PART III. DEEP WELL BORINGS.

R. A. SMITH.

DEEP BORINGS.

During the past three years a considerable number of deep borings have been sunk in the state chiefly for water, salt, oil and gas. Logs of most of these and sets of samples from many have been obtained. A number of records of wells, drilled prior to 1913, have also been recently obtained. The following are the compiled records of the more important borings.

ALLEGAN COUNTY.

Saugatuck. Mr. P. G. DeGuenther in 1916 drilled a test well for oil near Saugatuck. A log and a set of samples were preserved for the lower portion of the well. The well evidently penetrated the Dundee limestone but no oil or gas was reported. The exact location of the well was not learned.

A detailed record of the lower portion of this well would have been of great value in throwing light on the structure of Dundee limestone in western Allegan county. Since the depth to the top of this formation at Saugatuck cannot be determined within close limits, direct comparison cannot be made with the wells at Allegan to the eastward and in Berrien county to the south.

SAUGATUCK WELL.

Location: Near Saugatuck. Record by R. A. Smith from samples taken at every change and from driller's log. Drilled for oil in 1916 by P. G. DeGuenther.

Elevation not known but probably about 600 ft. A. T.

	Thickness, feet.	Depth, feet.	Sp. taken.
Pleistocene or glacial deposits:			
"Dark loam"	20	20	1
Dark grayish yellow sand with considerable white chert and blue shale. Grayish cast due to shale particles. "Water sand."	20	40	2
Fine yellow sand—"quicksand."	30	70	3
Coarse gravel and boulders with water. 10-in. drive pipe to 85 ft.	10	80	4
Fine sand—"quicksand," and gravel. Quicksand filled up pipe 40 ft.	10	90	5
Fine sand with small pebbles—"quicksand"	10	100	6
Sticky dark bluish boulder clay. "Slow to drill"	15	115	7
"Quicksand"	25	140	8
Gravel and sand, water. "Can't bail down." Sample at 160 ft. is labeled "Clay and gravel"	40	180	9
Clay at 180 ft., pebbly. Record from 180 to 195 ft. not certain	15	195	.....
Quicksand fills up hole 60 ft. Gravel at 285 ft. 8-in. casing to 200 ft.	90	285	10
"Clay, dark and sticky." "(Weathered shale at the top of the Coldwater[?]) "Soapstone" at 305 ft	20	305	11
Coldwater shale:			
Hard light gray very fine grained grit and gritty dolomitic shale breaking up into hard angular fragments, resembling "Light limestone."	35	340	12
Soft dark gray shale—"Soapstone. Easy to drill"	110	450	13
Hard gray fine grained dolomitic grit, with streaks of white dolomite. No. eff. with cold dilute HCl, vig. with hot. Smooth dark gray shale, very calcareous—"soapstone," at 460 ft.	10	460	14
Hard gray fine grained dolomitic grit, darker than above. "Blue shale, clean drilling."	50	510	.....
Berea horizon and Antrim shale:			
"Red rock and mixed lime." Gray to light green crystalline limestone with some white calcite and pyrite. Sample labeled 510 ft. is brick red and bright green shale. "Red rock mixed with lime."	25	535	.....
Sample labeled 535 ft. is chiefly very red gritty shale with some yellow shale and much gray to greenish white crystalline limestone and white calcite. Sample labeled 580 ft. is finely mottled gray very dolomitic fine grit	165	700	.....
Soft greenish gray shale. "Soft limestone. Easy drilling."	70	770	.....
Dark gray shale and hard gray, gritty dolomitic streaks. "Soapstone, no grit at 785 feet."	15	785	.....
Greenish gray shale with streaks of limestone; some calcite	15	800	.....
Dark gray bituminous shale, very smooth and soapy.—"soapstone"	80	880	.....
"Limestone and shale mixed." Gray and dark gray shale, calcite	70	950	.....
Clay, blue and sticky at 950 feet	250	1,200	.....
"Limestone and shale mixed." Sample at 1,200 ft. chiefly brown bituminous limestone.			

ARENAC COUNTY.

Pine River. Fred Oeder drilled a well for water near Pine River. The record was made from a few samples and a log from memory furnished by Mr. Oeder. Two gypsum beds were struck at 216 and 223 feet respectively.

PINE RIVER.

Location: Near Pine River, Standish Township. (T. 18 N., R. 4 E.) Drilled in February, 1915 by Fred Oeder, 208 N. DeWitt Street, West Bay City, Mich. Record from memory by Fred Oeder. Not accurate as to details, only for main changes in rock strata. Correlations by R. A. Smith.

	Thickness, feet.	Depth, feet.
Pleistocene or rock surface—Clay	22	22
Parma sandstone—White sandstone	38	60
Bayport limestone—Limestone	60	120
Michigan series:		
Blue shale	96	216
Gypsum (sample about ½ gypsum, rest blue and gray shale)	2	218
Blue shale	5	223
Gypsum—Sample mainly pure crystalline gypsum; some blue and gray shale (Shale probably from above Marshall sandstone—Smith).	8	231
Upper Marshall sandstone—Dark gray sandstone and shale mixed	269	500
Flowing water.		
Lower Marshall—Red sandy shale	125	625

BRANCH COUNTY.

COLDWATER.

Location: Exact location not given. Record by C. E. Wright from Dr. J. H. Bennett.

Elevation 983 ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift—Surface	115	115
Coldwater shale—Blue shale	701	816
Berea horizon (?)—Red calcareous shale	14	830
Antrim shale:		
Hard blue shale interstratified with limestone	50	880
Black bituminous shale	205	1,085
Traverse formation—Hard limestone	115	1,200

CLINTON COUNTY.

Bengal Township. In 1915, coal was struck in a well on the Verne Walker and Albert J. Moss farms on the town line between Bengal and Essex townships. The Consolidated Coal Co. of Saginaw, drilled two test holes one on each farm to determine the thickness and extent of the bed. The coal bed in both borings proved to be too thin for further investigation. Records of the borings were furnished the survey by Mr. J. H. Barnes, Field Engineer of the company and the record of the A. J. Moss hole, the deeper of the two, is given below:

Test Hole No. 1, Albert J. Moss Farm.

Location: Near N. E. cor. S. E. ¼ Sec. 33, Essex Twp. (T. 8 N., R. 3 W.), Clinton Co. about 10 feet from well and 7/10 of a mile N. E. of hole No. 1 on the Vern Walker farm.

Drilled in November, 1915, by Consolidated Coal Co., Saginaw. J. H. Barnes, field engineer. Churn drill. Thickness of coal determined by samples taken about one inch apart by specially devised bit and barrel. Record from J. H. Barnes. See also record of A. J. Moss well, 1915.

Elevation about 765 feet A. T.

	Thickness feet.	Depth feet.
Pleistocene or surface deposits:	.....	.....
Sand	8	8
Sandy clay	42	50
Clay	65	115
Hard pan	10	125
Clay	17	157
Sandy red clay (or soft red shale?)		
Saginaw formation:		
Shale	3	160
White sandstone	32	192
Gray slate	4	196
Black slate	1	197
Gray slate	10	207
Black slate, very black and oily	17	224
Poor coal	0–9″	224–9″
Sandstone	2–3	227
Fire clay	4	231
Gray sandstone	50	281
Gray sandy slate	57	338
Black slate	1	339
Fire clay	5	344
Black shale	20	364
Gray shale	16	380
Fire clay	2	382
Coal, fairly good	0–7″	382–7″
Fire clay	5–5	388
Gray slate	12	400

The slate above is shale.

DELTA COUNTY.

Escanaba. In 1917 the Chicago and Northwestern Railway Company completed a well for water at their shops in Escanaba. A carefully made log and a complete set of samples were preserved for the Survey by Mr. Geo. Loughnane, Division Engineer.

The well penetrated the red Huronian schists at a depth of about 854 feet. Horizons corresponding to the Madison sandstone and the Mendota limestone of the Wisconsin section occur below the "Calciferous" sandstone. The Lake Superior sandstone contained much coarse very porous sandstone below about 730 feet and yielded a large flow of artesian water, with a head apparently about 30 feet above the surface.

CHICAGO & NORTHWESTERN RAILWAY COMPANY WELL.

Location: C. & N. W. Ry. shops, Escanaba; 250 ft. north and 2,020 ft. west of southeast corner of N. W. ¼ of sec. 29, T. 39 N., R. 22 W.; and 635 ft. east of east line of Georgia Street; and 200 ft. north of north line of Thomas Street. F. M. Gray, Jr., well contractor. D. Curran, driller. Well completed April, 1917. Samples taken under the direction of Geo. Loughnane, Division Engineer. Record compiled by R. A. Smith, Michigan Geological Survey, from samples and from information given by Geo. Loughnane.

Elevation about 590 ft. A. T., 9 ft. above Lake Michigan, or 0 ft. above tracks at yards.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift:		
Coarse yellowish sand	10	10
Yellowish red sand	20	30
Coarse yellowish sand or fine gravel	10	40
Gravel, probably water bearing from about lake level down	10	50
Fine pink clay, very calcareous	30	80
Pinkish clay, apparently with gravel at the bottom	5	85
Sandy gravel, "hard pan gravel"	10	95
Very coarse gravel and pebbles	11	106
Galena—Trenton Limestone:		
Hard grayish buff limestone with small white crystalline masses. Violent effervescence with cold dilute HCl. "Shell rock" and pebbles from above	4	110
Hard grayish buff fossiliferous (brachiopods) limestone with orange red streaks and small white crystalline masses. Violent effervescence. Iron oxide decreases downward	20	130
Hard grayish buff limestone with white crystalline masses. Vig. eff. Little or no red iron oxide	10	140
Gray very argillaceous pyritic limestone and calcareous shale. Violent effervescence	20	160
Greenish gray calcareous shale. Moderate to slow effervescence	10	170
Buff gray argillaceous limestone. Vigorous to moderate effervescence	10	180
Gray calcareous shale and light to dark gray very argillaceous limestone	30	210
Gray to dark gray calcareous shale, and shaly and sandy limestone; sand composed of small round grains of colorless quartz	10	220
Gray calcareous shale and grayish white to gray argillaceous limestone. Violent effervescence	20	240
Gray to dark gray calcareous shale and shaly limestone	20	260
Light buff crystalline limestone with some gray to dark gray shaly and black bituminous streaks	50	310
Hard gray gritty limestone. Moderate effervescence	10	320
Light to greenish gray shale and gray limestone	10	330
Much greenish gray shale and dark buff gray limestone	20	350
Light grayish buff limestone with sandy phases; some greenish shale. Moderate to slow effervescence	10	360
Greenish gray to dark gray shale and buff sandy limestone; sand of rounded colorless quartz grains	10	370

	Thickness, feet.	Depth, feet.
Most of the upper beds of limestone are apparently low magnesian; the lower beds appear to be more magnesian, especially near the bottom. The characteristically high magnesian beds of the Galena do not appear to be present in this well but occur on the top of the bluffs near the mouth of the Escanaba River.		
St. Peter (?) Sandstone.		
Light to dark buff and gray magnesian limestone with sandy phases and streaks of dolomitic sandstone. Slow effervescence. Flow of water	10	380
Fine grained light buff sandy dolomite, hard	15	395
Fine white dolomitic sandstone, soft	15	410
Beekmantown—"Lower Magnesian" or "Calciferous."		
Light buff heavy magnesian limestone and much white sandstone, apparently in streaks or in part from the incoherent sandstone above. Slow effervescence	20	430
White dolomite, hard. Slow effervescence	10	440
White sandy dolomite, hard. Slow effervescence	10	450
Small flow of water from 450 to 480 ft.		
White dolomite and light buff sandy dolomite	10	460
Buff gray dolomite with sandy streaks and streaks of very red ferruginous dolomite	10	470
Fine grained gray dolomite with dark pyritic streaks and dense grained gray dolomite breaking with a smooth conchoidal fracture ("glass rock"?)	10	480
Jordan (?) (Madison) Sandstone.		
White sandstone of rounded colorless quartz grains; apparently some streaks of dolomite	20	500
St. Lawrence (?) (Mendota) Limestone:		
Light buff and gray dolomite with a streak of red dolomite	10	510
Buff and gray dolomite with sandy streaks; residue of 10 to 15% of white quartz sand	10	520
Light buff sandy dolomite; residue of 10-15% of white quartz sand	10	530
Very fine white dolomitic sandstone	10	540
Light buff gray dolomite and dolomitic sandstone, the latter probably in the upper part	10	550
Very red ferruginous dolomite with some white dolomite, probably at bottom. Large residue of red ferruginous matter	10	560
White dolomite	10	570
Light buff and red dolomite; some gray dolomite	20	590
Red buff and gray dolomite redder and apparently harder than above	20	610
Dark gray very argillaceous and pyritic dolomite and gray shale; sandy at the bottom	25	635
Lake Superior or Potsdam Sandstone:		
Gray to reddish sandstone, calcareous at top	55	690
Fine calcareous sandstone	10	700
White sandstone	40	740
Main water bearing horizon said to be from 730 to about 800 feet.		
Coarse white sandstone	20	760
Coarse grayish white to bluish gray sandstone	35	795
Red clay shale, slightly calcareous	5	800
Red and white sandstone, probably red sandstone streaked or mottled with white; fine to medium grained	30	830
Coarse gray sandstone with particles of red rock; probably water bearing; apparently red talcose schist at 850 feet	24	854
Pre-Cambrian:		
Red talcose schist with smooth "soapy" surfaces on cleavage plates; some pieces show crenulations	1–2″	855-2″

Casing: 106 ft. of 8 inch to rock, 5 ft. of 7¼ inch liner, and then 7¼ inch hole to 120 ft., and 6⅛ inch hole to bottom. To prevent caving, 5 3-16 inch casing was put in to 240 ft. to case off the shale rock from about 200 to 240 feet.

Artesian flow estimated at 150 gallons per minute. Water flows freely over top of casing 20 feet above ground. Head probably about 30 feet.

Pine Ridge. A test hole for iron was drilled near Pine Ridge about two and one-half miles west of Escanaba. The hole was abandoned at a depth of 530 feet without reaching the Huronian rocks. Judging from the Chicago and Northwestern Railway well at Escanaba drilled later, the Huronian rocks should occur in the vicinity of Pine Ridge at a depth of nearly 800 feet.

A complete set of samples were preserved and furnished the Survey by Mr. L. N. Schemmel of Escanaba who was connected with the project.

LOUIS N. SCHEMMEL TEST HOLE NO. 1.

Location: S. W. corner S. W. ¼ of N. E. ¼, sec. 28, T. 39 N., R. 23 W. Hole near Pine Ridge or 2½ miles west of Escanaba. Drilled for iron in 1914. Samples practically every 5 feet and at every change. Samples furnished by L. N. Schemmel and examined by R. A. Smith and L. P. Barrett.

Elevation 680 ± ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift (30 ft.):		
Sand and "drift"	10	10
Quicksand	8	18
Quicksand and broken limestone	12	30
Bed rock at about 25 ft. First sample at 30 ft.		
"Trenton" limestone (95 ft. Top eroded):		
Galena		
White to light buff and gray dolomitic limestone	19	49
Mixed bluish gray and white dolomitic limestone	5	54
Bluish gray argillaceous limestone and dolomite; pyrite at 125 ft	71	125
Platteville (and Galena in upper part) (?) (188 + 57 ft.)		
Bluish gray to light gray and white limestone	20	145
Dark gray argillaceous, pyritic limestone; some white limestone	15	160
Gray and light buff limestone; some bluish gray shale	5	165
Hard finely crystalline yellowish to grayish white limestone, dolomite, and dolomitic limestone; vein of water at 170 ft. which carried away the drillings; water not artesian	38	203
Dense light grayish dolomite and dolomitic limestone	15	218
St. Peter (?) sandstone:		
White sandy dolomite and dolomitic limestone. Abundant rounded colorless grains of quartz, in places forming more than one quarter of rock. Pyritic in places; vein of water at 248 ft. which carried away drillings; water not artesian	47	265
White sandy limestone. Large amount of small rounded colorless quartz grains	10	275
St. Peter sandstone (50 ft.):		
Pure white sandstone of rounded colorless quartz grains	14	289
Pure white sandstone somewhat calcareous. Drill became "highly magnetic."	5	293
White sandy dolomitic limestone	7	300
Bottom of hole at	.....	304
Drill dropped into a vug and wedged; broke cable about 2 ft. above tools in trying to loosen drill.		

Test Hole No. 2, 30 ft. from Hole No. 1.

No samples down to 300 ft.

	Thickness, feet.	Depth, feet.
White and very calcareous sandstone	10	310
White sandy limestone. Vig. eff	5	315
"Calciferous," Beekmantown (?), "Lower Magnesian" (85 ft.):		
White limestone and much red iron oxide and some argillaceous or clayey matter; limestone eff. vig	4	319
(This red oxidized horizon possibly represents the eroded land surface of the Calciferous upon which the St. Peter was deposited. The St. Peter apparently fills hollows and valleys in the Calciferous formation.)		
Very white limestone and some red iron oxide. Vig. eff. Some white quartz sand	1	320
Very sandy white limestone. Vig. eff	10	330
Grayish white limestone. Vig. eff	5	335
White limestone with some white quartz sand. Vig. eff	5	340
White to very light buff limestone. Mod. eff	5	345
White to very light buff limestone with some white quartz sand. Vig. eff	5	350
White sandstone	15	365
White sandstone and some very white dolomite. Slow eff	15	380
White sandy dolomite. Slow eff	5	385
White dolomite—some sand. Mod. eff	8	393
White dolomite. Mod. eff	3	396
White sandy and pyritic dolomite	4	400
The relatively vigorous effervescence with cold dilute HCl was due to the powdery character of the samples. Coarse particles obtained by washing gave slow reaction.		
Jordan (Madison?) sandstone (25 ft.):		
Very sandy white dolomite	2	402
A little pyrite from 330 to 402 ft.		
White and very calcareous sandstone, nearly half dolomitic limestone, some pyrite; hard, 5% of residue composed of fragments of steel from the drill	1	403
Soft white sandy dolomitic limestone, mod. eff. 20% pure white quartz sand	1	404
Yellowish white sandy dolomite; slow eff. 15% of pure white quartz sand, rather soft; drillings washed away from 404 to 415 ft	11	415
Soft yellowish white sandy dolomite; slow eff. 20% pure white quartz sand	3	418
Soft yellowish white sandy and pyritic dolomite; slow eff. 10% pure white quartz sand	7	425
"Drillings washed away from 420 ft. down." "From 404 ft. down to 425 ft. most of drillings washed away. Water did not rise to top of pipe nor did it overflow."		
St. Lawrence (Mendota?) limestone (84 ft.)		
Medium hard white dolomitic limestone with a little colorless quartz sand and brown ferruginous matter; mod. eff	7	432
Hard white dolomitic limestone with a small amount of brownish gray ferruginous material; mod. eff	3	435
Hard light buff dolomite with much *red brown* iron oxide; very little fine white quartz sand; slow eff	3	438
Hard white dolomitic limestone with a small amount of fine white quartz sand; mod. eff	7	445
Hard white dolomitic limestone with about 5% of fine colorless quartz sand; water turning reddish	5	450
Hard very light buff dolomitic limestone; a little fine white quartz sand and particles of brownish red iron oxide; mod. eff. Water reddish	5	455
Hard reddish buff sandy dolomitic limestone with much *brownish red iron oxide;* brisk eff. About 10% of colorless quartz sand; water colored *red*	5	460
Hard light buff dolomitic limestone with a reddish cast due to considerable *brownish red iron oxide;* brisk eff	2	462
Hard reddish buff sandy dolomitic limestone with considerable brownish red iron oxide and white quartz sand	3	465
Hard red sandy dolomitic limestone with a large amount of *brownish and orange red iron oxide; water blood red*	5	470
Hard light *reddish buff* sandy limestone; vig. eff.; much iron oxide and some fine white quartz sand; water blood red	1	471
Hard *reddish buff* dolomitic limestone, a very little sand and much iron oxide in brownish red particles; limestone fragments largely white; water blood red	1	472
Hard reddish buff dolomitic limestone, much *iron oxide;* limestone fragments varying from white to yellow and red; a little white quartz sand	1	473
ard very red buff dolomitic limestone; larger amount of *iron oxide* than in Hprevious samples; limestone particles white to red and yellow; water blood red	1	474

	Thickness, feet.	Depth, feet.
Hard very red buff dolomitic limestone; still larger amount of *iron oxide;* limestone particles white to yellow and red, with the two latter colors predominating; mod. eff.; water blood red	1	475
Hard deep buff red dolomitic limestone with a very large amount of iron oxide; some white quartz sand	2	477
Very buff red dolomitic limestone softer than at 477 ft. Mod. eff.; large amount of iron oxide; limestone particles chiefly yellow and orange colored; some white quartz sand; water dark blood red	3	480
Soft lighter *buff red* dolomitic limestone; mod. eff.; smaller amount of iron oxide; water dark blood red	2	482
Harder *buff red* dolomitic limestone; slow eff.; water dark blood red	3	485
Very *dark red* dolomitic limestone, softer; mod. eff.; water dark blood red	1	486
Softer very *dark red* dolomitic limestone with a very large amount of iron oxide; slow eff.; limestone particles yellow and orange; some of the iron oxide is in granular particles	4	490
Highly ferruginous and *very sandy* pyritic *red* limestone; vig. eff.; water blood red; residue of about 25% of white pyritic sand	5	495
Highly ferruginous and very sandy pyritic red limestone; vig. eff.; water red and residue of more than 25% of white and very pyritic sand. Color of sludge not as red as at 495 ft	2	497
Reddish gray sandy limestone; brisk eff.; much less *iron oxide*, pyrite, and sand than at 497 ft.; limestone particles white, red, and gray. Water reddish brown	3	500
Sandy gray pyritic limestone; "water blue black;" brisk eff.; limestone particles gray and white with some reddish ones	2	502
Sandy grayish buff limestone; brisk eff.; very little sand but considerable *iron oxide*; limestone particles white and gray	3	505
Very sandy reddish buff pyritic limestone; mod. eff.; residue of 30% white quartz sand; minute pyritic crystals with a considerable amount of iron oxide	4	509
Lake Superior or "Potsdam" sandstone (21 + ft.):		
Reddish buff ferruginous and calcareous sandstone; slow eff.; residue of 60% of white quartz sand; some pyrite	1	510
Light red, very sandy and ferruginous limestone; mod. eff.; residue of about 40% of fine white quartz sand	5	515
Reddish white sandstone; considerable iron oxide; but little calcareous matter	3	518
Reddish white calcareous and ferruginous sandstone; rock is essentially a sandstone	1	519
Calcareous white and red sandstone; sludge reddish gray; water nearly clear; rock hard	3	522
Calcareous white and red sandstone; sludge reddish yellow; rock hard	2	524
Red and white sandstone; sludge reddish yellow	2	526
White and red sandstone; sludge light reddish yellow; less ferruginous than from 524-526	4	530

EATON COUNTY.

Eaton Rapids. A 12-inch well was drilled in 1914 to the depth of 700 feet for the City Water Works of Eaton Rapids by the Frank P. Rust Co. of Detroit. The well apparently penetrated the Lower Marshall and perhaps the Coldwater. The upper sandstones in the Coal Measures and Parma yield a moderate supply of water but those of the Michigan series and the Marshall formation were reported to yield very little water. This is surprising in view of the fact that much of the sandstone in the Michigan series is porous. It appears possible that a proper pumping test was not made.

EATON RAPIDS MUNICIPAL WELL.

Location: At north end of waterworks plant, Eaton Rapids, T. 1 N., R. 3 W., Eaton County. 12-inch hole. Contractor, Frank P. Rust Co., Detroit. Record from notes and samples furnished by W. W. Tuttle, driller in charge. 1914. Samples examined by R. A. Smith.

Elevation 889 ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits—Loose sand	20	20
Coal Measures:		
Sandstone, white; water	15	35
Shale, bluish and black	92	127
Parma Sandstone:		
Sandstone	30	157
Gray sandstone and limestone; former full of small holes and drusy cavities	14	171
Sandstone	30	201
Bayport Limestone:		
White pyritic limestone, cherty, and some gray shale. Violent eff	15	216
Sandstone	40	256
Michigan Series:		
Gray dense dolomite and gypsum	10	266
White sandstone with a greenish cast from numerous green quartz grains	40 ±	381
Pure white sandstone, pyritic	40 ±	421
Shale (This may be the base of the Michigan series)	10	431
Light greenish gray sandstone (Marhsall (?))	43	474
Grayish yellow sandstone with some green quartz grains	42 ±	516
Brown (red) and green shale	29	545
Marshall sandstone:		
Very fine grained light greenish gray sandstone with little lime cement; grades downward into	55	600
Very fine grained light gray and very dolomitic sandstone. No eff. with cold dilute HCl. Sand grains tightly cemented, grades down into	40	640
Lower Marhsall and Coldwater (?) shale:		
Blue gray shale	60	700
Fine grained clay grit—very dolomitic at 700 ft. like that from 600 to 640 ft.		

GRATIOT COUNTY.

Ithaca. In 1917 A. R. Purcell bored a well 785 feet deep at Ithaca. The well is used to increase the municipal water supply.

ITHACA MUNICIPAL WELL.

Location: At Water Works, Ithaca, Gratiot County.

Drilled in 1917 by A. R. Purcell, well contractor, Jackson, Michigan. Record by R. A. Smith from samples furnished by A. R. Purcell. Samples every 5 feet.

Elevation apparently below 747 feet, A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits:		
Clayey sand	5	5
Fine yellow sand, finer and loamy toward the bottom	10	15
Dark pebbly clay	25	40
Pebbly clay, apparantly with sand and gravel at the bottom	5	45
Sand gravel, water bearing	5	50
Sand	5	55
Dark fine grained reddish clay	15	70
Sand and gravel, water bearing	20	90
Sand, water bearing	10	100
Sand and gravel at top and dark fine grained reddish clay	5	105
Dark fine grained reddish clay	15	120
Dark fine grained reddish clay at top and sand and gravel at bottom	5	125
Fine sand	5	130
Pebbly blue clay	5	135
Fine gray sand	20	155
Sand and fine gravel, more sandy toward bottom; water bearing	10	165
Fine sand	5	170
Gravelly sand	5	175
Fine sand	5	180
Sand and coarse gravel and clay apparently at bottom	5	185
Clay at top and sand at bottom	5	190
Dark sand, pebbly	5	195
Fine sand and clay	5	200
Dark red clay with pebbly blue clay probably at about 213 feet	15	215
Blue clay apparently with gravel at the bottom	5	220
Gravel, probably water bearing	5	225
Very calcareous fine grained blue clay. Pebbles in places	40	265
Dark reddish clay with pebbles and sand	45	310
Dark reddish sand with some clay	5	315
Dark reddish clay with pebbles and sand, with pure white gypsum in sample at 325 feet	10	325
Dark reddish clay and pure white gypsum	5	330
Pure white gypsum mixed with some red clay	5	335
Coarse gravel	5	340
Very pebbly red clay and pure white gypsum	5	345
Brick red clay	5	350
Coal Measures:		
Pinkish red and light gray sandstone	10	360
Dark gray to grayish black bituminous shale, black at the bottom; non-calcareous	40	400
Soft light gray shale	5	405
Light gray and dark gray shale, darker toward the bottom	15	420
Dark gray shale to grayish black bituminous shale	35	455
Soft light gray shale	5	460
Soft light gray shale at the top, red sandstone below, and gray sandstone at the bottom	5	465
Yellowish white sandstone	5	470
Fine grayish white sandstone, pyritic in places	105	575

	Thickness, feet.	Depth, feet.
Grayish white sandstone, pyritic in places	20	595
Grayish white very pyritic sandstone; masses of granular pyrite	15	610
Grayish white pebbly sandstone. Small pebbles of white quartz	5	615
Medium fine grained grayish white sandstone	20	635
Gray sandstone and dark gray shale	5	640
Dark gray shale	10	650
Dark gray shale and black bituminous shale with partings of black bituminous matter	15	665
Black very bituminous shale	5	670
Dark gray bituminous shale with some black shale	10	680
Chiefly light gray shale, some dark gray shale, non-calcareous	5	685
Parma Sandstone:		
Gray pyritic sandstone, some shale at top	5	690
Gray pyritic and conglomeratic sandstone. Numerous small pebbles of white quartz; typical Parma sandstone	15	705
Gray sandstone	20	725
Bayport Limestone:		
Light gray to gray limestone; viol. eff. with cold dilute HCl	5	730
Dark fine grained bituminous dolomite; slow eff	5	735
Light gray granular limestone, with very sandy streaks	10	745
Gray sandy dolomite with streaks of dolomitic sandstone	10	750
Gray sandy dolomite at top and light gray shale at the bottom	5	755
Light gray shale at the top and white dolomitic sandstone at the bottom	5	760
White to light gray very dolomitic sandstone	10	770
White to light gray dolomitic sandstone at top and buff to brownish dolomite at bottom	5	775
Chiefly dark brown bituminous dolomite, some buff dolomite	5	780
Gray very pyritic shale	5	785

HOUGHTON COUNTY.

Lake Linden. A deep boring for water was made in 1887 by the Calumet and Hecla Copper Mining Co. at their stamp mill at Lake Linden. A diagrammatic record of the boring was furnished by F. G. Coggin, Superintendent of the mill.

The well penetrated 1,450 feet of "Potsdam" or Jacobsville sandstone without reaching the bottom of the formation.

CALUMET & HECLA COPPER MINING CO. WELL.

Location: At Stamp mill of Calumet & Hecla Copper Mining Co., Lake Linden, Houghton County. Record from diagram and information furnished in 1893 by F. G. Coggin, Supt. of stamp mill. Well begun Jan. 24, 1887, and finished May 12, following.

Elevation about 635 feet. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits:		
Gravel. Water at 10 feet, then again at 24 feet	26	26
Hardpan	7	33
Quicksand and gravel	17	50
End of 12-inch drive pipe; 10-inch below this.		
"Potsdam" or Jacobsville sandstone:		
Sandstone	6	56
Sandstone, "Pretty solid" in the upper part; loose shale at about 93 feet and solid sandstone below. 82 ft. 2 inches of 10-inch pipe	42	98
Solid reddish sandstone	274	372
Water came in at about 142 feet and rose to within two feet of surface. Previous to this, after casing was in, there was not enough water to drill with. Bottom of pump at about 196 feet. 8-inch hole to 205 feet.		
Solid reddish sandstone but a little harder at top	101	473
Red sandstone. Rock harder from about 580 feet. At 600 feet water rose in well a little	128	601
Very fine sandstone, whiter and harder and with less red clayey matter	5	606
Red sandstone. Very hard at about 1,085 feet, then softer at about 1,130	524	1,130
Red sandstone with some marl from about 1,140 to 1,170 feet. Very hard about 1,267 feet, softer at 1,318 feet and then very hard at 1,330 feet	260	1,390
Coarse white sandstone	112	1,502
Very hard bed of red "marl" at 1,435 feet. Well yielded 60,000 gallons of water per day.		

HURON COUNTY.

Bad Axe. The Sugar Company at Bad Axe drilled a well for water, a number of years ago. The record is given below.

SUGAR COMPANY WELL.

5⅝ inch hole.

	Thickness, feet.	Depth, feet.
Surface deposits:		
Muck and shell marls (?) not in original record	5	5
Clay	20	25
Gravel	5	30
Hardpan (glacial material)	5	35
Unreported (discrepancy in the record)	10	40 or 50
Upper Marshall sandstone:		
Sandstone	30	80
White shale (soapstone)	5	85
Sandstone	30	115
Lime rock	8	123
Sand rock	30	153
Lower Marshall sandstone:		
Lime rock	10	163
White shale	27	190
Sand rock	25	215
Apparently the main flow of water was at about 207 feet. This was a strong stream which rose above the surface.	5	220
Lime rock	10	230
White shale	20	250
Sand and lime	25	275
Blue shale	20	295
White shale	5	300
Red sand	7	307
Black lime	5	312
Sand rock	5	317
Black lime	3	320
"Gravel" and sand rock. The gravel is conglomerate		
Coldwater shale:		
Blue shale	15	335
Lime rock	5	340
Probably a nodule of iron carbonate and dolomite ("lime").	10	350
Sandy shale	10	360
Lime rock		
Probably a big nodule of iron carbonate and dolomite ("lime").	40	400
White shale		

INGHAM COUNTY.

Lansing. A twenty-inch well was drilled for water in 1917 by A. R. Purcell of Jackson for the Lansing Water Works. A complete set of samples was preserved for the Survey by Mr. Purcell. The samples show that in the vicinity of the plant most of the sandstone in the Coal Measures above the salt horizon is fine grained and closely cemented to yield water freely. The sandstones in the Coal Measures generally vary greatly in texture and prosity, sometimes within very short distances. It is probable that, if exploration was carefully made and complete sets of samples preserved, more porous and more freely water bearing areas of sandstone could be discovered, in or about the city.

LANSING MUNICIPAL "20 INCH" WELL.

Location: Directly north of office of Cedar Street pumping station, about 200 feet south of Michigan Avenue and 200 feet west of Cedar Street. Drilled in 1917 by A. R. Purcell, well contractor, Jackson, Michigan. Record from samples taken by A. R. Purcell.

Elevation of well curb 833.3. ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial drift:		
Yellow pebbly clay	12	12
Clay and gravel or very pebbly clay	8	20
Sandy gravel	10	30
Gravelly sand	15	45
Coal Measures:		
Fine white sandstone, very calcareous	5	50
Fine white sandstone, micaceous	10	60
Very fine white sandstone, very micaceous	10	70
Fine gray grit, argillaceous, micaceous, and calcareous	5	75
Fine gray sandstone	5	80
Fine gray sandstone, micaceous	5	85
Fine gray grit, argillaceous, micaceous, and calcareous	10	90
Fine light gray, sandstone, micaceous	5	95
Fine gray grit, argillaceous and calcareous	5	100
Fine gray sandstone	5	105
Fine gray grit, argillaceous, micaceous, and calcareous	10	115
Fine light gray grit, argillaceous and calcareous	5	120
Light gray very gritty shale, calcareous	5	125
Fine white to grayish white sandstone	90	215
Very fine white sandstone	10	225
Gray sandstone	10	235
Fine gray sandstone	5	240
Fine gray argillaceous sandstone	5	245
Fine white sandstone	5	250
Fine gray argillaceous sandstone	5	255
Very fine white sandstone	40	295
Dark gray sandy shale	20	315
Very fine grayish sandstone, more or less argillaceous and shaly	10	325
Grayish white sandstone, medium to fine grained	35	360
Fine grained sandstone, argillaceous and shaly	5	365
Very dark gray shale	5	370
Light to medium gray shale, non-calcareous	7	377
Most of the sandstone in this well is too fine and close grained to yield water freely.		

IONIA COUNTY.

Ionia. In 1910, E. E. Strope of Mason drilled nine water wells for the city of Ionia. The striking fact concerning these wells is that most of them penetrated a gypsum bed at the top of the Coal Measures. The bed varied in thickness from 4 to 10 feet. Similar occurrences of gypsum are reported by coal drillers in Saginaw county. A log and samples of the gypsum were furnished the Survey by Mr. Strope.

IONIA MUNICIPAL WELL NO. 1.

Location: On the flats of Grand River south of the city. One of 9 wells. Drilled in 1910 by E. E. Strope, Mason, Mich.

Elevation 660 ± ft. A. T.

	Thickness, feet.	Depth, feet.
Surface deposits:		
Sand and gravel	14	14
White hard-pan, soft	28	42
Blue hard-pan, stone all the way through (Boulder clay)	22	64
Red clay	29	93
Coal Measures:		
Gypsum	4	97
Red sandstone	4	101
Shale	62	163
Sandy shale	12	175
Blue shale	48	223
Sandy rock (sandy shale or grit)	44	267
Blue shale	6	273
Blue sandstone	25	298
White sandstone	12	310
Brown shale	5	315
Blue sandstone	16	331
Bayport limestone (?):		
Limestone	5	336
	29	

JACKSON COUNTY.

Jackson. In 1916, the Eastern Michigan Power Co. drilled a well for water near their plant in Jackson. A careful set of samples were preserved and furnished to the Survey by Mr. A. R. Purcell, the well contractor. The samples indicate that the Saginaw Coal Measures extend to the depth of about 55 feet and from this depth, the Parma and Marshall sandstones, generally very fine and locally very argillaceous, extend to the depth of over 400 feet. Apparently the chief water bearing horizons are in the upper and lower portions of the sandstone. The sandstone, though fine grained, locally is poorly cemented and yields water rather freely.

EASTERN MICHIGAN POWER CO. WELL.

Location: At Plant of Eastern Michigan Power Co., corner of Mechanic and Trail Streets, Jackson. A. R. Purcell, Well Contractor. Rob't Porlier and C. J. Imler, drillers. Well drilled in 1916. Record by R. A. Smith from samples and data furnished by A. R. Purcell.

Elevation 940 + feet. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Surface material	2	2
Coal Measures:		
Fine grained argillaceous sandstone chiefly	33	35
Soft gray clay shale or "fire clay." Depth of bottom of this uncertain	20 ±	55 ±
Soft dark gray micaceous and bituminous shale, non-calcareous. Black specks of bituminous matter	2 ±	57
Parma and Marshall Sandstones:		
Fine grained thin bedded micaceous gray sandstone with numerous black particles, apparently bituminous matter	7	64
Gray sandstone, water bearing	42	106
Gray sandstone with very small scattered pebbles or grains of white quartz	7	113
Soft gray sandstone	7	120
Gray calcareous sandstone and streaks of black shale	7	127
Gray sandstone with scattered coarser grains; some soft fine grained argillaceous sandstone probably at bottom	7	134
Soft fine grained argillaceous sandstone	35	169
Bluish gray calcareous sandstone, coarser and less argillaceous than above but becomes finer grained again toward the bottom	14	183
Gray sandstone	21	204
Fine grained sandstone	7	211
Very fine grained gray shaly sandstone	7	218
Bluish gray gritty shale and very fine grained shaly grit toward the bottom	14	232
Bluish gray gritty shale	7	239
Bluish gray shaly fine grained sandstone and fine grained gray sandstone	7	246
Fine grained shaly sandstone and gritty blue shale	7	253
Very gritty blue shale	28	281
Very shaly fine grained sandstone and very gritty shale	28	309
Very fine grained sandstone, much less argillaceous	7	316
Very gritty bluish shale	7	323
Dark gray very calcareous and argillaceous fine grained sandstone	14	337
Gray very shaly grit or fine grained sandstone	7	344
Gray gritty shale and shaly grit or very fine grained shaly sandstone	35	379
Fine grained gray calcareous and argillaceous sandstone	14	393
Fine grained gray sandstone	7	400

KENT COUNTY.

Rockford. The village of Rockford drilled an 8-inch well for water in 1914. A moderate flow of very hard water being found between 180 and 190 feet. From descriptions of the well churnings, it is probable that gypsum was encountered in this well, indicating the extension of the Grand Rapids-Grandville gypsum area northeast of Grand Rapids for a distance of 10 miles or more.

ROCKFORD MUNICIPAL WELL.

Location: Rockford, Kent County. A. H. Smith Company, Toledo, Ohio, contractors. R. H. Kersey, driller. Well completed in 1914. Record furnished by A. H. Smith of 8-inch test well. Provisional correlations by R. A. Smith.

Elevation 782 ± feet. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits:		
Sand	35	35
Blue clay	45	80
Muddy sand	5	85
Red clay	40	125
Chalky substance (gypsum[?])	2	127
Coal Measures or Michigan series:		
Shale rock	53	180
Water bearing rock. Flow 21 gallons per minute at 185 ft.; temperature 52½° F	10	190
Rock crystals	1	191
Shale and clay. Water not increased below 185 ft.	19	210
Two of the wells shot which increased their flow.		

LENAWEE COUNTY.

Blissfield. The Continental Sugar Co. of Blissfield drilled a test well for water in 1914. The rock waters were found to be more or less strongly sulphated. A suitable water supply was afterward found in sand and gravel beds near the base of the overlying drift.

TEST WELL OF CONTINENTAL SUGAR CO.

Location: Near plant of Continental Sugar Co., Blissfield, T. 7 S., R. 5 E., Lenawee County. Drilled in 1914 by Wm. C. Mohr. Record by R. A. Smith from driller's log and notes furnished by A. H. Smith of A. H. Smith Company, Toledo, Ohio.

Elevation 690 ± ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Sand (estimated)	10	10
Blue clay (estimated)	40 ±	50 ±
Hard pan (possibly Illinoian till)	30 ±	80
Sand and water bearing gravel (estimated at 2 to 3 ft.)	2½	82½
Unrecorded, probably hard clay or "hard pan"	22½	105
Antrim shale:		
Soapstone	100	205
Black shale with a vein of gas at 240 ft	100 ±	305 ±
Traverse (Hamilton and Marcellus formation):		
Soapstone and mixed rock (probably calcareous shale and thin hard beds of limestone and shales). Strong flow of black water saturated with sulphur and salt. Water very rank from hydrogen sulphide and iron	45	350
Vein of clear water saturated with 30 percent of salt at	.....	380
Hard sand like rock—would cut glass, 3 to 4 ft. thick at	.....	405
Limestone (probably Dundee limestone in part)	142	547
5⅝ inch casing to 440 ft. 4¼ inch casing below.		

LIVINGSTON COUNTY.

Howell. A water well was drilled for the Howell Water Works by A. R. Purcell of Jackson who furnished the Survey a complete set of samples. This well shows that locally the Coal Measures down to 329 feet are largely very fine grained sandstone and shale and yield scant supplies of water. The most promising source of supply appears to be in the sand and gravel just above bed rock.

HOWELL MUNICIPAL WELL NO. 4.

Location: At Water plant, Howell, Mich. Drilled in spring of 1917 by A. R. Purcell, Well Contractor, Jackson, Mich. Record by R. A. Smith from samples taken every five feet by A. R. Purcell.

Elevation about 915 feet. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Blue clay	5	5
Gravel, very coarse at top	10	15
Fine gravel	20	35
Coarse gravel, waterbearing	10	45
Sand, gravelly at top grading to fine sand at bottom, water bearing	15	60
Fine loamy sand	15	75
Dark clay	5	80
Fine sand, coarser at bottom	10	90
Coarse sand, water bearing	10	100
Coal Measures:		
Fine gray sandstone	10	110
Soft blue non-calcareous shale	5	115
Fine grained sandstone apparently with shaly streak at 135 feet	25	140
Very fine close grained gray sandstone clayey and calcareous	10	150
Blue shale, apparently soft, slightly calcareous	25	175
Very fine and close grained calcareous gray sandstone or grit	10	185
Very fine and close grained calcareous gray sandstone with a streak of blue shale	5	190
Very fine and close grained gray calcareous sandstone with clayey partings	25	215
Soft blue shale	15	230
Very fine gray calcareous grit with clayey partings	15	245
Soft blue shale	5	250
Soft light blue and gray shale and calcareous gray grit	5	255
Black and brown shale	15	275
Dark gray calcareous shale	15	290
Black and brown shale	39	329

Cohoctah Township. A well was drilled for water by Frank Chapman of Fowlerville on the F. & C. Burkhart farm about 10 miles northwest of Howell in Cohoctah township. A detailed log and a set of samples were preserved for the Survey by Mr. Chapman. Very little water was found at any horizon and brine was below 400 feet. The fine-grained closely cemented sandstone and gritty shales provisionally referred to the Marshall are very similar to the section below 55 feet in the Eastern Michigan Power Co. well at Jackson, a record of which appears on another page of this report.

F. & C. BURKART WELL.

Location: Just south of W. ¼ corner sec. 33, T. 4 N., R. 4 E., Livingston Co. Farm of Frank and Claude Burkart. Drilled in 1915 by Frank Chapman, Fowlerville, Mich. Record by R. A. Smith from samples and data furnished by Frank Chapman.

Elevation about 915 ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Light sand	20	20
Fine water sand	12	32
Hard pan	3	35
Blue boulder clay—Boulder shot at 47 ft	12	47
Yellow and blue clay—Boulder shot at 88 ft	41	88
Water sand and blue clay	27	115
Coal Measures:		
Shale and sand rock	3	118
Apparently a little lime rock at 116 ft.		
Soapstone	2	120
Last shot to get casing through sandstone.		
Unreported	5	125
Drove 3½ inch casing to 125 ft.		
Blue shale and sandstone alternating, the shale soft and "dissolved," i. e. slacked quickly in water. At 150-170 ft. largest supply of water; poor and muddy. At 253 ft. sulphate water	135	260
Shale and sandstone mixed with white clay	35	295
Parma sandstone:		
Fair sandrock	20	315
Blue shale	8	323
Light sandy grit	22	345
Michigan Series (?) (Bayport limestone absent?):		
Light colored soft rock like gypsum	7	352
Sand and grit	3–6″	355-6″
Cased with 2 inch casing inside the 3½ inch to 355 ft. 6 in.		
Fine grained gray micaceous sandstone	4–6″	360
Soft blue and white clay shale	3–2″	363-2″
Ceased drilling until Sept. 22, 1915. Samples from 360 ft. to bottom of well.		
Soft shale	1–10″	365
Light gray fine grained sandy or gritty shale	3	368
Soft blue shale, calcareous	2	370
Fine grained calcareous sandstone, easy drilling	2	372
Hard fine grained brownish gray bituminous sandstone, hard to drill	1	373
Smooth unctuous brown bituminous shale	13	386
Hard brown and black shale	0–6″	386-6″
Blue, green and gray limestone	0–6″	387
Very fine grained calcareous, argillaceous and pyritic sandstone	1	388
Fine grained ferruginous and shaly sandstone	2	390
Very fine grained white sandstone	5	395
2 inches blue shale or clay at 394 ft. 6 in.		
Gray sandstone and light blue shale	1	396

	Thickness, feet.	Depth, feet.
Marshall sandstone (?):		
Fine grained calcareous sandstone, hard drilling	4	400
Water fresh or only slightly brackish at 396 ft., salt increasing with depth, brine at 400 ft.		
Very fine grained calcareous sandstone (mod. eff.) and some sandy gray shale. "Easy cutting"	2	402
Fine grained white and gray sandstone, very calcareous, (Vig. eff.) "Very hard, cuts like flint"	3	405
Light buff fine grained sandstone with a thin layer of chert at the top. "Cuts easier"	2	407
Buff fine grained sandstone. "Elastic, cuts like gypsum"	5	412
Very fine grained buff gray sandstone. "Chips come up, cuts harder"	4	416
"No chips, softer; easy cutting. Drill rods covered with a white scale"	4	420
White very fine grained calcareous sandstone	5	425
Gray very fine grained sandstone or grit. "About 8 inches of hard stone at 434 ft. 1 in. A little salt water"	9–9″	434-9″
Blue gritty shale. "Cuts hard."	3	437-9″
Fine grained gray sandstone or grit. Cuts hard	4–3″	442
Dark blue shale and streaks of fine grained grit. Cuts very hard. Used 3 drills and reamer could get nothing from 444 ft. 3 in. to 445 ft. 9 in. Brine	3	445
"White shale between streaks of hard fine grained grit"	2	447
Hard fine grained sandstone, calcareous	2	449
Alternating layers of dark gray shale and fine grained sandstone, harder toward the bottom; one foot of dark bituminous shale	6	455
Very fine grained sandstone or grit and calcareous gray shale	4	459
Soft dark gray bituminous and calcareous shale	1	460
Soft very dark gray shale and streaks of fine grained grit about every five feet	15	475
Soft fine grained sandstone with hard streaks about 6 inches thick	10	485
Very hard fine grained sandstone or grit. No shale	1–8″	486-8″
Shale and fine sandstone to (No samples)	.....	506

MACOMB COUNTY.

Mt. Clemens. A number of deep wells have been drilled by the various bathing establishments at Mt. Clemens. A record of one of the older wells, the Carson, was published in Publication 14. The records of the Olympia and Clementine bath house wells were furnished the survey by Dr. G. A. Persson of Mt. Clemens. The Clementine well is 1,500 feet in depth but the record is very unsatisfactory. The Olympia well is shallower but the record, given below, is more satisfactory.

The rock waters are more highly mineralized with depth, therefore most of the wells are drilled to the depths necessary to obtain water having a specific gravity or "strength" sufficient to exert a decided buoying up effect on the bather. Some of the wells yield considerable gas which is used in firing the boilers used for pumping and heating purposes.

THE OLYMPIA WELL.

Location: At Olympia Bath House, Mt. Clemens, Macomb County. Record from Dr. G. A. Persson, Mt. Clemens. Correlations by R. A. Smith.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits:		
Clay	40	40
Sand	98	138
Antrim shale:		
Black slate or shale	116	254
Traverse formation:		
White lime	46	300
Soapstone or calcareous shale	100	400
Lime	10	410
Shale	20	430
Dundee (Onondaga) limestone and Upper Monroe or Detroit River series:		
Red lime. Water at 620 feet	470	900
Sandy lime. (Upper part of Sylvania ?)	75	975
Sylvania sandstone—White sand	55	1,030
Lower Monroe or Bass Island series—Gray lime	235	1,265

Mt. Clemens. In 1913, F. E. Spence of Detroit drilled a well 3,182 feet in depth for oil on the Denewelt Brothers farm about two and one-half miles north of Mt. Clemens. At this depth, the cable broke. The well penetrated the red Queenston shales at the top of the Richmondian but was abandoned. No noteworthy signs of oil or gas were reported.

A good driller's log was furnished the Survey in 1915 by Mr. Spence. According to the log the aggregate thickness of the salt beds is 576 feet, comparable to the thicknesses of the salt beds penetrated at Royal Oak, Oakland county, and at Dearborn, Wayne county. Near the bottom of the salt bearing horizon, one bed is 316 feet thick and probably is to be correlated with the thick bed penetrated in the deeper wells to the southwest along Detroit River. Very probably this bed contains partings of dolomite and shale.

DENEWELT BROS. WELL.

Location: Two and one-half miles north of Mt. Clemens on Denewelt Bros. farm. T. 3 N., R. 13 E. Drilled in 1913 by F. E. Spence, 44 Mt. Vernon Ave., Detroit, Michigan. Record by R. A. Smith from driller's log furnished by F. E. Spence.

Elevation about 610 (?) feet.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Chiefly clay with thin beds of sand and gravel; 10 inch drive pipe to 213 ft; 8 inch to 244 ft	244	244
Antrim shale:		
Limestone (probably in part dolomite and iron carbonate concretions)	10	254
Black shale	46	300
Traverse formation (Hamilton):		
Limestone and shale	50	350
Hard sandy limestone	25	375
Limestone and shale	25	400
White shale (Bell or Marcellus)	175	575
Dundee (Onondaga) limestone:		
Hard limestone	25	600
Limestone	75	675
Salt water to 660 ft. Line of separation between Dundee and Upper Monroe not recognized but should occur between 675 and 700 ft.		
Upper Monroe or Detroit River Series—Limestone (dolomite)	305	980
Sylvania or Middle Monroe:		
Fine sand (white sandstone resembling granulated sugar[?])	150	1,130
Lower Monroe or Bass Island Series—Fine grained limestone (dolomite)	370	1,500
Salina formation:		
Rock salt	40	1,540
Limestone (dolomite)	15	1,555
Rock salt	75	1,630
Limestone (dolomite)	42	1,672
Rock salt	62	1,734
Limestone (dolomite)	103	1,837
Rock salt	33	1,870
White shale	10	1,880

	Thickness, feet.	Depth, feet.
Limestone (dolomite)	64	1,944
Rock salt	316	2,250
Hard limestone (dolomite)	175	2,425
Shales	5	2,430
Limestone (dolomite)	20	2,450
Rock salt	50	2,500
Guelph (Upper Niagaran) and Lockport formations. Limestone (dolomite chiefly)	280	2,780
Upper part bluish to sugary white very crystalline dolomites of H. R. Ford well, Dearborn from 2,225 to 2,320 ft. Ford Motor Co. well, Highland Park, from 2,395 to 2,485 ft. Leamington Oil Co. Well, Leamington, Ont. from 1,075 to 1,495 ft. Lockport relatively thin and probably gray argillaceous dolomites.		
Cataract formation:		
Shale	38	2,818
Red rock (red shale or clay)	20	2,838
White shale	72	2,910
Limestone (Manitoulin)	64	2,974
Queenston Shale	16	2,990
Red rock (red shale and clay)	132	3,122
Limestone	60	3,182
Lost tools in hole and abandoned well. Top of Trenton is probably 350 ft. or more below bottom of hole.		

MANISTEE COUNTY.

Manistee. In 1913 the Louis Sands Salt and Lumber Co. of Manistee drilled a new salt well at their plant. A very complete log and set of samples were preserved for the Survey by Mr. C. W. Smith, President of the company. Particular attention was directed toward the possible occurrence of commercially important quantities of oil and gas but only a strong smell of petroleum was struck at about 1,305 feet, and other depths below. A rock salt bed over 27 feet thick was struck at 1,987 feet.

LOUIS SANDS SALT AND LUMBER COMPANY WELL NO. 4.

Location: South end of Cross St. and 132 ft. 4 in. south of south line of Lake St., Manistee; also 105 ft. south of No. 3 well and 276 ft. west; and 113 ft. 4 in. south of No. 2 well, and 56 ft. 9 in. west of same. Drilled by Peter McGahan. Well was begun Aug. 7, 1913. Record by R. A. Smith from a very complete set of samples and from a carefully made log by T. B. Jones, Supt. Samples and log furnished by C. W. Smith, President.

Elevation of well 17 ft 10 in. above Lake Manistee, or 598 ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits:		
Yellow sand	7-10″	7-10″
Coarse sand and fine gravel	20	27-10″
Fine light yellow sand	18-8″	46-6″
Coarse sand with very coarse gravel and stone at 95 ft	48-6″	95
Very calcareous reddish brown clay; Viol. eff. with cold dilute HCl	3	98
Sand and fine gravel	22	120
Very calcareous reddish brown clay; viol. eff	4	124
Fine yellowish white sand; water temp. 63° F	16	140
Fine yellowish white sand	13	153
Partly carbonized wood—stems and branches of plants and a cone from some cone bearing plant; cone similar to a small pine cone. Pre-Wisconsin peat bed	.....	153
Fine yellowish white sand	28	181
Brownish red clay, very calcareous; viol. eff	4	185
Coarse yellowish gray sand and fine gravel	2	187
Light blue very calcareous clay; viol. eff. (just enough for sample). Black carbonaceous loam; mod. eff.; much carbonaceous material, bits of carbonized plant stems, etc., "Just enough for sample." at	.....	187
Fine calcareous sand and gravel. Pebbles of limestone and chert form a conspicuous proportion of all the gravels down to this point	23	210
Yellowish gray sand and gravel	2	212
Fine white "quicksand"—fine calcareous sand with 10 to 15 percent of marl and clay; viol. eff	2	214
Sand and gravel, "water sand" of driller, water temp. 62° F	2	216
"Quicksand inside of 10″ "drive pipe for 150 ft."		
Sand and gravel with water (sample mainly gravel)	22	238-7″
Extremely calcareous light gray clay; vig. eff. Clay apparently 20% to 25% marl	5	243-7″
Yellowish white sand—"quicksand"	24	267-7
Gray clay; sample chiefly sand, probably in great part from the quicksand above. Water at 269 ft.—Temp. 53° F	1–5″	269
Highly calcareous light gray clay and "hardpan;" vig. eff	4	273
Very calcareous red clay; viol. eff	25	298
Yellowish gray sand—"quicksand" "hardpan"	115	413
Red highly calcareous clay—"hardpan"	1	414
Fine yellowish gray sand with water; Temp. 53° F	2	416
Red and very calcareous clay, "hardpan"	22	438
Very fine yellowish gray sand	17	455
Red and light gray calcareous clay and "hardpan"	26	481
Red calcareous clay and fine yellowish gray sand	14	495
Red calcareous boulder clay	35	530
Coarse gravel and red clay "some gas"—the first struck	23	553
"Strong indications of gas" down to 118 ft. Pressure gage reg. 5 lbs. after well had stood 12 hrs.; gas cased off with 8 in. drive pipe.		

	Thickness, feet.	Depth, feet.
Dark blue sticky clay, some gas—non-calcareous; little eff	43	596
Light blue non-calcareous clay; little eff	16	612
Coldwater (Cuyahoga) shale:		
Light blue shale; slightly eff	6	618
8 ft. drive pipe drove to 627 ft. 8¼ in.		
Blue shale—some light blue; non-calcareous	92	710
Antrim (Genesee) shale:		
Dark gray and black shale, some very bituminous streaks	30	740
"Brown shale" and "strong smell of crude oil" at 710 ft. The brown color is probably the red top of the Antrim.		
Black and brown very bituminous shale, pyrites	87	827
"Dark brown shale and strong smell of crude oil."		
Very bituminous dark brown shale	13	840
Dark brown bituminous shale	23	863
Black and very dark gray bituminous shale with streaks of blue	11	874
Dark brown and very bituminous shale; powder burns readily before the blowpipe	5	879
Dark to light brown bituminous shale	23	902
Dark brown bituminous shale	10	912
Traverse (Hamilton) formation:		
Gray to dark gray and black bituminous pyritic shale, some limestone. Vig. eff	21	933
Gray limestone, dark gray and brown calcareous shale limestone; Vig. eff	12	945
Chiefly gray dense grained limestone, some very calcareous shale and shaly limestone. Limestone vig. eff. with large residue of clay	7	952
Dense grained gray limestone, vig. eff	12	964
Very calcareous blue shale and argillaceous limestone, pyritic and fossiliferous; vig. eff	10	974
Hard gray limestone; vig. eff. Black water at 983 ft	9	983
Buff gray limestone chiefly with some white; vig. eff. "Water filled hole to top of pipe"	20	1,003
Buff to gray bituminous limestone, some white; "salt and pepper" limestone; vig. eff. Considerable amount of bituminous oily matter	25	1,023
Buff gray and white limestone, more white limestone and less oily matter than in sample preceding. "Salt & pepper" limestone. Pure white chalk or marl at 1,028, reported by driller as "gypsum and only enough for a sample" but the material violently eff. and completely dissolves in cold dilute HCl	5	1,028
Blue, non-calcareous shale with pure white chalk or marl similar to above. Probably from the seam at 1,028	7	1,035
Brown to buff hard sandy and bituminous limestone; vig. eff.; residue 20% pure white quartz sand with round uniform grains. Much oily bituminous matter	.....	1,041
Sandy white finely crystalline limestone; vig. eff. 10% white quartz sand residue. "Only enough for a sample." Weak mineralized brine at	.....	1,041
Buff and gray bituminous limestone, some white "salt and pepper" limestone; vig. eff	20	1,061
Gray very calcareous shale; vig. eff. 80% clay residue	31	1,092
Crevice or geode	3	1,095
White chalk or marl, vig. eff.; practically all dissolves. "Only enough for sample" at	.....	1,095
Light gray to light buff limestone, and chalk or marl; vig. eff	20	1,115
Dark brown and black bituminous shale and limestone, gray and buff fossiliferous limestone; vig. eff. Large amount of bituminous and oily matter. Shells of Atrypa reticularis	10	1,125
Gray and buff gray limestone, vig. eff	20	1,145
White gray very pyritic limestone and much gray chert; vig. eff. Pyrite chiefly in white limestone in minute crystals	32	1,177
Soft gray calcareous shale; vig. eff	24	1,201
Gray limestone with some shale; vig. eff	15	1,229
Gray shale, limestone and chert; vig. eff. A little gypsum, crystals of selenite	23	1,252
Dark brown bituminous limestone with white limestone; vig. eff	10	1,262
Buff gray and white limestone; viol. eff	11	1,273
Grayish buff limestone; vig. eff.; some gypsum, massive crystalline variety	9	1,282
Light grayish buff limestone; vig. eff	5	1,287
Hard light yellow and dark grayish buff limestone; vig. eff	6	1,293
Chiefly dark grayish buff limestone, bituminous and argillaceous. Residue 10 to 15% of clay. Much oily and bituminous matter. Vig. eff	12	1,305
Brown and black bituminous limestone and white limestone. The white is apparently from heads of stromatopora imbedded in the matrix of brown and black bituminous limestone similar to the Rockport beds at the base of the Traverse. "Soft easy drilling. Strong smell of petroleum"	3	1,308

	Thickness, feet.	Depth, feet.
Light brown bituminous and white stromatoporoid; limestone vig. eff	28	1,336
Light brown bituminous and white stromatoporoid limestone; vig. eff	16	1,352
Chiefly very bituminous black and brown limestone, a little white stromatoporoid limestone; vig. eff. Strong smell petroleum, large amount of bituminous matter	23	1,375
Brown and black very bituminoua limestone, some white stromatopora rock. Strong smell of petroleum and a large amount of bituminous matter	7	1,382
Light buff, brown, very bituminous black limestone; some white coralline and stromatoporoid rock; vig. eff.; considerable amount of bituminous matter	18	1,400
Hard grayish buff, brown, and black bituminous limestone, some white; vig. eff	15	1,415
Hard, grayish, buff, brown and black bituminous limestone, a little white calcite and white limestone, vig. eff	26	1,441
Grayish buff, brown, black, bituminous limestone, considerable calcite and grayish white crystalline limestone; vig. eff.; considerable bituminous matter. "Soft rock, easy drilling" from 1,441 to 1,469 feet	28	1,469
Dark grayish brown and some black limestone; vig. eff.; very little white limestone, very bituminous	25	1,494
Bell (Marcellus) shale:		
Soft calcareous shale; mod. eff. Caves. According to log this is given as "Dark gray lime rock" but the sample is labelled "gray shale, caving rock"	33	1,527
Gray slightly calcareous shale; mod. eff. Caves; apparently somewhat harder than above	11	1,538
Dundee (Onondaga) limestone:		
Soft, very pyritic white to buff gray limestone; large residue of insoluble material chiefly pyrite and argillaceous matter most of which was apparently from the shale above. Very viol. eff	18	1,556
Soft pyritic buff gray limestone; some white; vig. eff. "Soft easy drilling" from 1,527 to 1,580 feet	24	1,580
Hard gray pyritic limestone; some white; viol. eff	19	1,599
Hard dark gray pyritic limestone, some white and some black bituminous limestone. A little white quartz sand; mod. eff	8	1,607
Hard dark buff gray very bituminous pyritic limestone, some small white rounded quartz grains; viol. eff. Put in 5 to 6 inch liner pipe to depth of 1,620 ft	27	1,634
Hard brown very bituminous limestone; very viol. eff	8	1,642
Very hard brown and very bituminous and pyritic limestone, viol. eff. A little white quartz sand. Much black bituminous residue	12	1,654
Very hard light grayish buff limestone, very little pyrite and bituminous matter. "Very hard drilling" from 1599 to 1675 feet	21	1,675
Soft buff limestone, viol. eff. "strong smell of crude oil"	5	1,680
Very hard grayish buff limestone, viol. eff	36	1,716
Monroe formation:		
Light brown magnesian limestone, very bituminous and apparently very hard. Mod. to brisk eff.; effervescence much slower than in any of the preceding samples of limestone	15	1,731
Gray and brown bituminous limestone, viol. eff	5	1,736
Chiefly dark grayish brown bituminous dolomite, very bituminous. Some very black particles of limestone and considerable pure white limestone and calcite, probably from geodes and fossiliferous rock	27	1,763
Light brown dolomite; brine and strong smell of petroleum at 1,766 feet; 30 per cent brine at 1,780 feet	16	1,780
Light brown dolomite	69	1,849
Hard light brown dolomite, with soft strata at about 1,942 (?) ft. Brine 81 per cent, salinometer test	137	1,987
Salina formation:		
Rock salt	27–6″	2014-6″

MARINETTE, WISCONSIN.

Marinette. Two wells were drilled by the city of Marinette, Wisconsin, which is across the river from the city of Menominee, Michigan. The first hole was drilled only 716 feet and the tools lost at that depth, but the second hole, only eight feet from the first was drilled 978 feet deep, penetrating the pre-Cambrian rocks for nearly 200 feet. A brief record of the first well was published in the Annual Report of the Geological Survey for 1903 and a summary record of the second well in the Annual Report for 1904. A good set of samples were preserved from the second well. A study of the samples and especially a comparison with the very complete sets of samples from the recent borings at Escanaba and Pine Ridge, Delta county (see Delta county) throw much light on the geology along the west side of Green Bay. For this reason it has been deemed advisable to publish the record of the deeper Marinette well in detail.

MARINETTE MUNICIPAL WELL NO. 2.

Location: At city water works, Marinette, Wis. Samples preserved by H. B. Simcox. Record by R. A. Smith from samples, and data published in the Annual Reports of The Geological Survey for 1903 and 1904.

Elevation about 600 (?) feet A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or glacial deposits—Sand and gravel	69	69
Galena-Trenton:		
Very bright buff dolomite, mod. to slow eff	31	100
Bluish gray, crystalline dolomite, some light colored, sandy dolomite; rounded quartz grains embedded in the dolomite; mod. eff	25	125
Sandy "salt and pepper" dolomite—a mixture of white and bluish gray, crystalline dolomite. Considerable amount of rounded, colorless quartz sand	20	145
Sandy gray to white crystalline dolomite, slow eff. considerable colorless quartz sand	15	160
Gray to dark gray crystalline dolomite, slow eff. a little white sand	15	175
Gray crystalline dolomite, slow eff.; a little white sand	15	190
White and light buff crystalline dolomite, slow eff. some blue shale and colorless quartz sand	25	215
Gray to light buff crystalline dolomite, slow eff.; a fragment of dark brown dolomite; some colorless rounded quartz grains embedded in the dolomite	10	225
Grayish buff, crystalline dolomite with some gray dolomite; slow eff	20	245
White sandstone; rounded, colorless quartz grains embedded in a matrix of white dolomite—characteristic; some fragments of dolomite	15	260
Sandy, dark brownish gray and white dolomite	15	275
Bluish gray, dolomitic shale, or very argillaceous dolomite, and gray dolomite, very pyritic in places; slow eff	15	290
Dark and light gray, fine grained, argillaceous dolomite, and gray dolomite; slow eff.; very pyritic in places	35	325
St. Peter sandstone:		
Pure white sandstone, some fragments of dolomite	40	365
White to yellowish gray and white dolomite, very sandy in places	35	400

	Thickness, feet.	Depth, feet.
Beekmantown or "Calciferous" sandstone:		
White dolomite and some dark red shale and argillaceous dolomite, slow eff.; some rounded white quartz sand	20	420
Jordan sandstone—Pure white sandstone with some dolomite near the top	40	460
St. Lawrence:		
Gray sandstone and sandy dolomite	70	530
Gray sandstone with some sandy dolomite. Rounded colorless quartz grains embedded in the dolomite	20	550
Very white sandy, crystalline dolomite	10	560
Lake Superior or Potsdam sandstone:		
Pure white sandstone	20	580
Grayish white sandstone; rounded, colorless quarts grains	20	600
Pure white sandstone	60	660
Greenish white sandstone	40	700
White sandstone	60	760
Reddish white sandstone, most grains stained yellow or red	15	775
Light brick red quartzite and white sandstone. Evidently the sample at 795 was from the top of the Pre-Cambrian quartzite	20	795
Pre-Cambrian (Huronian [?]):		
Jaspilitic arkose, quartzite of various shades of red with white mica, pyrite, feldspar, etc. Locally much stained, colored by iron oxide. Artesian water struck at 860 feet	183	978

MIDLAND COUNTY.

Sanford. A well 400 feet in depth was drilled at Sanford to secure an adequate supply of water for the proposed State Sanitorium for Tuberculosis. In the first well there were no fresh water-bearing strata in the surface deposits or in the bed rocks below. A little salt water was encountered below 228 feet. A second well 400 feet from the first was drilled to the depth of 245 feet. These and other wells indicate that the underground supplies of fresh water in the vicinity of Sanford are limited.

SANFORD SANITORIUM WELL NO. 1.

Location: Near site of proposed State Sanitorium for Tuberculosis, Sanford, Midland Co., T. 15 N., R. 1 W. Drilled in 1914. Record furnished by Dr. E. B. Pierce, Superintendent of Michigan State Sanitorium at Howell.

Elevation about 620 A. T.

	Thickness, feet.	Depth feet.
Pleistocene or glacial depth:		
Sand	5	5
Clay	46	51
Hardpan	175	226
Saginaw Coal Measures:		
Shale	2	228
Sandrock and shale 1% brine	108	334
Depth of well	.....	400

Test well No. 2 was driven to the depth of 245 feet, 400 feet from the first, with similar results.

OAKLAND COUNTY.

Avon Township. D. M. Ferry and Co. drilled a number of test wells for water on their seed farm near Rochester. The surface deposits contained only very thin beds of sand and gravel, yielding but a scanty supply of water. The deepest well penetrated rock and struck brine in the Berea sandstone. A suitable supply of fresh water was found in the drift by directing exploration northwest from the farm toward the morainic country.

D. M. FERRY & Co. WELL NO. 1.

Location: Center-south, Section 23, Avon Twp. (T. 3 N., R. 11 E.) Oakland Co. Drilled Sept. 1912, by O. N. Phillips, Troy, Contractor for D. M. Ferry Co. of Detroit. Record furnished by O. N. Phelps.

Elevation about 760 feet.

	Thickness, feet.	Depth feet.
Pleistocene or glacial deposits:		
Sand	7	7
Blue clay	121	128
Fine sand streaked with hard pan	10	138
Sand hardpan	27	165
Coldwater shale:		
Blue shale	15	180
Black shale and slate rock	45	225
Water shales	5	230
Berea sandstone:		
Sandstone	50	280
Antrim shale:		
Gray shale	95	375

OTTAWA COUNTY.

Zeeland. A test well for water was drilled in 1913 for the village of Zeeland. Very little water was found in the drift and brine was struck in the Coldwater shale below. Zeeland is near the feather edge of the Marshall sandstone. In a later well, water was struck in considerable quantity in an outlier of Marshall sandstone southwest of the village. The record below was compiled from a sketch furnished by the W. J. Sherman Co. of Toledo.

ZEELAND MUNICIPAL WELL NO. 1.

Location: Zeeland, Michigan. R. 14 W. T. 5 N. Copied by W. J. Sherman Co., Toledo, Ohio, from sketch furnished by village authorities December, 1913.

	Thickness, feet.	Depth feet.
Pleistocene or Glacial Drift:		
Yellow sand	1.5	1.5
Yellow clay	5.5	7
Tough blue clay	5	12
Clay and sand mixed	28	40
First water at 40 feet.		
Sand hard pan with large boulders	20	60
Sand hard pan	65	125
Seam of water sand 125 feet.		
Sand hard pan	25	150
Water sand at 150 feet.		
Sand hard pan with large boulders	50	200
Clay hard pan	2	202
Coldwater shale:		
Shale rock	291	493
Brownish rock with mica	2	495
Gray lime rock	45	540
Brine—60% salt at 540 feet.		
Gray lime rock	37	577
Shale at 577 feet.		

ROSCOMMON COUNTY.

Roscommon. Franz Jahncke began a test well for oil at Roscommon for Walker and Bell of Alpena. At a depth of 874 feet the well was abandoned. A record was furnished the Survey by Mr. Jahncke. The Marshall sandstone was 125 feet thick and yielded a large flow of artesian water.

ROSCOMMON WELL.

Location: Roscommon, Roscommon County. Drilled in 1914 for Walker and Bell Company by Franz Jahncke of Alpena, Mich.

Elevation about 1,125 ±.

	Thickness, feet.	Depth feet.
Pleistocene or surface deposits:		
Mostly sand and gravel; no gypsum or sharp cornered lime rock in the drift	417	417
Michigan Series:		
Soft sand rock	8	425
Black limestone, big flow of mineral water	0–6″	425–6″
Hard gray blue rock, very sharp; one bit would not drill more than 10 inches or a foot	59–6″	485
Blue Shale	63	548
Upper Marshall:		
Sand rock, micaceous toward bottom	125	673
Big flow of water at 550 ft., rising 7 ft. above surface.		
Lower Marshall and Coldwater—Blue shale full of gas	201	874

ST. CLAIR COUNTY.

Port Huron. In 1916 the Morton Salt Co. formerly the Port Huron Salt Co. drilled a deep well for salt of which a careful log and a complete set of samples were preserved for the Survey. The following is the record as compiled from the drillers' log and samples. The samples were taken every five feet. This made it possible to draw the line of separation between the Dundee limestone and the Monroe formation within very narrow limits. The samples from this well and the wells at Dearborn and Highland Park, Wayne county, show that in southeastern Michigan the Dundee limestone has a thickness varying from about 100 feet in the vicinity of Detroit to 125 feet at Port Huron.

MORTON SALT CO. WELL NO. 11.

Location: At Plant, southern part of the city of Port Huron. Well began May 15, 1916; completed Sept. 9, 1916. Drilled by Brogan Drilling Company, Port Huron. Record by R. A. Smith from a complete set of samples and data furnished by Morton Salt Co. through C. A. Sotherland. Samples every 5 feet from depth of 167 feet.

Elevation 24-25 feet above St. Clair River or about 604 feet. A. T.

	Thickness, feet.	Depth feet.
Pleistocene or surface deposits:		
Drift with 2 ft. of gravel with water 14 ft. 4 in. of 12 in. pipe	12–2″	12–2″
Clay with 2 ft. of sand and gravel in bottom of clay, struck gas but pipe shut it off. Rock at 134 feet. Put in 132 ft. 5 in. of 10 in. drive pipe	121–10″	134
Antrim shale:		
Grayish and brownish black shale, very pyritic in places and very black at 247 ft	168	302
Lots of gas from black shale crevice at 190 ft. Shale very hard in bottom from about 182 to 222 feet		
Traverse formation:		
Gray argillaceous limestone; violent effervescence	10	312
Gray and buff limestone, hard limestone from 321 feet to 400 feet, viol. eff	15	327
Hard limestone and streaks of gray very calcareous shale—soapstone; viol. eff	25	352
Hard gray to buff and brownish limestone with streaks of shale	40	392
Gray calcareous shale, some limestone	8	400
Gray and buff to dark bituminous limestone with some shale; viol. eff	12	412
Dark gray calcareous and fossiliferous shale; some limestone at 510 and 515 ft	125	537
Dark bituminous crystalline limestone, viol. eff., some shale	5	542
Bell shale:		
Dark gray shale, fossilferous; viol. eff	58	600
Dundee (Onondaga) limestone:		
Dark buff and bituminous limestone; viol. eff. Some shale apparently from above	7	607
Light buff and buff limestone, viol. eff. Hard and slow drilling, crevice, black water, and gas at 640 feet	35	642
Dark gray and buff limestone, viol. eff	5	647
Gray to buff limestone, brown and bituminous in places, viol. eff	85	732
Upper Monroe or Detroit River Series:		
Buff dolomite, slow eff	20	752
Buff and brown to black bituminous dolomite with shaly streaks; slow effervescence	5	757

	Thickness, feet.	Depth feet.
Buff dolomite, sandy; slow eff. Numerous small colorless grains of quartz in places. Much black bituminous matter in streaks and partings	30	787
Gray and buff dolomite with streaks of black bituminous and gray shaly matter; slow eff	30	817
Grayish black very bituminous dolomite, slow eff. Some buff and gray dolomite	20	832
Buff and gray dolomite with much anhydrite	10	842
Buff to dark buff bituminous dolomite, slow eff. Wet hole and at 918 feet hole was full of water	10	852
Dark buff and brown very bituminous dolomite slow eff. "Wet hole"	15	867
Buff to dark buff bituminous dolomite; slow eff	10	877
Buff dolomite and anhydrite, slow eff	5	882
Light buff to grayish buff fine grained dolomite, a little gypsum at 928 feet, slow eff. Hole full of water from 918 ft. down to 1,393 ft. 10 in. Put in 1,393 ft. 6 in. of 6¼ inch casing with packer	65	947
Gray fine grained shaly dolomite; slow eff	5	952
Light buff fine grained dolomite, slow eff	5	957
Gray to dark gray shaly dolomite and shale, slow eff	40	997
Dark brownish gray and dark brown bituminous dolomite, very argillaceous in places	60	1,057
Limestone very "sharp" at 1,033 ft. Oil at 1,007 feet.		
Hard dark gray to grayish black and brown dolomite, argillaceous in places	25	1,082
Dark gray argillaceous dolomite	10	1,092
Dark gray and buff argillaceous dolomite, close grained and very argillaceous or shaly in places	35	1,127
Very hard buff to dark buff fine grained dolomite; bluish at 1,170 ft. Cherty from about 1,176 to 1,182 feet	55	1,182
Hard buff dolomite with anhydrite	15	1,197
Dark gray argillaceous dolomite	5	1,202
Gray to buff dolomite and much anhydrite. "Sharp" or hard granular dolomite at 1,210 feet	35	1,237
Gray argillaceous to very argillaceous dolomite. Twelve feet of hard "blue lime" 1,267 to 1,279 feet. Cherty at 1,275 feet	45	1,282
Dark gray shale	5	1,287
Light colored dolomite	10	1,297
Dark gray shale and shaly dolomite	5	1,302
Light buff dolomite	5	1,307
Dark gray shale	5	1,312
Dark gray shaly dolomite	5	1,317
Light colored dolomite	10	1,327
Gray shale and shaly dolomite	5	1,332
Light to buff dolomite	5	1,337
Gray shale and shaly dolomite	5	1,342
Light to buff dolomite, with dark gray shale at the bottom	20	1,362
Dark gray shale, some dolomite and anhydrite ($CaSO_4$)	20	1,382
Gray shaly dolomite	10	1,392
Dark gray shale and shaly dolomite	5	1,397
Black bituminous shale and shaly dolomite	5	1,402
Buff to gray dolomite	5	1,407
Chiefly buff dolomite. Struck brine at 1,421 feet which tested 90 per cent	15	1,427
Dolomite and much anhydrite ($CaSO_4$)	25	1,452
Buff dolomite, gray shale, and some anhydrite	10	1,462
Gray argillaceous dolomite, in places shaly, some anhydrite. "Bottom of blue limestone"	53	1,515
Salina:		
White salt with some streaks of shale	15	1,530
White salt	55	1,585
Anhydrite, shale, and salt	5	1,590
White salt. "Bottom of salt." (Other beds of salt occur below this depth—S.)	6–4″	1,596–4″
Dolomite	4	1,600–4″
Casing: 52 feet 7 inches of 12-inch drive pipe, 132 feet 5 inches of 10-inch pipe, 1,396 feet 10 inches of 6¼-inch casing; 1,597 feet 6 inches of 3 and 3½-inch tubing and 561 feet 5 inches of air line.		

North Port Huron. In 1915 the Michigan Central Oil and Mining Co. of Port Huron drilled an oil well on the low ground on the north side of Black River about two miles west of North Port Huron. This well is the most northerly of the oil wells drilled in the Port Huron anticline. No oil or gas was reported but it is probably that oil and gas were struck in small quantities similar to the wells on the south side of the river on the May and Gillette farms as described in Publication 19, Mineral Resources of Michigan for 1914.

OXBOW WELL NO. 1.

Location: On the Oxbow of Black River a few rods north of the river channel, near S. E. corner N. W. ¼ sec. 32, T. 7 N., R. 17 E. Drilled in 1915 by Michigan Central Oil & Mining Co., Port Huron. Record by R. A. Smith from samples furnished by C. M. VanCuren, Pres., and G. W. VanCuren, Manager of the company.

Elevation about 586 ft. A. T.

	Thickness, feet.	Depth feet.
Pleistocene or surface deposits:		
River silt and clay	70	70
Coarse gravelly sand, very dark from fragments of black shale, shale particles angular	35	105
Antrim shale:		
Black bituminous and pyritic shale	105	210
Black pyritic shale and buff to gray limestone; mod. eff.	5	215
This screw apparently penetrated the Traverse about 2 ft.		
Traverse (Hamilton) formation:		
Hard, fine grained buff magnesian limestone; mod. eff.	6	221
Record missing	20	241
Gray and grayish buff limestone; vig. eff.	9	250
Record missing	280	530
Soft blue gray calcareous shale or soapstone (Marcellus); vig. eff.	10	540
Dundee (Onondaga) limestone:		
Dark gray limestone; viol. eff.	2	542
Dark gray very pyritic limestone; viol. eff.	4	546
Light buff crystalline limestone; viol. eff.	16	562

WAYNE COUNTY.

Dearborn. In 1915 Henry R. Ford drilled a well at Dearborn, Wayne county, largely for scientific purposes. The well as planned was to be 5,000 feet deep or down to the "granite" or pre-Cambrian rocks. The well was begun June 14, 1915, and by the middle of October it was down to 4,035 feet, when the drill wedged in a crevice, breaking the cable. After several months of vain effort to recover the tools, the well was abandoned. This is the deepest well in the state, being over 350 feet deeper than the deep well at Mt. Pleasant, Isabella county.

A careful log and duplicate sets of samples were preserved, one set for the State Survey and the other for Mr. Ford. The samples were taken every five feet and with the log afford detailed information concerning the character, thickness, and depth of the rock strata down nearly to the Cambrian. The Mt. Pleasant well ended in the top of the Dundee (Onondaga) limestone at a depth of 3,680 feet and the Dearborn well began in the top of this formation. The two wells thus give a complete section of the Paleozoic rocks nearly down to the Cambrian.

The most important facts shown by the record are the exceptional aggregate thickness of the rock salt beds, the presence of about 300 feet of gypsiferous and celestitic rocks below the salt bearing horizons, the thinness of the "Niagara," and the exceptional thickness of the so-called "Trenton" limestone.

The salt beds at Dearborn have an aggregate thickness of over 550 feet in a section of 870 feet. In the Royal Oak well, over 600 feet of salt was penetrated in a section of 932 feet. These thicknesses are much greater than farther east along Detroit River and indicate that the salt beds extend a considerable distance northwest toward the center of the state.

In most of the earlier records of wells drilled in southeastern Michigan, the line separating the Salina from the "Niagara" was drawn near the base of the salt bearing horizon. At Dearborn and also at Highland Park, the strata are dark, bituminous, shaly dolomite simliar to the Monroe beds above the Salina. Moreover, the beds are brecciated and locally contain an abundance of gypsum and celestite, the latter being most abundant in the cavities of the breccias.

The removal of these beds from the "Niagara" limestone leaves this formation very thin in southeastern Michigan; it is about 90 feet thick at Dearborn. The record of the Ford Motor Co. well at Highland Park, Detroit, indicates a similar thickness.

In the Northern Peninsula the "Trenton" has a maximum thick-

ness of about 270 feet and is to be directly correlated with the Galena and Platteville limestones of Wisconsin. In southeastern Michigan the Trenton has an average thickness of over 850 feet as shown by the Dearborn and the LaSalle (Monroe county) wells, and is to be correlated with the Ontario rather than the Wisconsin section. According to Ulrich most of the "Trenton" in southeastern Michigan is probably Black River.

No oil or gas was found at any horizon. An abundance of sulphuretted water was struck just above and in the top of the Dundee, and much sulphate water down to the bottom of the Sylvania sandstone. Below this there was very little water until the St. Peter sandstone was reached.

The following is an illustrated record of the Dearborn well.

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Highland Park. A few years ago the Ford Motor Company drilled a test well for water near their plant in Highland Park, Detroit. A complete set of samples was preserved from which a duplicate set was made for the Survey. Apparently no log was kept and the following is a detailed record made from the samples:

FORD MOTOR CO. WELL.

Location: 48 ft. 4 in. south of north property line and 6 ft. 3 in. west of West Brush St. line of Ford Motor Co., Woodward Ave., Highland Park, a suburb on the north side of Detroit. Drilled in 1913. Record by R. A. Smith from samples furnished through W. H. Smith of the Ford Motor Company. Record down to 230 ft. is based on general geological data.

Elevation about 633 ft. A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Sand and sandy clay	25 +	25 +
Clay with some intercallated beds of sand and gravel	115 ±	140 ±
Antrim (Genesee) shale—Black bituminous shale	60 ±	200 ±
Traverse (Hamilton) formation:		
Limestone and calcareous shale or "soapstone" probably	30	230
Soapstone or soft gray, highly calcareous shale; vig. eff. with cold dilute hydrochloric acid. Fossiliferous (athyris) between 270 and 280 ft	70	300
Hard gray limestone, some gray shale or soapstone, viol. eff	5	305
Hard gray, crystalline limestone, viol. eff	5	310
Bell (Marcellus) shale:		
Soft highly calcareous, light gray shale or "soapstone," very smooth grained	40	350
Dundee (Onondaga) limestone:		
Hard, light gray, crystalline limestone; vig. eff. Sample 350 to 355 badly rusted	10	360
Hard, white to light gray and buff gray and buff, crystalline limestone with dark brown and black streaks and laminae of bituminous matter. Viol. eff. 2 to 3% of pure white sand, grains very rounded in sample 470 to 475 feet	115	475
Very hard, crystalline, light gray, pyritic and sandy limestone, vig. eff. to to viol. eff. many very small crystals of pyrite and 5% or more of pure white quartz sand with rounded grains of uniform size similar to the Sylvania	5	480
Buff, bituminous and white to light grayish buff limestone. Buff limestone is very sandy appearing but contains very little sand; viol. eff. Crinoidal from 485-490 ft	10	490
Upper Monroe dolomites or Detroit River Series:		
Chiefly white, earthy looking dolomite with fine laminae of pyritic and black bituminous matter; slow eff. A little buff, bituminous limestone apparently from Dundee above, vig. eff. cf. H. R. Ford well, Dearborn at 220 ft	5	495
Buff, bituminous limestone and native sulphur	10	505
White, light gray and buff bituminous limestone and native sulphur	5	510
Light gray dolomite; mod. eff	5	515
Light gray to buff dolomite; mod. to brisk eff	5	520
Light, grayish buff to dark buff dolomite and dolomitic limestone; slow to brisk eff. Some dark gray shale. Eff. with fine powder seems to be due to crystals of calcite in geodes and seams	10	530
White and buff dolomite and dolomitic limestone. Slow to brisk eff	5	535
Hard, buff, granular dolomite and dolomitic limestone; slow eff. to moderate eff	5	540
Hard, light buff dolomite; slow to mod. eff	15	555
Buff, bituminous dolomite; slow eff	15	570
White and light buff dolomite; slow eff	5	575
Light buff and buff dolomite and some black shale; slow eff	5	580
Light buff dolomite, pure white anhydrite and gypsum—apparently cleavage plates of selenite	5	585
Light buff to buff dolomite and much pure white anhydrite; slow eff	15	600
Dark buff dolomite; slow eff	5	605
Light buff dolomite, slow eff	5	610

	Thickness, feet.	Depth, feet.
Chiefly white dolomite, some light buff; slow eff	10	620
Light gray, earthy looking dolomite; slow to moderate effervescence	5	625
Buff crystalline dolomite; slow to mod. eff	5	630
Light buff, crystalline dolomite, sandy about 5% of pure white quartz sand, grains rounded, slow to mod. eff	15	645
White and very light buff, dense grained dolomite, slow to mod. eff	10	655
Light buff dolomite	5	660
Buff gray, argillaceous dolomite with streaks and laminae of black bituminous shale, slow eff. Considerable residue of clay	5	665
Light buff and white, finely crystalline dolomite, mod. eff	15	680
Light buff dolomite and pure white anhydrite—25% anhydrite	10	690
Light, grayish buff, fine grained dolomite with black, bituminous laminae	5	695
Very light gray, grayish buff and white dolomite; mod. eff	5	700
Buff dolomite with black bituminous streaks and soft white chalky limestone, the latter viol. eff	5	705
Dark grayish buff, dolomitic limestone; moderate to brisk effervescence	5	710
Grayish buff limestone; vig. to viol. eff. The limestone from about 705-730 ft. may be the Anderdon beds	5	715
Buff limestone with much white chalky limestone, viol. eff	5	720
Light buff limestone; viol. eff	5	725
Light buff to buff limestone, viol. eff., and dark buff bituminous dolomite, slow eff	5	730
Dark buff gray dolomite and some light buff limestone, the first slow eff.—latter viol. eff	5	735
Sample from 735 to 745 missing—very probably dolomite	10	745
Grayish buff dolomite and considerable shaly, white limestone, the latter viol. eff	5	750
Grayish buff dolomite and dolomitic limestone; brisk eff	25	775
Buff gray dolomite; brisk eff	10	785
Sylvania sandstone or Middle Monroe:		
Pure white sandstone of uniform sized grains of white or colorless quartz—a glass sand. A little admixture of buff dolomite from above	5	790
Pure white sandstone—sample badly rusted from fragments of the drill	30	820
White dolomitic sandstone; slow eff. 80% pure white quartz sand	5	825
Pure white sandstone	25	850
Pure white sandstone and gray sandy dolomite	5	855
Gray sandy dolomite—pure white rounded sand grains embedded in a dolomitic matrix	5	860
Lower Monroe or Bass Island Series:		
Hard, light gray dolomite; mod. to brisk eff. Some white chalky limestone, viol. eff	20	880
Light gray and very white crystalline dolomite, slow to mod. eff	5	885
Grayish buff to dark gray, argillaceous dolomite, some pure white chert	15	900
Gray dolomite with white chalky limestone, the latter vig. eff. Chalky material apparently from cavities and seams	10	910
Light grayish buff dolomite	10	920
Light gray and gray dolomite, slow eff	10	930
Grayish buff dolomite with considerable pure white, crystalline dolomite, apparently from geodes	5	935
Light buff dolomite, slow eff	5	940
Samples missing from 940 to 955 feet	15	955
Light buff and gray dolomite	10	965
Light buff dolomite	20	985
Very light buff, fine grained dolomite, mod. eff	5	990
Light buff, dense grained dolomite	15	1,005
Very light grayish buff, dense grained dolomite	10	1,015
Buff, dense grained dolomite with bituminous streaks and laminae	10	1,025
Light buff, dense grained dolomite. Insoluble residue of 10% of bituminous and argillaceous matter and pure white quartz sand, the latter probably from the Sylvania above. Very slow eff	15	1,040
Gray, shaly dolomite with thin streaks and laminae of dark to black bituminous matter, slow eff. Considerable insoluble residue of clay and bituminous matter	5	1,045
Chiefly buff, dense grained dolomite with some gray and dark bituminous streaks and laminae, slow eff	5	1,050
Hard, buff gray dolomite, considerable clay residue, slow eff	5	1,055
Grayish to dark buff and brown bituminous dolomite	5	1,060
Light gray dolomite, some dark buff and brown, slow eff	5	1,065

	Thickness, feet.	Depth, feet.
Salina (?) formation:		
Pure white salt. This sample is apparently out of place. There is not the slightest trace of salt in the samples preceding or in the samples immediately following this one and some salt should certainly be found in the samples from 1,070 to 1,075	5	1,070
Buff gray to dark grayish buff and brown, bituminous and argillaceous dolomite, slow eff	5	1,075
Chiefly grayish buff dolomite with black, bituminous streaks and laminae, slow eff	5	1,080
Light buff to buff dolomite and gray shaly dolomite, some dark bituminous laminae, slow eff	10	1,090
Light grayish buff, dense grained dolomite, argillaceous, slow eff	25	1,115
Light buff and gray and dark buff and brown bituminous dolomite	5	1,120
Gray, shaly dolomite, some buff dolomite with bituminous streaks and laminae, and considerable white anhydrite and gypsum	5	1,125
Dark buff, bituminous dolomite with white seams of crystalline dolomite; slow eff	5	1,130
Gray to dark gray, shaly and light buff dolomite and white anhydrite, slow eff. Large clay residue, considerable bituminous matter	10	1,140
Gray, very shaly dolomite and much white anhydrite and gypsum	5	1,145
Dark gray shale and some white anhydrite	10	1,155
Chiefly white anhydrite, some light buff dolomite	5	1,160
Light buff to buff, very dense grained dolomite, very thinly bedded	10	1,170
Buff to dark buff, bituminous and very dense grained dolomite, very thin bedded	5	1,175
Very light buff dolomite and white anhydrite, dolomite very thin bedded, largely precipitate of barium sulphate	5	1,180
Gray dolomite	5	1,185
Grayish buff and dark gray, bituminous dolomite, slow eff	10	1,195
Gray and buff dolomite and anhydrite	15	1,210
Gray shale, buff and gray, shaly dolomite, and some anhydrite	10	1,220
Chiefly gray shale, some gray shaly dolomite	15	1,235
Gray, shaly dolomite	5	1,240
Dark gray shale and gray argillaceous dolomite	10	1,250
Buff gray dolomite and gray shale	15	1,265
Salina formation:		
White salt with a little dolomite and shale probably from above. Strong flame coloration for potassium on samples 1,265 to 1,275, weak from clear salt samples. Flame test for potassium, using a Merwin triple screen for flame reactions, was run on all of the samples of salt and of the shale and dolomite immediately above each salt bed. Strong flame colorations were given almost uniformly by the shale and shaly dolomite and also by the impure salt, i. e., the salt mixed with shale and shaly dolomite. The solutions made from the samples of clear salt and also those of shale and dolomite gave only faint flashes of color. The flame colorations apparently were due to potassium compounds in the shale and shaly matter and not to free potash salts in the salt beds	40	1,305
White salt and considerable shale with some anhydrite, apparently a streak of shale	5	1,310
White salt, chiefly with a little admixture of shale and dolomite	10	1,320
Yellowish white salt with much buff dolomite, some anhyrdite	5	1,325
Argillaceous dolomite and anhydrite	5	1,330
Argillaceous dolomite, bright potassium flame	5	1,335
Chiefly white salt, some dolomite and shale	10	1,345
Clean, white salt, stained yellow with rust from the drill	45	1,390
White salt and anhydrite	5	1,395
Gray shale, dolomite and anhydrite	5	1,400
Chiefly anhydrite, some shale and dolomite	5	1,405
Sample missing	5	1,410
Chiefly buff dolomite and gray shale	5	1,415
Buff dolomite, gray shaly dolomite, and much white anhydrite	5	1,420
Buff dolomite and gray shale	5	1,425
Clean, white salt	20	1,445
Sample missing	5	1,450
Chiefly anhydrite and salt, some buff dolomite	10	1,460
Chiefly white salt, some anhydrite and dolomite	5	1,465
Sample missing, probably salt	5	1,470
Clear white salt	5	1,475
Sample missing, probably salt	10	1,485
White salt	10	1,495
Salt, anhydrite and dolomite	5	1,500
White salt	5	1,505
Soft buff dolomite, bituminous, slow eff	10	1,515

	Thickness, feet.	Depth, feet.
Buff dolomite and considerable anhydrite	10	1,525
Buff dolomite and gray shale and shaly dolomite, slow eff	5	1,530
Chiefly white salt, some shaly dolomite and shale	5	1,535
Clean white salt	15	1,550
Sample missing, probably salt	5	1,555
White salt	5	1,560
White salt and gray shale	5	1,565
White salt, a very little gray shale at 1,570 ft., the latter an admixture from above	50	1,615
White salt and gray shale	5	1,620
Gray shale, a little white anhydrite	5	1,625
Chiefly gray dolomitic shale and a little light buff dolomite	5	1,630
Very light buff dolomite and white anhydrite, some gray shale	15	1,645
Light buff dolomite and some dark gray and black shale	5	1,650
Chiefly gray shale, some light buff dolomite	5	1,655
Buff dolomite and gray shale with some anhydrite	15	1,670
Buff to dark buff dolomite and dark gray to black bituminous shale	10	1,680
Buff dolomite, gray shale and anhydrite	5	1,685
Chiefly light buff dolomite and some dark bituminous dolomite, a little anhydrite	10	1,695
Buff, granular dolomite with fine black, bituminous laminae	10	1,705
Light to dark buff dolomite	5	1,710
Light buff to buff, brecciated dolomite with clay cement, dark bituminous streaks	5	1,715
Light to dark buff, bituminous dolomite, slow eff	15	1,730
Clean white salt	5	1,735
White salt with a little dolomite and shale	25	1,760
Light buff to buff dolomite	5	1,765
Buff dolomite, gray argillaceous dolomite, gray shale, and anhydrite	50	1,815
Light buff and gray dolomite, gray shale and much anhydrite	5	1,820
Sample missing, probably similar to sample above	5	1,825
Light buff and gray dolomite, gray shale and much white anhydrite	5	1,830
White salt with considerable gray shale and gray and buff dolomite	5	1,835
Clean white salt	10	1,845
Sample missing, probably salt	5	1,850
Clean white salt	10	1,860
Sample missing, probably salt	5	1,865
White salt and considerable dolomite and shale	5	1,870
Buff dolomite and white salt	5	1,875
Sample missing	5	1,880
White salt	5	1,885
Sample missing	5	1,890
Buff dolomite, gray shale, anhydrite and salt	5	1,895
White salt, dolomite and anhydrite	5	1,900
Chiefly white salt, some dolomite, apparently from above	5	1,905
Sample missing, probably salt	5	1,910
White salt	15	1,925
Sample missing, probably salt with more or less dolomite, shale and anhydrite	35	1,960
Chiefly white salt (some of the samples badly rusted, difficult to determine natural color of salt)	15	1,975
White salt with a little shale and dolomite	5	1,980
White salt, shale and dolomite	10	1,990
Chiefly white salt, a little shale and dolomite	20	2,010
Sample missing	5	2,015
Clean white salt	5	2,020
White salt with a little shale and dolomite	10	2,030
Nearly clear white salt	10	2,040
Chiefly salt, some shale, anhydrite and dolomite	5	2,045
Clean salt	5	2,050
White salt with some shale and dolomite	10	2,060
Clear white salt	5	2,065
Sample missing, probably salt	5	2,070
Clean white salt	5	2,075
White salt, dolomite and shale	5	2,080
Nearly clean white salt, salt stained by rust from drill	5	2,085
White salt, buff dolomite, shale and some anhydrite	10	2,095
White salt	5	2,100
Sample missing, probably salt	5	2,105
White salt	10	2,115
Buff to dark buff dolomite and salt, dolomite bituminous	5	2,120
Buff to dark buff and brown, bituminous dolomite, some anhydrite in sample from 2,120 to 2,125	15	2,135
Gray shale and buff dolomite, some white anhydrite	5	2,140
Buff to dark buff dolomite, with bituminous streaks and laminae	30	2,170

	Thickness, feet.	Depth, feet.
Chiefly dark buff and grayish brown dolomite, argillaceous	5	2,175
Buff dolomite with anhydrite and some gray shale	5	2,180
Buff to dark buff dolomite	15	2,195
Dark buff, bituminous dolomite or dolomitic limestone, very argillaceous in places, vig. eff. From 2,195 to 2,275 ft. and 2,315 to 2,395 ft. there is more or less limestone or dolomite with much calcite from drusy cavities and seams	45	2,240
Sample missing	5	2,245
Dark gray, bituminous and agrillaceous dolomite or dolomitic limestone and light gray dolomite or dolomitic limestone, vig. eff	5	2,250
Gray, calcareous shale, vig. eff.—some dark, dolomitic limestone	5	2,255
Sample missing	5	2,260
Gray, calcareous shale and light buff and buff gray, fine grained, dolomitic limestone; vig. to viol. eff	5	2,265
Chiefly dark buff, bituminous, dolomitic limestone, very dense grained and thin bedded, breaks up into thin plates, some light buff; vig. eff	10	2,275
Light to dark buff dolomite, dark gray shale and shaly dolomite, white anhydrite and celestite, slow to mod. eff. Bituminous	15	2,290
Chiefly white celestite and anhydrite, some dolomite, nearly pure white anhydrite and celestite 2,300 to 2,310 ft., considerable dolomite in sample 2,310 to 2,315. Strong reaction for strontium	25	2,315
Buff to dark buff and brown bituminous dolomite, very dense grained and thin bedded, vig. to viol. eff. With acid gives a strong smell of petroleum and large residue of bituminous matter	15	2,330
Buff, bituminous, dolomitic limestone, very dense grained and thin bedded. With acid gives strong smell of petroleum. Vig. to viol. eff. moderate eff., 2,350 to 2,355 ft	25	2,355
Buff, dolomitic limestone and a little anhydrite, vig. eff	15	2,370
Buff, dolomitic limestone apparently. Sample wet and very badly rusted	5	2,375
Dark buff, bituminous dolomite, slow to mod. eff	20	2,395
Guelph (Upper Niagaran) dolomites:		
White to very light gray and very light buff, crystalline dolomite with some dark buff, bituminous dolomite; mod. eff	40	2,435
Most of the samples badly rusted, original color hard to determine.		
Chiefly white to very light buff crystalline dolomite	5	2,440
White to light buff dolomite and considerable buff to dark buff dolomite	10	2,450
Light to dark buff bituminous dolomite; mod. to vig. eff	5	2,455
Chiefly white and light buff dolomite; mod. eff. Samples wet and badly rusted	10	2,465
White, light buff and buff crystalline dolomite, slow eff. Samples badly rusted.	5	2,470
White, light to dark buff, crystalline dolomite and blue shale	15	2,485
Light to dark buff crystalline dolomite	10	2,495

Detroit. The Federal Carbonic Co. drilled a comparatively shallow well in the northwestern part of Detroit for water. The record is indicative of the limited water possibilities in northern and northwestern Detroit.

THE FEDERAL CARBONIC CO. 5″ WELL.

Location: Greenwood Ave. and G. T. R. R., Detroit, T. 1 S., R. 12 E. Drilled Dec., 1914, for the Federal Carbonic Co., Detroit, by E. S. Beal, Lansing, Mich. Record furnished by E. S. Beal from cores.

Elevation 42 feet above Detroit River or 617 ft. A. T.

	Thickness, feet.	Depth feet.
Pleistocene:		
Fill, yellow sand	12	12
Blue clay with small pebbles, very firm	30	42
Blue clay smooth with occasional sand pockets	60	102
Blue clay very gritty with limestone cobbles and boulders	40	142
Gravel, 35 ft. coarse, 11 ft. very fine. Dry all the way	46	188
Traverse formation:		
Limestone	4	192
Bell shale:		
Black shale, very fossiliferous with shining grains, pyrites of iron	9	201
Soft gray slate or shale, slacks on exposure to air	14	215
Hard gray slate, cores run from 8 inches to 3 feet long	24	239
Dundee (Onondaga) limestone:		
Blue limestone	7	246
White limestone very fossiliferous, numerous calcite seams. Small flows at 285 ft., 3 gallons per minute	45	291
Sandy limestone, very soft	11	312
Blue limestone, trace of oil and iron pyrites	12	324
Cherty limestone	4	328
Limestone, coral formation, very fossiliferous	9	337
Upper Monroe:		
Dolomite, gray, sharp grit and very hard	23	360
Dolomite, whitish, sharp grip and very hard. Small flows of water at 376 ft., water 30 ft. from surface, 6½ gals. per minute.	30	390
Dolomite, yellow, sandy, soft	5	395

"Expected to get bed rock at this location at 120 to 140 feet but drilled through a 46 ft. deposit of gravel, dry all the way; found a short deposit of limestone at 188 to 192 ft. then ran into Bell shale and the gray slate down to the Dundee at 239, or 100 ft. below my estimate, showing a great depression at this location. Found the limestone very dense, no pockets or fractured rock and only two seams and they were very tight; small flow at 285 ft., 3 gals. per minute; small flow at 376 ft. in the dolomite. The water head stood at 35 ft. from surface and would flow 6½ gals. per minute.

Shot the well with 40 lbs of 60% dynamite; put in a 1¼″ air lift and a 2″ discharge and blowed 14½ gals per minute. The water is very black and salty, showing oily substance on top and black sand on bottom after standing 2 hours."

Trenton. The records of some of the Church and Co. wells at Trenton were recently obtained from the U. S. Geological Survey and the record of the No. 4 well, the deepest, is given below. A record of the No. 5 well was published in Publication 14.

CHURCH AND COMPANY WELL NO. 4.

Location: Near plant of Church and Company in the northern part of the village of Trenton. Record from driller's log.

Elevation 580 (?) feet.

	Thickness, feet.	Depth feet.
Pleistocene or glacial drift:		
Clay and gravel	30	30
Dundee (Onondaga) limestone and probably Upper Monroe in the lower part:		
Hard brown limestone	70	100
Upper Monroe or Detroit River series:		
Gray limestone	25	125
Soft gray brown limestone	55	180
Dark brown limestone	100	280
Sylvania sandstone:		
Hard white sandstone	140	340
Brittle gray shale rock and white sandstone	95	435
Lower Monroe or Bass Island Series:		
Hard gray shale rock	115	550
Gray and brown limestone with gypsum (anhydrite) at the bottom	230	780
Salina:		
Gypsum and shale	220	1,000
Brown shale	90	1,090
Gypsum	55	1,145
Gypsum and shale	40	1,185
Salt	30	1,215
Salt shales	60	1,275
Shale	50	1,325
Gypsum	50	1,375
Shale	55	1,430

Redford. In 1914 two wells were drilled near the village of Redford for a municipal supply of water. There was no water in the surface deposits and only a little salt water in the bed rocks below. The local supplies of water appear to be very limited. Records of the borings were furnished the Survey by Caster Brothers, the well contractors. The record of the deeper well is given below.

REDFORD MUNICIPAL WELL NO. 1.

Location: Village of Redford, Wayne County, S. E. ¼ Sec. 9, T. 1. S., R. 10 E. Record furnished by Caster Brothers, drillers. Well drilled in latter part of 1914.

Elevation about 630 feet A. T.

	Thickness, feet.	Depth, feet.
Pleistocene or surface deposits:		
Sand	12	12
Clay	78	90
Antrim shale:		
Lime rock	90	180
Lime shale; no water at all	25	205
Sand rock; a little salt water at 213 feet	10	215
Traverse formation (?):		
Lime rock—dry	61	276
Light shale—dry	128	404
Lime rock—dry	8	412

APPENDIX.

DIRECTORY OF THE PRODUCERS OF NON-METALLIC MINERALS IN MICHIGAN, 1916.

BRICK AND TILE MANUFACTURERS, 1916.

Operators.	Office.	Works.
Allegan County:		
Allegan Brick Works (Fish & Fish)	Allegan	Allegan.
Zeeland Brick Co	Zeeland	Zeeland.
Barry County:		
Leonard, Wm	Delton	Delton.
Bay County:		
Michigan Vitrified Brick Co	Bay City	Bay City.
Berrien County:		
Mamer Brick Co	Benton Harbor	Benton Harbor.
Branch County:		
Reynolds & Sons, Lorenzo D	Quincy	Algansee.
Charlevoix County:		
East Jordan Clay Products Co	East Jordan	East Jordan.
Chippewa County:		
Rudyard Brick Works	Rudyard	Rudyard.
Dickinson County:		
Vulcan Brick Works	Vulcan	Vulcan.
Eaton County:		
American Sewer Pipe Co	Broad St., Akron, Ohio	Grand Ledge.
Baker Clay Co	Grand Ledge	Grand Ledge.
Grand Ledge Clay Products Co	Grand Ledge	Grand Ledge.
Emmet County:		
De Arment, C. A	Petoskey	Petoskey.
Genesee County:		
Gale Bros	Atlas	Atlas.
Scholl, L. J. & C. E	Clio	Clio.
McCann, Fred'k W	Gaines	Gaines.
Sharp, Frank	R. D. No. 1, Linden	South Mundy.
Flint Clay Products Co	Flint	.....
Gladwin County:		
Korkoske, Christ	Gladwin	Gladwin.
Grand Traverse County:		
Traverse City Brick Co	Traverse City	Keystone.
Gratiot County:		
Ashley Tile Co	Ashley	Ashley.
Stevenson & Sons, David	Ashley	Ashley.
Lee, Chas	North Star	North Star.
Peet, C. D	North Star	North Star.
Lyle G. Smith & Fred Bernard	St. Louis	St. Louis.
Riverside Brick & Tile Co	Sumner	Sumner.
Hillsdale County:		
Jerome Brick & Tile Co	Jerome	Jerome.
Ingham County:		
Clippert, Spaulding & Co	Lansing	Lansing.
Ionia County:		
Van Der Heyden, Fred H	Ionia	Ionia.
Isabella County:		
Mt. Pleasant Brick & Tile Co	Mt. Pleasant	Mt. Pleasant.
Jackson County:		
Disque, Price P., Warden Michigan State Prison	Jackson	Jackson.
American Sewer Pipe Co	Akron, Ohio	Jackson.
Kent County:		
Grand Rapids Brick Co	Mich. Ave. and Fuller St., Grand Rapids	Grand Rapids.
Blanchard, Addison H	Sparta	Sparta.

BRICK AND TILE MANUFACTURERS, 1916.—*Concluded.*

Operators.	Office.	Works.
Lenawee County:		
Wilt, C. H.	Blissfield	Blissfield.
Britton Pressed Brick Co	Ann Arbor	Britton.
Atkin, Wm. T	Deerfield	Deerfield.
Ruff, Lewis	Jasper	Jasper.
Ellis, G. D	Macon	Macon.
American Brick & Tile Co	Morenci	Morenci.
Comfort, Albert A	R. D., Tecumseh	Tecumseh.
Macomb County:		
Hartsig, Jacob	Warren	Centerline.
Hacker, Frank G	Mt. Clemens	Clinton.
Gass, East	R. D. No. 2, Washington	Davis.
Warren Brick & Tile Works	Warren	Warren.
New Baltimore Brick & Tile Co	New Baltimore	New Baltimore
Manistee County:		
Kujawske, Joseph	Oakhill	Oakhill.
Mecosta County:		
Nehmer, Wm. F	Big Rapids	Big Rapids.
Midland County:		
Rilett & Herwig, J. W	R. D. No. 3, Coleman	Coleman.
Monroe County:		
Meyer Bros	Azalia	Azalia.
Maybee Brick & Tile Co	Maybee	Maybee.
Angerer Clay Products Co	Scofield	Scofield.
Strong, John & Co	South Rockwood	South Rockwood.
Muskegon County:		
Holton Brick Co	Muskegon	Holton.
Newaygo County:		
Stevens & Sons, Wm	R. D., Grant	Grant.
Ottawa County:		
Zeeland Brick Co	Zeeland	Zeeland.
Saginaw County:		
Parker-Lohmann Brick & Tile Co	R. D. No. 10, Saginaw, W. S.	Saginaw, W. S.
Sperry Bros	Paines	Paines.
Day, James	R. D. No. 8, Saginaw	Saginaw.
Day, Thomas	R. D. No. 3, Saginaw	Saginaw.
Saginaw Paving Brick Co	1850 S. Jefferson Ave., Saginaw	Saginaw.
St. Clair County:		
Belknap & Phillips	Bell River Road, St. Clair	St. Clair.
Sanilac County:		
Croswell Brick Co	Croswell	Croswell.
Sandusky Brick & Tile Co	Sandusky	Sandusky.
Shiawasse County:		
Wolverine Brick Co	Box 289, Corunna	Corunna.
Tuscola County:		
Hall, Chas	Cass City	Cass City.
Wayne County:		
Daniel & Bro. Brick Co., Jacob	291 Clippert Ave., Detroit	Detroit.
Haggerty, John S	1815 Dime Sav. Bk. Bldg., Detroit	Detroit.
McDonald & Son, John C	707 Hammond Bldg., Detroit	Springwells.
Ajax Brick Co	66 Buhl Block, Detroit	Detroit.
Bunte Bros. Tile Co	Flat Rock	Flat Rock.
Clippert & Bro. Brick Co., Geo. H	1960 Michigan Ave., Detroit	Springwells.
Clippert, Wm	1960 Michigan Ave., Detroit	Springwells.
Mercier, Bryan, Larkins Brick Co	Michigan Ave. and Lonyo Road, Detroit	Springwells.
Lonyo Bros	613 Campbell Ave., Detroit	Springwells.
Porath Bros	306 Free Press Bldg., Detroit	Springwells.
Springwells Brick Co	1009 Hammond Bldg., Detroit	Springwells.
Wolf Brick Co., F. H	1467 Central Ave., Detroit	Detroit.
Pewabic Pottery & Tile Co	2161 Jefferson Ave., Detroit	Detroit.

SAND-LIME BRICK PRODUCERS, 1916.

Operators.	Office.	Works.
Genesee County:		
Flint Sandstone Brick Co	Flint	Flint.
Houghton County:		
Lake Superior Stone Brick Co	Calumet	Ripley.
Huron County:		
Sebewaing Sandstone Brick Co	Sebewaing	Sebewaing.
Jackson County:		
Jackson-Lansing Brick Co	Rives Junction	Rives Junction.
Kalamazoo County:		
South Michigan Brick Co	Kalamazoo	Kalamazoo.
Kent County:		
Grande Brick Co	Kalamazoo Ave., Grand Rapids	Grand Rapids.
Menominee County:		
Menominee Brick Co	Menominee	Menominee.
Oakland County:		
Rochester Brick & Sand Co	Rochester	Rochester.
Saginaw County:		
Saginaw Brick Co	321 N. Hamilton St., Saginaw	Saginaw.
Wayne County:		
Michigan Pressed Brick Co	Cor. Lawton Ave., and M. C. R. R., Detroit	Detroit.
Sibley Brick Co	Sibley	Sibley.
Flood & Hall	Foot of Jean St., Detroit	Detroit.

CEMENT PRODUCERS, 1916.

Operators.	Office.	Works.
Huron Portland Cement Co	1525 Ford Bldg., Detroit	Alpena.
Burt Portland Cement Co	Bellevue	Bellevue.
Peninsular Portland Cement Co	Cooley Block, Jackson	Cement City.
Michigan Portland Cement Co	Chelsea	Four Mile Lake.
Wolverine Portland Cement Co	Coldwater	Coldwater and Quincy.
New Aetna Portland Cement Co	412 Union Trust Bldg., Detroit	Fenton.
Omega Portland Cement Co	Jonesville	Mosherville.
Newaygo Portland Cement Co	Grand Rapids	Newaygo.
Peerless Portland Cement Co	Union City	Union City.
Wyandotte Portland Cement Co	1525 Ford Bldg., Detroit	Wyandotte.
Egyptian Portland Cement Co	Fenton	Fenton.

LIST OF MICHIGAN COAL MINES, LOCATION BY COUNTY, NAMES OF MANAGERS AND SUPERINTENDENTS.

Name of mine.	County.	Manager.	Address.	Superintendent.	Address.
Robert Gage Coal Co. No. 6	Bay	Chas. Coryell	Bay City	H. C. Lewis	Bay City.
Robert Gage Coal Co. No. 7	Bay	Chas. Coryell	Bay City	John Coryell	Bay City.
Beaver Coal Company	Bay	Chas. Coryell	Bay City	John Coryell	Bay City.
Wolverine Coal Mining Company No. 3	Bay	R. M. Randall	Saginaw	Alex Liddle	Bay City.
Wolverine Coal Mining Company No. 2	Bay	R. M. Randall	Saginaw	Alex Liddle	Bay City.
What Cheer Coal Mining Company No. 1	Bay	E. B. Foss	Bay City	Alex Jeffreys	Bay City.
Wolverine Mining Co	Calhoun	C. A. Hervey	Albion		
American Sewer Pipe Co	Eaton	Clyde H. Earl	Grand Ledge		
Pickens Mine No. 2	Eaton	Homer Pickens	Grand Ledge		
What Cheer Mining Company No. 2	Genesee	E. B. Foss	Bay City	Alex Jeffreys	Bay City.
Cedar River Coal Mining Company	Ingham	Thos. M. Jenkins	Williamston	Thos M. Jenkins	Williamston.
Robert Gage Coal Company No. 2	Saginaw	Chas. Coryell	Bay City	Richard Jenkins	St. Charles.
Bliss Coal Mining Company	Saginaw	John T. Phillips	Saginaw	John E. Evans	Saginaw. Swan Creek.
Banner Coal Mining Company	Saginaw	Wm. B. Carmichael	Saginaw. Swan Creek.	Jos. Skillcorn	Saginaw. Swan Creek.
Shiawassee Coal Mining Company	Saginaw	R. M. Randall	Saginaw	Thos. Westwood	Saginaw.
Pere Marquette Coal Company No. 3	Saginaw	R. M. Randall	Saginaw	R. Johnston	Saginaw.
Chappell and Fordney No. 2	Saginaw	R. M. Randall	Saginaw	Tim Hollis	Saginaw.
Caledonia Coal Mining Company No. 3	Saginaw	John Dagan	Saginaw	Geo. Thelly	Saginaw.
Superior Coal Co	Shiawassee	W. E. Evans	St. Charles	——— Evans	Owosso, R. F. D.
Wolverine Brick Co	Shiawassee	Wm. Brooks	Detroit		Corunna.
Akron Coal Mining Company	Tuscola	Chas. Handy	Bay City (W. S.)	John Morris	Akron.
Handy Bros. Mining Co	Tuscola	Chas. W. Handy	Bay City (W. S.)		

Hon. Duncan A. Reed, State Coal Mine Inspector, Flint, Michigan.

CLAY MINERS, 1916.

Operators.	Office.	Mine.
Barry County:		
Leonard, Wm	Delton	Delton.
Ontonagon County:		
Emmond, Wm. F	Rockland	Rockland.
Robinson Clay Products Co	1010 E. Market St., Akron, Ohio	Rockland.
Vogtlin, W. P	Rockland	Rockland.
Jeffs, F. A	Rockland	Rockland.
Wayne County:		
Geo. H. Clippert & Bro. Brick Co	Detroit	Springwells.

COKE PRODUCERS, 1916.

Operators.	Address.	Location of plant.	No. of ovens.	County.
Michigan Alkali Co	Wyandotte	Plant No. 2	30	Wayne.
Semet-Solvay Co	Syracuse, N. Y	Detroit	175	Wayne.

NATURAL GAS PRODUCERS, 1916.

Operator.	Address.
Benzie County:	
Gordon & Conklin	Beulah.
Hillsdale County:	
DeWitt, C. M	Osseo.
Macomb County:	
Hanekow, Mrs. Wm. H	Warren, R. F. D. No. 2.
Hartsig, Wm. L	Warren, R. F. D. No. 2.
Jacobs, Edward and Otto	Warren, R. F. D. No. 2.
Elwart, Franz	Warren, R. F. D. No. 2.
Oakland County:	
McClelland, James	Redford.
St. Clair County:	
Haas, H. G	Port Huron, 1615 Griswold St.
Michigan Central Oil, Gas and Mineral Co	Port Huron.
Michigan Development Co	Port Huron.
Stevens, H. Leroy	Port Huron.
Stock Co., G. B., Xylite Grease and Oil Co	Port Huron.
Mason, F. H	Port Huron, 2478 Military St.
Howe, Geo. W	Port Huron, 4008 Military St
Lawrence, Gillett	Port Huron.
May, Henry	Port Huron.
Rowe, John A	Marysville.
Washtenaw County:	
Harmon, H. E	Willis.
Wayne County:	
Bicht, Wm. F	Redford.

GRAPHITE PRODUCERS, 1916.

Name.	Address.	Quarry.
Detroit Graphite Co	10, 12th St., Detroit	L'Anse.
Northern Graphite Co	L'Anse	L'Anse.

GRINDSTONE AND SCYTHESTONE PRODUCERS, 1916.

Operator.	Office.	Quarry.
Huron County:		
Cleveland Stone Co	Cleveland, Ohio	Grindstone City.
The Wallace Co	Port Austin	Eagle Mills.
Cleveland Stone Co	Cleveland, Ohio	Port Austin.

PRODUCERS OF GYPSUM PRODUCTS, 1916.

Operator.	Office.	Name of plant.	Location of mine.
United States Gypsum Co	Chicago, Ill	Alabaster	Alabaster.
United States Gypsum Co	Chicago, Ill	Midland	Grand Rapids.
Acme Cement Plaster Co	St. Louis, Mo	Mill No. 5	Beverly.
Michigan Gypsum Co	Grand Rapids		Grand Rapids.
American Cement Plaster Co	Lawrence, Kas	Grand Rapids	Grand Rapids.
Grand Rapids Plaster Co	427 Mich. Trust Bldg., Gd. Rapids	Eagle Mill	Grand Rapids.
		Grandville	Grandville.

LIMESTONE AND LIME PRODUCERS, 1916.

Operators.	Office.	Quarry.
Alger County:		
The Munising Co	11th Fl. Rockfeller Bldg., Cleveland, Ohio	Eben.
Alpena County:		
Michigan Alkali Co	Wyandotte	Wyandotte
Great Lakes Stone and Lime Co	Alpena	Rockport.
Arenac County:		
McDonnell, Jas. (lime)	Twining	Omer.
Charlevoix County:		
Northern Lime Co. (lime)	Petoskey	Bay Shore.
Charlevoix Rock Products Co. (also lime)	Charlevoix	Charlevoix.
Cheboygan County:		
Campbell Stone Co. (also lime)	Indian River	Afton.
Cheboygan Limestone Prod'ts Co	Mackinaw City	Mill Creek.
Chippewa County:		
Scott Quarry Co	Sault Ste. Marie	Trout Lake.
Delta County:		
Delta Contracting Co	Escanaba	Escanaba (Hyde).
Bichler Bros	Gladstone	Pine Ridge.
Bichler, John	Groos	Groos.
Berkman, Andrew J	Gladstone, R. F. D. No. 1	Gladstone, R. F. D. No. 1, Escanaba Twp.
Dickinson County:		
Metronite Co., The	Milwaukee, Wis	Felch.
Emmet County:		
Antrim Lime Co. (lime)	912 Mich. Trust Bldg., Grand Rapids	Petoskey.
Emmet Co. Rd. Comm'rs	Brutus	
Northern Lime Co. (also lime)	Petoskey	Petoskey.
Petoskey Crushed Stone Co	Petoskey	Petoskey.
Huron County:		
Wallace Stone Co	Bayport	3 mi. E. of Bayport.
Jackson County:		
Lime Products Co	Jackson	Jackson.
Mackinac County:		
Ozark Stone Quarry	Ozark	Ozark.
Union Carbide Co	42nd St. Bldg., New York, N. Y.	Hendricks Quarry.
Fiborn Limestone Co	Sault Ste. Marie, Ontario, Can	Fiborn Quarry.
Mackinac County Rd. Commrs	St. Ignace	
Marquette County:		
City of Negaunee	Negaunee	Negaunee.
Menominee County:		
Menominee Co. Road Commrs	Menominee	
Spencer, Henry	Menominee	Menominee.
Monroe County:		
Shore Line Stone Co	Monroe	Frenchtown.
The France Stone Co	1800 Second Nat'l Bank Bldg., Toledo, O	Monroe.
Morris, Sam W	Monroe	Monroe, S. part of City.
Presque Isle County:		
Michigan Limestone & Chemical Co	55 Liberty St., New York, or Rogers City, Mich	Calcite.
Schoolcraft County:		
The White Marble Lime Co (Also lime).	Manistique	Blaney, Manistique and Marblehead.
Boylett, D. T	Crystal Falls	Blaney.
Fredun, Gust	Whitedale (Gulliver P. O.)	
Delta Contracting Co	Escanaba	Manistique.
Wayne County:		
Solvay Process Co	Syracuse, N. Y	Trenton and Sibley.
Dunbar Stone Co	Detroit or River Rouge	Mouth of Detroit River.

MINERAL PAINT PRODUCERS, 1916.

Operator.	Pigment.	Office.	Location of plant.
Acme White Lead & Color Works	White lead, red lead, litharge, orange mineral	Detroit	Detroit.
Ditzler Color Co		Detroit	Detroit.
Metronite Co	Whiting (paint filler)	Milwaukee, Wis.	Dickinson Co.
Pickands, Mather & Co	Met. Paint	Cleveland, Ohio.	Iron county.

MINERAL AND SPRING WATER PRODUCERS, 1916.

Operators.	Office.	Spring.
Arctic Spring Water Co	412 Ottawa Ave., Grand Rapids	Arctic.
Bailey Marvel Springs Co	Bellaire	Alden.
Willis, J. L	Bangor	Beaver.
Bromo-Hygeia Mineral Water Co	Coldwater	Bromo-Hygeia.
Crystal Spring Water, Fuel & Ice Co	35 No. Division St., Grand Rapids	Crystal Spring.
Israelite—House of David	Benton Harbor	
Deep Springs Water Co	Northville	
Eastman Springs Co	Benton Harbor	Eastman.
Polaris Water Co	Marquette	Lake Superior Mineral Spring.
Jarvis Mineral Water Co	901 River Street, Lansing	Lansing.
Mt. Clemens Crystal Springs Water Co.	Mt. Clemens	Mt. Clemens Crystal Spring.
Ogemaw Spring Water Co	Bay City	Ogemaw.
Dewitt, C. M	Osseo	Osseo.
Ponce de Leon Co	Grand Rapids	Ponce de Leon.
Pike, Lute H	Topinabee	Sanitas.
Shorkey, Chas	Mt. Clemens	Victory.
Ypsilanti Mineral Water & Bath Co	Ypsilanti	Moorman Well.
Magnetic Spring Water Co	Saginaw, W. S	Andrew's Magnetic Mineral.
Beard Hill Mineral Spring Co	105 E. Bancroft St., Toledo, Ohio	Avoca.
Charbeneau, Jno. H	Mt. Clemens	Maple Leaf Springs.
Preussel, Frank W	47 Crocker Ave., Mt. Clemens	Panacea.
Wall, R. I	South Haven	Crystal.
Jackson, Roger	Crystal Falls	Sterling.
Sutton, Geo	Hartford	Sultana.
Silver Springs Water Co	Detroit	Northville.
McAlsfer Mfg. Co	Mt. Clemens	Eureka.

PETROLEUM PRODUCERS, 1916.

Operators.	Address.
Michigan Central Oil & Mineral Co	807 Pine St., Port Huron.
Stock Xylite & Oil Co., G. B	Port Huron.

PIG IRON PRODUCERS, 1916.

Operator.	Office.	Name of furnace.	Location of furnace.
Lake Superior Iron & Chemical Co	Detroit	Boyne City	Boyne City.
Lake Superior Iron & Chemical Co	Detroit	Chocolay	Chocolay.
Mitchell-Diggins Iron Co	Cadillac	Cadillac	Cadillac.
Detroit Furnace Co	1069 Jefferson Ave., Detroit	Detroit	Detroit.
Detroit Iron & Steel Co	149 Jefferson Ave., Detroit	A & B	Detroit.
East Jordan Furance Co	East Jordan		East Jordan.
Cleveland Cliffs Iron Co	Cleveland, Ohio.	Pioneer No. 1.	Gladstone.
Antrim Iron Co	Antrim	Antrim	Antrim.
Pioneer Iron Co	Marquette	Carp River	Near Marquette.
Pioneer Iron Co	Marquette	Pioneer No. 2.	Near Marquette.
Stephenson Charcoal Iron Co		Stephenson	Wells.
Charcoal Iron Co. of America	Detroit	Chocolay	Chocolay.
Charcoal Iron Co. of America	Detroit	Boyne City	Boyne City.
Charcoal Iron Co. of America	Detroit	Elk Rapids	Elk Rapids.
Charcoal Iron Co. of America	Detroit	Manistique	Manistique.
Charcoal Iron Co. of America	Detroit	Newberry	Newberry.
New Metals Process Co	Marquette		Marquette.

POTTERY PRODUCERS, 1916.

Operator.	Office.	Works.
Ionia County:		
Ionia Pottery Co	Ionia	Ionia.
Macomb County:		
Mt. Clemens Pottery Co	Mt. Clemens	Mt. Clemens.
Oakland County:		
Pontiac Clay Pipe & Novelty Co	Pontiac	Pontiac.
Wayne County:		
Jeffery-Dewitt Co	Detroit	Detroit.
Hupprich, Anton	2161 Michigan Ave., Detroit	Detroit.
Pewabic Pottery & Tile Co	2161 Jefferson St., Detroit	Detroit.
Hygeia Filter Co	338 Denton Ave., Detroit	Detroit.

QUARTZ PRODUCERS, 1916.

Operator.	Office.	Mine.
Marquette County:		
Michigan Quartz Silica Co	Milwaukee, Wis	Ishpeming.
Marquette Trap Rock Co	Marquette	Marquette.

SALT PRODUCERS, 1916.

Operators.	Office.	Works.
Bay County:		
Hine Lumber Co	Sta. A., Bay City	W. Bay City.
Biglow-Cooper Co	Bay City	Bay City.
Isabella County:		
Van Schaack & Sons, Peter	118 Lake St., Chicago, Ill	Mt. Pleasant.
Manistee County:		
Filer & Sons, Vacuum Pan Salt Wks.	Filer City	Filer City.
The Buckley & Douglass Lumber Co.	381 River St., Manistee	Manistee.
Sands Salt & Lumber Co., Louis	Manistee	Manistee.
Mason County:		
Morton Salt Co	Ludington	Ludington.
Stearns Salt & Lumber Co	Ludington	Ludington.
Midland County:		
The Dow Chemical Co	Midland	Midland.
Saginaw County:		
Mershon, Eddy, Parker & Co	Saginaw	Carrolton.
Bliss & Van Auken Lumber Co	Saginaw, W. S	Saginaw.
Eastman Salt Products Co	Saginaw, W. S	Saginaw.
Estate of Edward Germain	Holland Ave. near Genesee St., Saginaw, E. S	Saginaw.
Saginaw Plate Glass Co	Saginaw, W. S	Saginaw, W. S.
Saginaw Salt Co	430 Shearer Bldg., Bay City	St. Charles.
Strable Lumber & Salt Co	Saginaw	Saginaw.
St. Clair County:		
Michigan Salt Works	Marine City	Marine City.
Morton Salt Co	717 Ry. Ex., Chicago, Ill	Port Huron.
Diamond Crystal Salt Co	St. Clair	Port Huron.
Marine City Salt Co	Marine City	Marine City
Wayne County:		
Inland Delray Salt Co	Detroit	Delray.
Solvay Process Co	Detroit	Delray.
Detroit Rock Salt Co	Scranton, Pa	Detroit.
Mulkey Salt Co	610 Equity Bldg., Detroit	Oakwood.
Kay Salt Co	Charleston, W. Va	Ecorse.
Worcester Salt Co	168 Duane St., New York, N. Y	Ecorse.
Michigan Alkali Co	Wyandotte	Wyandotte.
Pennsylvania Salt Mfg. Co	115 Chestnut St., Philadelphia, Pa	Wyandotte.

SANDSTONE PRODUCERS. 1916.

Operator.	Office.	Quarry.
Houghton County:		
Portage Entry Redstone Co	Jacobsville	Jacobsville.
Huron County:		
Cleveland Stone Co	Cleveland, Ohio	Grindstone.
Wallace Co	Port Austin	Grindstone City.

SAND AND GRAVEL PRODUCERS, 1916.

Operator.	Office.	Pit.
Alcona County:		
Jas. Bell & Co	Greenbush	Greenbush.
Huron Shore Gravel Co	Greenbush	Greenbush.
Allegan County:		
Sutler, Fred W	Byron Center	Burnips Corners.
Wiest, Peter	Dorr, R. F. D. 2	Dorr.
Terpstra, Geo	Dunningville, R. F. D. 1	Dunningville.
Kool, Henry	New Richmond	New Richmond.
Pierce, Myron	Otsego	Otsego.
Powell, J. C	Plainwell	Plainwell.
Craine, W. C	Douglass	Douglass.
Hilaski, Stanley	Hopkins, R. F. D. 3	Hilliards.
Fry, W. G	South Haven, R. F. D. 6	South Haven.
Purdy, P	Fennville	Saugatuck.
Gray, Tom C	Fennville, R. F. D. 2	
Dendel, Martin	Allegan, R. F. D. 5	Monterey.
Stuby, J. F	Moline	Wayland.
Alpena County:		
Riley & Monkman	501 State St., Alpena	Alpena.
Antrim County:		
Sissons, F. E	Central Lake, R. F. D. 1	Central Lake.
McPherson, Guy	Eastport	Eastport.
Campbell, Wm. G	Mancelona	Mancelona.
Swan, Guy	Mancelona	Mancelona.
Burch, A. O	Central Lake	Central Lake.
Arenac County:		
Daniels, Wm	Sterling, R. F. D	Sterling.
Rogers, Sidney	Twining	Twining.
Mayor of Omer City	Omer	Omer.
Barry County:		
Woolston, Chas	Hastings	Hastings.
Hilt, Geo	Woodland	Woodland.
Renkes, Fred	Hastings	Hastings.
Dunham, P. O	Nashville	Grove Center.
Clever, Daniel	Nashville	Nashville.
Hinckley, C. G	Hastings	Hastings.
Bay County:		
Hayward, R	Bay City, R. F. D. 3	Bay City.
Histed, C. D	Munger	Munger.
Whitney, Geo. A	Bentley	Bentley.
Benzie County:		
Huddleston, Wm	Bendon, R. F. D. 1	Bendon.
Betsey River Orchards, Ben Newhall & Co	840 Ohio Bldg., Chicago, or Thompsonville, Mich.	Thompsonville.
Berrien County:		
Edgecombe, Geo. W	439 Main St., Benton Harbor	Benton Harbor.
Warren, Paul E	Lakeside	Lakeside.
Benton Harbor Sand Co	Benton Harbor	Benton Harbor.
American Sand & Gravel Co	Benton Harbor	Benton Harbor.
Garden City Sand Co	Riverside	Riverside.
Kerlikowske Bros	St. Joseph	St. Joseph.
Brewer, Frank	Galien	Galien.
Thar, Anton	Coloma, R. F. D. 3	Riverside.
Broderick Bros	Riverside	Riverside.
Brant, Mrs. Rebecca	Bridgeman	Bridgeman.
Swank, Wm	Galien	Galien.
Mettger, Henry	Berrien Springs	Oronoka.
Warren, E. H	Three Oaks	New Buffalo.
Branch County:		
Werner, Jake F	Bronson	Bronson.
Barnes, Mrs. J. M	Montgomery	Kinderhook.
Brehm, Jno. H	Kinderhook	Kinderhook.
Clark, Oliver	Kinderhook, R. F. D. 1	Kinderhook.
Wilkins, W. H	Coldwater, R. F. D. 3	Kinderhook.
Holcomb, Preston	Bronson	Bronson.
Graham, Herbert A	Elkhart, Ind	Union City.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Calhoun County:		
Abbott, Wallace	315 Irwin Ave., Albion	
March, Andrew	Union City, R. F. D. 5	Union City.
Young, Willard A	Albion	Albion.
Blowers, N. A	Athens	Athens.
Funk, F. J	Battle Creek, R. F. D. 2	Battle Creek.
Hiscock, Seth	Battle Creek	Battle Creek.
Grosbeck, Fred	Burlington	Burlington.
Adrian, John	323 Hamblin Ave	Battle Creek.
Crystal Sand & Gravel Co	12 E. Main St	Battle Creek.
Cline, Eli	Battle Creek, R. F. D. 1	
Brownlee Park & Material Co	Battle Creek	Brownlee Park.
Michigan United Traction Co	Jackson	Marshall.
Prince, Wm. A	Ceresco	Ceresco.
Phillips, L. W	Burlington	Burlington.
Van Sickles, Elmer	Albion	Albion.
Cass County:		
La Grange Twp	Cassopolis	Cassopolis.
Crandall, Lester	Cassopolis	Cassopolis.
Blanchard, A. G	Niles	Niles.
Graham, H. A	Elkhart, Ind	Union.
Charlevoix County:		
Healy, Chas	East Jordan, R. F. D. 2	East Jordan.
Ward, E. B	Charlevoix	Charlevoix.
Cheboygan County:		
Charpointiar, Jos	Cheboygan, R. F. D. 2	Cheboygan.
Chippewa County:		
Belanger, Louis	Sault Ste. Marie	Sault Ste. Marie.
Rye, Jas	409 Maple St., Sault Ste. Marie	Sault Ste. Marie.
Taylor, F. H	Pickford	Pickford.
Clare County:		
Littlefield, J. L	Farwell	Farwell.
Clinton County:		
Parmenter, Geo	Shepardsville	Shepardsville.
Gleason, S. B	Ovid	Ovid.
Allen, Frank	Elsie	Elsie.
Keys, Hiram	St. Johns	St. Johns.
Wilhelm, Noah	Bath, R. D	Bath.
Mich. United Traction Co	Jackson	DeWitt.
Stowell, Elmer	Ovid	Ovid.
Coats, Lewey	Ovid	Ovid.
Delta County:		
Potvin, Louis	Garden	Garden.
Chicago & N. W. R. R	Chicago	Escanaba.
Escanaba Stone & Gravel Co	Escanaba	Escanaba, Flat Rock.
Jorgensen, Adolph	Escanaba	Escanaba.
Bereman, Andrew	Gladstone	Gladstone.
Romean, A	Bark River	Bark River.
Dickinson County:		
Chicago & N. W. R. R	Chicago	Iron Mountain and Loretto.
Vulcan Brick Works	Vulcan	Vulcan.
Miench, Anton	107 E. Fleisheim St., Iron Mountain	Iron Mountain.
Eaton County:		
Palmiter, S. J	Bellevue, R. F. D. 4	Bellevue.
Hull Bros	Dimondale	Dimondale.
Johnson, A. C	Eaton Rapids	Eaton Rapids.
LaRock, Hiram	Grand Ledge	Grand Ledge.
Gates, Burton	Grand Ledge	Grand Ledge.
Kent, V. M	Grand Ledge	Grand Ledge.
Saier, H. E	Lansing, R. F. D. 6	Millett.
Wells, C. E	Vermontville	Vermontville.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Genesee County:		
Burns, Ed	Duffield	Duffield.
Farnham, Henry	Farnham, R. F. D. 3	Fenton.
Flint Sandstone Brick Co	Flint	Flint.
Reid, Alfred	Flint	Flint.
Scott, F. D	Genesee	Genesee.
Boston, H. W	Goodrich, R. F. D. 1	Goodrich.
Miner, Frank	Flint	Fenton.
Goodrich, Ford	Grand Blanc	
Stine, Martin	Goodrich	Goodrich.
Bowles, E	Linden	Linden.
Hogan, Daniel	Linden	Linden.
Brown, D	Duffield	Duffield.
Horning, A	Montrose	Montrose.
Johnson, Ernest	Swartz Creek	Swartz Creek.
Knox, Wm	Linden	Argentine.
Otisville Gravel Co	Saginaw	Otisville.
Goodrich, Wm. P	Goodrich	Goodrich.
Bigelow, Elma H	Grand Blanc	Grand Blanc.
Gladwin County:		
Wixom, F. L	Sanford	10 mi. S. of Beaverton.
Soldan, L. V	Butman	Butman.
Grand Traverse County:		
Koch, John	Mayfield	Mayfield.
Gratiot County:		
Church, I. H	Alma	Alma.
Dexter, Jas	Shepherd, R. D. 2	Summerton.
Sawvel, Robert	Breckenridge	Breckenridge.
Lippert, Jacob	Elwell	Elwell.
Curtis, C	Ithaca, R. F. D. 6	Ithaca.
Haas Bros	Northstar, R. F. D. 3	Northstar.
Tomlin, A	Sumner	Sumner.
Wiles, Wm	Sumner, R. F. D. 2	Sumner.
Church, E	Alma	Alma.
Hillsdale County:		
Zeiter, Geo	Reading	Camden.
Michigan Central R. R. Co	Jonesville	Jonesville.
Morgan, H. C	Camden, R. F. D. 37	Camden.
Scholfield, H. C	Pittsford	Pittsford.
Thompson, L. W	Waldron	Waldron.
Wolcott, C. Nelson E	Hillsdale	Hillsdale.
Kline, H. N	Camden	Camden.
Howald, Geo	Camden	Camden.
Houghton County:		
Winona Copper Co	Winona	Winona.
Huron County:		
Conkey, Sam	Caseville	Caseville.
Merrick Gravel Co	Pigeon	Pigeon.
Wallace Co., The	Port Austin	Port Austin.
Haskell, Miss Eliz. A	Port Austin	Port Austin.
Ingham County:		
Artz, Joe	Leslie	Sec. 23, Bunker Hill Twp.
Atkinson, Mr	Mason	S. W. Cor. Sec. 16, Vevay Twp.
Bell, O. E	Mason or Lansing	Sec. 36, Delhi Twp.
Bunker, Chas	Leslie or Stockbridge	Sec. 35, Bunker Hill Twp.
Burwell Sand & Gravel Co	S. Wash. Ave., Lansing	Lansing.
Corwin, W. L	Williamston	Sec. 2, Wheatfield Twp.
Couch, Chas	Mason	Sec. 25, Aurelius Twp.
Curtiss, Bert	Williamston	N. E. Cor. Sec. 21, Wheatfield Twp.
Potts, W. S	Mason, R. F. D. 1	Mason.
Dubois, D. D	Leslie	Sec. 28, Bunker Hill Twp.
Frost, A. J	Williamston	Sec. 22, Wheatfield Twp.
Frost, J. F	Williamston	Sec. 26, Wheatfield Twp.
Holbrook & Skinner	Lansing	Lansing (Holt).
Linn, Lew	Williamston	Sec. 15, Wheatfield Twp.
Saier, H. E	Lansing, R. F. D. 6	Lansing.
Stockman, F. M	Lansing	Lansing.
Campbell, Hugh	1516 6th St., Bay City	Mason.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Ingham County:—Con.		
Nice, Geo	Mason	Sec. 6, Vevay Twp.
Okobock, Dennis	Mason	Sec. 5, Vevay Twp.
Potts, Walter F	Mason, R. F. D. 1	Mason.
Rappe, A	Lansing or E. Lansing	Sec. 16, Meridan Twp.
Porter	Williamston	Sec. 34, Williamston Twp.
Sheltraw, A. E	Saginaw	Mason.
Smith, Geo	Mason	Sec. 10, Vevay Twp.
Stevens, F. B	Mason	Sec. 5, Vevay Twp.
Victory, Ward	Leslie or Stockbridge	Sec. 36, Bunker Hill Twp.
Michigan United Traction Co	Jackson	Sec. 25, Delhi Twp., Mason and Haslett.
Warner, Mr	Mason	N. W. Cor. Sec. 36, Aurelius Twp.
Williams, C. W	Williamston	Sec. 35, Williamston Twp.
Winters, J. P	Leslie or Stockbridge	Sec. 25, Bunker Hill Twp.
Hunter, DeWitt	Lansing	Lansing.
Ionia County:		
Crawford, Geo. W	Ionia, R. F. D. 3	Ionia.
Glick, Cephas M	Lowell, R. F. D	Saranac.
Ionia Cement Products Co	Ionia	Ionia.
Miller, Henry	East Main St., Ionia	Ionia.
Normington, Frank	Ionia, R. F. D. 1	Ionia.
Knapp, A. M	Ionia, R. F. D. 7	Ionia.
Trowbridge, Forest P	Ionia	Ionia.
Elvert, E. J	Muir, R. F. D	Muir.
Hazelitt, J. I	Ionia, Star Route	Palo.
Dansinger, Samuel	Saranac, R. F. D. 1	Saranac.
Gilmore, Niel	Shiloh	Shiloh.
Fellows, Jas. M	Lake Odessa	Lake Odessa.
Hauserman, Herman	Lake Odessa, R. F. D	Lake Odessa.
Millard, Seymour	Palo	Palo.
Ronald Twp. Gravel Pit	Palo	Palo.
Grieves, Mrs	Saranac, R. F. D. 12	Saranac.
Keyser, Chas	Saranac, R. F. D. 10	Saranac.
Dusman, Sam	Saranac	Saranac.
Iosco County:		
Boomer & Son, Jno	Tawas City	Tawas City.
Iron County:		
Ross, D. M	Crystal Falls	Crystal Falls.
Chicago, Milwaukee & St. Paul R. R	Chicago	Crystal Falls.
Isabella County:		
Coughlin, Will	Shepherd, R. F. D. 1	Shepherd.
Dexter, James	Shepherd	Shepherd.
Merrill, D. R	Shepherd, R. F. D. 5, Box 15	Shepherd.
Jackson County:		
Greenville Gravel Co	Greenville, O	Ackerman Lake, 3 mi., S. of Jackson.
Cooper, Fred B	Horton	Horton.
Winters, J. P	Jackson	Jackson.
Kimball, D. G	Jackson	Napoleon.
Blake, Wm	Jackson, R. F. D. 6	Jackson.
Emmons, Wm. P	123 Clinton St , Jackson	Jackson.
Watts, C. R	Jackson, R. F. D. 2	Jackson.
Berm, C. E	Parma	Parma.
Mich. Central R. R. Co	Detroit	Bloomerville.
Mich. United Traction Co	Jackson	Michigan City.
Hunn, G. L	Parma	Parma.
Kalamazoo County:		
Mich. United Traction Co	Jackson	Augusta.
Miller, J. B	Augusta	Augusta.
Balch, Wm. A	Kalamazoo	Kalamazoo.
Buurma, Sam'l H	Kalamazoo	Kalamazoo.
Haas Bros	Kalamazoo	Kalamazoo.
Huff, Archie	Kalamazoo	Kalamazoo.
Kalamazoo Gravel & Sand Co	Kalamazoo	Kalamazoo.
Klepper, Jacob	Kalamazoo	3 or 4 mi. N. of Kalamazoo on G. R. & I. siding.
Molhock, Peter	Kalamazoo	Kalamazoo.
		Kalamazoo.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Kalamazoo County.—Con.		
Owens, Michael	Kalamazoo	Kalamazoo.
Russell, Jas. T	Kalamazoo	Kalamazoo.
So. Mich. Brick Co	Kalamazoo	Richland Twp.
Mich. United Traction Co	Jackson	Augusta.
Gunn, J. W	Watervliet	Williams.
Kalamazoo County Rd. Comm	Kalamazoo	Kalamazoo.
Kalkaska County:		
Anderson, Lynn	Kalkaska	Kalkaska.
Hayward, W. F	South Boardman	South Boardman.
Kent County:		
Holt, C. E	Ada, R. F. D. 42	Ada.
Deiss, Jos	Ada, R. F. D. 17	Alpine.
Read, Percy	Alpine	Alpine.
Brewer, Earl	Byron Center, R. F. D	Byron Center.
Battjes Fuel & Bldg. Mat. Co	Grand Rapids	Grand Rapids.
Bunker Co., G. W	Grand Rapids	Grand Rapids.
Harrison Land Co., Ltd	Grand Rapids	Grand Rapids.
Carpenter Construction Co	Grand Rapids	Grand Rapids.
Pinyon, S. G	Grand Rapids	Grand Rapids.
Valley City Stone & Gravel Co.	Grand Rapids	Grand Rapids.
Ide, D. K	Grandville	Grandville.
Maloney, Pat	Harvard, R. F. D. 40	Harvard.
Holmgren, E. A	Kent City	Kent City.
Kriger, M	Kent City	Kent City.
Ryno, M. J	Ross, R. F. D	Ross.
Farnam, Reuben	Sand Lake	Sand Lake.
Standard Builders Supply Co	Grand Rapids	Grand Rapids.
Sargeant, John	Lowell	Lowell.
Trumm, C. C	Kent City	Tyrone Twp.
Mich. Railway Co	Jackson	Grand Rapids.
Lake County:		
Saunders & Co., G. W	Chase	Chase.
Lapeer County:		
Hallock, Roy P	Almont	Almont.
Miteen, Fred	Goodrich	Goodrich.
Caley, M	Metamora	Hunters Creek.
Broecher, Augut W	Goodrich, R. F. D. 2	Hadley.
Spears, W. A	Columbiaville, R. F. D. 3.	3 mi. S. E. of Columbiaville.
Leelanau County:		
Bronson, Margaret	Maple City, R. F. D. 1	Maple City.
Lenawee County:		
Shannon, F. J	Adrian	Adrian.
Smith, Porter C	Clinton	Clinton.
Fuller, Charles	Hudson	Hudson.
Lockwood, Sam	Hudson	Hudson.
Lowe, Frank	Hudson	Hudson.
Evans, Geo	N. Morenci	N. Morenci.
Gillispie, R. P	Tecumseh	Tecumseh.
Wilson, Ira	Tecumseh, R. F. D. 3	Tecumseh.
Tecumseh Gravel Co	Tecumseh	Tecumseh.
Baldwin, V. E	Morenci	Morenci.
Livingston County:		
Ohio & Michigan Sand & Gravel Co	1025 Nicholas Bldg., Toldo, Ohio	Chilson.
Coles, Ben	Fowlerville	Fowlerville.
Arnold, O. B	Gregory	Gregory.
Butler, Dwight	Hamburg	Hamburg.
Hosby, E. B	Howell	Howell.
Thomas, Henry	Oak Grove	Oak Grove.
Macomb County:		
Blay Bros	Mt. Clemens	Clinton River.
Horning Gravel Co	412 Weadock Bldg., Saginaw	Armada.
Pratt, Ben J	Armada	Armada.
Chapman, Jas	Memphis	Memphis.
Lake Side Ice & Coal Co	Mt. Clemens	Mt. Clemens.
Harder, Henry	Richmond	Richmond.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Macomb County:—Con.		
Wacker, H. Jacob	Mt. Clemens	Mt. Clemens.
Clark, Chas	Utica, R. F. D. 2	Utica.
Detroit Sand & Gravel Co	34 McGraw Bldg., Detroit	Utica.
Superior Sand & Gravel Co	Detroit	Utica.
Ruff, Michael	Lennox, R. F. D	Richmond.
Manistee County:		
Hubbell Sand Co	Manistee	Manistee.
Summerfield, Porter M	Manistee	Manistee.
Farr, M. A	Onekama	Onekama.
McMartin, Chas	Chief, R. F. D. 2	Chief.
Johnson, John	Chief	Chief.
Marquette County:		
Chicago & N. W. R. R	Chicago	Michigamme.
Champion Sand & Gravel Co	Marquette	Champion.
Mason County:		
Hall, Ed	Custer, R. F. D. 2	Custer.
Szymanski, Geo	Freesoil, R. F. D. 2	Freesoil.
Wahr, John	Freesoil, R. F. D. 2	Freesoil.
Beaune, Oliver	Ludington, Box 68	Ludington.
Clark, Henry	Ludington	Ludington.
Lorentz, Ferdinand	Ludington	Ludington.
Dodge, C. C	Tallman	Tallman.
Edmonson, James	Tallman	Tallman.
Percy, Stanton	Ludington	Ludington.
Hubbell Sand Co	Manistee	Ludington.
Mecosta County:		
Conklin, Wm	Big Rapids, R. F. D. 5	Big Rapids.
Riley, J. E	Millbrook, R. F. D. 2	Millbrook.
Carmichael, Ed	Evart	Chippewa Twp.
Main, W. J	Millbrook	Millbrook.
Stone, C. E	Hersey	Hersey.
Menominee County:		
Capt. Nels Olsen	Menominee	Menominee.
Schoen, Jno. W	Wilson	Wilson.
Midland County:		
Crane, H. A	Midland	Hope.
Gehoski, Mike	Midland, R. F. D. 1	Midland.
Schukofski, G. T	Midland, R. F. D. 1	Near Midland.
Missaukee County:		
Pickering, O. L	Lake City	Lake City.
Reeves, Kary D	McLean, Ill	McBain.
Monroe County:		
Falmstock, Emerson	Carlton	Carlton.
National Silica Co	Steiner	Steiner.
Montcalm County:		
Belknap Cement Products Co	Greenville	Greenville.
Boezwinkle, Wm	Pierson	Pierson.
Matz, Chas	Pierson	Pierson.
Tissue, Leonard	Stanton, R. F. D. 1	Stanton.
Sinkley, Mrs. L. M	Carson City	Carson City.
Anderson, Holgen	Greenville, R. F. D. 3	Greenville.
Williams, E. O	Edmore	Edmore.
Muskegon County:		
Bettis, Phil	Ravenna, R. F. D	Ravenna.
Homer, Wm	Ravenna, R. F. D	Ravenna.
Valley, Edw	Twin Lakes	Twin Lakes.
Barlow, John C	Muskegon	Casnovia.
Newaygo County:		
Wentland, Mrs. Johanna	Woodville	Woodville.
Hall, A. E	Newaygo	Newaygo.
Raymond, R. J	Grant	Grant.

SAND AND GRAVEL PRODUCERS, 1916.—*Continued.*

Operator.	Office.	Pit.
Oakland County:		
Park & Son, A. H	Birmingham, R. F. D. 2	Birmingham.
Mich. Portland Cement Paving Co	Griswold St., Detroit	Clarkston.
Ely, C	Farmington	Farmington.
Rice, E. J	New Hudson	New Hudson.
Campbell, John	Ortonville, R. F. D. 2	Ortonville.
Detroit-Oxford Gravel & Stone Co	Oxford	Oxford.
Bartlett, C. S. & A. S	Pontiac	Pontiac, 2 miles E.
Kemp, W. H	Pontiac	Pontiac.
Rockwell, C. L	Pontiac	Pontiac.
Slater Construction Co	Pontiac	Pontiac.
Heal, Geo	669 Baker St., Detroit	Rochester.
Rochester Sand & Brick Co	Detroit	Rochester.
Boomer Sand & Gravel Co	520 Forest St. E., Detroit	Rochester.
Thompson, W. R	100 Beaubien St., Detroit	Goodison.
Adams & Cummings	1105 Kresge Bldg., Detroit	New Hudson.
Oceana County:		
Aldrich, A. O	Hart	Crystal Valley.
Golden Twp. Pit	Mears	Mears.
Twp. Board of Newfield	Hesperia	Hesperia.
Cartright, Thos	Rothbury, R. F. D. 1	Rothbury.
Wherle, Frank	Rothbury, R. F. D. 1	Rothbury.
Ogemaw County:		
Brooks, H. F	Rose City	Rose City.
Harvey, D	West Branch, R. F. D. 1	West Branch.
Osceola County:		
Carmichael, Ed	Evart, R. F. D. 1	Evart.
Stone, Chas. E	Hersey, R. F. D. 1	Hersey.
Hoogerhide, Jno	Reed City, R. F. D. 6	Reed City.
Marvin, Seymour	Tustin, R. F. D. 1	Tustin.
Marquette Gravel Co	Saginaw	Evart, 4 mi. W. of.
Hale, C. H	Hersey	Hersey.
Ottawa County:		
Holtrop, Jno	Ferrysburg	Ferrysburg.
Graham, Mrs. T	West Olive	Grand Haven.
Walsma Van Toll Co	Grand Haven	Bass River.
Van Weelden & Co., J	609 Fulton St., Grand Haven	Grand Haven.
Presque Isle County:		
Kroll, Andrew	Posen	Posen.
Roscommon County:		
Campbell Gravel Co	Roscommon	Roscommon.
Saginaw County:		
Moilest & Donely	336 Howard St	Saginaw River.
St. Clair County:		
Armitage, Sidney	Atkins, R. F. D. 1	Atkins.
Kinney, Chester	Atkins, R. F. D. 1	Atkins.
Snyder, Wm	Atkins, R. F. D. 1	Atkins.
Kitchen, Cyrenius	Smiths Creek	Goodells.
McGennett, Jas	Smiths Creek	Smiths Creek.
Westrick & Son, C. A	Marine City	Marine City.
Caldwell Transit Co	1805 Dime Bk. Bldg., Detroit	St. Clair River and Lake.
United Fuel & Supply Co	Foot of 1st St., Detroit	Algonac.
Marine Contracting Co	211 Quay St., Port Huron	Port Huron.
James Co., R. C	Port Huron	Port Huron.
Superior Sand & Gravel Co	726 Dime Bank Bldg., Detroit	Marine City.
Thompson Co., W. R	Detroit	Port Huron.
St. Joseph County:		
Hill, S	Colon	Colon.
Kerlikowske Bros	St. Joseph	St. Joseph.

SAND AND GRAVEL PRODUCERS, 1916.—*Concluded.*

Operator.	Office.	Pit.
Sanilac County:		
Buck, C. J.	Marlette	Marlette.
Gilbert, Geo.	Melvin, R. F. D. 6	Melvin.
Mills, Henry	Minden City	Minden City.
Dawson & Son	Sandusky	Sandusky.
Carney, Chas.	Sandusky	Sandusky.
Shiawassee County:		
Graham, John	Byron	Byron.
Shannon, A. E.	Byron	Byron.
Schultz, A. A.	Laingsburg	Laingsburg.
Hibbard, Joseph	Byron	Byron.
Barnes, O. L.	Byron, R. F. D. 1	5 mi. from Byron.
Tuscola County:		
Hile, Tom	Caro, R. F. D. 2	Caro, S. W. of Caro in Juanita Twp.
Baker, Gilbert	Kingston	Kingston.
Whittaker, Benson	Kingston	Kingston.
Hill, Elmer A.	Unionville	Silverwood.
Van Buren County:		
Bennett & Son, Warren	Hartford	Hartford.
Burger, F. A.	Bangor	Bangor.
Hoppin, A. D.	Bangor	Bangor.
Shine, John	Bangor	Bangor.
Sherburn, John	Decatur	Decatur.
Otis, L. L.	Kibbie	Kibbie.
Wright, J. E.	Lawrence	Lawrence.
Fry, W. G.	South Haven	South Haven.
Funk, Merrifield	South Haven	Lakeside.
Washtenaw County:		
City Concrete & Coal Co.	1015 Dime Bank Bldg., Detroit	Delhi.
Eddie, Geo.	Ann Arbor, R. F. D. 8	Ann Arbor.
Fiegel, Fred	Ann Arbor, R. F. D. 3	Ann Arbor.
Pease, Wm.	Saline, R. F. D.	Saline.
Youngs, Ed	Saline, R. F. D.	Saline.
Crane, Mortimer R.	217 Mich. St., Ypsilanti	Ypsilanti.
Elsifor, S. A.	117 First St., Ann Arbor	Ann Arbor.
Washed Clean Sand & Gravel Co	Ann Arbor	Dexter.
Cadillac Sand & Gravel Co.	1452 Penobscot Bldg., Detroit	Ann Arbor.
Wayne County:		
Detroit United Fuel & Supply Co.	Detroit, Free Press Bldg.	Utica and Detroit.
Wabash R. R. Co., American Silica Co.	Rockwood	Rockwood.
Thompson, W. R.	Detroit, 606 Kress Bldg.	Detroit.
Pryor, R. C.	Detroit, 933 Dime Bank Bldg.	1½ miles E. of Rockwood.
Wexford County:		
Selma Twp. Pit	Cadillac	Boon.
Fewless, John	Manton, R. F. D. 3	Manton.

TRAP ROCK PRODUCERS, 1916.

Operator.	Office.	Quarry.
Marquette County:		
Durocher, T. L.	Marquette	Marquette.
The Park Cemetery Stone Co.	Marquette	Marquette.
City of Negaunee	Negaunee	Negaunee.
Marquette Trap Rock Co.	Marquette	Marquette.
Houghton County:		
Winona Copper Co.	Winona	Winona.

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