

STATE OF OHIO
Frank J. Lausche, Governor
DEPARTMENT OF NATURAL RESOURCES
A. W. Marion, Director
DIVISION OF GEOLOGICAL SURVEY
John H. Melvin, Chief

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REPORT OF INVESTIGATIONS NO. 11

ADDITIONAL ANALYSES
OF
BRINES FROM OHIO

By
Raymond E. Lamborn

COLUMBUS
1952

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INTRODUCTION

In 1932 the Geological Survey of Ohio published Bulletin 37 entitled "Brines of Ohio." This publication contains the analyses of 82 samples of brine collected either by the Geological Survey of Ohio or by the U. S. Geological Survey from various brine horizons penetrated in deep wells drilled in Ohio. Since 1932 a number of brine samples have been collected by the Ohio Survey or have been submitted to the Survey for analysis by representatives of various oil and gas companies. Some of these samples were analyzed by Downs Schaaf, former chemist for the Survey but now deceased, and by William Buckingham, chemist, The Engineering Experiment Station, The Ohio State University. Analyses of other of these samples were supplied the Survey by courtesy of the Dow Chemical Company, Midland, Michigan. Two analyses came from the Cleveland Electric Illuminating Company, Cleveland, Ohio, through Mr. Robert M. Atkins of the Development Department, and Mrs. A. H. Lawhead, geologist, who collected the samples.

In view of the continued interest in brines and brine horizons, it seems advisable to incorporate some recent unpublished analyses in a short publication for ready distribution. The present paper entitled "Additional Analyses of Brines of Ohio" includes the analyses of 42 samples collected during the past 19 years from 34 different wells. These wells are located chiefly in the western three-fifths of the State as shown on the map. The brine horizons represented by these samples range in stratigraphic position from the deep Sub-Trenton series penetrated in comparatively few wells to the First Water of the Big Lime. In the data presented here for each sample the analysis is accompanied by a log of the well, to better show the water horizons, depth, stratigraphic succession, and casing practice. It is believed that the data included in these pages is a worth while addition to published information concerning brines in Ohio.

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ANALYSES OF DEEP SUB-TRENTON BRINES

Sample No. 251, 248

Brine from the S. V. Kraus No. 1 well, by Ohio Oil Company, Lot 14, Ruggles Township, Ashland County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample No. 251 from a deep Sub-Trenton water horizon.

Depth, 5,041 - 5,048 feet.

Sample No. 248 from a deep Sub-Trenton water horizon.

Depth, 5,141 - 5,151 feet

Sample No. 251: Specific gravity 1.2158 at 20° C. Degrees Bé, 25.74.

Sample No. 248: Specific gravity 1.0985 at 20° C. Degrees Bé, 13.00.

Composition of Saline Water

	No. <u>251</u>	No. <u>248</u>
* CaCl ₂	8.44	4.34
MgCl ₂	1.66	0.80
NaCl.....	26.10	12.60
CaCl ₂ , MgCl ₂ Ratio.....	5.08	5.43
KCl.....	0.50	0.29
** I.....	11	7
Br	0.1437	0.0693
SrCl ₂	0.16	---

Composition of Saline Water

(Calculated by R. E. Lamborn)

	No. <u>251</u>	No. <u>248</u>
Ca.....	8.233	8.656
Mg	1.134	1.128
Na.....	27.747	27.385
K	0.708	0.842
Sr.....	0.238	---
Cl.....	61.547	61.605
Br.....	0.3883	0.3828
I.....	0.0029	0.0003
	<u>99.9982</u>	<u>99.9991</u>

* Not corrected for SrCl₂ .

** In parts per million.

BRINES OF OHIO

Total dissolved solids	{	Grams per kilogram	370.048	181,000
		Grams per liter	449.904	198.828

Drillers Record

Well-head elevation, 1,114 feet
Well completed, March 29, 1945

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Blue shale	0	416	
<u>Berea sand</u>	416	462	
Redrock	462	472	
Blue shale	472	477	
Redrock	477	483	
Shell	483	495	
Redrock	495	549	
Shale	549	1,252	
<u>Big Lime</u>	1,252	2,285	
First Water	1,483		
Second Water	2,120	2,305	
<u>Little Lime</u>	2,305	2,316	
Red lime	2,316	2,318	
Blue shale	2,318	2,325	
Lime and shale	2,325	2,338	
Blue shale	2,338	2,356	
Green shale	2,356	2,385	
Blue shale	2,385	2,462	
Shelly	2,462	2,490	
Redrock	2,490	2,722	<u>Red Medina shale</u>
Shale	2,722	3,537	
Brown shale and lime shell	3,537	3,573	
Brown shale	3,573	3,750	
<u>Trenton</u>	3,750	4,397	
Green sand	4,397	4,416	
<u>St. Peter</u>	4,416		
Show of gas	4,414	4,420	90,000 cu. ft.
Sand and lime	4,420	4,456	
Gas increased	4,421	4,424	210,000 cu. ft.
Sand and dolomite	4,456	4,683	
Water	4,683		Hole full
Sand with traces of dolomite	4,683	5,251	
Water	5,041		Hole full, sampled
Water	5,120		Hole full, sampled
Total depth		5,251	

Casing Record

Casing, 14-inch	65 feet
Casing, 10 $\frac{3}{4}$ -inch	267 feet
Casing, 8 5/8-inch	1,568 feet
Casing, 7-inch	3,786 $\frac{1}{2}$ feet
Casing, 5 $\frac{1}{2}$ -inch	4,819 $\frac{1}{4}$ feet

Sample No. 271

Brine from the Franz-Eichenberg Unit No. 1 well, by Benedum-Trees Oil Company, Lot 20, Mayfield Township, Cuyahoga County. The sample was submitted to the Survey by Benedum-Trees Oil Company and was analyzed by William Buckingham, chemist, Engineering Experiment Station.

Sample from a Deep Sub-Trenton water horizon. Depth, 5,815 - 5,823 feet

Specific gravity, 1.2239 at 15° C. / 15° C.

Composition of Saline Matter

Cl.....	62.70
Br.....	0.05
I.....	<0.01
SO ₄	0.05
CO ₃	none
HCO ₃	0.17
SiO ₂	none
Na.....	19.29
K.....	0.93
Ca.....	14.56
Mg.....	2.18
(Al. Fe) ₂ O ₃	0.04
SrO.....	<0.01
Ba.....	none
Mn.....	0.01
	<u>99.97</u>

Total dissolved solids { 302.09 grams per kilogram
369.72 grams per liter

Drillers Record

Well-head elevation, 1,017 feet
Well completed, August 13, 1949

BRINES OF OHIO

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Shale	0	1,526	
<u>Big Lime</u>	1,526	3,112	Show gas, 1,685-1,695 feet
<u>Oriskany sand, broken</u>	1,870	1,905	Water at 1,892 feet
Lime	1,905	2,168	
Lime and salt	2,168	2,571	
Lime	2,571	2,750	
<u>Newburg</u>	2,750	2,765	Gas, 200,000 cu. feet
Lime	2,765	3,112	Water at 2,865 feet
Shale	3,112	3,180	
Red rock	3,180	3,190	
Shale	3,190	3,200	
Broken lime	3,200	3,228	
Sandy lime, <u>Clinton</u>	3,228	3,266	
Broken lime	3,266	3,280	
Sandy lime, <u>Clinton</u>	3,280	3,290	
Shale and shells	3,290	3,375	
<u>Red Medina</u>	3,375	3,840	Show gas, 3,382-3,393 feet
Coving shale	3,840	4,980	
<u>Trenton lime</u>	4,980	5,690	
Lime	5,690	5,692	100,000 cu. ft. gas.
Lime	5,692	5,701	Show of oil
Lime	5,701	5,710	Show of green oil
Lime	5,710	5,715	300 feet of oil in hole
Lime	5,715	5,763	1,100 feet of oil in hole
Brown sandy lime	5,763	5,765	Show of brown oil
Light sandy lime	5,765	5,823	
Water	5,815	5,823	4,000 feet in hole.
Total		5,823	Samples

Casing Record

Casing, 10-inch	80 feet
Casing, 8 $\frac{1}{4}$ -inch	2,058 feet
Casing, 6 $\frac{5}{8}$ -inch	3,211 feet
Casing, 5 $\frac{1}{2}$ -inch	5,350 feet

Samples No. 62, 63

Brines from the Herman E. Vance No. 1 well*, by Chester Wise et. al., Lot 11, Section 3, Orange Township, Delaware County. The samples were collected by Wilber Stout for the Survey and were analyzed by Downs Schaaf, chemist.

Sample No. 62, from "blue lick" water horizon. Depth 2,738 - 2,760 feet.

Sample No. 63, from a deep Sub-Trenton water horizon. Depth 3,820 - 3,825 feet, sampled when drill was at depth of 3,860 feet.

Sample No. 62, Specific gravity, 1.05 at 15° C.

Sample No. 63, Specific gravity, 1.15 at 15° C.

Composition of Saline Matter

	No. 62	No. 63
Cl	61.86	61.96
Br	0.38	0.33
SO ₄	0.70**	0.27
CO ₃	0.03	none
HCO ₃	0.07	0.01
Na.	26.59	21.97
K.	0.55	0.83
Ca	6.15	12.24
Sr	0.28	0.50
Mg.	3.29	1.83
(Al. Fe) ₂ O ₃	0.06	0.04
SiO ₂	0.04	0.02
	<u>100.00</u>	<u>100.00</u>
Total dissolved solids	grams per kilogram	71.5 180.0
	grams per liter	75.7 206.88

Record

(From sample study by Wilber Stout and Carl A. Lamey, modified)

Well-head elevation, 920 feet
Well completed, May 15, 1937

* See Stout, Wilber and Lamey, C. A., Paleozoic and pre-Cambrian rocks of Vance Well, Delaware Co., Ohio, Am. Assoc. Pet. Geol., Vol. 24, pp. 672-692, 1940.

** Sample as received contained 60 parts per million of H S.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Shale, brown to black, fissile. <u>Ohio</u> shale	0	126	Fresh water at 100 ft.
Shale, gray, soft, calcareous, <u>Olentangy</u> shale	126	150	
Limestone, dark, hard, <u>Delaware</u>	150	188	
Limestone, light, hard, medium to heavy bedded, <u>Columbus</u>	188	280	Water at 280 ft.
Dolomite, dark gray to brown, thin-bedded, <u>Monroe</u>	280	690	
Dolomite, gray to bluish gray, soft to medium hard, <u>Niagara</u>	690	830	
Shale, light, calcareous, some dolomite, <u>Alger</u>	830	880	
Dolomite, with some calcareous shale, <u>Dayton</u>	880	905	
Shale, calcareous, with some dolomite	905	940	
Dolomite, limy, with some calcareous shale, <u>Brassfield</u>	940	980	
Shale, calcareous, with some limestone	980	1,005	
Shale, reddish brown, fine-grained	1,005	1,060	Red Medina of driller
Shale, dark gray, with thin limestones, <u>Richmond</u> and <u>Maysville</u>	1,060	1,650	
Shale, dark gray, with some nodular limestone, <u>Eden</u>	1,650	1,930	
Shale to shaly limestone, dark to brownish, <u>Utica</u>	1,930	2,100	
Limestone, light to dark, parts shaly, <u>Trenton</u>	2,100	2,250	
Limestone, dark, with some green shale at base, <u>Black River</u>	2,250	2,679	
Dolomite, generally light, siliceous, granular, with three beds of fine-grained dolomitic sandstone.	2,679	3,450	
Water	2,738	2,760	Sample No. 62

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Sandstone, light, hard, <u>Jordan</u>	3,450	3,510	
Water	3,450	3,455	With gas bubbles
Dolomite, gray, sandy, with 2 streaks of hard, pure sandstone	3,510	3,710	
Sandstone, hard, very pure, <u>Dresbach</u>	3,710	3,845	
Water	3,775	3,786	
Water	3,820	3,825	Sample No. 63 taken at depth 3,860 feet.
Crystalline rock, chiefly gneiss	3,845	4,291	
Total		4,291	

Casing Record

Casing, 10-inch	30 feet
Casing, 8-inch	830 feet
Casing, 6½-inch	2,782 feet

Sample No. 224

Brine from the Armintrout No. 1 well, by the Pico Oil Company, Section 16, Scioto Township, Pike County. A sample of brine from this well was collected by a representative of the Dow Chemical Company and was analyzed in their laboratories at Midland, Michigan. Analysis by courtesy of the Dow Chemical Company.

Sample from a deep Sub-Trenton water horizon. Depth of hole at sampling, 3,150 feet.

Specific gravity, 1.1290 at 20° C. Degrees Bé, 16.57

Composition of Saline Water

CaCl ₂	4.28
MgCl ₂	1.74
NaCl	9.43
KCl	0.37
Br	0.0817

Composition of Saline Water
(Calculated by R. E. Lamborn)

Ca	9.716
----------	-------

Mg.....	2.794
Na.....	23.329
K.....	1.220
Cl.....	62.427
Br.....	0.5137
	<u>99.9997</u>

Total dissolved solids { 159.017 grams per kilogram
 { 179.530 grams per liter

Drillers Record

Well-head elevation, 682 feet

Well completed, — 1949

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Soil	0	40	
Slate	40	100	
Shale, black	100	110	
<u>Berea sand</u>	110	160	
Slate and shell	160	250	
Shale, brown	250	605	Gas at 450 feet
Shale, white	605	695	
<u>Big Lime</u>	695	1,092	
Water	790		
Gas show	880	890	
Gas show	1,070	1,080	
Shale	1,092	1,115	
Red rock	1,115	1,154	
Green shale	1,154	1,157	
Red slate	1,157	1,214	
Green slate	1,214	1,243	
Blue slate and shell	1,243	1,248	
Brown, red, and green shale	1,248	1,256	
Gray shell	1,256	1,264	
Blue slate	1,264	1,320	
Slate and shells	1,320	1,350	
Red slate	1,350	1,390	
Brown shale	1,390	1,425	
White shale	1,425	1,545	
White slate and shells	1,545	1,565	
Slate and shells	1,565	1,655	
Blue clay	1,705	1,720	
Slate and shells	1,720	1,755	
Shells	1,755	1,785	
Slate	1,785	1,810	
Slate and shells	1,810	1,870	

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Slate, white	1,870	2,030	
Gray shells	2,030	2,060	
Gray slate and shell	2,060	2,100	
Black slate and shell	2,100	2,175	
White slate	2,175	2,195	
Shells and slate	2,195	2,210	
Sand	2,210	2,215	
Slate and shells	2,215	2,290	
Brown lime	2,290	2,320	
Gray lime	2,320	2,380	
Dark gray lime	2,380	2,420	
Lime, brown and gray	2,430	2,490	
Gray lime	2,490	2,500	
Lime, brownish	2,500	2,525	
Lime, light gray	2,525	2,610	
Lime, dark gray, hard	2,610	2,810	
Brown lime, fine, hard	2,810	2,850	
Gray lime, medium	2,850	2,910	
Dark gray lime	2,910	2,935	
White lime	2,935	2,970	
Light gray lime, some green slate, flaky	2,970	2,989	
Green shale, flaky	2,989	2,997	
Green shale, some lime	2,997	3,013	
Sand, water	3,013	3,020	"Blue lick" water,
Dolomite and shale	3,020	3,088	filled 1,100 feet in
Sand	3,088	3,122	12 hours.
Sand and dolomite	3,122	3,429	
Total		3,429	

Casing Record

Casing, 6 5/8-inch 1,245 feet

Samples No. 233, 234, 235, 236

Brines from R. Babst No. 1 well, by Frank Stahler et. al., Waverly, Ohio, Section 35, Beaver Township, Pike County. The samples were submitted to the Survey by Mr. Frank Stahler and were analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample No. 233, from a deep Sub-Trenton water horizon.
Depth 3,885 feet.

Sample No. 234, from a deep Sub-Trenton water horizon.
Depth 3,565 feet.

Sample No. 235, from a deep Sub-Trenton water horizon.
Depth 4,051 feet.

Sample No. 236, from a deep Sub-Trenton water horizon.
Depth 4,186 feet.

Sample No. 233. Specific gravity, 1.1813 at 20° C.
Degrees Bé, 22.25.

Sample No. 234. Specific gravity, 1.1510 at 20° C.
Degrees Bé, 19.02.

Sample No. 235. Specific gravity, 1.659 at 20° C.
Degrees Bé, 20.63.

Sample No. 236. Specific gravity, 1.1893 at 20° C.
Degrees Bé, 23.08.

Composition of Saline Waters

	No. <u>233</u>	No. <u>234</u>	No. <u>235</u>	No. <u>236</u>
CaCl ₂	7.17	5.23	5.52	7.90
MgCl ₂	2.24	1.84	2.39	2.48
CaCl ₂ , MgCl ratio	3.20	2.84	2.31	3.18
NaCl	12.00	11.20	12.00	11.70
KCl	0.54	0.40	0.45	0.56
* Br	0.1277	0.1007	0.1126	0.1372
I	0.0012	0.0009	0.0013	0.0013

Composition of Saline Matter

(Calculated by R. E. Lamborn)

	No. <u>233</u>	No. <u>234</u>	No. <u>235</u>	No. <u>236</u>	
Ca	11.724	10.058	9.733	12.521	
Mg	2.590	2.502	2.969	2.780	
Na	21.382	23.471	23.057	20.206	
K	1.283	1.117	1.152	1.289	
Cl	62.437	62.310	62.532	62.595	
Br	0.5783	0.5364	0.5504	0.6023	
I	0.0054	0.0047	0.0063	0.0057	
	<u>99.9997</u>	<u>99.9991</u>	<u>99.9997</u>	<u>99.9990</u>	
Total Dissolved Solids	Grams per kilogram	220.789	187.716	204.739	227.786
	Grams per liter	260.819	216.06	238.705	270.906

Record

(From driller's record and sample study by R. E. Lamborn)

Well-head elevation, 690 feet (Approx.)

Well completed, June 14, 1950

* Bromine corrected for iodine.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Soil and surface	0	15	
Blue mud	15	227	
Sand	227	235	Gas show at 227 feet
Shale	235	357	
Coffee slate	357	385	
<u>Berea sand</u>	385	434	
Blue shale	434	500	
Shale	500	1,065	
<u>Big Lime</u>	1,065	1,505	
Water	1,165		Filled to 100 ft. at sur- face
Blue shale	1,505	1,529	
Pink rock	1,529	1,625	
Green shale	1,625	1,664	
Red rock	1,664	1,680	
Lime and shale	1,680	1,682	
Green shale	1,682	1,738	
Red rock	1,738	1,743	
Shells	1,743	1,792	
Red rock	1,792	1,830	
Shale	1,830	2,760	
Shale with some limestone	2,760	2,846	
<u>Trenton limestone</u>	2,846	3,423	
Dolomite, gray, crystalline, sandy at bottom	3,423	3,560	Gas show 3,500-3,511 ft.
Sand	3,560	3,577	
Water	3,565		Filled to 500 ft. of sur- face. Sampled
Green shale	3,577	3,589	
Sand	3,589	3,603	
Sand and dolomite	3,603	3,756	
Dolomite with some sand	3,756	4,227	
Water	3,885		Filled to 500 feet of sur- face. Sampled
Water	4,050		Sampled
Water	4,186		Sampled
Total depth		4,227	

Casing Record

Casing, 13-inch	22 feet
Casing, 8 $\frac{1}{4}$ -inch	1,466 feet
Casing, 6 $\frac{1}{4}$ -inch	1,776 feet
Casing, 5 3/16-inch	3,867 feet

Sample No. 257

Brine from the Louis Barlage No. 1 well, by the Ohio Oil Company, Section 29, Liberty Township, Putnam County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed in Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample No. 257 from a deep Sub-Trenton water horizon.
Depth at sampling, 3,054 feet.

Sample No. 257, Specific gravity, 1.0942 at 20° C.
Degrees Bé, 12.48.

Composition of Saline Water

CaCl ₂	2.77
MgCl ₂	0.96
NaCl.....	12.00
CaCl ₂ , MgCl ₂ ratio.....	2.89
KCl.....	0.35
* I.....	6
Br.....	0.0453
SrCl ₂	----

Composition of Saline Matter
(Calculated by R. E. Lamborn)

Ca.....	6.201
Mg.....	1.520
Na.....	29.274
K.....	1.137
Cl.....	61.582
Br.....	0.2809
I.....	0.0037
	<hr/>
	99.9986

Total dissolved solids	{	Grams per kilogram	161.259
		Grams per liter	176.164

Record

Well-head elevation, 740 feet
Well completed, March 21, 1944

* Expressed in parts per million.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	55	
<u>Big Lime</u>	55	685	
Shale	685	1, 433	
<u>Trenton limestone and dolomite</u>	1, 433	2, 025	
Oil show	1, 454	1, 460	
Water	1, 477	1, 483	
Dolomite, white and green, impure (<u>St. Peter horizon</u>)	2, 025	2, 070	
Dolomite and sand	2, 070	3, 250	
Water	2, 098	2, 108	Hole full
Water	2, 422	2, 444	Hole full
Water	2, 733	2, 744	Hole full
Granite wash.	3, 250	3, 377	
Total depth		3, 377	

Casing Record

Casing, 10 $\frac{3}{4}$ -inch	56 feet
Casing, 8 5/8-inch	750 feet
Casing, 6 5/8-inch	1, 670 feet
Casing, 5 3/16-inch	2, 414 feet
Casing, 5 3/16-inch reset	2, 677 feet

Sample No. 252

Brine from the Harry Bishop No. 1 well, by the Ohio Oil Company. Section 13, Scipio Township, Seneca County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan by courtesy of the Dow Chemical Company.

Sample from a deep Sub-Trenton water horizon.
Depth, bottom of hole.

Specific gravity, 1.2119 at 20^o C. Degrees Be', 25.35

Composition of Saline Water

* CaCl ₂	9.78
MgCl ₂	2.69
NaCl.	25.60
CaCl ₂ , MgCl ₂ ratio	3.64
K	

* Not corrected for SrCl₂ .

BRINES OF OHIO

KCl.....	0.62
* I.....	15
Br.....	0.1402
SrCl ₂	0.11

Composition of Saline Matter
(Calculated by R. E. Lamborn)

Ca.....	9.067
Mg.....	1.770
Na.....	25.862
K.....	0.835
Sr.....	0.156
Cl.....	61.971
Br.....	0.3343
I.....	0.0038
	99.9991

Total dissolved solids	{	Grams per kilogram	389.417
		Grams per liter	471.934

Drillers Record

Well-head elevation, 908 feet
Well completed, September 5, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Drift	0	47	
<u>Big Lime</u>	47	900	
Water	110		
Shale	900	999	
<u>Clinton, broken</u>	999	1,020	
Shale	1,020	1,036	
Red rock	1,036	1,100	
Lime and shale	1,100	1,725	
Brown shale	1,725	2,056	
<u>Trenton lime</u>	2,056	2,636	
Show of oil and gas	2,050	2,072	
Green shale and lime	2,072	2,680	
Show of oil and gas	2,672	2,680	
Lime and sand	2,680	3,123	
Water	2,692		
Water	2,734		
Water	2,833	2,839	Hole full
Total		3,123	

* Expressed in parts per million.

Casing Record

Casing, 10-inch	52 feet
Casing, 8 5/8-inch	900 feet
Casing, 6 5/8-inch	2,821 feet
Casing, 5½-inch	3,042 feet

Sample No. 250

Brine from the Nora Heck No. 1 well, by the Ohio Oil Company, Section 18, Crawford Township, Wyandot County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample from a deep Sub-Trenton water horizon. Depth at sampling, 2,750 feet. The sample was taken after bailing the hole for 3 hours.

Specific gravity, 1.0507 at 20° C. Degrees Bé., 7.00.

Composition of Saline Water

CaCl ₂	1.45
MgCl ₂	0.55
NaCl	6.50
CaCl ₂ , MgCl ₂ , ratio.....	2.64
KCl.....	0.22
* I.....	4
Br	0.0226
SrCl ₂	----

Composition of Saline Matter

(Calculated by R. E. Lamborn)

Ca	5.987
Mg.....	1.606
Na	29.247
K	1.321
Cl.....	61.576
Br	0.2584
I	0.0045
	<hr/>
	99.9999

* Expressed in parts per million.

Total dissolved solids	{	Grams per kilogram	87.43
		Grams per liter	91.863

Drillers Record

Well-head elevation, 860 feet

Well completed, May 15, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Loam	0	1	
Lime	1	235	Water at 45 feet
Green shale	236	250	
<u>Shell</u>	250	260	
Green shale	260	350	
Red rock	350	370	
White shale	370	985	
Brown shale	985	1,321	
<u>Trenton lime</u>	1,321	1,890	
Show gas	1,329	1,335	
Green shale	1,890	1,920	
Sand	1,920	1,932	
Water	1,928	1,932	Three bailer per hr.
Sand	1,934	1,953	
Lime	1,953	2,140	
Water	1,975		Hole full
Sand	2,140	2,196	
Lime	2,196	2,274	
Green slate	2,274	2,276	
Lime	2,276	2,300	
Red rock	2,300	2,302	
Lime	2,302	2,582	
Sand	2,582	2,801	
Total		2,801	

Casing Record

Casing, 10 $\frac{3}{4}$ -inch	10 $\frac{1}{2}$ feet
Casing, 8 $\frac{1}{4}$ -inch	375 feet
Casing, 6 $\frac{5}{8}$ -inch	2,035 feet
Casing, 5 $\frac{1}{2}$ -inch	2,433 feet

ANALYSES OF BRINES
FROM "BLUE LICK" WATER HORIZON

Sample No. 60

Brine from the Emmet Brown No. 1 well, by the City Natural Gas Company, Lancaster, Ohio, Section 30, Amanda Township, Fairfield County. The sample was taken by R. L. Alkire et. al., Division of Geological Survey on May 17, 1951 and was analyzed by William Buckingham, chemist, Engineering Experiment Station.

Sample from the "blue lick" water horizon. Depth, 3,263 feet.

Specific gravity, 1.089 at 20° C. / 4° C.

Composition of Saline Matter

Cl.....	61.64
Br	0.45
I	0.01
SO ₄	0.02
CO ₃	0.00
H. CO ₃	0.09
SiO ₂	0.01
Na.....	26.65
K.....	1.20
Ca	7.33
Mg.....	2.30
(Al. Fe) ₂ O ₃	0.02
Sr.....	0.25
	99.97

Total dissolved solids	{	Grams per kilogram	125.922
		Grams per liter	137.13

Drillers Record

Well-head elevation, 920 feet (Approx.)
Well completed, May 1, 1951

BRINES OF OHIO

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	90	Water at 10 feet
Shale	90	128	Artesian water at 50 feet
<u>Berea sand</u>	128	132	
Shale	132	770	Show of gas at 495 feet
<u>Big Lime</u>	770	1,300	
Water	805		
Shale	1,300	2,637	
<u>Trenton lime</u>	2,637	3,263	
Water, show of oil	3,263		Water rose 600 feet
Total		3,263	

Casing Record

Casing, 10-inch	128 feet
Casing, 8-inch	165 feet
Casing, 6 3/8-inch	1,398 feet

Sample No. 68

Brine from the Archie Peterson No. 1 well, by Singleton and Williams and the Sun Oil Company, Section 19, Miami Township, Greene County. The sample was submitted to the Survey by Mr. George D. Lindberg of the Sun Oil Company and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth,
1,843 - 1,846 feet.

Composition of Saline Matter

Cl	51.92
Br	0.20
SO ₄	10.81
CO ₃	none
HCO ₃	0.40
Na.	30.01
K.	0.44
Ca.	3.98
Sr	trace
Mg.	2.19
(Al. Fe) ₂ O ₃	0.025
SiO	0.025
	<hr/>
	100.00

Total dissolved solids, 35 grams per kilogram

Record

(From driller's record and sample study by
George D. Lindberg, condensed)

Well-head elevation, 1,020 feet (Approx.)
Well completed, February 2, 1938

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	14	
Dolomite, <u>Niagara</u>	14	?	
Dolomite, blue gray, shaly, <u>Rochester</u> ?	?	35	
Limestone, <u>Brassfield-Dayton</u>	---	150	
Shale, <u>Cincinnati</u>	150	1,040	
Shale, black, and shaly limestone, <u>Utica</u>	1,040	1,198	
Limestone, some dolomitic, <u>Trenton</u>	1,198	1,689	
Shale, greenish, and buff dolomite, <u>St. Peter</u> horizon	1,689	1,720	
Dolomite, <u>Calciferous</u> or <u>Lower Magnesian</u>	1,689	1,846	
*Water sand, "blue lick" water	1,843	1,846	Sampled

Casing Record

Casing, 10-inch 18 feet
Casing 8-inch 180 feet

Sample No. 65

Brine from the John Heimhofer No. 1 well, by the Sun Oil Company, Section 32, Allen Township, Hancock County. The sample was submitted to the Survey by the Sun Oil Company and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth 1,853 feet.

Composition of Saline Matter

Cl	57.83
Br	0.17
SO ₄	4.50

* Six hundred feet of water in hole.

CO ₃	none
HCO ₃	0.36
Na.	29.48
K.	0.60
Ca.	4.84
Sr.	trace
Mg.	2.17
(Al. Fe) ₂ O ₃	0.025
SiO ₂	0.025
	100.00

Total dissolved solids, 41 grams per kilogram.

Record

(From sample study by George D. Lindberg, condensed)

Well-head elevation, 821.5 feet

Well completed, December 22, 1937

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	95	
Dolomite, <u>Niagara</u>	95	225	
Shale, <u>Rochester</u>	230	255	
Limestone, <u>Brassfield-</u> <u>Dayton</u>	255	330	Show of oil and gas,
Shale, <u>Medina</u>	330	410	255-260 feet
Limestone and shale, <u>Cincinnati</u>	410	925	
Shale, <u>Utica</u>	925	1,156	
Limestone and dolomite, <u>Trenton</u>	1,156	1,845	8,285 cu. ft. gas at
Shale, green, and buff dolomite, <u>St. Peter</u> horizon	1,845	1,850	1,252½ feet
Dolomite, <u>Calciferous</u>	1,850	1,875	
*Water, "blue lick"	1,850	1,875	Sampled
Total		1,875	

Casing Record

Casing, 8¼-inch	88 feet
Casing, 6 5/8-inch	416 feet

* Nine hundred feet of water in hole on April 7, 1938.

Sample No. 64

Brine from Charles Heininger No. 1 well, by Sun Oil Company, Section 14, Big Lick Township, Hancock County. The sample was submitted to the Survey by the Sun Oil Company and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth
1,975 - 2,030 feet.

Composition of Saline Matter

Cl.	56.10
Br	0.15
*SO ₄	5.23
CO ₃	none
H. CO ₃	0.99
Na.	31.07
K.	1.04
Ca	3.66
Sr.	trace
Mg	1.71
(Al. Fe) ₂ O ₃	0.025
SiO ₂	0.025
	100.00

Total dissolved solids, 38 grams per kilogram

Drillers Record

Well-head elevation, 865 feet

Well completed, October 14, 1937

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Gravel and mud	0	90	
Limestone	90	312	
Green shale	312	362	
Lime shells	362	381	
Lime, hard	381	423	
Pink shale	423	495	
Gray shale	495	705	
Lime shells	705	717	
Gray shale	717	1,007	
Brown shale	1,007	1,327	
Trenton limestone	1,327	1,955	
Green shale	1,955	1,975	
<u>St. Peter</u>	1,975	2,030	Hole full of water
Total depth		2,030	

* The sample as received contained 60 parts per million of H₂ S.

Casing Record

Casing, 14-inch 94 feet
 Casing, 10-inch 369 feet

Sample No. 247

Brine from the Bessie and Floyd Sims No. 1 well, drilled by Metzgar et. al., Section 23, Bearfield Township, Perry County. The sample was collected by R. L. Alkire of the Geological Survey and was analyzed at Midland, Michigan by courtesy of the Dow Chemical Company.

Sample from "blue lick" water horizon. Depth,
 6,058 - 6,100 feet.

Specific gravity, 1.2273 at 20° C. Degrees Bé, 26.83.

Composition of Saline Water

CaCl ₂	11.22
MgCl ₂	2.34
NaCl	10.80
CaCl ₂ , MgCl ₂ , ratio	4.80
Br	0.1812
SrCl ₂	0.26

Composition of Saline Matter

(Calculated by R. E. Lamborn)

Ca	16.332
Mg	2.409
Na	17.131
Sr	0.579
Cl	62.818
Br	0.7306
	<hr/>
	99.9996

Total dissolved solids	{	Grams per kilogram	248.012
		Grams per liter	304.385

Drillers Record

Well-head elevation, 885 feet
 Well completed, October 12, 1948

ANALYSES OF "BLUE LICK" BRINES

25

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Shale	0	55	
Red rock	55	65	
Green shales	65	85	
Sand	85	110	
Gray shale	110	120	
Sandy shale	120	184	
Coal	184	187	
Shale	187	220	
Coal	220	223	
Shale	223	255	
Shell	255	265	
Shale	265	295	
Shell	295	300	
Shale	300	428	
<u>Jingle rock</u>	428	445	
Shale	445	625	
<u>Big Injun</u>	625	672	
Shale	672	795	
Shell	795	800	
Shale and shells	800	1,095	
Brown shale	1,095	1,120	
<u>Berea grit</u>	1,120	1,140	
Red rock	1,140	1,170	
Blue shale	1,170	1,180	
Black shale	1,180	1,205	
Shale	1,205	2,055	
Brown shale	2,055	2,380	
Gray shale	2,380	2,545	
Black shale	2,545	2,650	
<u>Niagara Lime</u>	2,649	3,597	
Water	3,360		
Shale	3,597		
<u>Big Shell</u>	3,780	3,795	
<u>Clinton sand</u>	3,804	3,845	
<u>Medina sand</u>	3,922	3,928	
Red rock	3,928	4,170	
Gray shale	4,170	4,325	
Shelly shale	4,325	4,660	
Gray shale	4,660	4,980	
Black shale	4,980	5,000	
Gray shale	5,000	5,075	
Black shale	5,075	5,152	
Brown shale	5,152	5,209	
<u>Trenton</u>	5,209	5,913	
<u>St. Peter</u>	6,058	6,100	Water. Sampled
Total		6,100	

Casing Record

Casing, 10-inch 251 feet
 Casing, 5 3/16-inch 3, 637 feet

Sample No. 66

Brine from the W. D. Williams No. 5 well, by the Norton Stewart Petroleum Corporation, Section 22, Blanchard Township, Putnam County. The sample was submitted to the Survey by George D. Lindberg of the Sun Oil Company and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth,
 2,002 - 2,004 feet.

Composition of Saline Matter

Cl.....	56.71
Br	0.18
SO ₄	4.90
CO ₃	none
HCO ₃	0.33
Na	29.20
K.....	0.61
Ca.....	5.70
Sr	trace
Mg	2.32
(Al. Fe) ₂ O ₃	0.025
SiO ₂	0.025
	<hr/>
	100.00

Total dissolved solids, 42 grams per kilogram

Record

(From driller's record and sample study
 by George D. Lindberg, condensed)

Well-head elevation, 766 feet
 Well completed, 1937 ?

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	40	
<u>Niagara, Rochester, and</u> <u>Clinton</u> beds	40	530	
<u>Medina, Hudson River, and</u> <u>Utica</u> shales	530	1, 340	

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Limestone, with thin streaks of dolomitic limestone and dolomite, <u>Trenton</u>	1,340	1,991	Slight oil saturation at 1,545-1,550 feet; 1,630-1,635 feet; 1,898-1,703 feet; 1,935-1,939 feet.
Some water	1,962	1,991	
Shale, green, and dolomite, <u>St. Peter</u> horizon	1,991	2,000	
Dolomite, yellow, " <u>Calciferous</u> "	2,000	2,004	
Water, "blue lick"	2,000	2,004	Sampled
Total		2,004	

Casing Record

Casing, 8-inch 42 feet
Casing, 6 $\frac{1}{4}$ -inch 530 feet

Sample No. 61

Brine from the Nook F. Hetrich No. 1 well by W. A. Montgomery, Section 31, Rice Township, Sandusky County. The sample was submitted to the Survey by W. A. Montgomery, and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" horizon. Depth, 2,149-2,169 feet.

Specific gravity, 1.004 at 15° C. Mineral sediment, none.

Composition of Saline Matter

Cl	59.10
Br	0.25
SO ₄	1.45
CO ₃	none
HCO ₃	2.50
Na	22.18
K	0.81
Ca	9.99
Sr	0.70
Mg	2.89
(Al. Fe) ₂ O ₃	0.097
SiO ₂	0.033
	<hr/>
	100.00

Drillers Record

Well-head elevation, 590 feet (Approx.)
Well completed, August 1, 1936

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Limestone, <u>Trenton</u>	1, 330	2, 122	
Green sand	2, 122	2, 149	
Water sand, with "blue lick" water	2, 149	2, 169	Water, sampled
Hard limestone	2, 169	2, 513	
Shale break	2, 513	2, 530	
Very hard limestone	2, 530	2, 615	
Sand	2, 615	2, 687	Soft drilling
Red rock sandstone	2, 687	2, 701	Fair drilling
Granite wash.	2, 701	2, 796	Very hard drilling
Total		2, 796	

Casing Record

Casing, 10-inch 505 feet

Sample No. 67

Brine from the Mary Crum No. 1 well, by the Sun Oil Company, Section 7, Clinton Township, Seneca County. The sample was submitted to the Survey by George D. Lindberg of the Sun Oil Company and was analyzed by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth 2,090 feet.

Composition of Saline Matter

Cl	61.01
Br.	0.32
SO ₄	0.86
CO ₃	none
HCO ₃	0.30
Na	30.74
K	0.56
Ca.	4.11
Sr	trace
Mg.	2.05
(Al. Fe) ₂ O ₃	0.025
SiO ₂	0.025
	<hr/>
	100.00

Total dissolved solids, 46.00 grams per kilogram

Drillers Record

Well-head elevation, 751.4 feet

Well completed, June 28, 1938

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Limestone, <u>Clinton</u>	410	420	
Red	487	540	
<u>Trenton</u>	1,459	2,062	
Green shale, (St. Peter horizon)	2,062	2,074½	
<u>Calciferous</u>	2,074½	2,090	Oil
Water, "blue lick"	2,090		Sampled
Total		2,090	

Casing Record

Casing, 12-inch 8 feet
 Casing, 8-inch 390 feet
 Casing, 6 5/8-inch 1,460 feet

Samples No. 69, 70

Brines from the H. B. Cross No. 1 well by the Sun Oil Company, Section 13, Plain Township, Wood County. The samples were submitted to the Survey by George D. Lindberg of the Sun Oil Company and were analyzed by Downs Schaaf, chemist.

Sample No. 69, from "blue lick" water horizon.

Depth, 1,821 feet.

Sample No. 70, from a deep Sub-Trenton water horizon.

Depth, 2,017 - 2,076 feet.

Sample No. 69. Specific gravity, 1.036 + at 15° C.

Sample No. 70. Specific gravity, 1.038- at 15° C.

Composition of Saline Matter

	<u>No.</u> <u>69</u>	<u>No.</u> <u>70</u>
Cl	61.71	61.73
Br	0.21	0.21
SO ₄	0.21	0.16
CO ₃	none	none
HCO ₃	0.29	0.30

Na	28.47	28.94
K.....	0.96	1.01
Ca	5.55	5.06
Sr.....	trace	trace
Mg.....	2.56	2.43
(Al, Fe) ₂ O ₃	0.02	0.14*
SiO ₂	0.02	0.02
	100.00	100.00
Total dissolved solids	{ Grams per kilogram	47.00 50.00
	{ Grams per liter	48.80 51.9

Record

(From sample study by R. E. Lamborn, condensed)

Well-head elevation, 676 feet

Well completed, July 19, 1939

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Dolomite, white to gray, <u>Niagara</u>	45	225	
Shale, greenish gray, with dolomite fragments, <u>Alger</u>	225	270	
Dolomite, dark gray to buff, <u>Brassfield-Dayton</u>	270	355	
Shale, dark, calcareous	355	410	
Shale, reddish brown and greenish gray, <u>Red Medina</u>	410	445	
Shale, dark bluish gray, calcareous	445	865	
Shale, brown to black	865	1,115	
Limestone, dolomitic in part, <u>Trenton</u>	1,115	1,795	
Shale, green, dolomitic, and brown dolomite, <u>St. Peter</u> horizon	1,795	1,821	
Dolomite, <u>Knox</u>	1,821		
Dolomite, gray to light buff, sandy, "blue lick" water in upper part	1,821	2,005	Water, sampled
Dolomite, white, sandy, water in upper part	2,005	2,104	Water, sampled
Dolomite and sand	2,104	2,190	

* 90% of which is Fe₂ O₃. This iron no doubt was dissolved from the drill tool.

Casing Record

Casing, 10-inch	30 feet
Casing, 8 $\frac{1}{4}$ -inch	340 feet
Casing, 6 5/8-inch	1,980 feet

Sample No. 56

Brine from the L. C. Brown No. 1 well, by Lewis-Innis Oil Company, Section 20, Grand Prairie Township, Marion County. The brine was sampled by the drillers on May 5, 1933 and the sample was submitted to the Survey by Mr. Innis for analysis. The composition was determined by Downs Schaaf, chemist.

Sample from "blue lick" water horizon. Depth at sampling, 2,245 feet.

Specific gravity, 1.025 at 15⁰ C. Mineral sediment, dolomitic.

Composition of Saline Matter

Cl	60.10
Br	0.17
SO ₄	1.40
CO ₃	none
HCO ₃	0.45
Na	32.48
K	0.77
Ca	2.71
Sr	0.06
Mg	1.81
(Al, Fe) ₂ O ₃	0.025
SiO ₂	0.025
	100.00

Total dissolved solids	{	Grams per kilogram	35
		Grams per liter	35.875

Drillers Record

Well-head elevation, 950 feet
Well completed, 1933

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Limestone, brown, shelly, cavey	95	360	
Lime, white	360	490	
Lime, hard, light brown	490	500	
Shale, break	500	537	
Slate and limestone shells	537	620	
Red rock	620	670	
Slate and shells	670	1,270	
Shale, gray	1,270	1,380	
Shale, brown	1,380	1,625	
<u>Trenton</u>	1,625		
Black sand	1,625	1,675	
Light brown lime	1,675	1,685	
Gray lime	1,685	1,750	
Brown lime	1,750	1,760	
Gray lime	1,760	1,815	
Light brown lime	1,815	1,825	
Dark brown lime	1,825	1,835	
Gray lime	1,835	1,875	
Light brown lime	1,875	1,890	
Gray lime	1,890	1,900	
Brown lime	1,900	1,940	
Gray lime	1,940	1,975	
Light gray lime	1,975	1,995	
Light brown lime	1,995	2,005	
Real dark brown lime	2,005	2,030	
Gray lime	2,030	2,065	
Almost black lime	2,065	2,075	
Brown lime	2,075	2,120	
Gray lime	2,120	2,150	
Light gray lime	2,150	2,190	
Gray lime	2,190	2,210	
Green lime	2,210	2,230	
Gray lime	2,230	2,245	Water
Blue mud	2,245	2,260	
Brown sand, fine and hard	2,260	2,265	
Dolomite	2,265	2,490	

Casing Record

Casing,	96 feet
Casing,	620 feet
Casing,	2,260 feet

ANALYSES OF BRINES
FROM SECOND WATER IN BIG LIME

Sample No. 225

Brine from the Hocking-Athens Coal Company No. 2 well, by Frank J. O'Mara in Section 35, York Township, Athens County. The sample was taken by Wilber Stout, Geological Survey of Ohio, on September 17, 1941, and was analyzed by Downs Schaaf, chemist.

Sample from Second Water of Big Lime. Depth,
2,732 - 2,812 feet.

Specific gravity, 1.234 at 15° C.

Composition of Saline Matter

Cl	63.04
Br	0.55
SO ₄	0.03
CO ₃	none
HCO ₃	0.04
Na.	17.69
K.	0.68
Ca.	14.93
Mg.	2.98
(Al. Fe) ₂ O ₃	0.04
SiO ₂	0.02
	100.00

Total dissolved solids	{	Grams per kilogram	278.1
		Grams per liter	343.17

Drillers Record

Well-head elevation, 733.9 feet
Well completed

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Big Injun sand	290	430	
Berea sand	890	940	
Big Lime	2,122	2,942	

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
*Second Water	2,732	2,812	Second Water, sampled
Big Shell	3,123	3,133	
Clinton sand	3,153	3,173	Oil, 3,160-3,173 feet
Oil at	3,168	3,173	
Total		3,183	

Sample No. 260

Brine from the C. Conkle No. 1 well, by the Ohio Oil Company, Tract 6, Clark Township, Coshocton County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed in Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample from Second Water of Big Lime. Depth,
3,015 - 3,032 feet.

Specific gravity, 1.1797 at 20° C. Degrees Bé,
22.09.

Composition of Saline Water

CaCl ₂	7.62
MgCl ₂	2.40
NaCl	22.00
CaCl ₂ , MgCl ₂ ratio	3.17
KCl	0.42
** I	11
Br	0.1262
SrCl ₂	----

Composition of Saline Matter

(Calculated by R. E. Lamborn)

Ca	8.447
Mg	1.881
Na	26.575
K	0.676
Cl	62.030
Br	0.3875
I	0.0033
	99.9998

* Static level of water, 360 feet from surface.

** Expressed in parts per million.

Total dissolved solids	{	Grams per kilogram	325.673
		Grams per liter	384.196

Drillers Record

Well-head elevation, 860 feet (Approx.)

Well completed, June 20, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Mud and gravel	0	71	
Shale and shells	71	158	Water at 75 feet
<u>Big Injun sand</u>	158	220	Water at 115 feet
Shale	220	760	
<u>Berea sand</u>	760	792	Small show of oil
Shale	792	1,820	
Big Cinnamon	1,820	1,950	
Shale	1,950	2,175	
<u>Big Lime</u>	2,175	3,270	
<u>Oriskany</u>	2,428	2,438	Small show of oil and gas
First Water	2,438		5 bailers in 2½ hours
<u>Newburg</u>	2,984	2,990	
Second Water	3,015		Hole full, sampled
Blue shale	3,270	3,361	
<u>Little Lime</u>	3,361	3,386	
Shale	3,386	3,418	
Red sand	3,418	3,441	
<u>Clinton sand</u>	3,441	3,445	Dry
Break	3,445	3,467	
<u>Clinton sand, broken</u>	3,467	3,490	Dry
Blue slate	3,490	3,500	
Red rock	3,500	3,510	
Shells	3,565	3,580	
Total		3,580	

Casing Record

Casing, 10-inch	71 feet
Casing, 8¼-inch	400 feet
Casing, 6 5/8-inch	2,515 feet
Casing, 5 3/16-inch	3,263 feet

Sample No. 249

Brine from the Charles Guthrie No. 1 well, by Ohio Oil Company, Lot 21, Clark Township, Coshocton County. The sample was submitted to the Survey by the Ohio Oil Company and was

analyzed at Midland, Michigan, through the courtesy of the Dow Chemical Company.

Sample from Second Water of Big Lime. Depth,
2,840 feet.

Specific gravity. 1.1601 at 20^o C. Degrees Bé,
20.01.

Composition of Saline Water

CaCl ₂	5.72
MgCl ₂	2.18
NaCl	19.90
CaCl ₂ , MgCl ₂ ratio	2.62
KCl	0.43
* I.	15
Br	0.1202
SrCl ₂	----

Composition of Saline Matter

(Calculated by R. E. Lamborn)

Ca	7.283
Mg	1.969
Na	27.612
K	0.795
Cl	61.911
Br	0.4239
I	0.0052
	<hr/>
	99.9991

Total dissolved solids	}	Grams per kilogram	283.517
		Grams per liter	328.908

Drillers Record

Well-head elevation, 799 feet
Well completed, November 23, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Sand and gravel	0	75	
Slate and shells	75	665	
<u>Berea sand</u>	665	695	
Shale	695	1,600	Water at 820 feet

* Expressed in parts per million.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Cinnamon	1,600	1,820	
Slate and shells	1,820	2,050	
<u>Big Lime</u>	2,050	3,105	
<u>Newburg</u>	2,784	2,792	
Second Water	2,840		Rose 200 feet in 1 hour
Shale	3,105	3,150	and 20 min., sampled
<u>Shell</u>	3,150	3,191	
<u>Little Lime</u>	3,191	3,213	
Shale	3,213	3,238	
<u>Clinton sand</u>	3,238	3,278	
Show of gas	3,248	3,252	
Broken sand and shells	3,278	3,289	
<u>Clinton sand</u>	3,289	3,310	
<u>Little Red</u>	3,310	3,333	
Slate and shale	3,333	3,379	
<u>Red Medina shale</u>	3,379	3,387	
Total		3,387	

Casing Record

Casing, 10 $\frac{3}{4}$ -inch	74 5/6 feet
Casing, 8 $\frac{1}{4}$ -inch	359 feet
Casing, 5 $\frac{1}{4}$ -inch	3,154 feet

Sample No. 253

Brine from the McCord et. al. No. 1 well, by the Ohio Oil Company, Section 23, Clark Township, Coshocton County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, through the courtesy of the Dow Chemical Company.

Sample from Second Water of Big Lime. Depth,
3,183 feet.

Specific gravity, 1.1705 at 20^o C. Degrees Bé,
21.12.

Composition of Saline Water

* CaCl ₂	7.23
MgCl ₂	2.38
NaCl	21.20
CaCl ₂ , MgCl ₂ , ratio	3.04

* Not corrected for SrCl₂.

BRINES OF OHIO

KCl	0.34
* I	11
Br	0.1188
SrCl ₂	----

Composition of Saline Matter
(Calculated by R. E. Lamborn)

Ca	8.347
Mg	1.943
Na	26.671
K	0.570
Cl	62.085
Br	0.3799
I	0.0035
	99.9994

Total dissolved solids	}	Grams per kilogram	312.699
		Grams per liter	366.014

Drillers Record

Well-head elevation, 1,000 feet
Well completed, October 23, 1943

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Sand and shells	0	500	
<u>Big Injun</u> sand	500	535	
Shale	535	1,044	
<u>Berea</u> sand	1,044	1,060	
Show of oil	1,048	1,052	
Shale, gray and brown	1,060	2,442	
Water	1,065		One-half barrel per hr.
<u>Big Lime</u>	2,442	3,519	
<u>Newburg</u>	3,152	3,166	
Second Water	3,183		Hole full. Sampled
Shale break	3,450	3,465	
Second break	3,479	3,492	
White sand	3,504	3,519	
Shale and slate	3,519	3,627	
<u>Packer</u> shell	3,627	3,653	
Slate	3,653	3,680	
Red sand	3,680	3,692	
<u>Clinton</u> sand	3,692	3,703	

* Expressed in parts per million.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Break	3,703	3,724	
<u>Clinton sand</u>	3,724	3,949	
Show of oil	3,737	3,744	
Slate	3,749	3,762	
Pink shell	3,762	3,766	
Slate	3,766	3,824	
<u>Medina Red shale</u>	3,824	3,838	
Total		3,838	

Casing Record

Casing, 10 $\frac{3}{4}$ -inch	24 1/3 feet
Casing, 8 5/8-inch	602 feet
Casing, 5 $\frac{1}{2}$ -inch	3,527 feet

Sample No. 267

Brine from the A. Smolin No. 1 well by the Ohio Fuel Gas Company, Parma Township, Cuyahoga County. The sample was submitted to the Survey by the Cleveland Electric Illuminating Company and was analyzed by William Buckingham, chemist, Engineering Experiment Station.

Sample from the Newburg (?) horizon. Depth,
2,772 - 2,782 feet.

Specific gravity, 1.0682 at 15^o C. / 15^o C.

Composition of Saline Matter

Cl	60.590
Br	0.238
SO ₄	1.380
CO ₃	none
HCO ₃	0.163
Na.	27.358
K.	1.519
Ca.	7.180
Mg.	1.484
(Al. Fe) ₂ O ₃	none
SiO ₂	0.086
Sr.	none
I.	<0.001
Ba.	none
Mn.	<0.001
	<u>100.000</u>

Total dissolved solids	{	Grams per kilogram	90.390
		Grams per liter	96.562

Drillers Record

Well-head elevation, 1,055 feet
Well completed, September 9, 1949

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Berea sand</u>	120	180	
<u>Big Lime</u>	1,590	3,036	
<u>Oriskany</u>	1,764	1,835	
Gas	1,798	1,820	23,000 cu. ft.
Water	1,910		Hole full
Salt	2,230	2,350	
<u>Newburg</u>	2,762	2,782	
Second Water	none		
<u>Shell</u>	3,090	3,102	
<u>Stray sand</u>	3,135	3,145	Dry
<u>Red sand</u>	3,145	3,188	260,000 cu. ft. gas
<u>Clinton sand</u>	3,188	3,200	Dry, broken
Total		3,212	

Casing Record

Casing, 10-inch	40 feet
Casing, 8 $\frac{1}{4}$ -inch	253 feet
Casing, 6 5/8-inch	2,092 feet
Casing, 5 3/16-inch	none

Sample No. 264

Brine from the E. D. Dittmer No. 1 well, by the Fruehauf Trailer Company, Avon Lake Township, Lorain County. The sample was submitted to the Survey by the Cleveland Electric Illuminating Company and was analyzed by William Buckingham, chemist, Engineering Experiment Station.

Sample from Second Water of Big Lime. Depth 2,127 feet.

Specific gravity, 1.2403 at 15° C. / 15° C.

Composition of Saline Matter

Cl 62.964

ANALYSES OF SECOND WATER BRINES

Br	0.579
SO ₄	0.142
CO ₃	none
HCO ₃	0.018
Na	15.062
K	0.568
Ca	17.050
Mg	3.070
(Al. Fe) ₂ O ₃	0.109
SiO ₂	none
Sr	0.431
I	0.0059
Ba	none
Mn	0.0019
	<hr/>
	100.00

Total dissolved solids	{	Grams per kilogram	264.780
		Grams per liter	328.410

Drillers Record

Well-head elevation, ——
 Well completed, October 22, 1949

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Berea sand</u>		none	
<u>Big Lime</u>	900	2,160	
First Water	1,200		Hole full
Salt	1,559	1,719	
<u>Newburg</u>	1,985	2,005	Dry
Second Water	2,127		Hole full, sampled
<u>Shell</u>	2,191	2,208	
<u>Clinton sand</u>		none	
Total		2,311	

Casing Record

Casing, 10-inch	23 feet
Casing, 8 $\frac{1}{4}$ -inch	150 feet
Casing, 6 5/8-inch	1,335 feet
Casing, 5 3/16-inch	2,179 feet

Sample No. 266

Brine from the Dan Haller No. 1 well, by the Fruehauf

Trailer Company, Avon Lake Township, Lorain County. The sample was submitted to the Survey by the Cleveland Electric Illuminating Company and was analyzed by William Buckingham, chemist, Engineering Experiment Station.

Sample from Second Water of Big Lime, Depth, 2,172 feet.

Specific gravity, 1.2181 at 15° C. / 15° C.

Composition of Saline Matter

Cl	63.100
Br	0.329
SO ₄	0.065
CO ₃	none
HCO ₃	0.013
Na	17.935
K	0.721
Ca	14.817
Mg	2.946
(Al. Fe) ₂ O ₃	0.054
SiO ₂	none
Sr	none
I	0.018
Ba	none
Mn	0.002
	<hr/>
	100.000

Total dissolved solids	{	Grams per kilogram	254.040
		Grams per liter	309.450

Drillers Record

Well-head elevation, 622 feet

Well completed, August 25, 1949

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Berea sand</u>		none	
<u>Big Lime</u>	185	2,172	
First Water	1,220		Hole full
Salt	1,460	1,500	
<u>Newburg</u>	1,995	2,015	Dry
Second Water	2,142		Sampled
<u>Shell</u>	2,195	2,204	
<u>Clinton sand</u>	2,260	2,262	Broken
Total		2,285	

Casing Record

Casing, 10-inch	24 feet
Casing, 8 $\frac{1}{4}$ -inch	152 feet
Casing, 6 $\frac{5}{8}$ -inch	1,333 feet
Casing, 5 $\frac{3}{16}$ -inch	2,172 feet

Samples No. 255, 261

Brine from the Isaac Brown No. 1 well, by the Ohio Oil Company, Section 24, Thorn Township, Perry County. The samples were submitted to the Survey by the Ohio Oil Company and were analyzed in Midland, Michigan by courtesy of the Dow Chemical Company.

Sample No. 255, from Second Water of Big Lime.

Depth, 2,400 - 2,430 feet.

Sample No. 261, from Second Water of Big Lime.

Depth, 2,485 feet.

Sample No. 255. Specific gravity, 1.1881 at 20° C.

Degrees Bé, 22.96.

Sample No. 261. Specific gravity, 1.1910 at 20° C.

Degrees Bé, 23.25.

Composition of Saline Water

	No. <u>255</u>	No. <u>261</u>
CaCl ₂	8.61	9.02
MgCl ₂	2.52	2.60
NaCl	23.00	23.30
CaCl ₂ , MgCl ₂ ratio	3.42	3.47
KCl	0.42	0.38
* I	12	10
Br	0.1386	0.1413
SrCl ₂	----	----

Composition of Saline Matter

(Calculated by R. E. Lamborn)

	No. <u>255</u>	No. <u>261</u>
Ca	8.960	9.187
Mg	1.854	1.873
Na	26.083	25.862
K	0.635	0.562

* Expressed in parts per million.

Cl	62.065	62.114
Br	0.3995	0.3989
I	0.0034	0.0028
	<u>99.9999</u>	<u>99.9997</u>

Total dissolved Solids	{	Grams per kilogram	346.898	354.423
		Grams per liter	412.150	422.102

Drillers Record

Well-head elevation, 1,085 feet
Well completed, June 19, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Loam and shale	0	18	
Shale	18	140	
Sand	140	185	
Shale	185	245	
Broken sand	245	280	
Shale	280	500	
<u>Big Injun sand</u>	500	520	
Shale	520	841	
<u>Berea sand</u>	841	871	
Gas and water	849		48,000 cu. ft. gas and
Red rock	871	918	1 bailer water per hour
Shale	918	1,246	
Shale, brown	1,246	1,323	
Cinnamon	1,323	1,720	
Shale, white	1,720	1,895	
<u>Big Lime</u>	1,895	2,685	
Water	2,400		Sampled
Second Water	2,430		Hole full, sampled,
Shale	2,685	2,785	2,485 feet
Shale, green	2,785	2,811	
Shell	2,811	2,823	
<u>Clinton sand</u>	2,847	2,868	
Show, oil and gas	2,864	2,868	
Shale break	2,868	2,897	
Total		2,897	

Casing Record

Casing, 10-inch	19 feet
Casing, 8 $\frac{1}{4}$ -inch	584 feet
Casing, 6 $\frac{5}{8}$ -inch	930 feet
Casing, 5 $\frac{1}{2}$ -inch	2,635 feet

Sample No. 263

Brine from the Lola and Zelma Coulter No. 1 well, by the Ohio Oil Company, Section 33, Clayton Township, Perry County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample from Second Water of Big Lime. Depth, 2,955 ft.

Specific gravity, 1.2327 at 20^o C. Degrees Bé, 27.37.

Composition of Saline Water

* CaCl ₂	11.47
MgCl ₂	2.88
NaCl	27.60
CaCl ₂ , MgCl ₂ ratio	3.98
KCl	0.47
** I	13
Br	0.1804
SrCl ₂	0.17

Composition of Saline Matter

(Calculated by R. E. Lamborn)

Ca	9.681
Mg	1.719
Na	25.386
K	0.576
Sr	0.219
Cl	61.994
Br	0.4217
I	0.0030
	99.9997

Total dissolved solids	{	Grams per kilogram	427.717
		Grams per liter	528.724

Drillers Record

Well-head elevation, 980 feet (Approx.)
Well completed, September 17, 1943

* Not corrected for SrCl₂.

** Expressed in parts per million.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Big Injun sand</u>	430	715	
<u>Berea sand</u>	1,015	1,035	
<u>Big Lime</u>	2,323	3,227	
<u>Newburg</u>	2,930	2,935	Small show of oil
<u>Second Water</u>	2,955		Sampled
<u>Little Lime</u>	3,347	3,354	
<u>Clinton sand</u>	3,361	3,401	Show of oil, 3,382-3,386
<u>Red Medina</u>	3,495		feet.
<u>Total</u>		3,508	

Casing Record

Casing, 13-inch	18 2/3 feet
Casing, 10-inch	159 1/4 feet
Casing, 8-inch	732 feet
Casing, 5-inch	3,187 feet

Sample No. 254

Brine from the Callie M. Dugan No. 1 well, by the Ohio Oil Company, Section 32, Clayton Township, Perry County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample from Second Water (?) of Big Lime. Depth 2,889 ft.

Specific Gravity, 1.2220 at 20° C. Degrees Bé, 26.34.

Composition of Saline Water

* CaCl ₂	10.74
MgCl ₂	2.92
NaCl	26.70
CaCl ₂ , MgCl ₂ , ratio	3.68
KCl	0.43
** I	13
Br	0.1711
SrCl ₂	0.15

* Not corrected for SrCl₂.

** Expressed in parts per million.

Composition of Saline Matter
(Calculated by R. E. Lamborn)

Ca	9.431
Mg	1.813
Na.	25.548
K	0.548
Sr	0.201
Cl.	62.039
Br	0.4161
I	0.0031

Total dissolved solids	{	Grams per kilogram	411.124
		Grams per liter	502.393

Drillers Record

Well-head elevation, 970 feet
Well completed, August 15, 1942

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Drift	0	40	
Shale	40	310	
Sand	310	672	
Slate	672	695	
Shale	695	995	
Sand, <u>Berea</u>	995	1,080	
Shale	1,080	2,275	
<u>Big Lime</u>	2,275	3,130	Show of oil at 2,355 ft.
Water	2,800		Sampled at 2,889 ft.
Second Water	2,925	2,940	Hole full
Water	3,070		
Shale	3,130	3,165	
Green shale	3,165	3,185	
Shale and shells	3,185	3,245	
<u>Shell</u>	3,210		
<u>Clinton sand</u>	3,245	3,280	Show of oil, 3,263 -
<u>Clinton sand and shale</u>	3,280	3,285	3,268 feet
Shale	3,285	3,325	
<u>Red Medina shale</u>	3,325		
Total		3,346	

Casing Record

Casing, 10-inch	37 feet
Casing, 8 $\frac{1}{4}$ -inch	701 feet
Casing, 6 $\frac{3}{8}$ -inch	1,074 feet
Casing, 5 $\frac{3}{16}$ -inch	3,070 feet

Sample No. 71

Brine from the W. J. Lynn No. 1 well, by the Brendel Producing Company, Deerfield Township, Portage County. The sample was submitted to the Survey by the Brendel Producing Company and was analyzed by Downs Schaaf, chemist.

Sample from Second Water of Big Lime. Depth at sampling, _____.

Specific gravity, 1.185 at 15^o C. Mineral sediment, none

Composition of Saline Matter

Cl	63.14
Br	0.30
SO ₄	0.05
CO ₃	none
HCO ₃	0.01
HS	none
Na	14.71
K	1.04
Ca	17.23
Sr	0.63
Mg	2.85
(Al, Fe) ₂ O ₃	0.02
SiO ₂	0.02
	100.00

Total dissolved solids	{	Grams per kilogram	211.00
		Grams per liter	250.035

Drillers Record

Well-head elevation, 1,045 feet
Well completed, November 20, 1933

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Sand, <u>Big Injun</u>	145	163	
Sand, <u>Squaw</u>	395	495	
Sand, <u>Weir</u>	515	530	
Sand, <u>Berea</u>		none	
<u>Big Lime</u>	2,755	4,523	
<u>Oriskany</u> horizon	2,870		Show of gas
Salt	3,468	3,755	
<u>Newburg</u>	4,280	4,287	Show of gas
Second Water	4,280		

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Shell	4,627	4,639	
Gritty rock	4,669	4,701	
Red rock	4,701	4,714	
Sand, <u>Clinton</u>	4,714	4,805	
Shale	4,805	4,827	
Sand, <u>Clinton</u>	4,827	4,820	23,000 cu. ft. gas
<u>Total</u>		4,868	

Casing Record

Casing, 10-inch	49 feet
Casing, 8 $\frac{1}{4}$ -inch	800 feet
Casing, 5 $\frac{3}{16}$ -inch	4,463 feet

Sample No. 59

Brine from the L. and E. Fritz No. 1 well, by the Brendel Producing Company, Section 10, Plain Township, Stark County. The sample was taken by R. E. Lamborn, Geological Survey of Ohio, October 26, 1933, and was analyzed by Downs Schaaf, chemist.

Sample from Second Water of Big Lime. Depth at sampling, 4,303 feet.

Specific gravity, 1.15 at 15^o C. Mineral sediment, dolomitic.

Composition of Saline Matter

Cl	62.55
Br	0.28
SO ₄	0.16
CO ₃	none
HCO ₃	0.03
HS	none
Na.	17.34
K	0.94
Ca.	15.55
Sr	0.60
Mg.	2.49
(Al, Fe) ₂ O ₃	0.03
SiO ₂	0.03
	<hr/>
	100.00

Total dissolved solids	{	Grams per kilogram	181.00
		Grams per liter	208.15

Drillers Record

Well-head elevation, 1,110 feet
Well completed, November 8, 1933

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Sand, <u>Big Injun</u>	240	420	
Sand, <u>Berea</u>	655	675	
<u>Big Lime</u>	2,741	4,324	
<u>Salt</u>	3,335	3,535	
<u>Newburg</u>	4,020		Show of gas
<u>Second Water</u>	4,020		Holl full, sampled
Backer shell	4,416	4,443	
<u>Stray sand</u>	4,466	4,487	
<u>Red sand</u>	4,487	4,518	
<u>Clinton sand</u>	4,518	4,550	
<u>Gas</u>	4,540	4,550	
Total		4,560	

Casing Record

Casing, 10-inch	79 feet
Casing, 8 $\frac{1}{4}$ -inch	756 feet
Casing, 5 $\frac{3}{16}$ -inch	4,321 feet

ANALYSES OF BRINES
FROM FIRST WATER IN BIG LIME

Samples No. 287, 288

Brines from the L. C. Miller No. 1 well by Frank Lyons, Lot 2, Macedonia Township, Summit County. The samples were collected by Mrs. Ann H. Lawhead for the Cleveland Electric Illuminating Company. Analyses showing the composition of the saline matter are here included by courtesy of the Cleveland Electric Illuminating Company.

Sample No. 287, from First Water of Big Lime.

Depth, 2,470 feet.

Sample No. 288, from Second Water of Big Lime.

Depth, 3,355 - 3,410 feet.

Sample No. 287, Specific gravity, 1.1511 at 15.5° C.

Sample No. 288, Specific gravity, 1.1892 at 15.5° C.

Composition of Saline Matter

	<u>No.</u> <u>287</u>	<u>No.</u> <u>288</u>
Cl	64.17	63.51
* Br	0.67	0.61
SO ₄	0.11	0.11
Na	9.36	15.19
K	1.01	0.81
Ca	18.36	14.51
Sr	0.70	0.55
Mg	5.36	4.51
NH ₄	0.13	0.11
(Al, Fe) ₂ O ₃	0.10	0.08
SiO ₂	0.01	0.01
	99.98	100.00
Total dissolved	Grams per kilogram	171.618
Solids	Grams per liter	223.545
		265.740

Drillers Record

Well-head elevation, 1,140 feet (Approx.)

Well completed, September 1, 1950

* Bromine figures include iodine.

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Berea sand</u>	285	345	Dry
<u>Big Lime</u>	1,998	3,585	
First Water	2,470		Hole full, sampled
Salt	2,720	2,910	
<u>Newburg</u>	3,024	3,061	Show oil
Second Water	3,355		Hole full, sampled
<u>Shell</u>	3,668	3,680	
<u>Stray sand</u>	3,701	3,707	Dry
Red sand	3,707	3,762	Dry
White sand, <u>Clinton</u>	3,762	3,796	Dry
Total		3,883	

Casing Record

Casing, 10-inch	11 feet
Casing, 8 $\frac{1}{4}$ -inch	382 feet
Casing, 6 $\frac{5}{8}$ -inch	2,585 feet
Casing, 5 $\frac{3}{16}$ -inch	3,677 feet

Sample No. 256

Brine from the Pearl Fitzgerald No. 1 well, by the Ohio Oil Company, Section 2, Center Township, Guernsey County. The sample was submitted to the Survey by the Ohio Oil Company and was analyzed at Midland, Michigan, by courtesy of the Dow Chemical Company.

Sample from First Water of Big Lime. Depth, 3,776 feet.

Specific gravity, 1.1961 at 20^o C. Degrees Bé, 23.77.

Composition of Saline Water

CaCl ₂	5.96
MgCl ₂	1.59
NaCl	24.50
CaCl ₂ , MgCl ₂ , ratio	3.75
KCl	0.49
* I.	24
Br	0.1287
SrCl ₂	----

* Expressed in parts per million.

Composition of Saline Matter
(Calculated by R. E. Lamborn)

Ca	6.585
Mg.....	1.242
Na	29.501
K	0.786
Cl.....	61.484
Br	0.3939
I	0.0073
	<hr/>
	99.9992

Total dissolved Solids	{	Grams per kilogram	326.711
		Grams per liter	390.779

Drillers Record

Well-head elevation, 860 feet
Well completed, May 5, 1943

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Coal, <u>Upper Freeport</u>	70	72	
<u>Berea sand</u>	1,135	1,208	
Water	1,149	1,154	
<u>Big Lime</u>	3,608		
First Water	3,776		Sampled
Water	4,490	4,500	
<u>Newburg</u>	4,725	4,735	
Water	4,885		Two barrels per bit
<u>Shell</u>	5,253	5,271	
<u>Stray sand</u>	5,288	5,306	
<u>Red sand</u>	5,306	5,340	
Gas	5,322	5,332	
<u>Clinton sand, broken</u>	5,340	5,352	
Total		5,476	

Casing Record

Casing, 14-inch	36 feet
Casing, 10-inch	816 feet
Casing, 8-inch	1,232 feet
Casing, 6-inch	3,957 feet
Casing, 5-inch	5,187 feet

Sample No. 57

Brine from the John Burkhardt No. 4 well, by E. R. Edson and Son, Section 4, Avon Township, Lorain County. The sample was taken by R. E. Lamborn, Geological Survey of Ohio, on October 23, 1933, and was analyzed by Downs Schaaf, chemist.

Sample from First Water of Big Lime. Depth at sampling, 1,150 feet.

Specific gravity, 1.125 at 15° C. Mineral sediment, dolomitic.

Composition of Saline Matter

Cl	64.01
Br	0.47
SO ₄	0.20
CO ₃	none
HCO ₃	0.10
HS	0.09
Na	14.43
K	0.60
Ca	14.23
Sr	0.47
Mg	5.32
(Al, Fe) ₂ O ₃	0.05
SiO ₂	0.03
	100.00

Total dissolved solids	{	Grams per kilogram	150.00
		Grams per liter	168.75

Drillers Record

Well-head elevation, 628 feet
Well completed, January 13, 1934

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Glacial drift	0	22	
Shale	22	874	
<u>Big Lime</u>	874	2,127	
First Water	1,105		Water rose 128 feet in
Salt	1,465	1,500	28 hours. Sampled
Salt	1,590	1,605	
<u>Newburg</u>	1,938	1,965	Show gas. 1,938-1,977 ft.
Second Water	2,029		2 barrels per hour

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
<u>Little Lime</u>	2, 150	2, 188	
<u>Sandstone</u>	2, 228	2, 229	
<u>Shell</u>	2, 238	2, 242	
<u>Red rock</u>	2, 262	2, 267	
<u>Limestone, black</u>	2, 308	2, 310	
<u>Limestone, shell, sandy</u>	2, 316	2, 334	
<u>Red rock</u>	2, 334	2, 407	
Total		2, 407	

Casing Record

Casing, 10-inch	22 feet
Casing, 8 $\frac{1}{4}$ -inch	103 feet
Casing, 6 5/8-inch	1, 300 feet
Casing, 5-inch	2, 156 feet

Sample No. 58

Brine from the John Rising No. 1 well, by the Ohio Fuel Gas Company, Lot 95, Grafton Township, Lorain County, The sample was taken by R. E. Lamborn, Geological Survey Ohio, on October 24, 1933, and was analyzed by Downs Schaaf, chemist.

Sample from First Water of Big Lime. Depth at sampling, 1, 625 feet.

Specific gravity, 1.18 at 15⁰ C. Mineral sediment, dolomitic.

Composition of Saline Matter

Cl	64.23
Br	0.35
SO ₄	0.05
CO ₃	none
HCO ₃	0.04
HS	0.02
Na	11.86
K	0.93
Ca	17.05
Sr	0.68
Mg	4.73
(Al, Fe) ₂ O ₃	0.04
SiO ₂	0.02
	100.00

Total dissolved solids	{	Grams per kilogram	205.00
		Grams per liter	241.90

Drillers Record

Well-head elevation, 925.8 feet
Well completed, November 22, 1933

	<u>Top</u>	<u>Bottom</u>	<u>Remarks</u>
Shale	0	206	
<u>Berea sand</u>	206	260	No oil, gas, or water
Shale	260	1,350	
<u>Big Lime</u>	1,350	2,572	
Water	1,560		2 bailers per hour.
Water	1,610		Hole full, sampled.
<u>Newburg</u>	2,400	2,425	
Water	2,445		
<u>Packer shell</u>	2,652	2,674	
Shale	2,674	2,772	Clinton sand, wanting.
Total		2,772	

Casing Record

Casing, 10-inch	44 feet
Casing, 8 $\frac{1}{4}$ -inch	316 feet
Casing, 6 $\frac{5}{8}$ -inch	1,665 feet
Casing, 5 $\frac{3}{16}$ -inch	2,582 feet



- Samples In Previous Bulletin No. 37
- Samples Added, 1933 - 1951

Map Showing Location Of
SALT AND BRINE
SAMPLES

BY
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