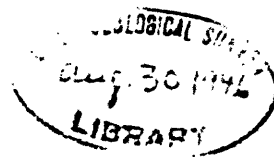


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THE TEXTURE OF PALEOZOIC SANDSTONES AND SANDY
LIMESTONES IN THE APPALACHIAN BASIN.

by
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Introduction.—This report presents the writers' textural (size) analyses of 21 outcrop and 162 well samples from the Silurian, Devonian, Mississippian, and Pennsylvanian sandstones and sandy limestones of Ohio, Pennsylvania, West Virginia, New York, and Michigan. These analyses supplement the textural data presented March 1946 by the same writers in a report entitled "The Texture of Mississippian, Upper Devonian, and lower Pennsylvanian sandstones in the Appalachian basin". As in the earlier report, the analytical data are presented without interpretation to permit their immediate use by oil and gas operators.

The data were obtained as part of the oil and gas investigations of the Appalachian basin by the Geological Survey, United States Department of the Interior. The analytical procedure for both well and outcrop samples was the same as that outlined in the previous report. Two changes have been made in presenting some of the data. First, for sandy limestones and for calcareous sandstones having more than 20 percent removed by treatment with hot dilute hydrochloric acid and subsequent washing of the sample, the percentage of "acid + fines" in the entire sample has been given in that column. The percentages of sand and coarse silt were computed to 100 percent separately. Second, some Clinton samples from Ohio were contaminated with limestone from other horizons. For these samples no percentages are given in the "acid + fines" column, and the sand and coarse silt are computed to 100 percent separately.

Presentation of data.—Textural data for both outcrop and well samples are presented in table 1. Outcrop data are grouped by State and measured section. Well samples are arranged by State and approximate alphabetical order of well-name. For well samples, the formation is given in the fourth column, and it is the driller's name unless followed by the designation (GR), which indicates that the driller's identification has been revised or confirmed by petrographic analysis.

West Virginia outcrop samples were collected from measured sections that are described in county reports of the West Virginia Geological Survey. The section names, bed number, county, and page are presented in the second, third, fourth, and fifth columns of table 1. Pennsylvania outcrop samples are located by distance in miles from 5-minute intervals of latitude and longitude. All well samples are located in the same way. In table 1 well samples are identified by symbol and well name. The full name, company, and location are given in table 2.

In the analytical data columns, "pan" represents sediment between 0.062 and about 0.01 mm. "Acid+ fines" represents acid soluble material (mainly carbonates and iron oxides) and insoluble material finer than about 0.01 mm. The degree of effervescence is indicated in the "acid + fines" column as follows: v₂, very vigorous; v, vigorous; m, medium; s, slight; and n, none.

Interpretation of textural data from calcareous rocks.— In most samples containing more than 20 percent of "acid + fines", the lime was present largely as lime sand, oolites, and rounded fossils or fragments of fossils. These calcareous grains were transported to their final place of deposition in the same way as quartz sand grains with which they are associated. The rocks so formed are true clastic sediments, even though they may contain 90 percent or more carbonate.

When deposited, the grain size distribution of such rocks would be essentially the same as the size distribution in pure quartz sands that were deposited under similar hydraulic conditions. The assumption cannot be made, however, that the

proportion of carbonate grains and quartz grains is the same for all sizes. Consequently, removal of the carbonate grains by acid treatment may leave a quartz sand size distribution that is not representative of the whole rock and does not reflect the exact conditions under which the rock was deposited.

At present so little is known about the relation of quartz and lime grains in clastic calcareous rocks that interpretation of the textural data is difficult. Several observations and suggestions may be made. First, the lime sand grains usually will be as coarse or coarser than the quartz grains with which they are associated. Consequently, the average or median grain size of the entire rock will be as large or larger than the average size of the quartz alone. A minimum value for the average grain size may thus be obtained.

Second, in general the average size of the quartz grains and the proportion of quartz to lime sand may be expected to decrease at increasing distances from the source of the quartz sand, though the rate of change may not be the same in different directions. Along a shoreline, for example, the rate of change along the shore may be much less rapid than that normal to the shoreline. The possibility that this relationship may be helpful in determining the direction and distance to shoreline deposits certainly merits further investigation.

Third, the presence of quartz sand in a calcareous rock strongly suggests that the whole rock is clastic. If so, the rock was deposited in the same way as quartz sandstones. Beach, bar, dune, or channel deposits may be present. These will be similar in all respects, except mineral composition, to quartz sands and may form stratigraphic traps favorable for the accumulation of oil and gas. Such deposits should have the same shape and trends as quartz sand deposits of similar origin.

Acknowledgments.—The writers wish to thank the West Virginia University and the West Virginia Geological Survey for the use of office and laboratory space and equipment, and the many individuals and companies who have made well samples available for analysis.

Table 1.--Texture of outcrop and well samples from West Virginia, Ohio, and Pennsylvania

Sample	Measured section	Bed No.	County report	Page	Formation	Size grade			Pan	Acid + Fines
						>2 mm.	2-1 mm.	.5-.25 mm.		
WEST VIRGINIA OUTCROP SAMPLES										
						Pct.	Pct.	Pct.	Pct.	Pct.
652	Droop Mt.	11	Pocahontas	114	Webster Sp.	---	---	6.4	42.8	23.6
653	do	1	do	113	Droop	---	---	16.5	66.4	10.4
662	Roach Run	-	Greenbrier	179	Stony Gap	---	---	.1	25.2	38.9
663	do	-	do	do	do	---	---	20.0	49.4	12.3
665	do	-	do	do	Above Avis	---	---	1.8	19.7	39.2
666	do	-	do	do	Princeton	---	---	52.0	19.3	6.4
676	Beverly	1	Randolph	156	U. Raleigh	tr.	0.1	62.2	8.5	2.1
677	do	3	do	do	Stony Gap?	---	tr.	10.8	47.8	16.4
685	Cheat Bridge	12	do	167	Nuttall	---	tr.	67.7	11.6	4.8
686	do	21	do	do	U. Raleigh	---	tr.	53.1	8.3	3.5
690	Durbin	4	Pocahontas	116	Stony Gap	---	---	12.7	47.5	17.9
691	Cromer Top	6	Randolph	163	do	---	---	6.8	32.4	28.5
695	Evenwood*	1	do	192	Droop	---	---	2.0	36.6	31.3
717	Stony Gap	53	Mercer	197	Stony Gap	---	tr.	24.6	53.3	11.4
718	do	do	do	do	do	---	---	14.6	57.0	16.1
723	Pride	10	do	214	Princeton	0.1	.7	47.5	16.2	5.4
731	Bellepoint	1	do	249	do	1.6	4.6	44.3	13.5	2.8
741	Hinton	63	do	248	Stony Gap	---	---	5.6	33.8	39.6
PENNSYLVANIA OUTCROP SAMPLES										
779	0.6 40°25'		3.5 78°55'		Loyalhanna	---	---	45.2	22.1	18.7
822	1.6 41°30'		1.8 79°25'		Shenango	---	---	12.5	60.4	15.5
828	1.8 41°45'		.1 80°15'		Corry	---	tr.	.1	16.5	46.6
										7.9 57.8(v)2**
										6.5 5.1(n)
										19.5 17.3(v)

* Sample from new highway cut.
** Loss in entire sample; percentages other than acid plus fines total 100%.

WELL SAMPLES — WEST VIRGINIA

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Sample	Well name	Depth (in feet)	Formation	> 2 mm.	2-1 mm.	1-.5 mm.	Size grade .5- mm.	.25- mm.	.125- .062 mm.	Pan ,	Acid +	Fines
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
BA-1	Wet-321	2275-2288	Big lime (GR)	—	—	0.8	26.6	39.0	25.5	8.0	76.1(v)2*	
BA-2	do	2300-2308	do	—	—	3.8	26.4	37.4	25.2	7.2	52.0(v)2*	
BA-3	do	2328-2342	Big Injun (GR)	—	—	1.0	43.5	41.0	8.3	2.8	3.2(v)	
BA-4	do	2411-2424	do	tr.	tr.	.6	33.3	44.8	9.3	4.1	7.8(m)	
CS-1	Put-272	1883-1900	Big lime (GR)	—	tr.	.3	11.4	72.1	15.1	1.1	66.0(v)2*	
CS-2	do	1940-1959	do	—	—	2.0	6.6	10.0	68.2	13.2	93.8(v)2*	
CS-3	do	2009-2028	Big Injun (GR)	0.3	1.5	6.4	7.4	56.7	22.9	1.3	3.3(m)	
CS-4	do	2028-2041	do	—	.2	1.5	4.1	41.7	37.9	5.2	9.4(v)2*	
CS-5	do	4942-4948	Criskany	—	—	.3	7.2	52.3	37.2	3.3	20.2(v)2*	
CS-6	do	4958-4969	do	—	—	1.0	19.2	47.2	18.7	2.4	11.4(v)	
FC-1	Nic-21	1790-1795	Keener	—	tr.	1.7	23.9	37.0	15.9	1.7	19.5(v)	
FC-2	do	1799-1804	Big Injun	—	.3	10.0	41.4	28.4	9.4	3.2	7.1(m)	
FC-3	do	1810-1815	do	.1	.1	.9	9.4	45.4	26.5	6.6	10.9(s)	
FI-1	Up-94	1361-1379	Big lime (GR)	—	—	—	6.8	49.6	36.6	7.0	86.8(v)2*	
FI-2	do	1411-1440	do	—	—	.1	7.9	39.3	44.0	8.6	69.4(v)2*	
FI-3	do	1443-1452	do	—	—	.1	3.2	20.1	63.8	12.8	71.7(v)2*	
FI-4	do	1478-1492	do	—	—	.7	5.2	25.8	57.8	10.6	73.4(v)2*	
FI-5	do	1492-1501	do	—	—	.1	6.4	16.6	50.3	26.6	47.3(v)2*	
FL-1	Rit-1059	2180-2197	Berea (GR)	—	—	.1	15.7	61.4	13.4	1.3	8.1(s)	
FL-2	do	2197-2201	do	—	.1	1.2	19.4	64.7	8.0	.4	6.3(s)	
FL-3	do	2201-2205	do	—	.3	1.1	13.3	54.7	16.4	2.2	12.0(m)	
FL-4	do	2205-2210	do	—	.6	3.2	26.2	32.4	19.7	5.3	11.7(s)	
FL-5	do	2210-2215	do	.9	18.7	26.0	25.9	20.6	2.9	.2	2.2(s)	
GN-1	Ral-36	1895-1905	Not given	—	.2	10.5	23.3	36.5	17.7	3.7	8.1(m)	
GN-2	do	1905-1915	do	—	1.3	9.6	21.4	42.6	16.4	2.6	6.3(m)	
GN-3	do	1915-1925	do	—	.1	.7	9.9	28.4	38.2	15.8	6.9(m)	
GN-4	do	1925-1931	do	—	.3	4.6	23.2	36.5	19.5	7.6	8.3(m)	
GN-5	do	2040-2070	do	—	tr.	2.2	25.1	36.3	16.4	9.3	10.7(m)	
GN-6	do	6273-6278	Oriskany	—	tr.	2.2	28.3	49.2	16.2	4.1	31.1(v)2*	
GN-7	do	6287-6297	do	—	tr.	1.6	14.0	42.3	33.6	8.5	40.3(v)2*	

* Loss in entire sample; percentages other than 100.

Sample	Well Name	Depth (in feet)	Formation	Size grade						Pan	Acid + Fines
				>2 mm.	2-1 mm.	1-.5 mm.	.5- .25 mm.	.250- .125 mm.	.125- .062 mm.		
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
GN-8	Rel-36	6297-6307	Oriskany	---	tr.	1.8	36.0	47.2	12.5	2.5	69.3(v) ² *
GN-9	do	6316-6321	do	---	0.1	.9	18.1	53.4	25.6	1.9	43.5(v) ² *
GN-10	do	6330-6335	do	---	---	.9	22.1	56.6	18.1	2.3	39.6(v) ² *
GR-3	Har-79	1290-1300	Big lime (GR)	---	---	.1	17.9	25.4	39.6	16.9	59.2(v) ² *
GR-4	do	1315-1330	do	---	.2	40.9	34.1	5.8	12.5	6.4	53.2(v) ² *
GR-5	do	7350-7360	Oriskany	---	tr.	4.1	21.8	26.8	30.1	17.1	65.4(v) ² *
GR-6	do	7375-7385	do	---	.1	1.4	9.6	13.7	24.7	50.5	75.2(v) ² *
HD-1	Cal-794	2162-2173	Big lime (GR)	---	---	tr.	2.4	48.8	29.3	19.5	99.7(v) ² *
HD-2	do	2193-2200	do	---	---	.4	3.0	35.6	53.2	7.8	71.3(v) ² *
HD-3	do	2211-2225	do	---	---	.6	11.2	33.0	45.2	10.0	83.1(v) ² *
HD-4	do	2235-2240	do	---	---	7.5	31.0	21.5	32.4	7.6	73.9(v) ² *
HT-3	Roar-19	1875-1888	Big lime (GR)	---	---	.3	9.2	62.5	27.2	.9	64.2(v) ² *
HT-4	do	1948-1973	Big Injun (GR)	---	---	1.0	5.1	46.2	39.6	7.8	27.4(v) ² *
HU-1	Brax-131	1669-1695	Big lime (GR)	---	.1	.5	6.5	14.2	44.0	34.8	89.5(v) ² *
HU-2	do	1393-1414	Not given	---	---	.5	14.2	42.5	29.1	6.3	7.7(s)
HT-1	Ran-1	1756-1759	Oriskany	---	.1	1.9	28.3	53.7	13.4	2.5	47.2(v) ² *
HT-2	do	1775-1778	do	---	tr.	.2	7.3	58.1	30.8	3.5	42.6(v) ² *
HT-3	do	1792-1794	do	---	---	1.2	23.8	38.4	27.7	8.9	22.5(v) ² *
HT-4	do	1804-1808	do	---	.1	2.9	26.7	50.4	11.5	8.4	38.3(v) ² *
HT-5	do	1819-1823	do	---	---	.2	6.8	27.6	45.6	19.8	35.1(v) ² *
HT-6	do	1834-1837	do	---	---	.2	16.7	51.2	21.7	4.0	6.2(v) ²
HT-7	do	1848-1850	do	---	---	.2	15.8	53.8	19.9	5.5	4.8(v) ²
HT-8	do	1871-1873	Helderberg	---	---	.8	5.7	19.6	48.0	25.9	41.8(v) ² *
HT-9	do	1897-1902	do	---	tr.	.7	8.9	45.7	32.8	11.8	76.2(v) ² *
HT-10	do	1914-1920	do	---	---	.8	3.3	14.2	52.4	29.4	82.5(v) ² *
HT-11	do	4343-4344	Albion	---	---	5.7	34.8	38.1	8.0	1.7	11.6(v)
HT-12	do	4387-4388	do	---	tr.	9.7	36.6	41.2	4.2	.4	5.6(v)
HT-13	do	4428-4429	do	0.7	1.6	.3	27.8	56.8	10.9	.9	3.3(v)
KR-2	Lew-53	2183-2205	Big lime (GR)	---	tr.	.8	13.3	50.6	27.6	7.6	87.8(v) ² *
KR-3	do	2210-2231	do	---	tr.	.3	12.8	44.9	37.6	4.1	59.6(v) ² *

* Loss in entire sample; percentages other than acid plus fines total 100%.

Size grade

Sample	Well name	Depth (in feet)	Formation	>2 mm.	2-1 mm.	1-.5 mm.	.5- .25 mm.	.250- .125 mm.	.125- .062 mm.	Pan	Acid +	Fines
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
MS-1	Tay-17	898-916	Big lime (GR)	---	---	---	0.4	4.9	12.8	82.0	74.5(v) ² *	
MS-2	do	929-942	do	---	tr.	0.7	5.2	9.8	11.8	72.5	97.6(v) ² *	
MS-3	do	975-983	do	---	---	tr.	17.9	50.1	14.9	2.4	14.6(s)	
MS-4	do	988-994	do	---	---	tr.	14.6	58.4	15.0	2.4	9.6(s)	
MS-5	do	1015-1031	do	---	---	.6	31.8	40.3	17.0	10.1	78.4(v) ² *	
MS-6	do	1049-1066	do	---	0.2	10.4	24.2	27.6	27.1	10.3	67.0(v) ² *	
MW-1	Dod-71	6988-6992	Oriskany	---	---	.1	11.1	45.5	26.4	2.6	14.3(v)	
MW-2	do	7010-7015	do	---	.1	.5	8.9	36.2	30.2	9.0	15.1(v)	
MW-3	do	7070-7080	do	---	---	.1	6.4	43.5	42.0	8.0	26.6(v) ² *	
MW-4	do	7092-7096	do	---	---	tr.	1.9	25.2	58.1	14.7	23.3(v) ² *	
OR-1	Woo-72	1514-1519	Big lime (GR)	---	---	.2	6.4	62.9	26.9	3.6	79.7(v) ² *	
OR-2	do	1525-1534	do	---	.2	16.8	28.0	24.7	21.8	8.4	77.8(v) ² *	
OR-3	do	1619-1627	Big Injun (GR)	---	---	.1	1.1	29.4	31.8	24.5	13.1(m)	
OR-4	do	1635-1637	do	---	---	tr.	1.1	26.0	33.2	28.0	11.6(m)	
OR-5	do	4306-4317	Oriskany	---	---	2.4	23.9	37.4	24.4	2.8	9.1(m)	
OR-6	do	4317-4321	do	---	tr.	3.4	24.3	42.5	25.2	4.4	32.7(v) ² *	
PA-1	Wirt-91	861-875	Sharon (GR)	---	.4	8.3	44.5	39.6	4.8	.9	1.4(s)	
PA-2	do	969-990	Big lime (GR)	---	---	.7	7.7	27.0	51.1	13.5	91.1(v) ² *	
PA-3	do	993-1007	do	---	tr.	6.9	34.1	31.0	20.8	7.1	72.9(v) ² *	
PA-4	do	1028-1038	Big Injun (GR)	0.3	4.0	13.8	32.3	25.1	14.3	2.5	7.5(m)	
PA-4a	do	1038-1050	do	5.3	8.0	4.9	5.2	21.2	32.9	5.9	16.6(m)	
PA-5	do	1054-1060	do	.1	4.0	19.1	31.5	29.0	8.5	1.2	6.6(m)	
PA-6	do	1060-1070	do	.8	4.3	17.2	21.4	30.0	14.9	3.5	7.8(m)	
PA-7	do	1070-1087	do	.1	1.3	3.6	2.8	26.9	40.5	5.6	19.2(v)	
PK-1	Dod-98	1849-1866	Big lime (GR)	---	---	1.2	21.6	48.5	25.0	3.7	61.0(v) ² *	
PK-2	do	1873-1882	do	---	tr.	10.5	27.7	23.7	26.7	11.4	56.6(v) ² *	
PR-1	Jac-197	1845-1851	Sharon (GR)	.6	3.6	17.9	51.4	20.3	3.7	.6	1.6(s)	
PT-1	Mon-151D	1904-1928	Big lime (GR)	---	---	.4	22.6	41.0	29.0	7.0	38.2(v) ² *	
PT-2	do	1928-1955	do	---	---	.8	17.3	37.6	33.4	10.9	47.7(v) ² *	
PT-3	do	1967-1986 ¹⁷	Big Injun (GR)	---	---	2.5	52.4	33.1	5.8	1.8	4.5(v)	
PT-4	do	1986 ¹⁷ -2007 ¹⁵	do	---	---	.7	46.3	42.8	5.7	1.2	3.2(s)	

* loss in entire sample; percentages other than acid plus fines total 100%.

Sample	Well name	Depth (in feet)	Formation	Size grade					Pan	Acid + Fines
				>2 mm.	2-1 mm.	1-1/5 mm.	.5- .25 mm.	.250- .125 mm.		
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
RO-1	Gil-406	1730-1745	Pottsville (GR)	0.3	2.2	16.1	45.2	24.6	1.5	1.7(s)
RO-2	do	1895-1906	Big lime (GR)	---	---	.4	21.5	59.2	2.1	82.4(v) ² *
RO-3	do	1906-1918	do	---	---	.7	20.0	57.6	1.9	77.8(v) ² *
RO-4	do	1918-1930	do	---	---	1.1	21.4	43.0	7.2	81.6(v) ² *
RO-5	do	1946-1969	do	---	---	3.4	17.9	25.4	10.0	81.2(v) ² *
RO-6	do	1969-1978 ¹	do	---	---	6.6	23.4	22.5	9.7	75.9(v) ² *
SN-1	Boa-443	2058-2077 ¹⁶	Big Injun	---	.8	4.9	9.0	55.4	1.4	9.7(m)
W-2	Kan-155	1240-1248	Sharon (GR)	---	---	.1	4.4	50.9	4.9	2.5(s)
W-3	do	1374-1384	Big lime (GR)	---	.1	3.1	9.7	7.9	11.9	87.4(v) ² *
W-4	do	1384-1395	do	---	.1	2.8	12.8	15.4	7.5	82.5(v) ² *
W-5	do	1449-1453	Big Injun (GR)	---	1.1	14.1	31.0	30.6	1.3	17.3(v)
W-6	do	1453-1459	do	---	.4	8.2	27.2	40.0	1.5	8.3(v)
W-7	do	1459-1465	do	---	.2	5.0	16.1	47.3	1.9	7.0(v)
W-8	do	1465-1471	do	.1	.6	2.1	7.1	48.3	2.7	9.0(v)
W-9	do	1471-1481	do	---	.1	.2	2.0	51.5	2.7	10.0(v)
W-10	do	1481-1491	do	---	.1	.3	.7	28.9	7.7	24.4(v)
W-11	do	1735-1741	Weir (GR)	---	.2	1.5	37.3	31.8	7.2	10.4(m)
WM-1	Cab-428	1521-1526	Big lime (GR)	---	tr.	.1	2.4	53.0	2.0	29.1(v) ² *
WM-2	do	1547-1552	do	---	---	tr.	10.2	72.2	.7	36.0(v) ² *
WM-3	do	1682-1694	Big Injun (GR)	---	1.4	12.5	33.5	34.4	1.5	7.8(v)
WM-4	do	1727-1742	do	---	.6	2.7	8.4	31.8	5.5	7.6(v)
WT-1	Gil-653	1856-1870	Big lime (GR)	---	---	1.2	15.6	60.9	2.6	94.9(v) ² *
WT-2	do	1897-1905	do	---	tr.	1.6	17.6	35.4	6.5	62.6(v) ² *
WY-1	Way-358	1718-1731	Big Injun	---	---	tr.	.1	.4	20.1	12.9(v)
WELL SAMPLES — OHIO										
AC-1	Archer	2520-2530	Clinton	---	.1	.2	.7	11.9	59.7	63.9(v) ² *
AC-2	do	2593-2605	do	---	---	---	.1	2.6	67.5	(v) ² *

* Loss in entire sample; percentages other than acid plus fines total 100%.

** Sample contaminated with limestone.

Sample	Well name	Depth (in feet)	Formation	72 mm.	2-1 mm.	1-.5 mm.	.5- .25 mm.	.250- .125 mm.	.125- .062 mm.	Pan	Acid + Finos
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
DA-1	Davis	3659-3664	Clinton	---	---	---	2.6	17.2	43.4	36.8	(n)**
DA-2	do	3676-3683	do	---	---	---	3.7	28.3	43.9	24.1	(n)**
DA-3	do	3687-3695	do	---	---	---	5.3	23.6	40.8	22.8	7.5(n)
DA-4	do	3703-3713	do	---	---	---	2.2	33.1	35.4	17.1	12.2(n)
DO-1	Dodoz	3954-3961	do	---	---	tr.	2.8	16.6	35.5	33.9	11.1(s)
DO-2	do	3967-3974	do	---	---	---	.2	10.8	51.7	37.2	30.7(n)*
DO-3	do	3982-3993	do	---	---	---	.3	27.0	39.5	23.6	9.6(n)
H-26	Ullman	4651-4663	Oriskany	---	0.1	2.4	24.2	40.2	14.5	1.0	17.8(n)
H-27	do	4671-4677	do	---	---	.1	1.8	34.5	43.1	3.1	17.4(v)
H-28	do	4680-4685	do	---	.2	tr.	1.3	25.8	56.5	7.5	8.7(m)
H-29	do	4697-4710	do	---	---	tr.	1.3	27.5	44.7	5.8	20.7(v)
HG-1	Houser	2780-2789	Clinton	---	---	---	---	14.3	44.1	41.6	75.0(v)*
HG-2	do	2824-2839	do	---	---	---	.3	24.9	45.7	29.1	21.1(v)*
HE-1	Horshborge	4124-4136	do	---	---	---	1.6	37.1	42.2	5.3	10.8(s)
LI-1	Lisle	2909-2911	do	---	---	---	.3	6.7	57.0	35.9	(v)**
LI-2	do	2946-2952	do	---	---	---	.1	23.6	56.0	20.2	(v)**
MO-2	Mobley	5658-5663	Oriskany	---	---	4.0	31.8	43.9	10.4	.7	9.1(v)
MO-3	do	5672-5677	do	---	---	1.6	15.7	47.1	15.1	1.5	18.9(v)
MO-4	do	5685-5689	do	---	---	.1	.4	49.9	45.1	4.6	55.5(v)*
MO-5	do	5695-5700	do	---	---	tr.	4.9	27.9	42.4	6.0	18.8(v)*
ND-1	Neidert	4090-4093	Clinton	---	---	---	.8	14.0	34.6	35.9	14.8(v)
ND-2	do	4104-4106	do	---	---	---	.2	24.1	56.6	13.7	5.3(m)
ND-3	do	4139-4140	do	---	---	---	.1	48.7	39.5	7.0	4.8(m)
SE-1	Steele(Hall)	2839-2848	do	---	---	---	.1	11.2	40.3	48.3	(v)*
SE-2	do	2882-2885	do	---	---	---	tr.	19.4	55.0	11.6	14.0(v)
SK-1	Stockert	4199-4205	do	---	---	.1	4.8	27.2	54.1	6.0	7.8(v)
SK-2	do	4215-4223	do	---	---	---	.2	24.0	40.2	24.3	11.3(v)
SK-3	do	4252-4256	do	---	---	tr.	.1	50.4	36.0	6.4	7.1(v)
SM-30	Smith	3030-3039	Oriskany	---	---	6.7	53.2	17.4	1.9	.6	20.2(v)*
SM-31	do	3039-3045	do	---	---	1.2	47.2	34.5	1.9	.3	14.9(v)

* Loss in entire sample; percentages other than acid plus fines total 100%.

** Sample contaminated with limestone.

Size grade

Sample	Well name	Depth (in feet)	Formation	>2 mm.	2-1 mm.	1-.5 mm.	.5- .25 mm.	.250- .125 mm.	.125- .062 mm.	Pan	Acid + Fines
				Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
SR-1	Strouse	3332-3342	Clinton	---	---	---	0.4	7.0	63.8	28.6	(v) 2*
SR-2	do	3382-3389	do	---	---	---	.3	17.5	53.5	21.7	6.9(v)
WO-1	Holfe	2961-2970	do	---	---	---	.3	18.8	64.0	16.9	(v) 2*
WO-2	do	2995-3004	do	---	---	tr.	.5	14.2	56.6	15.5	13.1(v)
YO-1	Yost	3100-3111	do	---	---	---	.1	30.7	52.9	6.8	9.6(v)
YO-2	do	3121-3131	do	---	---	tr.	1.8	43.2	41.0	6.2	7.8(v)

WELL SAMPLES --- PENNSYLVANIA

CD-1	Childs	1663-1680	Oriskany	---	tr.	13.7	63.1	15.1	.7	.1	7.6(v)
CD-2	do	1680-1695	do	---	.1	2.8	37.8	50.6	7.6	1.0	27.1(v)*
SY-19	Schmittau	714-725	Pottsville(GR)	tr.	.4	4.9	37.8	35.5	11.1	4.2	6.1(v)
SY-20	do	741-746	Loyalhanna(GR)	---	---	tr.	22.1	60.6	11.0	1.6	4.7(v)
SY-21	do	751-757	do	---	tr.	.3	20.6	54.7	14.8	3.6	5.9(v)

WELL SAMPLES --- NEW YORK

LN-1	Lynch	4715-4719	Oriskany	---	---	1.2	49.1	37.3	1.9	.3	10.2(v)
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WELL SAMPLES --- MICHIGAN

HR-1	Harris	242-250	Berea	---	.4	2.8	4.7	16.4	43.7	13.1	18.9(v)
HR-2	do	262-270	do	.1	.6	2.7	7.3	21.7	44.5	3.7	19.3(v)
HR-3	do	285-289	do	---	tr.	.7	7.5	31.0	41.2	10.0	9.5(m)

* Sample contaminated with limestone.

TABLE 2 — Names and locations of wells from which samples were analyzed.

Symbol	Well name	Company*	Township	County	Permit	Miles south of	Location
WEST VIRGINIA WELLS							
BA	Varr Tract No. 24	S. Penn.	Triadelphia	Logan	115	1.90	39°35' 3.14 80°30'
CS	G. W. Casto No. 1 (521)	W. Va. Gas	Union	Putman	272	0.50	38°40' 4.32 81°40'
FC	Federal Coal Co. No. 2 (1110)	Cabot	Jefferson	Nicholas	21	5.80	38°20' 1.87 81°05'
FI	A. M. Fitzgerald No. 1 (304)	C. and A.	Mead	Upshur	94	3.55	38°55' 4.45 80°10'
FL	General Fling No. 8978	Hope	Murphy	Ritchie	1059	2.98	39°05' 3.42 80°55'
GN	C. E. Guinn No. 1 (1115)	Cabot	Richmond	Raleigh	36	3.27	37°50' 4.62 80°50'
GR	D. S. Gribble No. 8517	Hope	Grant	Harrison	79	0.58	39°10' 4.28 80°15'
HD	A. & N. Hardman No. 1	S. Penn.	Sherman	Calhoun	794	0.77	38°50' 0.99 81°05'
HE	J. W. Heinzman No. 4053	UFG	Curtis	Roane	19	3.37	38°50' 0.25 81°30'
HU	O. C. & W. H. Hutchinson No. 1	Prunty	Salt Lick	Braxton	131	0.44	38°45' 3.00 80°35'
HT	Endress Hartmon No. 1	Potter	New Interest	Randolph	1	5.13	39°05' .03 79°50'
KR	Joseph Krenn No. 10	S. Penn.	Freemans Creek	Lewis	58	4.97	39°10' 0.08 80°40'
MS	D. Bruce Mason No. 2 (6129)	P. & W. Va.	Booths Creek	Taylor	17	2.94	39°25' 1.75 80°05'
MI	Lewis Maxwell No. 11F (GW-43)	Col. Carb.	West Union	Doddridge	71	3.83	39°20' 2.48 80°45'
OR	W. H. Orem No. 1 (1200)	New Penn.	Harris	Wood	72	0.02	39°05' 2.75 81°40'
PA	W. C. Patterson No. 1 (1523)	Carnegie	Burning Springs	Hirt	91	4.11	39°05' 2.91 81°15'
PK	Anna E. Parks No. 1 (6114)	P. & W. Va.	Southwest	Doddridge	98	5.40	39°15' 0.14 80°50'
PR	O. C. Parsons No. 1 (8586)	Hopo	Washington	Jackson	197	0.29	38°50' 4.02 81°35'
PT	Pratt-Tennant No. 3	S. Penn.	Clay	Monongalia	151D	2.19	39°40' 1.21 80°10'
RO	Nora V. Roberts No. 5963	Hope	Center	Gilmer	406	4.08	38°55' 1.41 80°55'
SN	M. J. Snodgrass No. 23	S. Penn	Smithfield	Roano	443	0.09	38°40' 2.38 81°10'
W	Mary C. Wingfield No. 1	B-T	Elk	Kanawha	155	1.12	38°25' 2.52 81°30'
WM	Woodal & Morton No. 1 (526)	W. Va. Gas	Grant	Cabell	428	4.77	38°30' 0.80 82°05'
WT	Fred Wilt No. 4	S. Penn.	Dekalb	Gilmer	653	1.80	39°00' 0.30 81°00'
WY	Ferguson-Wellman No. 1 (703)	O. L. O.	Union	Wayne	353	2.27	38°15' 0.42 82°25'

OHIO WELLS

AC	A. E. Archer No. 1 (7260)	OFG	L12 Huntington	Iorain		1.04	41°05' 3.42 82°10'
DA	David Davis Est. No. 1 (7636)	OFG	23 Jackson	Coshocton		1.22	40°15' 1.45 81°55'

* Full names of companies are at end of table.

Symbol	Well Name	Company	Township	County	Permit	Location	
						Miles south of	Miles west of
DO	W. D. Dodoz No. 1 (6245)	OFG	10 Paint	Wayne		2.79	40°45'
H	J. Ullman Heirs No. 1	Galley	21 Elk	Nobel		1.23	39°40'
HG	G. F. Houser No. 1 (6765)	OFG	28 Washington	Holmes		0.31	40°40'
HH	J. M. Horshberger (6261)	OFG	4 Berlin	Holmes		5.32	40°40'
LI	J. Lislo No. 1 (6716)	OFG	35 Mohican	Ashland		1.50	40°45'
MO	T. H. Mobley No. 1	Nat. Gas	19 Smith	Belmont		3.35	40°00'
ND	Phillip Neidort (6263)	OFG	5 Jackson	Stark		0.68	40°55'
SE	B. C. Steele No. 2 (L. D. Hall) (6683)	OFG	22 Jackson	Ashland		4.10	41°00'
SK	John T. Stockart No. 2 (6399)	OFG	17 Jackson	Stark		2.61	40°55'
SM	G. Smith No. 1	Col. Carb.	9 Franklin	Tuscarawas		2.55	40°40'
SR	T. W. Strouse (6263)	OFG	131 Monroe	Holmes		3.23	40°35'
WO	A. T. Wolfe No. 3 (8100)	OFG	24 Butler	Knox		1.53	40°25'
YO	C. R. Yost No. 2 (6565)	OFG	13 Congress	Wayne		3.10	41°00'
PENNSYLVANIA WELLS							
CD	Jay Childs No. 1	Ohio Oil	Springfield	Erie		2.35	42°00'
SY	Georgo Schmittau	Galley	Hampton	Allegheny		4.26	40°40'
NEW YORK WELLS							
LN	Lynch No. 1	BQDC	Steuben	Hartsville		2.13	42°15'
MICHIGAN WELLS							
HR	Harris No. 1	Alpha	Howell	Livingston		2.90	42°40'

0.20 83°55'

3.82 77°35'

0.92 80°30'

0.78 79°55'

*Alpha	Alpha Oil Co.	New Penn.	New Penn Development Co.
B-T	Benedum-Trees Oil Co.	OTG	Ohio Fuel Gas Co.
BQDC	Belmont Quadrangle Drilling Co.	Ohio Oil	Ohio Oil Co.
Cabot	Godfrey L. Cabot, Inc.	O. L. O.	Owens, Libbey-Owens Gas Dept.
Carnegie	Carnegie Natural Gas Co.	P. & W. Va.	Pittsburgh & West Virginia Gas Co.
Col. Carb.	Columbian Carbon Co.	Potter	Pottor Development Co., W. E. Sneo, et al.
C. & A.	Cumberland & Alleghony Gas Co.	Prunty	A. D. Prunty
Galoy	John T. Galoy	S. Penn.	South Penn Natural Gas Co.
Hopo	Hopo Natural Gas Co.	W. Va. Gas	West Virginia Gas Corp.
Nat. Gas	Natural Gas Co. of W. Va.	U. F. G.	United Fuel Gas Co.