November 24, 1952

Blackwood & Nichols
1313 Liberty Bank Building
Oklahoma City, Oklahoma

Gentlemen:

Enclosed herewith is the report of the analysis of the 2" Rotary core taken from the Linn Lease, Well No. 1-W, Butler County, Kansas, and submitted to our laboratory on November 11, 1952.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:cr

e.c.

BLACKWOOD & NICHOLS

CORE ANALYSIS REPORT

LINN LEASE WELL NO. 1-W

BUTLER COUNTY, KANSAS

OILFIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

NOVEMBER 24, 1952

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Blackwood & Nichols Lease Linn Well No. 1-W

Location SW¼, NW¼

Section 5 Twp. 26S Rge. 5E County Butler State Kansas

Name of Sand		Admier
Top of Core		620.00
Bottom of Core		670.00
Top of Pay Sand		640.15
Bottom of Pay Sand		658.55
Total Feet of Permeable Sand	(Analyzed)	5.20
Total Feet of Floodable Sand	(Analyzed)	3.80

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 100	1.55	1.55
100 - 200	0.75	2.30
200 - 300	1.25	3.55
300 - 400	0.15	3.70
400 - 500	0.20	3.90
500 & above	1.30	5.20

Average Permeability Millidarcys	270.93
Average Percent Porosity	25.04
Average Percent Oil Saturation	36.53
Average Percent Water Saturation	52.66
Average Oil Content, Bbls./A. Ft.	720.
Total Oil Content, Bbls./Acre	4,359.
Average Percent Oil Recovery by Laboratory Flooding Tests	8.64
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	171.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	428.
Total Calculated Oil Recovery, Bbls./Acre	1,300.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water was used in making up the circulating fluid used in the coring of the sand in this well.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
620.00 - 625.00	Gray calcareous fossiliferous shale.
625.00 - 629.00	Gray shale.
629.00 - 636.00	Gray calcareous fossiliferous shale.
636.00 - 638.00	Loss
638.00 - 639.80	Gray calcareous fossiliferous shale.
639.80 - 640.15	Light brown fine grained calcareous micaceous sandstone.
640.15 - 644.00	Brown fine grained micaceous sandstone.
644.00 - 658.00	Loss.
658.00 - 658.55	Brown fine grained micaceous sandstone.
658.55 - 660.85	Gray slightly laminated sandy shale.
660.85 - 661.15	Brown fine grained micaceous sandstone.
661.15 - 662.10	Alternate layers of shale and sandstone.
662.10 - 662.35	Brown fine grained micaceous sandstone.
662.35 - 662.70	Slightly laminated sandstone and shale.
662.70 - 663.20	Gray shale.
663.20 - 663.50	Brown fine grained micaceous sandstone.
663.50 - 664.40	Gray laminated sandy shale containing a sand streak.
664.40 - 664.55	Brown fine grained micaceous sandstone.
664.55 - 665.50	Gray laminated sandy shale.
665.50 - 665.80	Brown fine grained laminated micaceous shaley sandstone.
665.80 - 667.50	Gray shale.
667.50 - 670.00	Loss.

Coring was started at a depth of 620.00 feet in gray calcareous fossiliferous shale and completed at 670.00 feet probably in shale. There was a loss extending from 667.50 to 670.00 feet. This core shows a total of 6.05 feet of sandstone. There was a loss extending from 644.00 to 658.00 feet which was probably pay sand. For the most part, the pay is made up of fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 289.58 and 74.11 millidarcys respectively; the overall average being 270.93 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from 15 millidarcys to a maximum of 620 millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fair weighted average percent oil saturation, namely, 36.53. The weighted average percent oil saturation of the upper and lower sections is 36.80 and 35.54 respectively. The weighted average percent water saturation of the upper and lower sections is 51.98 and 55.15 respectively; the overall average being 52.66 (See Table IV). This gives an overall weighted average total fluid saturation of 89.19 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analysed for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it

is evident that considerable flushing of the sand did occur during coring as, for the most part, the zones of higher permeability have the lower chloride content.

The weighted average oil content of the upper and lower sections is 727 and 696 barrels per acre foot respectively; the overall average being 720. The total oil content, as shown by this core, is 4,359 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core responded fairly well to laboratory flooding tests as a total recovery of 428 barrels of oil per acre was obtained from 2.50 feet of sand. The weighted average percent oil saturation was reduced from 37.68 to 29.04, or represents an average recovery of 8.64 percent. The weighted average effective permeability of the samples is 23.79 millidarcys, while the average initial fluid production pressure is 8.3 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 3 samples tested, all produced water and oil. This indicates that all of the sand represented by these samples is floodable. The tests also show that, for the most part, the sand is very loose and should take water very freely.

CONCLUSION

On the basis of the above data, it is evident that a recovery of approximately 1,300 barrels of oil per acre or an average of 342 barrels per acre foot can be obtained from the 3.8 feet of floodable pay sand analyzed. In calculating this recovery, an allowance was made for oil lost during coring, and it is assumed that the primary production and

the true water saturation of the sand are 10 and 38 percent respectively. Of course, the above recovery value is based only on the 3.8 feet of floodable pay sand analyzed. It is very unfortunate that most of the good sand was lost during coring as it is doubtful whether the sand analyzed is representative of the entire sand section. The sand represented by this core should take water very freely as it has a high permeability.

Oilfield Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Blackwood & Nichols Lease Linn Well No. 1-W

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	640.00	128.	0.35	0.35	44.80
2	640.70	271.	0.90	1.25	243.90
3	641.45	620.	0.65	1.90	403.00
4	641.90	240.	0.35	2.25	84.00
5	642.25	92.	0.55	2.80	50.60
6	642.90	110.	0.40	3.20	44.00
7	643.15	15.	0.35	3.55	5.25
8	643.50	555.	0.65	4.20	360.75
8A	658.05	61.	0.20	4.40	12.20
9	658.30	410.	0.20	4.60	82.00
10	658.50	300.	0.15	4.75	45.00
11	661.45	34.	0.10	4.85	3.40
12	662.15	89.	0.25	5.10	22.25
13	663.95	77.	0.10	5.20	7.70

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Blackwood & Nichols Lease Linn Well No. 1-W

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
639.80 - 658.55	4.75	289.58	1,375.50
661.40 - 664.00	0.45	74.11	33.35
639.80 - 664.00	5.20	270.93	1,408.85

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Blackwood & Nichols Lease Linn Well No. 1-W

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	639.88	15.2	23.4	54.6	78.0	276	0.35	0.35	97
2	641.22	29.4	35.0	50.0	85.0	798	1.55	1.90	1,237
3	642.09	27.4	33.4	57.7	91.1	710	0.85	2.75	604
4	643.02	26.9	47.0	51.0	98.0	982	0.80	3.55	785
5	643.82	20.3	44.2	41.5	85.7	697	0.65	4.20	453
6	658.40	20.5	31.7	60.7	92.4	505	0.55	4.75	278
8	660.91	26.9	41.5	46.0	87.5	867	0.30	5.05	260
9	662.28	24.8	43.5	46.8	90.3	838	0.25	5.30	210
10	663.42	25.9	36.7	56.6	93.3	737	0.30	5.60	221
11	664.49	24.9	40.4	49.1	89.5	782	0.15	5.75	118
12	665.59	21.7	19.0	72.5	91.5	320	0.30	6.05	96
							Total - - - - - - - - -		4,359

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Blackwood & Nichols Lease Linn Well No. 1-W

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
639.80-658.55	4.75	25.31	36.80	51.98	727	3,454
660.85-665.80	1.30	24.08	35.54	55.15	696	905
639.80-665.80	6.05	25.04	36.53	52.66	720	4,359

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Blackwood & Nichols Lease Lim Well No. 1-W

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
2	641.09	29.6	37.0	827	7.1	165	28.9	71.0	664	567	25.70	5
5	643.68	20.4	44.2	668	14.2	287	28.0	66.0	443	168	54.97	5
10A	668.28	26.2	36.7	747	4.7	96	32.0	68.4	671	63	1.07	15

Notes: cc = cubic centimeter.
* = Volume of water recovered at the time of maximum oil recovery.
** = Determined by passing water through sample which still contains residual oil.

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Blackwood & Nichols Lease Linn Well No. 1-W

Depth Interval, Feet	640.15 - 663.50
Feet of Core Analyzed	2.50
Average Percent Porosity	26.84
Average Percent Original Oil Saturation	37.68
Average Percent Oil Recovery	8.64
Average Percent Residual Oil Saturation	29.04
Average Percent Residual Water Saturation	69.56
Average Percent Total Residual Fluid Saturation	98.60
Average Original Oil Content, Bbls./A. Ft.	776.
Average Oil Recovery, Bbls./A. Ft.	171.
Average Residual Oil Content, Bbls./A. Ft.	605.
Total Original Oil Content, Bbls./Acre	1,940
Total Oil Recovery, Bbls./Acre	428.
Total Residual Oil Content, Bbls./Acre	1,512.
Average Effective Permeability, Millidarcys	23.79
Average Initial Fluid Production Pressure, p.s.i.	8.3

NOTE: Only those samples which recovered oil were used in calculating the above averages.

Oilfield Research Laboratories

RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Blackwood & Nichols Lease Linn Well No. 1-W

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	639.88	30,600			
2	641.22	10,500			
3	642.09	30,000			
4	643.02	55,800			
5	643.82	30,800			
6	658.40	46,900			
8	660.91	64,400			
9	662.28	41,700			
10	663.42	43,100			
11	664.49	57,100			
12	665.59	70,100			

Note: ppm - parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Blackwood & Nichols Lease Linn Well No. 1-W

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
639.80 - 658.55	30,093		
660.85 - 665.80	55,592		
639.80 - 665.80	35,572		

Note: ppm - parts per million.