COMPLETION REPORT

Cousland No. 5.

W.A.H. Keenlyside

U.K.195 W.A.H.K.

A Note on the Cousland Area

by

W.D.V. Jones.

22nd October, 1954. Eakring.

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by

W.A.H. KEENLYSIDE

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C O U S L A N D NO. 5

Completion Report

1. Introduction

Cousland No. 5 is the first borehole to be drilled for the Gas Council in this area in a structure proved by field work and earlier borings. It was located near Southfield cottages, Cousland, 1000 feet S.S.W. of No. 1. On the evidence then available, the location appeared to be some 20' structurally higher than No. 1 and on the crest of the structure.

The drilling of No. 5 has proved however that it is structurally lower than No. 1: at 1900' No. 5 is some 130' lower. Further, the gas sands have deteriorated between No. 1 and No. 5. In the latter they are in some cases thinner and contain fireclay and shale intercalations.

The borehole showed oil indications at two and gas indications at several horizons in the Oil Shale Group. None of these shows are of economic importance.

It would seem, from the amounts of water and gas produced during packer tests, that the well is situated on or about the gas/water level of the several horizons.

2. General

(a) Well Data

I	Co-ordinates:	$2^{\circ}59'$ 44.7" W. $55^{\circ}53'$ 55.6" N.
II	Relevant 6" O.S. Sheet:	Midlothian VIII N.E.
III	Rotary Table Elevation:	551'
IV	Derrick:	Hack-knife
V	Power	Diesel
VI	Drilling:	Commenced 15.2.54. Suspended 6.5.54.
VII	Suspension:	Plugged with cement 792'-728' and 100'-surface
VIII	Final Depth:	1918'
IX	Casing:	$8\frac{5}{8}$"; 767' to surface

X Diameter of borehole: $7\frac{3}{4}$" from 770' to 1773'
$5\frac{3}{8}$" from 1773' to 1918'

XI Deviations 1^{o} at 1000', 1^{o} at 1350', 1^{o} at 1550'

(b) Well History

The cellar was dug out to 14-6" below the rotary table and drilling began with a $10\frac{5}{8}$" bit on 15th February. Straight drilling continued to 770' when a string of $8\frac{5}{8}$" casing was run to 767' and cemented to surface on February 26th. Drilling (and coring) continued at $7\frac{3}{4}$" diameter to 1635' when on 31st February a $5\frac{3}{8}$" pilot hole was drilled (and cored). On 10th April when the depth was 1694' the pilot hole was reamed out $7\frac{3}{4}$" to 1675', and again on 28th April, when the depth was 1857', the pilot hole was reamed to 1773', leaving 145' of pilot hole at the suspension of operations at 1918' on 6th May.

All the major sandstones below 830' and the main leaf of the Burdiehouse Limestone were cored.

Details of the cores are given in a section below.

Between 823' and 1903', 15 production tests were carried out, of which 10 were mechanically successful.

The decision to suspend drilling was taken at 1918 feet, below the base of the lower group of gas-bearing sandstones.

The hole was surveyed by calipers, and electrical and gamma-ray methods between 7th and 9th May.

The hole was plugged with cement from 792' to 728' and from 100' to surface between 10th and 18th May, and the remaining intervals filled with 1.25 S.G. mud.

(c) Drilling Fluid

A bentonite-base mud was used throughout the drilling of the well. Losses of circulation to the sandstones down to 500' were experienced but these shows were effectively mudded off. After cementing the casing at 770', the cement-cut mud was entirely replaced and it was again replaced on 20th March when the depth was 1351' because of the high sand content.

The mud thereafter had average figure of 21 seconds viscosity and 1.15 specific gravity and very little trouble was then experienced.

The mud figures overleaf are typical.

Date	S.G.	Visc. 500/946	Water Loss
16.2.54.	1.02	15	33
22.2.54.	1.16	22	-
5.3.54.	1.07	23	21
8.3.54.	1.14	23	19
15.3.54.	1.24	21	11
22.3.54.	1.10	20	12
29.3.54.	1.19	24	9
5.4.54.	1.15	20	8
10.4.54.	1.19	24	8
15.4.54.	1.15	20	8
22.4.54.	1.14	20	9
28.4.54.	1.16	21	-
6.5.54.	1.15	23	9

(d) Oil and Gas Indications

Occurrences of hydrocarbons in this well are confined to the Oil Shale Group.

There are two occurrences of oil. Cores of the sandstone 1350'-1376' oozed oil and in a production test this interval was shown to be capable of producing 40 gallons of oil per day. Cores of the sandstone 1511'-1527' also oozed oil but produced no oil in a packer test.

There are seven occurrences of gas, ranging from gassy reservoir water to water-free gas, each proved by a production test. They occur in sandstones over the following intervals:-

885 - 910 Gassy water
1349 - 1376 Oil and gas
1511 - 1527 Gas
1656 - 1665 Gas and water
1712 - 1720 Gassy water
1730 - 1752 Gassy water
1873 - 1890 Gas and water

(e) Production Tests

Packer tests were carried out on all the potentially productive sandstones below 826'. Of the 15 tests performed 10 were mechanically successful. In all the tests a Johnson Tester was used, with a $7\frac{1}{4}$" wall packer for the first four tests in the $7\frac{3}{4}$" hole and with a $5\frac{1}{8}$" wall packer for the remaining six tests in the $5\frac{3}{8}$" pilot hole.

The first of these tests was carried out on the sandstone 887'-907'. The interval tested was 887'-916'. During 75 minutes reservoir water of 1.004 S.G. was produced at an initial rate of 6630 gallons per day, declining to 1650 gallons per day at the end of the test. 312 linear feet of gaseous fluid were present in the drill pipe on pulling out. This gives an overall production rate of 4800 gallons per day.

The second test was carried out on the interval 1053'-1084' on two sandstones; the upper from 1050' to 1065' and the lower from 1072' to 1101'. The test lasted 2 hours 17 minutes during which time 12 cubic feet were recorded on the gas meter representing a production figure of 790 gallons per day. Fluid rose 160 feet in the drill pipe. This gives an overall production figure of 840 gallons of water per day.

The third test was performed on an oily sandstone occurring from 1350' to 1376'. The interval tested was from 1327' to 1370'. A throughput of 18 cubic feet was recorded during 2 hours 25 minutes amounting to an overall production rate of 1100 gallons per day. 146' of fluid rose up the drill pipe of which the first 29 feet was oil of 0.88 S.G. This amounts to a production rate of 40 gallons per day. The remainder of the fluid (117') consisted of drilling mud. Thus the gas production rate amounted to some 60 cubic feet per day.

The fourth test was also carried out on an oily sandstone, that occurring from 1511' to 1527'. The interval tested was 1509'-1527'. During 3 hours 28 cubic feet was recorded on the gas meter. No oil and only 40 feet of muddy fluid were found in the drill pipe, hence production consisted of gas at an overall rate of 224 cubic feet per day.

The throughput in the fifth test over the interval 1646' to 1694' on a medium-grained, fawn sandstone from 1656'-1665' was 70 cubic feet in 2 hours 36 minutes amounting to an overall production rate of 1570 cubic feet per day. After closing in the drill pipe for 16½ hours, a closed-in pressure of 300 p.s.i. was recorded on the wellhead, and a gas production of 3850 cubic feet per day was recorded through the gas meter. Water was also produced at a rate of 220 gallons per day.

The sixth production test was performed on a thin medium-grained sandstone from 1693'-1700' over the interval 1686'-1702'. The production consisted of gas at an overall rate of 80 cubic feet per day and water at an overall rate of 190 gallons per day.

The next test was done on another thin sandstone in the interval from 1712'-1720'. The interval tested was 1706'-1722'. During 3 hours 53 minutes 146 cubic feet of production was recorded, which was found to be reservoir water with a little gas at an overall rate of 1675 gallons per day.

The next test was of the sandstone at 1730'-1753', consisting of fine grained sandstone with silty bands. The interval tested was 1724'-1755'. During 3 hours 28 minutes a throughput of 144 cubic feet was recorded on the gas meter, amounting to an overall production rate of 1000 cubic feet per day. This figure represents overall production rates of 2410 gallons of water per day and 350 cubic feet of gas per day.

The ninth production test was of two sandstones; an extremely fine-grained one from 1835'-1844' and a fine-grained one from 1853'-1858'. During 37 minutes there was a throughput of 0.2 cubic feet signifying in effect no production.

The last test to be performed was done on two sandstones: the upper a fine-grained cemented sandstone from 1873'-1878' and the lower a medium-grained sandstone with silty bands, from 1880' to 1890'. In 1 hour 57 minutes, 61 cubic feet of prdoction was recorded giving an overall production rate of 780 cubic feet per day. This was found to be made up of water at an overall production rate of 3100 gallons per day and gas at a rate of 280 cubic feet per day.

Bottom hole temperatures recorded during the tests are as follows:-

55°F at 916', 59°F at 1084', 63°F at 1370', 66°F at 1527', 70°F at 1694', 75°F at 1702', 73°F at 1722', 71°F at 1755', 70°F at 1881' and 72°F at 1903'.

Summing up the results of the above tests, it is evident that in general more water than gas was produced, and further, the amount of gas proved was not in economic quantities.

3. Geological

(a) Summary of Stratigraphy

	Thick-ness	Depth to base
(i) Superficial Deposits Soil	5'	10'
(ii) Scottish Carboniferous Limestone Series Lower Limestone Group	275'	280'
(iii) Calciferous Sandstone Series. Oil Shale Group	1638' +	1918' +

(b) The Stratigraphical Succession (in feet)

(i) Superficial Deposits (5')

0 - 10 Soil

(ii) Scottish Carboniferous Limestone Series (10' - 280')

Lower Limestone Group (275')

10 - 45	Dark grey limestone
45 - 54	Very dark grey calcareous shale
54 - 69	Dark grey limestone
69 - 78	V. dark grey shale with pyrites
78 - 96	Light grey limestone becoming darker downwards
96 - 123	Grey and brown pyritic sandstone
123 - 126	Coal
126 - 129	Fawn sst. and little shale
129 - 132	Coal and shale
132 - 192	Brown mic. sst. and pyrites
192 - 231	Dark grey limestone
231 - 234	Coal and shale
234 - 252	Fine grained grey sandstone
252 - 280	White crystalline limestone passing down in grey lst.
280 - 306	Alternating bands of grey sandstone, dark grey silt and black shale
306 - 317	Light grey shale
317 - 322	Grey shale with limonitic ironstone
322 - 375	Fawn medium sst. with coarser bands, slightly bituminous and pyritic
375 - 441	Black shale and silt, sandy in parts
441 - 450	Fawn sandstone
450 - 531	Dark grey and black silt
531 - 559	Grey carbonaceous micaceous sandstone with silt bands
559 - 592	Alternating thin bands of sandstone silt and shale
592 - 616	Black silt and sandstone
616 - 661	Light grey felspathic sandstone
661 - 667	Gap - samples all bentonite
667 - 714	Grey and black silts with thin sandstone bands
714 - 722	Oil shale
722 - 770	Fawn and white felspathic, and slightly bituminous sandstone with coarser bands.
770 - 775	Black shale
775 - 778	Fawn and white sandstone
778 - 808	Light grey sandy fireclay with bands of sandstone
808 - 817	Greenish fireclay
817 - 826	Coarse fawn sandstone - finer at base
826 - 874	Dark grey shale
874 - 885	Grey fireclay
885 - 909	White sandstone with bands of fireclay
909 - 911	Black shale

911	- 912	Fawn limestone
912	- 924	Grey fireclay
924	- 931	Limestone with ostracods
931	- 945	Grey shale, silt and fireclay
945	- 949	Fawn sandstone
949	- 951	Limestones with ostracods
951	- 1002	Grey shale and silt (with ostracods at 964') and little fireclay
1002	- 1019	Black silty shale
1019	- 1020'6"	Limestone with ostracods
1020'6"	- 1026	Fireclay and shale
1026	- 1043	Fine grained mica. sandstone with ironstone and shale break 1033' - 1036'
1043	- 1050	Siltstone
1050	- 1065	Light sandstone
1065	- 1072	Dark grey shale with plants and shells
1072	- 1101	Grey fairly coaarse sandstone
1101	- 1138	Dark grey silts and shales
1138	- 1141	Light grey limestone
1141	- 1156	Light grey sandstone
1156	- 1219	Silts and shales with ironstones and thin ssts.
1219	- 1234	Fawn-grey calcareous sandstone
1234	- 1237	Fawn crystalline limestone
1237	- 1327	Dark grey silts and shales, thin sandstones and oil shales
1327	- 1333	Grey-fawn limestone with ostracods
1333	- 1338	Light grey fireclay
1338	- 1340	Brown limestone
1340	- 1350	Light grey fireclay and dark grey shales
1350	- 1376	Clear-grained sandstone containing oil and gas
1376	- 1400	Dark grey shales and silts
1400	- 1403	Brown limestone
1403	- 1427	Oil shale
1427	- 1454	Grey shale and silt. Thin bands of sandstone and ironstone nodules
1454	- 1463	Oil shale
1463	- 1466	Fawn limestone
1466	- 1508	Grey shales and fireclays
1508	- 1511	Oil shale
1511	- 1525	Sandstone, light grey at top, black and oily below
1525	- 1561	Greenish and grey fireclays and shales
1561	- 1563	Dark grey impure limestone
1563	- 1566	Fine grained carbonaceous sandstone
1566	- 1578	Black shales and silts
1578	- 1593	Thin shales, silts and fine grained sandstone and fireclays
1593	- 1596	Dark grey-brown limestone with few ostracods
1596	- 1602	Grey fireclay and silt with ironstone
1602	- 1609	Fine grained fawn compact sandstone
1609	- 1610	Grey fireclay
1610	- 1611	Grey fireclay
1611	- 1622	Black shale, with ironstone
1622	- 1623	Limestone
1623	- 1634	Oil shale
1634	- 1635	Fawn-fine grained sandstone
1635	- 1638	Dark grey shale
1638	- 1642	Ironstone
1642	- 1645	Grey shale
1645	- 1646	Dark brown limestone with ostracods
1646	- 1648	Fireclay
1648		Thin band of dolomite-siderite oolite
1648	- 1652	Grey fireclay
1652	- 1656	Grey micaceous silt
1656	- 1665	Fawn medium grained sandstone
1665	- 1693	Black shale and silt with a thin f.g.sst. at 1686'

1693 - 1700	Medium-grained grey sst. micaceous, calc. and carbonaceous
1700 - 1707	Dark mic. silt and silty shale with ironstone and lamellibranchs
1707 - 1711	Dark brown compact limestone with much ostracod detritus
1711 - 1712	Grey micaceous silt
1712 - 1730	Grey mica. silt with ironstone
1730 - 1741	Fine grained fawn carbonaceous felspathic micaceous sst.
1741 - 1750	Thin alternating bands of above sandstone and grey shale
1750 - 1752	Carbonaceous and highly felspathic sandstone
1752 - 1772	Grey micaceous silt grading into black shale
1772 - 1775	Buff crystalline limestone with ostracods and detrital quartz
1775 - 1807	Grey micaceous silt grading down to grey shale
1807 - 1817	Brown and white mottled limestone, pyritic with ostracods, spirorbis, fish scales, interbedded with black pyritic shale with controted laminations and ostracods, and coaly streaks with plant impressions
1817 - 1823	Very fine grained grey micaceous sandstone
1823 - 1835	Grey micaceous silt
1835 - 1846	Extremely fine grained light grey sandstone with silt and shale laminations
1841	Black shale with ostracods
1846 - 1853	Grey fireclay
1853 - 1860	Fawn fine grained sandstone
1860 - 1861	Black shale
1861 - 1873	Light grey fireclay and shale
1873 - 1878	Fine and medium grained fawn sst.
1878 - 1887	Alternating bands of sandstone and shale and fireclay
1887 - 1890	Grey fine-medium grained sandstone
1890 - 1918	Black shale becoming silty at base

(c) Notes on the Stratigraphical Succession

Lower Limestone Group

Only the lower part of the Lower Limestone Group is present in this borehole, the upper having been removed by erosion. This lower part is 280' thick and consists essentially of two limestones, separated by sandstone. The upper limestone, the North Greens, is at surface and 90 feet of its thickness was penetrated. The lower limestone, the Gilmerton, has two leaves separated by sandstone, shale and a 3 foot coal seam, and has a total thickness of 85 feet. The two limestones are separated by 100 feet of sandstone with two three foot coal seams at 123' and 129' respectively.

Oil Shale Group

This is an alternating succession of sandstones and shales, with subordinate fireclays and thin ostracod limestones. The oil-shales occur in seams overaging 4 feet thick, except for one composite seam with fireclay and limestone, 1623'-1634'.

The sandstones frequently show current bedding and the finer grained sandstones and "fakes" (alternating thin bands of fine-grained sandstone and silt) show slump structures. A feature of the shales is the development of thin bands and nodules of siderite ironstone with thin calcite veins.

(d) Cores

21 cores, (a total of 136 feet), were obtained from this well and 75% of the strata cored were recovered at the surface. All the major sandstone groups below 826' were cored, and the main leaf of the Burdiehouse limestone. A certain amount of shale was also cored with the sandstone.

Dips obtained from the cores are:-

10° at 900'
12° at 1370'
8° at 1740'

In the remaining cores the dips are horizontal, or no dip values could be ascertained.

(e) Palaeontology

The age of the rocks encountered in the borehole was never in doubt and therefore palaeontology was subsidiary to lithology for purposes of correlation.

The most abundant fossils discovered were ostracods which occur throughout the Oil Shale Group, chiefly in the limestones, but also in the black shales. The abundance of the ostracods makes them appear of little use (as yet) for correlation purposes.

At 1129'-33' black silt with abundant white shell fragments was noted, which is tentatively correlated with the Pumpherston Shell Bed.

Between 1065' and 1072' lamellibranchs with affinities to Naiadites were recovered in a core. These were forwarded to the Geological Survey, Edinburgh, and at the time of writing the results of identification are not to hand. Fish scales and planty material were also recovered in this core and at other horizons. Spirobis was recovered at 1814' in pyritic shale.

4. Regional Stratigraphy

(a) Formation Thicknesses

	No.3	No. 2	No. 1	No. 5	No. 4
Edge Coal Group	153+	-	-	-	-
Lower Limestone Group	537	328+	247+	280+	89+
Oil Shale Group	1479+	2104+	2630+	1638+	1806+

(b) Changes in thicknesses

In none of the boreholes with the exception of No. 3 (which is not on the Cousland anticline) can the changes in absolute thickness of the Groups be measured, because the top of the Lower Limestone Group is eroded, and the base of the Oil Shale Group was never reached. (The thickness of the Oil Shale Group on the D'Arcy anticline to the south is proved to be 2957'.) Changes of thickness of groups within the Oil Shale Group can however be measured and are set out on the table overleaf.

	No. 3	No. 2	No. 1	No. 5	No. 4
Base of Gilmerton to top of Burdiehouse	700	583	562	632	713
Upper Gas Sand Horizon	79	95	46	26	23
Middle Gas-sand Horizon	162	10	50	66	38
Lower Gas-sand Horizon	-	120	86	55	67

There appears to be a general thinning of the gas-sands from No. 3 to No. 4, that is from north to south. The extreme condition is reached in No. 4 where the sandstones are thin and separated by shale intercalations.

(c) Structural Considerations

When the depths of certain of the marker horizons of No. 5 are compared with those of No. 1 (the nearest well in the area), it is seen that No. 5 is structurally lower, the amount varying with the depth.

The base of the North Greens limestone is 68 feet lower than in No. 1 and a sandstone in No. 1 at 262' which is correlated with one at 324' in No. 5 indicates a difference of 76 feet between the two holes. The strata of the interval from the base of the Gilmerton Limestone to this sandstone above are 24 feet thicker in No. 5: this difference is explained by that amount being faulted out in No. 1. Similarly a second fault is postulated to explain an increase in thickness of 30 feet in the strata between 450' and 530'. This second fault brings No. 5 104' structurally lower than No. 1.

The Burdiehouse is found to be 121 feet lower than in No.1 and at 1810' a limestone correlated with one at 1694 in No. 5 indicates that at this depth No. 5 is 117' structurally lower.

Dips recorded in cores from No. 5 show no or only low dips, but dips of the order of 20° to 65° are recorded in No. 1 over the interval 1800'-2100'. It is therefore possible that the change in elevation is due to a monoclinal fold with an inclined axis (see Section Appendix No. 2).

Whether this interpretation be correct or not, it remains proved that the Cousland anticline is saddle shaped, with two crest maxima, one to the north of Cousland No. 1, and the other centred on Cousland No. 4.

5. Further Prospects in the Area

Fieldwork carried out since the suspension of drilling at No. 5 has brought to light new evidence about the structure of the northern end of the Cousland anticline. The structure rises from No.5 to No.1 and the field evidence supports the view that it continues to rise northeastwards from No.1 before the nose of the anticline finally pitches down.

Eakring,
22.10.54.
WDVJ/RLB

A Note on the Cousland Area

by

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Report on the Cousland Area

1. Introduction

The first borehole drilled by D'Arcy Exploration Company on the main Cousland Anticline produced gas from sandstone within the Calciferous Sandstone Series. This gas was in considerable quantity, one of the sandstones giving production of about 4 million cubic feet per day.

This anticline became of great importance when the Gas Council decided to institute a search for Natural gas in Britain. It was decided that a further borehole should be drilled in the same general area with the view of obtaining a better estimate of the recoverable gas reserves.

This borehole was then located about 1100 feet south of No.1 on the best geological information available at that time. The results of the drilling and the search for gas are given in two reports: one being the Completion Report for Cousland No. 5 by W.A.H. Keenlyside and the other the Petroleum Engineering Report on the Cousland Area by C.M. Adcock.

This note is directed to an analysis of the results of the drilling of Well No. 5 and the exploration situation in the Cousland Area around Well No. 1.

2. The Results of Drilling at No. 5

The location chosen for No. 5 was near the central line of a north-south axis near the culmination of which No. 1 had been drilled. The new borehole was put south of No. 1 and should have been 20' higher structurally than No. 1.

In the event the gas-bearing strata were some 110' lower in No. 5 than in No. 1 and were very near to gas/water level. Further, the reservoir conditions in No. 5 were poorer and the reservoirs themselves were thinner than in No. 1. In brief, loss of good reservoir conditions and loss of elevation of the strata were responsible for the failure of No. 5 as a gas-producer.

The existing contour maps in this area have had therefore to be modified to include the results of this borehole. Whilst this work was being done it was discovered that some shallow borings to investigate the Limestones forming the surface beds of the area had been drilled. These records were made available to the Company by the Scottish Geological Survey in Edinburgh on a confidential basis.

3. The Present State of Knowledge of the Cousland Anticline

(a) Contour Map and Sections

The results of the drilling of No. 5 have changed the shape of the existing contour map of the north end of this anticline and made it necessary to close in the south side of the gas reservoir. This makes the gas field smaller than had originally been thought and has changed it from an approximately N-S structure to one which runs more nearly E-W.

Analysis of the results of the drilling of the shallow boreholes has shown that the picture of an E-W anticline is a probability at least. This analysis has been complicated by the fact that each of the two suface limestones (No. 1 or Gilmerton and No. 2 or North Greens) are about 100' thick and each is underlain by about 100' of sandstone. The Geological Survey believe that all these boreholes began above the No. 1 Limestone and this conclusion being agreed, sections and a contour map of the area on the top of the calciferous sandstone series have been drawn (Figures 2 and 1).

And above the No. 2 also!

Figure No. 1 is the contour map and shows the results of co-ordination of surface and borehole evidence. The two faults are as drawn by the Survey; only the northern area (south of Cousland) of the much larger Cousland D'Arcy Anticline is shown. This contour map shows two high areas, one east and north of No. 1 and the other some 2000' south of Southfield. This latter could be as much as 75' higher than No. 1. These are separated by a saddle running generally NW-SE passing south of No. 2 and about 1000' south of No. 5.

The three sections are self-explanatory and show that a rise of some 22' above No. 1 could be expected at a point some 1000' from No. 1 in a direction of E. by N.

(b) Structure at Depth

Information at depth near the crest of the anticline is confined to No. 5 and No. 1. The remaining borehole (No.2) was drilled intentionally down flank. It is apparent from the results of No. 1 and No. 5 that although it is possible to draw a reasonable contour map on the base of the No. 1 Limestone (= top of the Calciferous Sandstone Series) the same structure may not be developed at depth. Correlation between No. 1 and No. 5 (Figure 5) shows that there are thickness differences in the Calciferous Sandstone Series just below the No. 1 Limestone. In Fig. 5 these amount to an excess of 61' in No. 5 over the same intervals in No. 1 and therefore the total loss of elevation = 45' + 61' or 106'. This is ascribed to faulting within this zone in No. 1 causing apparent thinning of strata from No. 5 to No. 1. A slight variation in these figures as compared with those in the Completion Report does not invalidate the argument. The factor is, however, quite impossible to assess and Figure 4 has been drawn on the assumption that the thicknesses at No. 5 are in fact the true thicknesses.

The mean diameter of the area in which the gas-bearing sandstones are above gas/water level then appears to be of the order of 2,500 feet. C.M. Adcock, assuming 15% average porosity for the volume of reservoir above water level and 40% for the average interstitial water content of that fraction, has calculated that the volume of the gas in situ in a 50' sandstone would be 1,000 x 10^6 cubic feet.

4. Reservoir Conditions

Within the area of No. 1 borehole, permeability conditions appear to be fairly good in the immediate neighbourhood but connection at distance appears to be more limited. These conclusions represent a fair statement after the results of the production tests on No. 1 producing sandstones.

In No. 5 there appears to be very limited connection in reservoirs thinner than in No. 1. The better reservoir connections and reservoirs themselves are therefore found when moving from No. 5 towards No. 1. If a further borehole in this area be required then any possible location should be chosen with this in mind.

5. Future Work

There is a possibility that the north-eastern side of the structure is not so uncomplicated as has been shown and it may be necessary to drill through the base of the No. 1 Limestone in two places to control this flank. This should be a necessary preliminary to any further deep drilling.

The anticline south of No. 5 across the saddle area is not at the moment thought to offer any strong attraction. It may be a pitching nose with the cross-fault cutting the axis further and further down pitch as the depth increases.

6. Conclusions

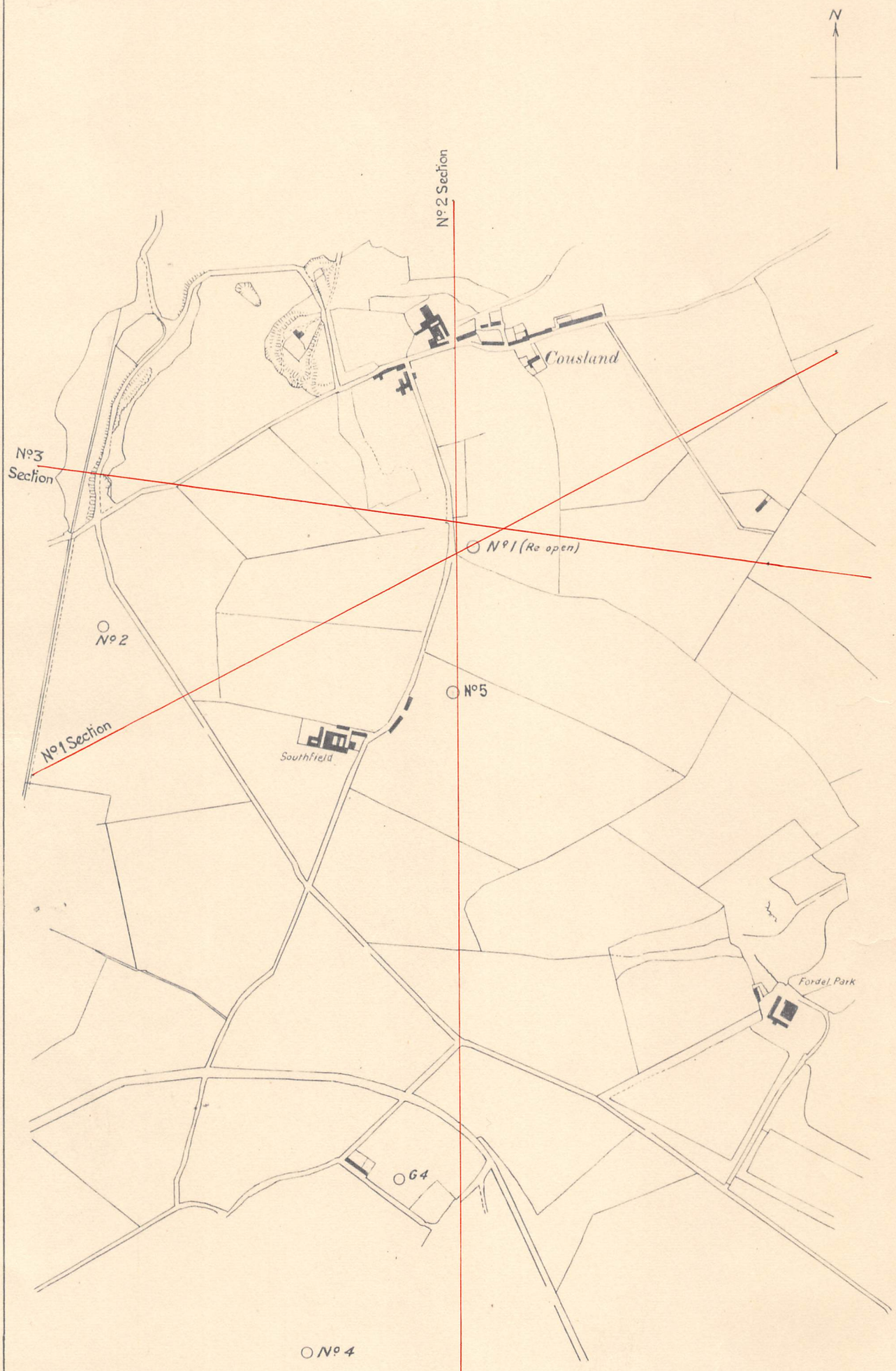
An area exists E. of No. 1 which is as high if not higher on the No. 1 Limestone than No. 1.

This high area is further removed from the poor reservoir area of No. 5 than No. 1.

The diameter of the area of sandstone above gas/water level is roughly 2,500'.

Eakring,
22.10.54.
WDVJ/MG

Section Lines on Fig. 1



Scale: 6 Inches = 1 Mile

Ft 1000 0 1000 2000 3000 Ft.