

41
August 3rd 1940.

(6-7)

244

Cousland No.1 and No.2 Locations.

No.2 Well. Tests carried out on July 22nd.

Water Level.

2.00 p.m. By running the float the level was found to be 178' from the R.T. The R.T. elevation is 431.5' and hence the elevation of the water level is 10252.5'. N.B. the flange from which measurements are made is 10' below the R.T. On December 1st 1939 the water level was found to be 195' from the R.T. Hence the rise in water level over this period is 17'.

Water Pressure.

3.20 p.m. The Amerada gauge was run into the well, the top of the gauge being at 2016' and hence the bottom at 2018' from the R.T. A check pressure was obtained first of all at 1500' from the R.T. The 12 hours clock was used when running the Amerada, and the gauge was left for $\frac{1}{2}$ hour at each depth. A maximum thermometer was run as well, but the minimum temperature which it would register was 60°F, and no record was obtained at this temperature. The calibrating temperature was 58°F, and hence no corrections have been applied to the measured pressure. The Amerada gauge was calibrated at pressures of 795 and 800 lbs/sq.in.; and the water pressure at the depth of 2016' from the R.T. was hence determined to be 796 lbs/in.² gauge.
N.B. The max. thermometer was checked up against a lab. thermometer by immersing in a beaker of warm water, & it was found to be registering correctly.

No.1 Well. Tests carried out on July 23rd.

Closed in pressure.

10.00 a.m. The U.I.P. was measured by D.W.T. and was found to be 614.2 lbs/sq.in. gauge at 64°F. The elevation of the R.T. is 565'-2", and the distance from the R.T. to the cellar floor is 12'. The position of measurement was 5'-2" above the top of the cellar wall (the depth of the cellar being 6'), and hence the elevation of the pressure measurement is 10562'-4". The pressures recorded in previous reports were all determined at the above elevation. The last pressure was obtained on December 11th 1939 and was found to be 589.9 lbs/sq.in.; and hence the rise of pressure was 24.3 lbs/sq.in.

Wellhead gas for Sumbury Research Station.

Three O.W.E. cylinders were filled with gas at a pressure of 600 lbs/in.² gauge, and were despatched to Sumbury by passenger train, the filling temperature being 65-70°F.

Layout of Nos. 1 & 2 Locations.

Two plans are attached herewith showing the position of all equipment at Nos. 1 and 2 locations, and the present boundaries to the land. At No.2 location the earth mound made for the bund is still in existence, and no doubt this earth would be used for filling up the cellar when the surrounding concrete walls etc are demolished. There is a good cinder track at No.1 location which could be used by light lorries, but there is no made-up track or roadway at No.2 well.

COUGLAND NO. 2 WELL.

NOTE ON PACKER TEST BETWEEN 2290 FEET AND 2432 FEET.

3RD MAY, 1939.

Bottom of 7 $\frac{1}{2}$ " hole 2432 feet.

Bottom of 10 $\frac{1}{2}$ " hole 1945 feet.

The packer was first set at 2272 feet but failed to effect a shut off. It was then reset at 2290 feet and a satisfactory test carried out.

The packer stop-cock was opened at 11.42 p.m. whereupon saline water entered the drill pipe and rose to 142 feet from surface in 135 minutes. The following is a record of observations of the rate of rise of water in the drill pipe :-

<u>TIME.</u>	<u>POSITION OF WATER LEVEL.</u>	
11.42 p.m.	Stop-cock opened.	2290
11.59 "	738 feet.	739
12.3 a.m.	586 "	1552
12.9 "	430 "	
12.19 $\frac{1}{2}$ "	280 "	
12.33 "	200 "	
12.55 "	160 "	
1.25 "	148 "	
1.57 "	142 "	

It is evident from these figures that equilibrium had practically been obtained when the test was concluded.

The maximum pressure as measured by the Amerada recording gauge at 2308' ⁹⁵⁵ was ~~950~~ lbs. per square inch \pm 5 lbs. per square inch. The instrument was calibrated at the surface at 77^o F.

A sample of water of Sp.gr. 1.008 at 60 F was collected from just above the packer and sent to Sunbury for analysis.

10432
2308

8124

COPY.

76

NOTE ON PACKER TEST FROM 2021 TO 2120 FEET IN COUSLAND NO.2
AND POSSIBLE PRESSURE EQUILIBRIUM WITH COUSLAND NO.1.

SUMMARY.

The present note records the observations carried out during the packer test on Cousland No.2 on the 15th of April and reports the results of the recent closed in pressure tests on Cousland No.1 subsequent to perforating the casing opposite the 1760 to 1806 feet sand and clearing the hole of water. It is shown that in each case equilibrium conditions appear to have been reached in the formations before the tests were completed. In Cousland No.2, the water pressure at 2039 feet or 8393 elevation was measured by a recording gauge to be 850 lbs. per square inch. In Cousland No.1 the gas pressure at 4 feet or 10561 elevation was measured by dead weight tester to be 659 lbs. per square inch.

On the assumption that the sands in these two wells are in direct communication, the position of a possible gas water level is worked out to be at the 8763 elevation. This is at 1802 feet in No.1. Should further evidence from No.2 prove definitely that the 2021 to 2120 feet sands are the equivalent of the 1760 to 1806 feet sands of No.1, it would seem highly improbable that there is any commercial oil in this bed.

COUSLAND NO.2 PACKER TEST.

The packer test was carried out on the 15th April in 7.3/4" hole with bottom at 2120 feet. The packer was first set at 2010 feet but the rubber failed to effect a shut off. The packer was then reset at 2021 feet and a satisfactory test carried out. On opening the stop-cock in the packer at 8.30 p.m. water started to rise inside the drill pipe. A record of the fluid rise in the drill pipe, measured by float, is contained in Appendix I, which shows that by 10.50 p.m., when the float was withdrawn, equilibrium had been practically reached. The specific

gravity of a sample of the water from just above the packer was 1.007 at 60°F.

The Amerada recording pressure gauge was run in the anchor pipe below the packer and its chart shows clearly the effect of setting the packer and opening the stop-cock. On setting the packer the bottom hole pressure fell from 1063 lbs., the pressure due to the column of mud in the hole, to 890 lbs. per square inch and was still falling at that pressure when the stop-cock was opened. Immediately on opening the stop-cock, there was a sharp further drop in pressure to 200 lbs. per square inch, followed by a gradual rise in pressure as the fluid rose in the drill pipe. The following are some points on the pressure curve:-

<u>Time.</u>	<u>Pressure from calibration chart.</u>	<u>Pressure by direct calibration.</u>
8.30 p.m.	200 lbs/sq.in.	-
9.00 "	750 "	-
9.30 "	840 "	838
10.00 "	845 "	846
10.30 "	849 "	851
10.50 "	849 "	851

For purposes of calculation the pressure at 2039 feet, the position of the gauge when the packer was set, is taken as 850 lbs. per square inch in gauge, which should be accurate to within ± 2 lbs. per square inch.

The Amerada recording pressure gauge has proved to be extremely useful in the present instance as it has eliminated the uncertainty in calculating the bottom hole pressure from the fluid rise in the drill pipe, which is inevitable when using a flow tester owing to the lack of uniformity in the fluid column. Its accuracy appears to be adequate for our purpose.

COUSLAND NO.1 CLOSED IN PRESSURE TEST.

The 8" casing on this well was perforated between 1806 feet and 1760 feet on the 20th to the 23rd of March. The water was then bailed and flowed from the hole. After the hole was clear, two short flowing tests were carried out, totalling about 2 hours flow. The well was then shut in to measure the maximum closed in pressure and a float run to find the water level. The water level was at 1801 feet, the flowhead pressure then being 654.6 lbs. per square inch. Appendix II records the rise in flowhead pressure; the pressures are also plotted on the attached graph which shows that equilibrium had been reached by about the 12th of April. Irregularities in the graph are probably due to barometric changes.

For purposes of calculation the flowhead pressure is taken as 659 lbs. per square inch at 10561 feet, the elevation of the "dead weight tester" which measured the pressure.

PRESSURE CORRELATION.

On the assumption that the contents of the 2021 feet to 2120 feet sands in Cousland No.1 and of the 1760 feet to 1806 feet sand in Cousland No.2 are in hydrostatic equilibrium the position of a gas water level is calculated in Appendix III to be at 8763 elevation. This elevation is equivalent to 1802 feet depth in Cousland No.1, i.e. four feet above the bottom of the perforations. Should further evidence from No.2 prove definitely that the sands at 2021 to 2120 feet are the equivalent of the 1760 to 1806 feet sand of No.1, the pressure correlation would appear to be quite valid and to eliminate any possibility of commercial oil being found in this bed.

(Sgd.) R. K. DICKIE.

Cousland.
20th April, 1939.

APPENDIX I.

COUSLAND NO. 2.

FLUID RISE IN DRILL PIPE 15/4/39.

<u>Time</u>	<u>Depth of Fluid Level below Rotary Table.</u>	<u>Remarks.</u>
8.30 p.m.	-	Stop-cock of packer opened.
8.50 "	686 feet	
8.55½ "	545 "	
8.57 "	510 "	
8.58 "	488 "	
9.1 "	428 "	
9.4 "	384 "	
9.7½ "	340 "	
9.11 "	280 "	
9.15½ "	230 "	
9.19 "	190 "	Float was then pulled out.
10.00 "	145 "	Float run in again.
10.7 "	141 "	
10.14 "	140½ "	
10.19 "	140 "	
10.29 "	139½ "	
10.40 "	138 "	
10.50 "	137½ "	

The float was then pulled out and the stop-cock closed.

APPENDIX II.

COUSLAND NO. 1.

CLOSED IN PRESSURE OBSERVATIONS AT 10561 ELEVATION.

Date.	Time.	Pressure lbs/sq.in.	Temperature °F	Pressure corrected to 60°F lbs/sq.in.
30/3/39.	1.30 p.m.	653.3	-	Approx. 653.5
	4.5 "	653.7	-	" 653.9
31/3/39.	9.5 a.m.	654.5	-	" 654.7
	12.30 p.m.	654.6	-	" 654.8
1/4/39	10.30 a.m.	656.0	-	" 656.2
2/4/39	11.45 "	656.7	-	" 656.9
3/4/39	10.00 "	657.2	-	" 657.4
4/4/39	10.45 "	657.9	-	" 658.1
5/4/39	9.15 "	658.0	-	" 658.2
6/4/39	2.30 p.m.	658.0	42	658.2
7/4/39	2.40 "	658.0	45	658.2
11/4/39	9.15 a.m.	658.4	50	658.5
	4.10 p.m.	658.7	63	658.7
12/4/39	4.5 "	658.9	57	658.9
13/4/39	3.30 "	658.8	52	658.9
14/4/39	3.30 "	659.0	51	659.1
15/4/39	10.20 a.m.	658.7	47	658.9
17/4/39	10.00 "	658.9	48	659.1

APPENDIX III.

CALCULATION OF POSSIBLE FLUID EQUILIBRIUM BETWEEN 1760' TO 1806'
SAND IN COUSLAND 1 AND 2021' TO 2120' SANDS IN COUSLAND 2.

COUSLAND NO. 1.

The formula $\log_{10} P_2 = \log_{10} P_1 + \frac{qsl}{144 \times 2.3026 \times Ay}$ gives the pressure at the bottom of a gas column with sufficient accuracy in the present case, where:-

P_2 = pressure at bottom of column.

P_1 = pressure at 10561 elv., 659 lbs/sq.in.gauge = 674 lbs/sq.in. abs.

q = density of air at atmospheric pressure.
and average temperature of gas column = 0.07565 lbs/cu.ft.

s = sp.gr. gas c.f. air = 0.6

l = length of column = 1800 feet, say.

A = atmospheric pressure = 14.7 lbs/sq.in.

y = deviation factor for gas under average pressure and temperature of column = 0.899.

$$\begin{aligned}\log P_2 &= \log 674 + \frac{0.07565 \times 0.6 \times 1800}{144 \times 2.3026 \times 14.7 \times .899} \\ &= 2.82866 + 0.01864 \\ &= 2.84730\end{aligned}$$

whence $P_2 = 703.6$ lbs/sq.in.abs. = 689 lbs/sq.in.gauge.

Average weight of gas column in lbs/sq.in. per foot =

$$\frac{689 - 659}{1800} = 0.01667.$$

COUSLAND NO. 2.

Pressure at 2039' (8393 elev.) = 850 lbs/sq.in.gauge.

Sp.gr. water = 1.007 at 60°F.

Pressure per foot of water = 0.436 lbs/sq.in.

CONDITION FOR EQUILIBRIUM ASSUMING NO OIL.

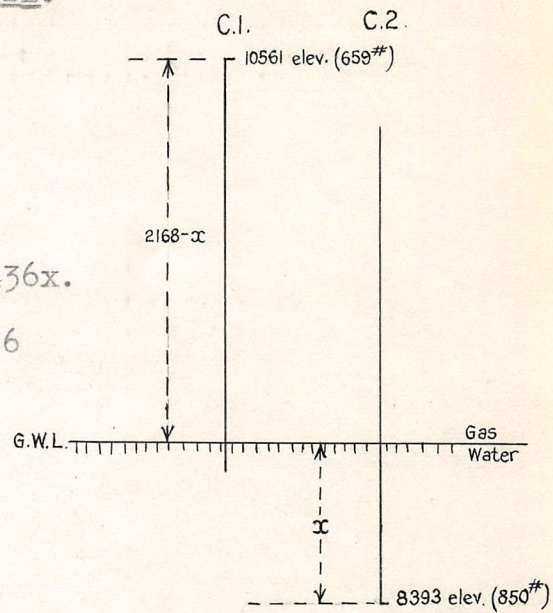
For equilibrium

$$659 + 0.01667(2168 - x) = 850 - .436x.$$

$$x (.436 - .01667) = 850 - 659 - 36$$

$$\text{whence } x = \frac{155}{.4193} = 370 \text{ feet.}$$

The elevation of the gas water level is therefore 8763 feet. (1802 feet depth in No.1).



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Copy sent to site 6 Feb 1939.
12/3/39.

ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

UK/Cousland 2 H.2

REPORT NO. N/188.

10.5.39.

Sunbury Ref. G.849.

Retention Amt.

WATER SAMPLE EX COUSLAND NO. 2. WELL

at 2290 - 2432'.

Requested by:-

D'Arcy Exploration Co. Ltd.,
and Refining Branch in memo
of 5.5.39. (H.O.No.1540).

Object:-

Analysis.

See Analyses
file

CONCLUSIONS.

This is a brine of total solids content 994.2 parts per 100,000. It differs but slightly from the previous sample from the 2016-2120' sandstone. The bicarbonate content is greater in the present sample but there is little difference in the sulphate contents.

HISTORY.

Lab. No. 6294 - received on the 8th. May, 1939. This sample was obtained during a packer test of the formation between 2290-2432' in Cousland No. 2. It represents formation water from the 2284-2412' sandstones.

N/188.

2

EXPERIMENTAL.

The analysis of this water after filtration is as follows:-

Specific Gravity at 60°F.	1.0055
Total Solids (dried @ 110°C.) pts/100,000	1043
" " (ignited @ 800°C.) pts/100,000	885.6
pH before boiling	8.5
pH after boiling	9.0


Constituent.	parts per 100,000	Equivalents x 1000		Equivalent Percentage
		Acidic	Basic	
Sulphate.	6.68	138		0.43
Chloride.	500.0	14090		44.00
Bicarbonate.	108.5	1779		5.56
Magnesium.	9.4		773	2.41
Calcium.	39.5		1975	6.18
Potassium.	5.15		131	0.41
Sodium *	325.0		13128	41.01
Totals.	994.2	16007	16007	100.00

* By difference.

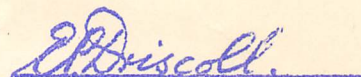
For ANGLO-IRANIAN OIL COMPANY LTD.



CHIEF RESEARCH CHEMIST.

JO'D	
------	---

HMG.



ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

MR. NORRIS.

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

WR/Cousland 2/T.2

REPORT NO. N/185.

28. 4. 39.

Sunbury Ref. G .849.

M. Tait
M. Comins
M. Waterhouse

WATER SAMPLE EX COUSLAND NO. 2 WELL.
FROM 2016 - 2120 FEET SANDSTONE.

Requested by: D'Arcy Exploration Company
Limited via Refining Branch in
memo of 20.4.39. (H.O.No:1518)

see Analyses
+12

Object: Analysis.

CONCLUSIONS:

This is a brine of total solids content 963.5 parts per 100,000.

It differs from the waters previously examined from this site (vide Sunbury Reports Nos. N.180 and N.183 dated 16th and 29th March respectively) in having smaller total solids content and relatively larger quantities of sulphate and bicarbonate. Magnesium is absent and potassium and iron are present in traces.

HISTORY:

Lab.No: 5932 - The sample was collected during a packer test of the 2016' - 2120' sandstone with the packer set at 2020' and the bottom of the hole 2120'.

N/185.

EXPERIMENTAL:

The analyses of this water after filtration is as follows: -

Specific Gravity at 60°F.	1.007
Total Solids (dried @ 110°C.)	
pts. per 100,000	1080
" " (Ignited @ 600°C.)	
pts. per 100,000	927
pH value as received	8.0
pH value after boiling	9.0

Constituent	Parts present per 100,000	Equivalents x 1000		Equivalent Percentage
		Acidic	Basic	
Sulphate	9.2	189		0.59
Chloride	533	15,020		46.66
Bicarbonate	54.1	888		2.76
Iron(ferrous)	1.9		68	0.21
Magnesium	Absent		-	-
Calcium	40.2		2005	6.23
Potassium	4.7		120	0.37
Sodium*	320.5		13,904	43.18
Totals	963.6	16,097	16,097	100.00

* By difference

The iron is probable present as ferrous bicarbonate, since, on standing, ferric hydroxide was precipitated.

For ANGLO-IRANIAN OIL CO., LTD.

JO'D 


CHIEF RESEARCH CHEMIST



ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

REPORT NO. N/183.

29.3.39.

Sunbury Ref. G.849.

R. Jacks
~~*R. S. Hill*~~
J. Lane
R. Hollis
file

WATER SAMPLE EX COUSLAND NO.2.WELL.

Depth - 1878 ft.

Requested by:-

D'Arcy Exploration Co.Ltd.,
via Refining Branch in memo
of 21.3.39. (H.O.No.1486).

Object:-

Analysis.

*see Analyses
file*

CONCLUSIONS.

This is a brine containing fairly large quantities of calcium, & magnesium chlorides. Sulphates, bicarbonates and iron are present in traces only. Its total solids content, 4800 p.p. 100,000, is rather greater than that of the sample of water from 1490' to 1528' sand examined in Report No.N/180.

HISTORY.

Lab. No. 5435. This water was collected during a Halliburton Packer Test carried out on 1.3.39.

Depth of Hole 1878' below rotary table.

Position of Packer 1726' below rotary table.

The sample was taken from just above valve in tester.

N/183.

EXPERIMENTAL.

The analysis of this water, after filtration, is as follows:-

Specific Gravity at 60°F.	1.0335
Total Solids (dried @ 110°C.) parts per 100,000	5,488
-do- (ignited @ 600°C.) - do -	4,585
p H value as received	7.5
- do - after boiling	9.5

Constituent.	Parts present per 100,000	Equivalents x 1000		Equivalents % age
		Acidic	Basic	
Sulphate	2.0	42		0.02
Chloride	3058	86,150		49.82
Bicarbonate	17	279		0.16
Iron (ferrous)	3.3		177	0.10
Magnesium.	181		14,900	8.02
Calcium.	481		24,050	13.00
Potassium.	absent		-	-
Sodium *	1090		47,344	27.38
Totals.	4832.3	86,471	86,471	100.00

* by difference

Since the filtered water deposited ferric hydroxide on standing, it is presumed that the iron is present as ferrous bicarbonate.

For ANGLO-IRANIAN OIL COMPANY LTD.

CHIEF RESEARCH CHEMIST.

RAL. RAL

EMG

ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

D'Arcy Exploration Co.

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

uk/Cousland/T.2
uk/T.3.

REPORT NO. N/180.

16.3.39.

Sunbury Ref. G.849.

To Treks AM
~~To ...~~ JCH
To W. H. ...
To ...
To ... (separate copy)
file
(copy sent to site 17/3/39)

WATER SAMPLE FROM COUSLAND NO. 2. WELL

FROM 1490' - 1528' SAND.

Requested by:-

D'Arcy Exploration Co. Ltd.
via Refining Branch in
memo of 3.3.39. (H.O.No.1474).

see Analysis file

Object:-

Analysis and a comparison
with the water produced from
Cousland No.1.Well, between
2178' and 2209'.

CONCLUSIONS.

This is a slightly alkaline brine containing small quantities of calcium and magnesium chlorides. Sulphates are present in traces only. Its total solids content is practically ten times that of the water drawn from Cousland No.1.Well between 2167' and 2227', examined in Report No.AP.N/150. This latter contained a higher concentration of sulphate and bicarbonate than the present sample.

N/180.

HISTORY.

Lab. No. 5059. One Winchester quart of this sample was received on 6.3.39. The water was obtained from a Halliburton packer test, and consists of unfiltered fluid taken from just above the packer after the latter had been pulled.

Date of Collection 1.3.39.
 Position of Packer 1461' below rotary table.
 Bottom of Hole. 1528' below rotary table.

EXPERIMENTAL.

The analysis, after filtration, of this sample is as follows :-

Specific Gravity at 60°F. 1.0245
 Total solids dried at 110°C.
 pts.per 100,000 - 3,791
 Total solids ignited @ 600°C
 pts.per 100,000 - 3,271
 p.H value as received. 8.0
 p.H value after boiling. 9.5

Constituent	Parts present per 100,000	Equivalents x 1000		Equivalent % age.
		Acidic	Basic.	
Sulphate.	1.6	33		0.01
Chloride.	2110	59400		49.57
Bicarbonate.	30.5	500		0.42.
Magnesium.	57.5		4730	3.95
Calcium.	227.5		11375	9.50
Iron & Potassium.	absent		-	-
Sodium *	1009		43828	36.65
Totals.	3436	59933	59933	100.00

* by difference

N/180.

The analysis of the water from Cousland No.1. between 2187' and 2227', taken from Report AP.N/150 of 5.8.38, is given below for comparison :-

Total solids dried at 110°C. (pts per 100,000). 376
Total solids ignited @750°C. (pts per 100,000). 319
p.H. of water (original). 8.0
p.H. of water (after boiling). 9.5

Constituent.	Parts present per 100,000.	Equivalents x 1000		Equivalent % age.
		Acidic	Basic	
Sulphate.	23.1	480		4.10
Chloride.	170.0	4780		40.80
Bicarbonate.	36.6	600		5.10
Magnesium.	5.5		460	3.92
Calcium.	22.1		1100	9.38
Potassium.	absent		-	-
Sodium *	99.0		4300	36.7
Total	356.3	5860	5860	100.00

For ANGLO-IRANIAN OIL COMPANY. LTD.



CHIEF RESEARCH CHEMIST.

RAI. 



HMG.

47
uk/T3.
ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

REPORT NO. N/207.

4. 8. 39.

Sunbury Ref. G. 849.

CORE SAMPLES FROM COUSLAND NO. 2. WELL.

Requested by:-

D'Arcy Exploration Co. via
Refining Branch in memo
dated 31st. May, 1939.

(H.O.No.1578).

Object:-

To determine the porosities
of core samples from the 2018'
to 2284' sandstones in Cousland
No. 2.

HISTORY.

Thirteen samples of cores from various depths in Cousland
No. 2. Well were received on 31st. May, 1939.

RPI-
G.S.

EXPERIMENTAL.

Lab.No.	Depth.	Nature.	Porosities.
6956	2057 ⁰	Fairly coarse sandstone with carbonaceous laminae.	6.6
6957	2072 ⁰ 273 ⁰	Fairly coarse micaceous sandstone with carbonaceous laminae.	3.6
6958	2286 ⁰	Rather soft carbonaceous flags with concretions.	5.6
6959	2295 ⁰	Fairly fine flaggy sandstones.	11.7
6960	2310 ⁰	Fairly fine sparkling slightly oil sandstone.	9.4
6961	2330 ⁰	Rather coarse micaceous sandstone.	5.2
6962	2340 ⁰	Fairly fine flaggy carbonaceous sandstone.	7.2
6963	2360 ⁰	Fairly fine slightly indurated, slightly oily sandstone.	3.1
6964	2365 ⁰	White kingley sandstone.	4.1
6965	2375 ⁰	Fairly fine slightly indurated sandstone.	11.1
6966	2385 ⁰	Fairly fine slightly indurated, slightly oily sandstone.	10.7
6967	2392 ⁰	Fairly fine carbonaceous, slightly oily sandstone.	4.6
6968	2404 ⁰	White carbonaceous kingley sandstone.	7.5

For ANGLO-IRANIAN OIL COMPANY LTD.

D. H. Howells
 CHIEF RESEARCH CHEMIST.

JOD. *[Signature]*

HMG.

SCOTTISH OILS LIMITED.

CENTRAL LABORATORY, MIDDLETON HALL, UPHALL.

REPORT NO. SO.M/118/39

REPORT ON THIRTEEN SANDSTONE CORES FROM COUSLAND NO.2 BORE TAKEN FROM THE 2016' and 2284' SANDSTONES.

Permeability determinations were carried out on duplicate discs cut from each sample, with the following results:-

Sample No.	Particulars of Sample.	Permeability as received. (Millidarcys)	
		1	2
1	Depth 2056'	16.28	6.94
2	" 2071/2'	19.00	19.90
3	" 2286'	2.16	2.26
4	" 2295'	10.46	11.98
5	" 2310'	19.39	24.07
6	" 2330'	451.0	451.0
7	" 2340'	3.08	4.15
8	" 2365'	3.73	3.39
9	" 2367'	7.08	4.20
10	" 2375'	37.36	38.44
11	" 2385'	45.76	42.50
12	" 2392'	6.02	5.92
13	" 2404'	2.16	2.26

(Sgd.) G.H. Smith
For Chief Chemist.

WRG/MC

4th July, 1939.

ANGLO-IRANIAN OIL COMPANY, LTD.

RESEARCH STATION

P.O. Box 1,

CHERTSEY ROAD,

SUNBURY-ON-THAMES.

① Mr. Comins
② Mr. Faith
③ Mr. Waters

REPORT NO. S/68.

21. 6. 39.

Sunbury Ref. G. 849

SANDSTONE CORES FROM COUSLAND NO. 2 WELL

Requested by: D'Arcy Exploration Company
via Refining Branch in memo
dated 12. 4. 39. (H. O. No: 1509)

Object: To determine the porosities
of specimens of cores from
Cousland No. 2 Well.

HISTORY:

The following samples were received on 11. 4. 39. -

Lab. No:	5771	-	Fairly coarse sandstone	from	1496'
"	"	5772	-	Flakey sandstone	" 1512'
"	"	5773	-	Fine rather flaky sandstone	1515'
"	"	5774	-	Fine sandstone	2028'
"	"	5775	-	Fairly coarse sandstone	2095'

EXPERIMENTAL:

The following is the required data: -

		<u>Percentage Porosity</u>
Lab. No:	5771	8.6
"	" 5772	1.2
"	" 5773	10.4
"	" 5774	10.2
"	" 5775	6.7

For ANGLO-IRANIAN OIL CO., LTD.

JO'D | *[Signature]*

[Signature]
CHIEF RESEARCH CHEMIST

[Signature]

C O P Y.

SCOTTISH OILS LTD.,
CENTRAL LABORATORY,
MIDDLETON HALL, UPHALL.

MR. F.C. SLINGER,
D'ARCY EXPLORATION CO.LTD
COUSLAND, DALKEITH.

21st April, 1939.

SANDSTONE CORES FROM COUSLAND NO.2.

With reference to your letter of 7th April,
we enclose herewith copy of Report No.SO.M/71/39,
giving the results of permeability tests on the five
samples of sandstone you sent us.

(Sgd.) G.H.SMITH.
Chief Chemist.

c.c. Mr.Taitt,
Britannic House.

COPY.

SCOTTISH OILS LIMITED.

CENTRAL LABORATORY, MIDDLETON HALL, UPHALL.

REPORT NO. SO/M/71/39.

REPORT ON FIVE SAMPLES OF SANDSTONE CORES FROM
COUSLAND NO. 2 WELL.

Permeability determinations were carried out in duplicate on all samples with the following results:-

Sample No.	Particulars of Sample..	Permeability as received. Millidarcys.	
		1	2
1	Fairly coarse sandstone, 1496'	197.0	198.3
2	Fakey sandstone, 1512'	1.88	3.32
3	Fine, rather fakey sandstone, 1515'	2.96	2.73
4	Fine sandstone, 2028'	53.72	55.20
5	Fairly coarse sandstone, 2095'	186.3	186.3

(Sgd.) G.H. SMITH
Chief Chemist.

(Sgd.) W. ROBT. GUY.

WRG/MC.

21st April, 1939.

Cousland No.1 & No.2 locations.

No.2 Well.

Determination of free water level on 23rd. June.

Since no Halliburton equipment was available, the water level was determined by means of a length of string and a 100 foot steel tape measure. The water mark on the string was readily determined as the water left a pronounced black stain on the string as well as wetting, the string above the water level being clean and dry.

The water level was found to be 159' from the wellhead flange, or 169' from the rotary table. (See report C G - 7 dated 3rd August 1940). This represents a rise of 9' in nearly 3 years; the previous level having been recorded on 22nd July 1940.

No.1 Well.

Determination of Closed in pressure on 22nd. June.

No dead weight tester was available to measure the pressure, so that the pressure measured by the wellhead gauge (Budenberg No. 6216176) was recorded, and a second measurement was made on another gauge (Wm: Bramall No.454428) which was calibrated subsequently at Bakring by D.W.T. The results obtained were as follows:-

Date	Wellhead gauge.	Test Gauge	D.W.T.	Hence Wellhead
	Budenberg	Wm: Bramall	pressure	gauge correction
11.00 a.m. 22nd June	627 lbs/sq.in.	640 lbs/sq.in.	615 lbs/ sq.in.	-12 lbs/sq.in.

The last pressure measured on the well was recorded by D.W.T on 23rd July, 1940 and was found to be 614.2 lbs/sq.in., so that the pressure now recorded does not necessarily mean that there has been a rise in pressure, although the rise could have been as much as 2 lbs/sq.in.. In view of the rise of the water level at No.2 well, it is considered probable that some rise in the pressure at No.1 well has taken place.

Gas Samples collected for Sunbury whilst the well

was flowing (a) at 650,000 (b) at 500,000 cubic feet per day.

June 22nd	11.00 a.m.	Closed in pressure 627 lbs/sq.in. gauge reading
	12.10 p.m.	Started flowing well at 650,000 cubic feet per day.
	4.10 p.m.	Shut well in.
	4.15 p.m.	Closed in pressure 625 lbs/sq.in. gauge reading
June 23rd	9.35 a.m.	Closed in pressure 626 lbs/sq.in. gauge reading
	9.45 a.m.	Started flowing well at 650,000 cubic feet per day.
	12.00 p.m.	Collected gas sample No.G1 (cylinder No.2/4)
	12.05 p.m.	Adjusted rate of flow to 500,000 cubic feet per day.
	2.15 p.m.	Collected gas sample No.G2 (cylinder No.2/5)
	4.00 p.m.	Closed in pressure 625 lbs/sq.in. gauge reading

June 24th 10.05 a.m. Started flowing well at 650,000 cubic feet per day.
 1.10 p.m. Filled first of Sunbury cylinders.
 2.38 p.m. Filled second of Sunbury cylinders.
 3.28 p.m. Shut well in.
 4.30 p.m. Closed in pressure 625 lbs/sq.in. gauge reading.

Notes on flowing tests.

A check on the length of the burning line was carried out. It was confirmed that this was 324 feet (0.0614 miles) as given in the report C G - 1 dated 13th November 1939. The well was then connected from the 3" side valve to the burning line by means of a short length of 1" hose. This hose had been replaced by a newer length in good condition, but nevertheless it was not considered satisfactory to produce the well through this hose.

The 3" side valve and burning line were in too confined a position to enable them to be connected together readily and quickly by means of 3" fittings. It was therefore decided to connect them together by means of 1/2" fittings, the rate of production being controlled through a 1/2" H.P. needle valve. This "hook-up" has been left connected to the well.

It was found that the 1/2" valve could handle the 650,000 cubic feet per day production, but frequent adjustment of the valve "setting" was found to be necessary. This was essentially due to the cold generated by the gas expansion, but whether the valve became slowly blocked by "ice" or "hydrates" is not known. If it had not been for this blocking the 1/2" valve would have probably been capable of handling a production of about 1,000,000 cubic feet per day; but for continuous production the 1/2" "hook-up" would probably not be able to handle more than about 500,000 cubic feet per day.

Connected into the burning line was a 3" valve, but the effect of this has been neglected in calculating production rates. A stand pipe had been connected to the end of the burning line on a previous occasion to deliver the gas well up into the atmosphere, and so it was not necessary to burn it. This means that continuous production tests could be carried out if required, without having to shut the well in during 'Black-out' hours.

All the cylinders were filled through a 1/2" connection taken below "B" and "N" valves. No cylinder was filled until the well had been flowing for two hours beforehand on the day in question; and when the production rate was changed, the well was flowed for a further two hours before collecting the sample. For the sake of comparison, production rates have been calculated from (a) the A.I.O.C. (b) the Weymouth (c) the Oliphant formulae

Barometric pressures were recorded by means of a pocket aneroid barometer, which had previously been calibrated at Bakring against a mercury barometer.

The following table enumerates the results obtained:-

4.10 p.m.	Shut well in.
4.15 p.m.	Closed in pressure 625 lbs/sq.in. gauge reading
9.35 a.m.	Closed in pressure 625 lbs/sq.in. gauge reading
9.45 a.m.	Started flowing well at 650,000 cubic feet per day.
12.00 p.m.	Collected gas sample No. 01 (cylinder No. 2/A)
12.05 p.m.	Adjusted rate of flow to 500,000 cubic feet per day.
2.15 p.m.	Collected gas sample No. 02 (cylinder No. 2/B)
3.15 p.m.	Shut well in.
4.00 p.m.	Closed in pressure 625 lbs/sq.in. gauge reading

COUSLAND NO. 1 WELL - RECORD OF PRODUCTION DATA OVER PERIOD 22ND - 24TH JUNE INC. 1943.

DATE.	Time well flowing.			Atmosphere.	Well Flowing press. lbs./in ²	Line Temps. °F.	Line Pressures				Production Rates			Av. Prod. rate ft. per 24 hrs.	Prod. during period cu. feet.	Cumulative Prod. cubic feet. From well.*							
	From	To	Hrs.				cum. hours.	Temp. °F.	Pressure lbs. / sq. ins.	Gauge	Corr. Gauge	Initial end	Terminal				Initial end	Terminal	A.I.O.C.	Weymouth	Oliphant		
22nd June.	12.10 pm.	4.10pm.	4	4	-	29.2	14.28	611	599	31	47	39	7.0	3.43	0.9	0.44	676,000	660,000	690,000	675,000	112,500	112,500	30,336,500
23rd June	9.45 am.	12.05pm.	2.33	6.33	61	29.14	14.31	610	598	30	54	42	7.3	3.58	1.2	0.59	677,000	659,000	688,000	675,000	65,500	178,000	30,402,000
	12.05 pm.	3.05pm.	3	9.33	61	29.16	14.32	615	603	36	56	46	4.7	2.31	0.8	0.39	528,000	514,000	535,000	526,000	65,700	243,700	30,467,700
24th June	10.05 am.	3.25 pm.	5.33	14.66	64	29.39	14.43	610	598	29	49	39	7.0	3.43	0.9	0.44	678,000	660,000	690,000	676,000	150,300	394,000	30,618,000

* The Cumulative gas production from the well has been recorded since the beginning of the production test on 3rd November, 1939.

32,500
30,650,000

Notes on the cylinders filled.

The D.E.C. cylinders consisted of two 2 litre cylinders which were filled at a pressure of 600 lbs/sq.in. Each cylinder was blown down 10 times to remove any traces of air before the final sample was taken. Cylinder No.2/4 was filled when the well was flowing at a rate of 675,000 cubic feet per day, and cylinder No.2/5 when the well was flowing at a rate of 526,000 cubic feet per day.

Mr. Duck arrived from Sunbury on 24th June (the third day of flow) to collect further samples. He had two cylinders each having a capacity of one cubic foot to fill, of the oxygen type, with only one outlet. The cylinders had been evacuated at Sunbury, but they did not appear to have retained their vacuum on arrival at Cousland. Mr. Duck had been given no guidance as to the rates at which the well should be flowed when each cylinder was filled, but he explained that he wished to fill both cylinders under similar conditions so that both samples should be as nearly as possible identical; and so it was decided to fill them both when the well was flowing at a rate determined to be 676,000 cubic feet per day. He filled and emptied each cylinder four times before taking the final sample, the filling pressures being 540 lbs/sq.in. and 580 lbs/sq.in. respectively. All four cylinders were forwarded to Sunbury by goods train, this having been their instructions for the dispatch of their own cylinders.

Reference numbers allocated to earlier reports.

CG-1	Dated	13th November	1939
CG-2	"	20th "	1939
CG-3	"	27th "	1939
CG-4	"	4th December	1939
CG-5	"	11th "	1939
CG-6	Not Dated	?12th "	1939
CG-7	Dated	3rd August	1940

COUSLAND NO.2 - FLUID LEVELS.

SEPTEMBER 1939.

Aug. 31 - 199 feet from surface.

Sept. 4 - 198 feet do.

8 - 197.5 feet do.

11 - 197 feet do.

15 - 197 feet do.

18 - 196.5 feet do.

22 - 196 feet do.

25 - 195.5 feet do.

29 - 195 feet do.

17th - 24th = April 1939
9th - 15th = May 1939
35-9 milk

for 1760-1806 cont.

REFINING & TECHNICAL BRANCH
JOB No. 1578

Copy

uk/Cousland 12ft. 2

From D'ARCY EXPLORATION CO. LTD.
LONDON.

To SUNBURY
via R. & T.

Our Ref.

Your Ref.

Date 31st May, 1939.

Subject CORE SAMPLES FROM COUSLAND NO. 2.

W. L. M.

A series of thirteen core samples from the 2016' and 2284 sandstones in Cousland No. 2 have been sent to Sunbury from Cousland.

Will you please arrange for porosity determinations to be made of these samples.

(Sgd.) A.H. TAITT.

Copy

uk/cont-1-2/12

From MR. F. C. SLINGER,
D'ARCY EXPLORATION CO. LTD.,
COUSLAND, DALKEITH.

To CHIEF CHEMIST,
SCOTTISH OILS LIMITED,
IPHALL.
Date 25th May, 1939.

Our Ref. Your Ref.

Subject SANDSTONE CORES FROM COUSLAND NO.2.

I am sending you herewith a box containing thirteen core-samples of sandstone obtained from our Cousland No.2 Well. Will you kindly arrange for permeability determinations to be carried out on these samples? They are taken from the 2016' and 2284' sandstones, and are as follows :-

<u>Midd. desc.</u>	<u>DEPTH.</u>	<u>NATURE.</u>
150-200	2056'	Fairly coarse sandstone with carbonaceous laminae.
150-200	2071' ¹ / ₂ '	Fairly coarse micaceous sandstone with carbonaceous laminae.
10-30	2286'	Rather soft carbonaceous flags with concretions.
30-50	2295'	Fairly fine flaggy sandstone.
25-50	2310'	Fairly fine sparkling slightly oily sandstone.
50-200	2330'	Rather coarse micaceous sandstone.
25-50	2340'	Fairly fine flaggy carbonaceous sandstone.
less than 1	2365'	White kinglgy sandstone.
25-50	2367'	Fairly fine sparkling slightly oily sandstone.
25-50	2375'	Fairly fine slightly indurated sandstone.
25-50	2385'	Fairly fine slightly indurated slightly oily sandstone.
25-50	2392'	Fairly fine carbonaceous slightly oily sandstone.
less than 1	2404'	White carbonaceous kinglgy sandstone.

cc - Mr. Taitt, London.

T.C.S.

Copy

From MR. F. C. SLINGER,
D'ARCY EXPLORATION CO. LTD., To
COUSLAND, DALKEITH. ANGLo IRANIAN OIL CO. LTD.,
RESEARCH STATION,
SUNBURY-ON-THAMES.

Our Ref. Your Ref. Date 25th May, 1939.

Subject SANDSTONE CORES FROM COUSLAND NO.2.

I am sending you by passenger train, one box containing thirteen core samples from our Cousland No.2 Well. Will you please determine the porosity of each of these samples? They are taken from the 2016' and 2284' sandstones, and are as follows :-

<u>DEPTH.</u>	<u>NATURE.</u>
2057'	Fairly coarse sandstone with carbonaceous laminae.
2072'/3'	Fairly coarse micaceous sandstone with carbonaceous laminae.
2286'	Rather soft carbonaceous flags with concretions.
2295'	Fairly fine flaggy sandstone.
2310'	Fairly fine sparkling slightly oily sandstone.
2330'	Rather coarse micaceous sandstone.
2340'	Fairly fine flaggy carbonaceous sandstone.
2360'	Fairly fine slightly indurated slightly oily sandstone.
2365'	White kingley sandstone.
2375'	Fairly fine slightly indurated sandstone.
2385'	Fairly fine slightly indurated slightly oily sandstone.
2392'	Fairly fine carbonaceous slightly oily sandstone.
2404'	White carbonaceous kingley sandstone.

J.C.S.

UK/T.8

27th April, 1939.

Société de Prospection Electrique
Procédés Schlumberger,
30, Rue Fabert,
PARIS, VIIe.

Dear Sirs,

Cousland No.2 Borehole, near Edinburgh.

With reference to your Engineer's visit to Edinburgh on April 28th in order to carry out two perforation jobs for the Anglo-American Oil Co. Ltd., we shall be obliged if you will kindly arrange for him to carry out at the same time an electrical survey, Resistivity and Porosity, of the remaining portion of our Cousland No.2 well, i.e. from 1879 ft. to 2000 ft.

We suggest that this work could be carried out on completion of, or, if more convenient, between the two Anglo-American perforation jobs.

Yours faithfully,
For D'ARCY EXPLORATION COMPANY LTD.

c.c. Anglo-American Oil Co. Ltd.,
Edinburgh.
Superintendent, Eskdale.
✓ D.E.C Cousland.

AGHM/CEP

uk/Cousland 2/T.2 · REFINING & TECHNICAL BRANCH
JOB No. 1509CopyFrom D'ARCY EXPLORATION CO. LTD.
LONDON.To SUNBURY
via R. & T.

Our Ref.

Your Ref.

Date 12th April, 1939.

Subject

SANDSTONE CORES FROM COUSLAND NO. 2.

The following core samples have been sent
direct from Cousland

Fairly coarse sandstone	...	from 1496'
Fakey sandstone	...	" 1512'
Fine rather fakey sandstone	"	1515'
Fine sandstone	...	" 2028'
Fairly coarse sandstone	...	" 2095'

Will you please arrange for Perosity
determinations to be carried out on these samples.

(Sgd.) A.H. TAITT.

uk/Cousland 2/T.2

Copy

From MR. F. C. SLINGER,
D'ARCY EXPLORATION CO. LTD.,
COUSLAND, DALKEITH. **To** ANGLO IRANIAN OIL CO. LTD.,
RESEARCH STATION,
SUNBURY-ON-THAMES. *Case*

Our Ref. **Your Ref.** **Date** 7th April, 1939.

Subject SANDSTONE CORES FROM COUSLAND NO.2.

*Not requested.**12/4.*

I am sending today by passenger train, a box containing pieces of sandstone core from the 1490' and 2016' sandstones of Cousland No.2 Well.

Will you please determine the porosity of each of these samples? They are taken from the following depths :-

1496'	- Fairly coarse sandstone.	} Sandstone with } saline water.
1512'	- Fakey sandstone.	
1515'	- Fine, rather fakey sandstone	
2028'	- Fine sandstone.	} As yet untested, } but probably a } water sand.
2095'	- Fairly coarse sandstone.	

cc - Mr. Taitt.*FCS.*

Copy

From MR. F. C. SLINGER,
D'ARCY EXPLORATION CO. LTD.,
COUSLAND. **To** CHIEF CHEMIST,
SCOTTISH OILS, LTD.,
UPHALL.

Our Ref. **Your Ref.** **Date** 7th April, 1939.

Subject SANDSTONE CORES FROM COUSLAND NO.2.

I send you herewith a box containing five samples of sandstone core from the 1490' and 2016' sandstones of Cousland No.2 Well. Will you please arrange for permeability determinations to be carried out on these samples? They are labelled, and are taken from the following depths :-

1496'	- Fairly coarse sandstone.	}	Sandstone with saline water.
1512'	- Fakey sandstone.		
1515'	- Fine, rather fakey sandstone.		
2028'	- Fine sandstone.	}	As yet untested, but probably water sand.
2095'	- Fairly coarse sandstone.		

cc - Mr. Taitt.

F.C.S.

(4) Chloride type water of well 2

Interval	1726' - 1878'	2290' - 2432'
Sand	1770' - 1780'	2230' - 2410'
S.G. @ 60°F.	1.0335	1.0075
Solids per 10 ⁵	4832	994
<u>Gram Equivalents</u>		
Sodium (& K)	47.34	13.26
Calcium	24.05	1.93
Magnesium	14.90	0.77
Chlorides	86.15	14.09
Sulphates	0.04	0.14
Carbonates	0.28	1.78
<u>Ionic %</u>		
Sodium (& K)	27.38	41.42
Calcium	13.90	6.18
Magnesium	8.62	2.41
Chlorides	49.82	44.00
Sulphates	0.02	0.43
Carbonates	0.16	5.56
Sunbury Ref. (or W.W.T.)	N/183	N/188

Remarks:

Saline water rose to 1117' below R.T. About 5000 ft³/day gas produced.

Saline water rose to 142' below R.T. Probably substantially uncontaminated edge-water.