OILFIELD RESEARCH LABORATORIES
536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

December 3, 1966

Jackson Brothers
514 North Main
Eureka, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Jackson Heirs Lease, Well No. 16, Greenwood County, Kansas, and submitted to our laboratory on November 26 and 27, 1966.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:rf

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GENERAL INFORMATION & SUMMARY

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Location NE SW NW

Section 23 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Squirrel
Top of Core	2135.0
Bottom of Core	2156.0
Top of Sand (Cored)	2135.0
Bottom of Sand	2153.9
Total Feet of Permeable Sand (Analyzed)	1.6
Total Feet of Floodable Sand	

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.

Average Permeability Millidarcys	17.0
Average Percent Porosity	13.1
Average Percent Oil Saturation	13.0
Average Percent Water Saturation	64.0
Average Oil Content, Bbls./A. Ft.	159.
Total Oil Content, Bbls./Acre	255.
Average Percent Oil Recovery by Laboratory Flooding Tests	
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	
Total Calculated Oil Recovery, Bbls./Acre	
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

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GENERAL INFORMATION & SUMMARY

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Location NE SW NW

Section 23 Twp. 25S Rge. 8E County Greenwood State Kansas

Name of Sand	Bartlesville
Top of Core	2406.0
Bottom of Core	2435.9
Top of Pay Sand	2408.6
Bottom of Sand (Recovered)	2435.9
Total Feet of Permeable Formation	24.7
Total Feet of Floodable Sand	16.8

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 1	4.1	4.1
1 - 5	8.8	12.9
5 - 10	2.5	15.4
10 - 20	6.3	21.7
20 & above	3.0	24.7

Average Permeability Millidarcys	9.2
Average Percent Porosity	15.8
Average Percent Oil Saturation	30.0
Average Percent Water Saturation	54.1
Average Oil Content, Bbls./A. Ft.	368.
Total Oil Content, Bbls./Acre	10,580.
Average Percent Oil Recovery by Laboratory Flooding Tests	6.5
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	88.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,471.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	4,335.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. The core was sampled and sealed in tin cans by an employee of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
	-SQUIRREL SAND-
2135.0 - 2135.4	Light brown, fine grained sandstone.
2135.4 - 2136.0	Hard conglomeratic sandstone.
2136.0 - 2138.0	Gray, fine grained sandstone.
2138.0 - 2153.9	Gray sandstone (discarded at well)
2153.9 - 2156.0	Shale (discarded at well)
	-BARTLESVILLE SAND-
2406.0 - 2407.2	Gray and light brown, laminated, shaly sandstone.
2407.2 - 2407.8	Gray shale.
2407.8 - 2414.2	Light brown, laminated, shaly sandstone.
2414.2 - 2416.6	Gray, finely laminated sandstone and shale.
2416.6 - 2421.0	Light brown, shaly sandstone.
2421.0 - 2424.6	Brown, fine grained sandstone.
2424.6 - 2435.9	Light brown, fine grained sandstone.
2435.9 - 2437.0	Loss.

-BARTLESVILLE SAND-

Coring was started at a depth of 2406.0 feet in gray, light brown laminated, shaly sandstone and completed at 2437.0 feet. There was a core loss from 2435.9 to 2437.0 feet (total depth). This core shows

a total of 26.9 feet of sandstone. For the most part, the pay is made up of light brown, fine grained 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 2.7 and 15.2 millidarcys respectively; the overall average being 9.2 (See Table III). 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 impermeable to a maximum of 37. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fair weighted average percent oil saturation, namely, 30.0. The weighted average percent oil saturation of the upper and lower sections is 32.5 and 27.1 respectively. The weighted average percent water saturation of the upper and lower sections is 55.9 and 51.6 respectively; the overall average being 54.1 (See Table III). This gives an overall weighted average total fluid saturation of 84.1 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VI and VII. From the data given in these tables and on the coregraph, it is evident that considerable flushing of the sand did occur, especially in the lower section as the sand in this zone has a much lower chloride content.

The weighted average oil content of the upper and lower sections

is 362 and 375 barrels per acre foot respectively; the overall average being 368. The total oil content, as shown by this core, is 10,580 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

When taking into consideration that the sand in the core has only a fair oil saturation, part of the samples responded very well to laboratory flooding tests, as a total recovery of 1,471 barrels of oil per acre was obtained from 16.8 feet of sand. The weighted average percent oil saturation was reduced from 30.1 to 23.6, or represents an average recovery of 6.5 percent. The weighted average effective permeability of the samples is 1.57 millidarcys, while the average initial fluid production pressure is 30.9 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 30 samples tested, 19 produced water and 17 oil. This indicates that approximately 57 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

From a study of the above data, we estimate that approximately 4,335 barrels of oil per acre or an average of 258 barrels per acre foot, can be recovered from the area, represented by this core, by efficient primary and waterflood operations. Of course, any primary oil that has already been recovered would have to be subtracted from the above value. The following data and assumptions were used in calculating the above oil recovery value:

Original formation volume factor	1.22
Irreducible water saturation, percent	36.0

Primary recovery, estimated, percent	None
Present oil saturation, percent	54.0
Average porosity, percent	17.4
Oil saturation after flooding, percent	23.6
Performance factor, percent	55.0
Net floodable pay sand, feet	16.8

This core shows a rather thick sand section having a fair oil saturation, a high water saturation and low average permeability.

The chloride tests show that considerable flushing of the sand occurred during coring. This would partly account for lower oil and higher water saturations.

The core of the Squirrel sand shows that it does not contain sufficient pay to justify completion in this zone.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
						-SQUIRREL SAND-					
1A	2135.1	20.2	28	61	89	439	58.	0.4	0.4	176	23.20
2A	2136.1	10.7	8	65	72	66	3.3	1.2	1.6	79	3.96
						-BARTLESVILLE SAND-					
1	2406.1	11.3	28	57	85	246	Imp.	0.5	2.1	123	0.00
2	2407.1	13.8	35	40	75	375	0.29	0.7	2.8	263	0.20
3	2408.1	11.5	21	72	93	187	3.6	0.8	3.6	150	2.88
4	2409.1	14.8	32	46	78	367	2.1	1.0	4.6	367	2.10
5	2410.1	14.4	46	49	95	514	1.1	1.0	5.6	514	1.10
6	2411.1	12.1	33	63	96	310	Imp.	1.0	6.6	310	0.00
7	2412.1	15.5	36	45	81	433	1.2	1.0	7.6	433	1.20
8	2413.1	12.0	21	70	91	196	Imp.	1.0	8.6	196	0.00
9	2414.1	12.4	21	69	90	202	Imp.	0.6	9.2	121	0.00
10	2415.1	12.1	25	70	95	235	0.16	1.4	10.6	329	2.24
11	2416.1	13.8	36	59	95	386	Imp.	1.0	11.6	386	0.00
12	2417.1	12.1	28	68	96	263	0.98	1.0	12.6	263	0.98
13	2418.1	18.3	33	44	77	469	4.3	1.0	13.6	469	4.30
14	2419.1	16.1	48	43	91	600	14.	1.0	14.6	600	14.00
15	2420.1	15.2	23	56	79	271	1.0	1.4	16.0	379	1.40
16	2421.1	16.3	41	49	90	519	1.7	0.6	16.6	311	1.02
17	2422.1	15.6	47	47	94	569	0.62	1.0	17.6	569	0.62
18	2423.1	18.2	32	49	81	452	8.1	1.0	18.6	452	8.10
19	2424.1	18.8	30	49	79	438	25.	1.0	19.6	438	25.00

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. / A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
20	2425.1	16.7	24	60	84	311	10.	1.0	20.6	311	10.00
21	2426.1	17.4	26	52	78	351	18.	1.0	21.6	351	18.00
22	2427.0	18.7	23	55	78	334	-	0.5	22.1	167	-
P22	2427.2	-	-	-	-	-	5.0	0.5	22.6	-	2.50
23	2428.1	17.4	25	52	77	337	15.	1.0	23.6	337	15.00
24	2429.1	16.3	32	55	87	406	3.6	1.0	24.6	405	3.60
25	2430.1	15.7	27	55	82	329	2.3	1.0	25.6	329	2.30
26	2431.1	18.8	25	57	82	365	26.	1.0	26.6	365	26.00
27	2432.1	18.7	23	53	76	334	8.2	1.0	27.6	334	8.20
28	2433.1	16.2	29	56	85	364	16.	1.0	28.6	364	16.00
29	2434.1	19.5	26	49	75	393	37.	1.0	29.6	393	37.00
30	2435.1	19.5	28	46	74	424	18.	1.3	30.9	551	23.40

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
	-SQUIRREL SAND-		
2135.0 - 2136.6	1.6	17.0	27.16
	-BARTLESVILLE SAND-		
2406.0 - 2422.6	11.9	2.7	32.04
2422.6 - 2435.9	12.8	15.2	195.10
2406.0 - 2435.9	24.7	9.2	227.14

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
			-SQUIRREL SAND-			
2135.0 - 2136.6	1.6	13.1	13.0	64.0	159	255
			-BARTLESVILLE SAND-			
2406.0 - 2422.6	16.0	14.0	32.5	55.9	362	5,783
2422.6 - 2435.9	12.8	17.9	27.1	51.6	375	4,797
2406.0 - 2435.9	28.8	15.8	30.0	54.1	368	10,580

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Jackson Heirs Well No. 16

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
					-SQUIRREL SAND-							
1A	2135.1	19.8	28	430	5	77	23	73	353	264	5.40	10
2A	2136.1	11.2	6	52	0	0	6	87	52	27	0.40	30
					-BARTLESVILLE SAND-							
1	2406.1	11.6	25	225	0	0	25	65	225	0	Imp.	-
2	2407.1	13.4	31	322	0	0	31	48	322	0	Imp.	-
3	2408.1	12.0	18	168	0	0	18	76	168	5	0.20	40
4	2409.1	15.1	32	375	5	59	27	71	316	6	0.20	50
5	2410.1	14.3	46	514	11	122	35	54	392	4	0.10	50
6	2411.1	11.7	30	272	0	0	30	68	272	0	Imp.	-
7	2412.1	15.1	33	387	0	0	33	50	387	0	Imp.	-
8	2413.1	12.4	20	192	0	0	20	75	192	0	Imp.	-
9	2414.1	12.1	23	216	0	0	23	70	216	0	Imp.	-
10	2415.1	11.8	22	202	0	0	22	75	202	0	Imp.	-
11	2416.1	13.3	33	341	0	0	33	65	341	0	Imp.	-
12	2417.1	12.4	26	250	0	0	26	72	250	8	0.30	50
13	2418.1	18.6	33	476	8	115	25	72	361	10	0.30	50
14	2419.1	16.5	48	615	17	218	31	67	397	23	0.50	30
15	2420.1	14.8	21	241	0	0	21	64	241	0	Imp.	-
16	2421.1	15.8	38	466	0	0	38	56	466	0	Imp.	-
17	2422.1	15.3	43	510	0	0	43	53	510	0	Imp.	-
18	2423.1	18.0	32	447	8	112	24	67	335	25	0.60	40
19	2424.1	18.4	30	428	7	100	23	69	328	80	1.50	20
20	2425.1	16.0	24	298	1	12	23	73	286	30	0.60	30

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.

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Jackson Brothers Lease Jackson Heirs Well No. 16

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
21	2426.1	17.6	26	355	5	68	21	77	287	80	1.60	20
22	2427.0	18.7	23	334	5	73	18	75	261	256	8.10	20
23	2428.1	17.1	25	332	4	53	21	68	279	137	2.80	20
24	2429.1	16.3	32	406	8	102	24	68	304	11	0.20	50
25	2430.1	16.0	27	335	3	37	24	74	298	23	0.50	30
26	2431.1	18.7	25	363	5	73	20	77	290	104	2.40	20
27	2432.1	19.0	23	339	3	44	20	76	295	85	1.80	20
28	2433.1	16.7	29	376	6	78	23	71	298	72	1.80	20
29	2434.1	20.0	26	403	8	124	18	81	279	240	5.40	20
30	2435.1	19.5	28	424	6	91	22	75	333	72	1.60	30

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.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Depth Interval, Feet	2406.0 - 2422.6	2422.6 - 2435.9	2406.0 - 2435.9
Feet of Core Analyzed	4.0	12.8	16.8
Average Percent Porosity	16.1	17.8	17.4
Average Percent Original Oil Saturation	39.8	27.0	30.1
Average Percent Oil Recovery	10.3	5.3	6.5
Average Percent Residual Oil Saturation	29.5	21.7	23.6
Average Percent Residual Water Saturation	66.0	73.1	71.4
Average Percent Total Residual Fluid Saturation	95.5	94.8	95.0
Average Original Oil Content, Bbls./A. Ft.	495.	375.	404.
Average Oil Recovery, Bbls./A. Ft.	128.	75.	88.
Average Residual Oil Content, Bbls./A. Ft.	367.	300.	316.
Total Original Oil Content, Bbls./Acre	1,980.	4,799.	6,779.
Total Oil Recovery, Bbls./Acre	514.	957.	1,471.
Total Residual Oil Content, Bbls./Acre	1,466.	3,842.	5,308.
Average Effective Permeability, Millidarcys	0.27	1.98	1.57
Average Initial Fluid Production Pressure, p.s.i.	45.0	26.5	30.9

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

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RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VI

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
		-SQUIRREL SAND-			
1A	2135.1	6,120			
2A	2136.1	217,000			
		-BARTLESVILLE SAND-			
1	2406.1	146,450			
2	2407.1	135,800			
3	2408.1	92,500			
4	2409.1	95,800			
5	2410.1	106,300			
6	2411.1	105,600			
7	2412.1	108,800			
8	2413.1	105,200			
9	2414.1	87,850			
10	2415.1	104,300			
11	2416.1	97,000			
12	2417.1	92,500			
13	2418.1	95,950			
14	2419.1	87,900			
15	2420.1	104,000			
16	2421.1	100,000			
17	2422.1	109,900			
18	2423.1	68,650			
19	2424.1	33,150			
20	2425.1	73,200			
21	2426.1	19,525			
22	2427.0	11,200			
23	2428.1	12,950			
24	2429.1	92,775			
25	2430.1	64,600			
26	2431.1	7,090			
27	2432.1	23,200			
28	2433.1	70,450			
29	2434.1	32,150			
30	2435.1	42,750			

Note: ppm — parts per million

Oilfield Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Jackson Bros. Lease Jackson Heirs Well No. 16

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
	-SQUIRREL SAND-		
2135.0 - 2136.6	164,217		
	-BARTLESVILLE SAND-		
2406.0 - 2422.6	103,264		
2422.6 - 2435.9	43,667		
2406.0 - 2435.9	76,777		

Note: ppm — parts per million.