata,B.robusta,B.textularioides, Cassidulina subglobosa, Ehrenbergina serrata, Discorbis globularis, Heronallenia lingulata, Gyroidina soldanii, Eponides repandus, ?Pulvinulinella ~~acuti~~ lemni-marginata, Epistomina elegans, Siphonina australis, Anomalina glabrata, Cibicides victoriensis, C.sorrentae, Dyocibicides serialis, Amphistegina radiata, Globigerina bulloides, G.triloba.

Polyzoa.- Steganoporella patula, Tessaradoma elevata, Porina(Acropora) vertebralis, Hornera tuberculata.

Ostracoda.- Cythere dictyon, Cytherella subtruncata.

Sample 29. 770'-780'. Dark greenish-grey, polyzoal and shelly marl. Numerous oil globules liberated when washed.

Coarse Washings with abundant Polyzoa, Mopsea joints and a few Foraminifera(Lenticulina and Textularia).

Medium Washings with numerous foraminifera and a few Ostracods.

Foraminifera.- Lenticulina orbicularis, L.articulata, L.cultrata, Dentalina consobrina, Lagena marginata, L. orbignyana, Nodogenerina adolphina, Discorbis tuberculata, Eponides scabriculus, Mississippina concentrica, Cibicides victoriensis, Globigerina bulloides,G.triloba, Textularia rugosa.

Ostracoda.- Bairdia foveolata, Cythere retroflexa.

Polyzoa.- Cellaria gracilis, Amphiblestrum spathulo-

Sample 29A. 780'- 794'. Pale grey, plastic, polyzoal marl.

Coarse Washings with abundant polyzoa, Foraminifera (Lepidocyclina), shell-fragments and joints of Mopsea.

Medium Washings with numerous Foraminifera and a few echinoid spines.

Fine Washings with abundant minute foraminiferal tests (Globigerina and rotalines).

Foraminifera.- Lenticulina cultrata, L.rotulata, Dentalina obliqua, Ceratobulimina haueri, var.australis, Eponides repandus, var., ?Pulvinulinella tenuimarginata, Mississippina concentrica, Cibicides victoriensis, Amphistegina lessonii, Globigerina triloba, Lepidocyclina martini, L. marginata.

Polyzoa.- Lepralia continua, Acropora vertebralis, Diastopora cf. dennanti,

Ostracoda.- Bairdia amygdaloides.

Sample 30. 790'-794'. Dark greenish-grey sandy marl. During washing, air bubbles encased with oil globules are liberated.

Coarse Washings contain numerous polyzoa, echinoid(spatangoid)spines, large Foraminifera(Lenticulina) and occasional rounded quartz grains.

Medium Washings with abundant Foraminifera, spatangoid spines and delicate,well preserved polyzoa.

Fine Washings with abundant Foraminifera(Cassidulina and rotalines; also abundant dolomite crystals.

Floatings yield abundant Tunicate spicules(Leptoclinum), and spicules of ?Spongilla, a freshwater sponge.

Foraminifera.- Lenticulina cultrata, L.orbicularis, L. convergens, L.gibba, Vaginulina legumen, Dentalina communis, D. consobrina, D.consobrina var. emaciata, D.farcimen, Lagena orbignyana, Cassidulina subglobosa Discorbis vesicularis, Heronallenia cf. biconcava, Gyroidina nitida, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, C.victoriensis, Dyocibicides biserialis, Sphaeroidina bulloides, Globigerina triloba, G. bulloides,

Sample 30 contd.

Sample 31 contd.

Polyzoa.- Cellaria gracilis, Amphiblestrum, spathuloides, Adeonellopsis clavata, Crisia acropora, Hornera prominens, H. tuberculata, ?Diastopora dennanti.

Sample 31. 794'-800'. Pale grey to green plastic marl, with chalky patches. Dried material, when immersed in water gives rise to abundant bubbles with gas and oil; these bubbles suddenly break on applying a lighted match.

Coarse Washings with abundant polyzoa, brachiopod fragments, Mopsea joints, cidaroid spines, ossicles of Antedon and Foraminifera(Lenticulina). The polyzoa are much eroded.

Medium Washings contain abundant Foraminifera, Mopsea joints and fragments of polyzoa.

Fine Washings contain an abundance of minute Foraminifera, chiefly rotalines and Globigerina bulloides with occasional echinoid spines(spatangoid).

Foraminifera.- Lenticulina orbicularis(c.), L.convergens, L.cultrata, L.elongata, Vaginulina legumen, Dentalina consobrina, D.consobrina,var.emaciata, D.fissicostata, Nodosaria scalaris, cf.Pyrulina fusiformis, Cassidulina subglobosa, Heronallenia lingulata, Eponides repandus, ?Pulvinulinella acutimarginata, Mississippina concentrica, Cibicides victoriensis, Dyocibicides biserialis, Carpenteria proteiformis, C.rotaliiformis, Amphistegina lessonii, Globigerina bulloides, G.triloba, Operculina victoriensis.

Polyzoa.- Tessarodoma elevata, Conescharellina philippinensis.

Imray Well contd.

Sample 32. 800'-803'. Whitish-grey marl, somewhat plastic. During washing abundant bubbles given off, showing gas and oil.

Coarse Washings containing large Foraminifera (Amphistegina abundant). Also polyzoa, ossicles o of starfish, plates of Antedon and a fragment of a brachiopod valve, indet.

Medium Washings contain a few Foraminifera, rather worn, fragments of polyzoa, Antedon ossicles and echinoid spines.

Fine Washings with minute Foraminifera (chiefly rotalines), shell fragments and polyzoa.

Foraminifera.- Lenticulina orbicularis, Lagena orbignyana, Guttulina lactea, Cassidulina subglobosa, Eponides repandus, ?Pulvinulinella acutimarginata, Cibicides victoriensis, C.ungerianus, C. sorrentae, Dyocibicides biserialis, Amphistegina lessonii, Awervulina inhaerens, Sphaeroidina bulloides, Gaudryina pupoides.

Polyzoa.- Entalophora verticillata, Hornera tuberculata, Haswellia producta.

Ostracoda.- Bairdia amygdaloides.

Sample 33. 803'-806'. Friable, granular marl, of a grey colour, with a slight tinge of green. This sample gave off innumerable bubbles on immersion in water.

Coarse Washings with numerous fragments of polyzoa, large Foraminifera (Lenticulina, Operculina and Amphistegina), ossicles of starfish and Antedon, spines of cidaroids, brachiopod valves, indet. and joints of Mopsea.

Medium Washings rich in Foraminifera, and with occasional polyzoa.

Fine Washings with minute Foraminifera (small glassy forms as Bolivina, Lagena and Ehrenbergina), spines of echinoids and joints of Mopsea.

Imray Well.

Sample 33 contd.

Foraminifera.- Lenticulina orbicularis, L.macrodiscus, L.cultrata, Dentalina consobrina var. emaciata, D. fissicostata, Lagena favosopunctata, L.hispida, Globulina gibba, Pyrulina fusiformis, Sigmoidella elegantissima, Bolivina robusta, var.decorata, Cassidulina subglobosa, Ehrenbergina serrata, Eponides repandus, ?Pulvinulinella acutimarginata, Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides refulgens, C.lobatulus, C.victoriensis, Amphistegina lessonii(c.), Globigerina bulloides, Globorotalia dehiscens, Operculina victoriensis, Globotextularia sp.

Polyzoa.- Smittia tatei, S.areolata.

Gasteropod.- ?embryo of Phorus sp.

Sample 34. 806'-816'. Pale grey, friable marl. Bubbles given off on immersion in water; when examined under microscope seen to be covered with minute oil globules.

Coarse Washings with abundant polyzoa, cidaroid spines, brachiopod(Murravia), joints of Mopsea, ossicles of Antedon and large Foraminifera(Amphistegina, c., Lenticulina, c., and Eponides).

Medium Washings with numerous Foraminifera (Cassidulina abundant, joints of Mopsea, broken polyzoa and echinoid spines.

Fine Washings with minute hyaline Foraminifera, echinoid spines and Tunicate spicules.

Foraminifera.- Lenticulina orbicularis, L.cultrat L.reniformis, L.navicularis, var.nov., Dentalina consobrina var.emaciata, Nodosaria cf. raphanistrum, Lagena orbignyana, Sigmoidella elegantissima, Cassidulina subglobosa, Discorbis bertheloti, Heronallenia lingulata, Eponides repandus, E.karsteni,

Imray Well.

Sample 34 contd.

Foraminifera contd.- Mississippina concentrica, Anomalina glabrata, Cibicides ungerianus, C.sorrentae, Carpenteria proteiformis, Amphistegina lessonii, Pullenia quinqueloba, Globigerinoides inflata, Globorotalia dehiscens, Gaudryina rugosa.

Polyzoa.- Membranipora marginata, Schizoporella phymatophora, Adeonellopsis clavata, Acropora vertebralis, Entalophora verticillata,

Brachiopoda.- Murravia triangularis.

Sample 35. 816'-826'. Pale grey, slightly plastic marl. When immersed in water, gives off bubbles and more abundant oil globules than preceding sample. Unwashed material gives strong reaction for oil with chloroform.

Coarse Washings contain polyzoa, large Foraminifera (Lenticulina, Flabellina, Nodosaria, Carpenteria and Eponides repandus); also occasional joints of Mopsea and echinoid remains.

Medium Washings rich in Foraminifera, some polyzoa and echinoid spines and plates.

Fine Washings with abundant minute Foraminifera and fragments of polyzoa.

Foraminifera.- Lenticulina rotulata, L.cultrata, L. orbicularis, L.protracta, Vaginulina legumen, Flabellina sp.nov., Dentalina soluta, D.farcimen, D.fissicostata, Nodosaria vertebralis, Lagena orbignyana, L.marginata, Guttulina problema, Bolivina limbata, Reussella spinulosa, Cassidulina subglobosa, Anomalina glabrata, A. wuellerstorfi, Cibicides lobatulus, C.victoriensis, Dyocibicides biserialis, Carpenteria rotaliformis, Amphistegina lessonii, Sphaeroidina bulloides, Globigerina dubia, Haplophragmoides sp., Textularia rugosa, Verneuilina triquetra.

Polyzoa.- Adeonellopsis clavata, Retepora beaniana, Hornera tuberculata.

Imray Well contd.

Sample 36. 826'-836'. Pale grey plastic marl, with a greenish tinge. The unwashed material gives a strong reaction with chloroform.

Coarse Washings with much polyzoa, large Foraminifera (Amphistegina and Carpenteria abundant), echinoid spines and plates, Antedon ossicles, joints of Mopsea and ostracoda.

Medium Washings with abundant Foraminifera, fragments of polyzoa, echinoid spines and ostracoda.

Fine Washings with abundant, minute Foraminifera and fragments of polyzoa. Also a large proportion of minute dolomite crystals in the finest siftings.

Foraminifera.- Lenticulina orbicularis, L.cultrata, L.costata, L.reniformis, Flabellina sp.nov., Dentalina consobrina, Lagena orbignyana, L.marginatoperforata, Bolivina limbata, Cassidulina subglobosa, Heronallenia lingulata, Eponides repandus, Mississippima concentrica, Siphonina australis, Anomalina glabrata, A.nonionoides, Cibicides victoriensis, C.ungerianus, Dyocibicides biserialis, Gypsina globulus, Carpenteria proteiformis, C.rotaliformis, Amphistegina lessonii(C.), Jaculella sp.

Polyzoa.- Tubucellaria cereoides, Conescharellina philippinensis, Haswellia producta, Idmonea sp. Idmonea hochstetteriana, Mecynoecia proboscidea, Hornera tuberculata, Entalophora punctata, Stomatopora meandrina.

Ostracoda.- Aglaia sp., Bairdia amygdaloides, Paradoxostoma sp.nov.

Sample 37. 836'-846'. Whitish plastic marl. Bubbles given off on immersion. The unwashed material gave fairly strong reaction with chloroform.

Coarse Washings contain large Foraminifera (Amphistegina, Carpenteria and Dentalina fissicostata), echinoid spines and plates, abundant polyzoa and a calcitic cast of Lima sp.

Imray Well Contd.

Sample 37. 836'-846' contd.

Medium Washings with abundant Foraminifera, polyzoa and echinoid spines and plates.

Fine Washings rich in minute Foraminifera; many pelagic, as Globigerina and Pulleniatina. Also echinoid spines, tunicate spicules and dolomite crystals.

Foraminifera.- Lenticulina orbicularis, L.cultrata, L.reniformis, L.protracta, Dentalina fissicostata, Nodosaria scalaris, Guttulina silvestrii, Bulimina sp.nov., Bolivina limbata, Cassidulina subglobosa, Heronallenia lingulata, Eponides karsteni, E. repandus, E.scabriculus, Siphonina australis, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, Carpenteria rotaliformis, Amphistegina lessonii, Sphaeroidina variabilis, Globigerina bulloides, Pulleniatina obliquiloculata, Textularia sagittula, Dorothia gibbosa.

Polyzoa.- Membranipora macrostoma, Porella baculina, Hornera prominens.

Ostracoda.- Bairdia amygdaloides, B.subdeltoidea.

Sample 38. 846'-856'. Friable grey marl. On immersion in water bubbles are given off containing minute oil globules.

Coarse Washings contain abundant polyzoa, echinoid spines (Goniocidaris prunispinosa), joints of Mopsea, shell fragments (chiefly bivalves) and large Foraminifera (Lenticulina, Carpenteria, Gypsina, Amphistegina, and Dentalina).

Medium Washings consist chiefly of broken polyzoa and numerous small Foraminifera (Cassidulina, Bolivina and rotalines).

Fine Washings with minute Foraminifera (rotalines and Globigerinae).

Foraminifera.- Lenticulina cultrata, L.orbicularis, Dentalina fissicostata, Bolivina limbata, Cassidulina subglobosa, Discorbis vesicularis, Heronallenia lingulata,

Sample 38. 846'-856' contd.

Eponides repandus, Mississippina concentrica, Siphonina australis, Anomalina rotula, Cibicides ungerianus, Gypsina globulus, Carpenteria rotaliformis, Amphistegina lessonii, Globigerina bulloides.

Polyzoa.- Cellaria australis, Amphiblestrum cf. simplex, Acropora gracilis, Steganoporella patula.

Ostracoda.- Bairdia amygdaloides, B.foveolata.

Sample 39. 856'-866'. Pale grey plastic marl, with whitish patches containing minute fossils. Small bubbles of gas on immersion in water, enclosing globules of oily matter. The floatings show, under a high power, abundant coccolith-similar to those in living plankton, and these are generally accompanied with minute calcareous rods (cf. rhabdoliths) Coarse Washings rich in polyzoa; also spines of Goniocidaris prunispinosa, joints of Antedon (feather star) and Mopsea (an octocorallan). Amongst the larger Foraminifera are Carpenteria rotaliformis, Operculina victoriensis and Dentalina fissicostata.

Medium Washings with abundant Foraminifera (chiefly Anomalina and Cassidulina); also broken polyzoa.

Fine Washings with minute Foraminifera, chiefly rotalines and Bolivina; also abundant tunicate spicules.

Foraminifera.- Lenticulina orbicularis, L.cultrata, Dentalina consobrina, D.fissicostata, Lagena lacunata, Bolivina sp., Cassidulina subglobosa, Ehrenbergina serrata, Discorbis turbo, Heronallenia lingulata, Eponides karsteni, Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides victoriensis, C.ungerianus, Dyocibicides biserialis, Carpenteria rotaliformis, Globigerina bulloides, Operculina victoriensis, Haplophragmoides cf. canariensis, Textularia sp.

Polyzoa.- Cellaria contigua, Canda fossilis, Adeonellopsis clavata, Acropora vertebralis, Filisparsa orakeiensis.

Sample 40. 866'-876'. Pale grey tenacious marl, with whitish patches containing polyzoa and other small fossils. Bubbles of gas liberated in washing, accompanied by globules of oil. Floatings containing abundant coccoliths.

Coarse Washings with abundant polyzoa, Foraminifera(Lenticulina), echinoid spines(Goniocidaris pentaspinosa), brachiopod shell fragments and an ostracod(Cythere).

Medium Washings with abundant Foraminifera(Cassidulina and rotalines), broken polyzoa and joints of Mopsea.

Fine Washings with minute Foraminifera, chiefly rotalines and Globigerina, fragments of polyzoa and tunicate spicules.

Foraminifera.- Lenticulina orbicularis, L.vortex, Dentalina fissicostata, Sigmoidella kagaensis, Cassidulina subglobosa, Heronallenia lingulata, Eponides repandus, Mississippina concentrica, Anomalina glabrata, Cibicides ungerianus, C.wuellerstorfi, Carpenteria rotaliformis, Globigerina bulloides, G.triloba, Pulleniatina obliquiloculata, Elphidium craticulatum, Textularia sagittula,var.fistulosa.

Polyzoa.- Smittina tatei, Himantidium liversidgei,Retepora schnapperensis, Hornera tenuis, Idmonea sp.

Ostracoda.- Cythere dictyon.

Sample 41.- 876'-886'. Pale grey,tenacious polyzoal marl. Numerous gas bubbles liberated in water, with minute oil globules. Floatings with a large proportion of coccoliths.

Coarse Washings contain polyzoa, Antedon ossicles, echinoid spines(Goniocidaris prunispinosa), Mopsea joints and large Foraminifera(Lenticulina, Carpenteria and Anomalina).

Medium Washings with numerous Foraminifera(chiefly rotalines and Globigerina), broken polyzoa, echinoid spines and joints of Mopsea.

Fine Washings with abundant minute Foraminifera(Lagena, Bolivina, Eponides and Ehrenbergina), and siliceous sponge spicules; also abundant tunicate spicules.

Sample 41 contd.
876'-886'.
Foraminifera.- Lenticulina orbicularis, L.cultrata, L. articulata, Lagena lacunata, L. orbignyana, L.squamosa, L L.marginata var.inaequilateralis, Sigmoidella elegantissima, Bolivina limbata, Ehrenbergina serrata, E. hystrix, Heronallenia lingulata, H.wilsoni, Eponides repandus, Mississippina concentrica, Siphonina australis, S. cf. reticulata, Anomalina glabrata, A. rotula, Cibicides sorrentae, C. victoriensis, C.lobatulus, C.wuellerstorfi, C.ungerianus, Dyocibicides biserialis, Carpenteria rotaliformis, Globigerina bulloides, G.triloba, Textularia sagittula var.fistulosa, Arenobulimina sp., Dorothia brevis.
Polyzoa.- Schizoporella phymatophora, ?Hippozeugosella, Acropora gracilis, Cellepora sp., Retepora sp., Entalophora australis.

Sample 42. 886'-896'. Slightly friable, pale grey marl. Gas bubbles given off on immersion in water, associated with oily matter. Abundant coccoliths in floatings.
Coarse Washings contain abundant, well-preserved polyzoa, Antedon ossicles, echinoid spines(Goniocidaris prunispinosa), fragments of molluscan shells, joints of Mopsea and large Foraminifera(Carpenteria, Lenticulina and Dentalina).
Medium Washings contain numerous Foraminifera, chiefly rotalines, a few ostracoda and polyzoa, echinoid spines and joints of Mopsea.
Fine Washings with minute Foraminifera(Cibicides, Globigerina, Vaginulina); also abundant tunicate spicules.
Foraminifera.- Lenticulina orbicularis, L. rotulata, Vaginulina legumen, Dentalina fissicostata, Cassidulina subglobosa, Discorbis vesicularis, ?Pulvinulinella tenuimarginata, Epistomina elegans, Siphonina australis, Cibicides ungerianus, C.victoriensis, Dyocibicides biserialis, Cibicidella variabilis, Carpenteria rotaliformis, Sphaeroidina variabilis, Globigerina bulloides, Textularia sagittula, Dorothia gibbosa.

Sample 42 contd.
886'-896'.

Polyzoa.- Cellaria rigida var.perampla, Amphiblestrum simplex, Smittina tatei, cf.Schizoporella australis, S.phymatophora, Acropora vertebralis, Retepora sp., Crisia acropora, Mecynoecia proboscidea, Idmonea hochstetteriana, Hornera prominens.

Ostracoda.- Bairdia subdeltoidea, Loxoconcha sp.nov., Cytherella truncata.

Sample 43. 896'-902'. Light grey plastic marl. Bubbles with oily matter rising to the surface on washing. Fine floatings with tunicate spicules, coccoliths and much brown organic matter. Sponge spicules occasionally seen, resembling those of the freshwater Spongilla.

Coarse Washings with abundant Polyzoa, occasional joints of Mopsea, echinoid plates and spines, large Foraminifera(Lenticulina, Eponides, Anomalina, Planorbulinella,Textularia, Dorothia), and Ostracoda(Bairdia).

Medium Washings with abundant well-preserved polyzoa, spines of echinoids, joints of Mopsea, abundant Foraminifera, chiefly Rotalines and some ostracoda.

Fine Washings. Rich in minute Foraminifera, chiefly Rotalines and Cassidulina; also joints of Mopsea and tunicate spicules.

Foraminifera.- Lenticulina orbicularis, L. gyroscalprum, L. cultrata, Vaginulina legumen, Dentalina fissicostata, Lagena lacunata, L.rudis, Tubulogenerina conica, Cassidulina subglobosa, Discorbis vesicularis var.dimidiata, Heronallenia lingulata, Gyroidina soldanii, Eponides repandus, E.karsteni, ?Pulvinulinella tenuimarginata, Epistomina elegans, Siphonina australis, Anomalina glabrata, Cibicides victoriensis, C. ungerianus, C.wuellerstorfi, Dyocibicides biserialis, Cibicidella variabilis, Planorbulinella plana, Sphaeroidina variabilis, Globigerina triloba,G.bulloides, Quinque-

Sample 43 contd.
896'-902'.

loculina schreiberiana, Sigmoilina celata, S.bradyi, Textularia sagittula, Ammosphaeroidina sphaeroidiniformis, Clavulina szaboi var.australis, Verneuilina triquetra, Dorothia gibbosa.

Polyzoa.- Melicerita angustiloba, M.acutimarginata, Membranipora cf. macrostoma, Acropora vertebralis, Schizoporella phymatophora, Idmonea hochstetteriana, Hornera tuberculata.

Ostracoda.- Bairdia amygdaloides, Cythere sorrentae, Loxoconcha australis.

Sample 44. 902'-908'. Somewhat friable grey marl, with a greenish tinge. Bubbles on washing, carrying minute oil globules. Coccoliths abundant in finest washings.

Coarse Washings rich in well-preserved Polyzoa. Also numerous large Foraminifera(Elphidium, Eponides, Operculina, Carpenteria and Lenticulina), occasional Antedon joints and ossicles and echinoid spines and plates, chiefly of cidaroids.

Medium Washings with abundant Foraminifera, chiefly Cibicides and Elphidium; also broken polyzoa, Mopsea joints and sponge spicules.

Fine Washings with abundant tunicate spicules, rotaline foraminifera, and an occasional bright green glauconite cast of the same.

Foraminifera.- Lenticulina gyroscalprum, L.orbicularis, L.sp.nov. aff.costata, Globulina gibba, G.rotundata, Pyrulina fusiformis, Cassidulina sp., Eponides repandus, E.karsteni, Gyroidina soldanii, Cibicides ungerianus, C.victoriensis, C.sorrentae, C.wuellerstorfi, Planorbulinella larvata, Gypsina globulus, Carpenteria rotaliformis, Elphidium crespinae, E.howchini, Elphidium sp.indet., Polystomellina cf. miocenica, Operculina victoriensis, Textularia sagittula, Gaudryina rugosa, Dorothia gibbosa.

Sample 44. 902'-908' contd.

Polyzoa.- Steganoporella patula, Idmonea milneana, I.divergens, Filisparsa orakeiensis.

Sample 45. 908'-918'. Pale grey plastic marl, with a green slight greenish tinge. Abundant evidence of oil in gas bubbles. Finest floatings showing numerous coccoliths and rods (algae) with other organic remains such as minute foraminifera, the chambers of which are filled with a pale brown substance. Dolomite crystals also occur in the fine floatings.

Coarse Washings with abundant polyzoa, large Foraminifera (Carpenteria common, Lenticulina, Eponides, Gypsina, Elphidium, Quinqueloculina, Dorothia), joints of Mopsea, cidaroid spines and ossicles of Antedon frequent.

Medium Washings with abundant Foraminifera, broken polyzoa, occasional ostracoda, Mopsea joints and echinoid spines.

Fine Washings with minute Foraminifera(Nonion, Anomalina, Cibicides, Trifarina). Also abundant tunicate spicules and occasional bright green glauconite casts of foraminifera.

Foraminifera.- Spirillina inaequalis, Lenticulina rotulata, L. articulata, Dentalina consobrina, D.soluta, Lagena lacunata, Sigmomorphina cf. haeusleri, Trifarina bradyi, Cassidulina subglobosa, Heronallenia lingulata, Eponides repandus cf.Pulvinulinella tenuimarginata, Rotalia howchini, Siphonina australis, Anomalina glabrata, A.rotula, Cibicides victoriensis(c.), C.wuellerstorfi, C.ungerianus, C. lobatulus, C.refulgens, Dyocibicides serialis, Gypsina globulus, Carpenteria rotaliformis, Sphaeroidina variabilis, Nonion boueana, Elphidium verriculatum, Operculina victoriensis, Quinqueloculina lamarckiana, Sigmoilina bradyi, Dorothia gibbosa, Verneuilina triquetra.

Ostracoda.- Cythere sorrentae.

Anthozoa.- Mopsea tenisoni, M. sp.nov.

Polyzoa.- Cellaria rigida var.venusta, Adeonellopsis clavata, Retepora beaniana, Palmicellaria magna, Hornera prominens.

Sample 46. 918'-928'. Pale grey, rather plastic marl, w
a slight greenish tinge. Bubbles given off on washir
associated with tiny oil globules. Fine floatings co
tain abundant coccoliths and other organic particles;
also spicules of sponges and tunicates.

Coarse Washings with abundant polyzoa, including large fragments of Cellepora coronopus. Also Mopsea joints ossicles of Antedon, numerous fragments of molluscan shells, cidaroid plates and spines and large Foraminif era, including Lenticulina, Carpenteria, Gypsina, Dorothia, Eponides.

Medium Washings with broken polyzoa, abundant Foraminifera(Rotalia,Cibicides, Cassidulina, Anomalina), echi oid spines and joints of Mopsea.

Fine Washings with minute Foraminifera and tunicate sp spicules(common).

Foraminifera.- Lenticulina subalata, L.orbicularis, Dentalina fissicostata, Sigmorphina chapmani, Sigmoidella elegantissima, Cassidulina subglobosa, Discorbis globulus, Gyroidina soldanii, Eponides repandus, Rotalia howchini, R.compressiuscula, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.victoriens: C.sorrentae, Gypsina globulus, Carpenteria rotaliformi Pullenia sphaeroides, Globorotalia dehiscens, Elphidium verriculatum, E.sp., Textularia sagittula var.fistulosa, Dorothia gibbosa.

Polyzoa.- Steganoporella patula, Porella baculina, Idmonea hochstetteriana, I.atlantica, I.semispiralis, Hornera frondiculata.

Sample 47. 928'-938'. Pale grey plastic marl. Bubbles released on soaking, associated with oil globules. In fine floatings numerous coccoliths and other organic material present.

Coarse Washings, with abundant polyzoa, joints of Mopsea, echinoid spines and plates; also large Foraminifera, as Carpenteria(common), Lenticulina, Textularia, Eponides and Elphidium.

Medium Washings. Much fragmentary polyzoa, abundant Foraminifera(Lagena, Anomalina, Cibicides,common, and Elphidium, fairly abundant); also some joints of Mopsea and cidaroid spines.

Fine Washings with abundant smaller Foraminifera(Lagena, Anomalina and Cassidulina); also echinoid spines, abundant sponge spicules and some stellates of tunicates.

Foraminifera.- Lenticulina reniformis, L. cultrata, L.paucicostulata, L.articulata, L. orbicularis, Vaginulina sp., Lagena lacunata, L.sulcata, L.marginata, L. striata, L.hexagona, Bolivina cf.tenuis, Uvigerina hispida, Cassidulina laevigata, C.subglobosa, Discorbis vesicularis, D.bertheloti var.papillata, Gyroidina soldanii, Eponides karsteni, E.repandus, Siphonina australis, Anomalina glabrata, Cibicides victoriensis, C. ungerianus, C. sorrentae, Carpenteria rotaliformis(common), Globigerina bulloides, Elphidium verriculatum, Textularia sagittula, T.sagittula var. atrata, T. carinata, Dorothia gibbosa.

Polyzoa.- Cellaria australis, Adeonellopsis clavata, Retepora rimata, Entalophora longipora, Idmonea hochstetteriana, Diastopora sp.

Sample 48. 938'-948'. Grey marl, somewhat friable. Bubbles with oil globules given off on washing. Fine floatings showing a rich planktonic residue with coccoliths (floating life)together with bottom-living forms as minute foraminifera(Bolivina etc.),sponge-spicules and stellates of tunicates,of benthic orggin.

Coarse Washings.- Polyzoa abundant and well-preserved; cidaroid spines(Goniocidaris prunispinosa), numerous shell-fragments, occasional joints of Mopsea(M.tenisoni and M.sp.nov.), large Foraminifera(as Carpenteria, common, Dorothia, Eponides and Lenticulina), ostracoda (Bairdia) and ossicles of Antedon.

Medium Washings with abundant Foraminifera(rotalines, Cassidulina and Globigerina), broken polyzoa and joints of Mopsea.

Fine Washings.- Numerous minute Foraminifera(rotalines), broken polyzoa, abundant sponge spicules, joints of Mopsea and tunicate spicules.

Foraminifera.- Spirillina decorata, Lenticulina orbicularis, L.rotulata, Lagena lacunata, L.favosopunctata, L.striata, L.rudis, Reussella spinulosa, Trifarina bradyi var., Cassidulina subglobosa, Discorbis bertheloti, D.orbicularis, D.vesicularis, Heronallenia wilsoni, Lamarckina glencoensis, Eponides repandus, ?Pulvinulinella acutimarginata, Rotalia howchini, Siphonina australis, Anomalina glabrata(common), Cibicides victoriensis(v.c.), Cibicides ungerianus(c.), C.lobatulus, Carpenteria rotaliformis, Pullenia quinqueloba, Globigerina bulloides, G. triloba, Pulleniatina obliquiloculata, Textularia sagittula, T.carinata, Clavulina szaboi,var.australis, Dorothia gibbosa.

Polyzoa.- Membranipora perfragilis, Amphiblestrum spathuloides, Porella baculina, Acropora gracilis, Retepora beaniana, Hornera frondiculata var.aperta, Hornera diffusa, Mecynoecia proboscidea, Entalophora verticillata.

Ostracoda.- Bairdia foveolata, Cythere sp.

Sample 49. 948'-958'. Grey friable marl, with small fossil- visible on fractured surface. Bubbles and oily globules in evidence on washing. Finest floatings rich in micro-organisms, as coccoliths and foraminifera(as Sigmoilina and Discorbis) and minute ossicles of feather-stars(Antedo, Coarse Washings with abundant and well-preserved polyzoa. Also Antedon ossicles(common), molluscan shell-fragments, occasional stem-joints of Mopsea tenisoni, cidaroid plates and spines and large Foraminifera(Lenticulina, Dentalina, Eponides, Carpenteria, very common, Textularia,Gaudryina, Dorothea).

Medium Washings. Small polyzoa abundant, joints of Mopsea common, some spines of echinoids(spatangid) and numerous Foraminifera, chiefly rotalines.

Fine Washings with echinoid spines and minute Foraminifera; also alcyonarian and tunicate spicules.

Foraminifera.- Lenticulina articulata, L.gibba, Dentalina obliqua, Lagena lacunata, L. gracillima, L.favosopunctata, scottii, Bolivina fastigia, Loxostomum limbatum var.costulata, Cassidulina subglobosa, Discorbis bertheloti, Gyroidinax soldanii, Eponides repandus, Anomalina glabrata, Cibicides victoriensis, C.ungerianus(common), C.lobatulus, Dyocibicides biserialis, Sphaeroidina variabilis, Pulleniatina obliquiloculata, Carpenteria rotaliformis(v.common), Textularia sagittula, T.carinata, Gaudryina(Pseudogaudryina) crepinae, Dorothia cf.alleni, D.parri,

Polyzoa.- Cellaria gracilis, Smittina tatei, Hornera froriculata, H.tuberculata, Idmonea hochstetteriana, I. confert: Entalophora verticillata.

Sample 50. 958'-968'. Pale grey plastic marl, with whitish patches of shells and polyzoa. On immersion in water gives off bubbles with minute oil globules. Floatings with numerous coccoliths and rods.

Coarse Washings with abundant and well-preserved polyzoa, jc joints of Mopsea, spines of cidaroids(Goniocidaris pruni-spinosa. Many large Foraminifera(Dentalina, Sigmoidella,

Sample 50. Imray Well, contd.

958'-968'.

Guttulina, Sigmomorphina, Lamarckina, Eponides, Carpenteria, Clavulinoides, Gaudryina(Pseudogaudryina), Dorothia and Ammosphaeroidina). Also valves of ostracods (Bairdia Cythere).

Medium Washings. Rich in Foraminifera; arenaceous kinds especially abundant. Other remains include abundant pol zoal fragments and joints of Mopsea.

Fine Washings with abundant minute Foraminifera, as Bolivina, Heronallenia, Anomalina, Siphonina, and also spicules of tunicates and sponges.

Foraminifera.- Lenticulina orbicularis, L.cultrata, Dentalina obliquata, D.fissicostata, Lagena lacunata, L.acuticostata, Guttulina problema, Globulina gibba, Sigmomorphina chapmani, S. cf. haeusleri, Sigmoidella elegantissima, Bolivina aff. karreriana var. carinata, B. spathulata, Cassidulina subglobosa, Discorbis vesicularis, Heronallenia lingulata, Lamarckina glencoensis, Gyroidina soldanii, Eponides repandus, E.karsteni, Siphonina australis, S.bradyana, Anomalina glabrata, Cibicides victoriensis(common), C. ungerianus, C.sorrentae, Carpenteria rotaliformis(common), Pulleniatina obliquiloculata, Quinqueloculina lamarckiana, Q. vulgaris, Pyrgo bradyi, Ammosphaeroidina sphaeroidiniformis(common), Clavulinoides szaboi var.victoriensis, Dorothia parri, D. cf. alleni, Gaudryina(Pseudogaudryina) crespinae.

Polyzoa.- Cellaria contigua, C.rigida, Melicerita angustiloba, Acropora gracilis, Membraniporella sp., Retepora fissa, Hornera frondiculata, H.tuberculata, Mecynoecia proboscidea, Entalophora australis, Idmonea atlantica.

Ostracoda.- Macrocypris cf. setigera, Bairdia minima, B. amygdaloides, B.subdeltoidea, Cythere dictyon.

Sample 51. Imray Well.

968'-978'.

Pale grey plastic marl with whitish patches. Gas bubbles and oil globules present. Numerous coccoliths and unaltered organic particles in floatings.

Coarse Washings with abundant polyzoa, large Foraminifera (Carpenteria rotaliformis, Eponides repandus, Lenticulina and Clavulinoides), joints of Mopsea(rare), echinoid spines (Goniocidaris prunispinosa) and Ostracoda(Bairdia).

Medium Washings with abundant Foraminifera, some fragmentary polyzoa, joints of Mopsea(common), echinoid spines(spatangoid) and ossicles of Antedon.

Fine Washings with minute Foraminifera(Globigerina bulloides, Anomalina rotula, and Discorbis), and abundant tunicate spicules.

Foraminifera.- Spirillina decorata, Lenticulina cultrata, L. articulata, Dentalina fissicostata, D.obliqua, Nodosaria oviculа, Lagena castrensis, Guttulina silvestrii, Globulina gibba, Cassidulina subglobosa, Discorbis bertheloti, Heronallenia lingulata, Eponides repandus, Rotalia howchini, Siphonina australis, Anomalina glabrata, A.rotula, Cibicides lobatulus, C.victoriensis, C.ungerianus, C.sp., Carpenteria rotaliformis, Pullenia sphaeroides, P. quinqueloba, Quinqueloculina vulgaris, Dorothia parri, Clavulinoides szaboi, var.victoriensis.

Polyzoa.- Amphiblestrum simplex, A. sp., Porella baculina, Schizoporella rugosa, Mecynoecia proboscidea.

Ostracoda.- Bairdia subdeltoidea.

Sample 52.

978'-988'.

Pale grey plastic marl. Gas bubbles less evident; oil globules still present. Floatings with organic flocculent matter.

Coarse Washings. Few polyzoa, echinoid spines(cidaroids), joints of Mopsea, and large Foraminifera(Dorothia, Lenticulina and Clavulinoides).

Sample 52 contd.

Medium Washings. Numerous small Foraminifera, including Cassidulina, Cibicides and Quinqueloculina; also echinoid spines Mopsea joints, star-fish ossicles and fragmentary polyzoa.

Fine Washings with minute Foraminifera (Cassidulina, Anomalina, Lagena, Siphonina and Reussella); also siliceous and calcareous sponge spicules and abundant tunicate stellates.

Foraminifera.- Lenticulina orbicularis, L.articulata, Lagena castrensis, L.scottii, L.orbignyana, L.laevigata, Guttulina silvestrii, G. lactea, Reussella spinulosa, Cassidulina subglobosa, Discorbis bertheloti, D.bertheloti, var.papillata, Heronallenia lingulata, Eponides repandus, E.karsteni, E.scabriculus, Epistomina elegans, Siphonina australis, Anomalina glabrata, Cibicides lobatulus, C.victoriensis, C.ungerianus, C.wuellerstorfi, Quinqueloculina lamarckiana, Q. vulgaris, Sigmoilina sigmoidea, Biloculinella globulus, Textularia sagittula, Ammosphaeroidina sphaeroidiniformis, Dorothia parri, Verneuilina sp.nov. Clavulinoides szaboi, var.victoriensis, Liebusella rudis.

Polyzoa.- Ctionella circumdata, Hornera tuberculata, Idmonea venusta.

Sample 53.

988'-998'.

Pale grey plastic marl. Bubbling freely on immersion in water, with liberation of minute oil globules. Floatings contain abundant coccoliths.

Coarse Washings.- Polyzoa plentiful and fairly well preserved. Occasional ossicles of Antedon, spines of cidaroids (Goniocidaris pentaspinosa) and joints of Mopsea. Large Foraminifera include Dorothia (common), Clavinuloides, Lenticulina, Quinqueloculina, Textularia, Carpenteria and Guttulina.

Medium Washings, with abundant Foraminifera, chiefly rotaline and Lagenae, small polyzoa, well preserved and echinoid spines.

Fine Washings with minute Foraminifera, as Siphonina and Lagena, echinoid spines, joints of Mopsea and abundant tunicate spicules.

Imray Well.
Sample 53. 988'-998' continued.

Foraminifera.- Spirillina decorata, Lenticulina cultrata, L. rotulata, Dentalina cf.soluta, D.communis, D.fissicostata, D.cf.fistuca, Lagena lacunata, L.orbignyana, L.marginata, Guttulina problema, Glandulina laevigata, Bolivina dilatata, Trifarina bradyi, Cassidulina subglobosa, Cassidulinoides parkeriana, Discorbis bertheloti, D.bertheloti var. papillata, D.vesicularis, Heronallenia wilsoni, Eponides karsteni, ?Pulvinulinella tenuimarginata, Siphonina australis, Anomalina glabrata, A.rotula, Cibicides victoriensis, C.ungerianus, C.lobatulus, Dyocibicides biserialis, Planorbulinella cf. rubra, Carpenteria rotaliformis, Amphistegina lessonii, Sphaeroidina bulloides, Globigerina bulloides, Pullenia quinqueloba, Quinqueloculina lamarckiana, Q.vulgaris, Sigmoilina sigmoides, Triloculina trigonula, Biloculinella globulus, Textularia sagittula, Clavulinoides szaboi var. victoriensis, Dorothia parri.
Polyzoa.- Cellaria rigida var. perampla, Tessarodoma elevata, Filisparsa orakeiensis.

Sample 54. 998'-1010'.

Pale grey plastic marl, slightly darker than the preceding. Gas bubbles and oil globules in evidence during washing. Coccoliths and brown organic matter present in the floatings.

Coarse Washings contain occasional shells, more or less fragmentary, of brachiopods(indet.) and gasteropods (Rissoina and Turbonilla), joints of Mopsea, abundant cidaroid spines(including Goniocidaris prunispinosa), rarely polyzoa, ostracoda(Bairdia) and numerous large Foraminifera(Clavulinoides, Lenticulina, Dorothia, Quinqueloculina, Anomalina, Dentalina and Epistomina; also fish otoliths.

Medium Washings rich in Foraminifera. chiefly Cassidulina, Dorothia, Anomalina and Cibicides, with an occasional ostracod(Cythere), joints of Mopsea, small gasteropods indet. minute echinoid spines and rarely, fragments of polyzoa.

Imray Well.

Sample 54 continued. 998'-1010'.

Fine Washings, with a few mica flakes, abundant minute Foraminifera, as Discorbis, Globigerina and Bolivina; also abundant sponge spicules and stellates of Tunicata.

Foraminifera.- Lenticulina cultrata, L.gyroscalprum, L.clericii, L.orbicularis, L.rotulata, Dentalina fissicostata, Lagena marginata, L.scottii, L.lacunata, L.orbignyana, Guttulina problema, Globulina gibba, Sigmoidella elegantissima, Bolivina cf.spathulata, Cassidulina subglobosa, Discorbis bertheloti var.papillata, Heronallenia lingulata, Gyroidina soldanii, Eponides karsteni, E.repandus, ?Pulvinulinella tenuimarginata, Rotalia howchini, Epistomina elegans, Siphonina australis, Anomalina glabrata, Cibicides lobatulus, C. ungerianus, C.victoriensis, Carpenteria rotaliformis, Sphaeroidina variabilis, S.bulloides, Globigerina bulloides, Elphidium cf. verriculatum, Cornuspira involvens, Quinqueloculina vulgaris, Q. ferussacii, Q.schreibersiana, Q.agglutinans, Sigmoilina sigmoidea, S. schlumbergeri, Triloculina trigonula, Biloculinella globulus, Clavulinoides szaboi var.victoriensis, Dorothia parri, Liebusella rudis.

Polyzoa.- Amphiblestrum robustum, Smittia sp., Idmonea venusta.

Gasteropoda.- Turbonilla cf.mulderi, cf.Teinostoma(operculum).

Ostracoda.- Bairdia amygdaloides, Cythere sorrentae.

Sample 55. 1010'-1020'.

Grey plastic marl, slightly micaceous. Bubbles given off on washing of exceptional size, with oil globules. Floatings with abundant coccoliths and organic matter. Coarse Washings with few but well-preserved polyzoa, Mopsea joints, cidaroid spines(Goniocidaris prunispinosa), a few gasteropods including Turritella aldingae and Cerithiopsis sp., a bivalve(Arca sp.) and large Foraminifera of the following,- Lenticulina, Dentalina, Sigmoidella, Gyroidina, Elphidium, Quinqueloculina, Bdelloidina, Clavulinoides and Dorothia.

Imray Well.

Sample 55. 1010'-1020' continued.

Medium Washings.- Many Foraminifera, as Elphidium(abundant), Cibicides, Epistomina, Quinqueloculina, numerous joints of Mopsea, few polyzoa, plates, ossicles and spines of echinoidea and some bivalved shell fragments.

Fine Washings with small or broken polyzoa, Mopsea joints, stellates of tunicates, sponge spicules and occasional mica flakes; also minute Foraminifera as, Lagena, Cassidulina, Siphonina, Cibicides, Discorbis and Pulleniatina.

Foraminifera.- Spirillina decorata, Lenticulina orbicularis, L.gyroscalprum, Vaginulina legumen, Dentalina fissicostata, D. consobrina, Lagena lacunata, L.orbignyana, L.marginata, Guttulina silvestrii, Sigmomorphina batesfordensis, Cassidulina subglobosa, C.oblonga, Discorbis bertheloti, D.rarescens, Gyroidina soldanii, Epistomina elegans, Siphonina australis, Anomalina glabrata, Cibicides ungerianus, C.victoriensis, C.refulgens, Globigerina dutertrei, Elphidium cf. crespinae, E.macellum, Cornuspira involvens, Quinqueloculina lamarckiana, Q. vulgaris, Nummoloculina irregularis, Triloculina trigonula, Pyrgoella globulus, Clavulinoides szaboi var.victoriensis, Dorothia parri?, Bdelloidina sp.nov.

Polyzoa.- Cellaria rigida var. venusta, Amphiblestrum cf. ovatum, Adeonellopsis obliqua, Crisia tenuis, Entalophora cf. airensis, Filisparsa concinna,

Pelecypoda.- Cucullaea sp.

Gasteropoda.- Natica sp.

Sample 56. 1020'- 1030'. Dark grey, friable, slightly micaceous marl, with patches of whitish fossiliferous material. A few gas bubbles given off on immersion, with evidence of minute oil globules. The floatings contain some coccoliths, minute minerals grains and much brown flocculent matter.

Coarse Washings.- Polyzoa scarce, plates and spines of echinoderms abundant, and occasional molluscan shells as Turritella; large Foraminifera including Spirillina, Guttulina, Gyroidina, Cibicides, Anomalina, Sphaeroidina, Elphidium and Dorothia.

Imray Well.

Sample 56 continued. 1020'-1030'.

Medium Washings, with few polyzoa, occasional echinoid spines, joints of Mopsea, abundant Foraminifera(Anomalina, Cibicides, Globigerina, Quinqueloculina and Dorothia), ostracoda(Cytherella) and some bones of fishes.

Fine Washings with abundant minute Foraminifera(Cibicides, Gyroidina, Globigerina, Cassidulina), echinoid spines, Mopsea joints and stellate spicules of tunicates.

Foraminifera.- Spirillina tuberculata, S.inaequalis, Lentiulina orbicularis, Lagena orbignyana, Guttulina problema, Trifarina bradyi, Cassidulina subglobosa, Gyroidina soldanii, ?Pulvinulinella tenuimarginata, Siphonina australis, Anomalina glabrata, A.rotula, Cibicides ungerianus, C. victoriensis, C.wuellerstorfi, Sphaeroidina variabilis, Globigerina bulloides, Elphidium macellum, E. crassatum, Quinqueloculina lamarckiana, Q. vulgaris, Pyrgoella globulus, Discammina emaciata, Ammosphaeroidina sphaeroidiniformis, Dorothia parri.

Polyzoa.- Melicerita angustiloba, Porina gracilis, Retepora rimata, Entalophora airensis, Idmonea hochstetteriana, Idmonea sp.

Ostracoda,- Cytherella lata.

Gasteropoda.- Turritella sp.

Sample 57. 1030'-1040'. Dark grey, plastic, micaceous marl. On immersion in water showing a few gas bubbles. Minute oil globules numerous in floatings, with abundant coccoliths and other organic plankton elements in the floatings.

Coarse Washings with few polyzoa, some large cidaroid spines, and molluscan shell fragments, including Turritella. Large Foraminifera comprise Quinqueloculina, Sigmoilina, Elphidium, Sigmomorphina and Dorothia.

Imray Well.

Sample 57 contd. 1030'-1040'.

Medium Washings.- Few polyzoa, joints of Mopsea, echinoid spines and numerous Foraminifera, including Gyroidina, Cibicides, Elphidium and Dorothia.

Fine Washings.- Pelagic and other Foraminifera, including Globigerina, Bolivina, Lagena and many minute rotalinea. Also stellate spicules of tunicates and abundant mica flakes.

Foraminifera.- Lenticulina orbicularis, L. convergens, L.clericii, L. cultrata, Dentalina obliqua, Nodosaria sp., Lagena costata, L. orbignyana, Guttulina problema, Sigmoidina silvestrii, Sigmoidella kagaensis, Buliminella apiculata, Bolivina subreticulata, Gyroidina soldanii, Eponides karsteni, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.victoriensis, C.wuellerstorfi, Pullenia quinqueloba, Sphaeroidina variabilis, Globigerina bulloides, G.triloba, Elphidium cf. crespinae, E. macellum, E.howchini, Cornuspira involvens, Quinqueloculina vulgaris, Q. lamarckiana, Pyrgoella globulus, Planispirina irregularis, Spiroloculina nitida, Ammosphaeroidina sphaeroidiniformis, Dorothia parri.

Anthozoa.- Flabellum sp.nov.

Polyzoa.- Entalophora longipora, Hornera prominens.

Gasteropoda.- Astraea aster, Turbonilla sp.Turritella aldingae.

Sample 58. 1040'-1050'. Dark grey plastic micaceous marl. Showing abundant bubbles of gas and definite evidence of oil globules; coccoliths numerous in floatings.

Coarse Washings.- Contain a fair number of well preserved polyzoa, including a fragment of the reef-like Cellepora coronopus; numerous joints of Mopsea, spines of cidaroids (Goniocidaris prunispinosa), fragments of molluscan shells and numerous Foraminifera, as Lenticulina, Guttulina, Glandulina, Elphidium(common), Haplophragmoides and Dorothia(common). Ostracoda represented by Bairdia. Numerous ovoid mud pellets(?coprolitic) first appear in this sample.

Imray Well . Sample 58. 1040'-1050' contd.

Medium Washings.- Broken polyzoa, molluscan shell fragments, abundant joints of Mopsea and well preserved Foraminifera(Discorbis, Cibicides, Elphidium and Globigerina).

Fine Washings.- Abundant Foraminifera(Globigerina, Cibicides and Anomalina), numerous stellate spicules of tunicates and some mica flakes.

Foraminifera.- Spirillina decorata, Lenticulina articulata, L.convergens, L.vortex, L.orbicularis, L.cultrata, Lagena orbignyana, L.marginata, Guttulina lactea, G.problema, Sigmoidina silvestrii, Glandulina laevigata, Cassidulina subglobosa, Discorbis bertheloti, Heronallenia lingulata, Gyroidina soldanii, Epistomina elegans, Cibicides lobatulus, C.ungerianus, C.victoriensis, Anomalina glabrata, Globigerina bulloides, Pullenia quinqueloba, Elphidium howchini, E.cf.crespinae, Quinqueloculina vulgaris, Q.lamarckiana, Q. schreiberiana, Triloculina oblonga, T.trigonula, Pyrgoella globulus, Haplophragmoides canariensis, Dorothia parri.

Anthozoa.- Mopsea sp.nov.

Polyzoa.- Cellaria rigida var.perampla, C.rigida var.venusta, C,gracilis, Porella baculina, Cucullipora tetrasticha, Idmonea cf. venusta, cf.Diastopora.

Gasteropoda.- Cerithiopsis mitchellensis.

Sample 59. 1050'-1060'. Dark grey,plastic and shelly marl. Some gas bubbles on immersion in water; abundant oil globules. Coccoliths in profusion in the fine floatings.

Coarse Washings.- Polyzoa almost absent(Cellaria,Membranipora); occasional joints of Mopsea; shell fragments(Turritella and indet. pelecypoda); cidaroid spines; ovoid pellets 1.2 mm. long. Large Foraminifera comprise Elphidium(abundant), Epistomina and Dorothia(common), cf. Gaudryina and Liebusella(rare).

Medium Washings.- Joints of Mopsea,common; small ?coprolitic pellets abundant; also a large proportion made up of Foraminifera(Elphidium, Cassidulina, Globigerina, Epistomina and Cibicides). Also occasional mica flakes.

Fine Washings.- Minute Foraminifera and abundant mica flakes.

Imray Well. Sample 59. 1050'- 1060'. contd.

Foraminifera.- Lenticulina articulata, L.orbicularis, Lagena marginata, Guttulina problema, Cassidulina subglobosa, Ehrenbergina serrata, Gyroidina soldanii(c), Eponides karsteni, Rotalia howchini, Epistomina elegans, Cibicides ungerianus, C.victoriensis, Dyocibicides biserialis, Sphaeroidina variabilis, Globigerina bulloides, Elphidium cf. crespinae, E.macellum(c), E. imperatrix, E.howchini, Quinqueloculina seminulum, Sigmoilina bradyi, Pyrgoella glulus, Haplophragmoides canariensis, Ammosphaeroidina sphaeroidiniformis, Dorothia parri(c), Liebusella rudis, cf.Gaudryina.

Anthozoa.- Mopsea tenisoni.

Polyzoa.- Cellaria sp., Membranipora regularis.

Gasteropoda.- Turritella aldingae.

Sample 60. 1060'-1070'. Medium dark grey plastic, micaceous and shelly marl. A thick scum of gas bubbles and oil globules given off in water. Abundant planktonic material in fine floatings, including coccoliths, protoplasmic bodies(cf.foraminifera) and a large proportion of oily material.

General Contents.- Not examined in detail.

Foraminifera, comprising Dentalina fissicostata(large and well developed), D.consobrina var. emaciata, Lagena orbignyana, Gyroidina soldanii, Epistomina elegans, Cibicides victoriensis, Elphidium macellum, Quinqueloculina vulgaris, Q.seminulum, Haplophragmoides canariensis, and Dorothia parri.

Anthozoa.- Mopsea tenisoni. Echinodermata.- Spines of Goniocidaris pentaspinosa. Polyzoa rare, including Porina gracilis, Hornera tuberculata and H.frondiculata. Mollusca.- Cerithiopsis sp. and Dentalium sp. Ostracod.- Cythere dictyon. A Fish Otolith, indet.

Imray Well.

Sample 61. 1070'-1080'. Dark grey, pyritous and sa- marl, with chips of limestone from hard band. From the so material a few gas bubbles given off in water. Much org- matter in floatings, including coccoliths.

General Contents.- Not examined in detail. Foraminifera, comprising Dentalina fissicostata(c), Lagena marginata, Guttulina problema, Sigmoidina silvestrii, Rotal howchini, Cibicides sorrentae, Elphidium macellum(c), Quin- queloculina vulgaris, and Dorothia parri.

Anthozoa.- Conosmilia sp., Mopsea tenisoni. Echino- ata.- Goniocidaris prunispinosa(spines), Antedon sp.(caly Polyzoa.- Retepora subimmersa. Mollusca.- Turritella aldingae.

Sample 61 A. 1073'-1074'. (Hard Band).

Comminuted chips of hard grey marl, with softer fragmen and shells.

General Contents.- Not examined in detail.

Foraminifera.- Lenticulina orbicularis, Dentalina fi sicostata, Elphidium macellum and Dorothia parri.

Anthozoa.- joints of Mopsea tenisoni. Polyzoa.- Re- pora permunita, Hornera prominens. Mollusca.- gasteropo fragments, indet. Fish otoliths, indet.

Sample 62. 1080'-1090'. Dark grey plastic marl. A few gas bubbles given off in water. Also oil globules attached to organic matter in floatings, together with mu- ous coccoliths.

General Contents.- Not examined in detail.

Foraminifera, comprising Lenticulina gyroscalprum, El- idium macellum(c), Cibicides victoriensis(c), Quinquelo- ina vulgaris, Pyrgoella globulus.

Polyzoa.- Retepora subimmersa, Mecynoecia proboscidea Echinodermata.- Cidaroid spines, indet.

Pelecypoda.- Fragments, indet. Gasteropoda.- cf. Notose Turritella aldingae, T. cf. conspicabilis.

Imray Well.

(for last sample, No.62, not examined in detail, substitute the following).-

Sample 62. 1080'-1090'. Dark grey plastic marl. A few gas bubbles given off in water. Also oil globules attached to organic matter in floatings, together with numerous coccoliths.

Coarse Washings, with much nodulous pyrites; also many mollusca, fragmentary and otherwise, including Estea, Turritella, Cerithiopsis and Marginella amongst gasteropods and pelecypoda indet.; polyzoa rare and occasional large Foraminifera(Lenticulina, Gyroidina, Cibicides, Elphidium, Quinqueloculina and Pyrgoella.

Medium Washings with occasional Foraminifera, chiefly rotalines and Globigerina; also numerous ovoid mud pellets.

Fine Washings with minute pelagic Foraminifera(Globigerina triloba) and a large proportion of sideritic grains which appear to be sideritic foraminiferal casts; also numerous mica flakes.

Foraminifera.- Lenticulina gyroscalprum, L. orbicularis, Gyroidina soldanii, Cibicides ungerianus, C. victoriensis, C.wuellerstorfi, Pullenia sphaeroides, Globigerina bulloides, G.triloba, Elphidium macellum, E.imperatrix; Quinqueloculina vulgaris, Sigmoilina bradyi, Pyrgoella globulus.

Polyzoa.- Schizoporella australis, Retepora subimmersa, Acropora sp., Mecynoecia proboscidea.

Gasteropoda.- Estea varicifera, Turritella aldingae, Cerithiopsis sp., Marginella micula.

Sample 63. 1090'-1100'. Dark greenish-grey plastic and shelly marl. Few gas bubbles and oily surface scum seen on washing. Under high power, floatings show abundant brown organic particles, with numerous coccoliths.

General Contents.- Not examined in detail.

Washings show a residue largely composed of sideritic grains with some particles of pyrites; also occasional glauconite grains and quartz particles(partially rounded).

Imray Well.

Sample 63 contd.

Foraminifera comprise,- Elphidium macellum and Liebusella rudis.

Polyzoa.- indeterminate fragments.

Fishes.- A minute tooth of Carcharias sp.

Sample 64. 1100'- 1110'. Grey, micaceous and plastic marl. Numerous gas bubbles given off in washing. A slight trace of oil globules.

General Contents.- Not examined in detail.

Pyrites and glauconite grains in coarser siftings; mica flakes in finer washings.

Foraminifera comprise,- Lenticulina gyroscalprum, Marginulina sp., Epistomina elegans, Cibicides victoriensis.

Polyzoa absent.

Pelecypod shell fragments, indet.

Gasteropods.- Turritella aldingae.

Sample 65. 1110'- 1120'. Grey plastic marl, slightly micaceous. Small gas bubbles given off on immersion in water. Oil globules abundant. Floatings show much organic matter, including coccoliths; also minute pentagonal plates of ?Antedon.

Coarse Washings, with abundant glauconite, many evenly shaped ovoid pellets generally of mud but occasionally including much granular glauconite. Some subangular quartz grains. Occasional Foraminifera, as Lenticulina, Gyroidina and Elphidium. Polyzoa rare and fragmentary. Molluscan fragments fairly abundant, including Dentalium.

Medium Washings with pyrites and glauconite grains; also abundant ovoid mud and glauconitic pellets. Foraminifera not rare, including rotalines and Globigerina.

Fine Washings, with minute foraminifera(abundant); numerous casts of foraminifera in glauconite and siderite; mica flakes abundant.

Imray Well.

Sample 65 continued. 1110'-1120'.

Foraminifera.- Lenticulina articulata, L.gibba, L.orbi ularis, Lagena striata, Globulina gibba, Cassidulina sub globosa, C.crassa, Discorbis bertheloti, D.sp.nov., Gyroi ina soldanii, Eponides karsteni, Rotalia howchini, Epi- stomina elegans, Siphonina australis, Cibicides ungeri- anus, C. victoriensis, C.variabilis, Elphidium macellum, E.cf.crespinae, E. howchini, Sphaeroidina variabilis, Gl igerina bulloides, G.triloba, Haplophragmoides sp., Text ularia sagittula var.fistulosa, Dorothia sp., Listerella communis.

Polyzoa.- Cellaria divaricata.

Mollusca- Scaphopoda.- Dentalium subfissura.

Ostracod.- Bairdia cf. amygdaloides.

Sample 66. 1120'-1130'. Grey, plastic, micaceous marl, with concretions of pyrite. Numerous gas bubbles on immer- sion, showing iridescence from presence of oil. Float- ings with brown organic matter, coccoliths and oil glob- ules.

General Contents.- Not examined in detail.

Washings consist largely of moderately fine sideritic san with some limonite, glauconite and an occasional rounded quartz grain. Mica flakes in the finer portion.

Foraminifera comprise,- Lenticulina gyroscalprum, Discor- bis sp.nov., Rotalia howchini, Cibicides sorrentae, Anom- alina glabrata, A.rotula, Globigerina bulloides.

Echinoid spines, indet.

Mollusca.- Turritella aldingae.

Sample 67. 1130'-1140'. Dark grey micaceous and plastic marl. Giving off gas bubbles in water. Floatings more or less organic, and with numerous globules of oil.

General Contents.- Not examined in detail.

Washings more calcareous than in the preceding sample. Con- a fair quantity of large ovoid pellets; also some rounded to subangular quartz grains. Mica flakes numerous in finer portion. Small echinoid spines present. Also the follow-

ing Foraminifera.- Trifarina bradyi, Cassidulina subglobosa, Cibicides victoriensis, Elphidium macellum.

Sample 68. 1140'-1150'. Dark grey, micaceous and plastic marl. Gas bubbles associated with abundant oil globules on immersion. Floatings rich in organic matter, with coccoliths. Coarse Washings contain numerous concretionary particles of iron pyrites, often showing replacements of organisms, as polyzoa; some subrounded quartz grains and a few large ovoid pellets. Molluscan shell fragments numerous, including Turritella, but mostly indet. Polyzoa rare; occasional Foraminifera (Lenticulina, Elphidium).

Medium Washings, chiefly granules of siderite and glauconite; also numerous mica flakes and occasional wind-worn quartz grains. Organisms include echinoid spines, fish otoliths and abundant Foraminifera (chiefly Cassidulina and Cibicides).

Fine Washings consist largely of angular quartz grains and casts of minute Foraminifera, numerous mica flakes and some chlorite and grains of glauconite.

Foraminifera.- Lenticulina gyroscalprum, Lagena melo, L. schlichti, Cassidulina subglobosa(c), Rotalia howchini, Siphonina australis, Anomalina glabrata, Cibicides victoriensis, C.ungerianus(c), C.refulgens, Pullenia quinqueloba, Sphaeroidina variabilis, Globigerina bulloides, Elphidium crassatum, Textularia carinata.

Polyzoa.- Schizoporella phymatophora.

Gasteropoda.- Turritella aldingae.

Pisces.- Teleostean fish otolith.

Sample 69. 1150'- 1160'. Pale grey shelly and plastic marl. Some gas bubbles, with oil globules. Abundant organic matter, with coccoliths in the floatings.

General Contents.- Not examined in detail. Washings consist of fine quartz sand, with siderite and pyritic granules, shelly fragments and mica flakes. Occasional Foraminifera, including Cibicides victoriensis, Textularia carinata, Cassidulina subglobosa.

Sample 70. 1160'-1170'. Dark grey, shelly and micaceous plastic marl. Gas bubbles given off freely on immersion. Oil globules numerous. Floatings with much organic matter and abundant coccoliths.

General Contents.- Not examined in detail. Washings contain numerous shelly fragments, including the gasteropod Olivella adelaidae, elsewhere a Lower Miocene species from the greensand marls of the Adelaide Bore, Muddy Creek and Torquay. Much pyritous sand present in the coarser portion, as well as some rounded to angular quartz grains and ovoid pellets in glauconite. Foraminifera are rare, including Sphaeroidina bulloides and Dorothia sp. Ostracoda were represented by one valve of Cytheropteron praeantarcticum.

Sample 71. 1170'- 1180'. Pale grey, slightly micaceous plastic marl. Gas bubbles freely given off on immersion. Oil globules abundant. Organic matter in floatings, with numerous coccoliths.

Coarse Washings.- Pyrites fragments moderately abundant, as also rounded to subangular quartz grains; ovoid pellets, more or less glauconitic, common. A large proportion of molluscan shell fragments present, including a juvenile specimen of the gasteropod, Marginella; occasional echinoid spines, rare and worn polyzoa and a fair number of Foraminifera, represented by Lenticulina, Rotalia, Cibicides, Elphidium and Dorothia.

Medium Washings contain abundant glauconite grains, chiefly as casts of Foraminifera, ovoid to rounded pellets and many angular quartz grains; also shelly fragments numerous and abundant Foraminifera, chiefly Cassidulina and and Rotalia.

Fine Washings.- Sideritic and glauconitic particles, fine angular quartz sand and numerous minute Foraminifera, chiefly rotalines and Globigerina.

Foraminifera.- Lenticulina gyroscalprum, L.rotulata, L.vortex, L.articulata, L.convergens, L.orbicularis,

Imray Well.

Sample 71. 1170'-1180' contd.

Foraminifera contd.-
Lagena orbignyana, Cassidulina subglobosa; Discorbis bertheloti, D.sp.nov.,Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides lobatulus, C.victoriensis and var., C.ungerianus, C.dutemplei, Sphaeroidina bulloides, Globigerina bulloides, Listerella communis, Dorothia brevis, Ammobaculites sp., Discammina emaciatum.
Also glauconite casts of Sigmoilina sp. and Cancris sp.
Polyzoa.- Cellaria rigida,var.venusta, cf.Mecynoecia proboscidea.
Gasteropoda.- Marginella cf. wentworthi.

Sample 72. 1180'-1190'. Greenish-grey, micaceous plastic marl. Gas bubbles freely given off; films of ditto carrying minute oil globules. Floatings with rich organic matter and coccoliths.

General Contents.- Not examined in detail.
Washings contain broken molluscan shells, abundant ovoid pellets mostly in glauconite, a few in mud. Finer washings with numerous mica flakes, glauconite and sideritic grains. Foraminifera are rare but interesting, as Nodosaria vertebralis, Discorbis sp.nov.,Cibicides ungerianus, Elphidium macellum. Polyzoa very rare, represented only by Cellaria rigida var.venusta.

Sample 73. 1190'-1200'. Dark greenish-grey,micaceous plastic marl. Bubbles of gas emitted on immersion in water. Organic matter in floatings.

General Contents. Not examined in detail.
Washings contain a few fairly large nodules of pyrites, abundant fragments of mollusca, occasional rounded quartz grains, numerous ovoid pellets in glauconite and abundant mica flakes. No polyzoa noticed. Foraminifera frequent, amongst which were seen,- Lenticulina gyroscalprum(common), L.subalata, Eponides karsteni, ?Pulvinulinella tenuimarginata, Discorbis sp.nov., Rotalia howchini, Cibicides victoriensis, C.sorrentae, Verneuilina sp.

Imray Well.

Sample 73 1190'-1200' continued.

Gasteropoda.- Mathilda decorata, Olivella adelaidae, Cylichnella cf. infundibulata.

Sample 74. 1200'-1210'. Dark greenish-grey micaceous, plastic marl. Numerous small gas bubbles emitted on immersion in water. Oil globules abundant.

Coarse Washings.- Abundant ovoid pellets(glauconitic), numerous shell fragments, indet. and Foraminifera, rare (Lenticulina).

Medium Washings, showing increase of glauconite compared with previous samples, numerous ovoid pellets, fragments of echinoid spines and mollusca. Foraminifera fairly common(chiefly Globigerina and rotalines). In the sandy residue, abundant mica flakes and occasional wind-worn quartz grains.

Fine Washings. chiefly sideritic, with abundant mica and ?chloritic flakes; also minute foraminifera and echinoid spines.

Foraminifera.- Lenticulina gyroscalprum, Bulimina pyrula, Cassidulina subglobosa, Discorbis sp.nov., Rotalia howchini, Anomalina rotula, Cibicides ungerianus, C.victoriensis, C.lobatulus, Sphaeroidina variabilis, Globigerina bulloides, Elphidium howchini, Psammosphaera fusca.

Sample 75. 1210'- 1220'. Greenish to grey-brown sandy and micaceous marl. Minute bubbles of gas emitted during washing. Oil globules in evidence.

General Contents. Not examined in detail.- A fair number of ovoid pellets in glauconite, occasional subangular quartz grains and mica flakes; shell fragments and echinid spines rare. Foraminifera rather common.- Lenticulina orbicularis, Cassidulina subglobosa, (c.f.) Ceratobulimina dehiscens, ?Pulvinulinella tenuimarginata, Rotalia howchini, Cibicides victoriensis, C. lobatulus, C.ungerianus, Cibicidella variabilis, Anomalina rotula, Sphaeroidina bullcides,

Imray Well.

Sample 75. 1210'- 1220' continued.-

Foraminifera contd.-

Globigerina bulloides, Elphidium macellum, Verneuilina sp. nov., Listerella communis.

Also polyzoa.- Cellaria sp.

Sample 76. 1220'-1230'. Greenish-grey, micaceous marl. numerous gasbubbles emitted on immersion; oil globules present.

General Contents. Not examined in detail.-

Much glauconite and siderite in washed material; also a few sub-rounded quartz grains, numerous ovoid pellets of a dark-brown colour, abundant mica flakes, some shell fragments, including gasteropods as Triforis sp. and a turrid (protoconch). Occasional Foraminifera include.-

Lenticulina orbicularis, L.gyroscalprum, Nodosaria oviculа, Lagena schlichti, Cassidulina subglobosa, Gyroidina soldanii, Eponides scabrosa, E.karsteni, Rotalia howchini, Epistomina elegans, Anomalina rotula, Cibicides ungerianus, C.ef.sorrentae, C.victoriensis, Sphaeroidina variabilis, Globigerina triloba, Pulleniatina obliquiloculata, Textularia carinata, Listerella communis, Tritaxilina hantkeni.

Polyzoa.- Retepora beaniana.

Sample 77. 1230'- 1240'. Green to brownish-grey, micaceous marl. Gas bubbles numerous. Oil globules present.

Coarse Washings.- Gritty glauconitic and limonitic particles abundant. Shell fragments mostly bivalves, indet., some ovoid pellets in glauconite and worn and broken Foraminifera(Nodosaria,Elphidium).

Medium Washings.- Numerous brown ovoid pellets, fragments of limonitised vermiculite, similar to that found in the basal beds of Aldinga(Blanche Pt.); occasional sub-rounded quartz grains and Foraminifera common, chiefly rotalines.

Sample 77 contd.-

Fine Washings, with fine sideritic material and glauconite particles; also numerous mica flakes and a few minute Foraminifera, chiefly Rotalines.

Foraminifera.- Nodosaria raphanistrum, Cassidulina subglobosa, Gyroidina sp., Eponides scabriculus, Rotalia howchini, Epistomina elegans, Anomalina rotula, A.glabrata, Cibicides sorrentae, C. victoriensis, C.ungerianus, Globigerina bulloides, G.triloba, Elphidium crassatum, E. howchini, E. macellum, Ammosphaeroidina sphaeroidiniformis, Discammina sp., Liebusella rudis.

Sample 78. 1240'-1249'. Greenish-grey, micaceous marl, with laminar structure. Gas bubbles given off on immersion. Oil globules present.

General Contents. Not examined in detail.- Washings largely glauconitic. Numerous mica flakes, in finer portion . Abundant ovoid(glauconitic) and rounded brown,pellets; also limonitic replacements of vermiculite. Echinoid spines frequent. Foraminifera fairly abundant, including,-

Glandulina laevigata, Cassidulina subglobosa, Discorbis bertheloti, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.refulgens, C.sorrentae, Dyocibicides biserialis, Globigerina triloba, Elphidium howchini.

Sample 79. 1249'-1253'3". Not Collected.

Imray Well contd.

Sample 80. 1253'3"- 1254'3". Glauconitic sandy mudstone. Colour dark green when moist. In the dry state, of a dull medium green with brownish patches. Fractured surface micaceous, with numerous brown ovoid pellets and their cavities.
Sample with a distinct petroliferous odour.
Film forming on surface of water in which sample was immersed showing under the microscope numerous ? waxy crystals.
Coarse Washings contain abundant ovoid pellets, with occasional Foraminifera and Ostracoda.
Fine Washings with glauconitic casts of Globigerina bulloides, abundant rotaline casts in glauconite and siderite, as well as a test of Cibicides sp.
The pellets are very uniform in size and shape, averaging in long diameter, 1.13mm. Under a high power they show a fragmentary structure, with small organic particles, including minute foraminifera, thus seeming to point to their excretory or coprolitic origin. The external edges of the sections of these pellets show traces of a thin ?waxy layer which is anisotropic with delicate but bright colours. The mounting medium(Canada balsam) surrounding the sections of the pellets includes swarms of tiny globules and waxy plates, probably induced by the heating of the slide.
Foraminifera.- Bolivina limbata, Cassidulina subglobosa, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.victoriensis, C.sorrentae, Pullenia sphaeroides, Globigerina bulloides, Globorotalia dehiscens.
Ostracoda.- Cythere dictyon.

Imray Well contd.

Sample 81. 1254'3". Glauconitic sandy micaceous mudstone, with occasional molluscan shell fragments.
Colour dark green when moist. In the dried state tea-green with a yellowish tinge. Lighter in colour than the preceding sample.
During the washing of the material the water, when examined under a 1 inch obj. was seen to be saturated with minute globules of oil.
Coarse Washings seen to consist of glauconite aggregated fragments with numerous large rounded quartz grains some of which are wind-polished; also occasional shelly molluscan fragments, an infilling of Semicassis sp. in glauconite, occasional fish remains, and fragments of pyrites and chalcopyrite.
Medium Washings with numerous ovoid pellets in green glauconite and brown (cf.) colophane. A few foraminifera preserved with tests, but glauconitic casts abundant.
Foraminifera.- Cibicides ungerianus, Trochammina sp.

Sample 82. 1255'. Rock similar to the last but more evenly textured. On the surface are seen fragments of Polyzoa, indet.
When immersed in water a scum arises which shows similar crystalline characters under the microscope as before noted, (cf.stearine). Tested with chloroform, separation of oil and crystals of wax result.
Coarse washings contain numerous subangular and rounded quartz pebbles and grains, a few of which are decidedly wind-polished. Also a few tests of Foraminifera are present besides numerous glauconite casts of same. Green and brown pellets abundant.
Medium and Fine Washings contain small foraminifera,

Imray Well contd.

Sample 82 contd.

chiefly Cassidulina, as well as numerous casts in glauconite.

Foraminifera.- Cassidulina subglobosa, Anomalina glabrata, Cibicides ungerianus, Orbulina universa.

Sample 83. 1256'. Glauconitic sandy mudstone. Of a bright tea-green colour when dried, dark green when moist. Gives off a strong petroleum odour during washing.

Coarse Washings with numerous well rounded quartz grains. Ovoid pellets both green and brown, numerous,

Medium and Fine Washings contain ovoid pellets associated with ovoid and contorted cylindrical bodies of similar material which show transverse shrinkage cracks. Mica flakes abundant. Foraminifera fairly numerous.

Foraminifera.- Cassidulina subglobosa, Eponides karsteni, Epistomina elegans, Anomalina glabrata, A.rotula.

Sample 84. 1256'9". Glauconitic sandy mudstone. Colour like the preceding, but rock more consolidated.

Much free oil in tiny globules liberated during washing, and strong petroliferous odour.

Coarse Washings with numerous rounded quartz grains. Pellets abundant.

Medium Washings with a few shelly foraminifera and numerous glauconitic casts. Pellets abundant.

Fine Washings with some tests of foraminifera.

Foraminifera.- Lenticulina rotulata, Cassidulina subglobosa, Anomalina nonionoides, Cibicides ungerianus, C.victoriensis.

Imray Well contd.

Sample 85. 1257'3". Same characters as the preceding but more friable and with shelly fragments.
Coarse Washings contain a few shell fragments and some rounded quartz grains.
Medium Washings with shelly foraminifera fairly common.
Fine Washings with a few foraminifera and numerous glauconitic casts.
Foraminifera.- Cassidulina subglobosa, Eponides scabriculus, Rotalia howchini, Cibicides wuellerstorfi, Elphidium verriculatum.

Sample 86. 1258'6". Glauconitic sandstone, together with some more friable material. Of a tea-green colour in the dry state, darker when moist. More few shelly particles than in the last samples.
Coarse Washings with abundant shell fragments, indet. and a few rounded quartz grains.
Medium Washings with a few spines of echinoids.
Fine Washings with some well-preserved Foraminifera.
Foraminifera.- Cassidulina subglobosa, Discorbis bertheloti, Cibicides lobatulus, C. wuellerstorfi, C.victoriensis.

Sample 87. 1259'6". Light tea-green glauconitic sand-rock with shells. Dark green when moist. Numerous fragments and one perfect inferior valve of the pelecypod Gryphaea tarda Hutton, a species also recorded from the glauconitic sandstone of Aldinga, S.Australia.
Oil present in dried rock by chloroform test.
Coarse Washings with numerous rounded quartz grains, fragments of echinoid tests and spines partly changed into glauconite, molluscan shell fragments and glauconite pellets.
Medium Washings with occasional Foraminifera, wind polished quartz grains and green and brown pellets.
Fine Washings
Fine Washings with minute Foraminifera as casts in

Imray Well contd.

Sample 87. 1259'6" contd.
glauconite and siderite.
Foraminifera.- Lenticulina rotulata, Cassidulina subglobosa, Gyroidina soldanii, Anomalina rotula, Cibicides ungerianus, C.lobatulus.

Sample 88. 1260' 6". Tea-green glauconitic and micaceous mudstone, consolidated in part. When moist, dark green. A strong oil reaction with chloroform. Under a high power the water that is drawn off is seen to contain numerous oil globules in suspension. Strong petroliferous odour noticeable when drying.
Coarse Washings with fragments of shells(cf.Gryphaea), rounded quartz grains and Foraminifera(Epistomina).
Medium Washings with wind-polished quartz-grains, and numerous pellets. Organisms indlude shell-fragments, echinoid spines and Foraminifera.
Fine Washings with casts of Foraminifera in siderite and glauconite; also tests of Cassidulina.
Foraminifera.- Cassidulina subglobosa, Rotalia howchini, Epistomina elegans, Anomalina rotula, Cibicides ungerianus.

Sample 89. 1262'. Tea-green glauconitic sandy marl, with hard lumps and shelly fragments. Dark green and plastic when moist. Oil globules suspended in water when washing. Finer floatings consist of pale yellowish-brown resinous particles, probably referable to colophane. This note applies to most of the other samples of the glauconite band.
Coarse Washings with a few subangular to rounded quartz grains, shelly fragments and Foraminifera(Epistomina).

Imray Well contd.

Sample 89. 1262' contd.

Medium Washings with fairly numerous Foraminifera and casts of same.

Fine Washings with foraminiferal casts, mica flakes and minute angular quartz grains.

Foraminifera.- Cassidulina subglobosa, Rotalia howchini, Cibicides ungerianus, C. victorianus. C.lobatulus, Epistomina elegans.

Sample 90. 1263'. Tea-green friable sandy micaceous mudstone. Dark green when moist. Strong petroliferous odour when drying.

Coarse Washings with fragmentary Polyzoa, echinoid spines and abundant shell fragments; also a few foraminiferal tests. Rounded quartz grains present.

Medium Washings with a few Foraminifera and small rounded and wind-polished quartz grains.

Fine Washings with minute Foraminifera; also casts of same in glauconite and siderite. Abundant angular quartz grains.

Foraminifera.- Cassidulina subglobosa, Gyroidina soldanii, Eponides scabriculus, E. karsteni, Rotalia howchini, Anomalina rotula, Cibicides ungerianus, Elphidium ~~verriculatum~~ cf. crespinae, cf. Ammobaculites.

Sample 91. 1264'. Tea-green glauconitic sandy mudstone, with hard lumps. Dark green when moist. Minute oil globules seen in suspension when washing.

Coarse Washings with large subangular and rounded quartz grains.

Medium Washings with numerous subangular and rounded wind-polished quartz grains and a fair number of foraminiferal tests. Also glauconite casts of same and some ovoid pellets.

Fine Washings with minute foraminiferal casts.

Foraminifera.- Eponides scabriculus, Anomalina glabrata, A.rotula.

Imray Well contd.

Sample 92. 1265'. Tea-green glauconitic and micaceous sandstone, consolidated in parts. Darker in colour when moist. Water poured from washings saturated with minute oil globules, imparting a yellowish-green tinge.
Coarse Washings with numerous subangular and rounded quartz grains and a rolled foraminiferal test of Rotalia howchini.
Medium Washings with pellets, wind-polished quartz grains, echinid spines and numerous tests of Foraminifera.
Fine Washings consist of glauconitic and sideritic casts of minute Foraminifera and abundant mica flakes
Foraminifera.- ?Cassidulina subglobosa, ?Discorbis sp.(in glauconite), Eponides scabriculus, Rotalia howchini, Ahomalina rotula, cf.Ruditaxis.

Sample 93. 1265'9". Similar to preceding. Oil globules present in water from washing.
Coarse Washings contain abundant subangular to rounded quartz grains and tests of Foraminifera(Rotalia), and also a few glauconite pellets.
Medium Washings with numerous tests of Foraminifera and also their casts in glauconite; also echinoid spines,fragmentary. Rounded and wind-polished quartz grains are abundant and also glauconite pellets.
Fine Washings contain numerous mica flakes and minute Foraminifera,chiefly as casts.
Foraminifera.- cf.Lenticulina sp., Cassidulina subglobosa, Rotalia howchini(very common), Eponides scabriculus, Ahomalina glabrata(frequent), Cibicides ungerianus, C.victoriensis.

Imray Well contd.

Sample 94. 1268'6". Similar to the preceding, but more consolidated. Some of the softer material yields oil globules on washing. During drying a strong bituminous odour is given off.

Coarse Washings contain some subangular to rounded quartz grains; also some shelly fragments and a few Foraminifera(Lenticulina).

Medium Washings contain numerous pellets and a few Foraminifera.

Fine Washings contain minute Foraminifera, mainly preserved as casts.

Foraminifera.- Lenticulina rotulata, L. orbicularis, Rotalia howchini, Anomalina glabrata.

Sample 95. 1269'6". Tea-green friable glauconitic sandstone. Dark green when moist.

Coarse Washings with some angular to rounded quartz grains, together with a few jasper-like particles. Cylindrical and twisted ?coprolitic bodies common, as glauconitic replacements. There are a few shelly fragments present, as well as tests of Cassidulina and Eponides scabriculus. Also the valve of an ostracod(Cythere).

Medium Washings with an abundance of ovoid and cylindrical ?coprolites. Well-rounded and wind-polished quartz grains.

Fine Washings with occasional foraminiferal tests and casts of same in glauconite. An abundance of minute angular quartz grains.

Foraminifera.- Lenticulina cultrata, Glandulina laevigata, Cassidulina subglobosa, Gyroidina soldanii, Eponides scabriculus, Anomalina glabrata, Cibicides lobatulus, C.victoriensis, C. ungerianus, Elphidium chapmani.

Brachiopoda.- Fragments,indet.

Ostracoda.- Cythere sp.

Imray Well contd.

Sample 96. 1271'. Tea-green, moderately hard, glauconitic and shelly sandrock. Dark brownish green when moist. Oil globules present in water during washing. Coarse Washings with fragments of Gryphaea, numerous pieces of brachiopod shells, indet., and a few larger Foraminifera, as Elphidium. Distributed throughout the siftings are numerous subangular to rounded quartz grains and ovoid pellets.

Medium Washings contain wind-polished quartz grains, ovoid pellets, a little mica, some fragments of echinoid spines and numerous Foraminifera.

Fine Washings include echinoid spine fragments, casts of Foraminifera in glauconite and some mica flakes and minute angular quartz grains.

Foraminifera.- Cassidulina subglobosa(c.), Eponides repandus, Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus(c.), C. victoriensis(c.), Elphidium aff. crassatum.

Sample 97. 1272'9". Hard glauconitic and shelly sandstone, of a pale tea-green colour with a yellowish tinge. Dark green when moist. Fine floatings with oil globules and coccoliths(planktonic algae).

Coarse Washings with a few quartz and chalcedonic particles subangular to rounded, mica flakes and Foraminifera(Cassidulina and Gyroidina).

Medium Washings with numerous coprolitic bodies, rounded and wind-polished quartz grains and foraminiferal tests fairly abundant.

Fine Washings with abundant minute angular quartz grains, some chlorite and mica flakes, and casts of foraminifera in glauconite and siderite.

Foraminifera.- Guttulina irregularis, Cassidulina subglobosa, Gyroidina soldanii, Eponides scabriculus, Cibicides victoriensis, C. ungerianus, C.lobatulus.

Ostracoda.- Cytherella subtruncata.

Imray Well contd.

Sample 98. 1274'. Dark tea-green, hard glauconitic sandrock. When fresh, more or less plastic and saturated with oily matter. Fine floatings showing coccoliths and oil globules.

Coarse Washings with numerous subangular to well-rounded grains.

Medium Washings with occasional wind-polished spherical quartz grains, some ovoid brown and green pellets, shelly fragments and tests of Foraminifera.

Fine Washings with glauconite casts of Foraminifera minute quartz grains, some ovoid brown and green pellets, minute quartz splinters and mica flakes.

Foraminifera.- Nodosaria raphanus, Cassidulina subglobosa, Rotalia howchini, Cibicides ungerianus, (c.) C.victoriensis, (c.) Sphaeroidina bulloides.

Sample 99. 1274'6". Tea-green, hard to friable shelly glauconitic sandy marl. Saturated with oil when fresh. Numerous oil globules in fine floatings.

Coarse Washings with numerous shelly fragments, subangular quartz grains and a few large Foraminifera (Cibicides).

Medium Washings with numerous pellets, wind-polished quartz grains, mica flakes, occasional echinoid spines and tests of Foraminifera.

Fine Washings with angular quartz, mica flakes and glauconite casts of Foraminifera.

Foraminifera.- Cassidulina subglobosa, Gyroidina soldanii, Eponides karsteni, Rotalia howchini, Epistomina elegans, Anomalina glabrata, Cibicides ungerianus, C.lobatulus, C. refulgens, C.victoriensis.

3. Notes on Stratigraphical and Palaeontological Characters found in the Glauconite Oil Bearing Beds.

Test on Glauconite with oil, from the

Imray Well, at 1274'. 10/8/38.

Sample dark green, with oozing oil; plastic in character.

Sample taken weighed 260 grains.

Soaked in changes of ether, for two hours.

Result, a friable glauconitic sand, weighing 210 grains.

(Sgd.) F. C.

11/8/38.

Showing approximately at least 20% oil.

NOTES ON STRATIGRAPHICAL AND PALAEONTOLOGICAL CHARACTERS FOUND IN THE GLAUCONITE OIL-BEARING BEDS OF THE IMRAY WELL.

Locality and Depth:

The Imray Well lies 16 chains to the North-west of Foster's Bore.

The Glauconite bed was struck, in the Imray Well, at 1253'3" (Reduced Level, 1116'3").

In Foster's Bore the same bed was met with at 1230' (R.L. 1137'), showing a drop from Imray's Well of 20'9", or a dip of 1° 7'.

Relation of the Glauconite to the overlying Micaceous Shales:

The glauconite bed in the Lakes Entrance field is unmistakeable in boring. It is a hard green-coloured rock which differs considerably from the bed above, typically brown and micaceous, with some scattered glauconite grains, and a foraminiferal fauna which is richer in species as well as in individuals as compared with the reservoir glauconitic rock beneath.

Although there are these differences between the glauconite bed below and the micaceous shales above, it only amounts to a partial disconformity and not a distinct lithological break, as was recently expressed by Dr. Tieje in a letter on the subject.

Graduation of the two beds to the West:

To the west of Metung, however, the two separate divisions of Micaceous Shales and Glauconite Rock do not occur, for the one shades insensibly into the other; it is only by the foraminiferal fauna that the exact stratigraphical position of the two horizons of Zone a in the vertical scale can be determined.

General Composition of the Reservoir Rock:

When broken down by crushing and washing, and incidentally by making thin

sections, this rock was seen to be largely made up of grains of glauconite and some doubtful chlorite. As to the former mineral, which is by far the most abundant, there is definite evidence as to many of the grains having been moulded within the empty chambers of foraminifera. Many instances are seen in which the tests of foraminifera, such as Gyroidina, Epistomina, Rotalia and Cibicides, actuall, show the glauconite within the walls of the calcareous shell, whilst polyzoa, echinoid spines and even cavernous shell-fragments have their interstitial pores filled with the same dark green mineral.

To gain an idea of the composition of a typical sample from the Imray Well, that from 1268'6" was taken, as follows: The coarser washings (not passing a 30 to the inch mesh) showed 70.37%. This residuum was largely made up of irregular glauconite fragments with abundant pellets of the same, and others of brown? colophane, with a small proportion of subangular quartz grains and an occasional foraminiferal test (Lenticulina). Medium washings (passing through a 30 to the inch mesh) amounted to 9.259%. This consisted of glauconite casts of foraminifera, small pellets and occasional tests.

Fine washings (passing 60 to the inch mesh) showed a proportion of 20.37%/ Of this about 50% was represented in casts of minute foraminiferal casts in glauconite and siderite, and of angular quartz and other minerals, including mica flakes, 50%. Tests for Hydrocarbons, by pure ether, on seven samples of fresh glauconite rock from the Imray Well gave results varying from 2.47% to 19.23%.

A test was also made for hydrocarbons on the ovoid pellets and other bodies, by pure ether. These were placed under the microscope with a power of 37 diameters. Viewed by both incident and oblique illumination it was seen that the

ovoid pellets, especially those with a brownish-green colour, gave a strong reaction in the form of a series of concentric zones of globules of an oil nature, whilst the cylindrical, twisted greenish bodies gave a weak response. The test was made on a sample at 1271'.

Origin of the Glauconite:

Although Glauconite is not a definite mineral species, being a hydrous silicate of potash and ferric oxide, with a variable quantity of alumina, ferrous oxide, magnesia and often lime, it is sufficiently distinct as to be easily recognised, especially in connection with sediments that are associated with organic remains and which have been disturbed by oceanic currents. That they show in most cases a relationship with the tests of foraminifera, establishes the theory that glauconite grains are formed, at least at the beginning, within the shells of those organisms. Even when the grains have a conretionary structure, they often show within a sign of such origin. Gümbel supposed that gases disengaged by organisms, gave rise to deposits of glauconite, and that the hydrocarbons often associated with such deposits were also part of the same reactions.

Conditions Favouring the De position of Glauconite:

According to Murray and Renard (see "Deep Sea Deposits") these are "the lower limits of wave, tidal and current action". In "the shallower depths beyond this line" (the mud line) "that is to say in depths of about 200 to 300 fathoms, the typical glauconite grains are more abundant than in deeper water." The statement of these authors, as to the absence of glauconite in littoral and sublittoral zones, has of late been discovered disproved by records of Japanese

scientists, that show how these glauconitic sediments can be, and have been, formed in the estuaries of rivers. In as yet unpublished reports, on my investigations of Queensland Cretaceous rocks, I have noted that glauconite occurs abundantly in shore-line faunas of the age of the Tambo series.

Probable effect of migration of oil towards the enrichment of the Glauconite Bed:

From the fact that an appreciable quantity of oil and wax still exists in the strata above, in both the Micaceous Shales (Upper Oligocene) and the marls and limestones of the Miocene, in the Lakes Entrance area, it may be assumed that there we may have a potential source of hydrocarbons which has hitherto been overlooked. Notwithstanding the fact that some of the oil in the glauconite bed is certainly autochtonous, the above fact, which I have recently proved by frequent testing, has a most important bearing on the subject of the possibilities of the region as a whole.

Particularly illuminating are the observations of W. S. Kew, on p.113 of his "Geology and Oil Resources of a part of Los Angeles and Ventura Counties, California" Bull. 753 U.S. Geol. Survey, 1924, where he says, - By experiment it has been found that capillarity may exert a considerable force in the migration of oil. This may account for the driving out of the oil from shale into coarser rocks where water is present, but the movement upward into the tops of the anticlines required other means. In substance, the hypothesis is that water, which is usually present in the strata, having a surface tension approximately three times as great as that of oil and therefore a correspondingly greater capillary

force, will drive out the oil from the finer into the coarser grained rocks that are within the range of capillary action. This hypothesis was advocated by Washburne and later was made the basis for experimentation by McCoy, who arrived at the conclusion "that the segregation of oil and water in openings of ordinary oil rocks is not according to the general hydrostatic idea, but that the water forces the oil into the larger openings, regardless of elevation or structure." Further, M. J. Munn "considers that the action of underground circulating water, together with the capillary action of water, drives the oil as small globules before it."

(Sgd.) F. CHAPMAN,

31/8/38.

4. Geochemical Analysis

W404

CHEMICAL LABORATORIES—
Departments of Agriculture, Health, and Mines, Victoria.

Phone: F 0234.

State Laboratories,

GISBORNE STREET,
MELBOURNE, C.2.

13th March, 1945.

REPORT ON SAMPLES Nos.M.91-100/45.

Samples ... Crude Oil.
Locality ... Imray Well - Lakes Entrance.
Sender ... H.J.Cook,
Supervisor,
Lakes Entrance Oil Project.

RESULTS.

No.	Marks	Depth	Water Content.
91	0	top	Less than 0.5 %
92	1	100'	" " "
93	2	200'	Trace
94	3	300'	Less than 0.5 %
95	4	400'	Trace.
96	5	500'	Less than 0.5 %
97	6	600'	Trace.
98	7	700'	"
99	8	800'	"
100	9	900'	"

Specific Gravity $\frac{60^{\circ}F.}{60^{\circ}F.}$ = 0.957

L.F.Seidl.

CHEMIST & ASSAYER, MINES SECTION.

F. H. CAMPBELL, D.Sc., F.A.C.I.
Associate Institute of Patent Attorneys of Australia
◎
CONSULTING AND INDUSTRIAL RESEARCH CHEMIST
PUBLIC ANALYST
◎
TEL. M U 4315

CHAMBER OF COMMERCE BUILDINGS
35-43 WILLIAM STREET
MELBOURNE, C.1

17th. October 1939.

The Secretary,
Austral Oil Drilling Syndicate,
Temple Court,
MELBOURNE. C.1.

Dear Sir,

Imray Well Water.

My analysis of the sample of Water from the Imray Well, submitted by you, resulted as follows:-

	Imray Bore 10/10/39.	Foster's Bore 7/9/36.	Midwest Bore 15/11/37.
	Parts per 100,000.		
Total solids	138.6		168.2
Organic & volatile solids			38.0
Non-volatile solids		147.4	130.2
Silica	3.0	1.4	9.0
Oxides of iron & aluminium	1.0	1.5	3.2
Calcium oxide	2.1	0.2	nil
Magnesium oxide	1.1	1.9	1.0
Chlorine	25.6	23.7	46.0
Sulphur trioxide	1.1	5.4	1.7
Alkalinity (as sodium bicarbonate)	98.5	121.8	111.5

A comparison of the figures in the first column with those in the second and third indicates that the sample from the Imray Bore consists mainly, if not entirely, of ground water. The possibility of the admixture of some rain water cannot be excluded, but it would not seem that the water entering below had suffered any considerable dilution.

Yours faithfully

F. H. Campbell

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Yours faithfully

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CHARTERED
CONSULTING AND INDUSTRIAL RESEARCH
CHEMIST
PUBLIC ANALYST

TEL. M.U. 4315

CHAMBER OF COMMERCE BUILDINGS
35-43 WILLIAM STREET
MELBOURNE, C.1

14th. June 1938.

C.S.Demaine Esq.
Austral Oil Drilling Syndicate,
Temple Court,
MELBOURNE. C.1.

Dear Sir,

Bore Core, Imray Well.

I have to report that my analysis of the sample of Bore Core submitted by you under the mark "Imray Well, 1253'3'' to 1254'3"" resulted as follows:-

Moisture	22.11 per cent
Oil	1.05 " "
Oil volatile in steam	nil

The oil obtained had the characteristics of samples of oil from your Foster's bore previously examined by me.

Yours faithfully

F.H. Campbell

P.S. I find that the gas samples have not been preserved. I regret that these are not available, but feel sure that it will be more satisfactory to have a freshly drawn sample examined.

FHC

Airdrie.
Actual Oil

5. Progress Log.

AUSTRAL OIL DRILLING SYNDICATE
NO LIABILITY

Progress Log of New Bore known as IMRAY WELL.

Spudded in on April 4th, 1938
Day shift

Depth of Bore 20 feet.

April 5th,1938

6 a.m. to 2 p.m.
Formation - Sandy yellow clay. Depth of bore 47 feet.

April 5th,1938

2 p.m. to 10 p.m.

Hard limestone band at 60 feet.
Width of band 1 foot 3 inches.
Change of formation at 61 ft.3 inches.
Loose gravel. Depth of bore 71 ft. 9 inches.

April 6th,1938

6 a.m. to 2 p.m.
Marl formation to 90 feet.
Blue grey marl at 90 feet. Depth of bore 94 ft. 6 inches.

2 p.m. to 10 p.m.
Formation blue grey marl. Depth of bore 118 feet.

April 7th, 1938

6 a.m. to 2 p.m.

Formation Blue grey marl. Depth of bore 142 feet.

2 p.m. to 10 p.m.

Formation blue grey marl. Depth of bore 168 feet.

April 8th, 1938.

6 a.m. to 2 p.m.

Formation greyish marl. Depth of bore 188 feet.

2 p.m. to 10 p.m.

Formation grey marl. Depth of bore 215 ft. 6 inches.

April 9th, 1938
6 a.m. to 2 p.m.
Formation grey marl Depth of bore 244 feet.
2 p.m. to 10 p.m. 274 feet.

April 11th,1938

6 a.m. to 2 p.m.
Formation from 274 to 282 feet depth grey marl.
Formation gradually changing from grey marl at
282 feet to gritty shell. First indication
of polyzoal at 282 feet.
Struck pure clean white polyzoal at 300 feet.
Depth of bore at end of shift
335 feet.

2 p.m. to 10 p.m.
Formation polyzoal to 368 feet 6inches
where formation changes to sticky grey marl.
Water from polyzoal rose to 125 feet from
surface. Depth of bore 368 feet.

April 12th, 1938

6 a.m. to 10 p.m.
The hole was bailed out to allow polyzoal water
only in the hole. Samples of 6 bottles of water
taken by bailer from bottom of hole.
These bottles contain polyzoal water taken

Progress log of New Bore known as IMRAY WELL.

from the depth at 396 feet.
Sticky grey marl from 368feet 6 inches to 396 ft,
where drilling ceased for 8 " casing to be inserted.
Depth of bore 396 ft.

April 12th, 1938

2 p.m. to 10 p.m.

Placing 8" casing on rack from No. 4 site.
Reaming out the hole and cleaning same. Depth of bore 396 ft.

April 13th, 1938

Both drilling crews on day shift completed
getting 8" casing into position and started
inserting 8" casing in bore.

April 14th, 1938

Both drilling crews on day shift.
Completed running in 8" casing with steel shoe
on bottom. Cleaned out bore thoroughly.
Cemented 8" casing in at 398 feet. Cement used
1100 lbs. Bore hole kept full of water and
sealed head in position, then bore closed down.
Easter holidays to follow.
The hole was deepened 2 feet before setting in 8"
casing, making depth of bore lined with 8" casing. — 398 feet.

April 18th and 19th, 1938.

Drilling crew on day shift. Carting 6" casing.
The 8" casing made secure in hole with steel
clamps.

April 20th, 1938.

Unscrewed 8" casing head from the 8" casing in
hole and found all joints watertight.
Then bailed hole dry.
Made up a string of tool s for drilling.

April 21st, 1938. 6 a.m. to 2 p.m.
Drilling out what cement remained in bottom of
8" casing.

2 p.m. to 10 p.m.

Cleaned out all cement and bailed hole dry.
Drilled to 408 feet in grey marl. — 408' 6"

April 22nd, 1938

		Depth of Bore.
6 a.m. to 2 p.m.		
Reaming out hole and cleaning out sludge. Bailed hole dry.	408' 6" to 412'6"	412ft. 6"
2 p.m. to 10 p.m.		
Have to run water into bore to drill with. Formation grey marl.		425 ft.
Drilling with walking beam. Bailed hole dry.		

April 23rd, 1938

Formation grey marl Putting water in bore to drill with.	470 ft.
2 p.m to 10 p.m.	
No change in formation Still in grey marl.	476 ft.

Austral Oil Drilling Syndicate N.L.
PROGRESS LOG OF NEW BORE - IMRAY WELL.

April 25th, 1938 — Depth of Bore.

No work - Anzac Day.

April 26th, 1938

6 a.m. to 2 p.m.

476 ft to 494 ft - Formation still in grey marl.

2 p.m. to 10 p.m.

494 ft to 516 ft. - Grey marl. — 516 ft.

April 27th, 1938.

6 a.m. to 2 p.m.

516 ft to 540 ft. - Formation shelly grey marl.

2 p.m. to 10 p.m.

540 ft to 565 ft. - Formation shelly grey marl.
At 8 p.m. water started rising in bore.
10 p.m. Depth of water in bore was measured and showed 100 ft water. — 565 ft.

April 28th, 1938

6 a.m. to 2 p.m.

565 ft to 586 ft. - Formation grey marl.
7 a.m. Depth of water in bore 355 ft.

2 p.m. to 10 p.m.

586 ft to 607 ft. - Formation grey marl to 590 ft. then changed to whitish grey samples had a very strong odor. - Water rose to 400 ft. from bottom. — 607 ft.

April 29th, 1938. 6 a.m. to 2 p.m.

607 ft. to 630 ft. - Formation still whitish grey marl. Water rose to 500 ft. from bottom.
Drilling tools and bailer turned black. apparently by formation or water encountered. (Took samples of water)

2 p.m. to 10 p.m.

630 ft to 651 ft. - Formation still same. — 651 ft.
Water at same level.

April 30th, 1938 6 a.m. to 2 p.m.

651 ft. to 670 ft. - Formation whitish grey to 654. ft. then changed to blue grey.

2 p.m. to 10 p.m.

670 ft to 685 ft. - Formation blue grey marl to 673 ft., then changed to greenish marl.
Bore hole started to cave. Water level 130 ft. from surface. — 685 ft.

May 2nd, 1938.

Both crews on day shift. Made up casing lines. Ran in casing to 685 ft. Checked correctly with bore measurements. Casing pulled back 6 ft. and set in position. String of tools made up for drilling in 6" casing.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY" WELL.

	Depth of Bore
May 3rd, 1938. 6 a.m. to 2 p.m.	
Cleaned out bore set timbers for casing spider, spliced sandline. Depth 686' 6" grey marl.	686'6"
2 p.m. to 10 p.m.	
Depth 697'6" Formation grey marl. Casing to 689 feet.	697'6"
May 14th, 1938. 6 a.m. to 2 p.m.	
Depth 703 feet. Formation grey marl.	703'
2 p.m. to 10 p.m.	
Formation grey marl. Depth 713 feet. Casing to 702'10"	713'
May 5th, 1938. 6 a.m. to 2 p.m.	
Depth 721'6" Formation grey marl Casing to 720 feet.	721'6"
2 p.m. to 10 ap.m.	
Depth 734 feet. Formation grey marl.	734'
May 6th, 1938. 6 a.m. to 2 p.m.	
Depth 748 feet. Formation grey marl to 735 feet. Changing to soft white limestone to 738 feet, then grey marl. Casing to 735'9".	748'
2 p.m. to 10 p.m.	
Depth 752'6" Formation grey marl. Casing to 751'9"	752'6"
May 7th, 1938. 6 a.m. to 12 a.m.	
Depth 760 feet. Formation grey marl.	760'
2 p.m. to 10 p.m.	
Depth 766'6" Formation grey marl. Bailer showed a little gas and oil.	766'6"

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY" WELL.

Depth of Bore

May 9th, 1938. 6 a.m. to 2 p.m.

Still drilling in a grey marl formation with a little gas and oil films showing. Formation sticky.
Depth of bore at end of shift 770 feet. 770 feet

May 9th, 1938. 2 p.m. to 10 p.m.

there is no noticeable change in the formation which is still showing a grey marl with a little gas and slight oil films showing in slurry or sludge drain. The 6" casing has been lowered to 766'6".
Depth of bore now 775'6". 775'6"

May 10th, 1938. 6 a.m. to 2 p.m.

Formation shows the same as yesterday grey marl. The gas seems to be more active here as it can be lighted on top of the bailer, but dies away after a few seconds.

Depth of bore 781 feet. 781 feet

2 p.m. to 10 p.m.
Grey marl formation with no change in gas pressure or oil films.
Depth 788 feet. 788 feet

May 11th, 1938. 6 a.m. to ~~10~~ 2 p.m.

The formation is grey marl. The gas is becoming more active here that is from 788 ft. to 790'6". The gas will burn continuously on bailer and will remain alight while bailer is being hoisted over to sludge drain. Slurry boils over at top of bailer. Just here the hole is caving badly and the hole keeps filling in at bottom where there is only 10 feet of open hole below the 6" casing.
Depth now 790 ft. 6". 790'6"

2 p.m. to 10 p.m.
In grey marl to 794 where there was a change to a hard band. to 795. This band would be about 6 inches thick making this band from 794 to 794'6". This formation appears to be a rounded small grained quartz; samples hard to get.
Depth 800 feet. 800 feet

May 12th, 1938. 6 a.m. to 2 p.m.

Formation under the reported hard layer at 794'6" has changed to a light grey marl which carries on to 803 feet. At 803 feet, formation again changes to a whitish lime-stone for 3 feet stopping at 806. From 806 ft. the formation changes back to grey marl. The gas pressure at 803 to 806 lime formation became more active here than at above depths where gas was reported. The drilling here became much easier and more progress made as formation stands up better. The 6" casing has been lowered to 788'5".
Oil films showing. Depth of bore now 810 feet. 810 feet.

2 p.m. to 10 p.m. - Oil films here.
The formation from 810 showing grey marl again with thin bands of a harder formation which looks like lime as the slurry from bailer is like a whitewash in the lamp light.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY" WELL. Depth of Bore.

May 12th, 1938. 2 p.m. to 10 p.m. (continued)

These slight hard lime bands occur at 812 to 814 and a 6" band at 819 to 819'6". This is good drilling and tools come out of hole nice and clean. Gas is still strong all time.

Depth 820 feet. 820 feet.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY WELL".

Depth of Bore.

May 13th, 1938. 6 a.m. to 2 p.m.

There is no change in colour of formation. We still call this formation grey marl. The formation is of a crumbly nature and falls in a lot, even if there is only 3 feet of open hole below the 6" casing. Gas is quieter here, and does not light very easily on bailer top. Oil films showing slightly.
Depth of bore 826 feet. 826 feet

2 p.m. to 10 p.m.
Grey marl showing all through this shift. Formation standing up a little better below casing. Gas slight. Oil films noticeable through shift.
Depth of bore 836 feet. 836 feet

May 14th, 1938. 6 a.m. to 2 p.m.

Very little gas showing during this shift. Slight oil films showing. Formation same as previous shift - grey marl. Gas started to die away on this shift.
Depth of bore 843 feet 6 inches. 843'6"

2 p.m. to 10 p.m.
There us very little gas showing during this shift in the bailer, but a few gas bubbles rise and burst in slurry when bailer is dumped or emptied in sludge drain. Faint oil films showing. Formation grey marl.
Depth 849'6" 849'6"

May 16th, 1938. 6 a.m. to 2 p.m.

In grey marl formation very little gas. Slight oil films showing. Formation caves in a lot, hard job to get enough open hole to run in another length of casing. Casing lowered to 855'1".
Depth of bore 855'6". 855'6"

2 p.m. to 10 p.m.
Ran in hole with core barrel and took a core at 860 to 861 ft. This core showed there is a hard band at 860 ft. 9". to 861'3". Core barrel obtained 3 inches of this hard band after coring, the formation cored above this hard band was grey marl. The remaining 3 inches of hard band was drilled out after the core was taken, and immediately below hard band, grey marl formation continues. Gas is very scarce through shift, very little oil films showing. Core obtained 9 inches grey marl and 3 inches harder band.
Depth of bore 865 feet. 865 feet

May 17th, 1938. 6 a.m. to 2 p.m.

There is nothing to report during this shift. Formation grey marl. Drilling progress much better, not caving so badly. Very little gas. Oil films only slight.
Depth of bore 874 feet. 874 feet.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY WELL"

Depth of Bore

May 17th, 1938. 2 p.m. to 10 p.m.

Formation grey marl, very little gas, not many films of oil showing during this shift. This formation caves in a lot and has to be followed up with casing within 4 feet of bottom. Casing to 871'10". Casing head kept well up above floor level so as to give plenty of room for drill to work below casing shoe.
Depth of bore 880 feet. 880 ft.

May 18th, 1938. 6 a.m. to 2 p.m.

Formation grey marl, very little gas. Caves badly through shift. Oil films not very prominent here.
Depth of bore 885 ft. 6 ins. 885' 6"

2 p.m. to 10 p.m.
Formation grey marl. Very little gas.
Formation caves badly.
Depth 892 ft. 6 ins. 892' 6"

May 19th, 1938. 6 a.m. to 2 p.m.

Formation changes at 902 to a light green coloured gritty marl. This drills very good, and a little more gas is beginning to show. Casing lowered to 890 ft. 1 in.
Depth of bore 904 feet. 904 feet

2 p.m. to 10 p.m.
A change of formation occurs at 904 feet to 908 feet to a greenish marl. During this change the gas became very active. When the bailer reaches the surface the gas has lowered the fluid in the bailer by 2 feet. The bailer is 18 feet long. The gas burns very freely and has a purple colour, and the odor given off is like fumes from a methylated flame. From 908 to 916 feet, the formation changes back to grey marl which is very sticky. Casing lowered to 908'7".
Depth of bore 916 feet. 916 feet.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY WELL"

		Depth of Bore
20th May, 1938.	6 a.m. to 2 p.m.	
Grey marl continues through this shift. Gas showing a little stronger in bailer. Slight caving. The formation is sticky. Depth of bore 926 feet.		926 feet
	2 p.m. to 10 p.m.	
In sticky grey marl, still caving. Gas is showing fairly strong here. The casing has been lowered to 925'10". This of course shuts off the gas higher up. Depth of bore 934'6"		934' 6"
21st May, 1938.	6 a.m. to 2 p.m.	
The formation is the same as previous shift, grey marl; gas is still fairly strong here. Slight caving, no signs of oil films showing. Depth 945' 6".		945' 6"
	2 p.m. to 10 p.m.	
Formation grey marl. Gas is not so strong here. Casing has been lowered to 942' 1". No oil films showing here. Depth of bore 956' 6".		956' 6"
23rd May, 1938.	6 a.m. to 2 p.m.	
The drill cable was changed over on this shift, viz. end for end. Formation is grey marl, sticky and caves a lot. Very little gas showing, no oil films. Casing has been lowered to 959' 7". Depth of bore 964' 6".		964' 6"
	2 p.m. to 10 P.m.	
Sticky grey marl with very little gas. Slight caving but a little better than previously. Depth of bore 971' 6".		971' 6"

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of New Bore - "IMRAY WELL"

	Depth of Bore
May 24th, 1938. 6 a.m. to 6 p.m.	
Formation grey marl, faint showings of oil films. Gas mild here. Hole caving a little. Casing lowered to 976' 1". Depth of bore 986 ft.	986 ft.
6 p.m. to 6 a.m.	
There is no change of formation (grey marl), little gas. Slight oil films. Casing lowered to 992'2". Depth of bore 1,000 feet.	1,000 ft.
May 25th, 1938. 6 a.m. to 6 p.m.	
From 1,000 feet, the formation gradually changes to a darker colour just noticeable, to 1,010 feet where formation becomes a darker brown, looks like a micaceous clay. Depth of bore 1,012' 6".	1,012 ft. 6 ins.
6 p.m. to 6 a.m.	
Formation brown micaceous clay. Gas burns freely on bailer. Many oil films showing in slurry. This formation is very sticky and caves badly. Casing lowered to 1,008 feet 10 inches. Depth of bore 1,018 feet.	1,018 feet
May 26th, 1938. 6 a.m. to 2 p.m.	
Formation brown mica clay which is very sticky. Gas is strong here and burns freely on bailer. Oil is showing freely.during this shift in sludge drain. Casing has been lowered to 1,026 ft. 10 ins. Depth of bore 1,033 ft. 6 ins.	1,033 feet 6 ins.
2 p.m. to 10 p.m.	
Formation brown micaceous clay, very sticky and caves a great deal. Depth 1,043 feet.	1,043 ft.
May 27th, 1938. 6 a.m. to 2 p.m.	
In brown micaceous clay. Gas came in very strong here 1,045. Gas burned freely in casing top. Screwed sealed head on casing and gas pressure rose, 20 lbs. in 17 minutes, as shown by pressure gauge screwed into sealed head. Water came back into hole during this gas pressure and helped to compress gas. Water has gone off again. The gas flame had an orange colour and was odourless. Caught gas samples. Casing lowered to 1,042 ft. 5 ins. Depth of bore 1,046 feet.	1,046 feet.
2 p.m. to 10 p.m.	
In brown micaceous clay. Gas is still fairly active through this shift. Caving a great deal. Slight films of oil showing. Casing lowered to 1,042 feet 5 ins. Depth of bore 1,053 ft. 6".	1,053 ft. 6"
May 28th, 1938. 6 a.m. to 2 p.m.	
The formation is the same in appearance as	

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of - "IMRAY WELL"

Depth of Bore

(contd. p.11)

previous shift. (Brown mica clay). Gas quieter here. Depth of bore 1,064 ft. — 1,064 feet

May 28th, 1938. 2 p.m. to 10 p.m.

There is no change in formation. Still in brown micaceous clay. This is sticky stuff and caves in in places. Casing lowered to 1,060 ft. 10 ins.
Depth of bore 1,071 feet. — 1,071 feet

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of - "IMRAY WELL"

	Depth of Bore
30th May, 1938. 6 a.m. to 2 p.m. Formation brown micaceous clay to 1073 where a hard band was struck 1 foot in thickness. Looks like a grey hard limestone to 1074 feet. Below this band, brown micaceous clay continues which is very sticky. Not so much gas here, but oil films are showing during the last 2 feet. Hard band at 1,073' to 1074'. Depth of bore 1079' 6"	1079' 6"
2 p.m. to 10 p.m. Repairs to walking beam on machine took 3½ hours. Casing lowered to 1079' 6". Formation unchanged. Brown micaceous clay, caves a lot, and is very sticky. Very little gas here. Depth 1084' 6".	1084' 6"
31st May, 1938. 6 a.m. to 2 p.m. Brown mica clay to 1091 ft., then a 6" hard band to 1091' 6". Formation is brown micaceous clay, very little gas. Slight oil films showing. Hard band at 1091 ft. to 1091' 6". Depth 1095 feet.	1095"
2 p.m. to 10 p.m. Brown micaceous clay with a few pieces of iron pyrites showing. Casing lowered to 1098' 1". Depth 1106 ft.	1106'
1st June, 1938. 6 a.m. to 2 p.m. Brown micaceous clay to 1113 ft. where a hard band was struck, the band was 2' 6" in thickness. Not much gas showing here. Hard band 1113' to 1115' 6". Depth of bore 1117 feet.	1117'
2 p.m. to 10 p.m. In brown micaceous clay to 1128' 6". Stuck a hard band here, 1' 6" in thickness. Very little gas. Hard band 1128' 6" to 1130'. Casing lowered to 1116' 1". Depth of bore 1130' 6".	1130' 6"
2nd June, 1938. 6 a.m. to 2 p.m. Brown micaceous clay, a little darker in colour. Casing lowered to 1132 feet. Depth 1144 ft.	1144 feet.

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress log of - "IMRAY WELL".

	Depth of Bore
2nd June, 1938. 2 p.m. to 10 p.m. Formation dark brown micaceous clay. Casing lowered to 1140. Struck hard band at 1147 to 1147'6". Another hard band at 1155' 6" to 1156' 6". Casing lowered to 1150' 4". Depth of bore 1157 feet.	1157'
3rd June, 1938. 6 a.m. to 2 p.m. Formation dark brown micaceous clay. Casing lowered to 1167' 3". Depth of bore 1170 feet.	1170 feet
2 p.m. to 10 p.m. Formation dark brown micaceous clay. Hard band at 1173 to 1173' 6". Depth of bore 1183 feet.	1183 feet
4th June, 1938. 6 a.m. to 2 p.m. Dark brown micaceous clay. Casing has been lowered to 1183' 10". Sticky formation. Iron pyrites showing. Depth of bore 1196 ft.	1196 ft.
2 p.m. to 10 p.m. Formation dark brown micaceous clay. Slight oil films showing. Also a little gas. Casing lowered to 1201' 6". Depth of bore 1210 feet.	1210 ft.
6th June, 1938. 6 a.m. to 2 p.m. Formation dark brown micaceous clay. A hard band at 1214 ft. 6 ins. to 1216 ft. Gas shows very strong here and burns freely on bailer. Oil films are showing better here. Had to make a repair job to band wheel key way. Drilling delayed for 3 hours. Drilling now resumed. Depth of bore 1216 ft. 6".	1216' 6"

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of - "IMRAY WELL"

	Depth of Bore
6th June, 1938. 2 p.m. to 10 p.m. Drilling in brown micaceous clay. Iron pyrites still showing in this formation. Casing lowered to 1218' 1". Depth of bore 1229' 6".	1229' 6"
7th June, 1938. 6 a.m. to 2 p.m. Still drilling in dark brown micaceous clay to 1236' then a hard band of 1 ft. to 1237'. Casing lowered to 1235' 4". Depth of bore 1242' 6".	1242' 6"
2 p.m. to 10 p.m. Formation dark brown micaceous clay to 1252' 6" then a change to a hard band of limestone 3" inches in thickness to 1252' 9". A further 6 inches drilled below this looks like the top of glauconite at 1253' 3" showing a sandy clay and a little gas and oil globules. Casing to 1235' 4". Depth of bore 1253' 3".	1253' 3"
8th June, 1938 6 a.m. to 2 p.m. Cored about 9 inches beyond this 1253' 3" to 1254" and this core showed a greenish sandy formation with specks of oil showing in it and a little gas also. This small core hole made at bottom of bore was plugged up with clay, and preparations made for reaming 20 feet of open hole for cementing. Depth 1253' 3".	1253' 3"
2 p.m. to 10 p.m. Reaming out hole with reamer for cementing. The hole is caving and gas is showing. The bore now reamed down to 2' 6" from bottom.	
9th June, 1938 6 a.m. to 2 p.m. Reamed hole to bottom. The hole was given a good clean out by bailing from the bottom of bore.	
2 p.m. to 10 p.m. 460 feet of bad rope taken off sandline spool. 500 ft. of better rope spliced in its place. Hole further cleaned out. A repaired casing wheel was placed back in its position on top of derrick.	
10th June, 1938 8 a.m. to 4 p.m. Both crews on day shift cementing 6" casing in. Casing lowered close to bottom and filled up bore with water. Dumped 12 sacks. x 100 lb. cement to bottom. This Baker dump cement bailer is 27 feet in length and 4" in diameter. The bailer was filled 7 times with cement and sent to bottom of bore. The casing was then pulled back 25 Ft. allowing cement to fill open hole. The casing was filled with water under a sealed head and lowered to bottom leaving very little cement in casing as shown by testing with bailer. Quickardo cement used 12 sacks. Casing cemented at 1253' 3".	1253' 3"

AUSTRAL OIL DRILLING SYNDICATE N.L.

Progress Log of - "IMRAY WELL"

Depth of Bore

18th June, 1938.
6 a.m. to 2 p.m.

Bailing out water after cement had set.
Water going away quickly.

2 p.m. to 10 p.m.

Bailed hole to bottom, then let hole stand for 2 hours. Ran bailer and found hole perfectly dry. Dressed drill for cleaning out.

20th June, 1938.
8 a.m. to 5 p.m.

Took three cores to 1260-9. Cleaned down hole with drill and bailed dry.

21st June, 1938
8 a.m. to 5.30 p.m.

Took further cores to 1266-8. Cleaned out to bottom and bailed dry.

22nd June, 1938.
8 a.m. to 5.30 p.m.

Took further cores to 1273-6. Cleaned down to bottom with drill and bailed dry,

23rd June, 1938.
8 a.m. to 4 p.m.

Bailed 4¾ gallons of oil from bore.

24th June, 1938.
8 a.m. to 4 p.m.

Bailed 6¾ gallons of oil from bore after standing 23 hours. Crew fixing up sand line.

25th June, 1938.
8 a.m. to 4 p.m.

Bailed 6½ gallons of oil from bore after standing 24 hours, there being no water showing in this test.

25th June, 1938 (Sat.)

Same shift on getting reamer fixed up to ream out oil sands. Hole closed down after bailing test until Monday 27th.

(Copy of Log)

AUSTRAL OIL DRILLING SYNDICATE N.L. - IMRAY WELL.

Elevation 135' - 16 chains N.W. of Foster's Bore.

Surface to 60' - sandy yellow clay.

61'3" - hard limestone band

61'3" to 90' - loose gravel, then marl.

90' to 274' - blue grey marl

274' to 282' - change to gritty shell

300' " 368' - white polyzoal

368'6" " - sticky grey marl - water

398' Casing 8" inserted and cemented

408' to 516' - grey marl

565' " - water rising in well 100' - shelly grey marl

586' " - 355 ft. water in well - " " "

590' - grey marl

590' to 607' - whitish grey marl

Water 400' to 500' from bottom

685' - whitish grey, blue grey, then greenish marl and started to cave

Water 555 feet from bottom

From here inserted 6" casing, following the drill

689' to 734' - grey marl

735' " 752'6" - grey marl to 735', soft limestone then grey marl

752'6" " 788' - little gas and oil, gas more active at depth.

800' - gas burnt continuously, caving marl

794' " 794'6" - hard bar

820' - grey marl, limestone, oil films

Hard bands 812'4" and 819' to 819'6" - gas strong.

836' to 849'6" - caving grey marl, oil films and gas

Hard bands at 860'9" to 861'3"

Core barrel used between bands, caving badly

874' to 892'6" - caving grey marl

916' - greenish marl, then grey, gas very active

934'6" to 1000' - grey sticky marl, caving, little gas and oil films

1018' " 1071' - brown micaceous clay, very sticky - gas.

Hard bands 1073'4" and 1091'6", brown clay, little gas, and oil films, few iron pyrites.

Imray Well (contd.)

Hard Bands	1113'	to	1115'6"	)
" "	1128'6"	"	1130'6"	)
" "	1147'	"	1147'6"	) Micaceous clay between bands.
" "	1155'6"	"	1156'6"	)
" "	1173'	"	1173'6"	)
" "	1214'6"	"	1216'	- gas strong and oil films - iron pyrites present.
Hard Bands	1236'	"	1237'	- gas strong
" "	1252'6"	"	1252'9"	- gas and oil globules.
Cored -	1253'	"	1254'	- green sand, oil and gas, plugged core hole with clay before reaming 20' of open hole preparatory to cementing 6" casing. Casing lowered to bottom, filled with water, dumped 12 sacks cement, casing lifted 25' allowing cement to fill open hole, casing again filled to top with water and lowered to bottom of well with sealed head attached and allowed stand for 8 days.

Undergoing tests for production.

6. Prooduction Figures

IMRAY WELL

PRODUCTION FIGURES

Date		Gals. Oil Bailed	Standing Hours	Pints Water
1938				
June	23	4¾		
	24	6¾	23	
	25	6½	24	no water
	27	7	48	"
	28	7	24	
	29	10	17	
	30	5¼	18	
July	1	5½	23	
	2	4½	24	
	4	10½	48	
	5	7	24	
	6	5		
	7	7	24	
	8	4	24	
	9	5¼	24	6
	11	10	48	10
	12	5½	24	4
	13	5		3
	14	5½	24	
	15	5⅛	24	
	16	5⅛	24	
	18	9 and 1/3rd.	48	
	19	5¼	24	
	20	5	24	
	21	5⅛	24	1
	22	5	24	2
	23	5	24	3
	25	10	48	10
	26	5	24	1
	27	4⅞	24	1
	28	5¼	24	
	29	5	24	2
	30	5 and 1/5th	24	2
Aug.	1	9¾	48	9
	2	5	24	4
	3	4½	24	4
	4	5	24	2
	5	5	24	4
	6	5	24	2
	8	10	48	6
	9	5	24	2
	10	5	24	3
	11	4¾	24	3
	12	4½	24	
	13	6¼	24	3
	15	10½	48	12
	16	4	24	4
	17	4½	24	3
	18	5	24	3
	19	5	24	3
	20	5	24	3
	22	9½	24	12
	23	5¼	25	4
	24	5	24	
	25	2¾	24	
	26	3	24	
	27	4¼	24	
	29	6¼	48	
	30	4¼	24	
	31	5½	24	
Sept.	1	5	24	3
	2	5	24	

Date	Gals. Oil Bailed	Standing Hours	Pints Water
Sept. 3	5	24	
5	10½	48	
6	5¼	24	
7	4	17	
8	5½	24	
9	4½	24	
10	6¼	17	
12	11¼	48	
13	4	24	1
14	6½	24	3
15	5½	24	2
16	5½	24	1
17	5	24	
19	10½	48	2
20	5	24	
21	5¼	24	1
22	5½	24	
23	4¾	24	1
24	5	24	2
26	10½	48	4
27	5½	24	
28	5¼	24	
29	5¼	24	
30	5	24	1
Oct. 1	4½	22	
3	11½	50	3
4	5¼	24	3
5	5	24	1
6	4½	24	1
7	5	24	½
8	5	24	½
10	10½	48	1
11	5	24	½
12	5	24	½
13	5	24	½
14	5¼	24	½
15	5	24	½
17	10¾	48	½
18	5½	24	
19	5½	24	
20	5½	24	
21	5¼	24	1
22	5	24	½
24	12¾	48	1
25	5	24	½
26	5	24	½
27	5¼	24	1
28	4¾	24	1
29	5	24	1
31	9	48	1
Nov. 1	5	24	½
2	5	24	½
3	5	24	½
7	18½	92	1
8	5	24	½
9	5½	24	½
10	5¼	24	½
14	19	92	1
15	6	28	½
16	5	24	
17	5½	24	
21	18½	90	½
22	6½	28	½
23	5¼	24	½
24	5	24	½
28	18½	92	12
29	5	24	2
30	5¾	24	

Date	Gals. Oil Bailed	Standing Hours	Pints Water
Dec. 1	5½	24	
5	19	92	1
6	5	24	1
7	5¼	24	1
8	5¼	24	1
12	18½	92	8
13	5½	26	4
14	5	24	3
15	5	24	3
19	18¾	92	10
20	6	26	2
21	5	24	2
22	5	24	2
26	23½	112	8
27	6	24	4
28	5¼	24	3
30	5	24	1½
1939			
Jan. 3	18½	92	8
4	6¼	24	½
5	5	24	1
9	18½	92	11
10	6	26	1½
12	5	24	1
16	17	92	14
17	5½	26	4
18	5½	24	
19	5	24	½
23	17	92	20
24	6	26	½
25	5	24	½
26	4¾	24	1
30	18	90	8
31	6½	28	½
Feb. 1	5	24	½
2	5	24	1½
6	17	92	1¼
7	6½	26	4
8	5	24	1
9	5	24	½
13	18½	96	6
15	9½	44	1½
16	6	26	1
20	18¼	92	6
23	15¾	72	4
27	18	92	6
28	7	26	¾
Mar. 1	5½	24	¾
2	5	24	¾
6	19	92	4
7	6¼	26	4
8	5	24	1
9	5	24	1
13	17½	92	8
14	6	26	4
15	5	24	¾
16	5	24	½
20	17½	92	8
21	5½	26	½
22	5	24	1½
23	4¾	24	½
27	18	92	6
28	6	26	3
29	5¼	24	3
30	5	24	1½
Apl. 2	6		
3	12	92	12
4	5½	26	4

Date	Gals. Oil Bailed	Standing Hours	Pints Water
Apl. 5	5	24	
6	5¼	24	¼
11	22½	116	6
12	5¾	26	½
13	5	24	
17	16½	92	6
18	6¾	26	1½
19	5½	24	1
20	5	24	1
24	17½	92	6
26	10½	46	9
27	5	24	1
	1,537 gals		pints 431 : 3.48%

7. Determination of Reservoir Pressure
From Liquid Level Data (2 copies)

W 4204

1945

DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES.

Report No. 1945/34- Plans Nos. 1234 to 1236 inclusive.

THE DETERMINATION OF RESERVOIR PRESSURE FROM LIQUID LEVEL DATA, IMRAY AND PILOT BORES - LAKES ENTRANCE.

The pressure of the liquid, or reservoir pressure, within the glauconitic sandstone at Lakes Entrance has been the subject of conjecture in recent years and the low yields of oil which typify the field have been attributed by some observers to low reservoir pressure. Reservoir pressure, however, is only one of a number of factors upon which the rate of yield depends. Other factors of equal importance are the permeability of the producing formations and viscosity of the fluids produced.

However, it was not until the Imray bore had been drilled by Austral Oil Ltd. that any satisfactory evidence was obtained which permitted a true estimate of reservoir pressure being made. In this bore, glauconitic sandstone was entered at 1253 feet from the surface and drilling was stopped after 21 feet of glauconitic sandstone had been penetrated. It is probable that 10 to 20 feet of sandstone separates the bottom of the bore from the artesian water horizon. The sandstone provides an effective barrier to the ingress of water from the latter horizon. The bore is cased from the surface to the top of the glauconitic sandstone where it is seated in cement, and all aquifers above the sandstone are sealed off.

Bailing tests showed that the 23 feet of glauconitic sandstone exposed yielded a daily average of approximately 31 pints of oil and 9 pints of water. Later, the liquid yielded was allowed to accumulate in the bore casing and at intervals over a period of some 24 months, the liquid level was recorded. The curve in Fig. 1 shows the liquid level (H) plotted against time in months. The values used have been taken from a similar curve published in The Petroleum Times (1).

It will be observed that the rate of rise, for instance the rise per month, decreased as time went by - this decrease becoming more apparent towards the end of the test period. It is evident that the curve is tending asymptotically towards a value of H of the order 1200 to 1400 feet, at which value the back pressure provided by the liquid column would be sufficient to prevent the flow of liquid from the reservoir. In other words, the back pressure would be equal to the reservoir pressure.

A particular method of plotting enables a reasonably accurate estimation of reservoir pressure to be made from such a curve as Fig. 1 without the necessity of waiting until the liquid level reaches its final value. As this method will be applied to date from the Pilot bore as well as Imray, its description will be delayed until the Pilot bore and the data obtained in tests conducted on it are described.

The Pilot bore is the most recent in the Lakes Entrance district and was under close observation from its inception. It was drilled primarily to obtain information of the yield from water-bearing formations which the nearby shaft would penetrate, but, as has been described elsewhere (2), it provided valuable information about the oil and water yields from the glauconitic sandstone.

The bore is cased with five inch casing from the surface to the top of the glauconitic sandstone at 1196 feet, into which it is firmly cemented. Before proceeding with the drilling of the glauconitic sandstone, bailing tests proved that the cement provided a tight seal and no water entered the casing from formations above the glauconitic sandstone. This was of utmost importance to the subsequent bailing tests as it could be assumed that any fluid entering the bore after sections of the glauconitic sandstone had been drilled came from the glauconitic sandstone exposed.

The glauconitic sandstone was drilled in steps of approximately two feet and bailing tests were made after each successive two foot section was drilled. Drilling was suspended when 22 feet 10 inches of glauconitic sandstone had been penetrated. After the necessary bailing tests had been completed, the liquid yielded by the section of glauconitic sandstone was allowed to accumulate in the bore and daily records were kept of the height of the liquid column as it rose in the casing.

The height was found by lowering the bailer into the bore to a predetermined depth - withdrawing it and noting the position of the liquid coating on the bailer. With experience it was possible to determine in advance the depth to which the bailer should be lowered so that it penetrated this liquid by a matter of only two or three inches. A correction was applied to the liquid height to allow for the liquid displaced by the bailer. The test was conducted over a period of 65 days the final height of the liquid column being 513 feet 10 inches.

The liquid heights are shown in Fig. 2 plotted against the time in days. Because of the shorter time used in this test, the falling off in the rate of rise with time is not so marked in this curve as it is in the corresponding curve (Fig. 1) for the Imray test, but a comparison with the straight line drawn through the origin and tangential to the curve at the origin demonstrates the decline in the rate of rise with time.

Determination of Reservoir Pressure from Liquid Level Data.

Time and the liquid level are related to one another by the following relationship:- (3)

$$\frac{\gamma g c t}{a} = -\log_e \frac{He - H}{He - Hi} \qquad ----- \quad (1)$$

where γ = density of liquid column.
g = gravitational constant.
c = productivity index which is a constant for the bore.
t = time
a = area of cross section of bore casing.
He = liquid height corresponding to reservoir pressure.
H = liquid height at time t.
Hi = liquid height at time zero.

Equation (1) may be expressed as:-

$$t = K \log_{10} (He - H) \qquad ----- \quad (2)$$

i.e. if values of t are plotted against corresponding values of $\log_{10}$ (He-H), the curve will be a straight line with a slope θ where $\tan \theta = K$.

In the examples under consideration, the value of He is unknown, but equation (2) provides a means of determining it. This can be done by a method of trial and error. Various values

of He are assumed and curves derived from equation (2) are plotted. The correct value of He will give a straight line, whereas the curves for other values of He will depart from the straight line. In the case of the Imray bore, a set of such curves is shown in Fig. 3. Values of He range from 1200 feet to 1400 feet. It will be observed that the curve for He = 1250 feet is the closest to a straight line of those shown. A closer approximation could be found by choosing intermediate values of He, but as will be shown presently in connection with the results from the Pilot bore, the value of He which gives the closest approximation to a straight line can be found by another method.

The set of curves for the Pilot bore, corresponding to those in Fig. 3 for Imray, are shown in Fig. 5. Selected values of He range from 800 feet to 2000 feet.

A departure from a straight line is clearly evident in the curves for He = 800 and 1000 feet and is present, but not very obvious in some of the other curves.

The choice of the most probable value of He, i.e. the value that gives the closest approximation to a straight line, is not at all evident from these curves, but a value has been arrived at in another way, which has also been applied to the Imray results.

A set of values typical of those used in plotting the curves in Fig. 3 and 5 are tabulated below:-

Imray Bore.

Time (months)	H feet	He = 1200 feet. He - H	$\log_{10}$(He - H)	d. log (He - H)	Departure from mean
0	240	960	2.9823		
				.2713	.0961
5	686	514	2.7110		
				.3045	.0629
10	945	255	2.4065		
				.3273	.0401
15	1080	120	2.0792		
				.4994	.1320
20	1162	38	1.5798		
				.3674 (Mean value)	.3311 (Total)

The ratio of total departure to mean d.log (He-H) = $\frac{.3311}{.3674}$ = .90 and will be called the departure function.

Departure functions have been determined for each value of He for both the Imray and Pilot bores, and they are tabulated below.

Imray Bore.

He (ft.)	Dept.function
1200	.90
1250	.175
1300	.20
1400	.70

Pilot Bore.

He (ft.)	Dept.function
800	.81
1000	.35
1200	.136
1400	.106
1600	.138
1800	.175
2000	.244

When the departure function is a minimum the curve of equation (2) will more nearly approximate a straight line than for any other value of He.

The departure functions are plotted against the appropriate values of He. In the case of the Imray bore, this curve is shown in Fig. 4. It has a minimum value at approximately He = 1270 feet.

The corresponding curve for the Pilot bore is shown in Fig. 6. It has a very broad minimum as one would expect from the nature of the curves in Fig. 5. It extends from approximately 1280 feet to 1380 feet with a mean of 1330 feet.

The values of He obtained for the Imray and Pilot bores are 1270 feet and 1330 feet respectively. The average density of the fluid in the Imray bore was 0.99 and in the Pilot bore 0.97. The pressures corresponding to these values of He are respectively 550 lb/sq. inch and 560 lb/sq. inch. These pressures are very close to the estimated artesian water pressure of 600 lb/sq. inch and it is reasonable to assume that reservoir pressure is identical with artesian water pressure.

This seems a rational result in view of the fact that none of the bore logs examined or bore cores tested for permeability suggests the presence of an impermeable layer between the artesian water horizon and the glauconitic sandstone such as would of necessity be present if reservoir and artesian waters pressure were substantially different.

In many of the bore logs the cores when brought to the surface have been described as being "dry". There is an inference in such a description that the pore spaces in the cores are incompletely saturated with liquid. If this is so, then the pores must contain gas at a pressure equal to reservoir pressure and one would expect, as a consequence of its very low viscosity relative to water and oil, a gas yield of a magnitude which would be immediately apparent. The amount of gas escaping from Imray and the Pilot bore is, however, of a negligible quantity.

It is the writer's belief that the pore spaces in the glauconitic sandstone are completely filled with liquid, this liquid being in contact through the pores of the rock with the water in the artesian horizon and in consequence, the liquid in the glauconitic sandstone (the reservoir) has a pressure comparable with that of the artesian water.

If, as is implied above, the glauconitic sandstone is completely saturated with liquid and the reservoir pressure is of the order of 600 lb. per sq. inch, it may seem surprising that so little liquid is yielded by the glauconitic sandstone. The writer believes, however, that the known physical properties of the glauconitic sandstone provide an explanation.

The rate at which a bore hole will produce liquid depends upon the reservoir pressure and the permeability of the producing formation, other factors being constant for any given bore hole. If a reservoir pressure of approximately 600 lb. per sq. inch exists, then the low yield rate is apparently due to extremely low permeability.

Tests of permeability on samples of glauconitic sandstone from 1255 feet to 1291 feet in the No. 10 bore (4) gave an average value of approximately 2.2 millidarcies for dry samples. This section of No. 10 bore corresponds to the glauconitic sandstone exposed in the Imray and Pilot bores. This figure, however, of 2.2 millidarcies would be considerably decreased by the presence of water as was shown in a number of tests conducted for the purpose of ascertaining the magnitude of this effect. It was shown (5) that in certain types of glauconitic sandstone, the effect was more marked than in others. For instance, samples

from 1277 - 1278 feet showed an average decrease of 2.4 per cent. in permeability for 1 per cent. water saturation, while samples from 1291 - 1300 feet showed an average of only 0.73 per cent. decrease per 1 per cent. water saturation.

It is believed that in the latter case the decrease may be due entirely to the reduction in the cross-section of the interstices between the grains due to water adhering to the grains. In the former case, however, the effect appears to be too great to be explained in this fashion and an alternative explanation is offered, namely, that some of the material comprising the sandstone takes up water and swells, and that this swelling is partly responsible for the decrease in permeability.

Garrison (1939) in an article on the surface chemistry of clays and shales describes the swelling which can occur when certain minerals take up 'planar water' by the agency of weak electrostatic forces on the tops and bottoms of flat plates of micaceous minerals. Bentonite exhibits an extreme case of this swelling. The swelling of deep shales from which the planar water has been pressed out by the pressure of overburden is attributed to the re-entry of planar water. If favourable minerals are present in the glauconitic sandstone the abnormal reduction in permeability may be due to such minerals taking up 'planar water' and swelling.

Sandstone of the kind represented by the samples from 1277' - 1278' would tend to have very low permeability at moderately high water saturations. It is believed that the sandstone exposed in Imray and the Pilot bores is of this kind. The latter kind are typical of the section 1294 - 1300 feet in No. 10 bore. Sandstone of this latter kind could be expected to have appreciable permeability at high water saturations and thus yield appreciable quantities of water as was found to be the case when they were penetrated in the No. 10 bore.

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The writer wishes to acknowledge the work of Mr. L.C. Noakes in co-ordinating and plotting the data from the Pilot bore. It is desired also to acknowledge the interest and co-operation of Mr.H.J. Cook, Supervisor of the Lakes Entrance project, and particularly to commend the care with which the liquid level measurements were carried out by the driller Mr. Ted Smith.

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June, 1945.
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DEPARTMENT OF SUPPLY AND SHIPPING.

BUREAU OF MINERAL RESOURCES.

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However, it was not until the Imray bore had been drilled by Austral Oil Ltd. that any satisfactory evidence was obtained which permitted a true estimate of reservoir pressure being made. In this bore, glauconitic sandstone was entered at 1253 feet from the surface and drilling was stopped after 21 feet of glauconitic sandstone had been penetrated. It is probable that 10 to 20 feet of sandstone separates the bottom of the bore from the artesian water horizon. The sandstone provides an effective barrier to the ingress of water from the latter horizon. The bore is cased from the surface to the top of the glauconitic sandstone where it is seated in cement, and all aquifers above the sandstone are sealed off.

Bailing tests showed that the 23 feet of glauconitic sandstone exposed yielded a daily average of approximately 31 pints of oil and 9 pints of water. Later, the liquid yielded was allowed to accumulate in the bore casing and at intervals over a period of some 24 months, the liquid level was recorded. The curve in Fig. 1 shows the liquid level (H) plotted against time in months. The values used have been taken from a similar curve published in The Petroleum Times (1).

It will be observed that the rate of rise, for instance the rise per month, decreased as time went by - this decrease becoming more apparent towards the end of the test period. It is evident that the curve is tending asymptotically towards a value of H of the order 1200 to 1400 feet, at which value the back pressure provided by the liquid column would be sufficient to prevent the flow of liquid from the reservoir. In other words, the back pressure would be equal to the reservoir pressure.

A particular method of plotting enables a reasonably accurate estimation of reservoir pressure to be made from such a curve as Fig. 1 without the necessity of waiting until the liquid level reaches its final value. As this method will be applied to data from the Pilot bore as well as Imray, its description will be delayed until the Pilot bore and the data obtained in tests conducted on it are described.

The Pilot bore is the most recent in the Lakes Entrance district and was under close observation from its inception. It was drilled primarily to obtain information of the yield from water-bearing formations which the nearby shaft would penetrate, but, as has been described elsewhere (2), it provided valuable information about the oil and water yields from the glauconitic sandstone.

The bore is cased with five inch casing from the surface to the top of the glauconitic sandstone at 1196 feet, into which it is firmly cemented. Before proceeding with the drilling of the glauconitic sandstone, bailing tests proved that the cement provided a tight seal and no water entered the casing from formations above the glauconitic sandstone. This was of utmost importance to the subsequent bailing tests as it could be assumed that any fluid entering the bore after sections of the glauconitic sandstone had been drilled came from the glauconitic sandstone exposed.

The glauconitic sandstone was drilled in steps of approximately two feet and bailing tests were made after each successive two foot section was drilled. Drilling was suspended when 22 feet 10 inches of glauconitic sandstone had been penetrated. After the necessary bailing tests had been completed, the liquid yielded by the section of glauconitic sandstone was allowed to accumulate in the bore and daily records were kept of the height of the liquid column as it rose in the casing.

The height was found by lowering the bailer into the bore to a predetermined depth - withdrawing it and noting the position of the liquid coating on the bailer. With experience it was possible to determine in advance the depth to which the bailer should be lowered so that it penetrated this liquid by a matter of only two or three inches. A correction was applied to the liquid height to allow for the liquid displaced by the bailer. The test was conducted over a period of 65 days the final height of the liquid column being 513 feet 10 inches.

The liquid heights are shown in Fig. 2 plotted against the time in days. Because of the shorter time used in this test, the falling off in the rate of rise with time is not so marked in this curve as it is in the corresponding curve (Fig. 1) for the Imray test, but a comparison with the straight line drawn through the origin and tangential to the curve at the origin demonstrates the decline in the rate of rise with time.

Determination of Reservoir Pressure from Liquid Level Data.

Time and the liquid level are related to one another by the following relationship:- (3)

$$\frac{ygct}{a} = -\log_e \frac{He - H}{He - Hi} \qquad ---- \quad (1)$$

where y = density of liquid column.
g = gravitational constant.
c = productivity index which is a constant for the bore.
t = time
a = area of cross section of bore casing.
He = liquid height corresponding to reservoir pressure.
H = liquid height at time t.
Hi = liquid height at time zero.

Equation (1) may be expressed as:-

$$t = K \log_{10} (He - H) \qquad ---- \quad (2)$$

i.e. if values of t are plotted against corresponding values of $\log_{10}$ (He-H), the curve will be a straight line with a slope θ where $\tan \theta = K$.

In the examples under consideration, the value of He is unknown, but equation (2) provides a means of determining it. This can be done by a method of trial and error. Various values

of He are assumed and curves derived from equation (2) are plotted. The correct value of He will give a straight line, whereas the curves for other values of He will depart from the straight line. In the case of the Imray bore, a set of such curves is shown in Fig. 3. Values of He range from 1200 feet to 1400 feet. It will be observed that the curve for He = 1250 feet is the closest to a straight line of those shown. A closer approximation could be found by choosing intermediate values of He, but as will be shown presently in connection with the results from the Pilot bore, the value of He which gives the closest approximation to a straight line can be found by another method.

The set of curves for the Pilot bore, corresponding to those in Fig. 3 for Imray, are shown in Fig. 5. Selected values of He range from 800 feet to 2000 feet.

A departure from a straight line is clearly evident in the curves for He = 800 and 1000 feet and is present, but not very obvious in some of the other curves.

The choice of the most probable value of He, i.e. the value that gives the closest approximation to a straight line, is not at all evident from these curves, but a value has been arrived at in another way, which has also been applied to the Imray results.

A set of values typical of those used in plotting the curves in Fig. 3 and 5 are tabulated below:-

Imray Bore.

Time (months)	H feet	He = 1200 feet. He − H	$\log_{10}(He - H)$	d. log (He − H)	Departure from mean
0	240	960	2.9823		
				.2713	.0961
5	686	514	2.7110		
				.3045	.0629
10	945	255	2.4065		
				.3273	.0401
15	1080	120	2.0792		
				.4994	.1320
20	1162	38	1.5798		
				.3674 (Mean value)	.3311 (Total)

The ratio of total departure to mean d.log (He-H) = $\frac{.3311}{.3674}$ = .90 and will be called the departure function.

Departure functions have been determined for each value of He for both the Imray and Pilot bores, and they are tabulated below.

Imray Bore.

He (ft.)	Dept.function
1200	.90
1250	.175
1300	.20
1400	.70

Pilot Bore.

He (ft.)	Dept.function
800	.81
1000	.35
1200	.136
1400	.106
1600	.138
1800	.175
2000	.244

When the departure function is a minimum the curve of equation (2) will more nearly approximate a straight line than for any other value of He.

The departure functions are plotted against the appropriate values of He. In the case of the Imray bore, this curve is shown in Fig. 4. It has a minimum value at approximately He = 1270 feet.

The corresponding curve for the Pilot bore is shown in Fig. 6. It has a very broad minimum as one would expect from the nature of the curves in Fig. 5. It extends from approximately 1280 feet to 1380 feet with a mean of 1330 feet.

The values of He obtained for the Imray and Pilot bores are 1270 feet and 1330 feet respectively. The average density of the fluid in the Imray bore was 0.99 and in the Pilot bore 0.97. The pressures corresponding to these values of He are respectively 550 lb/sq. inch and 560 lb/sq. inch. These pressures are very close to the estimated artesian water pressure of 600 lb/sq. inch and it is reasonable to assume that reservoir pressure is identical with artesian water pressure.

This seems a rational result in view of the fact that none of the bore logs examined or bore cores tested for permeability suggests the presence of an impermeable layer between the artesian water horizon and the glauconitic sandstone such as would of necessity be present if reservoir and artesian waters pressure were substantially different.

In many of the bore logs the cores when brought to the surface have been described as being "dry". There is an inference in such a description that the pore spaces in the cores are incompletely saturated with liquid. If this is so, then the pores must contain gas at a pressure equal to reservoir pressure and one would expect, as a consequence of its very low viscosity relative to water and oil, a gas yield of a magnitude which would be immediately apparent. The amount of gas escaping from Imray and the Pilot bore is, however, of a negligible quantity.

It is the writer's belief that the pore spaces in the glauconitic sandstone are completely filled with liquid, this liquid being in contact through the pores of the rock with the water in the artesian horizon and in consequence, the liquid in the glauconitic sandstone (the reservoir) has a pressure comparable with that of the artesian water.

If, as is implied above, the glauconitic sandstone is completely saturated with liquid and the reservoir pressure is of the order of 600 lb. per sq. inch, it may seem surprising that so little liquid is yielded by the glauconitic sandstone. The writer believes, however, that the known physical properties of the glauconitic sandstone provide an explanation.

The rate at which a bore hole will produce liquid depends upon the reservoir pressure and the permeability of the producing formation, other factors being constant for any given bore hole. If a reservoir pressure of approximately 600 lb. per sq. inch exists, then the low yield rate is apparently due to extremely low permeability.

Tests of permeability on samples of glauconitic sandstone from 1255 feet to 1291 feet in the No. 10 bore (4) gave an average value of approximately 2.2 millidarcies for dry samples. This section of No. 10 bore corresponds to the glauconitic sandstone exposed in the Imray and Pilot bores. This figure, however, of 2.2 millidarcies would be considerably decreased by the presence of water as was shown in a number of tests conducted for the purpose of ascertaining the magnitude of this effect. It was shown (5) that in certain types of glauconitic sandstone, the effect was more marked than in others. For instance, samples

from 1277 - 1278 feet showed an average decrease of 2.4 per cent. in permeability for 1 per cent. water saturation, while samples from 1291 - 1300 feet showed an average of only 0.73 per cent. decrease per 1 per cent. water saturation.

It is believed that in the latter case the decrease may be due entirely to the reduction in the cross-section of the interstices between the grains due to water adhering to the grains. In the former case, however, the effect appears to be too great to be explained in this fashion and an alternative explanation is offered, namely, that some of the material comprising the sandstone takes up water and swells, and that this swelling is partly responsible for the decrease in permeability.

Garrison (1939) in an article on the surface chemistry of clays and shales describes the swelling which can occur when certain minerals take up 'planar water' by the agency of weak electrostatic forces on the tops and bottoms of flat plates of micaceous minerals. Bentonite exhibits an extreme case of this swelling. The swelling of deep shales from which the planar water has been pressed out by the pressure of overburden is attributed to the re-entry of planar water. If favourable minerals are present in the glauconitic sandstone the abnormal reduction in permeability may be due to such minerals taking up 'planar water' and swelling.

Sandstone of the kind represented by the samples from 1277' - 1278' would tend to have very low permeability at moderately high water saturations. It is believed that the sandstone exposed in Imray and the Pilot bores is of this kind. The latter kind are typical of the section 1294 - 1300 feet in No. 10 bore. Sandstone of this latter kind could be expected to have appreciable permeability at high water saturations and thus yield appreciable quantities of water as was found to be the case when they were penetrated in the No. 10 bore.

ACKNOWLEDGMENTS.

The writer wishes to acknowledge the work of Mr. L.C. Noakes in co-ordinating and plotting the data from the Pilot bore. It is desired also to acknowledge the interest and co-operation of Mr.H.J. Cook, Supervisor of the Lakes Entrance project, and particularly to commend the care with which the liquid level measurements were carried out by the driller Mr. Ted Smith.

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(1) The Petroleum Times, Page 502. Sept., 18th, 1943.

(2) L.C. Noakes, Preliminary Report on the Examination of Cores from the Pilot Bore - Lakes Entrance, Vic., Comm. Min. Res. Surv. Report No. 1945/24.

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(6) Allan D. Garrison - 1939, Surface Chemistry of Clays and Shales. Trans. A.I.M.M.E. Vol. 132.

June, 1945.
CANBERRA, A.C.T.

R.F. Thyer,
Geophysicist.

8. Notes on Gippsland Oil Bores.

W404 Imray Bore

Page 1 of 5

Notes on Gippsland Oil Bores

By I. C. H. Croll, B.Sc.

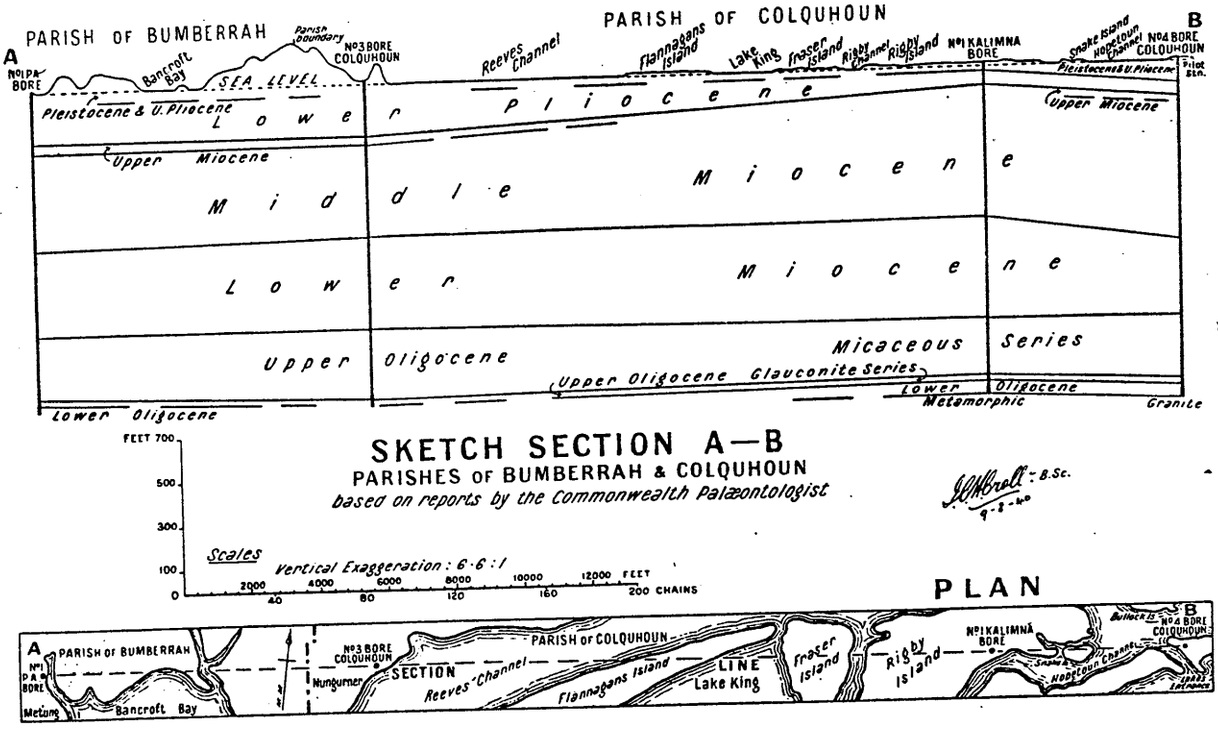
GOVERNMENT BORES.

Since the beginning of 1940 the Victorian and Commonwealth Governments have extended the exploratory drilling campaign for oil by completing three bores in the Parish of Colquhoun, whilst two others are in progress in that parish and one in the Parish of Bengworden South. The three completed bores yielded a great amount of valuable geological information, as they were all in regions which had not previously been drilled, and help to fill in gaps in the knowledge of the structural conditions of the district between Lakes Entrance and Metung. The accompanying west-east section A-B includes two of these bores, Nos. 3 and 4, and indicates how the information gained from them links up with the data from No. 1 Point Addis bore at Metung and No. 1 Kalimna bore at Rigby Island (see *Records of Boring Operations* 1923-30, pp. 116 and 117). It should be noted that the relation of the vertical to the horizontal scales is 6.6 : 1, and that after allowing for this considerable exaggeration the surfaces of stratigraphic divisions are relatively flat. As the section is along the strike of the beds this is not surprising, but it does indicate how remote is the possibility that faulting has occurred along the direction of the dip, as has been claimed.

Cores from each bore were sent to the Commonwealth Palaeontologist at Canberra, and summaries of her reports, where available, are given below. As the purpose of the bores was primarily to obtain a more complete knowledge of the physical properties of the glauconitic series, the samples of this material were sealed on recovery, and are being tested for porosity, permeability, saturation, and lithological details.

No. 3 Bore, Nungurner.

This bore is situated on the shore of Reeves Channel (Lake King), about 20 chains north-easterly of the Nungurner jetty, in the township of Nungurner. No drilling difficulties were encountered until the top of the glauconitic sandstone series was reached at 1,434 feet, when the depth and hard drilling made progress very slow. The series comparable with the oil-bearing beds at Lakes Entrance proved to be only a few feet thick, and was succeeded by bands of a very hard sandstone containing some glauconite. It is not unreasonable to regard this hard sandstone as part of the glauconitic series, rather than to make a separate subdivision of it or to include it with the Lower Oligocene beds with which it has no affinity, and it has been shown on the section in that way. A similar hard sandstone



SKETCH SECTION A—B

PARISHES OF BUMBERRAH & COLQUHOUN

based on reports by the Commonwealth Palæontologist

J.C.H. Croll - B.Sc. 9-8-40

PLAN

was recorded below the typical glauconitic bed at the Gippsland Oil Company's No. 1 bore (see below). The Commonwealth Palaeontologist has determined the following sequence in the Nungurner bore:—

Lower Pliocene	100′–243′
Upper Miocene	243′–283′
Middle Miocene	283′–706′
Lower Miocene	706′–1,112′
Upper Oligocene, micaceous series	1,114′–1,434′
Upper Oligocene, glauconitic series	1,434′–1,454′

The limit of the plant was reached at 1,454 feet, and the equipment was moved to a new site near Kalimna, where No. 6 bore is in progress.

No. 4 Bore, Lakes Entrance.

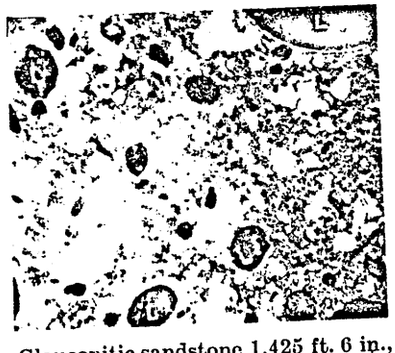
The Commonwealth-owned deep-drilling plant was shifted from Sperm Whale Head to a site at the Pilot Station on the eastern side of the entrance to the lakes (see plan), and drilling commenced early in 1940. A complete sequence of Tertiary beds was passed through, and the Commonwealth Palaeontologist has reported as follows:—

Pleistocene and Upper Pliocene ..	to 100′
Lower Pliocene	100′–160′
Upper Miocene	174′
Middle Miocene	184′–798′
Lower Miocene	799′–1,140′
Upper Oligocene, micaceous series	1,150′–1,421′
Upper Oligocene, glauconitic series	1,421′–1,444′
Lower Oligocene	1,484′–1,498′
Basement (granite)	1,508′

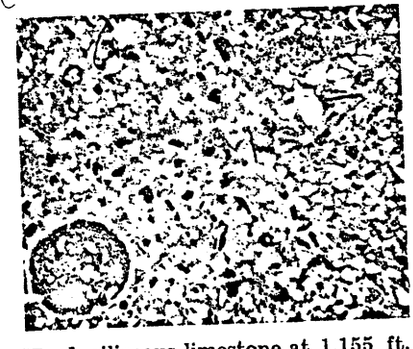
Several samples in the lower parts of this bore were of sufficient interest to warrant having sections cut for microscopic examination. At 1,425 ft. 6 in. the material is a greyish green glauconitic sandstone containing abundant loose and rounded pellets of limonite. A freshly fractured face of the sample has the appearance of high porosity, due to the limonitic pellets being so loose and dropping out, but the rock is probably no more porous in bulk than that from the bores further north and north-east. In thin section (No. 43,586) the material is seen to consist of abundant sharply angular quartz grains less than 0.1 mm. in diameter and some biotite set in a granular aggregate of dull green glauconite, together with circular or oval pellets of limonite which have a maximum diameter of 1.5 mm. Some of these pellets appear to be homogeneous, whilst others have formed by the deposition of concentric layers of limonite round grains of biotite. In only one respect does this material differ to any extent from that recorded in other bores in the district, and that is in the comparative abundance of foraminifera, of which Mr. W. J. Parr has been able to determine at least six genera—*Globigerina, Cibicides, Pullenia, Elphidium, Eponides,* and *Bolivina.*

The core from 1,491′–1,494′ consists of a soft yellowish brown ironstone almost entirely made up of replacements of organic remains. In thin section (No. 43,607) the organic remains appear as limonitic replacements of parts of polyzoa, foraminifera, shells and echinoid spines, set in a matrix of siderite and calcite. At 1,494 feet (section 43,609) the rock is a ferruginous sandstone and organic remains are rare. Quartz grains occur in two distinct groups—fairly abundantly as small angular fragments less than 0.1 mm. across, and sparingly as sub-angular or oval grains ranging from 0.5 to 1.5 mm. in diameter. Limonite is moderately abundant, both interstitial and in the form of the concentrically coated pellets, and other minerals present include small amounts of glauconite, biotite in various stages of alteration to chloritic material, highly decomposed felspar, and fragments of granite, all set in a sideritic and calcareous matrix.

The bore entered solid granite at 1,508 feet, and a piece of core 3 inches long was obtained before drilling was suspended at 1,508 ft. 6 in. (section No. 43,612). The rock has a mottled appearance, due apparently to the pink colour of the orthoclase felspar and the faint greenish tinge of the plagioclases, and it does not closely resemble the pink granite that is quarried north of Lakes Entrance at Colquhoun. The minerals present are quartz; orthoclase felspar altering to kaolin; plagioclases (principally oligoclase) with prominent zoning; microcline; biotite altering in part to chlorite; apatite; and ilmenite or magnetite. Potash felspars appear to predominate over the soda-lime felspars, and the rock is a true biotite granite similar to that found at the bases of the No. 2 L.E.D. and No. 1 Government bores.



Glauconitic sandstone 1,425 ft. 6 in., No. 4 bore, Parish of Colquhoun. Angular quartz grains set in glauconitic matrix. Note rounded pellets of limonite (L).



Hard, siliceous limestone at 1,155 ft. 6 in., No. 5 bore, Parish of Colquhoun, showing rounded segration of glauconite enclosing fragments of quartz.

Hard siliceous limestone, 1,217 ft., No. 5 bore, Parish of Colquhoun. Similar to hard band at 1,155 ft. 6 in. but without segregations of glauconite.

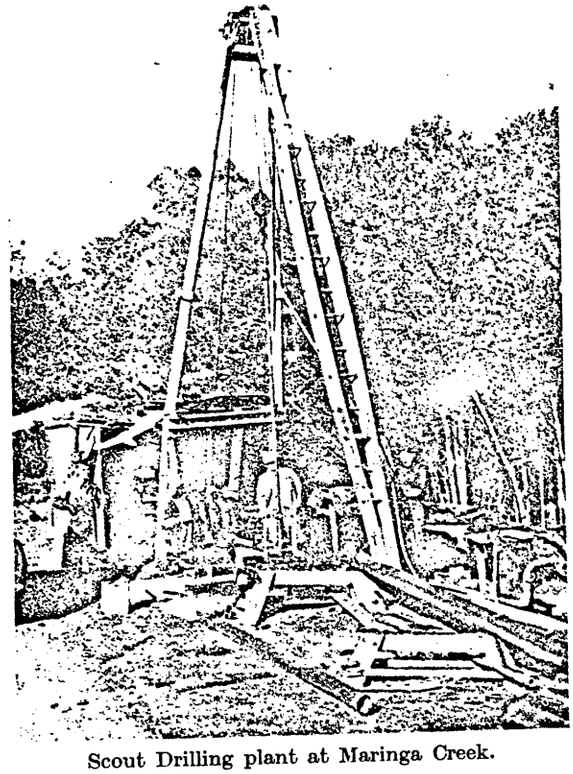
Traces of free oil were recorded in the glauconitic series at 1,441 and 1,443 feet, but the upper part of the series was apparently quite dry.

On completion of this bore the plant was removed to a site at Holland's landing in the Parish of Bengworden South where work is now in progress.

No. 5 BORE, MARINGA CREEK.

The site of this bore is on the north bank of Maringa Creek, approximately 1 mile south-south-westerly of the Kalimna West Post Office and State School (Parish of Colquhoun). The stratigraphic sequence has been determined as follows:—

Pleistocene and Upper Pliocene ..	10′–70′
Lower Pliocene	80′–120′
Middle Miocene	130′–700′
Lower Miocene	710′–1,060′
Upper Oligocene, micaceous series	1,070′–1,228′
Upper Oligocene, glauconitic series	1,228′–1,249′ (last sample).



Scout Drilling plant at Maringa Creek.

The bore reached a depth of 1,255 feet, but the last 6 feet of core was not recovered after the rods broke and left an obstruction in the hole. The thickness of the glauconitic series at this point is therefore in doubt, but is not less than 21 feet.

One feature of the micaceous series in this bore was the unusual number of nine hard bands, from 4 to 12 inches thick, nearly double the number hitherto recorded in other bores. At 1,155 ft. 6 in. to 1,156 ft. 6 in. (section 43,738) the hard band is a fine grained grey siliceous limestone containing abundant fragments of angular quartz less than 0.1 mm. across; some irregular shaped and some oval segregations of grass-green glauconite up to 1 mm. in diameter, enclosing fine fragments of quartz and biotite; moderately abundant small flakes of biotite mostly altered to an emerald green chloritic material; and organic remains; all set in a very fine calcareous matrix. The organic remains include foraminifera, polyzoa, and a sponge spicule. At 1,217 feet (section 43,745) the material is a buff coloured limestone almost identical with that at 1,155 ft. 6 in. except that the segregations of glauconite are absent.

The boring plant has now been removed to a site near the mouth of Lake Bunga.

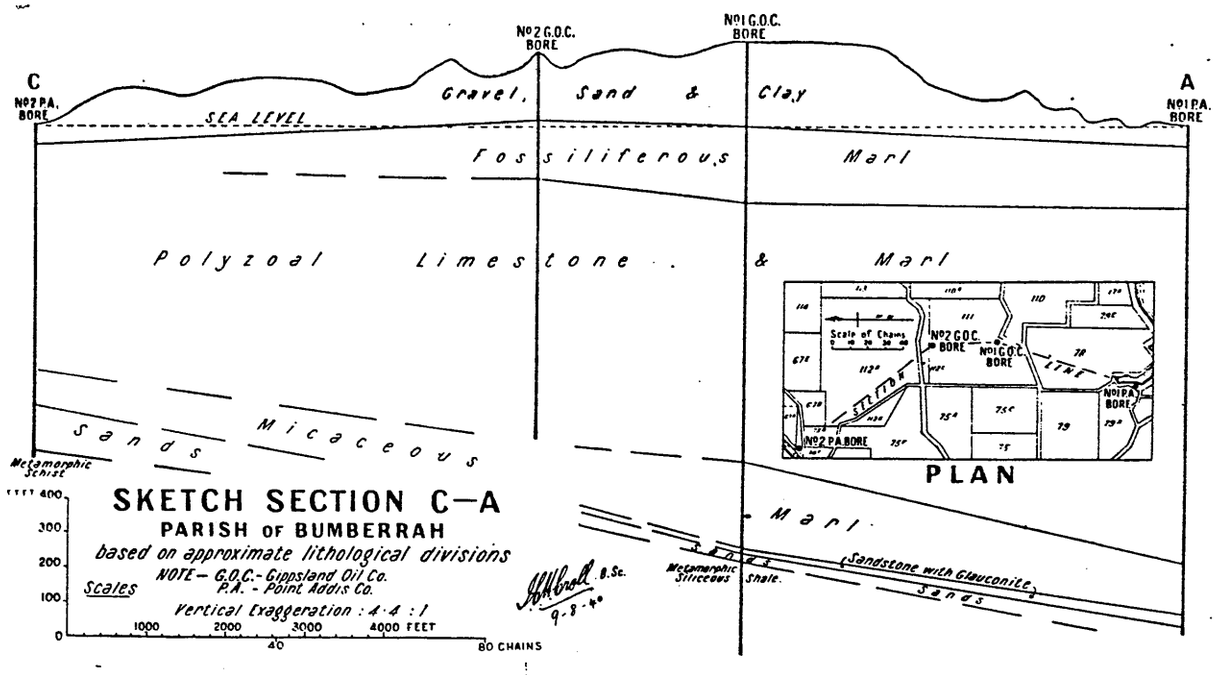
GIPPSLAND OIL COMPANY.

This company is holder of Petroleum Prospecting Licence No. 68, embracing an area of 10,227 acres between Lakes Entrance and Metung. The following notes on the prospecting activities are compiled from the reports supplied by the company to the Department supplemented by personal inspections, examination of the core samples, and some analyses made at the Mines Department laboratory. The accompanying section C-A shows the relation between the information gained by the company's two bores in the Parish of Bumberrah and that obtained by the Nos. 1 and 2 bores of the Point Addis Company (vide *Records of Boring Operations* 1923-30, pp. 35 and 116). The section indicates the existence of a very gentle southerly dip not exceeding about 3 deg. and rather less than that on the average.

No. 1 BORE. W418. GIPPSLAND-1

Drilling commenced at this bore, the site of which is shown on the plan, on 28th February, 1939, and at the present time is reported to have reached a depth of 1,766 feet. The surface level is ~~255~~ feet. Samples of the cores have been submitted to the Department as requested, and the following summary is based on an examination of the samples. (*Note.*—The depths are those shown on the sample labels.):—

To 250′ ..	Sand and clay.
250′–463′ ..	Shelly marl.
500′–1,200′ ..	Polyzoal limestone.
1,216′–1,373′ ..	Micaceous marl.
1,446′–1,458′ ..	Grey-green soft sandstone with some glauconite.
1,458′–1,462′ ..	Hard grey sandstone with a little glauconite.
1,462′–1,477′ ..	Fine and coarse loosely compacted white quartz sand and clayey sand.
1,483′–1,484′ ..	White quartz sand with chips of grey shale and sandstone.
1,484′ ..	Grey siliceous metamorphic shale with fine quartz veinlets.
Below 1,484′ ..	Samples of shale, or sand mixed with chips of shale.



It is quite clear from the samples that drilling beyond the depth of 1,484 feet, where the first definite bedrock sample was obtained, cannot be justified as far as the search for oil is concerned.

The glauconitic sandstone obtained in this bore at 1,446 to 1,458 feet is comparable with the Lakes Entrance material, but appears to contain more clay and less glauconite. Extraction tests for oil on several samples gave completely negative results. The hard sandstone from 1,458 to 1,462 feet is similar to that in the Nungurner bore (see above), and has been similarly grouped with the more typical glauconitic material in constructing the section. A slide of the hard sandstone at 1,460 feet shows it to consist of abundant grains of angular quartz of an average width of 0.2 mm., less abundant rounded grains of quartz up to 1.5 mm. diameter, biotite in various stages of alteration to chlorite and glauconite, pale green aggregates of glauconite, and some calcareous cementing material.

A number of fossils obtained from the loose sands below the glauconitic beds included several small well preserved sharks' teeth, fish scales, and some pyritic replacements of corals and mollusca.

Water.

The first water horizon was reported at 290 feet, but apparently no sample was taken until the bore had reached 705 feet. Analysis of a sample marked "705 feet" resulted as follows (Lab. No. 400/1939):—

Sodium.—165 parts per million—24 per cent.
Chlorides.—250 parts per million—36 per cent.
Sulphates.—Not tested.
Carbonates and bicarbonates.—96 parts per million —14 per cent.
Concentration.—690 parts per million.

This water has a lower concentration than the upper water at Lakes Entrance, but the proportions of the radicles present, as far as the analysis was carried, are approximately the same.

The lower water horizon was encountered in the vicinity of 1,462 feet, although the volume of water did not appear to be nearly as great as in many other bores. The surface level of this bore precludes the possibility of an artesian flow, and the water did not rise beyond 55 feet above sea level. Partial analysis of a sample of the lower water gave the following result:—

Chlorides.—830 parts per million—41 per cent.
Sulphates.—Nil.
Carbonates and bicarbonates.—640 parts per million—32 per cent.
Concentration.—2,020 parts per million.

The concentration in this case is somewhat higher than the Lakes Entrance lower water, but the chemical characteristics agree fairly closely, particularly in the entire absence of sulphates.

Gas.

A non-inflammable gas was reported at 175 feet, and analysis showed it to contain 11 per cent. of carbon dioxide and nitrogen, the remainder of the sample being air. Inflammable gas, probably methane, was recorded at various depths, and was in greatest abundance associated with the lower water.

Oil.

The company reported that the first traces of oil were obtained when drilling was in progress between 637 and 705 feet. At a depth stated to be 1,484 ft. 6 in. a faint film of oil was seen by me on the water brought up in the bailer while cleaning out after the first few inches of bedrock had been entered. While the bore was at the same depth the casing was pulled back and small quantities of oil were obtained, apparently from the sands immediately above bedrock where the company had reported "struck oil" at 1,482 feet. The occurrence of oil at the base of a series which here and elsewhere is completely saturated with water is most unusual.

No. 2 Bore. W430 GIPPSLAND-2

This bore is also situated in allotment 111, Parish of Bumberrah, as shown on the accompanying plan, and operations commenced on 30th November, 1939. Surface level is ~~225~~ feet. The company's weekly reports indicate the following general sequence:—

To 208′ .. Sand, clay, and gravel.
208′–372′ .. Shelly marl.
372′–1,106′ .. Polyzoal limestone and marl.

The present depth is reported to be 1,106 feet, at which it is stated that the limit of the plant has been reached, but that arrangements will be made to continue operations when a heavier plant is available.

Water.

The company reported that the first (upper) water horizon was met at 208 feet, and a sample marked "216 feet" was analysed at the Mines Department laboratory with the following result (Lab. No. 323/1940):—

Chlorides.—370 parts per million—32 per cent.
Sulphates.—30 parts per million—3 per cent.
Carbonates and bicarbonates.—310 parts per million—26 per cent.
Concentration (including solids in suspension).—1,160 parts per million.

Allowing for the inclusion of suspended solids in the figure for concentration, the water is comparable in concentration to the Lakes Entrance upper water, but has a lower sulphate content.

Gas.

A sample of gas marked "1,083 feet" was analysed (499/400), and shown to contain:—

Carbon dioxide	Trace
Oxygen	1%
Nitrogen	51.1%
Methane	47.9%
	100.0%

(The company has since stated that this sample was obtained from 1,738 feet in No. 1 bore.)

Gas was first reported at 500 feet, and at irregular intervals thereafter.

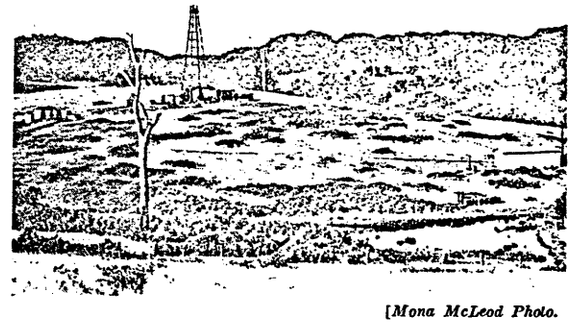
AUSTRAL OIL SYNDICATE.

Fosters Bore. W402

This bore was drilled in 1936 to a depth of 1,259 ft. 10 in., and some oil was produced by pumping. After a period of suspended operations during the time that the Imray bore was in progress, work was resumed at Fosters bore early in 1940, and an attempt has been made to shut off the water that was entering at the bottom of the bore. A cement plug was built up to 1,259 feet, and it is reported that bailing tests conducted since then indicate that at least a partial shut-off has been effected.

Imray Bore. W404

Bailing tests are conducted from time to time to determine the amounts of oil and water accumulating against the hydrostatic head of the fluid in the bore.



[*Mona McLeod Photo.*

Fosters Bore, Lakes Entrance.

On 13th May and 13th July, 1940, I witnessed two of these tests, at which the results were as follows:—

	13th May.	13th July.
Top of fluid column ..	481 feet from surface ..	388 feet from surface
„ „ water column ..	1,174 „ „ „ ..	1,154 „ „ „
Depth of oil column ..	693 feet	886 feet
„ „ water column	100 „	120 „
Amount of oil ..	849 gallons	1,074 gallons
„ „ water ..	122·5 „	147 „
Time of accumulation	38 weeks, 4 days ..	47 weeks, 2 days
Rate of accumulation—		
Oil	22·0 gallons per week	22·7 gallons per week
	3·1 „ „ day ..	3·2 „ „ day
Water	4·4 „ „ week	4·1 „ „ week
	0·6 „ „ day ..	0·6 „ „ day.

(Note.—The syndicate states that (*a*) the depth of the bore is 1,274 feet, (*b*) accumulation commenced on 17th August, 1939, and (*c*) 49 gallons of water were removed on 15th October, 1939.)

These figures suggest that my previous estimate of the formation pressure (vide *Mining and Geological Journal*, Vol, 2, No. 1, July, 1939, p. 64) was too low, as the rise of the fluid to a height of more than 800 feet in the bore cannot be accounted for by the pressure of artesian water, which apparently has not yet entered the bore. [16.7.1940.]